Connecticut National Estuarine Research Reserve Draft Environmental Impact Statement

NOAA Office for Coastal Management

August 2021

To All Interested Government Agencies and Public Groups:

In accordance with provisions of the National Environmental Policy Act (NEPA), we enclose for your review the National Oceanic and Atmospheric Administration (NOAA) Draft Environmental Impact Statement (Draft EIS) for the proposed Federal designation of the Connecticut National Estuarine Research Reserve (NERR).

This Draft EIS is prepared pursuant to NEPA to assess the environmental impacts associated with designating a Connecticut NERR. The NERR System is a network of protected areas representing the various biogeographic regions and estuarine types in the United States. The Connecticut NERR would be the nation's 30th and would add a 4th site in the Virginian–Southern New England biogeographic region. The Connecticut NERR would facilitate long-term research, education, and interpretation to promote informed management of the nation's estuaries and coastal habitats. The designation of the proposed Connecticut NERR would not change any existing uses in the proposed area and no new regulations are being proposed pursuant to this action.

NOAA is pleased to submit this Draft EIS for your review. Your review is an important part of the process. Comments made in writing will help us to develop a Final EIS. The purpose of the EIS is to: 1) assess the environmental impacts of NOAA's proposed action to designate the Connecticut NERR; and 2) inform decision-makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment. The Draft EIS is being released for a 45-day public comment period to solicit input from interested parties. Beginning September 3, 2021, written comments may be submitted electronically or by mail. All electronic public comments should be submitted through the Federal eRulemaking Portal by going to https://www.regulations.gov, entering NOAA-NOS-2020-0089 in the Search box, clicking on the "Comment" icon, completing the required fields, and entering or attach your comments. Written comments submitted by mail should be mailed to the decision maker identified below by October 18, 2021.

Due to the COVID-19 pandemic, the Draft EIS is available for download through https://www.regulations.gov unless a printed copy or electronic copy on a CD or USB flash drive is requested. Requests for copies should be directed to the responsible official.

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Sincerely,

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Front Matter Image: Bluff Point Coastal Reserve walking trail. *Photo credit*: BluffPt.maintrail2 by Judy Benson / Connecticut Sea Grant. https://www.flickr.com/photos/ctnerr/51160359724. (CC BY-NC 4.0)

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Blueback herring returning from sea to spawn - 1, by Peter J. Auster. www.flickr.com/photos/ctnerr/ (CC BY-NC 2.0)

List of Acronyms and Abbreviations

$	– U.S. dollars
%	– percent
<	– less than
°C	– degrees Celsius
°F	– degrees Fahrenheit
ACS	– American Community Survey
A.D.	– anno Domini
AIS	– Automated Information System
BMP	– Best Management Practice
B.P.	– before present (where "present" is 1950)
CAM	– Coastal Area Management
C.F.R.	– Code of Federal Regulations
C.G.S.	– Connecticut General Statute
CO_2	– carbon dioxide, a greenhouse gas
CMP	– Connecticut Coastal Management Program
CR	– Coastal Reserve
CT	– Connecticut
CT NERR	– Connecticut National Estuarine Research Reserve
CT-WAP	– Connecticut Wildlife Action Plan
CTWQS	– Connecticut Water Quality Standards
CZMA	– Coastal Zone Management Act
DA/BA	– Connecticut Department of Agriculture / Bureau of Aquaculture
DEEP	– Connecticut Department of Energy and Environmental Protection
DEP	– Connecticut Department of Environmental Protection
E	– endangered, used to identify species status in tables
EDT	– eastern daylight time
e.g.	– for example
et al.	– and others
et seq.	– and what follows, in reference to legal code
etc.	– and others; and so forth; and so on
ELIS	– eastern Long Island Sound
EnCon Police	– Environmental Conservation Police Officers
EFH	– Essential Fish Habitat
ESA	– Endangered Species Act
FEMA	– Federal Emergency Management Agency
ft	– foot or feet
GC3	– Governor's Council on Climate Change
GRP	– gross regional product
HAPC	– Habitat Areas of Particular Concern
i.e.	– in other words
IPaC	– Information for Planning and Conservation
INV	– invasive species, used to identify species status in tables
K-12	– Kindergarten through twelfth grade

LISS	– Long Island Sound Study
LWRD	– Land and Water Resources Division
m	– meter
m^3	– cubic meter
M	– Migratory Bird Treaty Act listed species, used to identify species status in tables
MBTA	– Migratory Bird Treaty Act
MMPA	– Marine Mammal Protection Act
MOA	– Memorandum of Agreement
MOU	– Memorandum of Understanding
NAAQS	– National Ambient Air Quality Standards
N.A.O.	– NOAA Administrative Order
NAP	– Natural Area Preserve
NAT	– native, used to identify species status in tables
NEPA	– National Environmental Policy Act
NERR	– National Estuarine Research Reserve
NIS	– nonindigenous species, used to identify species status in tables
NOAA	– National Oceanic and Atmospheric Administration
NOAA Fisheries	– NOAA Marine Fisheries, NOAA National Marine Fisheries Service (NMFS)
NY	– New York
OBIS-SEAMAP	– Ocean Biodiversity Information System—Spatial Ecological Analysis of Megavertebrate Populations
OCM	– Office for Coastal Management
OLISP	– Office of Long Island Sound Programs
ppb	– parts per billion
ppt	– parts per thousand
R.C.S.A	– Regulations of Connecticut State Agencies
Reserve System	– National Estuarine Research Reserve System
RI	– Rhode Island
RiverCOG	– Lower Connecticut River Valley Council of Governments
s	– second or seconds
SC	– species of concern in CT-WAP, used to identify species status in tables
SE	– State Endangered, used to identify species status in tables
SHPO	– State Historic Preservation Office
SLAMM	– Sea Level Affecting Marshes Model
SLAMS	– State and Local Air Monitoring Stations
sp.	– species
SSC	– State Special Concern in CT-WAP, used to identify species status in tables
ST	– State Threatened, used to identify species status in tables
SWMP	– System-Wide Monitoring Program
T	– threatened, used to identify species status in tables
The Sounds	– Long Island Sound and Fishers Island Sound
TMDL	– Total Maximum Daily Load
TNC	– The Nature Conservancy
UConn	– University of Connecticut
U.S.	– United States of America
USACE	– U.S. Army Corps of Engineers
U.S.C.	– United States Code
USDA	– U.S. Department of Agriculture

USEPA – U.S. Environmental Protection Agency
USFWS – U.S. Fish and Wildlife Service
USGS – U.S. Geological Survey
WFIS – western Fishers Island Sound
WMA – Wildlife Management Area
µg – microgram

Barred Owl - the Silent, Everwatchful Sentinel, by Corey Leamy. www.flickr.com/photos/ctnerr/ (CC BY-NC 2.0)

Executive Summary

The proposed federal action considered by the National Oceanic and Atmospheric Administration (NOAA) under this environmental review is the designation of the nation's 30th National Estuarine Research Reserve. This action will take the form of a formal designation by the NOAA Administrator and joint declaration by the NOAA Administrator and the Governor of Connecticut.

National Context

The National Estuarine Research Reserve System (hereinafter "Reserve System") is a partnership program between NOAA and coastal states and territories (hereinafter "states") that protects more than 1.3 million acres of coastal and estuarine habitat. Established by the Coastal Zone Management Act (CZMA) in 1972 (16 U.S.C. §§ 1451 *et seq.*), NOAA provides funding, national guidance, and technical assistance to reserves in the Reserve System, while a state partner manages each site on a daily basis with input from local partners. The Reserve System protects estuarine areas, provides educational opportunities to the public, facilitates research and monitoring, and facilitates the transfer of relevant information to coastal communities.

Representing different estuarine types and biogeographic regions, there are currently 29 reserves in 23 states and one territory. The focus of these reserves is on research and education. The goals, as identified in the Reserve System's strategic plan (NOAA OCM 2017), are provided here:

> *Protecting Places*—Enhance and inspire stewardship, protection, and management of estuaries and their watersheds in coastal communities through place-based approaches.
>
> *Applying Science*—Improve the scientific understanding of estuaries and their watersheds through the development and application of reserve research, data, and tools.
>
> *Educating Communities*—Advance environmental appreciation and scientific literacy, allowing for science-based decisions that positively affect estuaries, watersheds, and coastal communities.

State Context

On December 21, 2018, Connecticut Governor Dannel P. Malloy submitted a nomination to NOAA for the designation of a portion of eastern Long Island Sound, western Fishers Island Sound, lower Connecticut River, lower Thames River, and a series of state-owned upland properties adjacent to these waters as a National Estuarine Research Reserve (NERR), corresponding to Alternative A in this document. The State of Connecticut has proposed that the University of Connecticut (UConn) serve as the lead state agency for the proposed Connecticut National Estuarine Research Reserve (CT NERR), working in coordination with the owner of most of the land under consideration, Connecticut Department of Energy and Environmental Protection (DEEP).

The Draft Management Plan (*Appendix A*) for the proposed CT NERR identifies ways to support both the goals of the Reserve System (15 C.F.R. § 921.1(b)) and to help address Connecticut-specific issues.

These goals are based on an adaptive management planning framework and include addressing issues of justice, equity, diversity, and inclusion—both in programming considerations and as a place. The goals identified below reflect priorities during the first five years after designation and also speak to the long-term future of the proposed CT NERR. These goals and principles apply to all alternatives other than the No Action Alternative.

> *Goal 1*: Increase our understanding of the effects of human activities and natural events through collaborative research and monitoring to improve informed decision making and support adaptive management of coastal ecosystems.
>
> *Goal 2*: Strengthen stewardship, protection, and management of estuaries and their watersheds through place-based approaches to training and education in order to maintain and enhance natural environments.
>
> *Goal 3*: Advance environmental appreciation and scientific literacy utilizing a place-based approach, to enhance people's ability to make science-based decisions that positively affect estuaries, watersheds, and coastal communities.

This *Draft Environmental Impact Statement* has been developed to provide information to decision makers and the interested public on the potential impacts associated with designation of the proposed CT NERR under federal authorities. NOAA prepared this draft environmental impact statement pursuant to the National Environmental Policy Act (NEPA; 42 U.S.C. § 4321 *et seq.*) to assess the environmental impacts of NOAA's proposed action to designate the CT NERR, which would become the nation's 30th NERR. An environmental impact statement is required under NEPA for actions such as the designation of a NERR. (15 C.F.R. § 921.13(a). As stated in the Council on Environmental Quality's NEPA implementing regulations (see 40 C.F.R. Parts 1500-1508), "*[t]he primary purpose of an environmental impact statement is to serve as an action-forcing device to insure that the policies and goals defined in [NEPA] are infused into the ongoing programs and actions of the Federal Government. It shall provide full and fair discussion of significant environmental impacts and shall inform decision-makers and the public of the reasonable alternatives which will avoid or minimize adverse impacts or enhance the quality of the human environment.*" (15 C.F.R. § 1502.1.) To this end, NOAA developed a set of reasonable alternatives that meet the purpose and need (see *Chapter 2*), which includes a No Action Alternative, the originally-nominated site (Alternative A), and several additional alternative sites. In developing this set of reasonable alternatives, NOAA used specific screening criteria (see *Section 3.4*). These alternatives will allow NOAA to have a variety of options in weighing the impact to the human environment and meeting the proposed action's purpose and need. The designation and implementation of a proposed CT NERR, under all the alternatives analyzed, would not be expected to result in significant adverse impacts to either the natural or human environment. The designation of the CT NERR would be followed by operation of the reserve, with associated education, research, stewardship, and monitoring opportunities and activities. The activities, plans, and partners identified in the Draft Management Plan highlight major ongoing or planned activities that have the potential to contribute to a range of cumulative impacts that may have potential short-term and long-term effects on the affected environment. If a reserve is designated, future federal actions (including actions funded through NOAA cooperative agreements) would be evaluated individually to determine any necessary compliance activities pursuant to applicable mandates.

Boundary Alternatives and the Natural Environment

Four alternatives were evaluated as part of this *Draft Environmental Impact Statement*, in addition to the No Action Alternative. Together, these four alternatives constitute the project area under review. A summary is provided below and in Table 1.

> *No Action Alternative* - As required under NEPA, a "No Action Alternative" must be considered. The No Action Alternative is simply what would happen if NOAA did not act upon the proposal for action.
>
> *Alternative A* - Originally Nominated Site: The upland and offshore areas as proposed in the original site nomination from 2018 (DEEP et al. 2018). This site includes 48,160 acres inclusive of areas in eastern Long Island Sound, western Fishers Island Sound, lower Thames River, and lower Connecticut River. Upland properties include the Bluff Point complex (Bluff Point State Park, Bluff Point Coastal Reserve (CR), and Bluff Point Natural Area Preserve (NAP)), Roger Tory Peterson NAP, and Lord Cove NAP. Facilities include UConn Avery Point campus and DEEP Marine District Headquarters.
>
> *Alternative B* – Connecticut River Site: A reassessment of a highly-scoring site from the site selection process that did not become the nominated site (DEEP et al. 2018). This site includes 23,280 acres inclusive of areas in eastern Long Island Sound and lower Connecticut River. Upland properties include Machimoodus State Park, Haddam Neck Wildlife Management Area (WMA), Lord Cove NAP, Nott Island WMA, Ferry Point WMA, Baldwin Bridge State Boat Launch, Ragged Rock Creek WMA, and Roger Tory Peterson NAP. Facilities include UConn Avery Point campus and DEEP Marine District Headquarters.
>
> *Alternative C* - Lower Connecticut River Site: Includes alternate upland property in the lower Connecticut River owned by an assortment of state and non-state entities along with a modified offshore boundary. This site includes 30,970 acres inclusive of areas in eastern Long Island Sound and lower Connecticut River. Upland properties include Essex Land Trust's Great Meadows property, The Nature Conservancy's Lord Cove properties, Essex Land Trust's Thatchbed Island property, Thatchbed Island WMA, Ferry Point WMA, The Nature Conservancy's Ragged Rock Creek property, Ragged Rock Creek WMA, and The Nature Conservancy's Great Island and Griswold Point properties. Facilities include UConn Avery Point campus and DEEP Marine District Headquarters.
>
> *Alternative D* - Revised Nominated Site: Upland areas as proposed in the original nomination (Alternative A) but with the addition of Pine Island and incorporation of suggested changes to

offshore core and buffer areas to exclude security zones and active dredge material disposal sites as well as placing areas where manipulation may occur in the buffer zone of the reserve.

Reserve System typologies (as stated in 15 C.F.R. Part 921, Appendix II) within the project areas of the four Alternatives include (Latimer et al. 2014; Lynch 2017):

- Developed areas / infrastructure (at the site of core facilities)
- Shorelands
    - Maritime Forest-Woodland (temperate deciduous forest biome)
    - Coastal Shrublands
    - Coastal Grasslands
    - Coastal Cliffs
- Transition Areas
    - Coastal Marshes and Tidal (Saltwater and Brackish) Areas
    - Intertidal Beaches
    - Intertidal Mud and Sand Flats
    - Intertidal Rocky Algal Beds
- Submerged Bottoms
    - Subtidal Hardbottoms
    - Subtidal Softbottoms
    - Subtidal Plants

Areas in the subtidal waters were chosen to include areas of hardbottom (reefs, ledges, surficial sediment areas, and rocky / boulder features) surrounding areas of variable softbottom sediment types and areas mapped as submerged aquatic vegetation. Water depth ranges from just below the high tide line to 150 feet deep. The inclusion of a large and varied expanse of subtidal habitats spanning shallow to deep water across differing sedimentary types (fine-grained silt and clays to rocky hardbottom) is an important addition of typological uniqueness in the Acadian and Virginian Reserve System biogeographic regions.

Long Island Sound and Fishers Island Sound (The Sounds) are a contiguous coastal plains estuary with a coast sheltered from the full force of ocean storms by Long Island and Fishers Island, respectively. The proposed CT NERR includes the lower Connecticut River, one of the major rivers of the northeast contributing 75% of freshwater to Long Island Sound, and the lower Thames River, as well as four smaller embayments[1]: Baker Cove, Poquonnock River, Mumford Cove, and Palmer Cove.

[1] An embayment, as defined in the Connecticut Coastal Management Act (C.G.S. § 22a-93), refers to a protected coastal body of water with an open connection to the sea in which saline sea water is measurably diluted by freshwater including tidal rivers, bays, lagoons and coves. In Long Island Sound, the names of embayments often include the words Harbor (27%), River (23%), Cove (19%), Bay (10%), Creek (10%), and Pond (7%), with a few including the names Brook, Gut, Inlet, or Lake.

The upland properties of Alternatives A and D include State of Connecticut-defined Critical Habitats[2] (Metzler and Barrett 2006): beachshore, coastal woodland / shrubland, coastal grassland, poor fen, floodplain forest, and intertidal marsh (Barrett 2014). These alternatives also include a rocky bluff, large expanse of beach, a cove forest, and brackish and salt marshes. Alternatives C and D, lacking the eastern half of the project area, include fewer State of Connecticut-defined Critical Habitats: beachshore, floodplain forest, and intertidal marsh (Table 1).

Alternatives A and D host approximately 540 acres of subtidal eelgrass habitat (*Zostera marina*), an important habitat currently not found westward of the proposed reserve (Bradley and Paton 2018). Alternative B hosts no eelgrass and Alternative C hosts 12 acres of eelgrass (Table 1). Natural shellfish beds of approximately 109 acres are found in the lower Connecticut River, an area included in all alternatives (UConn CLEAR et al. 2018). Coldwater coral and a significant amount of hard bottom and complex seafloor are included in Alternatives A and D but are essentially absent from Alternatives B and C (DEEP 2019b). In contrast to the rock dominated coastline of the eastern portion of the proposed reserve, the Connecticut River area occupies a section of coastline that is sediment-dominated. A complex of overlapping glacial deltas overwhelmed and buried the glacially-smoothed bedrock surface as meltwater streams delivered large quantities of sediment to Glacial Lake Connecticut (18,000 to 20,000 years ago).

Table 1: Comparison of Boundary Alternatives

Comparison of areas of habitat types and presence / absence of certain key habitats. Land cover classification (last group in the table) was obtained by overlaying the alternative boundaries on 1-meter resolution land cover data (NOAA OCM 2021). Land cover acreage analysis will not total to the acres shown in other parts of the table.

	NO ACTION ALTERNATIVE	ALTERNATIVE A	ALTERNATIVE B	ALTERNATIVE C	ALTERNATIVE D
AREA					
Total Area (acres)	0	48,160	23,280	30,970	52,160
Landward Area (acres)	0	1,870	1,625	934	1,955
Subtidal Area (acres)	0	46,290	21,655	30,036	50,205
SELECTED CONNECTICUT HABITATS					
beachshore	0	present	present	present	present
coastal woodland / shrubland	0	present	absent	absent	present
coastal grassland	0	present	absent	absent	present
poor fen	0	present	absent	absent	present
rocky bluff	0	present	absent	absent	present
cove forest	0	present	absent	absent	present

[2] Connecticut Critical Habitats depicts the classification and distribution of twenty-five rare and specialized wildlife habitats in the state. It represents a compilation of ecological information collected over many years by state agencies, conservation organizations and many individuals. Examples of critical habitats include Acidic Atlantic White Cedar Swamps, Sand Barrens, Dry Subacidic Forests and Intertidal Marshes. Connecticut Critical Habitats is the result of a project which took place from 2007-2009, to create habitat maps to be used in land use planning and natural resource protection (Metzler and Barrett 2006).

	NO ACTION ALTERNATIVE	ALTERNATIVE A	ALTERNATIVE B	ALTERNATIVE C	ALTERNATIVE D
intertidal marsh	0	present	present	present	present
floodplain forest	0	present	present	absent	present
hard bottom seafloor	0	substantial	minor	minor	substantial
sediment dominated seafloor	0	substantial	substantial	substantial	substantial
eelgrass beds (acres)	0	540	0	12	540
natural shellfish beds (acres)	0	109	109	109	109
AQUACULTURE AND SHELLFISHING					
leased shellfish beds (acres)	0	860	0	0	860
bottom cages in leased areas (acres)	0	33	0	0	33
kelp longlines (acres)	0	27	0	0	27
recreational shellfish beds (acres)	0	8,275	0	0	8,275
NAVIGATIONAL CONCERNS AND SAFETY ZONES					
mooring fields (acres)	0	180	30	29	134
security zones (acres)	0	116	0	0	0
active dredge material disposal areas (acres)	0	1,100	0	0	0
inactive dredge material disposal areas (acres)	0	2,425	0	0	1,931
anchorage areas (acres)	0	2,715	708	1,719	2,530
navigation channels / turning basins (acres)	0	525	180	135	525
submerged cable / pipelines areas (acres)	0	1,977	185	200	1,977
LAND COVER CLASSIFICATION - Area (acres) from 1-meter resolution land cover dataset.					
barren land	0	32	19	12	34
impervious cover	0	37	33	26	37
developed, open space	0	32	30	20	32
pasture, hay, crops	0	17	0	0	17
grassland / herbaceous	0	20	46	4	20
scrub / shrub	0	103	18	5	103
mixed forest	0	761	326	127	762
floodplain forest	0	9	17	0	9
nontidal wetlands*	0	6	55	0	8
tidal wetlands	0	799	957	578	806
unconsolidated shore	0	59	50	33	59
* floodplain forest, a nontidal wetland, is in a separate category.					

Human Environment

Human uses of the project area include recreational boating and fishing, recreational diving, commercial fishing and aquaculture, ongoing research and monitoring, and transportation associated with the movement of people (ferries, recreational boating) and goods. New London, situated at the mouth of the Thames River, is a working waterfront. Located in the Thames River are a military base, a defense contractor, a major pharmaceutical plant, a ferry terminal, and commercial docks. In contrast, the mouth of the Connecticut River does not host a major port city due to the shifting sands of the lower river, though the Connecticut River does see significant boating activity primarily associated with recreational activities.

As a small but densely populated state (5th densest in the contiguous United States), the audience for reserve programs in Connecticut is large – including both school-age children and adults. The inclusion of two State Parks in the proposed CT NERR would capitalize on the already existing popularity of these sites and provide an outlet for self-guided outreach activities. There are eight existing nature centers, aquaria, and cultural history museums within a 15-minute drive of a reserve upland property. Four of these institutions (for which data were available) drew over 1,040,000 visitors combined in 2019 (*Appendix A*). Partnering with existing organizations to capitalize on the strengths of our potential strategic partners and the ability to offer reserve programming to wider audiences would be a guiding principle for the proposed CT NERR.

Proposed CT NERR Operations

The proposed CT NERR would be established as a Center at UConn, reporting to the Office of the Vice Provost for Research, and working in close partnership with DEEP, the owner of the majority of the land. Additional information regarding administration and management of the proposed CT NERR can be found in the proposed CT NERR *Draft Management Plan* found in *Appendix A*. The plan includes information about goals and objectives for the proposed CT NERR and for the major programs of the Reserve System (education, research and monitoring, and coastal training); administration; boundaries and acquisition; facilities and construction; visitor access; and resource protection, restoration, and manipulation.

Benefits of a Designation

The proposed designation action would provide a more coordinated approach that would encourage local partners to create a management structure that fosters collaboration among the landholding entities and other interested parties to work toward common goals for research, education, and resource stewardship.

Designation of a Connecticut research reserve does not alter existing state or federal regulations and authorities of the resource agencies and landowners within the proposed CT NERR. However, as a reserve, certain activities that are inconsistent with the reserve program or applicable Reserve System regulations (15 C.F.R. Part 921) may not be implemented as part of the NOAA-approved management plan (see *Appendix A*). These regulations are, in general, consistent with the recently-approved Long Island Sound Blue Plan, approved by the Connecticut State Legislature on May 14, 2021 (DEEP 2019b).

As discussed throughout this document, the proposed designation of a CT NERR within eastern Connecticut and the implementation of the proposed management plan would be expected to provide environmental, social, and economic benefits to the region. An improved understanding of resource management would be enhanced by linking research and educational efforts, natural and cultural resources, and people. We expect that physical alterations and impacts would be restricted to limited areas and associated with the construction of facilities and infrastructure supporting research, education, and public access activities. Additionally, the proposed CT NERR has the potential to acquire additional land to support future growth, though is not likely to occur within the first five years post designation. Environmental reviews would be conducted for individual facility development and land acquisition projects as these situations arise. Overall, it is expected that the natural resources found within the proposed CT NERR would benefit from coordinated and integrated conservation and management, and the reserve would serve surrounding communities by improving public understanding of estuaries, their benefits, and needs for stewardship.

Overview of Contents

This *Draft Environmental Impact Statement* includes the following chapters:

Chapter 1 – National Context provides background on the Reserve System and an introduction to a potential Connecticut reserve.

Chapter 2 – Purpose of and Need for Action describes the purpose of and need for the analysis, as well as background information on NOAA's Reserve System and its programs.

Chapter 3 – State Context provides an overview of the process in Connecticut, the project area, and the site selection process.

Chapter 4 – Boundary Alternatives describes the five alternatives considered in this *Draft Environmental Impact Statement*. The first— No Action Alternative—is an option without the establishment of a reserve in Connecticut. Four viable alternatives, and those alternatives considered but rejected from further analysis, are also described.

Chapter 5 – Affected Environment generally describes the physical, biological, and social environments of the project area, which is the area inclusive of all alternatives not including the No Action Alternative. The affected environment associated with the proposed action includes coastal upland and subtidal properties in eastern Connecticut.

Chapter 6 – Environmental Consequences describes the direct, indirect, and cumulative environmental impacts of the establishment of a reserve in Connecticut. NOAA is also required by other statutes to ensure that these actions are analyzed for their impact to the natural and human environment, including, but not limited to, endangered species and their critical habitats and managed fisheries and their Essential Fish Habitat (EFH).

Chapter 7 – Compliance With Other Environmental Review Requirements provides an overview of the compliance requirements.

Chapter 8 – List of Preparers

Chapter 9 – List of Contributors

Chapter 10 – Literature Cited

Appendices to the document include the *Draft Management Plan* and describe public comments received throughout *Draft Environmental Impact Statement* development, mitigating measures, and other supplementary information related to individual techniques or policies.

1 National Context

Estuaries provide a vast array of resources and services to people. An estuary is an ecosystem, comprising both the biological and physical environment, that has developed in a region where rivers meet the sea and fresh, flowing river water mingles with tidal saltwater to become brackish, or partly salty. The transport of sediments and nutrients at the interface between the land and water supports a diverse array of habitats and species. Providing food, freshwater, habitat, flood regulation, nutrients, recreational opportunities, soils, aesthetics and other values, estuaries have long been a focal point of human activity. Therefore, they have been heavily exploited throughout our history for natural resources, commerce, tourism, and a host of other purposes.

As of 2010, 52% of the U.S. population resided within coastal watershed counties (NOAA 2013). Population and development pressures on our coasts and estuaries as well as economic activities have subjected these areas to continuous degradation.

1.1 The Coastal Zone Management Act

In 1972, Congress passed the National Coastal Zone Management Act, as amended (CZMA; 16 U.S.C. §§ 1451 *et seq.*). Congress recognized the significance of coastal resources and the importance of these resources to the national, regional, and local economies. The CZMA further recognized the interrelationships between the land, water, and transitional areas between them. These relationships are reflected in the CZMA's 1996 reauthorization, which referenced the increasing and competing demands upon the lands and waters of our coastal zone that have resulted in the loss of living marine resources, wildlife, and nutrient-rich areas; permanent and adverse changes to ecological systems; decreased open space; and shoreline erosion (16 U.S.C. § 1451(c)). The reauthorization further notes that the habitat areas of the coastal zone, along with the fish, shellfish, other living marine resources, and wildlife therein, are ecologically fragile and consequently extremely vulnerable to destruction due to alterations by humans (16 U.S.C. § 1451(d)). In recognition of these issues, the CZMA established a national policy to preserve, protect, develop, and, where possible, restore and enhance the resources of the Nation's coastal zone for this and succeeding generations (16 U.S.C. § 1452(1)). The CZMA supports coastal states, territories, and local governments in developing tools and programs to improve their management capabilities in the rapidly developing coastal zone; to help protect, preserve, develop, and restore fragile natural resources such as the bays and estuaries, beaches, dunes, and wetlands, as well as the flora and fauna that are dependent on those habitats. Congress also recognized that scientific knowledge of our coastal zone was often limited. However, local decision-makers, developers and the public need to understand how the coastal ecosystems work and the consequences associated with development activities on these systems. To improve our understanding of these ecosystems and support coastal management, Congress provided an additional incentive in the CZMA with the establishment of the Reserve System (16 U.S.C. § 1461) as amended by the Coastal Zone Management Reauthorization Act of 1985 (see Pub. L. No. 99-272, 100 Stat. 82). The Reserve System provides states and territories (hereinafter "states") opportunities to seek answers to important questions about our nation's estuaries through a network of protected areas.

1.1.1 The National Estuarine Research Reserve System

The mission of the Reserve System is stated in the implementing regulations for the CZMA (15 C.F.R. Part 921) :

> *The establishment and management, through federal-state cooperation, of a national system . . . of estuarine research reserves . . . representative of the various regions and estuarine types in the United States.*

(15 C.F.R. § 921.1) Pursuant to the CZMA's implementing regulations, habitats within estuaries that typify different estuarine types within the United States can be designated as a NERR. (15 C.F.R. § 921.3(a).) Reserves are operated for long-term research and monitoring, estuarine education, training, and interpretation. The Reserve System provides a framework to conduct research; monitor estuarine health and conditions; model restoration techniques; and disseminate information for estuarine education, interpretation, or decision-maker training.

1.1.2 Reserve System Administrative Framework

The Reserve System is a partnership program between NOAA and the coastal states. NOAA provides funding, national guidance, and technical assistance through the Office for Coastal Management (OCM). Office for Coastal Management plays four important roles in operating the Reserve System.

- First, it supports the NOAA Administrator's review and approval of the designation of individual reserves.
- Second, it disburses and oversees expenditures of federal funds for research, monitoring, education, land acquisition, facilities construction, and operation of designated reserves, as well as for the development of future reserves.
- Third, it coordinates and provides policy guidance for the system.
- Fourth, OCM periodically evaluates the operation of reserves for compliance with applicable federal requirements and with a reserve's approved five-year management plan (16 U.S.C. § 1461(f).). OCM's Stewardship Division has day-to-day responsibility for the implementation of the Reserve System. Each reserve is managed on a daily basis by a lead state agency or university, with input from local partners.

1.1.3 Reserve System Biogeographic Regions

In the more than 45 years since Section 315 of the CZMA established the Reserve System, the system has grown into a national network of 29 protected estuaries that serve as reference sites for research, education, and stewardship. Reserves represent different biogeographic regions of the United States. A biogeographic region is defined by a geographic area with similar dominant plants, animals and prevailing climate. Regions are classified by ecosystem type (e.g., maritime forest, coastal mangroves) and physical characteristics (i.e., geologic, chemical, or hydrographic). There are 11 major biogeographic regions around the coast, with 29 subregions (Figure 1-1). The Reserve System currently represents nine of the major biogeographic regions and 20 of those subregions (Table 1-1). In the near term, priority for federal designation of new Reserve System sites is given to coastal states that are in unrepresented biogeographic regions and typologies.

Understanding the distinction of biogeographic regions and typologies is important as there are already three designated reserves in the Southern New England subregion: Hudson River, New York; Narragansett Bay, Rhode Island; and Waquoit Bay, Massachusetts. As a result, the Connecticut selection process evaluated and identified typological elements that were currently not represented in the neighboring reserves.

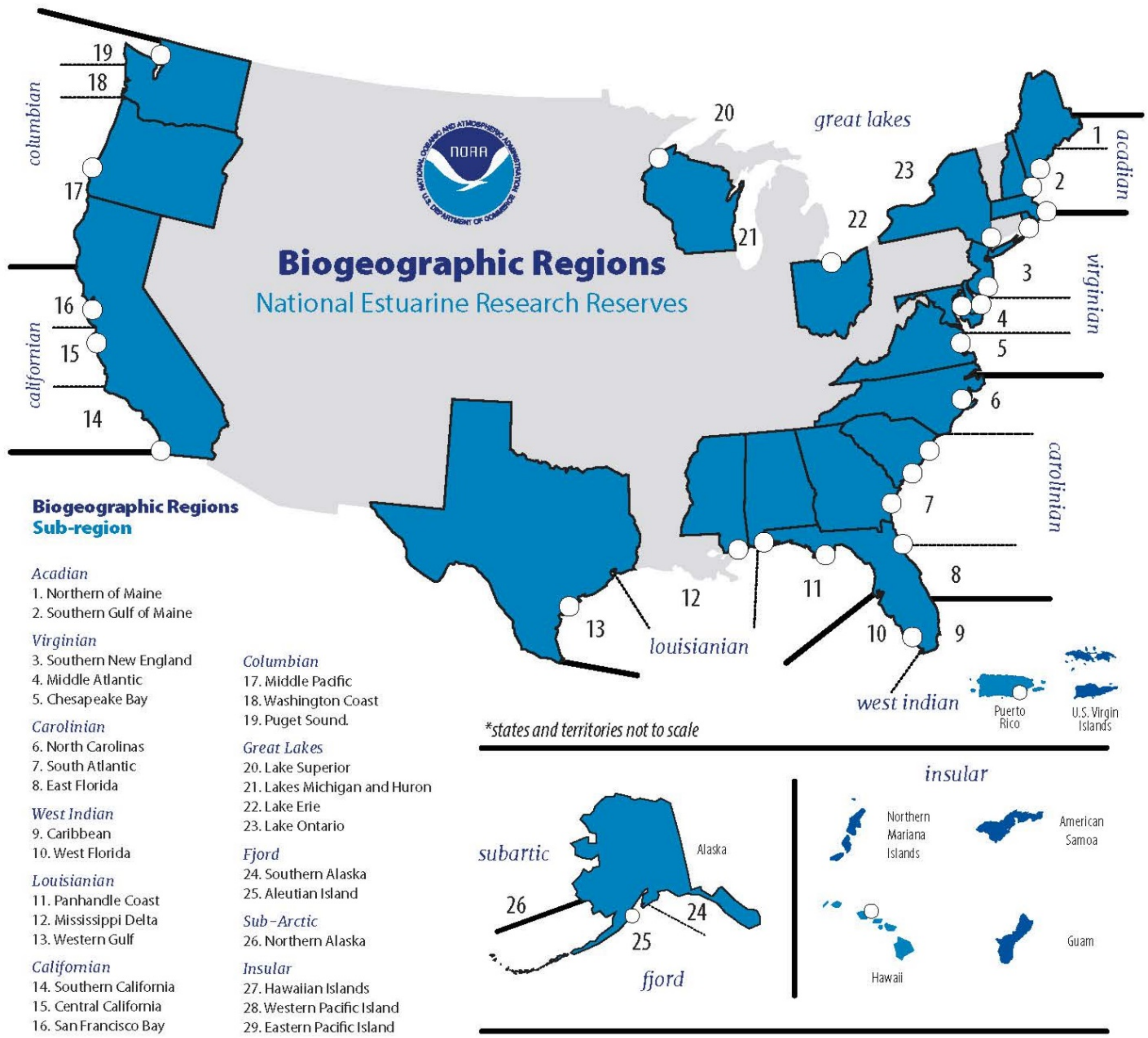

Figure 1-1: Biogeographic Regions of the Reserve System

Map of biogeographic regions of the United States and Reserve System sites.

Table 1-1: Biogeographic Regions of the National Estuarine Research Reserve System

Biogeographic regions and subregions of the Reserve System. Asterisk (*) indicates the biogeographic region is not currently represented by a reserve.

BIOGEOGRAPHIC REGIONS AND SUBREGIONS OF THE RESERVE SYSTEM	
1. Acadian – Northern Gulf of Maine*	16. Californian – San Francisco Bay
2. Acadian – Southern Gulf of Maine	17. Columbian – Middle Pacific
3. Virginian – Southern New England	18. Columbian – Washington Coast*
4. Virginian – Middle Atlantic	19. Columbian – Puget Sound
5. Virginian – Chesapeake Bay	20. Great Lakes – Lake Superior
6. Carolinian – North Carolina	21. Great Lakes – Lakes Michigan and Huron *
7. Carolinian – South Atlantic	22. Great Lakes – Lake Erie
8. Carolinian – East Florida	23. Great Lakes – Lake Ontario *
9. West Indian – Caribbean	24. Fjord – Southern Alaska *
10. West Indian – West Florida	25. Fjord – Aleutian Islands
11. Louisianan – Panhandle Coast	26. Sub-Arctic – Northern Alaska *
12. Louisianan – Mississippi Delta	27. Insular – Hawaiian Islands
13. Louisianan – Western Gulf	28. Insular – Western Pacific Island *
14. Californian – Southern California	29. Insular – Eastern Pacific Island*
15. Californian – Central California	

1.2 A Potential Connecticut NERR as Part of a Network of Reserves

The State of Connecticut proposed the Connecticut National Estuarine Research Reserve (CT NERR) on December 4, 2018 (DEEP et al. 2018). The Connecticut Department of Energy and Environmental Protection (DEEP) was identified as the lead state agency[3] for the proposed CT NERR, working in coordination with the University of Connecticut (UConn) who would take on the management of the CT NERR if the reserve is designated. Operating under a proposed five-year management plan (*Appendix A*), Reserve staff would work with resource managers, Native groups, neighboring communities, and

[3] Per 15 C.F.R. § 921.2(d), state agency means an instrumentality of a coastal state to whom the coastal state has delegated the authority and responsibility for the creation or management / operation of a National Estuarine Research Reserve. Factors indicative of this authority may include the power to receive and expend funds on behalf of the reserve, acquire and sell or convey real and personal property interests, adopt rules for the protection of the reserve, enforce rules applicable to the reserve, or develop and implement research and education programs for the reserve.

regional groups to address natural resource management issues such as nonpoint source pollution, toxics contamination, habitat restoration, climate change, and invasive species.

In total, the Reserve System represents a wide diversity of coastal ecosystems and physical characteristics found within the United States. Table 1-2 shows the other Reserve System sites along with their year of designation and area. The proposed CT NERR would include up to 80 square miles of wetlands, marine waters, and upland areas, and up to 40 miles of shoreline and riverbank, becoming the 8th National Estuarine Research Reserve within the Virginian biogeographic region and the 30th in the nation (Figure 1-2). The proposed CT NERR site would represent a significant addition to the Reserve System by increasing its biogeographic representation and adding new resources and capabilities to the national system.

Table 1-2: Reserve Statistics

Reserve designation dates (year), area, and biogeographic region

RESERVE	YEAR	ACRES	SQUARE MILES	REGION
South Slough, OR	1974	4,771	7.5	Columbian (17)
Sapelo Island, GA	1796	6,110	9.5	Carolinian (7)
Rookery Bay, FL	1978	110,000	171.9	West Indian (10)
Apalachicola Bay, FL	1979	234,715	366.7	Louisianian (11)
Elkhorn Slough, CA	1979	1,439	2.2	California (15)
Padilla Bay, WA	1980	12,100	18.9	Columbian (19)
Narragansett Bay, RI	1980	4,259	6.7	Virginian (3)
Old Woman Creek, OH	1980	573	0.9	Great Lakes (22)
Jobos Bay, PR	1981	2,883	4.5	West Indian (9)
Tijuana River, CA	1982	2,293	3.6	California (14)
Hudson River, NY (4 Components)	1982	4,838	7.6	Virginian (3)
North Carolina (4 Components)	1985, 1991	10,568	16.5	Carolinian (7) & Virginian (3)
Wells, ME	1986	2,250	3.5	Acadian (2)
Chesapeake Bay, MD (3 Components)	1985, 1990	6,249	9.8	Virginian (5)
Weeks Bay, AL	1986	6,525	10.2	Louisianian (11)
Waquoit Bay, MA	1988	2,804	4.4	Virginian (3)
Great Bay, NH	1989	10,235	16	Acadian (2)
Chesapeake Bay, VA (4 Components)	1991	3,072	4.8	Virginian (5)

RESERVE	YEAR	ACRES	SQUARE MILES	REGION
Ashepoo-Combahee-Edisto (ACE) Basin, SC	1992	99,308	155.2	Carolinian (7)
North Inlet Winyah Bay, SC	1992	18,916	29.6	Carolinian (7)
Delaware	1993	6,206	9.7	Virginian (4)
Jacques Cousteau, NJ	1998	114,873	179.5	Virginian (4)
Kachemak Bay, AK	1999	371,950	581.2	Fjord (25)
Grand Bay, MS	1999	18,049	28.2	Louisianian (12)
Guana Tolomato Matanzas (GTM), FL	1999	73,352	114.6	Carolinian (8)
San Francisco Bay, CA	2003	3,710	5.8	Californian (16)
Mission-Aransas, TX	2006	185,708	290.2	Louisianian (13)
Lake Superior, WI	2010	16,697	26.1	Great Lakes (20)
He'eia, HI	2016	1,385	2.2	Insular (27)
*Connecticut, CT	Proposed for 2022			Virginian (3)
TOTAL		1,335,838	2,088	

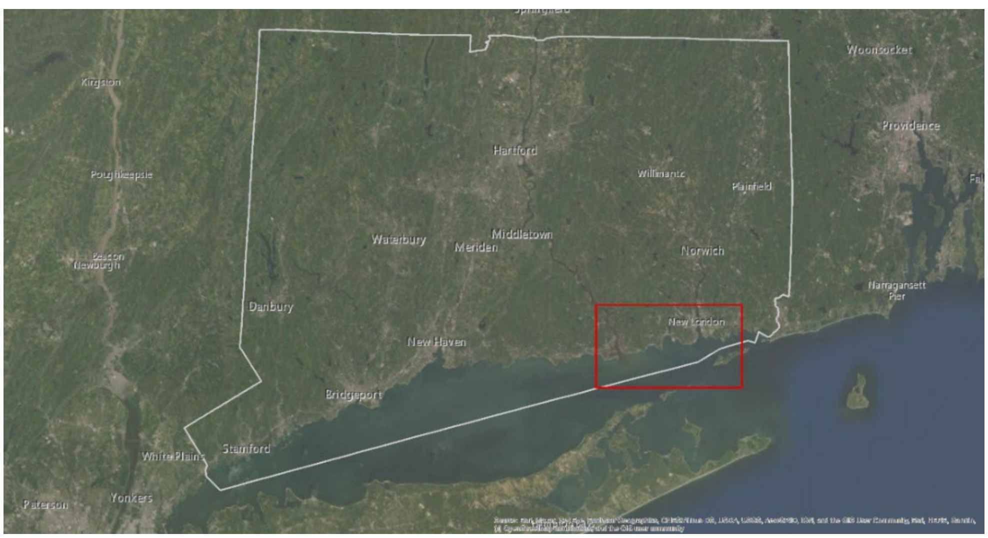

Figure 1-2: General Area of the Proposed CT NERR

Alternatives considered included portions of eastern Long Island Sound and western Fishers Island Sound within Connecticut state waters and upland properties along the Connecticut River, Thames River, a few embayments, and coastline of southeastern Connecticut.

2 Purpose of and Need for Action

2.1 Purpose of Proposed Action

The purpose of the action is to designate a National Estuarine Research Reserve in eastern Connecticut and within portions of eastern Long Island Sound and western Fishers Island Sound—collectively, The Sounds—as the 30th reserve in the Reserve System. As required by 15 C.F.R. § 921.20, the proposed action would also include NOAA approval of a management plan developed by the state, provided the plan meets the required elements described in the applicable Reserve System regulations, and a Memorandum of Understanding, "detailing the Federal-state role in Reserve management during the initial period of Federal funding and expressing the state's long-term commitment to operate and manage the Reserve." (15 C.F.R. § 921.12(a)(2).). If all requirements of the process are met and there is a designation of the proposed CT NERR, the state and NOAA would partner in the operation and management of the proposed CT NERR in accordance with 15 C.F.R. § 921.32. Therefore, the purpose of the proposed action is both the designation of the proposed CT NERR, including NOAA approval of the CT NERR *Final Management Plan*, and the subsequent implementation of the plan's management elements resulting from a reserve designation.

The proposed CT NERR would involve the cooperation and interaction of a unique combination of federal, state, local, and private partners. In this instance, federal-state and state-community partnerships have been developed to support the enhancement of representative natural habitats and to collaborate on operations and management plans that would increase our understanding, awareness, and stewardship of the resources. These partnerships ensure benefits that can be enjoyed by the people of Connecticut and visitors to the area, including across environmental, economic, and social domains.

Each reserve is part of the Reserve System's long-term water quality, biotic, land use, and habitat change monitoring programs that represent an unprecedented effort to compare data across a network of sites. Designating a new reserve provides the Reserve System with the ability to:

- Establish baseline data for environmental conditions, species (both endemic and not), and archaeological resources at the site.
- Create a research program that examines how different ecosystem-based management strategies contribute to a healthy and sustainable estuarine ecosystem in the face of ongoing anthropogenic impacts and human use demands.
- Integrate traditional cultural knowledge and practices with contemporary science and research to sustainably manage resources in the vicinity of the reserve site.
- Increase understanding of natural and anthropogenic processes, restoration efforts and their impacts to the estuary, and key ecosystem services.
- Inform resource management decisions enabling local communities to effectively address key coastal issues like climate change, habitat restoration, and water quality.

2.2 Need for Proposed Action

The need for the proposed action is to expand the national Reserve System identified as the Virginian – Southern New England region (region 3 in Figure 1-1, page 23). With the designation of a reserve in Connecticut, the Reserve System would have a fourth location identified under the Virginian – Southern New England region (of 11 total regions) and a twenty-first subregion (of 29 total subregions) represented. The proposed CT NERR would further the national goal to ensure the Reserve System reflects the wide range of estuarine types within the United States. It would also represent a significant addition to the Reserve System because of its unique estuarine type.

In evaluating the potential designation of a new reserve in Connecticut, NOAA was acting upon the nomination of a site by Governor Dannel P. Malloy of Connecticut for inclusion within the Reserve System. Given the site nomination submitted by Connecticut (DEEP et al. 2018), careful consideration of existing land uses and community support was integral to selecting alternatives that would enable the creation of a successful reserve in this biogeographic region. For the national system, a successful site designation takes into account the area's ecological characteristics; its value for long-term research and monitoring; how well natural resources and habitats are protected; suitability for education, training and outreach; and local management considerations.

A new reserve in Connecticut would coordinate existing research and establish new research, education, and management programs to address coastal management issues within the state. Its designation would also further the national goal to ensure the system reflects the wide range of estuarine types within the United States. A new reserve would also use existing authorities to ensure a stable environment for long-term research and provide a coordination and oversight mechanism for achieving reserve goals.

Key considerations with respect to establishing a reserve include its long-term viability, its ability to promote collaboration among entities conducting research in the area, and the availability of facilities (e.g., laboratories, dormitory space, monitoring infrastructure, etc.).

As described in the research and monitoring program within the *Draft Management Plan*, the proposed CT NERR presents a means to contribute to ecosystem-based management practices, responding to the coastal management needs of the State of Connecticut. The proposed CT NERR would provide a unique perspective on how different ecosystem-based management strategies influence a broad array of ecosystem services that contribute to a healthy and sustainable estuarine ecosystem in the face of ongoing anthropogenic impacts and human use demands.

3 State Context

3.1 Connecticut Site Selection and Nomination History and Process

Nomination History

Long Island Sound is among the most important and valuable estuaries in the nation, a fact made clear in 1987 when Congress designated Long Island Sound an "Estuary of National Significance." It supports over 1,200 species of invertebrates, 120 species of fish, and has recently been calculated to generate about $9.4 billion annually via activities that use and depend on its waters, living resources, and habitats (LISS 2021b). Fishers Island Sound, to the east of Long Island Sound, was also included in the project area under consideration. These two sounds will be referred to as "The Sounds" throughout this document. The Sounds, like other estuaries around the country, are constantly threatened by various factors such as urban development, pollution, invasive species, competitive uses, and the effects of climate change. These and other threats emphasize the importance of having access to current information required to make decisions, the ability to effectively communicate environmental messages, and the capacity to educate people on the benefits of science-based management. Designation of a reserve is a logical tool to help Connecticut address these threats.

The proposed CT NERR would enhance and extend complementary activities of programs like the Long Island Sound Study (LISS, part of the U.S. Environmental Protection Agency (USEPA) National Estuary Program), the Connecticut Coastal Management Program (CMP), and the Connecticut Sea Grant Program, through the addition of funding, resources, and expertise. Additionally, it would enable new directions and initiatives by leveraging existing Reserve System programs, including the system-wide monitoring program (SWMP), educational programs, and coastal training programs.

Connecticut has a long history of interest and effort to secure a reserve, originating in the offices of Connecticut's Coastal Zone Management Program within the Connecticut Department of Environmental Protection (DEP). The Connecticut Coastal Zone Management Program evolved since its inception in the early 1980s as several organizational units developed within DEP, namely Coastal Area Management (CAM), the Office of Long Island Sound Programs (OLISP), and the Land and Water Resources Division (LWRD).

Between 1981 and 1982, CAM provided comments on the *Draft Environmental Impact Statement* for the Hudson River reserve in New York. This was the genesis of the first effort to establish a reserve in Connecticut, specifically targeting the region of the Connecticut River from Long Island Sound north to the limit of tidal action in Windsor. In 1991, the state reached out to NOAA to seek formal support for a Connecticut River NERR. While the initial request was favorably received, NOAA rejected the proposal due to lack of funding for new initiatives and the larger need to focus on areas that were under-represented in the System.

By the early 2000s, OLISP had renewed the effort to pursue a Connecticut reserve. In late 2004, Connecticut again reached out to NOAA through the office of Governor M. Jodi Rell to express an interest in creating a reserve and designating DEP, through OLISP, as the lead agency.

In 2014, capacity within both NOAA and the Connecticut Department of Energy and Environmental Protection (DEEP)—a new agency combining the original DEP with the Connecticut Public Utility Rate Authority—reached a point where a reinvigorated designation effort resumed in 2016.

To implement this, a Connecticut Designation Steering Committee provided oversight to ensure the process was compliant with NOAA procedures. The Designation Steering Committee consisted of staff from DEEP Land and Water Resources Division, UConn Department of Marine Sciences, Connecticut Sea Grant, and eventually, the Connecticut Audubon Society. A site selection team, made up of resource and subject matter experts from a variety of state agencies, academic institutions, and non-governmental organizations was responsible for evaluating potential locations and providing a final version to the Designation Steering Committee. Staff from the NOAA Reserve System program office provided general guidance; and representatives from existing reserves in New York, Massachusetts, and Rhode Island offered key operational knowledge regarding reserve management and programming implementation.

From 2016 to 2019, the teams considered and analyzed many potential options for a reserve, applying criteria to evaluate the capacity for research, education, stewardship, and manageability, as well as resilience to the impacts of climate change. A final version combining several state-owned properties in Lyme, Old Lyme, and Groton, as well as parts of the lower Connecticut River, lower Thames River, eastern Long Island Sound, and western Fishers Island Sound was rated highest. This site was reviewed by the Designation Steering Committee and formally nominated to NOAA on December 21, 2018 through the office of Governor Dannell P. Malloy (DEEP et al. 2018). A subsequent campaign of public engagement resulted in several hundred letters of support sent to NOAA encouraging the acceptance of the nomination. Following a review period in 2019, NOAA accepted the site nomination as proposed and in 2020, Connecticut and NOAA began the next phases of the designation process by developing draft versions of the required environmental impact statement and reserve management plan.

Upon the anticipated completion of the required steps for designation in early 2022, the University of Connecticut would assume the role of the lead state agency for the proposed CT NERR, in partnership with DEEP.

3.2 The Project Area

The project area under consideration included all land and waters within the Connecticut Coastal Area as defined by Connecticut General Statute (C.G.S. § 22a-94(a)) and in the case of the lower Connecticut River, all land and tidal waters within the Ramsar Project Area[4] (Dreyer and Caplis 2001; USFWS 1994).

The project area is a large and diverse mosaic of upland and aquatic habitats located in southeastern Connecticut. The biogeographic region includes several neighboring reserves—the Hudson River in New York, Narragansett Bay in Rhode Island, and Waquoit Bay in Massachusetts. Many typologies within the proposed area – predominantly salt marsh, tidal rivers, and subtidal soft and hard bottom sediments – complement those found in regional neighbors. The Site Selection Team was aware, however, that any nominee also needed to bring either unique or exemplary typologies to the region (15 C.F.R. § 921.30).

[4] The Ramsar area in Connecticut is part of a worldwide system of tidal wetlands designated as “wetlands of international importance” by the Ramsar Convention, an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. It was adopted in the Iranian city of Ramsar in 1971 and came into force in 1975.

As a result, the proposed CT NERR would bring several key characteristics to the Reserve System. The full project area encompassing all proposed alternatives comprises a total land and water area of approximately 53,000 acres. The landward components include approximately 2,000 acres and the offshore components include approximately 51,000 acres. A full review of the project area and assorted boundary alternatives considered is provided in *Chapter 4*.

The coastal region of eastern Connecticut encompassing the footprint of the proposed CT NERR can be generally characterized as a combination of humid subtropical and temperate ocean climates, bringing a mix of hot, humid summers with milder winters consisting of a mix of rain with infrequent snow. Average monthly temperatures can range from lows in the 20s (°F) in January to highs above 80°F in July and August. Average annual temperatures range from the mid-40s (°F) to low 60s (°F). Rainfall is fairly consistent throughout the spring, summer, and fall, averaging around 4 inches per month. The average annual snowfall is about 24 inches per year, with the highest average amounts occurring in January and February.

The proposed CT NERR features a combination of a large area of eastern Long Island Sound, western Fishers Island Sound, and the mouths of two major Connecticut riverine systems – the Connecticut River and the Thames River. Both the Connecticut River and Thames River display a salt wedge estuarine structure whereby river circulation creates a distinct boundary between an upper, low-salt concentration layer and a high-salt concentration wedge beneath it. Tidal ranges in the mouths of both rivers are comparable, at approximately 2.5 feet in the Thames River and approximately 3.5 feet in the lower Connecticut River.

The rock-dominated coastline of the eastern portion of the project area shows irregularities that reflect the shape of the underlying bedrock surface. Seventeen glacially smoothed bedrock hills of various sizes extend seaward forming points, and 15 glacially modified bedrock valleys underlie the intervening embayments[5]. Ledges that commonly occur on the seaward side of the rocky points are generally attributed to “plucking” of rock material by southward moving glacial ice. This glacial plucking is the source of the glacial boulders that dot the landscape. Natural sandy beaches and spits develop in the valleys between the points as wave action erodes the sands and gravels of the glacial deltas. The size of these beaches and sandy spits is limited by the size of the delta supplying their sediment. Owing to the fact that the glacial delta surfaces are low and flat, they are the first to be inundated as sea level rises and they are where marshes have developed.

In contrast to the rock-dominated coastline of the eastern project area, the Connecticut River occupies a section of coastline dominated by sediment. A complex of overlapping glacial deltas overwhelmed and buried the glacially smoothed bedrock surface as meltwater streams delivered large quantities of sediment to Glacial Lake Connecticut (10,000 to 20,000 years ago). Coastal irregularities resulted from the presence of boulder- and cobble-laden recessional moraine ridges. The composition and shape of these ridges makes them more resistant to coastal retreat than the surrounding, low-lying, glacial delta sands and gravels and as a result, they form moraine-armored points. Where the moraines are

[5] An embayment, as defined in the Connecticut Coastal Management Act (C.G.S. § 22a-93), refers to a protected coastal body of water with an open connection to the sea in which saline sea water is measurably diluted by freshwater including tidal rivers, bays, lagoons and coves. In Long Island Sound, the names of embayments often include the words Harbor (27%), River (23%), Cove (19%), Bay (10%), Creek (10%), and Pond (7%), with a few including the names Brook, Gut, Inlet, or Lake.

subjected to wave action, fine-grained sediments are removed and boulder / cobble beaches develop. As is typical along the Connecticut coast, where glacial delta deposits are subjected to wave erosion, the sizes of the sandy beaches and spits that form are limited by the size of their deltaic sand source and the low flat delta surfaces become a platform for extensive marsh development in a rising sea.

The proposed CT NERR is composed of various habitat types, including a variety of upland properties, an offshore area, the lower Connecticut River, and the lower Thames River. Each possesses a variety of habitat types. For example, Haley Farm State Park is a mosaic of upland and wetland vegetation types, while Roger Tory Peterson NAP (formerly Great Island WMA) consists of an extensive system of brackish meadow marshes and tall reed marsh. In the most inland site along the Connecticut River, tidal freshwater marshes and upland forests dominate the landscape.

The proposed CT NERR also contains ecological characteristics of local, regional, and global significance. Current land-based and shore-centric human-use activities within the site boundaries vary and can range from hiking, biking, wildlife observation and photography, swimming, pleasure boating, paddling, diving, recreational fishing / shellfishing, and seasonally managed hunting, to large scale commercial and industrial water-dependent uses, most of which are centralized in the lower Thames River area and reflect its location as a center of maritime industry and trade.

3.3 Scoping

This *Draft Environmental Impact Statement* has been developed to provide information to decision makers and the interested public on the potential impacts associated with designation of the proposed CT NERR under federal authorities. In an effort to better understand potential concerns of interested parties with respect to the designation of the proposed CT NERR, considerable effort was made to include broad and diverse public and private participation through the National Environmental Policy Act (NEPA) scoping process. Groups and individuals had the opportunity to provide input and support since the commencement of the site designation process. This approach was designed to develop among the participatory groups a sense of "ownership" in the process and in the future of the proposed CT NERR.

The Reserve System regulations require that at least one public scoping meeting be held, and that a notice be published in the Federal Register at least 15 days prior to the meeting. (15 C.F.R. § 921.13(c).) Accordingly, a virtual public scoping meeting took place on Tuesday, August 4, 2020, from 7:00 p.m. to 9:00 p.m. EDT. The public was provided notice of the meetings in the Federal Register on July 20, 2020 (85 FR 43543), or 18 days in advance of the public scoping meeting, and through an advertisement posted on July 20, 2020, in The Hartford Courant, The Day, and Middletown Press.

3.4 Alternative Estuaries Considered During Site Selection

The National Environmental Policy Act requires that any federal agency proposing a major action (that is not categorically excluded) consider reasonable alternatives to the proposed action. To warrant detailed evaluation by NOAA, an alternative must be reasonable and meet the purpose and need. Screening criteria are used to determine whether an alternative is reasonable. After applying the screening criteria to an identified range of considered alternatives, five alternative configurations of the properties reviewed below were brought forward for detailed review in the *Draft Environmental Impact Statement* (this document), including a No Action Alternative.

In determining the boundary of the proposed CT NERR, the Site Selection Team performed a two-tier evaluation process. The first tier identified potential candidates (Figure 3-1) and the second tier applied some basic screening criteria with the goal of identifying reasonable alternatives for assessment.

From a wide variety of options, the Site Selection Team identified four sites, with each "site" consisting of several state-owned upland properties, plus an offshore component of public trust waters (intertidal and subtidal lands below the high tide line). Each site reflected a particular region of the Connecticut coastal area:

Western Long Island Sound:

- U.S. Fish and Wildlife Service's Stewart B. McKinney National Wildlife Refuge, properties on Sheffield Island, Chimon Island, and Goose Island
- DEEP's Sherwood Island State Park
- U.S. Fish and Wildlife Service's Stewart B. McKinney National Wildlife Refuge, Great Meadows, and Milford Point properties
- DEEP's Charles Wheeler WMA and water access at Stratford Point
- An offshore area, that generally extends east to west from the Housatonic River to Long Neck Point, Darien and south to just north of the Connecticut / New York state boundary

Central Long Island Sound:

- DEEP's Hammonasset State Park and Hammonasset NAP
- DEEP's Hammock River WMA
- DEEP's Duck Island Wildlife Area
- An offshore area that generally extends east to west from the Menunketesuck River, Westbrook to Meig's Point at Hammonasset State Park and south to just north of the Connecticut-New York State boundary.

Connecticut River:

- Upper (Freshwater) Component
    - DEEP's Machimoodus State Park
    - DEEP's Haddam Neck WMA
- Lower (Brackish) Component:
    - DEEP's Lord Cove NAP and Nott Island WMA
    - DEEP's Ferry Point WMA
    - DEEP's Roger Tory Peterson NAP
    - DEEP's Ragged Rock Creek WMA
    - DEEP's Marine District Headquarters
- An offshore area that generally extends east to west from Hatchett Point, Old Lyme to Cornfield Point, Old Saybrook and south to just north of the Connecticut / New York state boundary. The

main stem of the Connecticut River, from just north of Haddam Neck WMA to the mouth is also included.

Eastern Long Island Sound:

- DEEP's Bluff Point complex; includes Bluff Point State Park, Bluff Point NAP, and Bluff Point CR
- DEEP's Haley Farm State Park
- DEEP's Barn Island WMA
- Two offshore areas that:
    - Extend east to west from Groton Long Point, Groton to White Point, Waterford and south to just north of the Connecticut / New York state boundary. The mouth of the Thames River served as the Long Island Sound / riverine boundary.
    - Includes Wequetequock Cove and the Connecticut portion of Little Narragansett Bay.

During the second tier evaluation, the Site Selection Team focused on evaluating the finalists based on detailed information and data on nearly three dozen individual criteria organized into the following categories that address the qualities and functional needs a reserve must possess:

- Group 1: Environmental Representativeness
- Group 2: Value for Research, Monitoring, and Stewardship
- Group 3: Value for Education and Training
- Group 4: Acquisition and Management Aspects
- Group 5: Site and Resource Resiliency

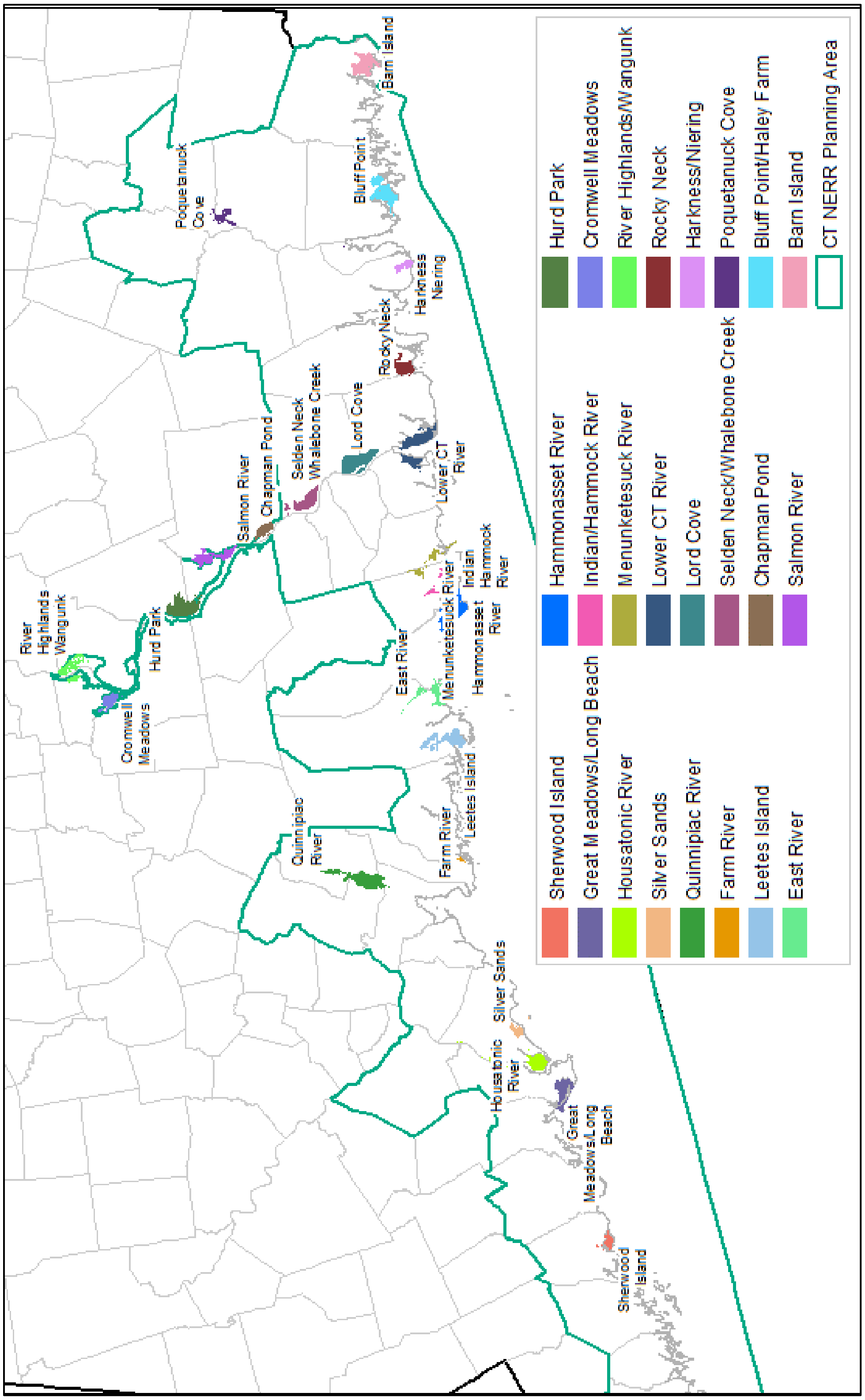

Figure 3-1: Initial Potential Site Inventory

These properties were evaluated as part of the first stages of the site selection process. Properties shown were evaluated, selected, and grouped into sites for moving onto the next stage in the site evaluation process.

3.5 Documents that Influenced the Scope of the Draft Environmental Impact Statement

The scope of this *Draft Environmental Impact Statement* was supported by a number of key documents and resources with a full list available in *Chapter 10 - Literature Cited*. These documents are either pre-existing or were created specifically in support of the proposed CT NERR designation as part of the preliminary impact analysis. The references most often cited in this document include:

Reports and Books

Barrett, J. 2014. **Long Island Sound Stewardship Ecological Sites Inventory Update** (including an Access database). Final report prepared by Connecticut Sea Grant. Prepared for: Long Island Sound Study and NEIWPCC.

DEEP. 2016. **Connecticut's Wildlife Action Plan -- 2015 Revision**. from: Connecticut Department of Energy and Environmental Protection. https://portal.ct.gov/DEEP/Wildlife/CT-Wildlife-Action-Plan/CT-WAP-Current-Status

DEEP. 2019. **Long Island Sound Blue Plan**. Connecticut Department of Energy and Environmental Protection. Hartford, CT. https://portal.ct.gov/-/media/DEEP/coastal-resources/LIS_blue_plan/blueplanfinaldraftversion12september2019pdf.pdf

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3.6 Permits, Licenses, and Entitlements Associated with the Action

The proposed CT NERR is located within various land use districts. Permits for activities associated with the study of fish, wildlife (including birds), threatened or endangered species, or marine mammals could require consultations with or permits issued by NOAA Fisheries (also known as NOAA National Marine Fisheries Service, NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending on the type of activity proposed and the species potentially affected. Wetlands in the Connecticut River section of the project area are designated as Wetlands of International Importance under the Ramsar Convention and as such, activities should be conducted consistent with treaty obligations (Ramsar Convention Secretariat 2013). In the future, all required permits would be obtained and consultations carried out in accordance with all applicable requirements. See *Chapter 7* for more information regarding compliance with applicable laws. As needed, impacts to cultural and historic resources from reserve activities would be considered. Consultations about future activities would be carried out with appropriate entities, including Connecticut's State Historic Preservation Office (SHPO) and Native American Tribes in and adjacent to the project area.

4 Boundary Alternatives

Multiple alternative configurations for the proposed CT NERR were considered (Table 4-1), including a No Action Alternative. Each alternative includes core and buffer areas per Reserve System guidelines, 15 C.F.R. § 921.11(c)(3):

> *"Assurance that the site's boundaries encompass an adequate portion of the key land and water areas of the natural system to approximate an ecological unit and to ensure effective conservation. Boundary size will vary greatly depending on the nature of the ecosystem. Reserve boundaries must encompass the area within which adequate control has or will be established by the managing entity over human activities occurring within the Reserve. Generally, Reserve boundaries will encompass two areas: Key land and water areas (or ''core area'') and a buffer zone. Key land and water areas and a buffer zone will likely require significantly different levels of control (see §921.13(a)(7)). The term ''key land and water areas'' refers to that core area within the Reserve that is so vital to the functioning of the estuarine ecosystem that it must be under a level of control sufficient to ensure the long-term viability of the Reserve for research on natural processes. Key land and water areas, which comprise the core area, are those ecological units of a natural estuarine system which preserve, for research purposes, a full range of significant physical, chemical and biological factors contributing to the diversity of fauna, flora and natural processes occurring within the estuary. The determination of which land and water areas are ''key'' to a particular Reserve must be based on specific scientific knowledge of the area. A basic principle to follow when deciding upon key land and water areas is that they should encompass resources representative of the total ecosystem, and which if compromised could endanger the research objectives of the Reserve. The term buffer zone refers to an area adjacent to or surrounding key land and water areas and essential to their integrity. Buffer zones protect the core area and provide additional protection for estuarine-dependent species, including those that are rare or endangered. When determined appropriate by the state and approved by NOAA, the buffer zone may also include an area necessary for facilities required for research and interpretation. Additionally, buffer zones should be established sufficient to accommodate a shift of the core area as a result of biological, ecological or geomorphological change which reasonably could be expected to occur. National Estuarine Research Reserves may include existing Federal or state lands already in a protected status where mutual benefit can be enhanced. However, NOAA will not approve a site for potential National Estuarine Research Reserve status that is dependent primarily upon the inclusion of currently protected Federal lands in order to meet the requirements for Reserve status (such as key land and water areas). Such lands generally will be included within a Reserve to serve as a buffer or for other ancillary purposes; and may be included, subject to NOAA approval, as a limited portion of the core area."*

4.1 Description of Alternatives

The federal action proposed by NOAA is the establishment of a National Estuarine Research Reserve generally located in the southeastern part of Connecticut and including parts of the Connecticut River, Thames River, eastern Long Island Sound, and western Fishers Island Sound estuaries, based on the Site Nomination Report from the State of Connecticut (DEEP et al. 2018). This proposed action includes formal designation by the NOAA Administrator and joint declaration by the NOAA Administrator and the Governor of Connecticut. This would result in eligibility, as funding allows, for NOAA to award annual financial assistance to the proposed CT NERR for up to 70 percent of operation and program costs, and additional potential funding for acquisition and construction of facilities through a competitive award process.

The alternatives described in *Chapter 4* and summarized in Table 4-1 were developed consistent with 15 C.F.R. § 921.11(c)(2) and (3), which discuss overall ecological characteristics and their relationships with reserve goals and the degree of human influence, and the delineation of key land and water areas (core areas) and buffers. The alternatives analyzed include the No Action Alternative (i.e., not designating the proposed CT NERR), the proposed CT NERR site as nominated, and three alternate boundary configurations for the proposed CT NERR. Each alternative has programmatic impacts and impacts on the environment that inform the analysis of the different reserve configurations reviewed and described in *Chapter 6*.

All alternatives have widespread support from stakeholders. All alternatives provide appropriate accessibility to all portions of the properties and are equally supportive of long-term research, education, and the ability to enhance and advance estuarine awareness. Alternatives A and D, with nearly twice the acreage of Alternatives B and C, have the potential to serve more individuals by providing more opportunities to leverage the reserve capacity and capabilities.

Areas of shellfish or seaweed aquaculture do not constitute a habitat manipulation in the No Action Alternative or Alternatives A, B, C, and D and can thus occur within core or buffer areas. During the scoping process and preparation of this document, questions arose on whether aquaculture, in general, is considered a resource manipulation or would constitute a use which may (or may not) be allowable in core areas depending on the nature of the activity and the means of state control. After discussions with Reserve System leadership and local aquaculture experts from the Connecticut Department of Agriculture / Bureau of Aquaculture (DA/BA) and Connecticut Sea Grant, and in consideration of the nature of aquaculture in Connecticut and other examples within other reserves, aquaculture in Connecticut is best addressed as an allowable use (for more details and discussion, see *Section 5.2.3.6—Commercial Aquaculture and Recreational Shellfishing* and *Appendix A—The Draft Management Plan, Section 5.2*).

For the alternatives other than the no action alternative, UConn would be the lead management agency for the proposed CT NERR, working in close collaboration with DEEP who has existing responsibilities as the landowner of several properties. The University would employ the reserve manager and staff to assist in implementing the day-to-day activities of the reserve, with a Reserve Advisory Committee to provide advice and guidance and a Friends Group to assist with volunteerism, advocacy, and fundraising. Reserve staff would initially include the core positions of manager, education coordinator, and research coordinator with the addition of a fiscal manager and stewardship coordinator. The proposed CT NERR *Draft Management Plan* (included as *Appendix A*) indicates that as the reserve builds capacity, additional program staff (e.g., coastal training coordinator, volunteer liaison, communication specialist) as well as support staff (e.g., technicians, program assistants) would be added to support evolving needs. Reserve partners, including the landowner (DEEP) and other identified partners, would engage with reserve staff to address the goals and objectives identified in the *Draft Management Plan* (included as *Appendix A*).

The *Draft Management Plan* outlines, the vision (i.e., what the proposed CT NERR would achieve) and mission (describing the core purpose) of the proposed CT NERR, relevant to all alternatives except the No Action Alternative:

> *Vision: A resilient, healthy Long Island Sound estuary and watershed where human and natural communities thrive.*

> *Mission: To collaboratively integrate science, conservation, and management with learning, recreation, and economic viability using ecologically unique sites in southeastern Connecticut.*

Within that context, a number of priority interconnected coastal management issues have been identified that the goals and objectives of the proposed CT NERR would seek to address, relevant to all alternatives except the No Action Alternative.

> *Applying Science -* Current issues within climate-related impacts focus largely on sea level rise and increasing storm frequency and intensity in the context of resilient human communities and natural habitats. Communities need to address coastal erosion and protection of critical infrastructure, but traditional shoreline hardening puts marshes, habitat integrity, and habitat connectivity at risk.

> Continuing attention to impacts on water quality are necessary to support habitat integrity in an era where climate change symptoms act synergistically with nutrient pollution to impair water quality. Eastern Long Island Sound and Fishers Island Sound currently host seagrass habitats, an indicator of good water quality. Understanding the drivers of change in the estuary facilitates management to support improved water quality.

> *Protecting Places -* Maintaining habitat connectivity, diversity, and integrity supports success of native species—from plants and seaweed to birds, fish, mammals, and invertebrates. Stewardship of endangered species, other species of conservation concern, and terrestrial and aquatic habitats, maintaining habitat connectivity, and supporting decisions that consider the carrying capacity of the ecosystem are identified as priorities in Connecticut.

> Developing solutions and making decisions which integrate the needs of humans with supporting and protecting the natural environment requires an understanding of both the compatible and competing uses of the coastal zone. Encouraging green development ranges from stormwater management to decreasing impacts of point and nonpoint nutrient impacts on water quality. Understanding the interconnectedness of our local environment and the most important areas for our natural diversity requires expanded monitoring and assessment of both natural and built environments.

Educating Communities - Community engagement allows for coordination among the many organizations currently stewarding our local environment. Balancing the multiple uses of the coastal environment requires coordination and understanding among the varied user groups of the coastal zone. Education and outreach can be an effective tool in connecting communities to the estuary and increasing equitable access to coastal resources.

The *Draft Management Plan* (*Appendix A*) for the proposed CT NERR identifies ways to support both the goals of the Reserve System (15 C.F.R. § 921.1(b)) and to help address the Connecticut-specific issues identified above. These are based on an adaptive management planning framework and include addressing issues of justice, equity, diversity, and inclusion—both in programming considerations and as a place. The goals identified below reflect priorities during the first five years after designation and also speak to the long-term future of the proposed CT NERR.

Goal 1: Increase our understanding of the effects of human activities and natural events through collaborative research and monitoring to improve informed decision making and support adaptive management of coastal ecosystems.

Goal 2: Strengthen stewardship, protection, and management of estuaries and their watersheds through place-based approaches to training and education in order to maintain and enhance natural environments.

Goal 3: Advance environmental appreciation and scientific literacy utilizing a place-based approach, to enhance people's ability to make science-based decisions that positively affect estuaries, watersheds, and coastal communities.

4.2 Boundary Alternatives

Five boundary alternatives are presented in this section. An introductory summary is provided in Table 4-1 and a consolidated comparison of the five alternatives presented in *Sections 4.2.1* through *4.2.5* is available in *Section 4.2.6* (Table 4-2, page 69).

Table 4-1: Boundary Alternatives Summary
Summary of the five boundary alternatives considered within the project area.

ALTERNATIVE	APPROXIMATE TOTAL SIZE (ACRES)
No Action Alternative Proposed CT NERR is not designated as a National Estuarine Research Reserve.	0
Alternative A - Originally Nominated Site The upland and offshore areas as proposed in the original site nomination.	48,160
Alternative B - Connecticut River Site A reassessment of a highly-scoring site from the site selection process that did not become the nominated site.	23,280
Alternative C - Lower Connecticut River Site Additional upland property considerations in the lower Connecticut River owned by an assortment of state and non-state entities along with a modified offshore boundary.	30,970
Alternative D - Revised Nominated Site Upland areas as proposed in the original nomination but with the addition of Pine Island and incorporation of suggested changes to offshore core and buffer areas.	52,160

4.2.1 No Action Alternative

As required under NEPA, a “No Action Alternative” must be considered. The No Action Alternative is simply what would happen if NOAA does not act upon the proposal for action.

NOAA provides guidance to states with respect to planning how and where new reserves might be added to the national system (NOAA OCM 2018). While NOAA provides support (personnel, resources, funding, etc.) to applicants to undertake a site evaluation process, NOAA retains discretion as to whether a site will be designated, thus the No Action Alternative is considered a viable alternative.

Under the No Action Alternative, no portion of the State of Connecticut would be designated as part of the Reserve System, and therefore, there would be no change in current management or uses of the areas being evaluated in the following *Sections* (Figure 4-1). As such:

- The state-owned upland properties comprised of the Wildlife Management Areas of Haddam Neck, Lord Cove, Nott Island, Thatchbed Island, Ferry Point, and Ragged Rock Creek; Roger Tory Peterson NAP; Machimoodus State Park; Bluff Point complex (including Bluff Point State Park, Bluff Point CR, and Bluff Point NAP); and Haley Farm State Park would continue to be owned and managed by DEEP and used with no changes. The upland property of Pine Island would continue to be owned and managed by the University of Connecticut and used with no changes resulting from this action.

- Non-state-owned upland properties comprised of the Essex Land Trust parcels in Great Meadows and The Nature Conservancy parcels in areas proximal to Lord Cove NAP, Ragged Rock Creek WMA, and Roger Tory Peterson NAP would continue under the present ownership and management and used with no changes resulting from this action.
- All offshore waters of eastern Long Island Sound, western Fishers Island Sound, and portions of adjacent riverine areas would remain as public trust lands managed by the State of Connecticut and used consistent with current authorities.

Figure 4-1: Alternative – No Action

Under the No Action Alternative, no changes would be made to ownership, management, or use of any properties or public trust lands, and there would be no reserve in Connecticut.

4.2.2 Alternative A – Originally Nominated Site

Alternative A is composed exclusively of the nominated site described in the Site Nomination Report (DEEP et al. 2018) (Figure 4-2).

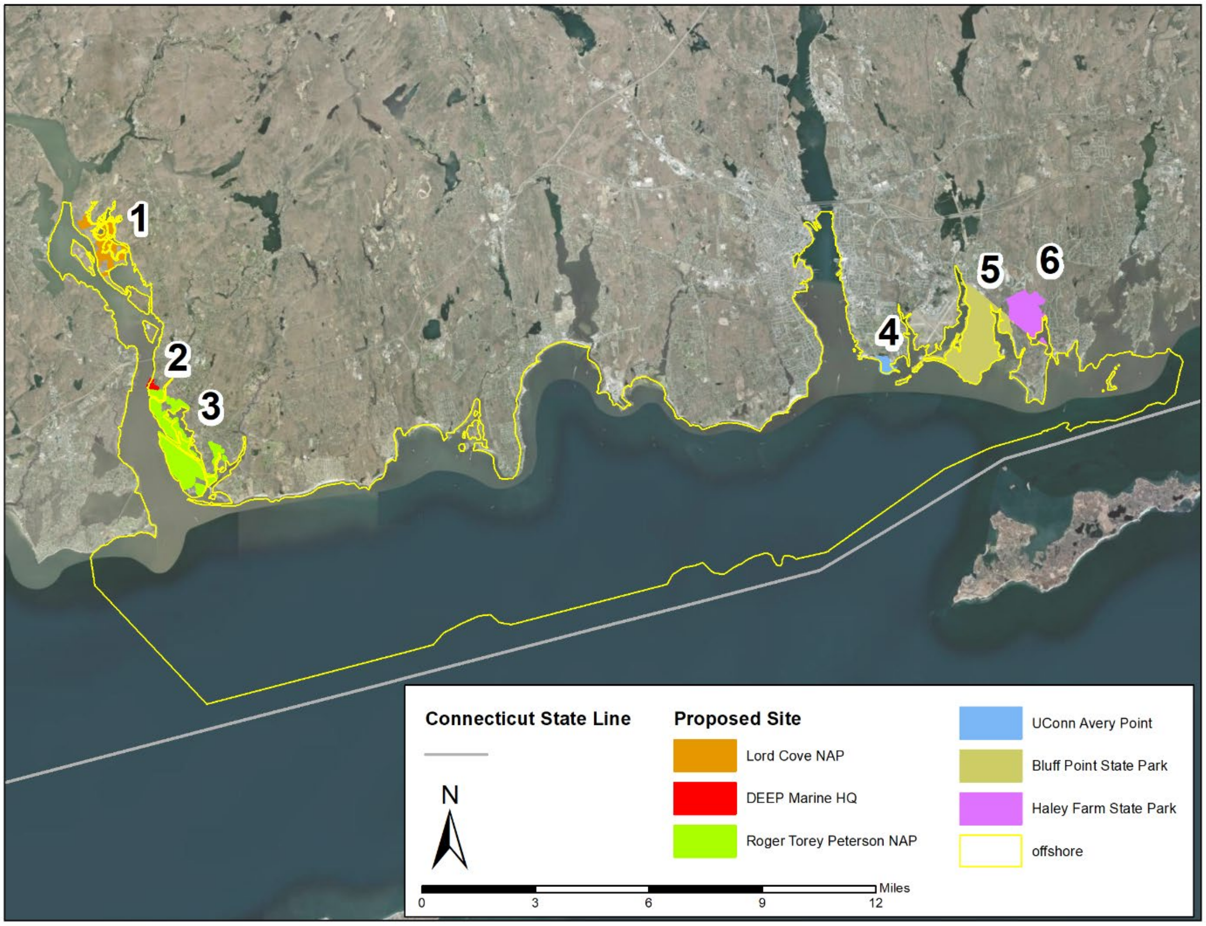

Figure 4-2: Alternative A – Originally Nominated Site

(1) Lord Cove NAP, (2) DEEP Marine District Headquarters; (3) Roger Tory Peterson NAP; (4) UConn Avery Point campus (5) Bluff Point complex (State Park, CR, and NAP), (6) Haley Farm State Park, plus offshore areas.

4.2.2.1 Site Boundary – Alternative A

Alternative A, including upland and subtidal properties, is approximately 48,160 acres. Landward components of Alternative A are state-owned properties located in Groton, Old Lyme, and Lyme. Subtidal components include the lower Connecticut River north to include Old Lyme, the lower Thames River north to the Gold Star Bridge / U.S. Route 1 / I-95, and most of the Connecticut waters of eastern Long Island Sound and western Fishers Island Sound (Figure 4-2).

The landward components of Alternative A (approximately 1,870 acres) include the following state-owned properties, owned and managed by DEEP:

- Bluff Point complex: Bluff Point State Park, Bluff Point CR, and Bluff Point NAP (Groton)
- Haley Farm State Park (Groton)
- Roger Tory Peterson NAP (Old Lyme)
- Lord Cove NAP (Lyme)

The subtidal components of Alternative A (approximately 46,290 acres) include the public trust waterbodies generally defined by:

- Long Island Sound ranging approximately from the mouth of the Connecticut River, east to Mason's Island in western Fishers Island Sound, and seaward of the mean high water shoreline to just north of the Connecticut-New York state boundary line in The Sounds.
- The area seaward of the mean high water shoreline of the lower Thames River from approximately the Gold Star Bridge south to the area described in (e).
- The area seaward of the mean high water shoreline within the lower Connecticut River from approximately Lord Cove, south to the area described in (e); which also includes the Lieutenant River and Back River to CT Route 156, and the Black Hall River to the Amtrak rail bridge.
- The embayments of Baker Cove / Birch Creek / Birch Plain Creek, Poquonnock River, Mumford Cove, and Palmer Cove.

As in Alternatives B, C, and D, facility space and associated support in Alternative A are provided by:

- UConn Avery Point campus (Groton)
- DEEP Marine District Headquarters (Old Lyme)

4.2.2.2 Purpose and Needs – Alternative A

Alternative A will satisfy the purpose and needs of the proposed action in the following ways:

1. Provides adequate land and water controls.

The upland properties are owned and managed by the State of Connecticut (specifically DEEP and UConn) with existing protections and management practices that ensure the long-term viability of their habitats and their ability to support appropriate human uses. Similarly, the subtidal areas are subject to various federal, state, and local controls that have long-standing approaches to balance resource protection while supporting an assortment of uses.

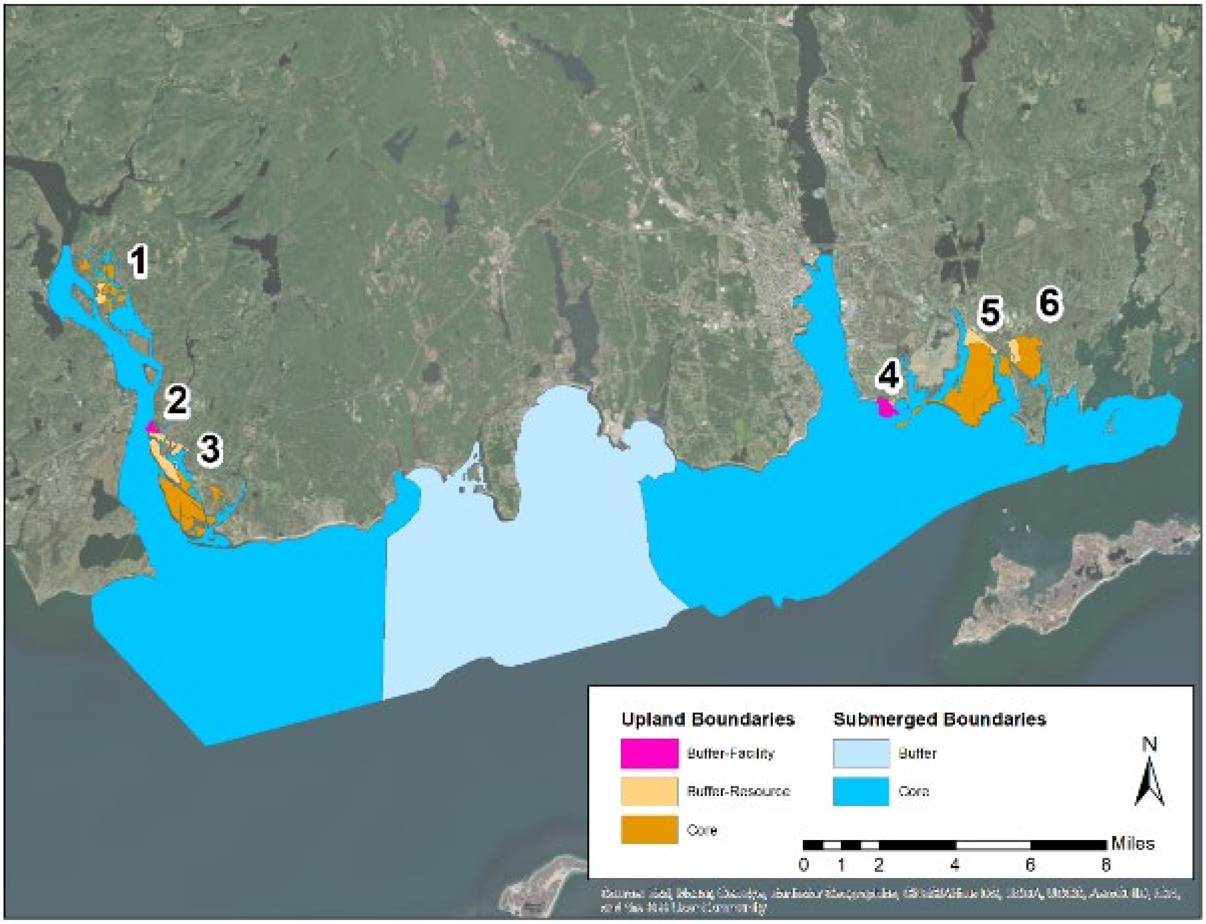

Figure 4-3: Alternative A – Originally Nominated Site Core and Buffer Areas
(1) Lord Cove WMA, (2) DEEP Marine District Headquarters; (3) Roger Tory Peterson NAP; (4) UConn Avery Point campus (5) Bluff Point complex (State Park, CR, and NAP), (6) Haley Farm State Park, plus offshore areas.

Core areas, vital to the function of the ecosystem, and buffer areas that can serve to protect or facilitate habitat shifts for core areas (15 C.F.R. § 921.11(c)(3)) are defined for Alternative A as (Figure 4-3):

- **Upland Core Areas:** The Bluff Point CR, Bluff Point NAP, and the largest and eastern most component of Haley Farm State Park. Also including those areas of marsh at Lord Cove NAP and Roger Tory Peterson NAP that are currently high marsh dominated, but may transition to low marsh as suggested by the Sea Level Affecting Marshes Model (SLAMM) land cover scenarios for 25-50 years in the future (Clough et al. 2019).
- **Upland Buffer Areas:** The Bluff Point State Park and the smaller western components at Haley Farm. Also including those areas of marsh at Lord Cove NAP and Roger Tory Peterson NAP that are identified as likely areas maintaining or transitioning to high marsh as suggested by the SLAMM land cover scenarios for 25-50 years in the future. The DEEP Marine District Headquarters property and the UConn Avery Point campus constitute facility-based buffer areas.

- **Subtidal Core Areas:** Two areas, located in the eastern and western areas of the proposed CT NERR that provide a connected ecological unit with their respective upland core areas, including all embayments identified for this alternative.
- **Subtidal Buffer Areas:** A third area, situated between the two subtidal core areas.

The subtidal core and buffer areas of Alternative A differ from those in Alternatives B, C, and D in that they do not place an emphasis on defining the core such that the core excludes longstanding, pre-existing habitat manipulations (15 CFR § 921.1 (d)).

2. Provides suitable typological balance, habitat composition, and access to support long-term research and education, and the ability to enhance and advance estuarine awareness with broad local support.

The inclusion of a large and varied expanse of subtidal habitats spanning shallow to deep water (0 to approximately 150 feet deep) across differing sedimentary types (fine-grained silt and clays to rocky hardbottom) is a significant addition of typological uniqueness in the Acadian and Virginian Reserve System biogeographic regions. Alternative A includes a wide array of habitat types, including upland and submerged habitats.

A few State of Connecticut-defined Critical Habitats [6] (Metzler and Barrett 2006) are found within the project area: beachshore, coastal woodland / shrubland, coastal grassland, poor fen, intertidal marsh, and floodplain forest (Barrett 2014). Poor fen is unique to Alternatives A and D. Alternative A also includes a rocky bluff, a large expanse of beach, and a cove forest. Alternative A lacks the extensive freshwater marshes found in Alternative B.

Alternative A hosts approximately 540 acres of subtidal eelgrass (*Zostera marina*), another important habitat (Bradley and Paton 2018). Coldwater coral and a significant amount of hard bottom and complex seafloor are included in Alternative A, primarily in the eastern half of the area (DEEP 2019b). In contrast to the rock dominated coastline of the eastern portion of Alternative A, the Connecticut River occupies a section of coastline that is sediment dominated. A complex of overlapping glacial deltas overwhelmed and buried the glacially smoothed bedrock surface as meltwater streams delivered large quantities of sediment to Glacial Lake Connecticut (18,000 to 20,000 years ago).

Alternative A includes all of the habitats found in Alternative D.

3. Balances ecological characteristics with human uses.

While upland areas of State Park properties are used for various active and passive recreational activities, WMA and NAP properties are managed to minimize human interference in order to maintain and support key habitats. Subtidal areas in Alternative A support a wider variety of uses than upland properties, given the overall area and location, including:

- concentrated areas of recreational vessel traffic routes in the lower Connecticut River and into The Sounds;

[6] Connecticut Critical Habitats depicts the classification and distribution of twenty-five rare and specialized wildlife habitats in the state. It represents a compilation of ecological information collected over many years by state agencies, conservation organizations and many individuals. Examples of critical habitats include Acidic Atlantic White Cedar Swamps, Sand Barrens, Dry Subacidic Forests and Intertidal Marshes. Connecticut Critical Habitats is the result of a project which took place from 2007-2009, to create habitat maps to be used in land use planning and natural resource protection.

- concentrated areas of recreational vessel traffic routes and commercial and military vessel traffic routes in the Thames River and into The Sounds;
- many mooring fields (approximately 180 acres);
- three security zones (116 acres), per 33 C.F.R. § 165.154, adjacent to power and military installations (which are not themselves included in the project area);
- all or part of three inactive (approximately 2,425 acres) and one active (approximately 1,100 acres) dredge material disposal areas;
- 17 anchorage areas (approximately 2,715 acres);
- all or parts of 13 navigation channels / turning basins (approximately 525 acres);
- all or part of 16 areas of submerged cable / pipelines (approximately 1,977 acres);
- all or part of 37 state and town lease areas (approximately 887 acres) for both commercial shellfish and seaweed aquaculture operations, 13 approved areas (approximately 8,275 acres) for recreational shellfishing, and two natural shellfish beds in the lower Connecticut River (109 acres);
- commercial fishing interests—while primarily concentrated in areas outside of Alternative A, activity does occur within the subtidal area, although specific locations are not typically shared by the fishing community for public knowledge.

The most impactful use may be intermittent dredging (which may occur in navigation channels and at various public and private locations within and outside of Alternative A) and disposal (which occurs at a singular location within Alternative A). However, these activities are tightly regulated at the state and federal levels through provisions of the Clean Water Act (33 U.S.C. § 1251 *et seq.*); the Marine Protection, Research and Sanctuaries Act (33 U.S.C. § 1401 *et seq.*); and the Connecticut Coastal Management Program permitting process—see text box on *Dredged Material in Eastern Long Island Sound* (page 49).

During the site nomination process, excluding pre-existing habitat manipulations as defined in 15 CFR § 921.1 (d) were not a significant focus when defining buffer areas. Thus, Alternative A includes locations in both core and buffers where the following may occur:

- dredging;
- activities involving installation and maintenance of typical shoreline coastal structures such as docks, jetties, groins, breakwaters;
- submerged cable or pipeline infrastructure;
- concentrated areas of water-dependent uses such as marinas, boatyards, marine transportation facilities, etc.

Dredged Material in Eastern Long Island Sound

A currently designated disposal site, the Eastern Long Island Sound Disposal Site, was authorized by a Final Rule from EPA in December, 2016 (81 FR 87820), having completed the necessary environmental impact statement development process. The environmental impact statement determined that, among three alternatives, the Eastern Long Island Sound Disposal Site provided the best characteristics to manage and monitor disposal to prevent potential adverse impacts to the marine environment.[1] More specifically it concluded that the preferred alternative Eastern Long Island Sound Disposal Site:

- would serve as a containment site, which would support effective management and monitoring;
- addressed the preference to designate sites in areas used in the past (40 C.F.R. § 228.5(e)) by being immediately adjacent to an existing location that had been used for dredged material disposal for over 30 years, for which site monitoring had determined that past and present management practices had been successful in minimizing short-term, long-term, and cumulative impacts to natural resources, including water quality and benthic habitat;
- was located entirely within waters of the State of Connecticut, which would have most of the need for open-water disposal of dredged material for the 30-year planning period; and
- was necessary for the eastern Long Island Sound region to support safe navigation and commerce by providing a capacity of 20 million cubic yards, sufficient to meet anticipated state (CT, RI, and NY) and federal needs over a 30-year planning period.

Additionally, the Final Rule set standards and procedures to promote the development and use of practicable alternatives to open-water disposal. Accordingly, a standing, interagency Steering Committee and Regional Dredging Team for Long Island Sound were established. These groups are comprised of federal and state agency representatives who work together to identify, develop, and promote the use of practicable alternatives to open-water disposal of dredged material, such as using sand for beach nourishment. They also review dredging projects and offer recommendations to the U.S. Army Corps of Engineers (USACE) regarding how the dredged material from such projects should be handled.

4.2.2.3 Alternative A – In Context

Alternative A provides a greater diversity of habitats and includes more diversity in the types of habitats present when compared to Alternatives B and C, but is comparable to Alternative D.

Alternative A includes the greatest range of human uses compared to Alternatives B, C, and D. However, no singular activity or activities dominate to the degree that the ecological characteristics or intended reserve functionality would be threatened. For instance, although boating and recreational fishing are nearly universal, they do not harm or threaten the overall ecology within the project area, nor does their presence hinder potential research, education, or monitoring.

Alternative A includes an active open water disposal site that may result in temporary disturbances to local and nearby habitats during dredging disposal activities. This is different from Alternatives B, C, and D, which do not include such disposal sites.

Alternative A may include areas within the core where habitat manipulations may occur. This is different from Alternatives B, C, and D.

4.2.3 Alternative B – Connecticut River Site

Alternative B revisits a proposed site that scored highly during the detailed site selection process (DEEP et al. 2018) (Figure 4-4).

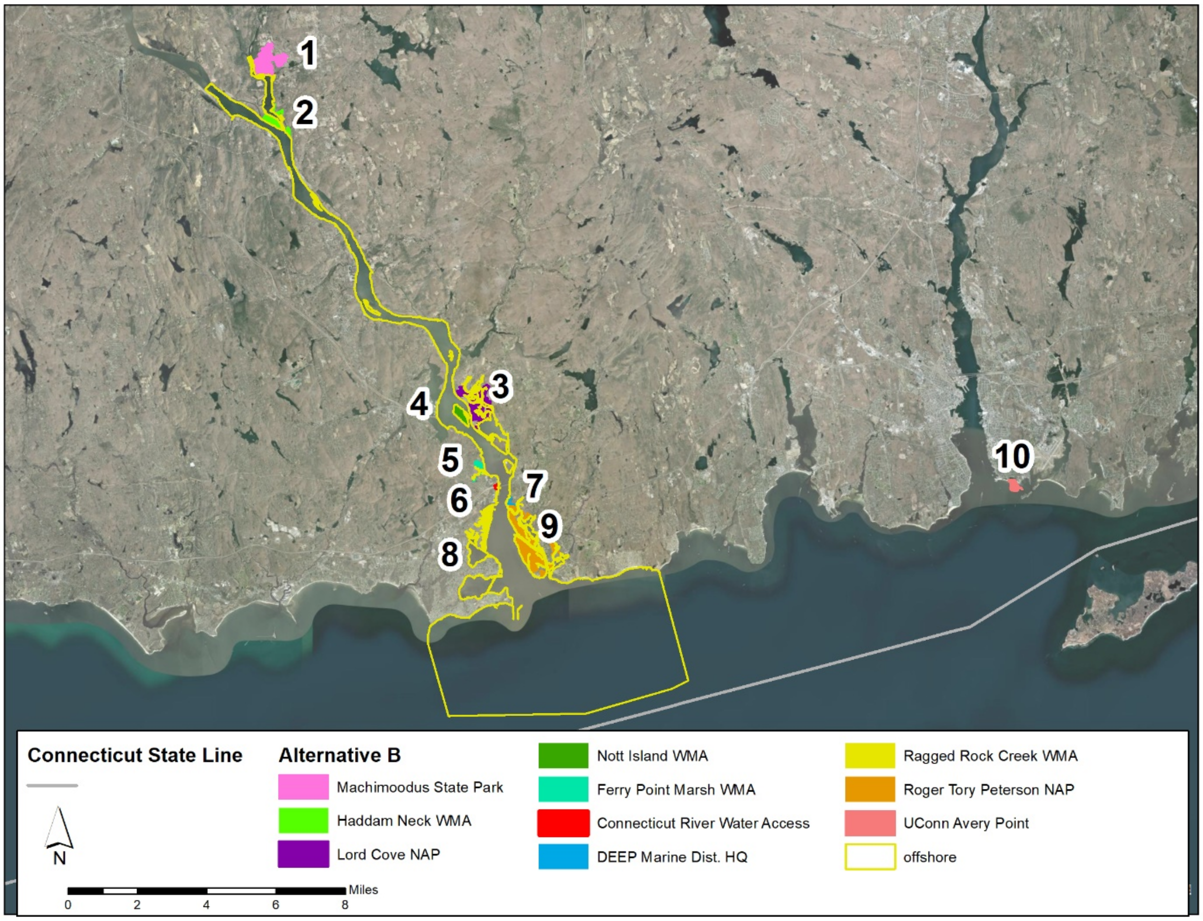

Figure 4-4: Alternative B – Connecticut River Site

(1) Machimoodus State Park, (2) Haddam Neck WMA, (3) Lord Cove NAP, (4) Nott Island WMA, (5) Ferry Point WMA, (6) Baldwin Bridge State Boat Launch, (7) DEEP Marine District Headquarters, (8) Ragged Rock Creek WMA, (9) Roger Tory Peterson NAP, (10) UConn Avery Point campus

4.2.3.1 Site Boundary – Alternative B

Alternative B, including upland and subtidal properties, is approximately 23,280 acres. Landward components of Alternative B are state-owned properties located in Old Lyme, Lyme, East Haddam, Haddam, and Old Saybrook. Subtidal components of Alternative B include the lower Connecticut River, north to include East Haddam, and extend southward to just north of the Connecticut-New York state boundary line in eastern Long Island Sound (Figure 4-4).

The landward components of Alternative B (approximately 1,625 acres) include several state-owned properties, owned and managed by DEEP, that are also included in Alternative A:

- Roger Tory Peterson NAP (Old Lyme)
- Lord Cove NAP (Lyme)

The landward components of Alternative B differ from Alternative A by including the following state-owned properties, owned and managed by DEEP:

- Haddam Neck WMA (Haddam)
- Machimoodus State Park (East Haddam)
- Nott Island WMA (Lyme)
- Ferry Point WMA (Old Saybrook)
- Ragged Rock Creek WMA (Old Saybrook)
- Baldwin Bridge State Boat Launch (Old Lyme)

The subtidal components of Alternative B (approximately 21,655 acres) include some of the public trust waterbodies included in Alternative A:

- The area seaward of the mean high water mark within the lower Connecticut River from approximately Lord Cove south to the mouth of the Connecticut River, which also includes the Lieutenant River, Back River, and Black Hall River to CT Route 156.

The subtidal public trust waterbodies included in Alternative B differ from Alternative A in the following ways:

- Alternative B extends the main stem of the Connecticut River north to just below Haddam Island and includes those parts of the Salmon River that connect the Connecticut River to Machimoodus State Park and Haddam Neck WMA, up to CT Route 151.
- Alternative B includes North Cove and South Cove in Old Saybrook.
- Within eastern Long Island Sound, Alternative B includes an area extending south from the mouth of the Connecticut River to just north of the Connecticut-New York state boundary line; extending west to roughly Cornfield Point, Old Saybrook; and extending east to roughly Hatchett Point, Old Lyme.
- Alternative B excludes areas of eastern Long Island Sound which are east of Old Lyme.

As in Alternatives A, C, and D, facility space and associated support in Alternative B are provided by:

- UConn Avery Point campus (Groton)
- DEEP Marine District Headquarters (Old Lyme)

4.2.3.2 Purpose and Needs – Alternative B

Alternative B will satisfy the purpose and needs of the proposed action in the following ways:

1. Provides adequate land and water controls.

As described for Alternative A, the properties in Alternative B are owned and managed by the State of Connecticut (specifically DEEP and UConn) and therefore ensure the long-term viability of habitats and the ability to support appropriate human uses. Similarly, the subtidal areas are subject to the same federal, state, and local controls that have long-standing approaches to balance resource protection while supporting an assortment of uses.

Core areas, vital to the function of the ecosystem, and buffer areas that serve to protect or facilitate habitat shifts for core areas and include areas where existing habitat manipulations may occur (15 C.F.R. § 921.11(c)(3)) are defined for Alternative B as (Figure 4-5):

- **Upland Core Areas:** In Alternative B, the Lord Cove NAP and Roger Tory Peterson NAP marshes retain the same upland core areas as in Alternative A, where those boundaries include areas that are currently high marsh dominated, but may transition to low marsh as suggested by the Sea Level Affecting Marshes Model (SLAMM) land cover scenarios for 25-50 years in the future (Clough et al. 2019). The additional Alternative B properties of Ragged Rock Creek WMA and Ferry Point WMA utilize the same SLAMM-based approach. Machimoodus State Park, also in Alternative B, is identified as a core area as its composition (primarily forest) differs from the other marsh dominated properties. The Alternative B areas of marsh at Haddam Neck WMA do not have SLAMM analyses to help delineate areas, so those parcels with a direct connection to the Connecticut River are designated as core to provide consistency with the core marsh areas in the lower Connecticut River.
- **Upland Buffer Areas:** In Alternative B, the Lord Cove NAP and Roger Tory Peterson NAP marshes use the same upland buffer areas as in Alternative A where those boundaries include areas identified as likely to maintain or transition to high marsh as suggested by the SLAMM land cover scenarios for 25-50 years in the future. The additional Alternative B properties of Ragged Rock Creek and Ferry Point WMAs utilize the same SLAMM-based approach. The Alternative B properties of Haddam Neck WMA that do not directly border the Connecticut River are designated as buffer areas. The DEEP Marine District Headquarters property, the Baldwin Bridge boat launch, and the UConn Avery Point campus constitute facility-based buffer areas in Alternative B.
- **Subtidal Core Areas:** In Alternative B, all of the subtidal area described in 4.2.3.1, exclusive of the buffer areas described below are considered core areas. This includes a substantial portion of the Connecticut River, and provides connection to estuarine waters for the upland areas of Roger Tory Person NAP, Ragged Rock Creek WMA, Ferry Point WMA, Nott Island WMA, Lord Cove NAP, and Haddam Neck WMA. It also includes part of the Salmon River which provides an estuarine connection to Machimoodus State Park. A substantial part of Long Island Sound is also part of the subtidal core.
- **Subtidal Buffer Areas:** Subtidal buffer areas include the following:

- Approximately 450-feet extended from the shoreline, or more when needed to contain a particular structure or activity (e.g., marina basins, docks, piers, wharves, floats, jetties, groins, breakwaters, or other similar structures).
- Navigation channels, turning basins, and submerged cable areas as indicated on NOAA nautical charts.
- Near-shore anchorage areas as indicated on NOAA nautical charts.
- South Cove, Old Saybrook.
- Any areas of extraneous cartographic features (e.g., slivers, holes, gaps, or similar) resulting from applying the conditions above were included on a case-by-case basis using best professional judgment.

The subtidal core and buffer areas of Alternative B differ from those in Alternative A by providing a greater emphasis on defining core versus buffer in order to place longstanding, pre-existing habitat manipulations per 15 CFR § 921.1(d) in the buffer rather than the core.

2. Provides suitable typological balance, habitat composition, and access to support long-term research and education, and the ability to enhance and advance estuarine awareness with broad local support.

The inclusion of a large and varied expanse of subtidal habitats spanning shallow to deep water (0 to approximately 150 feet deep) across differing sedimentary types (fine-grained silt and clays to rocky hardbottom) is a significant addition of typological uniqueness in the Acadian and Virginian Reserve System biogeographic regions found in all alternatives. Alternative B includes a wide array of habitat types, including upland and submerged habitats, though with less diversity than Alternatives A and D.

A few State of Connecticut-defined Critical Habitats (Metzler and Barrett 2006) are found within the project area: beachshore, intertidal marsh, and floodplain forest (Barrett 2014). Alternative B lacks the coastal woodland / shrubland, coastal grassland, and poor fen found in Alternatives A and D. Alternative B also lacks the rocky bluff, large expanse of beach, and cove forest found in Alternatives A and D. Alternative B includes freshwater marshes not found in the other alternatives.

Alternative B does not host subtidal eelgrass (*Zostera marina*), another important habitat, compared to approximately 540 acres found in Alternatives A and D (Bradley and Paton 2018). Coldwater coral are essentially absent and the amount of hard bottom and complex seafloor included in Alternative B are very low compared to Alternatives A and D (DEEP 2019b). In contrast to the rock-dominated coastline of the eastern portions of Alternatives A and D, the Connecticut River area included in Alternative B occupies a section of coastline that is sediment dominated. A complex of overlapping glacial deltas overwhelmed and buried the glacially-smoothed bedrock surface as meltwater streams delivered large quantities of sediment to Glacial Lake Connecticut (18,000 to 20,000 years ago).

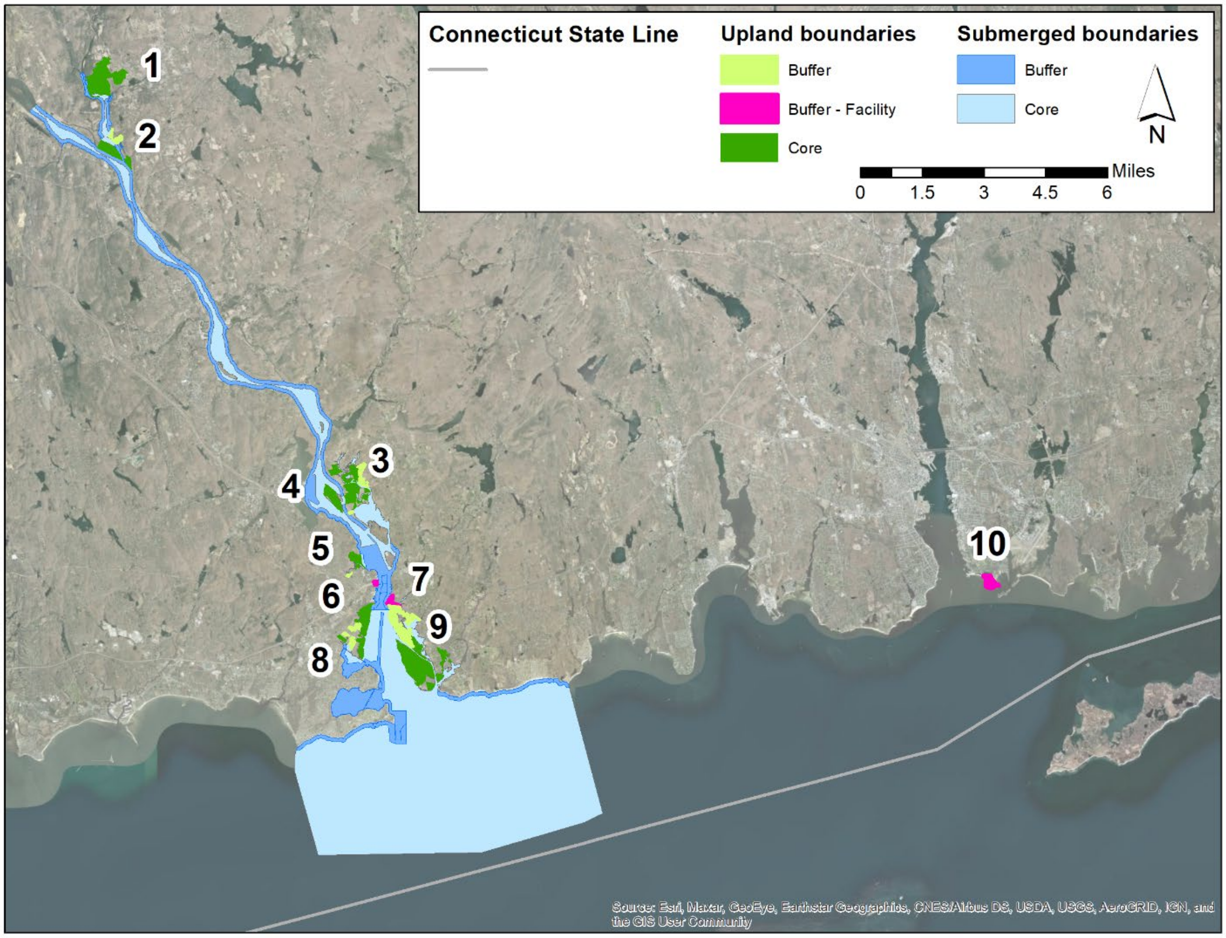

Figure 4-5: Alternative B – Connecticut River Site Core and Buffer
(1) Machimoodus State Park, (2) Haddam Neck WMA, (3) Lord Cove NAP, (4) Nott Island WMA, (5) Ferry Point WMA, (6) Baldwin Bridge State Boat Launch, (7) DEEP Marine District Headquarters, (8) Ragged Rock Creek WMA, (9) Roger Tory Peterson WMA, (10) UConn Avery Point campus

3. Balances ecological characteristics with human uses.

While upland areas of state park properties are used for various active and passive recreational activities, WMA and NAP properties are managed to minimize human interference in order to maintain and support key habitats. Subtidal areas support a wider variety of uses than upland properties, given the overall area and location, including:

- concentrated areas of recreational vessel traffic routes in core and buffer areas of the lower Connecticut River and into The Sounds;
- two mooring fields (approximately 30 acres) within the buffer area;
- riverine anchorage areas (approximately 168 acres) in the buffer area and part of an eastern Long Island Sound anchorage area (approximately 540 acres) in the core area;
- all or parts of 11 navigation channels / turning basins (approximately 180 acres) in buffer areas;

- areas of submerged cables / pipelines (approximately 185 acres) in buffer areas;
- two natural shellfish beds in the lower Connecticut River (109 acres) in core and buffer areas;
- commercial fishing interests—while primarily concentrated in areas outside of Alternative B, activity does occur within core and buffer areas of the subtidal area, although specific locations are not typically shared by the fishing community for public knowledge.

In Alternative B, the delineation of buffers encompasses areas of habitat manipulations (as defined in 15 CFR § 921.1(d)) and helps ensure the balance between ecological resources and human uses is maintained

4.2.3.3 Alternative B – In Context

When compared to Alternative A, the more limited subtidal footprint of Alternative B excludes security zones, active and inactive dredge disposal areas, state and town shellfish lease beds, kelp farming, and is not a significant source for military or commercial vessel traffic. Areas that contain long-term, pre-existing habitat manipulations are included in the buffer rather than in the core.

When compared to Alternative A, there is less diversity and range of benthic habitats in Alternative B, notably eelgrass and rocky hardbottom are missing. Similarly, the diversity and range of upland habitats are also lessened, and Alternative B does not include beaches, bluff, and grassland habitats. The UConn Avery Point campus—expected to be the focal point for reserve administration and facilities—is geographically disconnected from the main areas of upland and subtidal resources.

The Connecticut River mouth from Griswold Point. Photo credit: GriswoldPt.2.2020 by Judy Benson / Connecticut Sea Grant. www.flickr.com/photos/ctnerr/ (CC BY-NC 4.0).

4.2.4 Alternative C – Lower Connecticut River Site

Alternative C focuses on the general area of the lower Connecticut River—included as part of both Alternatives A and B—but includes additional subtidal areas and variations in the upland components (Figure 4-6).

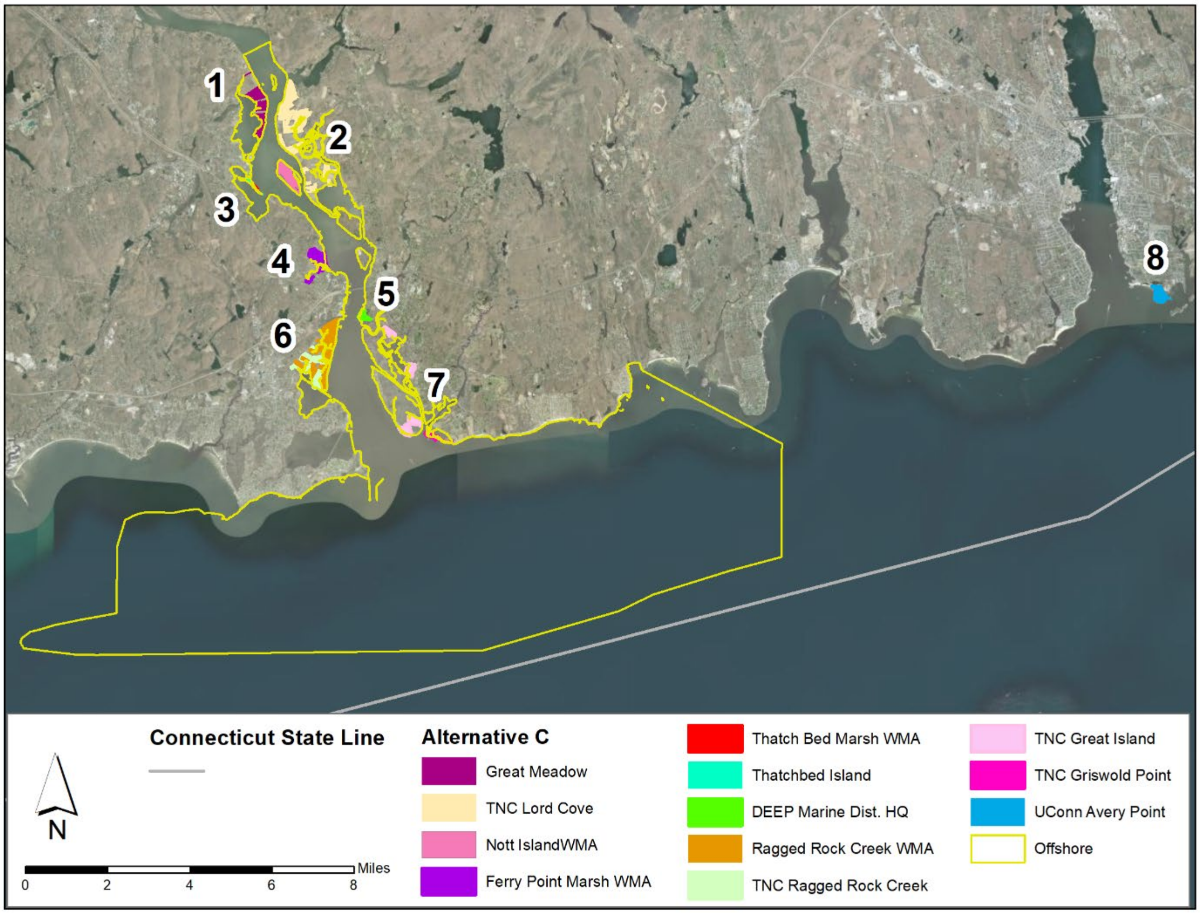

Figure 4-6: Alternative C – Lower Connecticut River
(1) Great Meadows-Essex Land Trust (2) Lord Cove-The Nature Conservancy (3) Thatchbed Island-Essex Land Trust and Thatchbed Island WMA (4) Ferry Point WMA, (5) DEEP Marine District Headquarters, (6) Ragged Rock Creek-The Nature Conservancy and Ragged Rock Creek WMA, (7) Great Island and Griswold Point properties-The Nature Conservancy (8) UConn Avery Point campus

4.2.4.1 Site Boundary – Alternative C

Alternative C, including upland and subtidal properties, is approximately 30,970 acres. Landward components of Alternative C are state-owned properties located in Old Saybrook, Essex, and Lyme; and non-state-owned properties in Old Saybrook, Essex, Lyme, and Old Lyme. Subtidal components of Alternative C include sites in the lower Connecticut River, north to include Lyme (Figure 4-6).

The landward components of Alternative C (approximately 934 acres) include several state-owned properties, owned and managed by DEEP, also included in Alternative B (but not in Alternative A):

- Ferry Point WMA (Old Saybrook)
- Ragged Rock Creek WMA (Old Saybrook)

The landward components of Alternative C differ from Alternative A and B by including additional state-owned properties, owned and managed by DEEP. Additionally, the inclusion of non-state-owned landward components in Alternative C addresses suggestions raised during the environmental impact statement scoping meeting:

State-Owned

- Nott Island WMA (Lyme)
- Thatchbed Marsh WMA[7] (Essex)

Non-State-Owned

- Essex Land Trust parcels in Great Meadows (Essex)—include a combination of parcels owned in fee and with conservation easements to the U.S. National Resource Conservation Service
- Essex Land Trust parcels on Thatchbed Island (Essex)—include a combination of parcels owned in fee and with conservation easements to the U.S. National Resource Conservation Service[8]
- The Nature Conservancy parcels on Great Island and Griswold Point (Old Lyme), Ragged Rock Creek (Old Saybrook), and Lord Cove (Lyme). These do not include easement properties, per request of The Nature Conservancy.

The subtidal components of Alternative C (approximately 30,036 acres) include some of the public trust waterbodies included in Alternatives A and B:

- The area seaward of the mean high water shoreline within the lower Connecticut River from approximately Lord Cove south to the mouth of the Connecticut River, which also includes the Lieutenant River, Back River, and Black Hall River to CT Route 156.

The public trust waterbodies of Alternative C differ from Alternative B in the following ways:

- Alternative C adds North Cove and South Cove in Essex and North Cove in Old Saybrook to connect the adjacent upland components.
- Alternative C extends the northern limit of the subtidal component in the Connecticut River to the Essex-Deep River town line.

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[7] There are three parcels making up Thatchbed Island associated with the Essex Land Trust as determined through the Essex Property records system. All three contain a U.S. National Resource Conservation Service conservation easement that spans parts of them; one parcel additionally contains the two units of Thatchbed Island WMA.

[8] Same as previous footnote.

- The eastern Long Island Sound area is extended further westward (“western addition”) in Alternative C to include Crane Reef and Long Sand Shoal and bounded on the north (landward) by the 30-foot depth contour as defined on NOAA nautical charts.
- The eastern Long Island Sound area is extended further eastward (“eastern addition”) to the vicinity of Black Point in East Lyme in Alternative C.

As in Alternatives A, B, and D, facility space and associated support are provided for Alternative C by:

- UConn Avery Point campus (Groton)
- DEEP Marine District Headquarters (Old Lyme)

4.2.4.2 Purpose and Needs – Alternative C

Alternative C will satisfy the purpose and needs of the proposed action in the following ways:

1. Provides adequate land and water controls.

The upland properties owned and managed by the State of Connecticut (specifically DEEP and UConn) ensure the long-term viability of their habitats and their ability to support appropriate human uses. The non-state-owned upland properties are owned by private and federal habitat and land conservation organizations and can provide adequate levels of control. As in previous alternatives, subtidal areas of Alternative C are subject to federal, state, and local controls that have long-standing approaches to balance resource protection while supporting an assortment of uses.

Core areas, vital to the function of the ecosystem, and buffer areas that serve to protect or facilitate habitat shifts for core areas and include areas where existing habitat manipulations may occur (15 C.F.R. § 921.11(c)(3)) are defined for Alternative C as (Figure 4-7):

- **Upland Core Areas:** Consistent with previous alternatives, Alternative C core areas were identified for those components of the lower Connecticut River marshes in the areas of Lord Cove, Great Meadows, Ragged Rock Creek, Ferry Point and Great Island / Roger Tory Person NAP that are currently high marsh dominated, but may transition to low marsh as suggested by the Sea Level Affecting Marshes Model (SLAMM) land cover scenarios for 25-50 years in the future (Clough et al. 2019).
- **Upland Buffer Areas:** Consistent with previous alternatives, Alternative C buffer areas were identified for those components of the lower Connecticut River marshes that are identified as likely areas maintaining or transitioning to high marsh as suggested by the SLAMM land cover scenarios for 25-50 years in the future (Clough et al. 2019), as well as forest-dominated areas of Lord Cove not directly adjacent to the Connecticut River. The DEEP Marine District Headquarters property and the UConn Avery Point campus constitute facility-based buffer areas in Alternative C.
- **Subtidal Core Areas:** All areas as described in the subtidal components described for Alternative C (h-l, above) exclusive of the subtidal buffer areas described below are considered core areas. This includes a substantial portion of the Connecticut River that provides connection to estuarine waters for the upland marshes in Lord Cove, Great Meadows, Ragged Rock Creek,

Ferry Point and in the area of Roger Tory Peterson NAP. A substantial part of Long Island Sound is also part of the subtidal core in Alternative C.

- **Subtidal Buffer Areas:** The subtidal buffer areas in Alternative C include the following:
    - Approximately 450-feet extended from the shoreline, or more when needed to contain a particular structure or activity (e.g., marina basins, docks, piers, wharves, floats, jetties, groins, breakwaters, or other similar structures).
    - Navigation channels, turning basins, and submerged cable areas as indicated on NOAA nautical charts.
    - Anchorage areas in waters generally less than 30 feet deep areas as indicated on NOAA nautical charts.
    - South Cove, Essex
    - Any areas of extraneous cartographic features (e.g., slivers, holes, gaps, or similar) resulting from applying the conditions above were included on a case-by-case basis using best professional judgment.

The subtidal core and buffer areas of Alternative C differ from those in Alternative A by providing a greater emphasis on core versus buffer in order to place long-standing, pre-existing habitat manipulations per 15 CFR § 921.1(d) in the buffer rather than the core. The subtidal core and buffer areas of Alternative C differ from those of Alternative B only in the areas defined, not in the approach to defining them.

2. Provides suitable typological balance, habitat composition, and access to support long-term research and education, and the ability to enhance and advance estuarine awareness with broad local support.

The inclusion of a large and varied expanse of subtidal habitats spanning shallow to deep water (0 to approximately 150 feet deep) across differing sedimentary types (fine-grained silt and clays to rocky hardbottom) is a significant addition of typological uniqueness in the Acadian and Virginian Reserve System biogeographic regions found in all alternatives. Alternative C includes a wide array of habitat types, including upland and submerged habitats, though with less diversity than Alternatives A and D.

A few State of Connecticut-defined Critical Habitats (Metzler and Barrett 2006) are found within the project area: beachshore and intertidal marsh (Barrett 2014). Alternative C lacks the coastal woodland / shrubland, coastal grassland, and poor fen found in Alternatives A and D. Alternative C also lacks the rocky bluff, large expanse of beach, and cove forest found in Alternatives A and D, and the extensive freshwater marshes and floodplain forest found in Alternative B. Alternative C includes additional brackish marshes, including an area known to have native common reed (*Phragmites* sp.).

Alternative C hosts approximately 12 acres of subtidal eelgrass (*Zostera marina*) within the core area (none in the buffer area), compared to approximately 540 acres found in Alternatives A and D (Bradley and Paton 2018). Coldwater coral are essentially absent and the amount of hard bottom and complex seafloor included in Alternative C are very low compared to Alternatives A and D (Bradley and Paton 2018). In contrast to the rock dominated coastline of the eastern portions of Alternatives A and D, the Connecticut River area included in Alternative C occupies a section of coastline that is sediment dominated. A complex of overlapping glacial deltas overwhelmed and buried the glacially smoothed bedrock surface as meltwater streams delivered large quantities of sediment to Glacial Lake Connecticut (18,000 to 20,000 years ago).

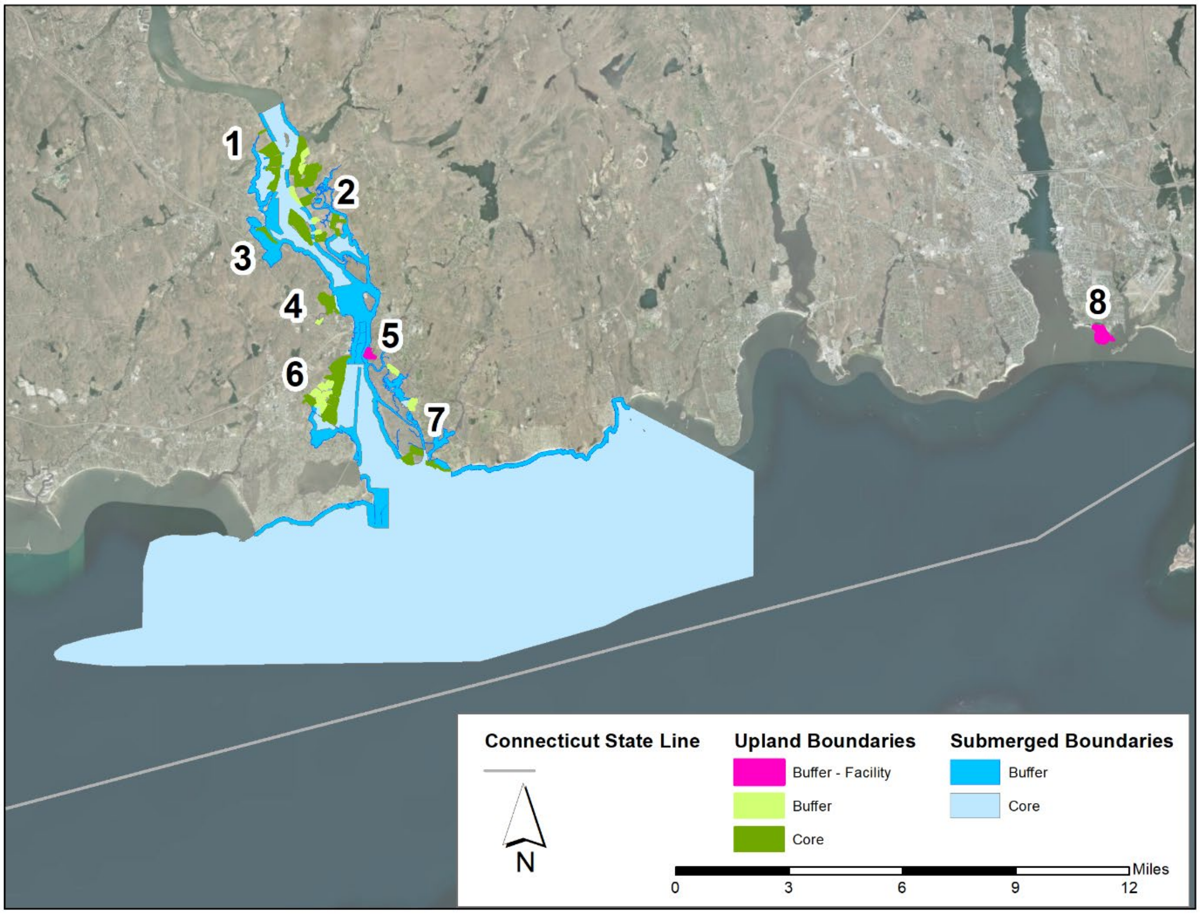

Figure 4-7: Alternative C – Lower Connecticut River Core and Buffer

Location of core and buffer lands and subtidal areas within Alternative C. (1) Great Meadows-Essex Land Trust (2) Lord Cove-The Nature Conservancy (3) Thatchbed Island-Essex Land Trust and Thatchbed Island WMA (4) Ferry Point WMA, (5) DEEP Marine District Headquarters, (6) Ragged Rock Creek-The Nature Conservancy and Ragged Rock Creek WMA, (7) Great Island and Griswold Point properties-The Nature Conservancy (8) UConn Avery Point

3. Balances ecological characteristics with human uses.

The upland, state-owned WMA properties are managed to minimize human interference in order to maintain and support key habitats, and similarly, non-state-owned properties are intended to support habitat conservation. Subtidal areas support a wider variety of uses than upland properties, given the overall area and location, including:

- concentrated areas of recreational vessel traffic routes in core and buffer areas of the lower Connecticut River and into The Sounds;

- one mooring field (approximately 29 acres) in the buffer area;
- one riverine anchorage (32 acres) in the buffer and one Long Island Sound anchorage area (approximately 1,687 acres) in the buffer area;
- six navigation channels and one turning basin (approximately 135 acres) in the buffer area;
- seven areas of submerged cables / pipelines (approximately 200 acres) in the buffer;
- two natural shellfish beds in the lower Connecticut River (109 acres);
- commercial fishing interests—while primarily concentrated in areas outside of the Alternative C, activity does occur within the subtidal core and buffer areas, although specific locations are not typically shared by the fishing community for public knowledge.

In Alternative C, the delineation of buffers encompasses areas of habitat manipulations (as defined in 15 CFR § 921.1(d)) and helps ensure the balance between ecological resources and human uses is maintained.

4.2.4.3 Alternative C – In Context

When compared to Alternative A, the more limited subtidal footprint of Alternative C excludes security zones, inactive or active dredge disposal areas, state and town shellfish lease beds, kelp farming, and is not a significant source for military or commercial vessel traffic. Areas that contain long-term, pre-existing habitat manipulations are included in the buffer rather than in the core, similar to Alternative B but not Alternative A.

When compared to Alternative A, Alternative C has less diversity and range of benthic habitats, notably eelgrass (*Zostera marina*) and rocky hardbottom. Similarly, the diversity and range of upland habitats in Alternative C is also lessened, and would not include beaches, bluff, and grassland habitats. The UConn Avery Point campus—expected to be the focal point for reserve administration and facilities—is geographically disconnected from the main areas of upland and subtidal resources in Alternative C. These features are largely consistent with Alternative B.

The bluff at Bluff Point CR. This property is included in Alternatives A and D, but absent from Alternatives B and C. Photo credit: BluffPoint.lookout by Judy Benson / Connecticut Sea Grant. www.flickr.com/photos/ctnerr/ (CC BY-NC 4.0)

4.2.5 Alternative D – Revised Nominated Site

Alternative D retains the properties included in the upland configuration as described in Alternative A with the addition of Pine Island, an island owned by the University of Connecticut (Figure 4-8). This island is in a geographic chain with Bushy Point Island (included in the Bluff Point CR). Compared to subtidal sections of Alternative A, Alternative D considers where existing habitat manipulations may occur (15 C.F.R. § 921.11(c)(3)) and places such areas in buffer versus core or completely excludes areas of extensive habitat manipulation from the proposed CT NERR boundaries.

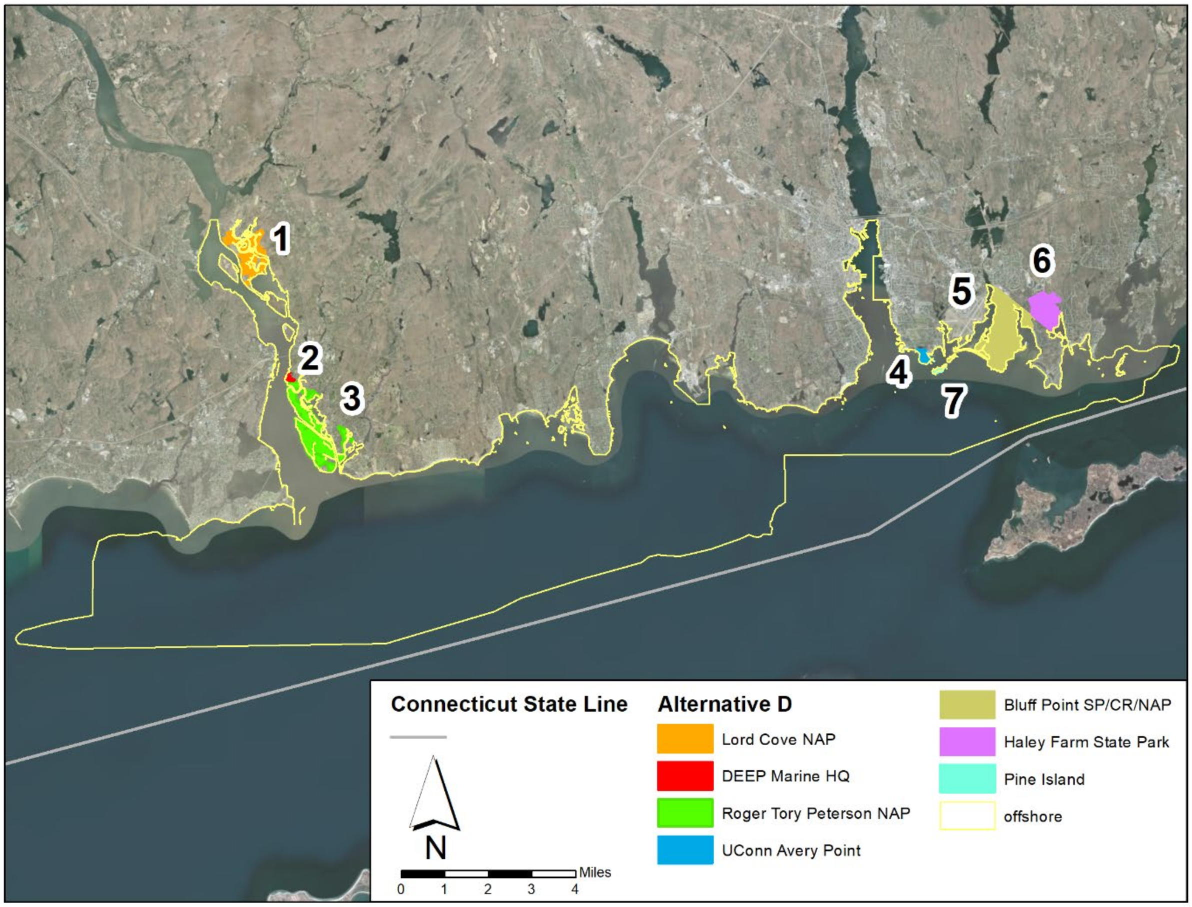

Figure 4-8: Alternative D – Revised Nominated Site

(1) Lord Cove NAP, (2) DEEP Marine District Headquarters, (3) Roger Tory Peterson NAP, (4) UConn Avery Point campus, (5) Bluff Point, (6) Haley Farm, (7) Pine Island

4.2.5.1 Site Boundary – Alternative D

Alternative D, including upland and subtidal properties, is approximately 52,160 acres. Landward components of Alternative D are state-owned properties located in Groton, Old Lyme, and Lyme. Subtidal components of Alternative D include the lower Connecticut River north to include Old Lyme, the lower Thames River north to the Gold Star Bridge / U.S. Route 1 / I-95, and most of the Connecticut waters of eastern Long Island Sound and western Fishers Island Sound (Figure 4-8).

The landward components of Alternative D (approximately 1,955 acres) include all of the state-owned properties in Alternative A, owned and managed by DEEP:

- Bluff Point complex: Bluff Point State Park, Bluff Point CR, and Bluff Point NAP (Groton)
- Haley Farm State Park (Groton)
- Roger Tory Peterson NAP (Old Lyme)
- Lord Cove NAP (Lyme)

The landward components of Alternative D differ from Alternative A by including one additional state-owned property, owned and managed by UConn:

- Pine Island (Groton), a State Archaeological Preserve

The subtidal components of Alternative D (approximately 50,205 acres) include the public trust waterbodies included in Alternative A with a few modifications:

- As in Alternative A, Alternative D includes eastern Long Island Sound ranging approximately from the mouth of the Connecticut River, east to Mason's Island in western Fishers Island Sound, and seaward of the mean high water shoreline to just north of the Connecticut-New York state boundary line in The Sounds.
- As in Alternative A, Alternative D includes the area seaward of the mean high water shoreline of the lower Thames River from approximately the Gold Star Bridge south to just north of the Connecticut-New York state boundary line in The Sounds.
- As in Alternative A, Alternative D includes the area seaward of the mean high water shoreline within the lower Connecticut River from approximately Lord Cove, south to just north of the Connecticut-New York state boundary line in The Sounds; which also includes the Lieutenant River, Back River, and Black Hall River to CT Route 156.
- As in Alternative A, Alternative D includes the embayments of Baker Cove / Birch Creek / Birch Plain Creek, Poquonnock River, Mumford Cove, and Palmer Cove.

Relative to Alternative A, Alternative D differs by:

- Removes two areas proximal to the General Dynamics Electric Boat facility in the Thames River (65 acres) and the Dominion Millstone Power Station in Waterford (45 acres); both are designated as subtidal security zones pursuant to 33 C.F.R. § 165.154.
- Removes 2,230 acres representing the currently designated Eastern Long Island Sound Disposal Site, the inactive disposal area immediately to the east of the active disposal area, plus a surrounding zone defined by a buffer of approximately 0.3 miles to provide additional space

between the proposed CT NERR boundary and the disposal area (see text box on *Dredged Material in Eastern Long Island Sound*, page 49).

- Adds a “western addition” area described in Alternative C. The “western addition” extends westward from the mouth of the Connecticut River to approximately Crane Reef and Long Sand Shoal and is bounded on the north (landward) by the 30-foot depth contour as defined on NOAA nautical charts. In Alternative D, however, this area is included as core area and not as a buffer.

As in Alternatives A, B, and C, facility space and associated support are provided for Alternative D by:

- UConn Avery Point campus (Groton)
- DEEP Marine District Headquarters (Old Lyme)

4.2.5.2 Purpose and Needs – Alternative D

Alternative D will satisfy the purpose and needs of the proposed action in the following ways:

1. Provides adequate land and water controls.

The upland properties of Alternative D are all owned and managed by the State of Connecticut (specifically DEEP and UConn) with existing protections and management practices that ensure the long-term viability of their habitats and their ability to support appropriate human uses. Similarly, the subtidal areas are subject to various federal, state, and local controls that have long-standing approaches to balance resource protection while supporting an assortment of uses.

Core areas, vital to the function of the ecosystem, and buffer areas that serve to protect or facilitate habitat shifts for core areas and include areas where existing habitat manipulations may occur (15 C.F.R. § 921.11(c)(3)) are defined for Alternative D as (Figure 4-9):

- **Upland Core Areas:** Alternative D areas are the same as described in Alternative A, with the addition of Pine Island. Both Alternative D and A include the Bluff Point CR, Bluff Point NAP, and the largest and eastern most component of Haley Farm State Park. As in Alternative A, Alternative D includes those areas of marsh at Lord Cove NAP and Roger Tory Peterson NAP that are currently high marsh dominated, but may transition to low marsh as suggested by the Sea Level Affecting Marshes Model (SLAMM) land cover scenarios for 25-50 years in the future (Clough et al. 2019).

- **Upland Buffer Areas:** Alternative D upland buffer areas are the same as described in Alternative A and include Bluff Point State Park and the smaller western components at Haley Farm. As in Alternative A, Alternative D includes those areas of marsh at Lord Cove NAP and Roger Tory Peterson NAP that are identified as likely areas maintaining or transitioning to high marsh as suggested by the SLAMM land cover scenarios for 25-50 years in the future. The DEEP Marine District Headquarters property and the UConn Avery Point campus constitute facility-based buffer areas in Alternative D.

- **Subtidal Core Areas:** Alternative D includes all riverine and subtidal areas except as noted below, in the description for subtidal buffer areas. Alternative D includes a portion of the Connecticut River that provides connection to estuarine waters for the upland marshes in Lord Cove and Roger Tory Person NAP. A substantial part of Connecticut’s waters in The Sounds are also part of the subtidal core. In a departure from Alternative A, Alternative D includes the “western addition” from Alternative C as core.

  - Areas completely removed from Alternative D include two security zones—proximal to the General Dynamics Electric Boat facility in the Thames River (65 acres) and the Dominion Millstone Power Station in Waterford (45 acres)—and the designated Eastern Long Island Sound Disposal Area and a nearby inactive dredge disposal site, plus a surrounding zone defined by a buffer of approximately 0.3 miles to provide additional space between the proposed CT NERR boundary and the disposal area.

- **Subtidal Buffer Areas:** The subtidal buffer areas of Alternative D include the following:
  - Approximately 450-feet extended from the shoreline, or more when needed to contain a particular structure or activity (e.g., marina basins, docks, piers, wharves, floats, jetties, groins, breakwaters, or other similar structures).
  - Navigation channels, turning basins, and submerged cable areas as indicated on NOAA nautical charts.
  - Anchorage areas in waters generally less than 30 feet deep as indicated on NOAA nautical charts.
  - Any other areas that involve or are known to be involved with past dredging activities not already addressed by the items in the first three bullets of this list. This excludes areas for active disposal and areas of recent disposal activity.
  - Areas depicted as submerged cable or pipeline areas on nautical charts.
  - Areas that, based on reasonable knowledge or expectations, may likely host new cable or pipeline infrastructure installations.
  - Any areas of the lower Thames River from the Gold Star Bridge / Interstate 95 to the vicinity of the river mouth that may not necessarily fall within the above categories but may have nearby high concentrations of water-dependent uses.

The subtidal core and buffer areas of Alternative D differ from those in Alternative A by providing a greater emphasis on core versus buffer in order to place long-standing, pre-existing habitat manipulations per 15 CFR § 921.1(d) in the buffer rather than the core. Alternative D buffer areas differ from Alternatives B and C only in the specific buffer areas, not in the approach to defining them.

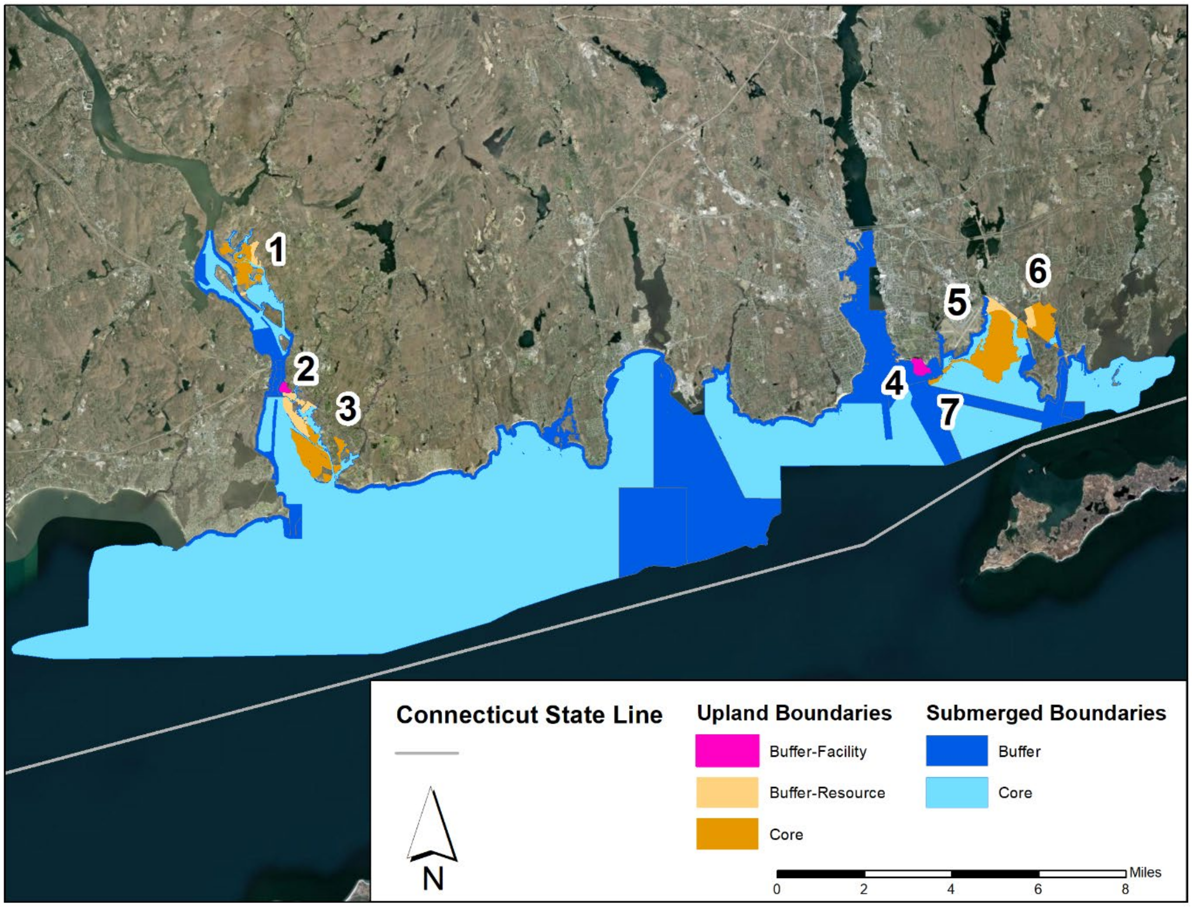

Figure 4-9: Alternative D – Revised Nominated Site Core and Buffer Areas
Location of core and buffer lands and subtidal areas within Alternative D. (1) Lord Cove NAP, (2) DEEP Marine District Headquarters, (3) Roger Tory Peterson NAP, (4) UConn Avery Point, (5) Bluff Point, (6) Haley Farm, (7) Pine Island

2. Provides suitable typological balance, habitat composition, and access to support long-term research and education, and the ability to enhance and advance estuarine awareness with broad local support.

Alternative D includes all of the habitats found in Alternative A. The inclusion of a large and varied expanse of subtidal habitats spanning shallow to deep water (0 to approximately 150 feet deep) across differing sedimentary types (fine-grained silt and clays to rocky hardbottom) is a significant addition of typological uniqueness in the Acadian and Virginian Reserve System biogeographic regions. Alternative D includes a wide array of habitat types, including upland and submerged habitats.

A few State of Connecticut-defined Critical Habitats (Metzler and Barrett 2006) are found within Alternative D: beachshore, coastal woodland / shrubland, coastal grassland, poor fen, floodplain forest, and intertidal marsh (Barrett 2014). Poor fen is unique to Alternatives A and D. Alternative D includes a rocky bluff, large expanse of beach, and a cove forest, but lacks the extensive freshwater marshes found in Alternative B.

Alternative D hosts approximately 540 acres of subtidal eelgrass habitat (*Zostera marina*) (Bradley and Paton 2018). Coldwater coral and a significant amount of hard bottom and complex seafloor are included in Alternative D (DEEP 2019b). In contrast to the rock dominated coastline of the eastern portion of Alternative D, the Connecticut River occupies a section of coastline that is sediment dominated. A complex of overlapping glacial deltas overwhelmed and buried the glacially smoothed bedrock surface as meltwater streams delivered large quantities of sediment to Glacial Lake Connecticut (18,000 to 20,000 years ago).

3. Balances ecological characteristics with human uses.

While upland areas of State Park properties are used for various active and passive recreational activities, WMA and NAP properties are managed to minimize human interference in order to maintain and support key habitats. Subtidal areas support a wider variety of uses than upland properties, given the overall area and location, including:

- concentrated areas of recreational vessel traffic routes in core and buffer areas of the lower Connecticut River and into The Sounds;
- concentrated areas of recreational vessel traffic routes and commercial and military vessel traffic routes in the buffer area of the Thames River and into The Sounds;
- five mooring fields (approximately 134 acres);
- all or parts of two inactive dredge material disposal areas in the buffer area (approximately 1,931 acres);
- all or part of 17 anchorage areas in the buffer area (approximately 2,530 acres);
- all or parts of 13 navigation channels / turning basins in the buffer area (approximately 525 acres);
- all or part of 16 areas of submerged cable / pipelines in the buffer area (approximately 1,977 acres);
- all or part of 37 state and town lease areas (approximately 887 acres) for both commercial shellfish and seaweed aquaculture operations in both the core and buffer areas;
- 13 approved areas (approximately 8,275 acres) for recreational shellfishing in both the core and buffer areas;
- two natural shellfish beds in the lower Connecticut River (109 acres) in both the core and buffer areas;
- commercial fishing interests—while primarily concentrated in areas outside of Alternative D, activity does occur within the core and buffer subtidal areas, although specific locations are not typically shared by the fishing community for public knowledge.

In Alternative D, the delineation of buffers encompasses areas of habitat manipulations (as defined in 15 CFR § 921.1(d)) and helps ensure the balance between ecological resources and human uses is maintained.

4.2.5.3 Alternative D – In Context

As with Alternative A, Alternative D includes a greater range of human uses compared to Alternatives B and C. However, no single activity or activities dominate to the degree that the ecological characteristics or intended reserve functionality would be threatened. For instance, although boating and recreational fishing are nearly universal, they do not harm or threaten the overall ecology of the project area, nor does their presence hinder potential research, education, or monitoring. Areas that contain long-term, pre-existing habitat manipulations are used to designate buffer areas, similar to Alternatives B and C, but not Alternative A.

When compared to Alternative A, there is a comparable diversity and range of benthic habitats. Notably, Alternative D includes a substantial area of eelgrass beds (*Zostera marina*) and rocky hardbottom. Similarly, the diversity and range of upland habitats in Alternative D is comparable to Alternative A and includes beaches, bluffs, and grassland habitats. Alternative D includes an array of habitats not present (or not present in a comparable way) in Alternatives B and C. The UConn Avery Point campus—expected to be the focal point for reserve administration and facilities—has a close geographic connection to the areas of upland and subtidal resources. This is consistent with Alternative A, but different from Alternatives B and C where the UConn Avery Point campus is much farther removed from the Connecticut River.

Alternative D completely excludes the security zones within the lower Thames River around the General Dynamics Electric Boat facility and around the Dominion Millstone Power Station in Waterford. This is consistent with Alternatives B and C, but not Alternative A.

4.2.6 Comparison of Alternatives

This section presents a consolidated comparison of the five alternatives presented in *Sections 4.2.1* through *4.2.5* (Table 4-2).

Table 4-2: Comparison of Boundary Alternatives

Comparison of areas of habitat types and presence / absence of certain key habitats. Land cover classification (last group in the table) was obtained by overlaying the alternative boundaries on 1-meter resolution land cover data (NOAA OCM 2021). Land cover acreage analysis will not total to the acres shown in other parts of the table.

	NO ACTION ALTERNATIVE	ALTERNATIVE A	ALTERNATIVE B	ALTERNATIVE C	ALTERNATIVE D
AREA					
Total Area (acres)	0	48,160	23,280	30,970	52,160
Landward Area (acres)	0	1,870	1,625	934	1,955
Subtidal Area (acres)	0	46,290	21,655	30,036	50,205
SELECTED CONNECTICUT HABITATS					
beachshore	0	present	present	present	present
coastal woodland / shrubland	0	present	absent	absent	present
coastal grassland	0	present	absent	absent	present
poor fen	0	present	absent	absent	present
rocky bluff	0	present	absent	absent	present

	NO ACTION ALTERNATIVE	ALTERNATIVE A	ALTERNATIVE B	ALTERNATIVE C	ALTERNATIVE D
cove forest	0	present	absent	absent	present
intertidal marsh	0	present	present	present	present
floodplain forest	0	present	present	absent	present
hard bottom seafloor	0	substantial	minor	minor	substantial
sediment dominated seafloor	0	substantial	substantial	substantial	substantial
eelgrass beds (acres)	0	540	0	12	540
natural shellfish beds (acres)	0	109	109	109	109
AQUACULTURE AND SHELLFISHING					
leased shellfish beds (acres)	0	860	0	0	860
bottom cages in leased areas (acres)	0	33	0	0	33
kelp longlines (acres)	0	27	0	0	27
recreational shellfish beds (acres)	0	8,275	0	0	8,275
NAVIGATIONAL CONCERNS AND SAFETY ZONES					
mooring fields (acres)	0	180	30	29	134
security zones (acres)	0	116	0	0	0
active dredge material disposal areas (acres)	0	1,100	0	0	0
inactive dredge material disposal areas (acres)	0	2,425	0	0	1,931
anchorage areas (acres)	0	2,715	708	1,719	2,530
navigation channels / turning basins (acres)	0	525	180	135	525
submerged cable / pipelines areas (acres)	0	1,977	185	200	1,977
LAND COVER CLASSIFICATION - Area (acres) from 1-meter resolution land cover dataset.					
barren land	0	32	19	12	34
impervious cover	0	37	33	26	37
developed, open space	0	32	30	20	32
pasture, hay, crops	0	17	0	0	17
grassland / herbaceous	0	20	46	4	20
scrub / shrub	0	103	18	5	103
mixed forest	0	761	326	127	762
floodplain forest	0	9	17	0	9
nontidal wetlands*	0	6	55	0	8
tidal wetlands	0	799	957	578	806
unconsolidated shore	0	59	50	33	59
* floodplain forest, a nontidal wetland, is in a separate category.					

4.3 Other Alternatives Previously Considered but Eliminated

A consistent theme from the *Draft Environmental Impact Statement* scoping meetings was to consider additional areas (typically, though not exclusively, upland properties) as part of the proposed CT NERR boundary. The evaluations of these elements relied on the following conditions:

- the state's ability to fulfill the requirements of having adequate control over key land and water areas sufficient to provide long-term protection for reserve resources in order to ensure a stable environment for research (Reserve System Regulations 15 C.F.R. § 921.30(a)(2));
- the types and distribution of estuarine habitats and ecosystems these new areas provide with respect to the suitability for long-term research, the contribution to typological balances within the system, and the ability to enhance public awareness of estuaries and provide suitable public education and interpretation (Reserve System Regulations: 15 C.F.R. § 921.30(a)(1), (3)).

4.3.1 Inclusion of Additional Ramsar Wetlands

Ramsar wetlands reference specific areas designated as "wetlands of international importance" under the Ramsar Convention (Dreyer and Caplis 2001; USFWS 1994). These sites were evaluated for recognition based on their significance for ecological value, both locally and globally, and the commitment to ensure their ecological character was maintained. In Connecticut, the Ramsar-designated wetlands are an integrated complex of many individual units and shallow-water riverine habitats from the mouth of the Connecticut River to just north of Middletown. These include public trust riverine areas (below mean high water), as well as 28 upland properties owned by DEEP, six municipally owned properties, and 28 other properties held by private conservation organizations. In total these amount to approximately 20,500 acres, with approximately 12,300 open water acres and approximately 8,200 upland acres.

It should be noted that all of the wetland and riverine areas of the Connecticut River are included within the alternatives under consideration in *Section 4.2* are components of the larger Ramsar complex. Therefore, Ramsar wetlands are being considered within the context of a proposed CT NERR designation, as is appropriate given their notable ecological significance and value.

When considering the totality of the Ramsar area however, several issues arose. While the State of Connecticut has jurisdiction within the public trust areas and roughly half of the upland properties, there are a substantial number of properties owned by various municipal and private entities. This level of mixed ownership would add additional complexity to management and coordination of a reserve, and likely present challenges to the state's ability to satisfy 15 C.F.R. § 921.30(a)(2). Further, the inclusion of all of these upland properties (62 units in total)—while potentially interesting to certain elements of reserve research and education goals—is not *necessary* to address 15 C.F.R. § 921.30(a)(1), (3). Subsets of the suite of properties can adequately satisfy these conditions. Thus, the consideration of all of the Ramsar properties is not a part of this environmental analysis.

4.3.2 Inclusion of the Silvio O. Conte U.S. Fish and Wildlife Service Property

A single parcel of land owned by the U.S. Fish and Wildlife Service as part of the Silvio O. Conte Fish and Wildlife Refuge was suggested to be added to the footprint of the proposed CT NERR. The entire Conte Refuge comprises nearly 40,000 acres within parts of the four Connecticut River watershed states of

New Hampshire, Vermont, Massachusetts, and Connecticut; and represents a diverse variety of unique habitats. The parcel in question is a roughly 55-acre property located within the town of Old Lyme and is situated between the Roger Tory Peterson NAP complex at the mouth of the Connecticut River and the Lord Cove wetlands on the border of Old Lyme and Lyme. It is largely dominated by upland coastal forest with a small number of tidal wetlands that connect to the Lieutenant River, a tributary off of the main stem of the Connecticut River.

The property was used as a studio by noted illustrator and naturalist Roger Tory Peterson, an important figure of the environmental movement in the 20th century. Aside from the historic and cultural aspects this property could add to the educational mission of the proposed CT NERR, it is not closely or directly connected to the Connecticut River (approximately 2.25 miles inland) and thus would require the inclusion of nearly all of the Lieutenant River to provide connection and access to the estuary. More critically, the habitat and land cover types provided do not uniquely distinguish it in a meaningful way from other alternatives; where the other properties provide the same or similar attributes and have a more direct connection to the Connecticut River estuary. Further, traversing the property to access the wetlands and river from the uplands requires hiking through undeveloped areas with no marked trails or easily navigable pathways. As such, this particular option does not substantially support 15 C.F.R. § 921.30(a)(1), (3) and therefore this property will not be part of this environmental analysis.

4.3.3 Inclusion of Connecticut Audubon Society Property

An approximately 55-acre property owned by the Connecticut Audubon Society in East Haddam located just south of Machimoodus State Park was noted during the scoping process. However, it is inland of the Connecticut River or any tributary thereof (located on the eastern side of CT Route 149). More critically, the habitat and land cover types provided (upland forest) do not uniquely distinguish it in a meaningful way from other properties included in the analysis that provide the same or similar attributes and have a direct physical connection to the Connecticut River estuary. As such, this particular option does not substantially support 15 C.F.R. § 921.30(a)(1), (3) and therefore this property will not be part of this environmental analysis.

4.3.4 Inclusion of Connecticut River Area TNC Conservation Easements

In addition to several properties owned in fee by The Nature Conservancy (TNC) that are immediately proximal to state-owned properties under consideration within this analysis, there are 23 conservation easements amounting to roughly 405 acres that are also nearby:

- 19 easements totaling approximately 375 acres in and around the Lord Cove area, and
- four easements totaling approximately 30 acres around the area of Griswold Point and the Roger Tory Peterson NAP, at the mouth of the Connecticut River.

Although these were identified in the environmental impact statement scoping meeting comments, at the request of The Nature Conservancy, the conservation easements were removed. Other Nature Conservancy properties, however, are included in Alternative C.

4.3.5 Inclusion of Rocky Neck State Park

Rocky Neck State Park, owned by DEEP, is a 710-acre property in East Lyme. As one of the many state parks and natural resource areas owned and managed by the state, it was included as part of the initial review of properties during the site selection process. While this site offers notable recreation and natural resource values, its evaluation with respect to the capacities needed to support a reserve did not elevate it to the levels of other properties that were ultimately considered in the final analyses of the selection process. A particular element of concern was the use of the beach as a significant location for public recreational bathing and swimming. Since this was previously considered during the initial phase of site selection but not advanced further, it does not warrant a repeated evaluation.

Osprey in flight over Palmer Cove, as photographed from Haley Farm State Park. Palmer Cove and Haley Farm State Park are included in Alternatives A and D, but not in Alternatives B and C. Photo credit: ospreys.3 by Judy Benson / Connecticut Sea Grant. www.flickr.com/photos/ctnerr/ (CC BY-NC 4.0)

4.4 NEPA Environmental Impact Statement Public Engagement Efforts

This *Draft Environmental Impact Statement* has been developed to provide information to decision makers and the interested public on the potential impacts associated with designation of the proposed CT NERR under federal authorities. In an effort to better understand potential concerns of interested parties with respect to the designation of the proposed CT NERR, considerable effort was made to include broad and diverse public and private participation through the NEPA process. Groups and individuals had the opportunity to provide input and support since the commencement of the site designation process. This approach was designed to develop among the participatory groups, a sense of ownership in the process and in the future of the proposed CT NERR.

The Reserve System regulations require that at least one public scoping meeting be held, and that a notice be published in the Federal Register at least 15 days prior to the meeting. (15 C.F.R. § 921.13(c). Accordingly, a virtual public scoping meeting took place on Tuesday, August 4, 2020, from 7:00 p.m. to 9:00 p.m. EDT. The public was provided notice of the meetings in the Federal Register on July 20, 2020 (85 FR 43543), or 18 days in advance of the public scoping meeting, and through an advertisement posted on July 20, 2020, in The Hartford Courant, The Day, and Middletown Press.

Lord Cove NAP, included in all Alternatives. Photo credit: A view of Lord Cove Oct2018, by Kevin P. O'Brien. www.flickr.com/photos/ctnerr/ (CC BY-NC 2.0)

5 Affected Environment

This chapter provides a narrative description of the resources and uses of the study area that could be affected by the boundary alternatives presented in *Chapter 4*. The information in this chapter provides the basis for NOAA's evaluation of the potential environmental impacts of the range of alternatives, as described in *Chapter 6*.

The scope of the affected environment is:

- the physical environment (air quality and climate, noise, geology and substrates, water);
- the biological environment (living marine resources and protected species and habitats);
- recreation and socioeconomics; and
- cultural and historic resources.

Both the natural environment and human environment are under threats from a range of sources (Table 5-1). Where appropriate, threats are identified in this chapter so that the choice of alternatives can be assessed in terms of how the alternatives differ in risk levels or may mitigate these potential impacts.

Table 5-1: Summary of Potential Threats

Threats were divided into a few classes. These designators will be used throughout. Icons were developed for this project. Text was adapted from the NOAA Fisheries website, unless otherwise noted (NOAA Fisheries 2021e). A comprehensive list of threats is also available in the Connecticut Wildlife Action Plan (DEEP 2016a).

ICON	THREAT	DESCRIPTION
	climate change	Climate change will have a wide range of effects on habitats, wildlife, and people. Increased temperatures are already contributing to sea level rise and increased extreme weather events. In the United States, a sea level rise of one foot could eliminate 17 to 43% of today's wetlands. Ocean acidification, a result of the ocean absorbing increased carbon dioxide, makes it harder for shellfish and cold water corals to grow. Extreme weather events will lead to coastal and marine habitat loss. Hurricanes and other storms destroy wetlands and other coastal habitats through erosion and flooding, and waves can damage coastlines. Seagrass meadows are particularly vulnerable to heat stress through alteration of ecosystem structure, function, and loss of biodiversity. Taken together, these losses leave coastal communities more vulnerable to future storms and food insecurity. Droughts and heat waves alter habitat conditions and affect the migratory patterns of fish and other wildlife.

ICON	THREAT	DESCRIPTION
	sea level rise	Along coastlines around the world, rising seas resulting from climate change threaten infrastructure necessary for local jobs and regional industries. Roads, bridges, railways, water supplies, oil and gas lines, power plants, sewage treatment plants, and landfills are all at risk from sea level rise (Lindsey 2009).
	coastal development	Coastal development and shoreline structures are leading to the loss of nesting beach habitat for some birds and horseshoe crabs, fragment coastal habitats, block marsh and seagrass migration inland as sea level rises, and create pollution which may enter neighboring natural habitats often worsened by the increase in impervious cover. Shoreline hardening or armoring (e.g., seawalls) can result in the complete loss of intertidal habitats and wave action can alter the subtidal habitats through erosion, sedimentation, and wave reflection. Artificial lighting disturbs many wildlife species, including birds and insects, and interferes with bat foraging and migration. Light pollution may interfere with communication, detecting and avoiding predators, finding food, and navigating.
	barriers, dams	Physical barriers, which may include shoreline and offshore structures for development (e.g., oil and gas delivery, dredging, pile driving) as well as dams along rivers, can limit access to important migration, breeding, feeding, or reproductive areas.
	noise	Ocean noise from human activities such as shipping, boating, construction, and energy exploration and development has increased in the Northwest Atlantic. Noise from these activities can interrupt the normal behavior of marine mammals and interfere with their communication. It may also reduce their ability to detect and avoid predators and human hazards, navigate, identify physical surroundings, find food, and find mates.
	marine debris	Ingestion of marine debris is a threat to all marine species, from microscopic copepods to whales. For example, sea turtles (e.g., green turtle) may ingest marine debris such as fishing line, balloons, plastic bags, floating tar or oil, and other materials which they can mistake for food, leading to increased injury and mortality. Microplastics are pervasive throughout the environment and cause harm through contaminants which adhere to the plastics and are ingested, and starvation by filter feeders who ingest these particles in place of food.

ICON	THREAT	DESCRIPTION
	pollution	Contaminants, including excess nutrients, enter ocean waters from many sources, including oil and gas delivery, wastewater discharges and septic systems, agricultural and urban runoff, and other industrial processes. Contaminants and excess nutrients may travel to the estuary through groundwater, surface waters (rivers and streams), or be directly discharged into the estuary. Once in the environment, these substances may degrade water quality and fuel harmful algae blooms, or move up the food chain and accumulate in top predators, including recreational and commercial fishery species. Some of these chemicals do not degrade and may harm individuals and their offspring.
	habitat loss	Over the past century, habitat loss has been the most common cause of extinction for freshwater fish in the United States. Many saltwater fish are also in decline due to habitat degradation. When habitats are damaged or lost, they are difficult and costly to restore. Since the early 1600s, the United States has lost more than half of its wetlands (more than 110 million acres) (NOAA Fisheries 2021d). Coastal wetlands continue to disappear at higher rates than those further inland. The coastal watersheds of the continental United States lost wetlands at an average rate of 80,000 acres a year from 2004 to 2009. In addition, fish nursery grounds are significantly affected by the loss of seagrass habitat. Recent trends indicate seagrass habitat losses of 50% in Tampa Bay, 76% in the Mississippi Sound, and 90% in Galveston Bay (NOAA Fisheries 2021d). Seagrass beds in the Chesapeake Bay declined 46% from 2008 to 2012. Seagrass beds in Long Island Sound may have declined between 2 and 10% between 2002 and 2017; the number is uncertain as mapping occurs every three to five years and ground-truthing of aerial photos was not possible in all years (Bradley and Paton 2018). The Long Island Sound Study Comprehensive Conservation and Management Plan goal of 3,827 acres in Long Island Sound is based on the possible habitat in which eelgrass could occur under good water quality conditions and accounting for the fact that eelgrass will not occupy all areas predicted by model outputs (Vaudrey et al. 2013). Current eelgrass coverage in The Sounds represents a minimum of a 60% loss relative to estimated historic values.

ICON	THREAT	DESCRIPTION
	habitat degradation	Habitat can be disrupted or lost because of various human activities such as dredging, dams, water withdrawals, intrusion by saltwater (often caused by pumping of groundwater from freshwater wells by or drought), chemical contamination of sediments, and other development-related impacts. Land use practices can degrade freshwater, coastal, and marine habitats. For example, forestry, agriculture, and development projects damage or destroy riparian areas that protect streams from erosion and filter pollutants. These areas also provide habitat structure, essential nutrients, and forage that animals depend on in the form of falling trees, leaf litter, and bugs that fall from the forest canopy.
	invasive species, nonindigenous species (alien species)	Invasive species are considered to be one of the greatest threats to marine and coastal biodiversity worldwide, second only to habitat loss (NOAA Fisheries 2021c). Exotic or nonindigenous species are animal or plant species moved from their original range (location) to a new one, but are not yet reproducing in that new range. Once enough individuals of an exotic species establish and begin to reproduce in the new range, and they create ecological or economic harm, the species is considered an invasive species.
	human harassment	Harassment applies to both animals and plants. For example, harassment of seals, including repeated exposure to vessel traffic and other disturbance, can degrade important nursery, molting, and haul out areas. Increased vessel traffic can also cause altered behavior, increased energetic expenditures, and increased exposure to stress. Mountain bikes, motorized vehicles and unleashed dogs can kill birds, destroy nests, and disrupt breeding of beach-nesting and other ground-nesting birds. For plants, trampling by walking or biking may damage individual plants and open the habitat up for encroachment of invasive species. Certain endangered and threatened plants may be collected illegally. In the water, boat wakes, propellers, anchors, and conventional mooring systems scar, crush, and uproot seagrass plants.
	hunting, direct harvest	Historically, some marine mammals and turtles were killed in extraordinarily high numbers for their fat, meat, and eggs. This led to the catastrophic global decline of these species. While illegal in the United States, killing of U.S. federally listed endangered and threatened animals (including birds and fish) may remain legal in some countries and this can disrupt regional efforts to recover the species. Hunting is and would continue to be allowed within sections of the proposed CT NERR. Species hunted include small and large mammals, and land and water fowl. Hunting is a regulated and legal activity that is also an important tool used for wildlife management. “Poaching” (i.e., illegal hunting) is a more accurate term to describe a threat associated with direct take for these terrestrial species.

ICON	THREAT	DESCRIPTION
	fishing / overfishing	In areas with recreational fishing, fishermen might accidentally or unknowingly catch federally listed species or managed species. Even if fish are released after being caught, they are particularly susceptible to post-release mortality from injury or stress. Some types of fishing gear, such as trawls and traps, can damage or destroy benthic habitats and sessile wildlife.
	bycatch	A primary threat to some marine animals is their unintended capture in fishing gear which can result in drowning or cause injuries that lead to death or debilitation (e.g., swallowing hooks, flipper / fin entanglement, capture in nets). The term for this unintended capture is bycatch. The primary types of gear that result in bycatch include trawls, gillnets, longlines, hook and line, and pots / traps.
 	vessel strikes turbine strikes	Strikes typically refer to direct impacts from vessels on marine mammals, sea turtles, and some fishes, but strikes from other vehicles (automobiles, planes) may also impact terrestrial animals and birds. These collisions can cause broken bones and massive internal injuries, cuts, and in some cases, death. Wind turbines may impact birds and bats in the same way.
	entanglement	Entanglement in fishing gear, plastic bags, or other human-sourced items impacts all wildlife. Fishing gear or plastic items can cut into an animal's body, cause serious injuries, and result in infections and mortality. Even if gear is shed or removed through disentanglement efforts, the time spent entangled can severely stress the animal, weaken it, prevent it from feeding, and sap the energy it needs to move, feed, and reproduce.

5.1 Natural Environment

The project area is a large and diverse mosaic of a variety of upland and aquatic habitats located in southeastern Connecticut. The various boundary alternatives include a total land and water area of approximately 53,000 acres with the landward component totaling approximately 2,000 acres; this estimate includes all land and aquatic areas presented in the four boundary alternatives (*Section 4.2*). Areas under consideration for inclusion in the proposed CT NERR include offshore components stretching from Mystic to Westbrook and selected neighboring land and bays, the mouth of the Thames River, and the Connecticut River, and selected adjacent properties north to East Haddam, CT.

Long Island Sound and Fishers Island Sound form a contiguous coastal plains estuary with a coast sheltered from the full force of ocean storms by Long Island and Fishers Island, respectively. Reserve System typologies (15 C.F.R. § 921) within the project area (Latimer et al. 2014; Lynch 2017) include:

- Developed areas / infrastructure (at the site of core facilities)
- Shorelands
    - Maritime Forest-Woodland (temperate deciduous forest biome)
    - Coast Shrublands
    - Coastal Grasslands
    - Coastal Cliffs
- Transition Areas
    - Coastal Marshes, Tidal (Saltwater and Brackish)
    - Coastal Marshes, Tidal Freshwater
    - Coastal Marshes, Nontidal
    - Intertidal Beaches
    - Intertidal Mud and Sand Flats
    - Intertidal Algal Beds
        - Rocky Intertidal
- Submerged Bottoms
    - Subtidal Hardbottoms
    - Subtidal Softbottoms
    - Subtidal Plants

The 2015 Connecticut Wildlife Action Plan (DEEP 2016a) defined ten key habitats[9] and associated sub-habitats based on Metzler and Barrett's (Metzler and Barrett 2006) ecoregions. A number of State of Connecticut-defined Critical Habitats[10] defined by Metzler and Barrett (2006) are found in the project area, including: beachshore, coastal grassland, coastal woodland / shrubland, floodplain forest, intertidal marsh, and poor fen.

The project area's subtidal waters were chosen to include areas of hardbottom (reefs, ledges, surficial sediment areas, rock / rocky / boulder features), surrounding areas of variable softbottom sediment types, and areas mapped as submerged aquatic vegetation inclusive of depth ranges from shallow (just below the high tide shoreline) to deep (> 150 feet).

The project area includes a number of freshwater coves and tributaries as well as estuarine embayments, where an embayment, as defined in the Connecticut Coastal Management Act (C.G.S. § 22a-93), refers to a protected coastal body of water with an open connection to the sea in which saline sea water is measurably diluted by freshwater, including tidal rivers, bays, lagoons and coves. In Long Island Sound, the names of embayments often include the words Harbor (27%), River (23%), Cove (19%), Bay (10%), Creek (10%), and Pond (7%), with a few including the names Brook, Gut, Inlet, or Lake.

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[9] Key habitats in the 2015 Connecticut Wildlife Action Plan (DEEP 2016a) include: upland forest, upland woodland and shrub, upland herbaceous, forested inland wetland, shrub inland wetland, herbaceous inland wetland, tidal wetland, freshwater aquatic, estuarine aquatic, unique - natural or manmade

[10] Connecticut Critical Habitats depicts the classification and distribution of twenty-five rare and specialized wildlife habitats in the state. It represents a compilation of ecological information collected over many years by state agencies, conservation organizations, and many individuals. Examples of critical habitats include Acidic Atlantic White Cedar Swamps, Sand Barrens, Dry Subacidic Forests and Intertidal Marshes. Identification of Connecticut Critical Habitats is the result of a project which took place from 2007-2009, to create habitat maps to be used in land use planning and natural resource protection (Metzler and Barrett 2006).

5.1.1 Physical Environment

The physical environment encompasses the air (atmosphere), water (hydrosphere), and land (lithosphere). Living organisms (biosphere) are addressed in *Section 5.1.2 Biological* Environment and *Section 5.1.3—Living Resources*.

5.1.1.1 Air (Atmosphere)

5.1.1.1.1 Climate

Climate is the weather of a place averaged over a period of time, often 30 years. Climate information includes the statistical weather information that tells us about the normal weather, as well as the range of weather extremes for a location. The coastal region of eastern Connecticut can generally be characterized as a combination of humid subtropical and temperate ocean climates, bringing a mix of hot, humid summers with mild to moderate winters consisting of a mix of rain with infrequent snow (Weather Atlas 2021) and seasonal storms, including winter Nor'easters and summer hurricanes.

SUMMARY BY BOUNDARY ALTERNATIVE

Conditions are similar among all boundary alternatives.

5.1.1.1.2 Weather

Weather is the day-to-day state of the atmosphere, and its short-term variation in minutes to weeks while climate is long-term trends for an area. Average monthly temperatures can range from lows in the 20s (°F) in January to highs above 80°F in July and August. Average annual temperatures range from the mid-40s (°F) to low 60s (°F). Rainfall is fairly consistent throughout the year at about four inches per month. The average annual snowfall is about 24 inches per year, with the highest average amounts occurring in January and February (NOAA 2021).

SUMMARY BY BOUNDARY ALTERNATIVE

Conditions are similar among all boundary alternatives.

5.1.1.1.3 Climate Change

Climate change is evaluated over years, decades, centuries, or millennia. Climate change impacts within the project area include increased air and water temperatures, rising sea level, ocean acidification, and changes to precipitation and freshwater supply.

The State of Connecticut is actively pursuing efforts to mitigate climate change and to develop strategies to make Connecticut resilient to, and prepared for, the impacts of climate change while "considering racial, class, gender, geographic and generational equity in both costs and benefits" (Governor's Council on Climate Change 2018b). The State of Connecticut's Governor's Council on Climate Change has established interim goals for reducing greenhouse gas emissions, requiring a 45% reduction in greenhouse gas emissions below 2001 levels by 2030 (Governor's Council on Climate Change 2018b); this puts Connecticut on the path towards achieving the 2050 goal of an 80% reduction relative to 2001 levels. This effort is largely targeted at green energy production, but also includes transportation and clean, efficient, and resilient buildings (Governor's Council on Climate Change 2018a).

In September 2019, the Governor's Council on Climate Change was re-established and expanded; in addition to continuing to address mitigation strategies to reduce greenhouse gases, the newly expanded Governor's Council on Climate Change will also continue to consider adaptation and resilience in the face of climate change impacts (Governor's Council on Climate Change 2021a). The Governor's Council on Climate Change recently conducted public meetings structured around sub-working groups, including the "Working and Natural Lands" group. Conclusions from this sub-group are especially relevant to the proposed CT NERR as its charge was to,

> *"Evaluate the role of nature-based solutions (e.g., scaling up the preservation and restoration of forests and wetlands, green and natural infrastructure, agricultural lands) in climate change mitigation and adaptation and how to best incorporate the economic, social, and environmental co-benefits of these solutions into Connecticut's climate change planning strategies."*

An additional charge to the Governor's Council on Climate Change was to,

> *"Develop and implement adaptation strategies to assess and prepare for the impacts of climate change in areas such as infrastructure, agriculture, natural resources, and public health."*

This included tasks such as: (1) conducting an inventory of vulnerable assets and operations; (2) revising and updating the 2011 Connecticut Climate Change Preparedness Plan; and (3) reporting on the alignment of climate change adaptation strategies incorporated into state agency planning processes and documents.

The following list is quoted from the Governor's Council on Climate Change's January 2021 report (Governor's Council on Climate Change 2021b) and includes a summary of expected impacts of climate change in Connecticut:

> *1. There is high confidence in projected changes through the mid-century. Projected changes after the mid-century will depend on mitigation actions taken in Connecticut and globally. Since our understanding of the processes that determine climate is advancing rapidly, and data is being continuously collected, we recommend a comprehensive review of projections be undertaken by the State at five-year intervals as outlined below.*
>
> *2. Mean sea level in Long Island Sound could be up to 20 inches above the National Tidal Datum Epoch (1983-2001) by 2050 (O'Donnell 2019). This projection is not sensitive to future trends in carbon dioxide emissions.*
>
> *3. Changes in mean sea level will significantly impact the frequency of flooding along the Connecticut coast, but the flood zone will not expand much in most areas. With 20 inches of sea-level rise, coastal flood risk could increase by a factor of 5 to 10 with no change in storm conditions. High water levels, like occurred during Superstorm Sandy, will then be expected every 5 to 10 years.*
>
> *4. Sea level rise will continue after 2050. Recent simulations indicate that the mean sea level could be up to 80 inches higher by 2100 if CO_2 emissions are not reduced soon.*

5. Average temperatures in Connecticut could increase by 5˚F (2.7˚C) by 2050 compared to the 1970-1999 baseline. Connecticut's temperature has already risen more than the global average in part because temperature changes tend to increase in middle and high latitudes (towards polar regions). Consequently, a 2˚C target for global average temperature will result in a higher temperature (than 2˚C) in Connecticut.

6. All indices of hot weather are expected to shift toward more frequent and higher temperature events. For example, by mid-century, the number of days per year with temperatures above 90 ˚F (32 ˚C) could increase. Statewide, from 1970 to 1999, the average number of days was 5, and this is projected to increase to an average of 25 days between 2040-2069. (Note that specific locations and specific years will show more days with extreme temperatures than statewide and long-term averages). The number of days with frost could decrease from 124 to 85.

7. Temperature projections after mid-century are sensitive to policy choices on carbon dioxide emissions. Coordinated mitigation now means it is more likely that the temperature will stabilize after 2050. If not, warming is likely to accelerate.

8. Drought risk is also expected to increase. The probability of unusual events (extremely low annual and summer water availability, and extremely high 1-day and 5-day precipitation) are projected to increase by a factor of between 2 and 4 by mid-century.

9. Though it is unclear whether the frequency or intensity of extratropical storms in Connecticut will change, they will likely bring more precipitation. In general, warmer temperatures will result in less snow and more rain, but increased humidity will yield high snowfall events when temperatures permit.

10. Projection of changes in the frequency of tropical cyclones in a warmer climate are uncertain. However, they will likely have stronger winds and more precipitation. Since 1980 there has been an increase in the frequency of hurricanes in category three or greater.

The Governor's Council on Climate Change report listed 61 near-term action strategies to mitigate climate impacts in Connecticut, to be implemented in late 2021 and early 2022 (Governor's Council on Climate Change 2021b). These strategies were grouped into sectors and sub-sectors:

- Equity and Environmental Justice
- Progress on Mitigation Strategies
    - Cross-Sector
    - Non-Energy
    - Transportation
- Working and Natural Lands
    - Forests
    - Wetlands
    - Rivers

- Agriculture and Soils
- Infrastructure and Land Use
- Public Health and Safety
- Financing and Funding Adaptation & Resilience
- Science and Technology

Threats to climate stability include climate change resulting from pollution (human-sourced carbon dioxide). Sea level rise, a result of climate change, threatens infrastructure and habitats. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

Conditions are similar among all boundary alternatives.

5.1.1.1.4 Air Quality

The Connecticut Department of Energy and Environmental Protection currently operates 14 stations as part of the national State and Local Air Monitoring Stations (SLAMS) network, established under the Clean Air Act (see *Chapter 7* for additional information on the Clean Air Act and its relevance to the proposed action). A SLAMS site is located at Fort Griswold State Park in Groton, just yards away from the aquatic portion of the project area in Alternative A and Alternative D and centrally located within these alternative's boundaries. For Alternative B and Alternative C, which include only the lower Connecticut River north to Machimoodus, the Madison-Hammonasset State Park SLAMS station is approximately 10.5 miles west of the project area while Fort Griswold is approximately 13.7 miles to the east.

The Groton-Fort Griswold SLAMS site monitors two key pollutants for the southeastern part of Connecticut, ozone and PM2.5 (fine particulate matter <2.5 microns); as well as PM10.0 / PM10.2.5 (particulate matter <10 microns and coarse particulate matter 2.5 to 10.0 microns). The Madison-Hammonasset State Park SLAMS site monitors ozone and total column nitrogen dioxide. Ozone is measured for compliance with the National Ambient Air Quality Standards (NAAQS) for ozone and for air quality forecasting and reporting, using the Air Quality Index. PM2.5 is also currently monitored for PM2.5 NAAQS compliance and Air Quality Index forecasting and reporting (DEEP 2020b). Based on the 2020 reporting of data from 2019, the Fort Griswold monitoring site as well as the other 13 SLAMS sites in Connecticut are currently meeting both the annual PM2.5 NAAQS of 12 µg / m and the 24-hr PM2.5 NAAQS of 35 µg / m^3 (DEEP 2020b; DEEP). In 2015, the USEPA adopted a more stringent ozone NAAQS of 70 parts per billion (ppb), averaged over an 8-hour period. However, the prior standard of 75 ppb remains in effect. There is a downward trend in the 8-hour ozone design values[11] in Connecticut for each year since 1983 and as of 2019, there are two monitors attaining the updated 70 ppb standard (Cornwall

[11] Ozone design values are calculated annually at each monitoring site (DEEP 2021a). This is done by taking the 4th highest maximum daily 8-hour ozone average from each year and then averaging these from the past three years. This method is used to lessen the influence of extreme weather events for any one year, such as heat waves and stagnation. If the design value does not exceed the 8-hour standard (70 ppb), then the monitor has attained the standard.

and East Hartford). The remaining 10 sites monitoring ozone indicate nonattainment of the 70 ppb standard and five of those monitors remain in nonattainment of the 75 ppb standard (DEEP 2020b).

The USEPA's Toxics Release Inventory tracks the management of certain toxic chemicals that may pose a threat to human health and the environment (40 C.F.R. § 355, 40 C.F.R. § 370). With respect to air releases, these include both fugitive air emissions (releases to air that don't occur through a confined air stream) and point source air emissions (releases to air that occur through confined air streams, such as stacks, ducts or pipes.) Twelve facilities in New London County (USEPA 2021c) and eleven facilities in Middlesex County (USEPA 2021b) must report annually on amounts of chemicals released to the environment or managed through recycling, energy recovery, and treatment. As of the 2019 National Analysis Dataset (released October 2020), these facilities have reported total air emission releases of 13,298 pounds per year in New London County and 45,524 pounds per year in Middlesex County, broken down as follows:

New London County

- Styrene (65.8%) - single facility located in Gales Ferry, on the Thames River
- Copper Compounds (19.2%) - majority from Norwich, on the Thames River
- Nickel (6.5%) - majority from two facilities in Groton, near project area of the Thames River
- Chromium (3.6%) - same facilities as nickel release
- Ethylbenzene (2.6%) - same facility as styrene release
- Cobalt (2.2%) - same facilities as nickel release
- Other (<0.2%)

Middlesex County

- Ammonia (87.7%) - two facilities in Middletown, on the Connecticut River
- Toluene (10.6%) - single facility in Middletown, inland
- Acetonitrile (1.5%) - single facility in Chester, inland
- Other (<0.25%)

The 2019 total air emissions of toxins are comparable to the previous 3 years in both counties and part of an overall downward trend in these emissions since 2003 in New London County (USEPA 2021c). Middlesex County showed a decrease in on-site total releases from 2003 to 2010, but has been variable since 2010 (USEPA 2021b).

Fossil fuels and energy use contribute to air pollution and contribute carbon dioxide and other greenhouse gases that impact climate change. Including all energy uses, about 38% of Connecticut's energy comes from petroleum products, with 20% of the total energy use from motor gasoline (excluding ethanol) and 18% from other petroleum products (U.S. Energy Information Administration 2020b). Other sources include natural gas (approximately 34%), nuclear power (approximately 21%), biomass (e.g., waste incinerators; approximately 5%), and <1% from other renewables, hydroelectric power, and coal. By sector, energy consumption includes residential (32.8%), transportation (31.5%), commercial (25.5%), and industrial (10.2%) uses (U.S. Energy Information Administration 2020a). As noted in the section on climate change (*Section 5.1.1.1.3*), Connecticut is moving towards sustainable energy sources and expects to transition away from fossil fuel use, replacing those sources with offshore wind energy and solar energy options.

Focusing on vehicles, sources of air pollution within the project area generally include vehicle emissions from road traffic (20% of Connecticut's energy consumption) and offshore vessels (U.S. Energy Information Administration 2020b). Aircraft emissions (1.8% of Connecticut's energy consumption) also bear noting as the Groton-New London Airport is located immediately to the west of the Bluff Point and Haley Farm properties, just across the Poquonnock River, centrally located within boundary Alternatives A and D (U.S. Energy Information Administration 2020b). The Chester Airport is 4 miles west of the Connecticut River and Alternative B; the airport is 6.6 miles from the portion of the Connecticut River included in Alternatives A, C, and D.

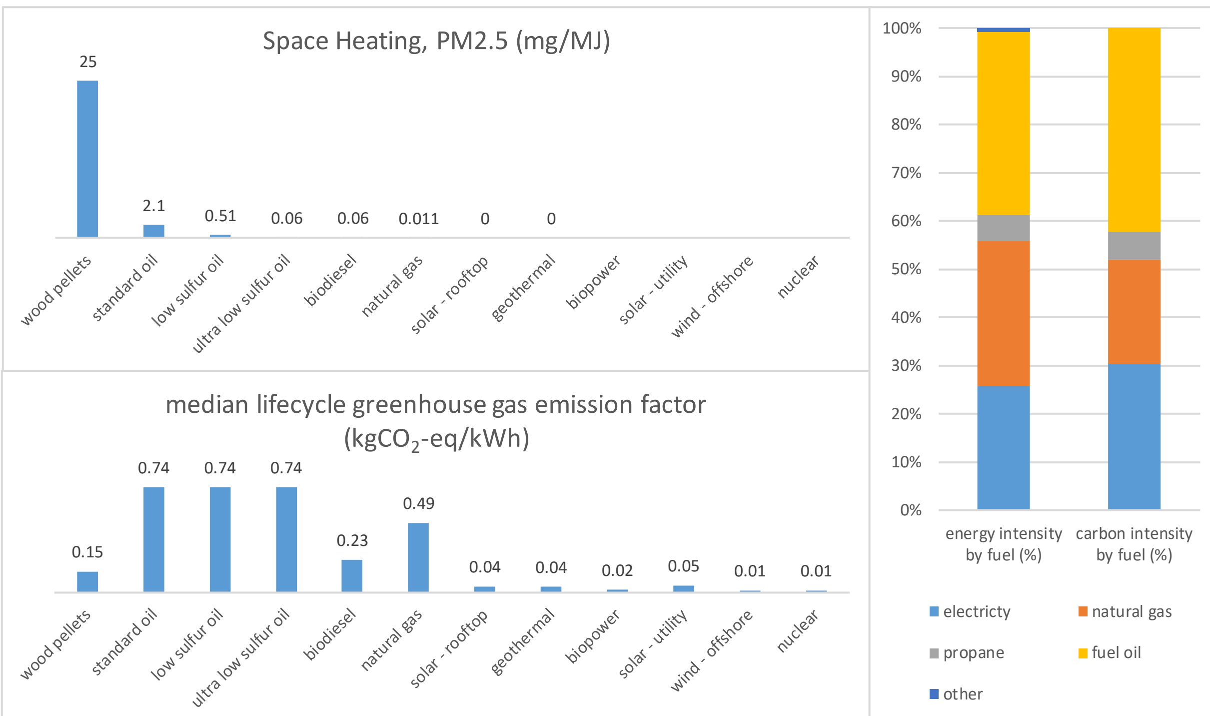


Figure 5-1: Home Heating Impacts

Upper left panel illustrates the impact of various home heating devices on air quality, as indicated PM2.5 (McDonald 2009). Categories without a number were not reported; they are sources related to electricity delivery to homes. Lower left panel illustrates the median value for the greenhouse gas emission factor over the full lifecycles of the energy source (Bruckner et al. 2014). Right panel illustrates the fraction of source for the carbon footprint of household energy use in Connecticut (Goldstein et al. 2020).

A large source of residential and commercial energy uses (58.3% of total energy use in Connecticut) relate to space heating and cooling, with associated air quality and climate-related impacts. Focusing on home heating to illustrate the issues, the contribution of various sources of fuel on PM2.5 and the median value for the contribution of greenhouse gases based on the lifecycle of the energy-generating methods illustrates the trade-offs associated with various home heating options (Figure 5-1). For example, wood pellets as a fuel source have a lower impact on greenhouse gas emissions, but a large influence on air pollution as indicated by PM2.5 output (wood pellets are a small source of fuel in Connecticut).

The major threat to air quality is pollution to the air. Warmer temperatures increase the impact of ozone and other contaminants in the atmosphere. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

Air quality across all boundary alternatives is impacted by the larger airshed and local inputs from vehicle emissions and manufacturing processes. Ozone levels and particulate matter are similar across all alternatives, based on a comparison of exceedances by month among the two SLAMS sites within the project area. Prevailing winds in Connecticut originate from the northwest to north during the colder months and southwest or south in warmer months, thus output of toxins from plants within and neighboring the alternatives can impact the project area.

Alternative A and *Alternative D*, in addition to the impacts distributed relatively equally throughout the project area, are impacted by the Groton-New London airport located centrally to the alternatives. All toxins listed for New London County and Middlesex County have the potential to reach the terrestrial and aquatic portions of the alternative, borne by prevailing winds.

Alternative B, in addition to the impacts distributed relatively equally throughout the project area, is impacted by the Chester airport located 4 miles west of this alternative. All toxins listed for Middlesex County have the potential to reach the terrestrial and aquatic portions of the alternative, borne by prevailing winds; toxins released in New London County should have relatively little impact on this alternative.

Alternative C, in addition to the impacts distributed relatively equally throughout the project area, is impacted by the Chester airport located 6.6 miles northwest of this alternative. All toxins listed for Middlesex County have the potential to reach the terrestrial and aquatic portions of the alternative, borne by prevailing winds; toxins released in New London County should have relatively little impact on this alternative.

5.1.1.2 Water (Hydrosphere)

5.1.1.2.1 Water Quality

Water quality refers to the chemical, physical, biological, and radiological characteristics of water (DEEP 2017). It is a measure of the condition of water relative to the requirements of one or more biotic species or to any human need or purpose. It is most frequently used by reference to a set of standards, the most common of which relate to health of ecosystems, safety for human contact, and safety for use as drinking water. Connecticut DEEP maintains a formal set of Connecticut Water Quality Standards (CTWQS) (R.C.S.A. §§ 22a-426-1 to -9) that function to convey policies regarding uses and classifications (Tables 5-2 and 5-3), and to provide the criteria needed to support them (Table 5-4) (DEEP 2019a). These standards are reviewed triennially. Within this section, all references are specific to waters under the jurisdiction of the State of Connecticut.

Table 5-2: Designated Use Definitions, Under the CTWQS

The Connecticut Water Quality Standards lists designated uses for waterbodies; those uses are defined here.

USE	DESCRIPTION
Recreation	Swimming, water skiing, surfing or other full body contact; as well as boating, canoeing, kayaking, fishing, aesthetic appreciation, or other activities that do not require full body contact.
Aquatic Life	Suitable for the protection, maintenance and propagation of a viable community of aquatic life and associated wildlife.
Shellfish Harvesting for Direct Consumption	Waters from which shellfish can be harvested both recreationally and commercially and consumed directly without depuration or relay. Waters may be conditionally approved.
Commercial Shellfish Harvesting	Waters supporting commercial shellfish harvesting for transfer to a depuration plant or relay (transplant) to approved areas for purification prior to human consumption (may be conditionally approved); also support seed oyster harvesting.
Drinking Water Supply	Presently used for public drinking water supply or officially proposed for future public water supply; and waters that have not been identified officially, but may be considered for public drinking water supply in the future.
Navigation	Capable of being used for shipping, travel, or other transportation by private, military, or commercial vessels.
Industrial Water Supply	Suitable for industrial supply.
Agriculture	Suitable for general agricultural purposes.

Table 5-3: Surface Water Quality Classes, Under the CTWQS

Waterbodies are assigned a class which relates to their status as inland or coastal / marine waters with the class also identifying the designated uses, where the designated uses are defined in Table 5-2.

AREA	CLASS	DESCRIPTION
Inland	Class AA	Designated uses: existing or proposed drinking water supply, fish and wildlife habitat, recreational use (may be restricted,) agricultural and industrial supply. Discharges restricted to: discharges from public or private drinking water treatment systems, dredging and dewatering, emergency and clean water discharges.
Inland	Class A	Designated uses: potential drinking water supply; fish and wildlife habitat; recreational use; agricultural and industrial supply and other legitimate uses including navigation. Discharges restricted to: same as allowed in AA.

AREA	CLASS	DESCRIPTION
Inland	Class B	Designated uses: recreational use; fish and wildlife habitat; agricultural and industrial supply and other legitimate uses including navigation. Discharges restricted to: same as allowed in A and cooling waters, discharges from industrial and municipal wastewater treatment facilities (providing Best Available Treatment and Best Management Practices are applied), and other discharges subject to the provisions of C.G.S. § 22a-430.
Coastal / Marine	Class SA	Designated uses: marine fish, shellfish and wildlife habitat, shellfish harvesting for direct human consumption, recreation and all other legitimate uses including navigation. Discharges restricted to: same as for AA or A surface waters.
Coastal / Marine	Class SB	Designated uses: marine fish, shellfish and wildlife habitat, shellfish harvesting for transfer to approved areas for purification prior to human consumption, recreation, industrial and other legitimate uses including navigation. Discharges restricted to: same as for B surface waters.

Table 5-4: Designated Use Support Level Definitions, Under the CTWQS

For each designated use, a waterbody may be assessed to determine the level to which it supports the designated use. Definitions of the support level are provided here in support of the CTWQS. NOTE: these are general definitions, refer to the *2018 Integrated Water Quality Report* for more specific information (DEEP 2019a).

SUPPORT LEVEL	DEFINITION
Fully Supporting	The designated use is fully achieved in the waterbody.
Not Supporting	The designated use is not supported in the waterbody.
Insufficient Information	Insufficient data / information available to support an evaluation of attainment of designated uses in the waterbody.
Not Assessed	No current, readily available information is available to assess use support.
Not Viable	Area is not suitable for shellfish growth.

Section 305(b) of the Federal Clean Water Act (33 U.S.C. § 1315(b)) requires states to monitor, assess and report on the quality of its waters relative to designated uses established in accordance with their water quality classification (DEEP 2021e). Section 303(d) of the Clean Water Act (33 U.S.C. § 1313(d)) requires each state to list waters not meeting water quality standards and prioritize those waters for Total Maximum Daily Load (TMDL) development or other management. Total Maximum Daily Loads provide the framework for restoring impaired waters by establishing the maximum amount of a pollutant that a waterbody can receive without adverse impact to fish, wildlife, recreation, or other uses. Total Maximum Daily Loads can also be developed to protect waterbodies that are meeting water quality standards. Although a TMDL for Long Island Sound was implemented to address the excessive discharge of nitrogen, this TMDL is primarily focused in the western portion of Long Island Sound and not in the vicinity of the project area. Within the context of 303(d), the state also maintains a list of impaired waterbodies which identifies those that do not fully support all designated uses. Reporting for Clean Water Act sections 305(b) and 303(d) is submitted to the USEPA every two years.

Many types of data including state, federal, and local agency data, as well as community science data, may be used to assess water quality use and support (DEEP 2019a). In Connecticut, the primary sources of data for rivers are:

- ambient monitoring data (e.g., annual evaluations of benthic and fish community reference sites, and focused monitoring (physical, chemical or biological) collected by DEEP);
- physical, chemical, and bacterial data collected at fixed sites by the United States Geological Survey (USGS);
- State and federal agencies, municipalities, utilities, consultants, academia, and volunteer monitoring groups; and
- bathing beach monitoring by state and local authorities pursuant to 33 U.S.C. § 1313.

For estuaries, use assessments are based primarily on:

- monitoring by DEEP for the Long Island Sound Study on a monthly schedule for dissolved oxygen and nutrients at 17 fixed stations; in addition, 25-30 stations are monitored every two weeks during summer months for dissolved oxygen;
- monitoring (physical, chemical, macroalgae) in embayments through the Unified Water Study (Save the Sound 2020);
- bacterial monitoring for shellfish sanitation by the Connecticut Department of Agriculture Bureau of Aquaculture; and
- bathing beach monitoring by state and local authorities pursuant to 33 U.S.C. § 1313.

For a robust description of the various water quality monitoring efforts in Long Island Sound, the reader is directed to the USEPA National Estuary Program's Long Island Sound Study website on water quality monitoring in Long Island Sound and embayments (LISS 2021e).

The assessment procedures utilized by DEEP generally follow guidance provided by USEPA and apply a "weight of evidence" approach using best professional judgment when using multiple types of data (USEPA 1997). For more information on the methods as they apply to designated uses, please refer to the *2018 Integrated Water Quality Report* Assessment Methodology section (DEEP 2019a).

Data from the *2018 Integrated Water Quality Report* are representative of current water quality status, though small changes occur year-to-year (DEEP 2019a; DEEP 2020a). A review of changes in the 2020 report relative to the 2018 report indicate the Thames River mouth is now listed for non-attainment of bacteria levels; this addition does not substantially change the data presented below as the Thames River mouth was already listed as impaired (DEEP 2020a). The data below characterize Long Island Sound as a whole and more specifically within the eastern Long Island Sound and western Fishers Island Sound proximal to the proposed CT NERR, including both estuarine and riverine components within relevant subregional watersheds. Not all waterbodies are assessed for all possible designated uses and some that were assessed previously as "Fully Supporting" may have changed to "Not Supporting" due to use-specific data age limitations (DEEP 2017). Any waterbody assessed as "Not

Supporting" in a prior report retains that assessment until new data confirm that use meets improved standards.

With respect to fish consumption, freshwaters of the state are addressed by a statewide limited consumption advisory for all freshwater fish, except trout, due to atmospheric deposition of mercury. Similarly, all estuarine waters have a statewide advisory on striped bass and bluefish due to polychlorinated biphenyl (PCB) contamination. An emerging concern is perfluoroalkyl and polyfluoroalkyl substances (PFAS) contamination (USEPA 2021d). The Connecticut Department of Public Health has consumption advisories related to PCBs and PFAS throughout the tributaries of the project area (DPH 2021). The waters summarized below contain fish consumption advisories beyond the statewide advisories (DPH 2021).

See *Section 5.2.1.3.1* (page 219) for the history of nitrogen and hypoxia (low oxygen) management in Long Island Sound and for a description of the specific anthropogenic (human-sourced) sources of nitrogen to the project area.

Estuarine Water Quality Characterization – Long Island Sound

Considering Long Island Sound as a whole (612 square miles), the 2018 data report the following with respect to the areas fully supporting designated uses (Figures 5-2 and 5-3):

- 236 square miles out of 553 assessed square miles (approximately 43%) fully support aquatic life use, with these areas predominantly located between New Haven and East Lyme.
- 28 square miles out of an assessed 44 square miles (approximately 64%) fully support Recreation.
- 75 square miles out of an assessed 312 square miles (approximately 24%) fully support Shellfish Harvesting, with these areas spread across the coastline.

Estuarine Water Quality Characterization – Long Island Sound, East Basin

To provide a more finely resolved look at water quality in the estuarine portion of the project area, we focus on the subunits (inner estuary, shore, midshore, and offshore) that comprise the East Basin of Long Island Sound (Figure 5-2). For a more complete depiction of these areas, see both the *2018 Integrated Water Quality Report* and appendices and the associated Geographic Information System (GIS) data (DEEP 2019a; DEEP 2021f).

All assessed areas are presented here because the use assessments are based on the sum of all sites. The towns are shown as these are towns within the sphere of influence of the project area. Additionally, these waterbodies do not exist in isolation, conditions in neighboring waterbodies may influence each other. Figure 5-3 provides a graphical representation of the more detailed text description provided for each subunit in the east basin.

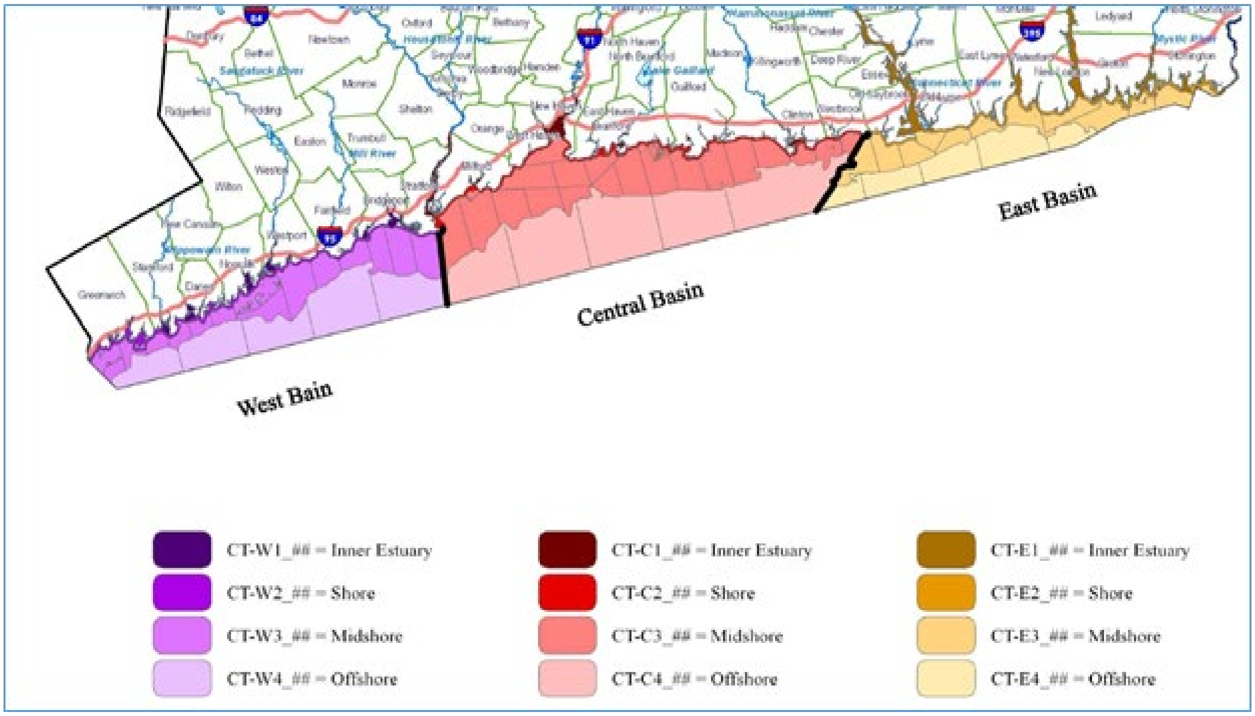


Figure 5-2: Subunits of Long Island Sound Within Connecticut Waters

Long Island Sound is divided into three basins. Within each basin within Connecticut state waters, subunits define the inner estuary, shore, midshore, and offshore areas; these subareas roughly mirror the depth distribution.

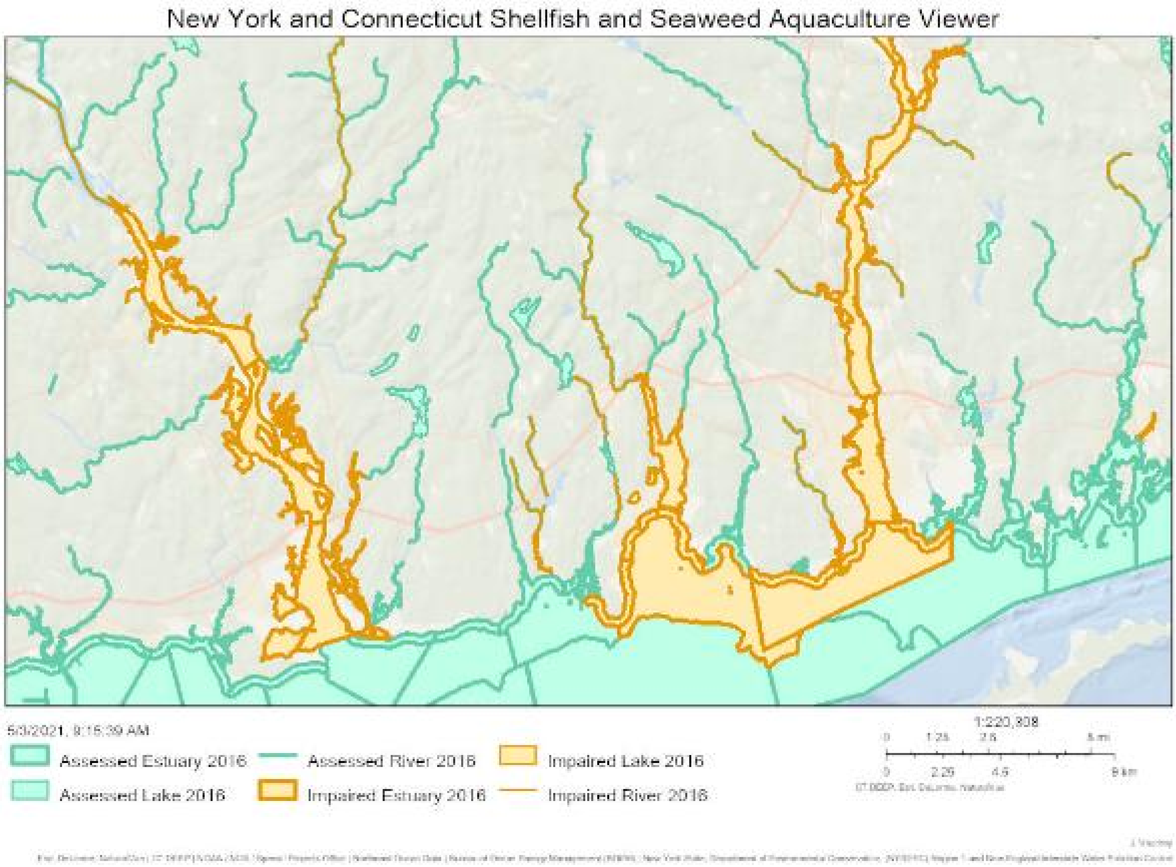


Figure 5-3: Eastern Basin Water Quality Subunits – Assessment, CTWQS

Within the east basin, subunits define the rivers, inner estuary, shore, midshore, and offshore areas. These areas were assessed and designated as impaired or unimpaired per Clean Water Act sections 305(b) and 303(d). These data are from 2016, the year that was available in the CT ECO Aquaculture Mapping Atlas (UConn CLEAR et al. 2018). Areas south of the Connecticut River mouth and Niantic Bay not shown on the map are also unimpaired. Data are similar to the 2018 and 2020 results.

The East Basin, Inner Estuary subarea (Table 5-5) encompasses 21.9 square miles of coastal / marine surface water classes, with 3.4 square miles (16%) classified as SA and 18.5 square miles (84%) classified as SB (see Table 5-3, page 88 for class definitions). Within this area, 20.0 square miles (91%) are impaired with those impairments relating to aquatic life, recreation, or shellfishing (Table 5-6).

Table 5-5: Waterbodies Included in the East Basin, Inner Estuary

Waterbodies included in the water quality assessment under CTWQS for this area are presented by town. Town names are followed by the boundary alternatives which include that town; embayments included in an alternative are underlined. Waterbodies preceded by an asterisk (*) and shown in bolded, italicized text are listed as unimpaired; all others carry some level of impairment. Grey areas indicate no data are present in those cells.

<table>
<tr><th>TOWN (ALTERNATIVE)</th><th>WATERBODIES WITHIN ONE TOWN</th><th colspan="3">WATERBODIES WITHIN MULTIPLE TOWNS</th></tr>
<tr><td>Old Saybrook (B,C)</td><td>Oyster River area</td><td rowspan="4">lower Connecticut River, includes Lord Cove</td><td></td><td></td></tr>
<tr><td>Essex (all) / Deep River (B) / Chester (B)</td><td></td><td></td><td></td></tr>
<tr><td>Lyme (all)</td><td>****Hamburg Cove / Eightmile River (mouth)***</td><td></td><td></td></tr>
<tr><td>Old Lyme (all)</td><td>Fourmile River (mouth), ****Black Hall River***, Duck River, Inner - Lieutenant River</td><td></td><td></td></tr>
<tr><td>East Lyme (A,D)</td><td>Bride Brook, Pattagansett River (mouth)</td><td></td><td rowspan="2">Niantic River (mouth)</td><td></td></tr>
<tr><td>Waterford (A,D)</td><td>Jordan Cove, ****Goshen Cove***</td><td rowspan="4">Thames River</td><td rowspan="2">Alewife Cove</td></tr>
<tr><td>New London (A,D)</td><td></td><td></td></tr>
<tr><td>Ledyard / Montville / Norwich / Preston</td><td></td><td></td><td></td></tr>
<tr><td>Groton (A,D)</td><td>Baker Cove, Beebe Cove / Mystic Harbor, Palmer Cove (Inner), Poquonnock River (Mouth), Mumford Cove (Inner)</td><td rowspan="2">Mystic Harbor</td><td></td></tr>
<tr><td>Stonington (A,D)</td><td>Inner Quiambaug Cove, Mystic River (Mouth), Pequotsepos Cove, Inner Stonington Harbor, ****Outer Stonington Harbor***, Inner Wequetequock Cove, Pawcatuck River</td><td></td><td></td></tr>
</table>

Table 5-6: Designated Use Assessments in the East Basin, Inner Estuary

Use assessments for the 21.9 square miles of the Inner Estuary subarea, encompassing the waterbodies listed in Table 5-5.

	Fully Supporting		**Not Supporting**		**Not Assessed**		**Not Viable**	
	area (sq. miles)	area (%)	area (sq. miles)	area (%)	area (sq. miles)	area (%)	area (sq. miles)	area (%)
Aquatic Life	2.0	9%	9.1	42%	10.7	49%	-	-
Recreation	4.0	19%	7.5	34%	10.3	19%	-	-
Shellfishing	2.0	9%	14.2	65%	3.4	16%	2.3	11%

The East Basin, Shore subarea (Table 5-7) encompasses 9.6 square miles of coastal / marine surface water classes, with 8.0 square miles (83%) classified as SA and 1.6 square miles (17%) classified as SB (see Table 5-3, page 88 for class definitions). Within this area, 9.0 square miles (94%) are impaired with those impairments relating to aquatic life, recreation, or shellfishing (Table 5-8).

Table 5-7: Waterbodies Included in the East Basin, Shore

Waterbodies included in the water quality assessment under CTWQS for this area are presented by town. Town names are followed by the boundary alternatives which include that town; areas included in an alternative are underlined. Waterbodies preceded by an asterisk (*) and shown in bolded, italicized text are listed as unimpaired; all others carry some level of impairment. Grey areas indicate no data are present in those cells.

<table>
<tr><th>TOWN (ALTERNATIVE)</th><th>WATERBODIES WITHIN ONE TOWN</th><th colspan="2">WATERBODIES WITHIN MULTIPLE TOWNS</th></tr>
<tr><td>Old Saybrook (all)</td><td>Indiantown Harbor, *Plum Bank, Willard Bay</td><td></td><td></td></tr>
<tr><td>Old Lyme (all)</td><td>Rocky Neck (Fourmile River), Soundview Beach, *Connecticut River Mouth (East)</td><td></td><td></td></tr>
<tr><td>East Lyme (A,D)</td><td>Niantic Bay (Black Point), Pattagansett River Mouth</td><td rowspan="2">Niantic Bay</td><td></td></tr>
<tr><td>Waterford (A,D)</td><td>Outer Jordan Cove</td><td rowspan="2">Thames River Mouth (West)</td></tr>
<tr><td>New London (A,D)</td><td></td><td></td></tr>
<tr><td>Groton (A,D)</td><td>Bluff Point, Outer Mumford Cove, West Cove (Groton Long Point), Thames River Mouth (East)</td><td></td><td></td></tr>
<tr><td>Stonington (A,D)</td><td>Mystic River Mouth, Outer Quiambaug Cove, Stonington Point, Wequetequock Cove, Wilcox Cove (Mason Island)</td><td></td><td></td></tr>
</table>

Table 5-8: Designated Use Assessments in the East Basin, Shore

Use assessments for the 9.6 square miles of the Shore subarea, encompassing the waterbodies listed in Table 5-7.

	Fully Supporting		**Not Supporting**		**Not Assessed**		**Not Viable**	
	area (sq. miles)	area (%)	area (sq. miles)	area (%)	area (sq. miles)	area (%)	area (sq. miles)	area (%)
Aquatic Life	0.5	5%	3.8	39%	5.3	56%	-	-
Recreation	4.2	44%	1.3	13%	4.0	42%	-	-
Shellfishing	0.9	9%	8.1	84%	0.6	6%	-	-

The East Basin, Midshore subarea (Table 5-9) encompasses 52.8 square miles of coastal / marine surface water classes, with 44.7 square miles (85%) classified as SA and 8.1 square miles (15%) classified as SB (see Table 5-3, page 88 for class definitions). Within this area, 45.5 square miles (86%) are impaired with those impairments relating to aquatic life, recreation, or shellfishing (Table 5-10).

Table 5-9: Waterbodies Included in the East Basin, Midshore

Waterbodies included in the water quality assessment under CTWQS for this area are presented by town. Town names are followed by the boundary alternatives which include that town; areas included in an alternative are underlined. Waterbodies preceded by an asterisk (*) and shown in bolded, italicized text are listed as unimpaired; all others carry some level of impairment. Grey areas indicate no data are present in those cells.

<table>
<tr><th>TOWN (ALTERNATIVE)</th><th>WATERBODIES WITHIN ONE TOWN</th><th colspan="2">WATERBODIES WITHIN MULTIPLE TOWNS</th></tr>
<tr><td>Old Saybrook (all)</td><td>areas around Indian Harbor, *areas related to Connecticut River plume</td><td></td><td></td></tr>
<tr><td>Old Lyme (all)</td><td>areas at mouth of Connecticut River</td><td></td><td></td></tr>
<tr><td>East Lyme (A,D)</td><td>areas around Rocky Neck</td><td rowspan="2">Niantic Bay</td><td></td></tr>
<tr><td>Waterford (A,D)</td><td></td><td rowspan="2">areas around the Thames River</td></tr>
<tr><td>New London (A,D)</td><td></td><td></td></tr>
<tr><td>Groton (A,D)</td><td>areas around Mystic River, areas around Thames River</td><td></td><td></td></tr>
<tr><td>Stonington (A,D)</td><td>*areas off Stonington Harbor</td><td></td><td></td></tr>
</table>

Table 5-10: Designated Use Assessments in the East Basin, Midshore

Use assessments for the 52.8 square miles of the Midshore subarea, encompassing the waterbodies listed in Table 5-9.

	Fully Supporting		**Not Supporting**		**Not Assessed**		**Not Viable**	
	area (sq. miles)	area (%)	area (sq. miles)	area (%)	area (sq. miles)	area (%)	area (sq. miles)	area (%)
Aquatic Life	23.9	45%	12.0	23%	17.0	32%	-	-
Recreation	0.0	0%	0.6	1%	52.2	99%	-	-
Shellfishing	9.7	18%	40.3	76%	2.9	5%	-	-

The East Basin, Offshore subarea (Table 5-11) encompasses 49.3 square miles of coastal / marine surface water classes, with 49.3 square miles (100%) classified as SA (see Table 5-3, page 88 for class definitions). Within this area, 0 square miles (0%) (Table 5-12) are impaired.

Table 5-11: Waterbodies Included in the East Basin, Offshore

Waterbodies included in the water quality assessment under CTWQS for this area are presented by town. Town names are followed by the boundary alternatives which include that town; areas included in an alternative are underlined. Waterbodies preceded by an asterisk (*) and shown in bolded, italicized text are listed as unimpaired; for this subarea, all waterbodies are unimpaired.

TOWN (ALTERNATIVE)	WATERBODIES WITHIN ONE TOWN
Westbrook (A,C,D)	***offshore areas***
Old Saybrook (all)	***offshore areas***
Old Lyme (all)	***offshore areas***
East Lyme (A,D)	***offshore areas***
Waterford (A,D)	***offshore areas***

Table 5-12: Designated Use Assessments in the East Basin, Offshore

Use assessments for the 49.3 square miles of the Offshore subarea, encompassing the waterbodies listed in Table 5-11.

	Fully Supporting		Not Supporting		Not Assessed		Not Viable	
	area (sq. miles)	area (%)	area (sq. miles)	area (%)	area (sq. miles)	area (%)	area (sq. miles)	area (%)
Aquatic Life	49.3	100%	0.0	0%	0.0	0%	-	-
Recreation	-	-	-	-	49.3	100%	-	-
Shellfishing	49.3	100%	0.0	0%	0.0	0%	-	-

Riverine Water Quality Characterization – Long Island Sound East Basin

For the purposes of this report, riverine waters are defined as those waters landward of the saltwater limit within the subregional watershed basins of the Thames River, Great Brook, Fourmile River, Jordan Brook, Pattagansett River, Lieutenant River, Niantic River, Bride Brook, Black Hall River, and the Southeast Shoreline.

The East Basin, Riverine subarea (Table 5-13) encompasses 43.5 square miles of inland surface water classes, with 41.74 square miles (96%) classified as A and 1.8 square miles (4%) classified as AA (see Table 5-3, page 88 for class definitions). Within this area, 14.2 square miles (33%) are impaired with those impairments relating to aquatic life, recreation, or shellfishing (Table 5-14).

Table 5-13: Waterbodies Included in the East Basin, Riverine

Waterbodies included in the water quality assessment under CTWQS for this area are presented by town. Town names are followed by the boundary alternatives which include that town; while none of these areas are included in a boundary alternative, all drain to waters included in the project area. Waterbodies preceded by an asterisk (*) and shown in bolded, italicized text are listed as unimpaired; all others carry some level of impairment. Grey areas indicate no data are present in those cells.

<table>
<tr><th>TOWN (ALTERNATIVE)</th><th>WATERBODIES WITHIN ONE TOWN</th><th colspan="2">WATERBODIES WITHIN MULTIPLE TOWNS</th></tr>
<tr><td>Old Lyme (all)</td><td>****Mill Brook, *Black Hall River***</td><td></td><td rowspan="2">****Fourmile River***</td></tr>
<tr><td>East Lyme (A,D)</td><td>Pattagansett River, Bride Brook, unnamed tributary to Bride Brook</td><td rowspan="2">****Oil Mill Brook***</td></tr>
<tr><td>Waterford (A,D)</td><td>Fenger Brook, ****Jordan Brook***, Stony Brook, ****unnamed tributary to Jordan Brook***</td><td></td></tr>
<tr><td>Ledyard</td><td>Billings Avery Brook, Flat Brook</td><td></td><td></td></tr>
<tr><td>Groton (A,D)</td><td>****Fort Hill Brook, *Hempstead Brook***</td><td></td><td></td></tr>
<tr><td>East Haddam, Colchester (B)</td><td>****Salmon River***</td><td></td><td></td></tr>
</table>

Table 5-14: Designated Use Assessments in the East Basin, Riverine

Use assessments for the 43.5 square miles of the Riverine subarea, encompassing the waterbodies listed in Table 5-13.

	Fully Supporting		Not Supporting		Not Assessed		Not Viable	
	area (sq. miles)	area (%)	area (sq. miles)	area (%)	area (sq. miles)	area (%)	area (sq. miles)	area (%)
Aquatic Life	14.7	34%	9.1	21%	15.3	35%	4.5	10%
Recreation	0.3	1%	9.3	21%	27.6	63%	6.4	15%
Shellfishing	0.0	0%	41.74	96%	1.8	4%	0.0	0%

TOXICS RELEASE INVENTORY

The USEPA's Toxics Release Inventory tracks the management of certain toxic chemicals that may pose a threat to human health and the environment (40 C.F.R. Parts 300.215, 355, 370, and 372). In New London and Middlesex Counties, release to underground injection wells is nonexistent and release to surface impoundments was minimal; the majority of releases were surface water discharges. With respect to water releases, these include discharges to streams, rivers, lakes, oceans, and other bodies of water. This includes releases from confined sources, such as industrial process outflow pipes or open trenches. Releases due to runoff, including stormwater runoff are also reportable to the Toxics Release Inventory under this category. Twelve facilities in New London County and eleven facilities in Middlesex County must report annually on amounts of chemicals released to the environment or managed through recycling, energy recovery, and treatment. As of the 2019 National Analysis Dataset (released October

2020), these facilities have reported total surface water discharges of 362 pounds per year in New London County and 384 pounds per year in Middlesex County, broken down as follows:

New London County

- Copper Compounds (80.8%) - one facility in Norwich; one in Groton, in the lower Thames River
- Zinc Compounds (9.9%) - single facility located in Gales Ferry, on the Thames River
- Lead (3.8%) - two facilities in Groton, on the Thames River
- Nickel (2.0%) - two facilities in Groton, one on the Thames River and one inland (drains to Thames River, Baker Cove, or Poquonnock River)
- Chromium (1.4%) - one facility in Groton, inland (drains to Thames River, Baker Cove, or Poquonnock River)
- Cobalt (1.4%) - same facility as chromium release
- Other (<0.8%)

Middlesex County

- Ammonia (95.1%) - one facility in Middletown, on the Connecticut River
- Nickel (1.3%) - single facility in Middletown, inland
- Cobalt (1.3%) - same facility as nickel release
- Chromium (1.3%) - same facility as nickel release
- Polycyclic Aromatic Compounds (1.0%) - same facility as ammonia release

The 2019 total water discharges of toxins for New London County are comparable to the previous 3 years. Toxin release saw a significant decline from 2007 (178,720 pounds per year) to 2008 (1,257 pounds per year) and has been holding relatively steady at 299 to 488 pounds per year since 2010 with the exception of a larger release (10,935 pounds per year) in 2013 (USEPA 2021c). Middlesex County discharges are more variable, with 50% of the annual values from 2001 to 2019 falling between 181 and 597 pounds per year (USEPA 2021b). The last three years have ranged from 384 to 1,046 pounds per year (USEPA 2021a).

THERMAL EFFLUENT

The Dominion Millstone Power Station sits on a headland in the center of the project area, on the eastern point of Niantic Bay. Millstone Environmental Laboratory prepares an annual report as part of their monitoring of the effects of the nuclear power plant's thermal plume on the rocky intertidal ecosystem, eelgrass, lobster, benthic infauna, and fish in the area near the Dominion power plant (DNC 2020). While public concern surrounding the impact of the thermal plume is reported in the news (Hladky 2015), and the plume is detectable within the spatial limits allowed by their permit, the impact on lobster and eelgrass in the area are not detectable (Craig 2018; Keser et al. 2003). The thermal plume impacts the intertidal community immediately adjacent to the effluent and this area has been used to investigate the potential impacts of climate warming on intertidal areas, using two reference sites (1 mile and 4 miles from the effluent, respectively) (Keser et al. 2005). Millstone Environmental Lab has been monitoring the area since the 1970s. This long-term data set has provided key insights into the factors influencing eelgrass in embayments and water quality related to land-use practices over time (Vaudrey et al. 2019).

Threats

Threats to water quality include pollution, rising temperatures, marine debris, and coastal development. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Throughout the project area, the inner, more landward portions exhibit water quality issues while the main stem of Long Island Sound and Fishers Island Sound exhibits better water quality, due to greater exchange with the Atlantic Ocean. Within the overall project area, water quality is supportive of aquatic life in 57% of the assessed area and 46% of the area is supportive of shellfishing (Table 5-15). Water quality supportive of recreation is not assessed for most of the deeper waters of the project area, including the midshore and offshore areas. Within the shore area, 13% is not supportive of recreation, with 42% of the area not assessed; these areas include the outer portions of embayments as well as areas with direct frontage on Long Island Sound or Fishers Island Sound. Within the inner embayments (inner estuary area), 34% is not supportive of recreation, with 19% of the area not assessed.

Table 5-15: Designated Use Assessments in the East Basin, Summary
Use assessments for the sum of the inner estuary, shore, midshore and offshore components.

	Fully Supporting		**Not Supporting**		**Not Assessed**		**Not Viable**	
	area (sq. miles)	area (%)	area (sq. miles)	area (%)	area (sq. miles)	area (%)	area (sq. miles)	area (%)
Aquatic Life	75.7	57%	24.9	19%	33.0	25%	0.0	0%
Recreation	8.2	6%	9.4	7%	115.8	87%	0.0	0%
Shellfishing	61.9	46%	62.6	47%	6.6	5%	2.3	2%

Alternatives A and D include four embayments with some form of impairment, including Baker Cove, Poquonnock River, Mumford Cove, and Palmer Cove. Other waterbodies with listed impairments include lower Thames River, Niantic Bay, Niantic River mouth, and the Lower Connecticut River (including Lord Cove), though the east side of the Connecticut River mouth is unimpaired. Within the midshore areas, the far east and far west of these alternatives are unimpaired with impairments between, in areas off the Connecticut River eastward to the area off the Mystic River. All included offshore areas are unimpaired. The total toxin load to the Connecticut River and Thames River areas are roughly equivalent, though the Thames River toxin load is dominated by copper compounds with some zinc and lead, while the Connecticut River load is dominated by ammonia.

Alternative B lacks many of the locations listed for Alternative A but includes impairments in the Lower Connecticut River (including Lord Cove), though the east side of the Connecticut River mouth is unimpaired. This alternative extends northward to the Salmon River, which is listed as unimpaired. Within the midshore area, the area off the Connecticut River is listed as impaired. The absence of the Thames River from this alternative removes the direct impact of that toxin load to the proposed CT NERR, though the total loads to the two rivers were roughly equivalent, albeit of a different composition.

Alternative C lacks many of the locations listed for Alternative A but includes impairments in the Lower Connecticut River (including Lord Cove), though the east side of the Connecticut River mouth is unimpaired. Within the midshore areas, much of the western buffer zone is unimpaired with impairments in the core and eastern buffer areas off the Connecticut River. The absence of the Thames River from this alternative removes the direct impact of that toxin load to the proposed CT NERR, though the total loads to the two rivers were roughly equivalent, albeit of a different composition.

5.1.1.2.2 Hydrology

SURFACE AND GROUNDWATER HYDROLOGY

The freshwater flow in the project areas includes two major rivers and a number of smaller rivers and streams that discharge directly to Long Island Sound or Fishers Island Sound. The Lower Connecticut River landward components of the project area are primarily marshes with surface flow driven by freshwater and tidal inputs. The Bluff Point properties and Haley Farm State Park, comprise areas that are predominantly forested and have less upstream freshwater inflow than the Lower Connecticut River landward components (Figures 5-4 and 5-5). Surface flow at the lower Thames River landward components is limited to tidal creek flow—no perennial streams flow through the sites from upstream. Average streamflow values for sub-areas within the project area from 1971 to 2000 were retrieved from the National Hydrography Dataset Plus (NHDPlus) high resolution NHDPlusEROMMA Table (Moore et al. 2019). Watershed areas were retrieved from the National Hydrography Dataset Plus high resolution value-added attributes (Moore et al. 2019). Risk of flood inundation from FEMA for each area are provided (FEMA 2020).

Haley Farm State Park lies between **Mumford Cove** (which receives freshwater from Fort Hill Brook, average streamflow 4.63 $ft^3\ s^{-1}$) and **Palmer Cove** (which receives freshwater from Fishtown Brook, average streamflow 6.65 $ft^3\ s^{-1}$). Haley Farm State Park tidal wetlands bordering Palmer Cove receive surface tidal flow from Palmer Cove (Figure 5-4). Haley Farm State Park includes one poor fen (1.8 acres), likely influenced by acidic groundwater, indicating some groundwater discharge-supplied surface water (DEEP n.d.-b). Portions of Haley Farm occur within the FEMA designated 100-year floodplain but most of the area is designated by FEMA as having a less than 0.2% chance of annual flooding (Figure 5-6).

Bluff Point State Park and **Bluff Point Natural Area Preserve** lie between the **Poquonnock River** (average streamflow 28.9 $ft^3\ s^{-1}$) and Mumford Cove. **Bluff Point Coastal Reserve** also lies between the Poquonnock River and Mumford Cove, with a section wrapping around the inland boundary of Mumford Cove. The Poquonnock River provides surface water to tidal wetlands in the southwest corner of Bluff Point State Park and tidal flow from Mumford Cove provides surface water to the Bluff Point CR wetlands. The low-lying marshes and sandy spit are designated by FEMA as a coastal high hazard area; a small transition area is in the 100-year floodplain and the interior woodlands and bluff are designated by FEMA as having a less than 0.2% chance of annual flooding (Figure 5-6). The barrier beaches at Bluff Point are designated as coastal barrier under the national Coastal Barrier Resources System.

Pine Island is an island; thus, surface water flow is governed by precipitation and groundwater storage is influenced by tidal intrusion of seawater. About half of Pine Island, areas on the eastern and western extremes, are designated by FEMA as having a less than 0.2% chance of annual flooding; the remainder is designated by FEMA as a coastal high hazard area.

The Thames River drains a 1,413 square mile watershed with an average streamflow of 2,672 $ft^3\ s^{-1}$ at the proposed CT NERR boundary. Upland areas in the lower Thames landward components are designated by FEMA as having a less than 0.2% chance of annual flooding. Land areas bordering Long Island Sound and adjacent coves are designated as coastal high hazard areas or 100-year floodplain (Figures 5-6 and 5-7).

Smaller rivers with average streamflow greater than 10 $ft^3\ s^{-1}$ that discharge directly to Long Island Sound within the project area boundaries from west to east are Fourmile River (12.6 $ft^3\ s^{-1}$), Pattagansett River (17.5 $ft^3\ s^{-1}$), Niantic River (63.0 $ft^3\ s^{-1}$), Jordan River (15.0 $ft^3\ s^{-1}$), and Poquonnock River (28.9 $ft^3\ s^{-1}$).

The Connecticut River drains a 10,904 square mile watershed with an average streamflow of 17,260 $ft^3\ s^{-1}$ at the proposed CT NERR boundary and is included in all boundary alternatives.

Roger Tory Peterson NAP: The Lieutenant River flows from east to west across the northern end of the Roger Tory Peterson NAP with an average streamflow of 22.8 $ft^3\ s^{-1}$ and discharges to the Connecticut River (Figure 5-4). A small fraction of flow from Lieutenant River (average streamflow 0.10 $ft^3\ s^{-1}$) flows south through the Roger Tory Peterson NAP, joining Duck River (average streamflow 1.47 $ft^3\ s^{-1}$). Duck River joins a side channel of the Connecticut River (average streamflow 3.22 $ft^3\ s^{-1}$). The side channel of the Connecticut River joins Black Hall River (average streamflow 9.09 $ft^3\ s^{-1}$) at Griswold Cove before discharging to the Connecticut River at the confluence with Long Island Sound. Tidal creeks and relic ditches create surface flow patterns within the site. The majority of the Roger Tory Peterson NAP is designated by FEMA as a coastal high hazard area, with the northern and eastern most sections of the site designated as 100-year floodplain (Figure 5-6).

Ragged Rock Creek WMA: Ragged Rock Creek WMA receives freshwater primarily through Ragged Rock Creek, which discharges directly to the Connecticut River draining a watershed area of 2.0 square miles with an average streamflow of 3.88 $ft^3\ s^{-1}$. Ragged Rock Creek WMA is bounded on the south by North Cove. The Ragged Rock Creek WMA is tidally influenced, receiving tidal flow primarily from the Connecticut River through Ragged Rock Creek, but also through secondary tidal creeks connected to the Connecticut River through North Cove (Figure 5-5). The Ragged Rock Creek WMA is designated by FEMA as a coastal high hazard area (Figure 5-7).

Ferry Point WMA: Surface streamflow in Ferry Point WMA is primarily through an unnamed tidal creek, which drains a 0.69 square mile watershed and discharges directly to the Connecticut River with an average streamflow of 1.18 $ft^3\ s^{-1}$ (Figure 5-5). Ferry Point WMA is tidally influenced, receiving tidal flow through the Connecticut River. The Ferry Point WMA occurs within the FEMA-designated 100-year floodplain (Figure 5-7).

Lord Cove NAP: Lord Creek flows through the Lord Cove NAP into Lord Cove and then to the Connecticut River (Figure 5-4). Average streamflow from the headwaters of Lord Creek is 0.77 $ft^3\ s^{-1}$. Tributary streams Deep Creek (average streamflow 1.62 $ft^3\ s^{-1}$) and Mack Creek (average streamflow 0.18 $ft^3\ s^{-1}$) discharge to Lord Creek from the east within the Lord Cove NAP. The Lord Cove NAP drains a watershed area of 2.43 square miles with an average streamflow of 4.78 $ft^3\ s^{-1}$ at the confluence of Lord Creek and Lord Cove. Streamflow throughout the Lord Cove NAP is tidally influenced; streams and tidal creeks receive tidal flow from the Connecticut River through Lord Cove. The Lord Cove NAP occurs within the FEMA-designated 100-year floodplain, with the southernmost 4.62 acres of the site designated as a coastal high hazard area (Figure 5-6).

Nott Island WMA and **Thatchbed Marsh WMA** are islands, thus surface water flow is governed by precipitation and tidal input of freshwater from the Connecticut River. The islands occur within the FEMA-designated 100-year floodplain (Figure 5-7).

Salmon River drains a 142.1 square mile watershed and discharges directly to the Connecticut River at East Haddam, CT with an average streamflow of 305 ft^3 s^{-1}. The Salmon River site includes Machimoodus State Park and Haddam Neck WMA. Machimoodus State Park is located at the confluence of the Salmon River and Moodus River (watershed area of 17.0 square miles and average streamflow of 37.93 ft^3 s^{-1}) (Figure 5-5). Two headwater streams originate within Machimoodus State Park and discharge to the Salmon River with a combined average streamflow of 0.71 ft^3 s^{-1}. Machimoodus State Park also receives freshwater from one unnamed stream that flows through the eastern portion of the site (average streamflow of 1.77 ft^3 s^{-1}) and discharges to the Moodus River. Machimoodus State Park is designated by FEMA as having a less than 0.2% chance of annual flooding except along the southern border, which is within the 100-year floodplain (Figure 5-7). Haddam Neck WMA is located at the confluence of the Salmon River and Connecticut River, and includes some backwater areas of the Salmon River (Figure 5-5). Haddam Neck WMA does not receive additional significant freshwater surface inputs, but is tidally influenced, receiving tidal flow through the Salmon River. Haddam Neck WMA occurs within the FEMA-designated 100-year floodplain, except small parts of the upland boundary that have less than 0.2% chance of annual flooding (Figure 5-7).

Threats to hydrology include diversion of water which can lead to habitat degradation, and changing precipitation patterns as a result of climate change, which changes the level and timing of freshwater recharge of groundwater. Pollution also impacts water quality of groundwater and surface waters. Sea level rise is causing saltwater intrusion into some freshwater systems. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

Alternative A includes the Lower Connecticut River, the major contributor of freshwater in the region and in Long Island Sound overall. This alternative also includes the Thames River, also a significant contributor of water to Long Island Sound, with 15% of the flow of the Connecticut River. All other freshwater sources are regionally minor compared to these two, but locally relevant in nourishing local habitats on the terrestrial properties. The majority of Haley Farm State Park and about 60% of the Bluff Point complex are designated by FEMA as having a less than 0.2% chance of annual flooding. The vast majority of Lord Cove and small areas in all other properties are in the FEMA 100-year floodplain. Almost all of the Roger Tory Peterson NAP and about a third of the Bluff Point complex are designated by FEMA as a coastal high hazard area.

Alternative B includes the Lower Connecticut River, the major contributor of freshwater in the region and in Long Island Sound overall. This alternative lacks the Thames River and the associated direct freshwater contribution, though Thames River water moves into the area with the tides. All other freshwater sources are regionally minor compared to these two, but locally relevant in nourishing local habitats on the terrestrial properties. This alternative includes the addition of the Salmon River and includes areas of the Connecticut River northward of all other alternatives. Properties also found in Alternative A include Lord Cove NAP, primarily in the FEMA 100-year floodplain, and the Roger Tory Peterson NAP, primarily designated by FEMA as a coastal high hazard area. New properties not found in

Alternative A include Ragged Rock Creek WMA (all FEMA coastal high hazard), Ferry Point WMA (all FEMA 100-year floodplain), Nott Island WMA (all FEMA 100-year floodplain), Haddam Neck WMA (primarily FEMA 100-year floodplain), and Machimoodus State Park (primarily having less than 0.2% chance of annual flooding).

Alternative C includes properties as described for Alternative B with the absence of the section of the Connecticut River (and properties) north of Lord Cove NAP to Machimoodus State Park and the Salmon River. This alternative adds Thatchbed Marsh WMA (all FEMA 100-year floodplain) and land trust properties associated with Lord Cove NAP and the Roger Tory Peterson NAP, with similar flooding risk as described for these properties in Alternative B.

Alternative D includes all freshwater influences listed for Alternative A with the addition of Pine Island. About half of Pine Island is designated by FEMA as having a less than 0.2% chance of annual flooding; the remainder is designated by FEMA as a coastal high hazard area.

A tidal creek at Griswold Point, on the eastern edge of the mouth of the Connecticut River. Photo credit: GriswoldPt.1.2020 by Judy Benson / Connecticut Sea Grant. www.flickr.com/photos/ctnerr/ (CC BY-NC 4.0)

Figure 5-4: Streams and Rivers – All Alternatives

Lighter terrestrial areas are in the project area. Streams and rivers of A) Lord Cove NAP, B) Roger Tory Peterson NAP, and C) Bluff Point properties and Haley Farm State Park. Panels A and B are included in All Alternatives; panel C is included only in Alternatives A and D.

Figure 5-5: Streams and Rivers – Alternatives B & C

Lighter terrestrial areas are in the project area. These areas are in Alternatives B and C. Streams and rivers of A) Machimoodus State Park and Haddam Neck WMA, B) Ferry Point WMA, and C) Ragged Rock Creek WMA.

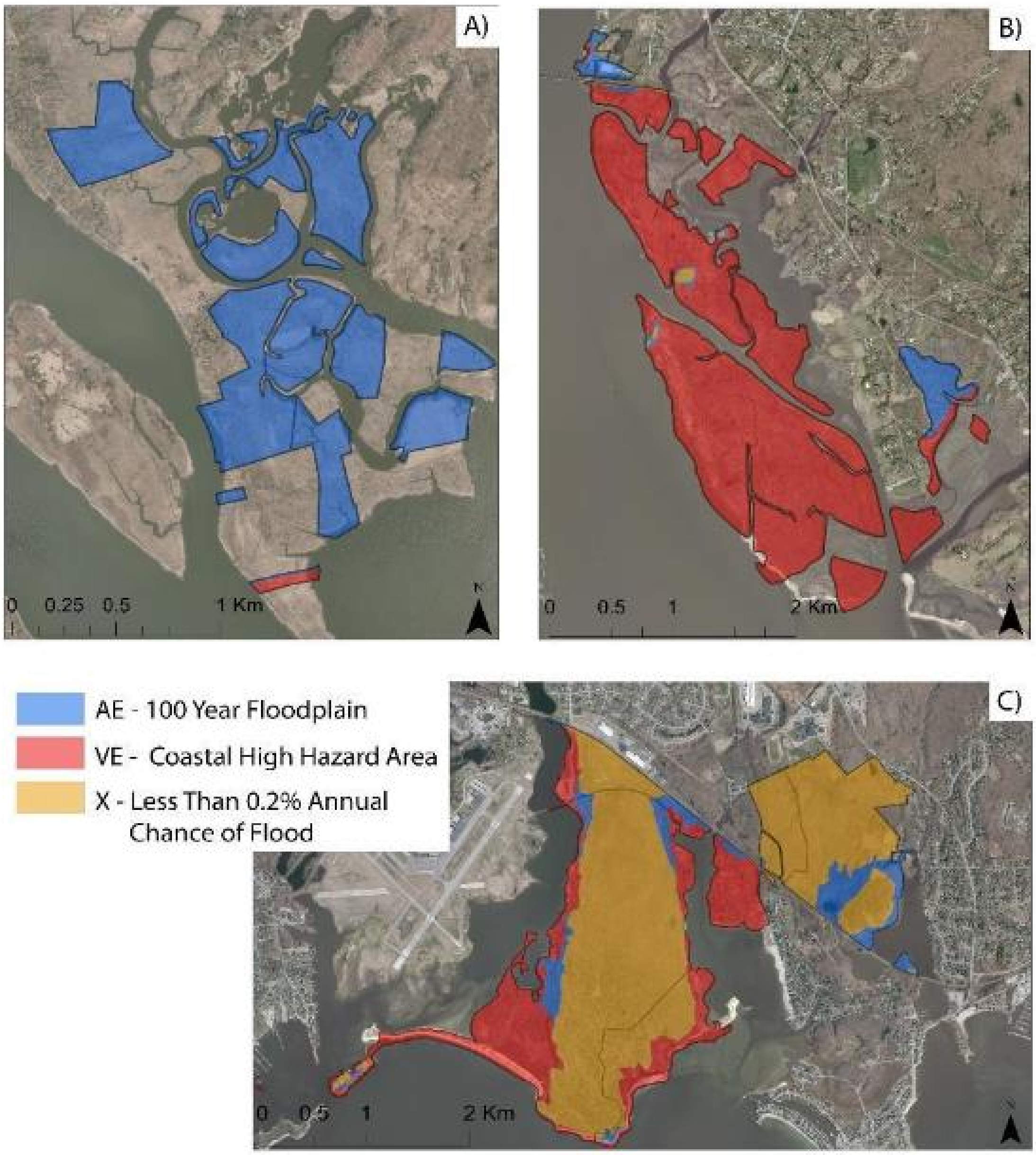


Figure 5-6: FEMA Flood Hazard Zones – Alternatives A & D, Parts of B & C

FEMA Flood Hazard Zones for the proposed CT NERR upland areas, A) Lord Cove NAP, B) Roger Tory Peterson NAP, and C) Bluff Point properties and Haley Farm State Park.

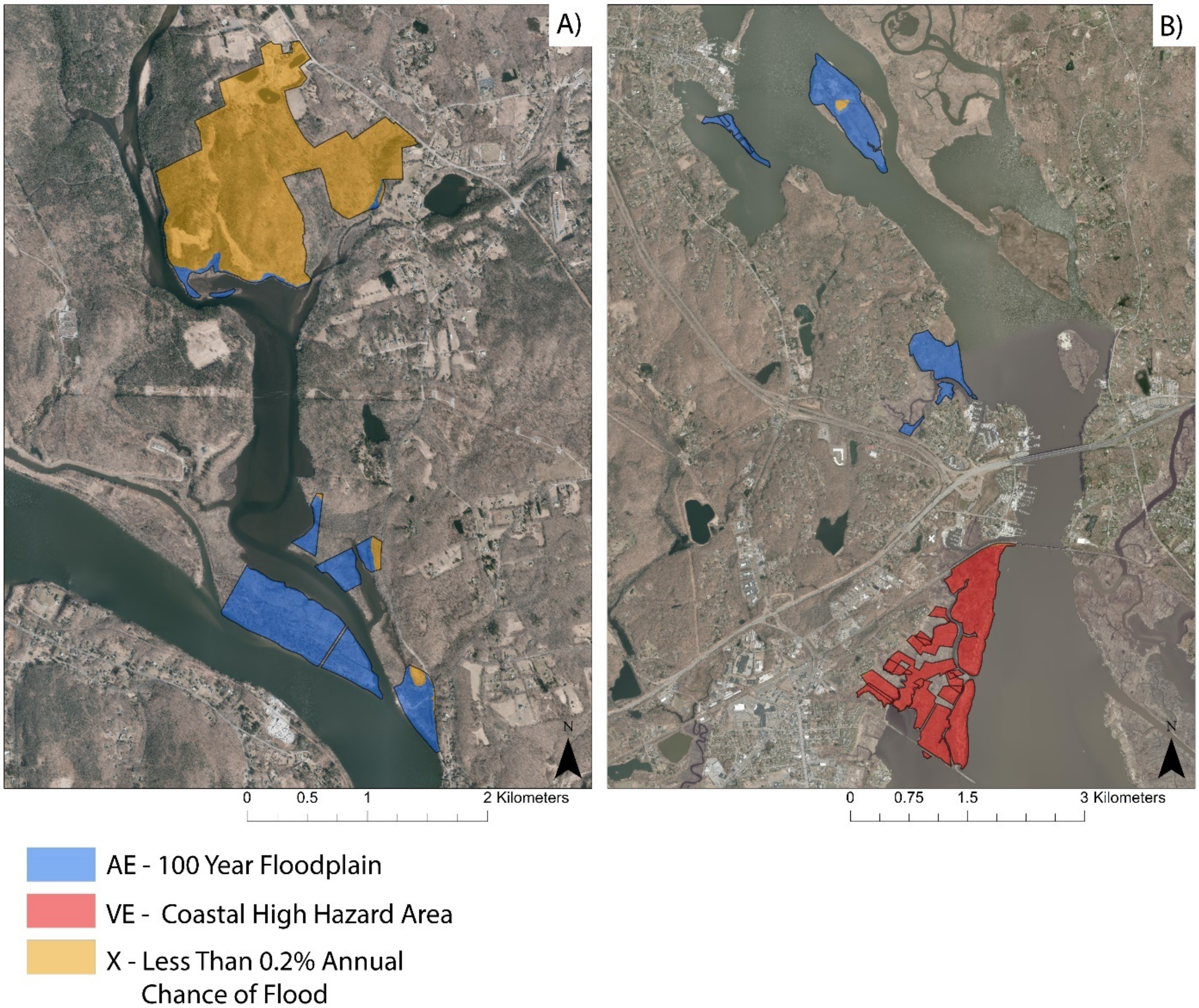


Figure 5-7: FEMA Flood Hazard Zones – Parts of Alternatives B & C

FEMA Flood Hazard Zones for the proposed CT NERR upland areas, A) moving north to south: Machimoodus State Park and Haddam Neck WMA, B) moving north to south: Nott Island WMA (on right side), Thatchbed Marsh WMA, Ferry Point WMA, Ragged Rock Creek WMA.

Estuarine Hydrology

The project area features a combination of a large area of eastern Long Island Sound, western Fishers Island Sound, and the mouths of two major Connecticut riverine systems – the Connecticut River and the Thames River.

A semi-diurnal tidal cycle of two highs and two lows is present throughout the project area. For the Long Island Sound and western Fishers Island Sound components of the project area, exclusive of the major riverine systems of the Connecticut River and Thames River, the mean tidal range is approximately 2.7 feet, increasing to approximately 3.2 feet on a spring tide, although these values differ in various embayments. Average current speeds can range between 1.2 to 2.0 knots on a flood tide and between 0.8 and 3.1 knots on an ebb tide (NOAA 2018).

Water temperatures vary from 32°F in the winter to 68°F in the summer but are moderated daily by the large volume of water moving with the tide. Temperatures in the embayments are influenced by the temperatures in The Sounds, and also flushing rates, depths, and solar radiation. Bottom waters in embayments range annually from 36°F to 75°F while surface waters range annually from 32°F to 86°F.

Both the Connecticut River and Thames River display salt wedge estuarine structure whereby river circulation creates a distinct boundary between a surface layer with lower salinity and a bottom layer with higher salinity. Mean tidal ranges in the mouths of both rivers are comparable at approximately 2.5 feet in the Thames River and approximately 3.5 feet in the Connecticut River (NOAA 2018). While both contribute freshwater inflows to Long Island Sound, the Connecticut River contributes the largest share – about 75% of total freshwater input (Latimer et al. 2014). Further, the Connecticut River has a different seasonal cycle from the Thames River due to the significant size and extent of its watershed (ranging from Long Island Sound to the mountains of northern New England and Canada) which results in large spring freshets and associated sediment plumes.

Salinity across most of the area of eastern Long Island Sound and western Fishers Island Sound is relatively constant averaging 30-32 ppt (ppt = parts per thousand) at the bottom and 28-30 ppt at the surface[12]. The horizontal salinity gradient between the ocean and freshwater sources generates characteristic circulation patterns such that on average, the bottom waters flow shoreward where they mix with surface waters in the embayments. Salinity regimes are influenced by freshwater at the riverine source and are at their lowest during periods of spring runoff (Dreyer and Caplis 2001). Waters north of Deep River (northward of Lord Cove) are freshwater and from Deep River south, waters are brackish[13]. Highest salinity values typically occur in the summer when rainfall is low and air and water temperatures are high. The salinity ranges in the marshes and near the beaches of the Connecticut River may vary quickly and extremely – variations from 0 to 26 ppt in a day have been recorded. Variations in the salinity at the mouth of the Thames River are also substantial, but not as extreme – here the range is typically 16 to 28 ppt (Latimer et al. 2014).

Threats to estuarine hydrology are related to climate change impacts – warming temperatures may lead to changes in stratification (though salinity is the driving factor for stratification). The greater climate-related impact will be changes in the timing and amount of freshwater flow which will alter estuarine hydrodynamics. Reduction in the snow pack in the northern portion of the Connecticut River watershed has already caused a reduction in the volume of the spring freshet. Sea level rise may lead to saltwater intrusion into groundwater aquifers and freshwater surface waters. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

Alternative A and *Alternative D* include the salt wedge estuaries of the Thames River and Connecticut River. The area at the mouth of the Connecticut River influenced by the plume of the river has different characteristics than the rest of the project area, having higher sediment during the annual spring floods

[12] Salinity from 30 to 35 ppt is termed euhaline or marine and is equivalent to ocean water; salinity from 18 to 30 ppt is termed polyhaline, the highest salinities considered estuarine or brackish. Estuarine waters are further characterized as mesohaline (5 to 18 ppt) and oligohaline (0.5 to 5 ppt), with freshwater < 0.5 ppt.

[13] Waters at the mouth of the river are in the high end of mesohaline (5 to 18 ppt) and the waters at Lord Cove are oligohaline (0.5 to 5 ppt). Upstream, the river is freshwater (< 0.5 ppt).

(spring freshet) and lower salinity throughout the year as a result of the river plume. The Thames River plume also exhibits these characteristics, but not to the degree seen at the mouth of the Connecticut River, due to differences in freshwater flow. Eastern portions of the project area are more heavily influenced by the Atlantic Ocean and can exhibit higher salinities than offshore Sound areas in the west of the project area.

Alternative B and *Alternative C* include only the Connecticut River area and portions of Long Island Sound located at the mouth of the river, within the influence of the river plume. These alternatives lack the ocean characteristics seen farther offshore in Long Island Sound and eastward along the coast.

5.1.1.3 Land (Lithosphere)

5.1.1.3.1 Geology[14]

REGIONAL OVERVIEW

The rock dominated coastline of eastern Connecticut shows irregularities that reflect the shape of the underlying bedrock surface, with this configuration resulting from the history of glaciation in the area. Seventeen glacially smoothed bedrock hills of various sizes extend seaward forming points, and 15 glacially modified bedrock valleys underlie the intervening embayments. The points are typically overlain by a blanket of thin till and the valleys are filled with layered sands and gravels (Eastern margin deltaic deposits) deposited as deltas in Glacial Lake Connecticut. Wave action against the till-covered bedrock points removes any fine glacial material and leaves behind a cobble / boulder lag sitting on bedrock. Ledges that commonly occur on the seaward side of the rocky points are generally attributed to "plucking" of rock material by southward moving glacial ice. This glacial plucking is the source of the glacial boulders that dot the landscape. Natural sandy beaches and spits develop in the valleys between the points as wave action erodes the sands and gravels of the glacial deltas. The size of these beaches / spits is limited by the size of the delta supplying their sediment. As the glacial delta surfaces are low and flat, they are the first to be inundated as sea level rises, and they are where marshes have developed.

Results of glacial plucking – boulder fields in Glacial Park, Ledyard, CT, the location of a recessional moraine. Photo credits: Glacial Park 2021 (left) and Glacial Park 2 2021 (right), by Jamie Vaudrey, UConn. http://www.flickr.com/photos/ctnerr/ (CC BY-NC 4.0)

[14] Personal communications – Ralph Lewis, Connecticut State Geologist (ret). August, 2017.

In contrast to the rock dominated coastline of the eastern portions of Alternatives A and D, the Connecticut River occupies a section of coastline that is sediment dominated. A complex of overlapping glacial deltas overwhelmed and buried the glacially smoothed bedrock surface as meltwater streams delivered large quantities of sediment to Glacial Lake Connecticut (18,000 to 20,000 years ago). Coastal irregularities result from the presence of boulder- and cobble-laden recessional moraine ridges. The composition and shape of these makes them more resistant to coastal retreat than the surrounding, low-lying, glacial delta sands and gravels. As a result, they form moraine-armored points. Where the moraines are subjected to wave action, fine sediments are removed and boulder / cobble beaches develop. As is typical all along the Connecticut coast, where glacial delta deposits are subjected to wave erosion, the size of the sandy beaches and spits that form is limited by the size of their deltaic sand source, and the low flat delta surfaces become a platform for extensive marsh development as sea level rises.

Upland Locations

Haley Farm State Park and the Bluff Point properties are representative of the general geologic character of the eastern region of coastal Connecticut; these properties are included in Alternatives A and D. Several examples of interesting geologic features are contained within the boundaries of the Bluff Point complex. This area hosts a barrier spit which developed from erosion of the glacial deltaic sands and gravels that fill the valley between Avery Point and Bluff Point. The large size of this glacial delta allowed for the development of a comparably-sized spit and provided an expansive substrate for the marsh complex that has grown over it. The Mystic recessional moraine that extends from Pine Island through Bushy Point Island and Bushy Point beach underlies the marsh behind the barrier spit and crosses the northern third of the glacially-smoothed Bluff Point bedrock ridge. On Bushy Point beach, the wave action has winnowed out finer components of the moraine and glacial boulders, and cobbles and exposed bedrock form the beach.

The cliff at the seaward end of Bluff Point forms a true bedrock bluff (more than 10 feet in height). Owing to the highly-fractured bedrock there, freeze and thaw cycles weather the bedrock into angular blocks of various sizes. Over time, these fall to the base of the bluff forming an angular boulder / cobble beach. In addition to this angular boulder / cobble beach, and the rounded boulder / cobble beaches of Bushy Point, four other distinct beach types exist at the Park: (1) the sandy / gravely beach of the barrier spit, (2) the cobble beach between Bluff Point and Mumford Point, (3) the adjacent large glacial boulder / bedrock beach (both derived from wave erosion of the thin till blanket), and (4) the exposed bedrock of Mumford Point. Each of these different beach types has its own compositional and ecological character. These features are not found in the Connecticut River area.

Within the lower Connecticut River area (included in all boundary alternatives), the proposed CT NERR properties are typical marshes resulting from the basic geological context, including Lord Cove NAP, Nott Island WMA, Thatchbed Island WMA, Ferry Point Marsh WMA, Ragged Rock Creek WMA, and Roger Tory Peterson NAP. However, a recessional ice position is inferred to extend eastward under Roger Tory Peterson NAP. Based on this, the southern half of the Roger Tory Peterson NAP marsh should be underlain by the erosional remnant of a glacial delta that was deposited between the Saybrook Point ice position and the Saybrook-Wolf Rocks moraine just to the south. The northern half of the Roger Tory Peterson NAP marsh is underlain by deltas that built south from the younger Ferry Point ice position.

Just northward of the lower Connecticut River, Alternative B includes the properties of Machimoodus State Park and Haddam Neck WMA, on the Salmon River, a tributary of the Connecticut River. In general, the park is typical of the upland settings described for other upland sites. What makes it a bit different is its setting high above the Connecticut River and its mineral content. The bedrock outcrops along the eastern flank of the river are generally steeper than their counterparts on the western bank. Some geologists believe this is due to the nature of the faulting in the region. The Pequot, Mohegan, and Narragansett people referred to this location as "the place of bad noises" or Machimoodus because of the numerous earthquakes ("Moodus Noises") that typically occur. The glacially smoother bedrock ridge along the river is imposing; glacial plucking removed bedrock on the south side of the ridge which created the sheer drop off at its south end. From a mineralogical standpoint, the park has pegmatite veins which contain interesting minerals. The remains of small pegmatite mines dot the ridge line.

Offshore Area

The Long Island Sound basin was initially dominated by fine grained glacial lake sediment (e.g., clays). Over time, tidal scour has removed much of these easily transportable sediments from the eastern areas of eastern Long Island Sound and western Fishers Island Sound and deposited them into the Central basin where they have coalesced with organics in the relatively quiescent waters. In contrast, the more constricted portions of the eastern Sound where currents are stronger tend to have coarser bottom sediments. This dynamic has impacted contaminant distributions—areas with concentrations of organics and clays are typically more affected based on the geochemical cation and adsorption processes that predominate there.

The subtidal area also offers several noteworthy features. Submerged portions of the bedrock points often extend seaward as identifiable bathymetric features (e.g., boulder reefs and exposed bedrock outcrops associated with Bartlett Reef and Rapid Rock) that extend at least a mile offshore from the Waterford coast. Glacial delta deposits extend offshore of most embayments and the mouth of the Thames River, and partially eroded lake bottom deposits of Glacial Lake Connecticut underlie eastern Long Island Sound and western Fishers Island Sound. This erosion locally exposes bedrock north of the Race (the deep, scoured area at the eastern entrance to Long Island Sound).

Evidence for the draining of Glacial Lake Connecticut comes in the form of the stream channels that cut across the glacial lake deposits. Bedforms of various sizes (some quite large) are common in areas just north and west of the Race. Their presence indicates substantial modern sediment transport along the bottom of eastern Long Island Sound. While the overall offshore area is dominated by Glacial Lake Connecticut Deposits (primarily Deltaic, Lake Bottom, and Lacustrine Fan, with the last being the rarer of the three), it also contains rare Glacial Ice laid Deposits. The area is also intersected by three southeast-to-northeast trending moraines: the Old Saybrook / Wolf Rocks, Mystic, and Clumps-Avondale Moraines. These moraine formations are concentrated in the western and eastern ends of the offshore areas.

Threats are unlikely to manifest in the next 100 years, as they happen on geologic timescales.

Summary by Boundary Alternative

Alternative A includes areas representing the general geologic character of southeastern Connecticut, with rock-dominated geology in the eastern portion of the project area and sediment-dominated geology in the area of the Connecticut River. A true bedrock bluff is found only in Bluff Point CR (Alternatives A and D). Moraine-armored points are present along the shoreline, from the western area of the Connecticut River to the eastern area of Bluff Point. Similar offshore features are seen throughout the project area, with moraine formations interspersed with glacial delta deposits in both the western and eastern areas.

Alternative B includes the areas around the Connecticut River, a sediment-dominated geology. This alternative lacks the rock-dominated geology and true bedrock bluff found in the eastern portions of Alternative A, though an impressive bedrock ridge is present in Machimoodus State Park. Offshore geology of this alternative is similar to Alternative A, with more sediment and less exposed moraine.

Alternative C includes all areas of Alternative B with the addition of a few brackish and freshwater marshes having a similar geologic character as the other marshes of the lower Connecticut River included in Alternatives A and B.

Alternative D includes all areas of Alternative A with the addition of Pine Island, formed through glacial processes.

5.1.1.3.2 Soils

REGIONAL OVERVIEW

The soils within and near the proposed CT NERR are comprised of mineral and organic soils found both on terrestrial land and submerged beneath waters of Long Island Sound and its tributaries. Submerged (or subaqueous) soils are soils that occur under water (both freshwater and saltwater) and are referred to as sediments in coastal scientific literature[15]. The majority of the terrestrial mineral soils are formed in soil parent materials deposited during the most recent continental glaciation during the Pleistocene epoch (i.e., till and glaciofluvial deposits). As shown in Table 5-16, these glacial parent materials comprise the majority of the nearby terrestrial areas (62% of an approximately 550-yard buffer around Alternative A). Some mineral soils (alluvial soils and subaqueous marine / estuarine deposits) and organic soils in the area formed in post-glacial deposits during the Holocene. These soils and their associated landforms represent the most dynamic soil-landscapes in the proposed CT NERR and may be altered during major flood events and coastal storms. Human-transported and human-altered soils, also known as anthropogenic soils, were formed extremely recently during the Anthropocene epoch. An example of the spatial diversity of soil parent materials within a small buffer of Alternative A is shown in Figure 5-8.

Table 5-16: Example Soil Parent Material Types
Summary of terrestrial Soil Parent Material types within a 500-meter buffer of Alternative A – Originally Nominated Site

SOIL PARENT MATERIAL TYPE	SOIL MAP UNIT ACREAGE	SOIL MAP UNIT COVERAGE
ablation / supraglacial till	2,448	13%
ablation / supraglacial till, shallow to bedrock	3,487	18%
alluvial deposits	1,250	7%
coastal sands	431	2%

[15] Study of their properties has yielded that these materials exhibit characteristics associated with soil development processes including physical and chemical additions, losses, translocations, and transformations.

SOIL PARENT MATERIAL TYPE	SOIL MAP UNIT ACREAGE	SOIL MAP UNIT COVERAGE
glaciofluvial deposits	4,894	26%
human transported material	2,134	11%
lodgment / subglacial till	927	5%
organic materials	3,381	18%
Grand Total	**18,952**	**100%**

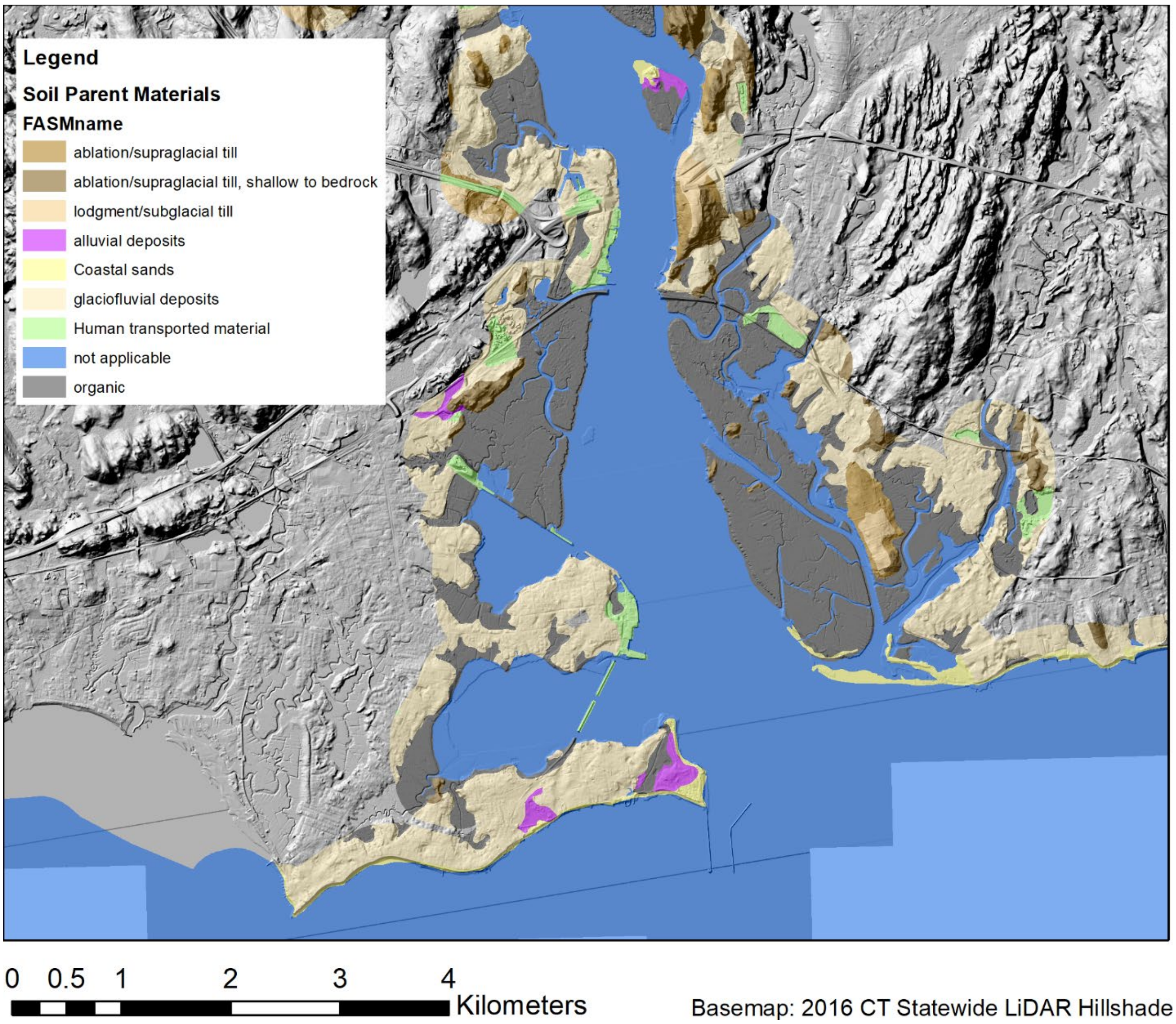


Figure 5-8: Example of Soil Parent Materials in the Lower Connecticut River

Example of Soil Parent Materials mapped near mouth of the Connecticut River within an approximately 550-yard buffer of Alternative A – Originally Nominated Site. Only areas within the project area and the 550-yard buffer are defined.

The soils in the area formed in a climate that transitioned from periglacial to temperate following deglaciation and have moisture conditions varying from very wet to excessively drained depending on landscape position. The mineralogy of the mineral soil material is considered primarily *mixed* due to large-scale homogenization from glacial disturbances and deposition in the region. Soils generally are very deep (apart from bedrock-controlled landforms), somewhat excessively drained to poorly drained, and loamy or sandy.

The dominant soil orders are *Entisols*, *Inceptisols,* and *Histosols*. These terms refer to different soil types, or soil orders, as classified in the soil classification system called Soil Taxonomy, the system of soil classification used by the National Cooperative Soil Survey. Entisols are conceptually very young mineral soils with little or no evidence of soil horizon development. Inceptisols are young mineral soils with minimal soil horizon development. Histosols are soils formed in organic soil materials.

Upland Soils

Upland areas in the immediate vicinity of the proposed CT NERR are dominated by young mineral soils with minimal soil horizon development formed primarily in glacial parent materials. There are also significant tidal marsh and floodplain soils directly adjacent to the proposed CT NERR waters. Table 5-17 summarizes the acreage and percent coverage by Great Group level using the *Keys to Soil Taxonomy* within a buffer of the NERR site (Soil Survey Staff 2014).

The main upland soils and their series, within and near the proposed NERR site are:

- *Aquepts* (wet Inceptisols, i.e. *Endoaquepts* and *Humaquepts*) that formed in till in depressions on hills and in drainageways (Leicester and Ridgebury series). Also, soils formed in alluvial materials on floodplains (Rippowam series).
- *Dystrudepts* (acid, moderately- and well-drained *Inceptisols*) that formed in till, loamy sediments over till, and dense till on till plains, hills, and ridges (Canton, Charlton, Chatfield, Gloucester, Hollis, Montauk, Paxton, Scituate, Sutton, and Woodbridge series), in glaciofluvial deposits on outwash plains and terraces (Merrimac series), and in alluvial materials on floodplains (Occum and Pootatuck series).
- *Fluvaquents* (wet *Entisols*) that formed in alluvial materials on floodplains.
- *Haplosaprists* that formed in organic material in depressions on uplands and outwash plains (Catden, Freetown, Natchaug, and Swansea series).
- *Sulfihemists* that formed in organic material on tidal marsh (Ipswich, Westbrook, and Pawcatuck series).
- *Udipsamments* (sandy *Entisols*) that formed in glaciofluvial deposits on outwash plains, terraces, kames, and eskers (Windsor series), in alluvial materials on floodplains and levies (Suncook series), and in human-transported material in urban areas (Bigapple and Fortress series).
- *Udorthents* (gravelly / cobbly, sandy *Entisols*) that formed in glaciofluvial deposits on outwash plains, terraces, kames, and eskers (Hinckley series) and in human-transported material in urban areas (Greenbelt, Ladyliberty, Laguardia, and Secaucus series).

Subaqueous Soils

The subaqueous soils within the proposed CT NERR are submerged beneath salt or brackish surface waters. These salt-affected soils have elevated electrical conductivity values, and many contain elevated amounts of sulfides that are of major interpretive concern for habitat as well as engineering / restoration applications of dredge. An example of a subaqueous soil survey with parent materials displayed is shown in Figure 5-9.

The main subaqueous soils and their series, within and near the proposed NERR site are:

- *Psammowassents* (permanently submerged soils) that formed in sandy estuarine and marine deposits along the coast (Nagunt and Rhodesfolly series).
- *Sulfiwassents* (permanently submerged soils) that formed in loamy and silty estuarine and marine deposits along the coast (Anguilla, Fort Neck, and Pishagqua series).

Table 5-17: Summary of Soil Types (by Great Group)

Summary of Soil Types (by Great Group) within a 500-meter buffer of Alternative A – Originally Nominated Site.

SOIL GREAT GROUPS	SOIL MAP UNIT (ACRE)	SOIL MAP UNIT (% COVERAGE)
Dystrudepts	8,286	50.8%
Endoaquepts	495	3.0%
Fluvaquents	6	0.0%
Haplosaprists	92	0.6%
Humaquepts	200	1.2%
Psammowassents	309	1.9%
Quartzipsamments	9	0.1%
Sulfaquents	3	0.0%
Sulfihemists	3,189	19.6%
Sulfiwassents	526	3.2%
Udipsamments	532	3.3%
Udorthents	2,651	16.3%
Grand Total	16,299	100.0%

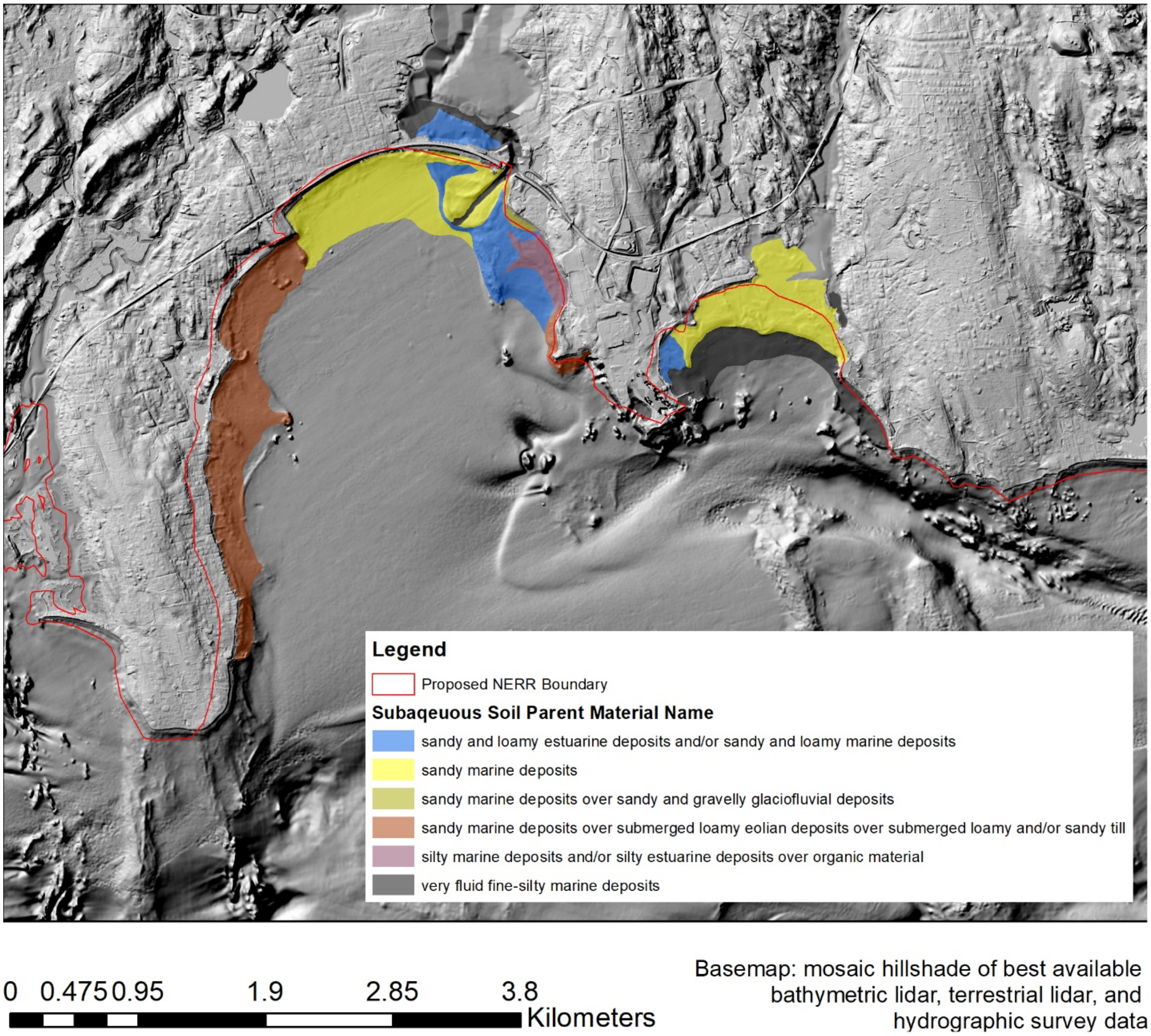


Figure 5-9: Example of a completed subaqueous soil survey

Example of a completed subaqueous soil survey within the project area, in Niantic Bay and Jordan Cove. Soils are not mapped deeper than approximately 5 meter water depth (NAVD88). Subaqueous soil survey projects are pending west and east of this area.

5.1.2 Biological Environment

The project area is composed of assorted upland properties, marshes, shallow freshwater and saltwater areas, and an offshore area including parts of eastern Long Island Sound, western Fishers Island Sound, and the lower Connecticut River and Thames River areas that include a variety of habitat types (Barrett 2014; DEEP n.d.-c; Dreyer and Caplis 2001; USFWS 1994). Habitats are described in this section, while flora and fauna found in the habitats are addressed in *Section 5.1.3—Living Resources*.

The Connecticut Wildlife Action Plan (CT-WAP) and associated Natural Diversity Data Base are an essential resource for the current status of Connecticut's habitats, flora, and wildlife—both common species and those which are endangered, threatened, or of special concern (DEEP 2015a; DEEP 2015b;

DEEP 2016a). The CT-WAP lists threats, stressors, and best management practices (BMP) by habitat and by species; the CT-WAP provides a sound foundation for the ecosystem-based management carried out by DEEP and partner organizations. Reserve staff would work closely with DEEP when conducting the site inventory of the proposed CT NERR and reserve staff would obtain all necessary permits and permissions necessary to conduct work in the project area.

5.1.2.1 Terrestrial Habitats

The NERR lies with the eastern coastal ecoregion (Dowhan and Craig 1976), a seaboard region that is five to seven miles wide where the regional forest is the Coastal Hardwoods. The terrestrial areas include a variety of coastal upland habitats. Focusing on only those areas which are above the mean higher high water line, the habitats include: coastal forests-woodland, coastal meadows / grassland, coastal shrublands, beach and dune grasslands, and coastal bluff (Table 5-18). A few State of Connecticut-defined Critical Habitats (Metzler and Barrett 2006) are found within the project area, these include: coastal woodland / shrubland, coastal grassland, and floodplain forest (Figures 5-10 through 5-12, pages 121 to 122).

Threats to terrestrial habitats include habitat loss and degradation, invasive species, pollution, coastal development, sea level rise, and climate change. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

Alternative A includes coastal forests, coastal shrublands, coastal grasslands, and a coastal bluff. The southeast section of Bluff Point hosts a unique coastal forest on a concave slope, known as a 'cove forest,' which supports trees that are nearly 100-years old (Barrett 2014). This habitat type, to our knowledge, does not exist or exists in a very limited fashion in the southern New England region. The mesic cove forest is found on sheltered coves and concave slopes within the Bluff Point property. Soils are often rocky and may be coarse or fine-textured, and may be residual, alluvial, or colluvial. Single tree gap-phase regeneration drives forest stand dynamics. A few State of Connecticut-defined Critical Habitats (Metzler and Barrett 2006) are found within the project area: coastal woodland / shrubland and coastal grassland (Barrett 2014).

Alternative B lacks most of the terrestrial habitat types found in Alternative A, including the coastal bluff and cove forest found in the Bluff Point complex. This site includes forested areas in Machimoodus State Park but otherwise lacks large expanses of terrestrial habitats. No State of Connecticut-defined Critical Habitats (Metzler and Barrett 2006) are found within the project area (Barrett 2014). This alternative lacks the coastal woodland / shrubland and coastal grassland found in Alternatives A and D.

Alternative C has no terrestrial habitat.

Alternative D matches the terrestrial habitat types found in Alternative A. This alternative includes the addition of Pine Island, habitat which is found elsewhere in Alternatives A and D.

Table 5-18: Habitats of the NERR, Land Parcels

The assignment of property to alternative is presented in the first six rows. For the remainder of the table, habitats found within each property are identified. An "x" indicates extensive tracts of this habitat are found in the area. A "p" indicates that the habitat is present in the area but is patchy or small relative to the size of the overall area. Inventory information taken from the *Long Island Sound Stewardship Ecological Sites Inventory Update* (Barrett 2014).

	Haley Farm State Park	**Bluff Point State Park, CR, & NAP**	**Pine Island**	**UConn Avery Point campus**	**Roger Tory Peterson NAP & DEEP Marine HQ**	**The Nature Conservancy properties near Roger Tory Peterson NAP**	**Ragged Rock Creek WMA & Ferry Point WMA**	**Lord Cove NAP**	**The Nature Conservancy properties near Lord Cove NAP**	**Nott Island WMA**	**Thatchbed Marsh WMA & Great Meadows (Essex Land Trust)**	**Haddam Neck WMA**	**Machimoodus State Park**
PROPERTIES INCLUDED IN ALTERNATIVES													
No Action Alternative													
Alternative A	x	x		x	x			x					
Alternative B				x	x		x	x		x		x	x
Alternative C				x		x	x		x	x	x		
Alternative D	x	x	x	x	x			x					
SHORELANDS													
coastal forest-woodland	x	x			p	p	p		x			p	x
coastal shrublands	x	x	x					p	p	p	p	x	
coastal grasslands		p											
coastal sand dunes		p											
coastal cliffs / bluffs		p											
TRANSITION AREAS													
freshwater marsh	x	p										x	x
tidal freshwater marsh												x	x
tidal brackish marsh		x			x	x	x	x	x	x	x		
tidal salt marsh		x		p									
rocky intertidal		p	x	p									

	Haley Farm State Park	Bluff Point State Park, CR, & NAP	Pine Island	UConn Avery Point campus	Roger Tory Peterson NAP & DEEP Marine HQ	The Nature Conservancy properties near Roger Tory Peterson NAP	Ragged Rock Creek WMA & Ferry Point WMA	Lord Cove NAP	The Nature Conservancy properties near Lord Cove NAP	Nott Island WMA	Thatchbed Marsh WMA & Great Meadows (Essex Land Trust)	Haddam Neck WMA	Machimoodus State Park
intertidal beaches		x	x	p	p	p				p			
intertidal mud & sand flats		p	x	p	p	p		p	p	p	p	p	
intertidal algal beds	p	p	x	p									
GEOLOGIC													
sheltered coast		x	x	x									
bay			x	x									
embayment / lagoon	x	x			x	x	x				x		
tidal river					x	x	x	x	x	x	x	x	x

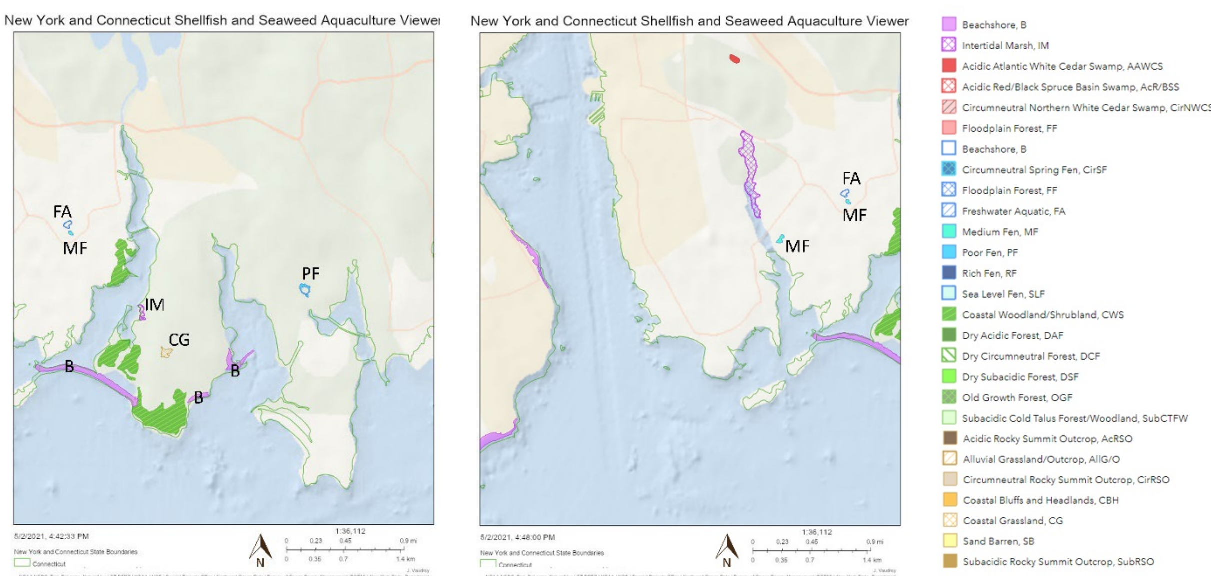


Figure 5-10: Critical Terrestrial and Intertidal Habitats – East

State of Connecticut-defined Critical Habitats for Connecticut were identified by Metzler and Barrett (2006), noted in the Long Island Sound Stewardship Ecological Sites Inventory Update (Barrett 2014), and mapped in the CT ECO Aquaculture Mapping Atlas (UConn CLEAR et al. 2018). Left panel: Bluff Point complex and Haley Farm State Park. Right panel: Avery Point campus and Pine Island.

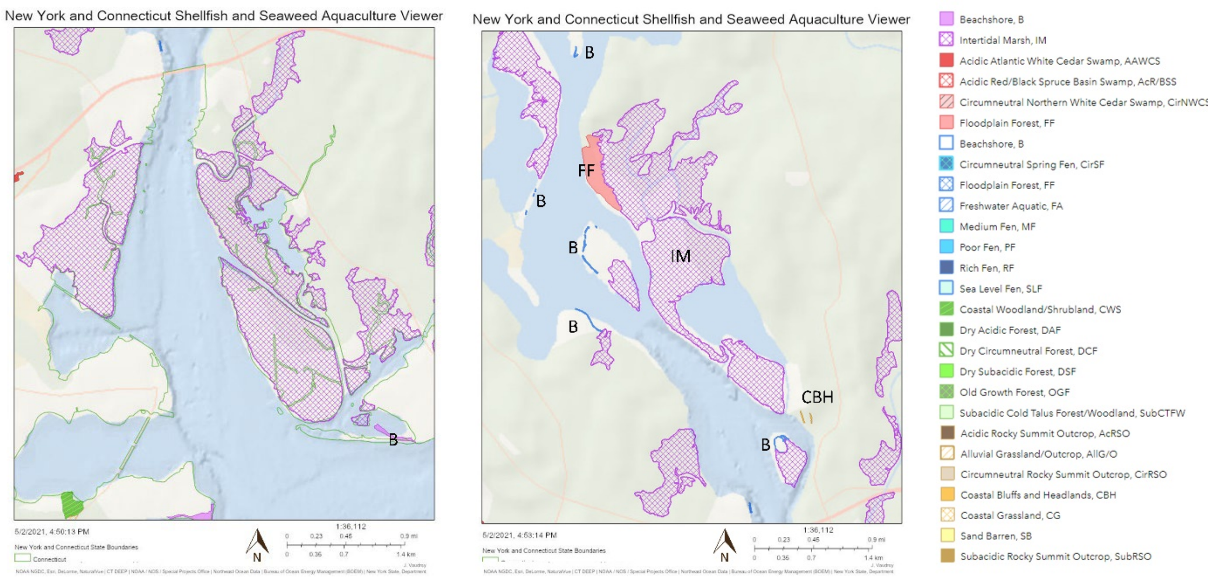


Figure 5-11: Critical Terrestrial and Intertidal Habitats – Lower Connecticut River

State of Connecticut-defined Critical Habitats for Connecticut were identified by Metzler and Barrett (2006), noted in the Long Island Sound Stewardship Ecological Sites Inventory Update (Barrett 2014), and mapped in the CT ECO Aquaculture Mapping Atlas (UConn CLEAR et al. 2018). Left panel: Roger Tory Peterson NAP and Ragged Rock Creek WMA. Right panel: Ferry Point WMA, Lord Cove NAP, Nott Island WMA, Great Island Land Trust, Thatchbed Island WMA.

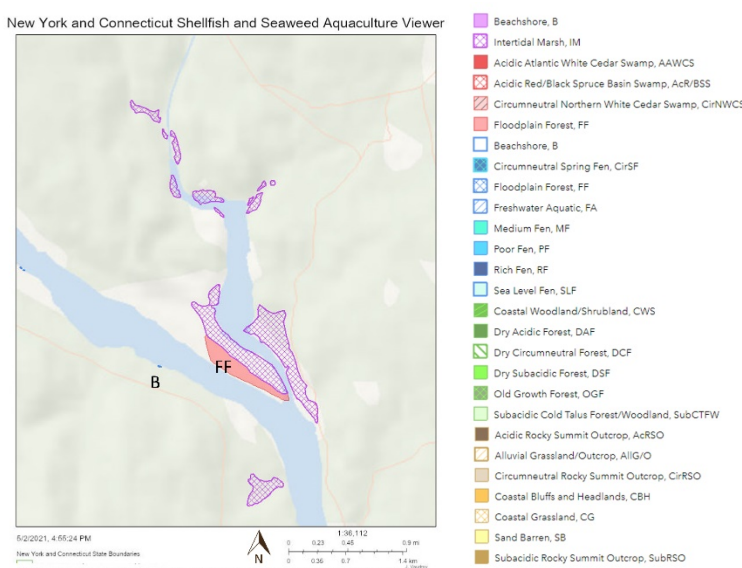


Figure 5-12: Critical Terrestrial and Intertidal Habitats – Salmon River Area

State of Connecticut-defined Critical Habitats for Connecticut were identified by Metzler and Barrett (2006), noted in the Long Island Sound Stewardship Ecological Sites Inventory Update (Barrett 2014), and mapped in the CT ECO Aquaculture Mapping Atlas (UConn CLEAR et al. 2018).

Intertidal marsh in the lower Connecticut River. Photo credit: LowerCtRiver, by Judy Benson / Connecticut Sea Grant. http://www.flickr.com/photos/ctnerr/ (CC BY-NC 4.0)

Table 5-19: Habitats of the NERR, Aquatic Parcels

The assignment of property to alternatives is presented in the first six rows. For the remainder of the table, habitats found within each property are identified. *Note* - the term "lower Connecticut River" and "upper Connecticut River" refer to the relative position within the project area, not along the length of the Connecticut River, which extends into Canada. An "x" indicates extensive tracts of this habitat are found in the area. Shellfish data were obtained from the CT ECO Aquaculture Mapping Atlas (UConn CLEAR et al. 2018). Eelgrass area (*Zostera marina*) was estimated using the 2017 survey (Bradley and Paton 2018). Towns along the coast are used as reference points, with the area due south of the listed towns included in the area. Maps of areas are available in *Chapter 4*.

	eastern project area, ELIS & WFIS (New London & Groton)	lower Thames River	central project area, ELIS (Waterford & East Lyme)	western project area, ELIS (Old Lyme & Old Saybrook)	western buffer, ELIS (Old Saybrook)	lower Connecticut River (mouth to north of Lord Cove)	upper Connecticut River (north of Lord Cove to Machimoodus)
PROPERTIES INCLUDED IN ALTERNATIVES							
No Action Alternative							
Alternative A	x	x	x	x		x	
Alternative B				x		x	x
Alternative C				x	x	x	
Alternative D	x	x	x	x	x	x	
TRANSITION AREAS							
tidal freshwater marsh							x
tidal brackish marsh						x	x
tidal estuarine marsh	x		x	x			
rocky intertidal	x	x	x				
intertidal beaches	x	x	x	x		x	
intertidal mud & sand flats	x	x	x	x		x	x
intertidal algal beds	x	x	x	x		x	
SUBMERGED BOTTOMS							
subtidal hardbottoms	x	x	x	x	x	x	x
subtidal softbottoms	x	x	x	x	x	x	x
subtidal plants (freshwater & marine)	x	x	x	x	x	x	x
eelgrass beds (acres)	247	6	274	12	0	0	0
leased shellfish beds (acres)	687	0	173	0	0	0	0
bottom cages in leased areas (acres)	26	0	7	0	0	0	0
kelp longlines (acres)	27	0	0	0	0	0	0

	eastern project area, ELIS & WFIS (New London & Groton)	lower Thames River	central project area, ELIS (Waterford & East Lyme)	western project area, ELIS (Old Lyme & Old Saybrook)	western buffer, ELIS (Old Saybrook)	lower Connecticut River (mouth to north of Lord Cove)	upper Connecticut River (north of Lord Cove to Machimoodus)
recreational shellfish beds (acres)	1415	0	6860	0	0	0	0
natural shellfish beds (acres)	0	0	0	0	0	109	0
GEOLOGIC							
sheltered coast	x	x	x	x	x		
bay		x	x				
embayment / lagoon	x		x			x	x
tidal river		x				x	x

5.1.2.2 Riparian and Freshwater Habitats

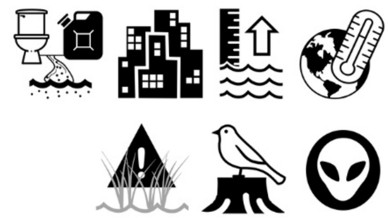
Properties located in the proposed CT NERR include freshwater ponds, freshwater coves, freshwater tidal and non-tidal marshes, and floodplain forests (Tables 5-18 and 5-19). A few State of Connecticut-defined Critical Habitats (Metzler and Barrett 2006) are found within the project area. These include: beachshore, intertidal marsh, freshwater aquatic, poor fen, and floodplain forest (Figures 5-10 through 5-12, pages 121 to 122).

Haley Farm State Park hosts a poor fen (Barrett 2014). These acidic, groundwater-fed wetlands are typically poor in species diversity, dominated by mosses. Vascular plants may be present as scattered individuals rather than as a dominant cover (New York Natural Heritage Program 2021a). A rare sea-level fen has been documented at Bluff Point Natural Area Preserve (Barrett 2014), though it is not mapped in Figure 5-10. Haley Farm State Park might also host this rare fen. In both locations, this fen is likely to be a very small area, at the upland edge of the salt marsh. In this habitat, elevation is slightly higher than the neighboring tidal marsh and the hydrology is dominated by low-nutrient groundwater seepage (New York Natural Heritage Program 2021b). Position next to a salt marsh is one characteristic used in the designation of an area as a sea-level fen. This area is occasionally flooded by the tides but sits above the reach of the typical spring high tides. This natural community is dominated by herbs, occasionally with some scattered shrubs or short trees.

The Connecticut River is the longest tidal river in the northeastern United States. It’s headwaters are located in the Connecticut Lakes region of New Hampshire, near the Canadian border. This river flows for 410 miles before discharging into Long Island Sound, constituting a 7.2-million acre watershed. The Connecticut River has the most extensive fresh and brackish tidal wetland systems in the Northeast. The Connecticut River is an important riverine migratory corridor for fish within this region and is federally-designated ESA Critical Habitat (16 U.S.C. § 1532(5); 50 C.F.R. § 424.12) for the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). This area is recognized as containing “Wetlands of International Importance” under the intergovernmental Ramsar Convention (Dreyer and Caplis 2001; USFWS 1994).

The aquatic portion of the project area includes or borders six freshwater coves and tributaries of the Connecticut River (see maps in *Section 4.2*). These are, from south to north:

- Salmon River, included in the project area
- Hamburg Cove, Deep River Cove, Selden Cove, Selden Creek, Hadlyme Cove, Chapman Pond; adjacent to the project area



Threats to riparian and freshwater habitats include habitat degradation, habitat loss, invasive species, pollution, coastal development, sea level rise and its impact on saltwater intrusion, and climate change. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

Alternative A includes freshwater marshes, ponds, and streams. Bluff Point Natural Area Preserve hosts one of the rarest freshwater wetlands, a sea-level fen, and Haley Farm State Park hosts a poor fen (Barrett 2014). Neither Alternative A nor D include tidal freshwater rivers, as the limit of saltwater in the Connecticut River and Thames River occur north (landward) of the alternative's boundaries. These alternatives include the lower Connecticut River, an important riverine migratory corridor. A few State of Connecticut-defined Critical Habitats (Metzler and Barrett 2006) are found within the project area: poor fen and intertidal marsh (Barrett 2014). Poor fen is unique to Alternatives A and D.

Alternative B also includes freshwater marshes, ponds, and streams, but lacks the sea-level fen found in Alternative A. As with Alternative A, this alternative includes the lower Connecticut River, an important riverine migratory corridor. Ragged Rock Creek, included in this alternative but not in A, is one of the largest brackish tidal wetland systems in the Connecticut River estuary with vegetation that is considered relatively intact i.e., it has suffered the least incursion of invasive *Phragmites australis* and hosts several populations of native *P. australis* (Barrett and Prisloe 2001; Moorhead III et al. 2009). This alternative includes tidal freshwater, within the streams that feed the marshes in the lower Connecticut River and in the tidal freshwater portions of the main stem of the Connecticut River as this alternative extends northward (landward) of the saltwater limit. This extension to the north also provides many more acres of freshwater marsh compared to all other alternatives. A few State of Connecticut-defined Critical Habitats (Metzler and Barrett 2006) are found within the project area: intertidal marsh and floodplain forest (Barrett 2014). This alternative lacks the sea-level fen and poor fen found in Alternatives A and D.

Alternative C includes the habitats described for Alternative B but does not extend northward (landward of the saltwater limit. This alternative lacks the tidal freshwater portions of the main stem of the Connecticut River and the freshwater marshes of the upper portion of the project area within the Connecticut River. A State of Connecticut-defined Critical Habitats (Metzler and Barrett 2006) is found within the project area: intertidal marsh (Barrett 2014). This alternative lacks the sea-level fen and poor fen found in Alternatives A and D.

Alternative D matches the freshwater and riparian habitat types found in Alternative A. This alternative includes the addition of Pine Island, habitat which is found elsewhere in Alternative A and D.

5.1.2.3 Estuarine Habitats

Including saline[16] areas below the mean higher high water line, habitats within the project area include: tidal marshes, rocky intertidal, intertidal beaches, intertidal mud and sand flats, intertidal algae beds, subtidal hard bottoms, subtidal soft bottoms, and submerged aquatic vegetation (Table 5-19). Commercially leased and recreational shellfish beds are concentrated in the eastern end of the proposed CT NERR while two large natural shellfish beds are located in the lower Connecticut River (Table 5-19). Most of the terrestrial sites within the proposed CT NERR include tidal salt marshes, tidal brackish marshes, or freshwater marshes along some part of their coastline (Table 5-18). The offshore areas of the proposed CT NERR include an array of submerged aquatic vegetation, softbottom, and hardbottom (reefs, bedrock / gravel zones, rocky / boulder areas), which span a depth regime from 1 to over 150 feet in depth (UConn et al. 2010). A few State of Connecticut-defined Critical Habitats (Metzler and Barrett 2006) are found within the project area, these include: beachshore and intertidal marsh (Figures 5-10 through 5-12, pages 121 to 122).

The project area is best described as a sheltered coast, as the shoreline is protected from the Atlantic Ocean by Fishers Island and Long Island. The area includes a few small bays (e.g., Esker Bay, Niantic Bay) and two main tidal rivers: the Thames River and the Connecticut River. The aquatic portion of the project area includes or borders 22 estuarine embayments. These are, from east to west:

- Waterbodies within the project area: Palmer Cove, Venetian Harbor, Mumford Cove, Poquonock River, Baker Cove / Birch Creek / Birch Plain Creek / , Griswold Cove / Black Hall River, Griswold Cove / Back River, and Lord Cove.
- Waterbodies adjacent to the project area: Alewife Cove, Goshen Cove, Jordan Cove, Gardners Pond, Niantic River, Pattagansett River, Bride Brook, Four Mile River, Threemile River, Lieutenant River, Duck River, North Cove (Essex), Middle Cove (Essex), South Cove (Essex), North Cove (Old Saybrook), and South Cove (Old Saybrook).

The coastal and estuarine habitats of Long Island Sound and Fishers Island Sound, such as seagrasses, shellfish beds and salt marshes, provide a home, feeding area and nursery for marine fish, marine invertebrates, sea turtles, marine mammals, and birds. As foundational, biogenic habitats essential for marine biodiversity and function, seagrass, shellfish, and salt marsh ecosystems represent a source of food security for humans through recreational and commercial fishing activities, and nursery habitat provision for major fisheries along the eastern seaboard. As ecological engineers, the species forming the habitats create structures that stabilize sediments and dampen wave energy, helping reduce coastal erosion and the impacts of storms. Seagrasses and salt marshes are also important carbon sinks, sequestering and storing up to ten times the amount of carbon by area as their terrestrial forest equivalents (Millenium Ecosystem Assessment 2005; Valiela 1995). Whales, sea turtles, and fish that migrate or move between coastal, estuarine, and ocean habitats as they feed and reproduce, depend on Long Island Sound, Fishers Island Sound, the rivers, and offshore habitats throughout their life histories.

Some of the tidal marshes are dominated by low and high marsh (here referred to as salt marshes) while others include more high marsh and upland habitats and exhibit more of a freshwater influence (here

[16] Salinity from 30 to 35 ppt is termed euhaline or marine and is equivalent to ocean water. Below 30 ppt, waters are considered estuarine or brackish: salinity from 18 to 30 ppt is termed polyhaline, 5 to 18 ppt is mesohaline, 0.5 to 5 ppt is oligohaline, with freshwater < 0.5 ppt.

referred to as brackish marshes). The marshes in the lower portion of Connecticut River are complexes of brackish marsh and tall reed marsh, often occurring within the same property (Barrett 1989). All marshes are highly-productive zones, providing food, shelter and breeding habitat for numerous invertebrates, fish and birds. Many of the brackish tidal wetlands along the Connecticut River have been recognized as wetlands of global importance by the Ramsar Convention (Dreyer and Caplis 2001; USFWS 1994).

Submerged aquatic vegetation and macroalgae are often the dominant structure-forming organisms in the nearshore shallow waters. Like terrestrial grasses and trees, these primary producers provide dissolved oxygen, food, and shelter for organisms living within the habitat. Dense meadows of seagrass (submerged aquatic vegetation tolerant of higher salinity estuarine to marine waters) provide refuge from predators and tidal currents.

Intertidal areas include rocky substrates, beach, and flats composed of mud and sand. The rocky intertidal areas support a more diverse assemblage of organisms, as there is a firm substrate for these organisms to hold onto. The intertidal beaches and flats support a less diverse area as the sediment shifts and moves with the waves and along-shore current.

Softbottom (sandy and silt / mud / clay) dominated habitats are perhaps the most prevalent and least complex of the range of subtidal habitats in the project area, but they are nevertheless important as many burrowing species adapt to life in these habitats. Tidal and storm currents form sand waves and sand ripples which, like rocks and fauna in more spatially complex habitats, provide refuge from current flows. The cohesive nature of fine silt and clay sediments as well as an abundance of nutrient rich material provide an optimal habitat for many infaunal and epifaunal invertebrates.

Boulder and gravel areas are the most spatially complex habitats. These areas range in structure from large piles of boulders to flat pavements of small cobbles and pebbles (Figure 5-13). The relative stability of rock substrates provides a home for many encrusting (including cold water corals) and mobile organisms, and the crevices between and under boulders provide cover from predators and refuge from swift currents.

Threats to estuarine habitats include habitat loss and degradation, invasive species, pollution, marine debris, climate change, sea level rise, barrier / dams, human harassment, and fishing / overfishing. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

Alternative A includes salt and brackish marshes, intertidal beaches, mud and sand flats, and intertidal algae beds. Rocky intertidal areas are found only in Bluff Point, Pine Island, and the Avery Point campus, all included in this alternative. Eelgrass beds (*Zostera marina* L.) are found in shallow waters of this alternative (approximately 540 acres), from the eastern-most boundary west to just offshore of East Lyme. Two natural shellfish beds are found in the lower Connecticut River (approximately 109 acres). This alternative includes approximately 8,275 acres of recreational shellfish beds and approximately 860 acres of commercially leased shellfish beds with approximately 33 acres of those leases hosting bottom cage culture. An additional approximately 27 acres in this alternative are used for the longline aquaculture of kelp. All bottom types found within the project area are represented in this alternative. A dredged material disposal area (840 acre active dredge site with a total area including the buffer of 2125 acres) is located offshore of New London, near the Connecticut-New York boundary in Long Island Sound (Louis Berger and University of Connecticut 2016). A few State of Connecticut-defined Critical Habitats (Metzler and Barrett 2006) are found within the project area: beachshore and intertidal marsh (Barrett 2014).

Alternative B submerged and offshore areas include only the lower Connecticut River and the area off the mouth of the River. This alternative extends the reserve boundary further up the Connecticut River, including more freshwater habitats and freshwater sections of the River. The offshore area of Alternative B includes more soft sediment and less hard, complex bottom substrates compared to Alternatives A and D. This alternative lacks the rocky intertidal habitats found in Alternatives A and D. No eelgrass (*Zostera marina*) is found in this alternative, though other species of brackish and freshwater submerged aquatic vegetation are present. No shellfish or kelp aquaculture nor recreational shellfishing are included in any portion of this alternative. A few State of Connecticut-defined Critical Habitats (Metzler and Barrett 2006) are found within the project area: beachshore and intertidal marsh (Barrett 2014).

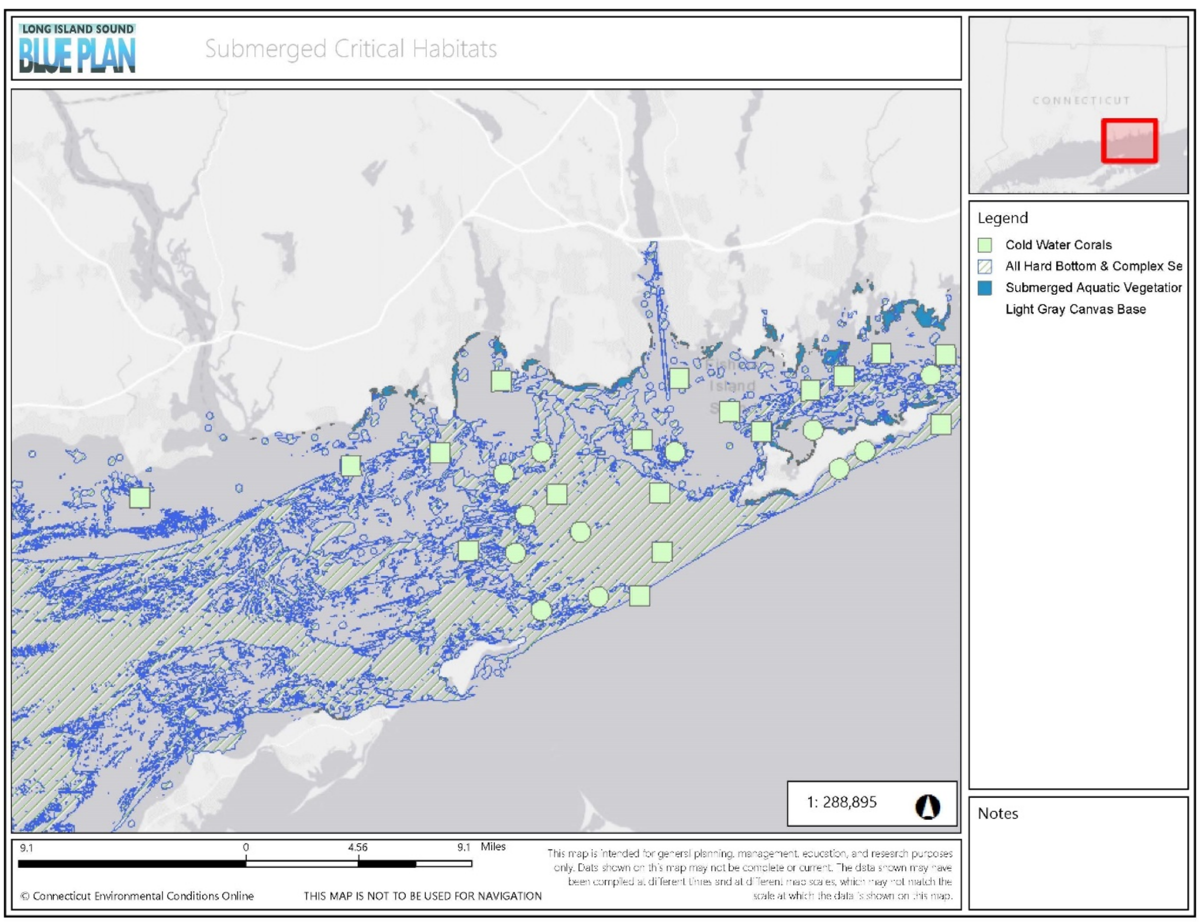


Figure 5-13: Hard Bottom and Complex Seafloor, Cold Water Coral, and Eelgrass
This map was generated using the Long Island Sound Blue Plan Viewer (DEEP 2019b).

Alternative C submerged and offshore areas include only the lower Connecticut River and the area off the mouth of the River, extending up the Connecticut River to the same point as seen in Alternatives A and D. An additional offshore buffer area is added to the west of the Connecticut River, to capture areas important in sediment dynamics; this western buffer area is also included in Alternative D, but is not in Alternatives A or B. A second buffer area extends to the east of the mouth of the Connecticut River. The offshore area of Alternative C includes more soft sediment and less hard, complex bottom substrates compared to Alternatives A and D. This alternative lacks the rocky intertidal found in Alternatives A and D. Relatively little seagrass (*Z. marina*) is found in this alternative (12.21 acres), though other species of brackish and freshwater submerged aquatic vegetation are present. No shellfish or kelp aquaculture nor recreational shellfishing are included in any portion of this alternative. A few State of Connecticut-defined Critical Habitats (Metzler and Barrett 2006) are found within the project area: beachshore and intertidal marsh (Barrett 2014).

Alternative D is a modification of Alternative A where the dredge material disposal site is excluded from the proposed CT NERR. Security zones around General Dynamics Electric Boat facility and Dominion's Millstone Power Station are also removed from the reserve area. The navigational channel and turning basin in the lower Thames River are buffer versus core area in this alternative. Alternative A buffer area in the central zone of the proposed CT NERR, off of Niantic Bay, is core area in this alternative; therefore, more seagrass habitat and hard bottom habitat are included in the core under this alternative. An additional offshore buffer area is added to the west of the Connecticut River, to capture areas important in sediment dynamics; this western buffer area is also included in Alternative C, but is not in Alternatives A or B.

5.1.3 Living Resources

The sensitivity of living resources to degradation or destruction in some cases leads to the need for protection. Species may be federally listed as endangered, threatened, or at risk under the Endangered Species Act (see *Chapter 7*).

In addition to federally listed species, there are also numerous species identified as State Endangered, State Threatened, or State Special Concern. The Connecticut Endangered Species Act, passed in 1989, recognizes the importance of Connecticut plant and animal populations and the need to protect them from threats that could lead to their extinction. Species are listed according to their level of risk, and their status is reviewed every five years (DEEP 2020c). Additionally, the Connecticut Wildlife Action Plan (CT-WAP) (DEEP 2016a) identifies species with the Greatest Conservation Need and classifies them as Most Important, Very Important, and Important:

- **Most Important**: Species of high regional or state conservation responsibility and have populations that are at high risk of declining in the absence of immediate conservation effort to address the threats they face.
- **Very Important**: Species of regional or state conservation responsibility and have populations that are at risk of declining in the absence of near-term (one to ten years) conservation effort to address the threats they face.
- **Important**: Species of regional or state conservation responsibility, or there is a lack of adequate life history information to make management decisions, or whose populations are at risk of

declining in the absence of long-term (ten or more years) conservation effort to address the threats they face.

An additional designation applied to species is nonindigenous species (NIS), referring to species of exotic origin, not native to the area. If these NIS become problematic, causing economic or ecological harm, they may be labeled as invasive (INV).

5.1.3.1 Flora – By Habitat

Descriptions of the flora for each habitat were drawn from the *Long Island Sound Stewardship Ecological Sites Inventory Update* for terrestrial and marsh plants and from *Long Island Sound: Prospects for the Urban Sea* for aquatic plants and algae (Barrett 2014; Latimer et al. 2014). *Seaweeds of Long Island Sound* and *A Field Guide to Long Island Sound* were referenced for all habitats (Lynch 2017; Van Patten 2009).

The Connecticut Botanical Society maintains a database of native and naturalized vascular plants of Connecticut which currently includes 2,856 species (Dreyer et al. 2014). Not all of these would be found in the proposed CT NERR area, but this list provides a reference when inventorying of the established reserve begins. Current taxonomic names were confirmed in the *USDA PLANTS database* (USDA NRCS 2021) and in the *AlgaeBase database* (Guiry and Guiry 2021) thus, the taxonomic names may differ from older resources for species identification.

Table 5-20: Common Vascular Plants

Vascular plants (including trees and shrubs) likely to occur within the Reserve are sorted by growth habit then by common name. Scientific names, growth habitat, and status as a nonindigenous species, indicated by (NIS) after the common name, were updated using the *USDA PLANTS database* (USDA NRCS 2021). (NIS / NAT) indicates that both native and nonindigenous varieties are present. Invasive plants (INV) were determined from the Connecticut Invasive Plant List (Oct, 2018) which includes Invasive and Potentially Invasive Plants as determined by the Connecticut Invasive Plants Council in accordance with C.G.S. §§ 22a-381a—22a-381d. An asterisk (*) after the common name indicates the species is listed as "Important" in the Connecticut Wildlife Action Plan (CT-WAP). State Status is designated by letters following the column name, where: SE = State Endangered, ST = State Threatened, SSC = State Special Concern. No species in this list are federally listed as endangered nor threatened. Typical habitats for each plant are indicated, though an inventory of the plants within the reserve is necessary to confirm their presence.

* = important in CT-WAP SE = State Endangered ST = State Threatened SSC = State Special Concern	(NIS) = nonindigenous species (NIS / NAT) = NIS and native varieties are in CT (INV) = invasive	coastal forest / woodland	coastal shrubland	grassland / dunes	freshwater wetlands	brackish / salt marshes	intertidal beaches	fully submerged plants	coastal cliffs & bluffs
	Alternative A – acres of habitat	761	103	52	15	799	59	540+	2
	Alternative B – acres of habitat	326	18	76	72	957	50	0	0
	Alternative C – acres of habitat	127	5	24	0	578	33	12+	0
	Alternative D – acres of habitat	762	103	52	16	806	59	540+	2
COMMON NAME	**SCIENTIFIC NAME**								
Nonvascular									
haircap moss	*Polytrichum ohioense*	X	X		X				
low sphagnum moss	*Sphagnum compactum*				X				
Lichenous									
British soldier lichen	*Cladonia cristatella*			X					
Erichsen's wart lichen	*Verrucaria erichsenii*						X		
green shield lichen	*Flavoparmelia caperata*						X		
reindeer lichen	*Cladonia rangiferina*			X					
Graminoid									
American beach grass*	*Ammophila breviligulata*			X					
bentgrass (NIS / NAT)	*Agrostis* sp.		X			X			
blackgrass	*Juncus gerardii*			X		X			
cheatgrass (INV)	*Bromus tectorum*			X					
common reed, invasive (INV)	*Phragmites australis* ssp. *australis*		X	X		X			
common reed, native* SSC	*Phragmites australis* ssp. *americanus*			X		X			
deer-tongue grass	*Dichanthelium clandestinum*		X	X					
dwarf spikerush	*Eleocharis parvula*					X			
foxtail grass (NIS / NAT)	*Alopecurus*	X	X						

* = important in CT-WAP ^{SE} = State Endangered ST = State Threatened ^{SSC} = State Special Concern	(NIS) = nonindigenous species (NIS / NAT) = NIS and native varieties are in CT (INV) = invasive	coastal forest / woodland	coastal shrubland	grassland / dunes	freshwater wetlands	brackish / salt marshes	intertidal beaches	fully submerged plants	coastal cliffs & bluffs
Alternative A – acres of habitat		761	103	52	15	799	59	540+	2
Alternative B – acres of habitat		326	18	76	72	957	50	0	0
Alternative C – acres of habitat		127	5	24	0	578	33	12+	0
Alternative D – acres of habitat		762	103	52	16	806	59	540+	2
COMMON NAME	**SCIENTIFIC NAME**								
little bluestem*	*Schizachyrium scoparium scoparium*			X					
New England bulrush^{SSC}	*Bolboschoenus novae-angliae*					X			
Olney's three-square sedge	*Schoenoplectus americanus*				X	X			
orchard grass (NIS)	*Dactylis glomerata*		X	X					
red fescue	*Festuca rubra L. ssp. arenaria*		X	X	X				
saltmeadow cordgrass	*Spartina patens*			X		X			
sandbur	*Cenchrus longispinus*			X					
seaside arrowgrass	*Triglochin maritima*		X			X			
sedges (NIS / NAT)	*Carex* sp.		X		X				
sedges (NIS / NAT)	*Cyperus* sp.	X	X	X	X				
short bayonet grass* ^{SSC}	*Bolboschoenus maritimus*				X	X			
smooth cordgrass	*Sporobolus alterniflorus*, also known as *Spartina alterniflora*			X		X			
spike grass	*Distichlis spicata*			X		X			
spikerush (NIS / NAT)	*Eleocharis*				X				
sturdy bulrush	*Bolboschoenus robustus*					X			
switchgrass	*Panicum virgatum*		X	X	X				X
three-square sedge	*Schoenoplectus pungens*				X	X			
umbrella sedge	*Cyperus strigosus*		X	X					
wild rice	*Zizania palustris*				X				
Forb / Herb									
American eelgrass	*Vallisneria americana*				X	X		X	
American searocket	*Cakile edentula*			X					
arrowhead (NIS / NAT)	*Sagittaria*				X	X			
Atlantic mock bishop-weed	*Ptilimnium capillaceum*		X		X	X			
Atlantic mudwort ^{SSC}	*Limosella australis*				X	X			
cinnamon fern	*Osmunda cinnamomea*	X	X		X				

* = important in CT-WAP SE = State Endangered ST = State Threatened SSC = State Special Concern	(NIS) = nonindigenous species (NIS / NAT) = NIS and native varieties are in CT (INV) = invasive	coastal forest / woodland	coastal shrubland	grassland / dunes	freshwater wetlands	brackish / salt marshes	intertidal beaches	fully submerged plants	coastal cliffs & bluffs
	Alternative A – acres of habitat	761	103	52	15	799	59	540+	2
	Alternative B – acres of habitat	326	18	76	72	957	50	0	0
	Alternative C – acres of habitat	127	5	24	0	578	33	12+	0
	Alternative D – acres of habitat	762	103	52	16	806	59	540+	2
COMMON NAME	**SCIENTIFIC NAME**								
cocklebur, beach clotbur	*Xanthium strumarium*			X					
common milkweed*	*Asclepias syriaca*		X						
common waterweed	*Elodea canadensis*				X			X	
common yarrow* (NIS / NAT)	*Achillea millefolium*		X	X					
eastern annual saltmarsh aster	*Symphyotrichum subulatum*					X			
eastern grasswort SSC	*Lilaeopsis chinensis*				X	X			
eelgrass	*Zostera marina*			X				X	
evening primrose	*Oenothera biennis*			X					
field horsetail	*Equisetum arvense*	X	X		X				
horned pondweed	*Zannichellia palustris*				X	X		X	
jewelweed	*Impatiens capensis*		X						
late purple aster	*Symphyotrichum patens*	X							
narrow-leaved cattail* (NIS / NAT)	*Typha angustifolia*				X				
New York aster	*Symphyotrichum novi-belgii*				X				
perennial saltmarsh aster	*Symphyotrichum tenuifolium*					X			
red goosefoot	*Chenopodium rubrum*			X					
Russian thistle (NIS)	*Salsola tragus*			X					
sea lavender	*Limonium carolinianum*			X		X			
seaside goldenrod*	*Solidago sempervirens*			X		X			
seaside plantain	*Plantago maritima*		X			X			
seaside spurge, sandmat	*Chamaesyce polygonifolia*			X					
sensitive fern	*Onoclea sensibilis*	X	X		X				
silverweed	*Argentina*				X	X			
spearscale, marsh orach (NIS)	*Atriplex patula*					X			
sweet flag (NIS)	*Acorus calamus*				X				
water horsetail	*Equisetum fluviatile*	X	X		X				

* = important in CT-WAP [SE] = State Endangered [ST] = State Threatened [SSC] = State Special Concern	(NIS) = nonindigenous species (NIS / NAT) = NIS and native varieties are in CT (INV) = invasive	coastal forest / woodland	coastal shrubland	grassland / dunes	freshwater wetlands	brackish / salt marshes	intertidal beaches	fully submerged plants	coastal cliffs & bluffs
Alternative A – acres of habitat		761	103	52	15	799	59	540+	2
Alternative B – acres of habitat		326	18	76	72	957	50	0	0
Alternative C – acres of habitat		127	5	24	0	578	33	12+	0
Alternative D – acres of habitat		762	103	52	16	806	59	540+	2
COMMON NAME	**SCIENTIFIC NAME**								
water-milfoil (NIS / NAT) (3 INV)	*Myriophyllum* sp.				X			X	
white wood aster	*Eurybia divaricata*	X	X						
whorled pennywort[SE]	*Hydrocotyle verticillata*				X				
widgeon grass	*Ruppia maritima*				X	X		X	
wild celery (NIS)	*Apium graveolens*				X				
wild geranium	*Geranium maculatum*	X							
wild yellow indigo*	*Baptisia tinctoria*			X					
yellow thistle[SE]	*Circium horridulum*		X	X					
Forb / Herb, Subshrub									
dusty miller, silver ragwort (NIS)	*Senecio cineraria*			X					
erect sea blight	*Suaeda linearis*					X			
Japanese knotweed (INV)	*Polygonum cuspidatum*		X						
jointed glasswort	*Salicornia depressa*			X		X			
marsh elder	*Iva frutescens*		X	X		X			
poison ivy	*Toxicodendron radicans* ssp. *radicans*		X	X					X
saltmarsh fleabane	*Pluchea odorata* var. *succulenta*				X	X			
seabeach orach, crested saltbush	*Atriplex cristata*			X					
swamp rose mallow	*Hibiscus moscheutos*		X			X			
tree clubmoss	*Lycopodium obscurum*	X	X		X				
Vine; or Shrub, Vine; or Forb / Herb, Vine									
Asiatic bittersweet (INV)	*Celastrus orbiculatus*		X						X
beach pea	*Lathyrus japonicus* var. *maritimus*			X					
black swallow-wort (INV)	*Cynanchum louiseae*		X	X					
bullbrier	*Smilax rotundifolia*		X		X				
catbrier	*Smilax glauca*		X	X					
field bindweed (NIS)	*Convolvulus arvensis*		X						
fox grape	*Vitis labrusca*		X						

* = important in CT-WAP SE = State Endangered ST = State Threatened SSC = State Special Concern	(NIS) = nonindigenous species (NIS / NAT) = NIS and native varieties are in CT (INV) = invasive	coastal forest / woodland	coastal shrubland	grassland / dunes	freshwater wetlands	brackish / salt marshes	intertidal beaches	fully submerged plants	coastal cliffs & bluffs
Alternative A – acres of habitat		761	103	52	15	799	59	540+	2
Alternative B – acres of habitat		326	18	76	72	957	50	0	0
Alternative C – acres of habitat		127	5	24	0	578	33	12+	0
Alternative D – acres of habitat		762	103	52	16	806	59	540+	2
COMMON NAME	**SCIENTIFIC NAME**								
goldenrod	*Solidago*	X	X						
Japanese honeysuckle (INV)	*Lonicera japonica*		X	X					X
Virginia creeper	*Parthenocissus quinquefolia*		X	X					
Shrub; or Subshrub; or Shrub, Subshrub									
autumn olive (INV)	*Elaeagnus umbellata*		X	X					
beach heather* ST	*Hudsonia tomentosa*			X					
beach plum	*Prunus maritima*		X	X					
beach rose (INV)	*Rosa rugosa*		X	X					X
bearberry	*Arctostaphylos uva-ursi*	X	X	X					
black huckleberry	*Gaylussacia baccata*	X	X						
broom crowberry	*Corema conradii*			X					
Carolina rose, pasture rose	*Rosa carolina*		X						
dewberry, northern dewberry	*Rubus flagellaris*		X						
eastern prickly pear cactus SSC	*Opuntia humifusa*	X	X	X					
highbush blueberry	*Vaccinium corymbosum*		X	X					
Japanese barberry (INV)	*Berberis thunbergii*	X	X						
mapleleaf viburnum	*Viburnum acerifolium*	X							
multiflora rose (INV)	*Rosa multiflora*	X	X						
pink azalea	*Rhododendron periclymenoides*	X							
wine raspberry (INV)	*Rubus phoenicolasius*		X	X					
Shrub, Tree									
American holly	*Ilex opaca*		X	X					
bear oak*	*Quercus ilicifolia*		X	X					
black cherry	*Prunus serotina*	X	X	X		X			
common hackberry	*Celtis occidentalis*		X	X					
common juniper	*Juniperus communis*			X	X				
flowering dogwood	*Cornus florida*		X						
groundsel tree	*Baccharis halimifolia*		X	X	X				

* = important in CT-WAP SE = State Endangered ST = State Threatened SSC = State Special Concern	(NIS) = nonindigenous species (NIS / NAT) = NIS and native varieties are in CT (INV) = invasive	coastal forest / woodland	coastal shrubland	grassland / dunes	freshwater wetlands	brackish / salt marshes	intertidal beaches	fully submerged plants	coastal cliffs & bluffs
	Alternative A – acres of habitat	761	103	52	15	799	59	540+	2
	Alternative B – acres of habitat	326	18	76	72	957	50	0	0
	Alternative C – acres of habitat	127	5	24	0	578	33	12+	0
	Alternative D – acres of habitat	762	103	52	16	806	59	540+	2
COMMON NAME	**SCIENTIFIC NAME**								
mountain laurel	*Kalmia latifolia*	X							
northern bayberry	*Morella pensylvanica*		X	X	X				X
sassafras	*Sassafras albidum*	X	X	X					
shining (winged) sumac	*Rhus copallinum* var. *latifolia*	X	X	X		X			X
smooth serviceberry	*Amelanchier canadensis*		X	X					
smooth sumac	*Rhus glabra*		X						X
spicebush	*Lindera benzoin*	X							
staghorn sumac	*Rhus hirta*		X	X	X				X
Tree									
American basswood	*Tilia americana*	X	X						
black birch	*Betula lenta*	X	X						
black locust (INV)	*Robinia pseudoacacia*		X	X					
black oak*	*Quercus velutina*	X	X	X					
eastern redcedar*	*Juniperus virginiana* var. *virginiana*		X	X					
eastern white oak	*Quercus alba*	X	X						
mockernut hickory	*Carya tomentosa*	X							
northern red oak	*Quercus rubra*	X	X						
paradise apple (NIS)	*Malus pumila*		X	X					
pignut hickory*	*Carya glabra*	X							
pitch pine*	*Pinus rigida*	X	X	X					
quaking aspen	*Populus tremuloides*		X	X					
red maple	*Acer rubrum*	X	X	X	X				
sugar maple*	*Acer saccharum* var. *saccharum*	X							
tree of heaven (INV)	*Ailanthus altissima*		X						
tuliptree	*Liriodendron tulipifera*	X			X				
tupelo, black gum	*Nyssa sylvatica*	X							

5.1.3.1.1 Terrestrial Flora

The terrestrial habitats include coastal forests / woodlands, coastal shrublands, coastal meadows / grassland, coastal beach and dune grasslands, and coastal bluff (see Table 5-18 for habitats in each property); characteristic species are listed by habitat (Table 5-20). Information in this section was largely adapted from the *Long Island Sound Stewardship Ecological Sites Inventory Update*, unless otherwise noted (Barrett 2014).

Forests are a dominant feature of the landscape in Haley Farm State Park, Bluff Point complex, and Machimoodus State Park. Other sites in the proposed CT NERR host small stands of trees but are dominated by other habitat types. The coastal forest / woodlands include large stands of birch (*Betula lenta*), oak (*Quercus* sp.), hickory (*Carya tomentosa*; *Carya glabra*) and black cherry trees (*Prunus serotina*). Other common species include eastern redcedar (*Juniperus virginiana* var. *virginiana*), maple (*Acer* sp.), and tulip trees (*Liriodendron tulipifera*). In 1973, a white oak on the Haley Farm site was found to be 142 years old, in the upper end of the life expectancy of the species. In Bluff Point, the older trees are 70 to 90 years old.

The shrublands found within the project area include highbush blueberry (*Vaccinium corymbosum*), black huckleberry (*Gaylussacia baccata*), and sumac (*Rhus* sp.). Catbrier (*Smilax glauca*), rose (*Rosa* sp.), and Asiatic bittersweet (*Celastrus orbiculatus*) have formed dense thickets in some disturbed areas. Where the soils are thicker, such as on the eastern slopes of Bluff Point, more herbaceous species occur.

The open grasslands are dominated by switchgrass (*Panicum virgatum*) and little bluestem (*Schizachyrium scoparium*). These grasslands contain a variety of plants that are preferred habitat for some insects and birds. It is interesting to note that due to significant land use changes over centuries, most native grasses across the state do not occur in the same locations as in the past. However, on the floodplain soils of Machimoodus State Park, grass species can be found that were present at the site from the 1600s or earlier.

The beach and dune grasslands include American beachgrass (*Ammophila breviligulata*), beach rose (*Rosa rugosa*), and seaside goldenrod (*Solidago sempervirens*). Beach rose (*Rosa rugosa*) and beach pea (*Lathyrus japonicus* var. *maritimus*) form scattered thickets on the back side of these dunes. These plants are essential for stabilizing the dunes, preventing wind from carrying away the sand and preventing waves from entering the marshes behind the dunes. Because of the shifting nature of sand, perennial plants are often uprooted, especially on the upper reaches of the beach. Thus, many beach plants are annuals whose seeds move around during the winter to come up in a new location the next spring. Plants in this habitat can withstand the salt spray received from the high waves of storms, including Russian thistle (*Salsola tragus*), seaside goldenrod (*Solidago sempervirens*), American searocket (*Cakile edentula*), and seaside spurge (*Chamaesyce polygonifolia*). The dunes behind Bushy Point Beach and Bluff Point Beach in Bluff Point Coastal Reserve are the largest set of dunes in the proposed CT NERR and a common gathering place for people visiting the park. The Griswold Point spit at the mouth of the Connecticut River, broken by coastal storms into numerous individual emergent sand formations, is one of the most dynamic coastal features along the Connecticut shoreline.

A coastal bluff is located in Bluff Point Coastal Reserve, at the southern tip of the point. This area is affected by salt spray and only plants that tolerate such conditions can live here. Salt spray pruning of the vegetation can be seen here. These include northern bayberry (*Morella pensylvanica*), sumac (*Rhus* sp.), Japanese honeysuckle (*Lonicera japonica*), Asiatic bittersweet (*Celastrus orbiculatus*), switchgrass (*Panicum virgatum*), beach rose (*Rosa rugosa*), and poison ivy (*Toxicodendron radicans* ssp. *radicans*).

Invasive plants in Connecticut are detailed in the Connecticut Invasive Plant List (Oct., 2018) which includes invasive and potentially invasive plants as determined by the Connecticut Invasive Plants

Council in accordance with C.G.S. §§ 22a-381a to -381d (Connecticut Invasive Plant Council 2018). Invasive plants are noted in Table 5-18. Invasive plant species are widespread in the terrestrial habitats within the project area. A recent survey of Bluff Point found at least one invasive plant species in 78% of the forested sample plots, with higher frequency in more open sites (C. Jones, 2020 unpublished report to DEEP). The Connecticut Invasive Plant Working Group, hosted by UConn Extension, evaluates and tracks invasive plants, delivers educational opportunities on invasives to the general public (13,406 hours in 2020) and provides information on the control of a subset of invasive plants, including plants known to occur in the proposed CT NERR area. The most common invasive plants in terrestrial sites within the project area include: Asiatic bittersweet (*Celastrus orbiculatus*), Japanese honeysuckle (*Lonicera japonica*) and Morrow's honeysuckle (*Lonicera morrowii*), multiflora rose (*Rosa multiflora*), Japanese barberry (*Berberis thunbergii*), autumn olive (*Elaeagnus umbellata*), and Japanese knotweed (*Polygonum cuspidatum*) (Connecticut Invasive Plant Council 2018). Black swallowwort (*Cynanchum louiseae*) is particularly pervasive at the coastal bluff in Bluff Point Coastal Reserve. Other invasive plants which potentially exist in the proposed CT NERR and for which the Council lists control measures include: garlic mustard (*Alliaria petiolata*), purple loosestrife (*Lythrum salicaria*), and spotted knapweed (C*entaurea biebersteinii*). Within the list of 97 species, the beach rose (*Rosa rugosa*) is noted as especially aggressive in coastal areas.

Threats to terrestrial flora include climate change impacts on stress levels, habitat loss and degradation, pollution, coastal development, human disturbance and collection, and invasive species. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

Alternative A represents the most diverse assemblage of terrestrial habitats within the project area; these alternatives include all potential terrestrial species found throughout the project area as shown in Table 5-20.

Alternative B includes only the terrestrial properties along the Connecticut River, with the addition of some forested land in Machimoodus State Park. This alternative lacks the species characteristic of sand dunes and bluffs, but otherwise includes species found in Alternative A.

Alternative C includes the terrestrial properties along the lower Connecticut River, and thus lacks the species characteristic of sand dunes and bluffs. The lower Connecticut River properties are dominated by marsh and thus this alternative lacks species characteristic of forests.

Alternative D includes all terrestrial properties found in Alternative A with the addition of Pine Island. The terrestrial species found on Pine Island are also found elsewhere in this alternative.

5.1.3.1.2 Riparian and Freshwater Flora

The riparian and freshwater habitats include floodplain forests, swamps, freshwater marshes, freshwater intertidal flats, and submerged aquatic vegetation beds (see Table 5-18 for habitats in each property). Characteristic species are listed by habitat (Table 5-20). Information in this section was largely adapted from the *Long Island Sound Stewardship Ecological Sites Inventory Update*, unless otherwise noted (Barrett 2014).

Swampy areas and floodplain forests within the proposed CT NERR are characterized by red maple (*Acer rubrum*) and tulip trees (*Liriodendron tulipifera*). Plants found along the shoreline of the floodplain forest include saltmeadow cordgrass (*Spartina patens*), sedge (*Carex* sp.; *Cyperus* sp.), and sphagnum moss (*Sphagnum compactum*).

Haley Farm State park hosts a poor fen (Barrett 2014). These acidic, groundwater-fed wetlands are typically poor in species diversity, dominated by mosses. Vascular plants may be present as scattered individuals rather than as a dominant cover (New York Natural Heritage Program 2021a). A rare sea-level fen has been documented at Bluff Point Natural Area Preserve (Barrett 2014), though is not mapped in Figure 5-10. Haley Farm State Park might also host this rare fen. In both locations, this fen is likely to be a very small area, at the upland edge of the salt marsh. In this habitat, elevation is slightly higher than the neighboring tidal marsh and the hydrology is dominated by low-nutrient groundwater seepage (New York Natural Heritage Program 2021b). Position next to a salt marsh is one characteristic used in the designation of an area as a sea-level fen. This area is occasionally flooded by the tides but sits above the reach of the typical spring high tides. This natural community is dominated by herbs, occasionally with some scattered shrubs or short trees.

The area of Salmon Cove, bordered to the north by Machimoodus State Park and to the south by Haddam Neck WMA at the very northern (and freshwater) extent of the proposed CT NERR, hosts a complex of high-quality freshwater tidal marshes, intertidal flats, and alluvial swamp. Some areas support wild rice (*Zizania palustris*). In this region, the marsh is dominated by sweet flag (*Acorus calamus*).

Freshwater tidal flats typically support dwarf spikerush (*Eleocharis parvula*), eastern grasswort (*Lilaeopsis chinensis*), tidal arrowhead (*Sagittaria latifolia*), and Atlantic mudwort (*Limosella australis*).

The subtidal freshwaters of the Connecticut River support an assortment of submerged aquatic vegetation with horned pondweed (*Zannichellia palustris*), wild celery (*Apium graveolens*), widgeon grass (*Ruppia maritima*), water-milfoil (*Myriophyllum* sp.), and common waterweed (*Elodea canadensis*) as the primary species (Barrett 1997).

As noted in the section on terrestrial flora, invasive plants in Connecticut are detailed in the *Connecticut Invasive Plant List (Oct, 2018)* which includes invasive and potentially invasive plants as determined by the Connecticut Invasive Plants Council in accordance with C.G.S. §§ 22a-381a to -381d (Connecticut Invasive Plant Council 2018). Invasive plants are noted in Table 5-18. Freshwater invasive plants known to occur within the towns hosting the reserve include: common reed (*Phragmites australis*), Eurasian water-milfoil (*Myriophyllum spicatum*), variable-leaf water-milfoil (*Myriophyllum heterophyllum*), curly leaf pondweed (*Potamageton crispus*), and water chestnut (*Trapa natans*) (CAES IAPP 2021; Capers et al. 2005). Recently, 200 acres of *Hydrilla verticillata* were mapped in the Connecticut River (CAES IAPP 2021; CT RC&D 2021; Werth 2020). Common reed has been controlled in many of the tidal marshes at and south of Lord Cove. Nonindigenous species not identified as invasive by the Plants Council were determined using the *USGS Nonindigenous Aquatic Species Database* (Table 5-18) (USGS 2021a).

Threats to riparian and freshwater flora include climate change impacts on stress levels, habitat loss and degradation, pollution, coastal development, human disturbance and collection, and invasive species. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

Alternative A includes a diverse assemblage of freshwater habitats, including a rare sea-level fen and a poor fen. This alternative lacks the high-quality freshwater tidal marshes supporting wild rice and the alluvial swamp found in Alternative B.

Alternative B includes a diverse assemblage of freshwater habitats but lacks the rare sea-level fen and poor fen found in Alternatives A and D. This alternative adds the area of Salmon Cove, which hosts high-quality freshwater tidal marshes, intertidal flats, and alluvial swamp.

Alternative C includes a diverse assemblage of freshwater habitats but lacks the rare sea-level fen and poor fen found Alternatives A and D. This alternative also lacks the high-quality freshwater tidal marshes supporting wild rice and the alluvial swamp found in Alternative B.

Alternative D includes all properties found in Alternative A with the addition of Pine Island. The freshwater and riparian species found on Pine Island are also found elsewhere in this alternative.

5.1.3.1.3 Estuarine Flora

Including saline areas below the mean higher high water line, estuarine habitats include: tidal salt and brackish marshes, intertidal beaches, intertidal mud and sand flats, intertidal algae beds, subtidal hard bottoms, subtidal soft bottoms, and submerged aquatic vegetation beds (see Table 5-19 for habitats found in project area areas). Most of the terrestrial sites within the proposed CT NERR include salt marshes, brackish marshes, or tidal freshwater marshes along some part of their coastline (see Table 5-18 for habitats in each property). The Connecticut River sites are predominantly brackish marsh with short meadow grasses at the south and tall reedy vegetation at Lord Cove while the Bluff Point complex hosts a small amount of salt marsh. Each habitat hosts a suite of characteristic vascular plants (Table 5-20) and seaweed (Table 5-21). Marsh information in this section was largely adapted from the *Long Island Sound Stewardship Ecological Sites Inventory Update* (Barrett 2014). *Seaweeds of Long Island Sound* and *A Field Guide to Long Island Sound* were also referenced for all habitats (Lynch 2017; Van Patten 2009).

As noted in the section on terrestrial flora, invasive plants in Connecticut are detailed in the *Connecticut Invasive Plant List (Oct, 2018)* which includes invasive and potentially invasive plants as determined by the Connecticut Invasive Plants Council in accordance with C.G.S. §§ 22a-381a to 381d (Connecticut Invasive Plant Council 2018). Invasive plants are noted in Table 5-18.

Van Patten's 2009 book summarizes the common estuarine macroalgae of the project area (Van Patten 2009). It is important to note that with the advent of molecular testing, the taxonomy of macroalgae is in transition. In addition, invasive species are often difficult to distinguish from the native species. For example, five species of sea lettuce (*Ulva* sp., blade form) which cannot be distinguished morphometrically have been distinguished using molecular techniques in nearby Jamaica Bay, NY (Lamb et al. 2019). Species referenced in this document represent the historically dominant species, though future research may reveal that the native species have been replaced. Species known to be nonindigenous are noted in Table 5-21, though other cryptic invasives are thought to occur in the project area.

Tidal Salt and Brackish Marshes

A comprehensive study of salt marsh plants within the project area has not been done, but a typical progression of vegetation, from the upper to lower marsh is likely. The upper boundary of the salt marshes in the proposed CT NERR can be expected to contain bayberry (*Morella* sp.) and marsh elder (*Iva frutescens*). Landward of this is either the freshwater marsh dominated by switchgrass (*Panicum virgatum*) or the forested wetland dominated by tupelo (*Nyssa sylvatica*). The brackish border of the salt marsh typically supports a band of black grass (*Juncus gerardii*) but in places this meadow has been replaced by common reed (*Phragmites* sp.). However where tupelo replaces switchgrass, common reed (*Phragmites* sp.) is steadily declining from shading. The high marsh zone includes saltmeadow cordgrass (*Spartina patens*), spike grass (*Distichlis spicata*), blackgrass (*Juncus gerardii*), jointed glasswort (*Salicornia depressa*), and sea lavender (*Limonium carolinianum*). Other plant associates include seaside goldenrod (*Solidago sempervirens*), perennial saltmarsh aster (*Symphyotrichum tenuifolium*), eastern annual saltmarsh aster (*Symphyotrichum subulatum*), and spearscale (*Atriplex patula*). The low marsh is characterized by a monoculture of smooth cordgrass (*Sporobolus alterniflorus*, also known as *Spartina alterniflora*). Pannes (shallow depressions) are common and contain jointed glasswort (*Salicornia depressa*), stunted smooth cordgrass (*Sporobolus alterniflorus*, also known as *Spartina alterniflora*), sea lavender (*Limonium carolinianum*), seaside plantain (*Plantago maritima*), and seaside arrowgrass (*Triglochin maritima*).

Within the brackish high meadow marshes, the dominant plant types include saltmeadow cordgrass (*Spartina patens*) and black grass (*Juncus gerardii*), similar to the high salt marshes. However, seaside goldenrod (*Solidago sempervirens*) and seaside arrowgrass (*Triglochin maritima*) are more abundant and jointed glasswort (*Salicornia depressa*) and sea lavender (*Limonium carolinianum*) are less abundant than in salt marshes. At lower soil salinities, bentgrass (*Agrostis* sp.), and spike rushes (*Eleocharis* sp.) dominate with sedges (*Carex* sp.), red fescue (*Festuca rubra*), Atlantic mock bishop-weed (*Ptilimnium capillaceum*), New York aster (*Symphyotrichum novi-belgii*), saltmarsh fleabane (*Pluchea odorata* var. *succulenta*), and silverweed (*Argentina* sp.) present as well. A distinctive community type consisting of several species of bulrushes and three-square sedges can also be found within brackish marshes. These colony forming species may cover several acres and consist of common three-square sedge (*Schoenoplectus pungens*) and Olney's three-square sedge (*Schoenoplectus pungens*), plus short bayonet grass (*Bolboschoenus* sp.), New England bulrush (*Bolboschoenus* sp.), and sturdy bulrush (*Bolboschoenus* sp.). Low marsh zones within brackish marshes are also dominated by smooth cordgrass (*Sporobolus alterniflorus*, also known as *Spartina alterniflora*). In contrast to the low salt marsh zone, there is often a distinct understory present commonly comprised of dwarf spike rush (*Eleocharis* sp.) or the diminutive umbellifer, eastern grasswort (*Lilaeopsis* sp.).

A different type of brackish marsh is found in the vicinity of Lord Cove NAP; this unditched marsh has a greater freshwater influence and consists of an extensive area of tall brackish reed marsh. In the high marsh zone, the dominant species is the hybrid cattail (*Typha* × *glauca*), which can reach an average height of 6 to 7 feet and grows in diffuse stands. At the downstream section of Lord Cove is found the narrow-leaved cat-tail (*Typha angustifolia*) which averages 5 feet in height and forms monocultures. Other colonizing reeds include sturdy bulrush (*Bolboschoenus* sp.), common three-square sedge

(*Schoenoplectus pungens*), common reed (*Phragmites* sp.), and swamp rose mallow (*Hibiscus moscheutos*). Although reeds dominate here, pockets of brackish meadow vegetation can also occur. In low-marsh zones, smooth cordgrass (*Sporobolus alterniflorus*, also known as *Spartina alterniflora*) is the principal species. Across the Connecticut River in Essex is the Great Meadows marsh where the co-dominant plant to hybrid cattail is the native common reed (*Phragmites* sp.) (Rozsa and Metzler 1982; Rozsa and Metzler 1987); this may be the largest colony in the northeast. With recent efforts to control the invasive common reed at Lord Cove, it may be possible to restore the native common reed.

Great Island Marsh and Upper Islands Marsh, included in all Alternatives, are a 588-acre tidal marsh, located at the mouth of the Connecticut River. This mainly brackish tidal marsh includes numerous creeks and mosquito ditches. Unfortunately, the ecological value of the Peterson Wildlife Area and the area's use by wildlife had been greatly diminished from the effects of grid ditching and the encroachment of the invasive plant, common reed (*Phragmites* sp.). The Peterson Wildlife Area project restored 300 acres of degraded marsh habitat to a mixture of brackish meadows interspersed with shallow, open water areas, a condition that approximates the pre-ditched marsh environment. The restoration also involved the elimination of 200 acres of common reed (*Phragmites* sp.) by plugging and filling ditches to restore the natural tidal flow of saltwater into the marsh. A 180-acre site at the Peterson Wildlife Area now has 30 new ponds with pannes and plugged grid ditches. Native plants and grasses have been able to return to the area, benefiting wildlife. The Ragged Rock Creek marsh, located across the river, was the subject of plant community analysis and mapping (Moorhead III et al. 2009); the outer section, owned by DEEP, is unditched and would serve as a valuable reference marsh.

Table 5-21: Common Macroalgae Species

Macroalgae likely to occur within the reserve (Van Patten 2009) are sorted by phyla then by common name, corresponding to the common names and phyla used within the text; known nonindigenous species are identified by (NIS) following the common name. Scientific names were updated using the *AlgaeBase database* (Guiry and Guiry 2021). Macroalgae are identified as intertidal (I), subtidal (S), or both (I,S). No seaweeds are listed as endangered, threatened, or of special concern by the Federal or State agencies nor in the Connecticut Wildlife Action Plan (CT-WAP). Cryptic invasives of many of the listed species may occur, status is largely unknown.

(NIS) = nonindigenous species **COMMON NAME**	**SCIENTIFIC NAME**	**(I)NTERTIDAL (S)UBTIDAL**
Phylum Cyanobacteria = blue-green bacteria		
cyanobacteria	*Calothrix* sp.	S
Phylum Ochrophyta = brown macroalgae		
Atlantic kelp	*Saccharina longicruris*	S
cord weed, shoestring weed	*Chorda filum*	I,S
false kelp, mini kelp	*Petalonia fascia*	S
finger kelp, horsetail kelp	*Laminaria digitata*	S
hairy shoelace	*Halosiphon tomentosus*	I,S
knotted wrack	*Ascophyllum nodosum*	S
ribbon weed, dotted weed	*Punctaria plantaginea*	I,S
rockweed	*Fucus distichus*	S
rockweed	*Fucus spiralis*	I
rockweed, poppers	*Fucus vesiculosus*	S

(NIS) = nonindigenous species **COMMON NAME**	**SCIENTIFIC NAME**	**(I)NTERTIDAL (S)UBTIDAL**
sargasso weed	*Sargassum filipendula*	I,S
sausage weed, sea sausage	*Scytosiphon lomentaria*	S
sea potato	*Leathesia difformis*	I,S
sour weed, stink weed	*Desmarestia viridis*	S
sugar kelp	*Saccharina latissima*	I,S
tarspot	*Ralfsia verrucosa*	S
troll's hair, pincushion weed	*Elachista fucicola*	I,S
whipweed, angel hair	*Chordaria flagelliformis*	I,S
	Ectocarpus siliculosus	I,S
	Hincksia granulosa	I
	Pylaiella littoralis	S
Phylum Chlorophyta = green macroalgae		
green fleece (NIS)	*Codium fragile*	I,S
green hair	*Cladophora* sp.	S
green rope	*Acrosiphonia arcta*	I,S
green sea fern, sea moss	*Bryopsis plumosa*	S
green thread	*Chaetomorpha linum*	S
gut weed	*Ulva intestinalis*	S
mermaid tresses	*Ulothrix flacca*	I
mini sea lettuce	*Ulva linza*	I
sea cellophane	*Monostroma grevillei*	S
sea lettuce	*Ulva lactuca*	S
short sea lettuce	*Prasiola stipitata*	I
stone hair	*Blidingia marginata*	I,S
	Rhizoclonium riparium	I,S
Phylum Rhodophyta = red macroalgae		
Agardh's red weed	*Agardhiella subulata*	I,S
banded weed	*Ceramium virgatum*	I,S
barrel weed	*Champia parvula*	I
beaded weed	*Spyridia filamentosa*	S
beauty weed	*Callithamnion tetragonum*	S
chenille weed	*Dasya baillouviana*	I,S
coral weed	*Corallina officinalis*	S
devil's tongue weed (NIS)	*Grateloupia turuturu*	I,S
discoid forked weed	*Polyides rotunda*	I
dulse	*Palmaria palmata*	I
gelatin weed, gel weed	*Gelidium pusillum*	I
graceful red weed	*Gracilaria tikvahiae*	I
grapevine weed	*Cystoclonium purpureum*	I
Grinnell's pink leaf	*Grinnellia americana*	I,S

(NIS) = nonindigenous species **COMMON NAME**	**SCIENTIFIC NAME**	**(I)NTERTIDAL (S)UBTIDAL**
hooked red weed	*Bonnemaisonia hamifera*	S
hooked weed	*Hypnea musciformis*	I,S
Irish moss	*Chondrus crispus*	I,S
lacy red weed	*Euthora cristata*	I,S
leaf weed	*Coccotylus truncatus*	S
nori, laver	*Porphyra purpurea*	I
polly	*Polysiphonia subtilissima*	I
polly, pitcher siphon weed	*Polysiphonia stricta*	I,S
polly, twisted siphon weed	*Vertebrata nigra*	I,S
polly, wrack siphon weed	*Polysiphonia lanosa*	S
purple sea hair	*Bangia atropurpurea*	I
red feathers	*Plumaria plumosa*	S
red fern	*Ptilota serrata*	I,S
red puff balls, red tufts	*Spermothamnion repens*	I
red sea skein (NIS)	*Antithamnion pectinatum*	S
rock plant	*Phymatolithon laevigatum*	I,S
rubber threads	*Nemalion elminthoides*	I,S
rusty rock	*Hildenbrandia rubra*	S
sea oak, oak leaf weed	*Phycodrys rubens*	I,S
siphon weed, polly	*Melanothamnus harveyi* (formerly *Neosophonia harveyi*)	I,S
stalked leaf bearer	*Phyllophora pseudoceranoïdes*	S
tufted red seaweed	*Rhodomela confervoides*	I,S
turkish washcloth	*Mastocarpus stellatus*	I,S
wire weed	*Ahnfeltia plicata*	S
worm weed	*Dumontia contorta*	S
	Audouinella sp.	S
	Caloglossa leprieurii	I,S
	Lomentaria baileyana	I,S
(NIS)	*Lomentaria clavellosa*	I,S

Rocky Intertidal Algae Beds

Within the rocky intertidal zones, located primarily at Bluff Point and other headland areas within the proposed CT NERR, exposed boulders often exhibit zonation which appears as distinct color bands (Niering et al. 1978). At the high tide line or splash zone, a black band is formed by microscopic blue-green algae. The mid- to lower-zone of the intertidal may consist of one or more color bands. A typical Southern New England zonation includes the green macroalgae stone hair (*Blidingia marginata*) which is found above the barnacle zone in the high intertidal, nori (*Porphyra purpurea*) a bit deeper in the intertidal at the bottom of the barnacles, and brown macroalgae (*Fucus* sp., *Ascophyllum nodosum*) in the lower intertidal intermingled with green gut weed (*Ulva* sp.) (Van Patten 2009). The typical browns include a few rockweeds and knotted wrack, with tarspot (*Ralfsia verrucosa*) encrusting the rocks in this same zone. Towards the lower end of the intertidal and extending into the subtidal, common species include the red macroalgae, Irish moss (*Chondrus crispus*), and the encrusting rusty rock (*Hildenbrandia rubra*). In areas experiencing nutrient pollution, the lower intertidal may harbor green macroalgae, including sea lettuce (*Ulva* sp.) and green hair (*Cladophora* sp.).

Intertidal Mud and Sand Flats

The major primary producers in these zones are benthic microalgae, including diatoms, euglenoids, dinoflagellates, and cyanobacteria (Latimer et al. 2014). Intertidal mud and sand flats are typically devoid of macroalgae. However, in areas experiencing nutrient pollution, these regions can be coated with macroalgae that may range from less than one inch to more than one feet deep. The most common species seen in these high-nutrient areas include graceful red weed (*Gracilaria* sp.), Aghard's red weed (*Agardhiella subulata*), sea lettuce (*Ulva* sp.), green hair (*Cladophora* sp.), and green thread (*Chaetomorpha linum*). Filamentous red macroalgae may also be found in these areas, especially when small rocks or shells provide a place to attach. Common filamentous red species include banded weed (*Ceramium virgatum*), assorted *Polysiphonia* species, and beaded weed (*Spyridia filamentosa*).

Intertidal Beaches

Due to the mobility of coarse-grained sediments on beaches, macroalgae are typically not present, though some macroalgae wash ashore from deeper areas. The major primary producers in these zones are benthic microalgae, primarily benthic diatoms (Latimer et al. 2014).

Subtidal Hard Bottoms

As with all photosynthetic organisms, macroalgae will occur in areas where sufficient light is available to sustain their growth (Latimer et al. 2014). The macroalgae found in the Reserve spend some portion of their life attached to a substrate via a holdfast, though some species will detach and become drift algae as they mature. While floating rafts of certain species are observed, especially during the summer, these macroalgae are benthic, not free-floating pelagic macroalgae. The most common species of macroalgae occurring in the project area include sea lettuce and gut weed (*Ulva* sp.), stone hair (*Blidingia marginata*), green fleece (*Codium fragile*), Irish moss (*Chondrus crispus*), graceful red weed (*Gracilaria* sp.), Agardh's red weed (*Aghardiella subulata*), the rockweeds (*Fucus* sp.), knotted wrack (*Ascophyllum nodosum*), and kelp (*Saccharina* sp.). In nutrient-rich areas, monocultures of macroalgae may develop; typical species include sea lettuce (*Ulva* sp.), graceful red weed (*Gracilaria* sp.), and a composite of green hair (*Cladophora* sp.), and green thread (*Chaetomorpha linum*) (Latimer et al. 2014). The vascular plant, eelgrass (*Zostera maritima*), can be found in some hard bottom areas (see "submerged aquatic vegetation" below).

Subtidal Soft Bottoms

Very few species of macrophytes colonize the soft bottom areas, the flora in these locations are often dominated by benthic microalgae. The vascular plant, eelgrass (*Zostera marina*), can be found in some soft bottom areas (see section below on "submerged aquatic vegetation" for more on eelgrass). Polly (*Polysiphonia* sp.) species are one of the few macroalgae to colonize mud flats. Other species can be found on soft bottom areas if a few pebbles or shells are available for attachment.

SUBMERGED AQUATIC VEGETATION

The project area hosts two fully submerged higher salinity (> 15 ppt) estuarine vascular plants (Table 5-20): eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*), collectively called seagrass. Dominant species in the lower salinity brackish areas (< 12 ppt), including the Connecticut River, are widgeon grass (*Ruppia maritima*), horned pondweed (*Zannichellia palustris*), and American eelgrass (*Vallisneria americana*) (Twilley and Barko 1990). Submerged aquatic vegetation, including seagrass and its lower salinity water relatives, provides habitat, nursery grounds, and foraging areas for many ecologically and economically important fauna. These beds of plants also function in reducing sediment in the water column and sequester nutrients into the sediment, including carbon sequestration (Latimer et al. 2014). While seagrass beds have been noted for their exceptional carbon sequestration ability (Al-Haj and Fulweiler 2020; Howard et al. 2014; Pendleton et al. 2012), the sequestration rate in Long Island Sound is unknown.

Widgeon grass (*Ruppia maritima*) is predominately found in brackish and freshwater environments and is occasionally found in estuarine waters. Widgeon grass has been an early colonizer of estuarine habitats following reductions of watershed nutrient loads. This transition of species from widgeon grass to eelgrass was observed in Mumford Cove in the early 2000s following the 1987 removal of a wastewater treatment outfall (Vaudrey et al. 2010), and again in a more recent occurrence of widgeon grass in Smith Cove, Niantic River following sewering of the neighboring watershed (Vaudrey 2020). Widgeon grass may also be found in brackish areas of marshes along the Connecticut River and salt marsh pools elsewhere in the proposed CT NERR.

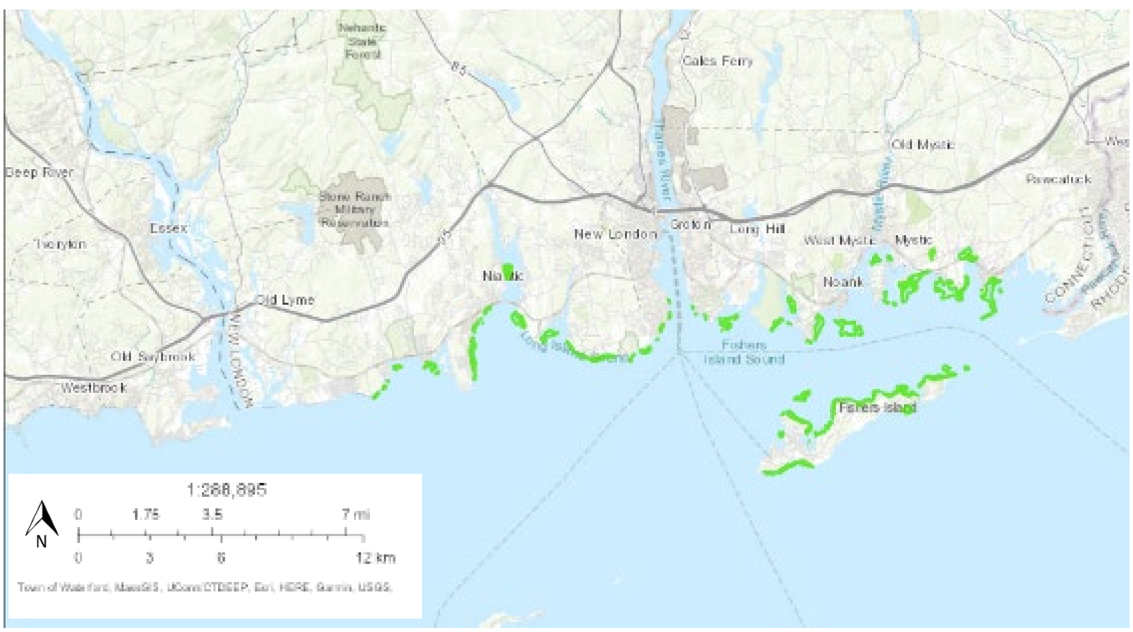


Figure 5-14: Eelgrass Distribution in Connecticut Waters

Location of eelgrass beds along the Connecticut coast and Fishers Island are shown outlined in green, based on the 2017 aerial survey (Bradley and Paton 2018). This map was generated using the online viewer developed as part of the mapping effort, referenced in the mapping report. Grey dashed lines are major navigational channels.

Mapping of Long Island Sound and Fishers Island Sound eelgrass via aerial images is conducted periodically, coordinated by the U.S. Fish and Wildlife Service; surveys were conducted in 2002, 2006, 2009, 2012, and 2017 (Bradley and Paton 2018). Historically, eelgrass meadows were abundant throughout the bays and harbors of Long Island Sound. Today, eelgrass is restricted to the shallow areas of eastern Long Island Sound and Fishers Island Sound, with the western-most occurrence of eelgrass found at the mouth of Clinton Harbor, CT and north of the Duck Island breakwater in Clinton, CT. This western-most occurrence was not captured in the 2017 aerial flights, though the beds still exist (Figure 5-14). Eelgrass requires high light levels and low nutrient enrichment of the water column to thrive, explaining the lack of eelgrass in the western Sound, which is impaired by both higher nutrient loads and lower water clarity when compared to the eastern Sound (Latimer et al. 2014). Based on the 2017 survey, the project area includes 540 acres of eelgrass and Alternatives A and D encompass 53% of Connecticut's eelgrass beds and 37% of Long Island Sound and Fishers Island Sound's (New York plus Connecticut) eelgrass beds. Alternative B lacks eelgrass and Alternative C includes only 12 acres of eelgrass, less than 1% of Connecticut's eelgrass.

The eelgrass of Connecticut is genetically diverse, showing very high clonal richness, indicating that these beds rely on sexual reproduction versus vegetative expansion (Short et al. 2012). When compared to other populations of eelgrass throughout New England, the Connecticut populations are less resilient to stressors such as higher nutrient loads, lower light levels, and warmer temperatures. Short and colleagues (2012) suggested utilizing eelgrass from the southern shore of Long Island in future restoration efforts in Long Island Sound, as the southern Long Island population was more resilient to stress, particularly high temperatures, when compared to the Connecticut population. The populations at Ram Island (south of Noank) and Duck Island (Clinton) were observed to contain private alleles, not found elsewhere in the New England region. Preservation of genetic diversity requires continuing protection of these habitats, as we are still uncertain as to the ecological value of these unique alleles. However, opportunities for increasing eelgrass area through habitat restoration should not detract from the importance of preventing the loss of remaining eelgrass meadows. For example, preservation of an existing seagrass meadow retains 50 times more carbon than new carbon sequestration into barren soil from a restoration project gains (Pendleton et al. 2012).

Threats to estuarine flora include climate change impacts on stress levels and distribution, habitat loss and degradation, pollution, coastal development, human disturbance and collection, invasive species, sea level rise, barrier / dams, and fishing / overfishing. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternative A includes a diverse assemblage of estuarine habitats, including approximately 540 acres of eelgrass beds *(Zostera marina*) with approximately 338 acres included in the core area and approximately 202 acres in the buffer area. In contrast, alternative D includes all of the eelgrass in the core area. The eelgrass and salt marshes in this alternative are not found in Alternatives B and C.

Alternative B lacks the eelgrass and salt marsh found in Alternatives A and D. As this alternative encompasses a smaller area than the other alternatives and has very little rocky shoreline, fewer rocky shoreline seaweed communities are expected.

Alternative C lacks the salt marsh found in Alternatives A and D. This alternative includes three small eelgrass beds on the eastern end (12 acres), included in the core area. As this alternative encompasses a smaller area than the other alternatives and has very little rocky shoreline, fewer rocky shoreline seaweed communities are expected. Alternative C is the only alternative to include the Ragged Rock Creek WMA, one of the largest brackish tidal wetland systems in the Connecticut River estuary with vegetation that is considered relatively intact, i.e., it has suffered the least incursion of common reed (Barrett and Prisloe 2001). This marsh has several populations of native common reed (*Phragmites* sp.). An extensive vegetation study of this property was conducted in 2009 (Moorhead III et al. 2009).

Alternative D includes the same estuarine habitats as found in Alternative A except that all 540 acres of eelgrass are included in the core area. This alternative excludes estuarine areas in restricted zones and the dredged material disposal site in the offshore area; habitats found in these areas are located elsewhere in this alternative.

5.1.3.2 Fauna – By Habitat

The fauna found within the intertidal and coastal areas of the proposed CT NERR are well-documented and described in *A Field Guide to Long Island Sound* (Lynch 2017); which provides a broad overview of the dominant species found in all habitats of the proposed CT NERR, from coastal forests to subtidal areas. The list of terrestrial species was supplemented using a census of New England terrestrial species (DeGraaf and Rudis 1983) and the *National Audubon Society Field Guide to New England* (Alden et al. 1998). For a deeper overview of coastal, estuarine, and marine fauna, refer to *Marine Animals of Southern New England and New York* (Weiss 1995). Additional resources include *Amphibians and Reptiles of Connecticut and Adjacent Regions* (Klemens 1993) and *Connecticut Wildlife: Biodiversity, Natural History, and Conservation* (Hammerson 2004).

5.1.3.2.1 Terrestrial Fauna

The fauna found in terrestrial areas include a variety of mammals, reptiles, amphibians, insects (Table 5-22), and birds (Table 5-23). Many of the species in Table 5-22 are common backyard visitors for southeastern Connecticut, in addition to occurring in larger tracts of natural lands. Mammalian species once extirpated from Connecticut but now increasing in abundance include the bobcat, *Lynx rufus*, and the black bear, *Ursus americanus*; DEEP tracks and provides maps of recent sightings for both of these species (DEEP 2020f; DEEP 2020g). New England cottontail (*Sylvilagus transitionalis*), Connecticut's only native rabbit, has experienced drastic population declines throughout its range over the last several decades but still occurs at Bluff Point (DEEP 2020h). Osprey (*Pandion haliaetus*) and bald eagle (*Haliaeetus leucocephalus*) populations have increased throughout the state – both were impacted by pesticides which led to a drastic decline following World War II (Dreyer and Caplis 2001). There are now more than 400 active osprey nests in Connecticut (Audubon Connecticut 2021) and as of 2010, there were 18 pairs of bald eagles making nesting attempts in the state with more than 100 eagles seen overwintering in Connecticut (DEEP 2010).

Because of the isolation of the Bluff Point peninsula (included in boundary Alternative A and Alternative D), white-tailed deer (*Odocoileus virginianus*) over-population was a problem in the past. Their numbers became so great that vegetation was heavily impacted and starvation of deer became common. By 1995, DEP determined to reduce the population and a series of controlled hunts were used to reduce the herd to the estimated carrying capacity of the area. A public hunt in 1996 and DEEP deer removal efforts after 1996 have successfully reduced the overabundant deer population from 222 deer per square mile to 20 deer per square mile between 1996 and 2001. No action was implemented in January 2002 or 2003. In January 2004, the deer management plan was modified to incorporate a new authority (C.G.S. § 26-3) to increase the efficiency of deer removal activities at Bluff Point. Currently, deer are removed at night by DEEP staff to maintain the deer herd at 20 deer per square mile. Beyond current deer removal efforts by DEEP staff, no public hunting is allowed in the Haley Farm State Park, Bluff Point complex, or Pine Island areas included in Alternative A *and* Alternative D*.*

Table 5-22 lists a very few common invertebrates; many more insects, spiders, worms, and other varieties of invertebrates are found within the proposed CT NERR area. Focusing on just earthworms as an example of the potential impact of invertebrates, the vast majority of earthworms found in Connecticut are invasive and are having a detrimental impact on forest ecology via their consumption of organic rich material in the soil (Dobson 2020; McCay and Scull 2019). A few native species are noted (Table 5-22), as these worms tend to be found in association with streams, ponds, lakes, wetlands, springs, or saturated soils – habitats found within the proposed CT NERR, though their presence in the reserve is unknown.

Invasive insects tracked and managed by DEEP include the emerald ash borer (*Agrilus planipennis*) which can be found throughout most of the state; this species was first detected in Connecticut in 2012 (DEEP 2020e). As this species is considered established in North America, efforts focus on slowing the spread into new areas and reducing population numbers, rather than eradication. The state is actively looking for the Asian longhorned beetle (*Anoplophora glabripennis*). Although not yet detected in Connecticut, this species is found in both New York and Massachusetts. The Asian longhorned beetle is an insect of federal regulatory concern; this status obligates the federal government to take direct action in partnership with the state and other local partners to contain and eradicate the pest. Other invasive insects in Connecticut include the gypsy moth (*Lymantria dispar*), Japanese beetle (*Popillia japonica*), the hemlock wooly adelgid (*Adelges tsugae*), and the European elm bark beetle (*Scolytus multistriatus*). DEEP manages invasive species in all state parks and as the landowner of many of the properties included in the proposed CT NERR, would continue with this activity if the NERR is designated.

Threats to terrestrial fauna include climate change impacts on stress levels, habitat loss and fragmentation, habitat degradation, pollution, coastal development, human disturbance, and invasive species. Hunting impacts prey species directly, but is managed by DEEP to preserve sustainable populations. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternative A includes the Bluff Point complex of properties, where over 200 bird species have been seen, including a number that are uncommon in Connecticut. Many of these uncommon species occur in migration, when Bluff Point acts as a landfall in the spring and a land trap in the fall. The result is that it attracts a wide species diversity and large numbers of individual birds. There is also a great diversity of nesting species, thanks to the variety of habitat types near one another. The Connecticut River marshes included in the proposed CT NERR are Wetlands of International Importance under the Ramsar Convention (Dreyer and Caplis 2001; USFWS 1994), providing habitat for resident bird species and migrants. Cruises along the Connecticut River allow birdwatchers and tourists to witness the massive congregations of tree swallows (*Tachycineta bicolor*) in August as they take a break from their migration and bald eagles (*Haliaeetus leucocephalus*) may be seen along the shoreline in February and March, eating fish caught in the River. Cruise participants may spot as many as 40 eagles as they make their way up the River, as well as sight seals. While less information is available for other vertebrates and invertebrates within the project area, the tracts of upland coastal forests and shrublands included in these two alternatives and absent from Alternatives B and D likely host a greater diversity of fauna.

Alternative B lacks the important bird area of Bluff Point included in Alternative A. This alternative includes more properties within the Connecticut River Ramsar wetlands, consisting mainly of brackish and freshwater marsh, but lacking the salt marsh of Alternative A. This alternative includes the forested area of Machimoodus State Park, including floodplain forest, but lacks the coastal forested shoreline and coastal shrublands found in Alternative A. The reduction in forest area and exclusion of salt marsh may translate to lower populations or less diversity of other vertebrates and invertebrates typically found in these habitats.

Alternative C includes properties included in Alternative B and thus lacks the important bird area of Bluff Point included in Alternative A. This site includes more properties within the Connecticut River Ramsar wetlands but lacks the freshwater wetlands, floodplain forest, and forest found in Alternative B. This alternative's terrestrial properties are dominated by brackish marshes, which reduces the diversity of species likely to be found in this area relative to Alternative A (with salt marsh and brackish marsh) and Alternative B (with brackish marsh and freshwater marsh).

Alternative D matches the properties included in Alternative A with the addition of Pine Island, a small island. The habitats found in Pine Island are found elsewhere in this alternative, so species composition and abundance should be similar to Alternative A.

At Haley Farm State Park. Photo credit: Eastern Chipmunk - Birdsong? Nope, just another Chipmunk, by Corey Leamy. https://www.flickr.com/photos/ctnerr/ (CC BY-NC 2.0)

Table 5-22: Terrestrial Vertebrates and Invertebrates

Sample of common and rare terrestrial vertebrates and invertebrates found in southeastern Connecticut, grouped by taxonomic phylum and sorted by common name. Birds are presented in a separate list (Table 5-23, page 154). This list does not include sea turtles, referring to turtles that spend a large portion of their life at sea; sea turtles are included in the marine fauna (Table 5-26, page 164). Taxonomic names were verified using the *Mammal Diversity Database* (Mammal Diversity Database 2021) and *ITIS (Integrated Taxonomic Information System)* (ITIS 2021). Many more invertebrates are found in southeastern Connecticut, only a few common seaside species of insects and arachnids are presented. Asterisks (*) indicate status in the Connecticut Wildlife Action Plan (CT-WAP), using the key in the Table headings (DEEP 2016a). State Status is designated by letters, where SSC = State Special Concern; no species presented here are listed as State Threatened or Endangered (DEEP 2015a). Two species of turtles are Federally listed as At Risk. Invasive worms were noted in Dobson (2020).

* = important in CT-WAP ** = very important in CT-WAP *** = most important in CT-WAP **COMMON NAME**	SSC = State Special Concern INV = invasive **SCIENTIFIC NAME**	**STATUS**
Phylum Chordata, Class Mammalia = mammals		
American red squirrel	*Tamiasciurus hudsonicus*	
big brown bat	*Eptesicus fuscus*	***
eastern chipmunk	*Tamias striatus*	
eastern cottontail	*Sylvilagus floridanus*	
eastern coyote	*Canis latrans*	
gray squirrel	*Sciurus carolinensis*	
long-tailed weasel	*Mustela frenata*	*
meadow vole	*Microtus pennsylvanicus*	
muskrat	*Ondatra zibethicus*	*
raccoon	*Procyon lotor*	
red fox	*Vulpes vulpes*	
southern flying squirrel	*Glaucomys volans*	
striped skunk	*Mephitis mephitis*	
Virginia opossum	*Didelphis virginiana*	
white-footed mouse	*Peromyscus leucopus*	
white-tailed deer	*Odocoileus virginianus*	
woodchuck (groundhog)	*Marmota monax*	
Phylum Chordata, Class Amphibia = frogs, toads, salamanders		
bullfrog	*Rana catesbeiana*	
eastern American toad	*Bufo americanus*	
four toed salamander	*Hemidactylium scutatum*	
gray treefrog	*Hyla versicolor*	*
green frog	*Rana clamitans*	
marbled salamander	*Ambystoma opacum*	*
northern dusky salamander	*Desmognathus fuscus*	*
northern leopard frog	*Rana pipiens*	SSC **
northern spring peeper	*Pseudacris crucifer*	
northern two-lined salamander	*Eurycea bislineata*	

* = important in CT-WAP ** = very important in CT-WAP *** = most important in CT-WAP **COMMON NAME**	SSC = State Special Concern INV = invasive **SCIENTIFIC NAME**	**STATUS**
pickerel frog	*Rana palustris*	
redback salamander	*Plethodon vehiculum*	
red-spotted newt	*Notophthalmus viridescens*	
spotted salamander	*Ambystoma maculatum*	
wood frog	*Rana sylvatica*	*
Phylum Chordata, Class Reptilia, Order Testudines = turtles		
common snapping turtle	*Chelydra serpentina*	
diamondback terrapin	*Malaclemys terrapin*	SSC *
eastern box turtle	*Terrapene carolina*	SSC **
eastern painted turtle	*Chrysemys picta*	
spotted turtle	*Clemmys guttata*	Federal At Risk SSC **
stinkpot, common musk turtle	*Sternotherus odoratus*	
wood turtle	*Glyptemys insculpta*	Federal At Risk SSC **
Phylum Chordata, Class Reptilia, Order Squamata = snakes		
black rat snake	*Pantherophis obsoletus*	
eastern garter snake	*Thamnophis sirtalis*	
eastern milksnake	*Lampropeltis triangulum*	
eastern racer	*Coluber constrictor*	*
eastern ribbon snake	*Thamnophis saurita*	SSC **
eastern smooth green snake	*Opheodrys vernalis*	SSC *
eastern worm snake	*Carphophis amoenus*	
northern brown snake	*Storeria dekayi*	
northern copperhead	*Agkistrodon mokeson*	*
northern redbelly snake	*Storeria occipitomaculata*	
northern ringneck snake	*Diadophis punctatus edwardsii*	
northern water snake	*Nerodia sipedon*	
Phylum Arthropoda, Class Arachnida = spiders, scorpions, ticks, mites		
American dog tick	*Dermacentor variabilis*	
blacklegged tick, deer tick	*Ixodes scapularis*	
lone star tick	*Amblyomma americanum*	
daddy-long-legs	*Leiobunum*	
wolf spider	*Hogna carolinensis*	
yellow garden spider	*Argiope aurantia*	
daring jumping spider	*Phidippus audax*	
Phylum Arthropoda, Class Insecta = insects		
black field cricket	*Gryllus* sp.	

* = important in CT-WAP ** = very important in CT-WAP *** = most important in CT-WAP **COMMON NAME**	SSC = State Special Concern INV = invasive **SCIENTIFIC NAME**	**STATUS**
black saddlebags dragonfly	*Tramea lacerata*	
common green darner dragonfly	*Anax junius*	
greenhead fly	*Tabanus* sp.	
marsh ground cricket	*Neonemobius palustris*	
monarch butterfly	*Danaus plexippus*	*
mosquitos	*Culicidae* sp.	
salt marsh grasshopper	*Conocephalus spartinae*	
seaside dragonlet	*Erythrodiplax berenice*	
seaside grasshopper	*Trimerotropis maritima*	
Phylum Annelida, Class Clitellata = tube worms, earthworms, leeches		
earthworm, night crawler	*Lumbricidae* Family	INV
jumping worms	*Megascolecidae* Family	INV
American barkworm	*Bimastos parvus*	
no common name	*Bimastos tumidus*	
American grey soil worm	*Eisenoides lonnbergi*	
American mud worm	*Sparganophilus tamesis*	

Table 5-23: Common Birds Within the Project Area

Birds commonly found in the project area with significant use in two categories (breeding, migrant, winter). Birds are in the Phylum *Chordata*, Class *Aves* and are grouped by Family in this list. Taxonomic names and nonindigenous species (NIS) were verified in *Avibase* (Lepage 2021). Asterisks (*) are used after the common name to indicate status in the Connecticut Wildlife Action Plan (CT-WAP), using the key in the Table headings. State Status is designated by letters, where SSC = State Special Concern, ST = State Threatened, SE = State Endangered. Species federally listed as At Risk (1 species), Threatened (1 species), and Endangered (1 species) are noted next to the common names. Birds listed in the Migratory Bird Treaty Act (MBTA) are fully described in *Section 5.1.3.3.3* (page 201); species in this table covered by the Migratory Bird Treaty Act are noted with an ^{M} following the common name.

CT-WAP status: * = important ** = very important *** = most important **COMMON NAME**	^{SSC} = State Special Concern ST = State Threatened ^{SE} = State Endangered ^{M} = MBTA listed species within the project area **SPECIES**	**USE OF AREA** **BREEDING**	**MIGRANT**	**WINTER**
Family Gaviidae = loons				
common loon* $^{SSC\ M}$	*Gavia immer*		significant	significant
red-throated loon ^{M}	*Gavia stellata*		significant	significant
Family Podicipedidae = grebes				
horned grebe	*Podiceps auritus*		significant	significant

CT-WAP status: * = important ** = very important *** = most important **COMMON NAME**	SSC = State Special Concern ST = State Threatened SE = State Endangered M = MBTA listed species within the project area **SPECIES**	**USE OF AREA**		
		BREEDING	**MIGRANT**	**WINTER**
Family Phalacrocoracidae = cormorants				
double-crested cormorant M	*Phalacrocorax auritus*	significant	significant	present
great cormorant	*Phalacrocorax carbo*		significant	significant
Family Ardeidae = herons, egrets, bitterns				
American bittern** SE	*Botaurus lentiginosus*	possible	significant	significant
least bittern** ST	*Ixobrychus exilis*	significant	significant	
Family Anatidae = ducks, geese, swans				
American black duck**	*Anas rubripes*	significant	significant	significant
common eider M	*Somateria mollissima*	possible	significant	significant
common merganser	*Mergus merganser*		significant	significant
greater scaup**	*Aythya marila*		significant	significant
long-tailed duck M	*Clangula hyemalis*		significant	significant
surf scoter* M	*Melanitta perspicillata*		significant	significant
white-winged scoter** M	*Melanitta deglandi*		significant	significant
wood duck	*Aix sponsa*	present	significant	present
Family Rallidae = rails, gallinules, coots				
clapper rail** M	*Rallus crepitans*	significant	significant	rare
king rail** SE-nesting	*Rallus elegans*	significant	significant	rare
Family Haematopodidae = oystercatchers				
American oystercatcher** ST M	*Haematopus palliatus*	significant	significant	rare
Family Charadriidae = plovers				
piping plover*** ST *(Federal-Threatened)*	*Charadrius melodus*	significant	significant	
Family Scolopacidae = sandpipers, phalaropes, dowitchers				
American woodcock***	*Scolopax minor*	significant	significant	rare
dunlin M	*Calidris alpina*		significant	significant
purple sandpiper M	*Calidris maritima*		significant	significant
sanderling**	*Calidris alba*		significant	significant
spotted sandpiper	*Actitis macularius*	significant	significant	
willet* M	*Tringa semipalmata*	significant	significant	
Family Laridae = gulls, terns, skuas, jaegers				
common tern* SSC M	*Sterna hirundo*	significant	significant	
herring gull M	*Larus argentatus*	significant	significant	present
least tern*** ST M	*Sternula antillarum*	significant	significant	

CT-WAP status: * = important ** = very important *** = most important COMMON NAME	SSC = State Special Concern ST = State Threatened SE = State Endangered M = MBTA listed species within the project area SPECIES	USE OF AREA		
		BREEDING	MIGRANT	WINTER
roseate tern*** SE M *(Federal-Endangered)*	*Sterna dougallii*	significant	significant	
Family Accipitridae = hawks, kites, eagles				
bald eagle* ST M	*Haliaeetus leucocephalus*	significant	significant	significant
northern harrier*** SE	*Circus hudsonius*	possible	significant	significant
Family Pandionidae = osprey				
osprey*	*Pandion haliaetus*	significant	significant	rare
Family Falconidae = caracara, falcons				
peregrine falcon* ST	*Falco peregrinus*	significant	significant	present
Family Strigidae = true owls				
snowy owl M	*Bubo scandiacus*		significant	significant
Family Alcedinidae = kingfishers				
belted kingfisher	*Megaceryle alcyon*	significant	significant	significant
Family Tyrannidae = tyrant flycatchers				
willow flycatcher*	*Empidonax traillii*	significant	significant	
Family Alaudidae = larks				
horned lark*** SE	*Eremophila alpestris*	possible	significant	significant
Family Troglodytidae = wrens				
marsh wren**	*Cistothorus palustris*	significant	significant	rare
Family Emberizidae = towhees, sparrows				
eastern towhee**	*Pipilo erythrophthalmus*	significant	significant	present
saltmarsh sharp-tailed sparrow*** SSC *(Federal At Risk)*	*Ammospiza caudacuta*	significant	significant	rare
Savannah sparrow* SSC	*Passerculus sandwichensis*		significant	significant
seaside sparrow** ST M	*Ammospiza maritima*	significant	significant	rare
swamp sparrow	*Melospiza georgiana*	significant	significant	present
Family Icteridae = blackbirds, orioles				
common grackle	*Quiscalus quiscula*	significant	significant	significant
red-winged blackbird	*Agelaius phoeniceus*	significant	significant	significant
rusty blackbird M	*Euphagus carolinus*		significant	significant
Family Calcariidae = longspurs, snow buntings				
snow bunting	*Plectrophenax nivalis*		significant	significant

5.1.3.2.2 Riparian and Freshwater Fauna

Terrestrial species are often found at the edges of riparian and freshwater habitats, as these habitats are a vital source of freshwater for most species (Tables 5-22 and 5-23). Some groups of animals, such as the freshwater turtles, can be found on land and in the water (Table 5-22). A few of the common freshwater invertebrates are listed in Table 5-24. A number of freshwater species of fish are found in the Connecticut River, its tributaries, and marshes (Table 5-25).

The freshwater marshes are habitats for a variety of animals, such as the bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), northern harrier (*Circus* sp.), American bittern (*Botaurus* sp.), and northern diamondback terrapin (*Malaclemys terrapin terrapin*). The freshwater marshes included in the proposed CT NERR are particularly important as both a movement corridor and migratory stopover for numerous avian species, especially waterfowl, and in particular, American black duck (*Anas rubripes*). Here, the river and marshes provide open-water wintering habitat when many inland areas are frozen over.

Invasive species are tracked and managed by DEEP (DEEP 2020d). Freshwater invasives of concern in Connecticut include the zebra mussel (*Dreissena polymorpha*), quaqqa mussel (*Dreissena bugensis*), rusty crayfish (*Orconectes rusticus*), Chinese mitten crab (*Eriocheir sinensis*), and New Zealand mud snail (P*otamopyrgus antipodarum*). None of these species have been observed in the proposed CT NERR (DEEP n.d.-a; USGS 2021b; USGS 2021c). The Asian clam (*Corbicula fluminea*) is a freshwater invasive of concern to DEEP that has been observed in the lower Connecticut River (USGS 2021b). The *USGS Nonindigenous Aquatic Species Database* lists additional nonindigenous species found within or neighboring the proposed CT NERR (USGS 2021b). These species may not rise to the level of invasive for DEEP if they are not causing undue harm to the environment. Nonindigenous species of exotic origin within the area include one jellyfish (freshwater jellyfish, *Craspedacusta sowerbyi*), one mollusk (Chinese mystery snail, *Cipangopaludina chinensis*), and a variety of fish (red-bellied pacu (*Piaractus brachypomus*), unidentified piranha (*Pygocentrus* sp. or *Serrasalmus* sp.), Jack Dempsey (*Rocio octofasciata*), goldfish (*Carassius auratus*), common carp (*Cyprinus carpio*), zebra danio (*Danio rerio*), ide (*Leuciscus idus*), suckermouth catfish (*Hypostomus* sp.), Siamese fighting fish (*Betta splendens*), guppy (*Poecilia reticulata*), and brown trout (*Salmo trutta*)).

Threats to riparian and freshwater fauna include climate change impacts on stress levels, habitat loss and degradation, pollution, coastal development, human disturbance, and invasive species. Fishing impacts prey species directly, but is managed by DEEP to preserve sustainable populations. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternative A lacks the extensive freshwater marshes and freshwater portion of the Connecticut River of Alternative B. Thus, fewer populations of freshwater vertebrates and invertebrates may be expected. Freshwater ponds and streams are present, especially in the eastern properties (Haley Farm State Park and the Bluff Point complex); but these areas are small in comparison to the freshwater portions of the Connecticut River and Salmon River included in Alternative B.

Alternative B includes extensive freshwater marshes and freshwater portions of the Connecticut River and Salmon River not included in the other alternatives. More populations of freshwater vertebrates and invertebrates are expected, and diversity of species may also be greater. This option lacks the freshwater habitats found in the eastern properties (Haley Farm State Park and the Bluff Point complex). However, these areas are small in comparison to what is found in this alternative.

Alternative C contains very little freshwater compared to the other alternatives. This alternative lacks the freshwater portion of the Connecticut River and Thames River, as well as the smaller contribution of freshwater habitats in the eastern properties (Haley Farm State Park and the Bluff Point complex). While freshwater streams feed the marshes in this alternative, the marshes are largely characterized as brackish, indicating some input of seawater.

Alternative D is the same as Alternative A, in this category.

Table 5-24: Common Freshwater Invertebrates

A few common aquatic invertebrates found in southeastern Connecticut. Crayfish listed have been observed in the area of the proposed CT NERR (DEEP n.d.-a). Riffle-dwelling invertebrates include species that are most commonly observed in DEEP's Riffle Bioassessment by Volunteers program (DEEP 2013). Taxonomic names were verified in *ITIS (Integrated Taxonomic Information System)* (ITIS 2021). Species were confirmed as indigenous species using the *USGS Nonindigenous Aquatic Species Database* (USGS 2021a). None of the species included are federally or state listed endangered or threatened species.

COMMON NAME	SCIENTIFIC NAME
Common Freshwater Inhabitants	
freshwater leech	*Macrobdella decora*
calico crayfish	*Faxonius immunis*
spiny-cheek crayfish	*Faxonius limosus*
White River crayfish	*Procambarus acutus*
Common Riffle-Dwelling Invertebrates (often nymphs or larvae)	
riffle beetle	*Elmidae* Family
water penny beetle	*Psephenidae* Family
midge fly	*Chironomidae* Family
black fly	*Simulium nigricoxum*
flat headed mayfly	*Spinadis simplex*
dobsonfly or hellgrammite	*Corydalus cornutus*
darner dragonfly, riffle darner	*Oplonaeschna armata*
club tail dragonfly	*Gomphidae* Family
common stonefly	*Paragnetina media*
saddle case maker caddisfly	*Glossosomatidae* Family
common netspinner caddisfly	*Hydropsychidae* Family
scud or sideswimmer	*Amphipoda* Order

Table 5-25: Fish of Southeastern Connecticut and Long Island Sound

Fish are divided by habitat where they are found: freshwater, diadromous, and seawater. Diadromous refers to fish that spend part of their lifecycle in freshwater and part in seawater. Some fish classified here as seawater can tolerate lower salinities found in brackish waters and in some cases, can tolerate freshwater. Examples are the mummichogs and killifish. The seawater fish are further divided into bony fish and cartilaginous fish (sharks, skates, rays). Taxonomic names were verified in *Fishbase* (Froese and Pauly 2020). Species Federally listed as Endangered (2 species) are noted under status. Asterisks (*) are used to indicate status in the Connecticut Wildlife Action Plan (CT-WAP), using the key in the Table headings. State Status is designated by letters, where SSC = State Special Concern, ST = State Threatened, SE = State Endangered. Nonindigenous species (NIS) were confirmed in the *USGS Nonindigenous Aquatic Species Database* (USGS 2021c).

CT-WAP status: * = important ** = very important *** = most important **COMMON NAME**	SSC = State Special Concern ST = State Threatened SE = State Endangered NIS = nonindigenous species **SPECIES**	**STATUS**
Superclass Osteichthyes = bony fish; habitat = freshwater fish		
black crappie	*Pomoxis nigromaculatus*	
brown bullhead	*Ameiurus nebulosus*	
brown trout	*Salmo trutta*	*** NIS
chain pickerel	*Esox niger*	**
channel catfish	*Ictalurus punctatus*	
common carp	*Cyprinus carpio*	NIS
gizzard shad	*Dorosoma cepedianum*	
golden shiner	*Notemigonus crysoleucas*	*
largemouth bass	*Micropterus salmoides*	*
pumpkinseed	*Lepomis gibbosus*	*
redbreast sunfish	*Lepomis auritus*	*
redfin pickerel	*Esox americanus*	
spottail shiner	*Notropis hudsonius*	
white catfish	*Ameiurus catus*	
white perch	*Morone americana*	
white sucker	*Catostomus commersonii*	*
yellow perch	*Perca flavescens*	*
Superclass Osteichthyes = bony fish; habitat = diadromous fish		
alewife	*Alosa pseudoharengus*	***
American eel	*Anguilla rostrata*	***
American shad	*Alosa sapidissima*	**
Atlantic salmon	*Salmo salar*	**
Atlantic sturgeon	*Acipenser oxyrinchus*	*Federal-Endangered* SE ***
blueback shad, blueback herring	*Alosa aestivalis*	SSC ***
hickory shad	*Alosa mediocris*	**
sea lamprey	*Petromyzon marinus*	**

CT-WAP status: * = important ** = very important *** = most important **COMMON NAME**	SSC = State Special Concern ST = State Threatened SE = State Endangered NIS = nonindigenous species **SPECIES**	**STATUS**
shortnose sturgeon	*Acipenser brevirostrum*	*Federal-Endangered* SE ***
Superclass Osteichthyes = bony fish; habitat = marine fish		
American fourspot flounder	*Hippoglossina oblonga*	
American sand lance (sand eel)	*Ammodytes americanus*	**
Atlantic bonito	*Sarda sarda*	
Atlantic butterfish	*Peprilus triacanthus*	
Atlantic cod	*Gadus morhua*	
Atlantic herring	*Clupea harengus*	*
Atlantic menhaden (bunker)	*Brevoortia tyrannus*	*
Atlantic moonfish	*Selene setapinnis*	
Atlantic silverside	*Menidia menidia*	*
Atlantic Spanish mackerel	*Scomberomorus maculatus*	
banded killifish	*Fundulus diaphanus*	
black seabass	*Centropristis striata*	*
bluefish	*Pomatomus saltatrix*	
crevalle jack	*Caranx hippos*	
cunner	*Tautogolabrus adspersus*	**
lined seahorse	*Hippocampus erectus*	*
little tunny	*Euthynnus alletteratus*	
longhorn sculpin	*Myoxocephalus octodecemspinosus*	
mummichog	*Fundulus heteroclitus*	**
northern pipefish	*Syngnathus fuscus*	*
northern searobin	*Prionotus carolinus*	*
pelagic butterfish	*Schedophilus maculatus*	
red hake	*Urophycis chuss*	*
red lionfish	*Pterois volitans*	
scup, northern porgy	*Stenotomus chrysops*	*
sea raven	*Hemitripterus americanus*	**
sergeant major	*Abudefduf saxatilis*	
sheepshead minnow	*Cyprinodon variegatus*	*
spot croaker	*Leiostomus xanthurus*	
spotfin butterflyfish	*Chaetodon ocellatus*	
striped bass	*Morone saxatilis*	*
striped killifish	*Fundulus majalis*	
summer flounder	*Paralichthys dentatus*	
tautog, blackfish	*Tautoga onitis*	***

CT-WAP status: * = important ** = very important *** = most important **COMMON NAME**	SSC = State Special Concern ST = State Threatened SE = State Endangered NIS = nonindigenous species **SPECIES**	 **STATUS**
three-spined stickleback	*Gasterosteus aculeatus*	*
weakfish	*Cynoscion regalis*	*
windowpane flounder	*Scophthalmus aquosus*	**
winter flounder	*Pseudopleuronectes americanus*	***
yellow jack	*Carangoides bartholomaei*	
Class Chondrichthyes = cartilaginous fish = sharks, skates rays; habitat = marine fish		
barndoor skate	*Dipturus laevis*	
bullnose eagle ray	*Myliobatis freminvillei*	
cownose ray	*Rhinoptera bonasus*	
dusky shark	*Carcharhinus obscurus*	
little skate	*Leucoraja erinacea*	
sand tiger shark	*Carcharias taurus*	SSC *
sandbar shark	*Carcharhinus plumbeus*	*
smooth dogfish	*Mustelus canis*	*
spiny dogfish, picked dogfish	*Squalus acanthias*	
winter skate	*Leucoraja ocellata*	*

5.1.3.2.3 Estuarine Fauna

The estuarine environment encompasses the areas touched by saltwater, ranging from the intertidal marshes and beaches down to the depths of Long Island Sound. This area encompasses different substrates, ranging from hard- to soft-bottoms and includes both the benthos and the water column. The diversity of life found in these areas is well-represented in *Marine Animals of Southern New England and New York* (Weiss 1995).

Marine mammals such as seals, porpoises, dolphins, and humpback whales have been observed foraging in and transiting through the area (see *Section 5.1.3.3.1.3*, page 192 for more on marine mammals). Rock clumps within the Reserve and along the shorelines of Fishers Island, NY provide hauling out spots for large congregations of seals during the winter. Sea turtles such as loggerheads (*Caretta caretta*) and green turtles (*Chelonia mydas*) also visit The Sounds (Table 5-26).

Wetlands throughout southeastern Connecticut provide vital breeding, foraging, resting, and migratory pathways for rare and diverse bird species. Prominent species include the American black duck (*Anas rubripes*), mallard (*Anas platyrhynchos*), mute swan (*Cygnus olor*), Virginia rail (*Rallus limicola*), piping plover (*Charadrius melodus*), osprey (*Pandion haliaetus*), snowy egret (*Egretta thula*), and bald eagle (*Haliaeetus leucocephalus*) (Table 5-23).

The lower Connecticut River contains the highest fish diversity in the region, in part due to the nutrient rich interface between freshwater and saltwater. Over seventy species of fish have been documented in the area (Table 5-25) including freshwater residents like largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), and white catfish (*Ameiurus catus*); estuarine species such as striped bass (*Morone saxatilis*), bluefish (*Pomatomus saltatrix*), winter flounder (*Pseudopleuronectes americanus*), and cunner (*Tautogolabrus adspersus*); and diadromous species such as Atlantic salmon (*Salmo salar*), American shad (*Alosa sapidissima*), and the federal and state endangered shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*). Forage fish, fast-growing species which form the main diet of larger fish, include American menhaden (*Brevoortia tyrannus*), Atlantic butterfish (*Peprilus triacanthus*), and blueback herring (*Alosa aestivalis*). Saltwater marshes see large congregations of minnows, including the migratory Atlantic silverside (*Menidia menidia*) and local residents like mummichogs and killifish (*Fundulus* sp.). Saltwater intertidal flats provide a spawning and nursery area for winter flounder (*Pseudopleuronectes americanus*), as well as other finfish and shellfish. Seagrass beds and macroalgae flats provide habitat for northern pipefish (*Syngnathus fuscus*) and lined seahorse (*Hippocampus erectus*). The offshore area serves as nursery grounds for nearly three dozen species of fish; a migration area for eight diadromous fish species, and a concentration area for eight fish species (Barrett 2014).

Invertebrates can be found from the intertidal to the offshore (Table 5-27). A variety of crabs are present, including green crabs (*Carcinus maenas*), blue crabs (*Callinectes sapidus*), and hermit crabs (*Pagurus* sp.). Many of these are being displaced by the Asian shore crab (*Hemigrapsus sanguineus*) (Latimer et al. 2014). The horseshoe crab (*Limulus polyphemus*), actually an arthropod, makes its home around the shores and marshes, laying eggs along some of The Sounds' beaches during the late spring and early summer (Sacred Heart University 2021).

Boulder and gravel areas are the most spatially complex habitats. These areas range in structure from large piles of boulders to flat pavements of small cobbles and pebbles. The relative stability of rock substrates provides a home for many encrusting (including cold water corals) and mobile organisms, and the crevices between and under boulders provide cover from predators and refuge from swift currents. These areas are well known for their populations of tautog (*Tautoga onitis*) and other rock-associated fish species. These hardbottom and rocky reef habitats support a variety of seaweed species and are colonized by diverse marine invertebrates – from the mobile echinoderms, cnidarians, and mollusks to the sessile sponges and tunicates. These habitats attract mature striped bass (*Morone saxatilis*) and a wide variety of other gamefish and forage species. Extensive shell bottom (e.g. *Crepidula* sp.) areas may occur adjacent to these hard bottom habitats.

The commercially important northern lobster (*Homarus americanus*), eastern oyster (*Crassostrea virginica*), and northern quahog (*Mercenaria mercenaria*) use estuarine areas as nursery and spawning grounds. Natural oyster beds (109 acres) are located in the lower Connecticut River. Lobster (*Homarus americanus*) were once a commercially important species in The Sounds, but declines in the population since 2003 have caused the local collapse of this fishery. The decline has been attributed to warmer temperatures directly affecting the lobsters (they do better in cool waters) coupled with increased populations of warmer tolerant fish that feed on lobster (LISS 2021c). Eastern oyster (*Crassostrea virginica*) and northern quahog (*Mercenaria mercenaria*) are harvested directly from Long Island Sound and Fishers Island Sound, both recreationally and commercially, and grown as part of aquaculture efforts (DA/BA 2021; LISS 2021d). The bay scallop is not currently harvested commercially in The Sounds, though a recreational fishery still exists. The Niantic River has been dubbed "The Scallop Estuary" based on a once-thriving scallop harvest (Marshall 1960; Marshall 1994).

Certain invasive species are tracked and managed by DEEP (DEEP 2020d). Saltwater invasives of concern in Connecticut include the Chinese mitten crab (*Eriocheir sinensis*) which has been found in Fairfield

County, with no sightings in the area of the proposed CT NERR (USGS 2021b). The *USGS Nonindigenous Aquatic Species Database* lists additional nonindigenous species found within or neighboring the proposed CT NERR (USGS 2021b). Additional nonindigenous estuarine species of exotic origin within the proposed CT NERR include: Asian shore crab (*Hemigrapsus sanguineus*) and green crab (*Carcinus maenas*). The common periwinkle (*Littorina littorea*) has been identified as invasive in the northwestern Atlantic (CABI 2021). The periwinkle arrived in Long Island Sound around 1880 and now dominates portions of the intertidal zone, displacing the native mud snail (*Ilyanassa obsoleta*) (Brenchley and Carlton 1983).

Threats to estuarine fauna include climate change, habitat loss and degradation (including that due to renewable energy development and transmission infrastructure), pollution, marine debris, coastal development, human disturbance, and invasive species. Fishing impacts prey species directly, but is managed by DEEP and regional fishery councils to preserve sustainable populations. Efforts are underway to seek better regulation of some forage species that may not be commercially important in and of themselves, but are important for supporting populations of commercially or recreationally important species. With large marine commercial fisheries, bycatch is a threat to some species, as is entanglement. Anadromous fish are especially threatened by barriers as they journey between freshwater and the marine environment. Vessel strikes also impact marine mammals and some larger species of fish. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternative A includes habitats that support all of the species mentioned in this section. The rock clumps favored by seals are located in the eastern portion of these alternatives.

Alternative B lacks the seagrass habitats found in the eastern portion of the project area, in Alternative A; northern pipefish and lined seahorse, which favor seagrass habitats, may be less prevalent. Alternative B also lacks commercial and recreational shellfish areas, as designated by the state and towns, though includes the 109 acres of natural shellfish beds located in the lower Connecticut River (also in Alternative A). Seals will be less frequent visitors to these areas because of the lack of rock clumps and small islands within these alternatives. The absence of rocky intertidal in the Connecticut River also limits the distribution of typical inhabitants of this habitat.

Alternative C is the same as Alternative B, for these species.

Alternative D is the same as Alternative A, for these species.

Table 5-26: Sea Turtles of Long Island Sound

A few species of sea turtles can be found visiting Long Island Sound and Fishers Island Sound. Taxonomic names were verified in the *WoRMS (World Register of Marine Species)* database (WoRMS Editorial Board 2021). Species Federally listed as Endangered or Threatened are noted. Asterisks (*) are used to indicate status in the Connecticut Wildlife Action Plan (CT-WAP), using the key in the Table headings. State Status is designated by letters, where ST = State Threatened, SE = State Endangered.

ST = State Threatened SE = State Endangered **COMMON NAME**	** = very important in CT-WAP *** = most important in CT-WAP **SCIENTIFIC NAME**	**FEDERALLY LISTED SPECIES**	**OTHER STATUS**
green turtle	*Chelonia mydas*	threatened	ST **
Kemp's ridley, Atlantic ridley	*Lepidochelys kempii*	endangered	SE ***
leatherback sea turtle	*Dermochelys coriacea*	endangered	SE ***
loggerhead sea turtle	*Caretta caretta*	threatened	ST **

Table 5-27: Common Saltwater Invertebrates

A few common estuarine and marine invertebrates found in southeastern Connecticut. Taxonomic names were verified in the *WoRMS (World Register of Marine Species)* database (WoRMS Editorial Board 2021). Species are grouped by Phylum. Asterisks (*) are used after the common name to indicate status in the Connecticut Wildlife Action Plan (CT-WAP), using the key in the Table headings. None of the species included are Federally-listed nor State-listed species (SSC = State Special Concern, ST = State Threatened, SE = State Endangered). Nonindigenous species (NIS) were confirmed in the *USGS Nonindigenous Aquatic Species Database* (USGS 2021a) and *CABI Invasive Species Compendium* (CABI 2021).

* = important in CT-WAP ** = very important in CT-WAP *** = most important in CT-WAP **COMMON NAME**	NIS = nonindigenous species **SPECIES**	**STATUS**
Phylum Annelida = segmented worms		
American bloodworm	*Glycera americana*	
amphitrites	*Amphitrite ornata*	
bamboo worm	*Clymenella*	
clam worm	*Nereis*	
cone worm	*Pectinaria* Savigny, *Sabellaria*	
feather duster worm	*Sabella*	
Phylum Arthropoda = crabs, lobster, shrimp		
amphipod (shallows)	*Orchestia*	
amphipods and isopods	Many species	
Asian shore crab	*Hemigrapsus sanguineus*	NIS
blue crab	*Callinectes sapidus*	**
burrowing mantis shrimp	Stomatopoda spp.	**
Chinese mitten crab	*Eriocheir sinensis*	NIS
flat-clawed hermit crab	*Pagurus pollicaris*	*
grass shrimp (prawns)	*Palaemon pugio*	*
green crab	*Carcinus maenas*	** NIS

* = important in CT-WAP ** = very important in CT-WAP *** = most important in CT-WAP **COMMON NAME**	NIS = nonindigenous species **SPECIES**	**STATUS**
horseshoe crab	*Limulus polyphemus*	***
isopod (shallows)	*Littorophiloscia vittata*	
Jonah crab	*Cancer borealis*	
lady crab	*Ovalipes ocellatus*	**
little gray barnacle	*Chthamalus fragilis*	
long-clawed hermit crab	*Pagurus longicarpus*	
marsh crab	*Sesarma reticulatum*	
mud fiddler crab	*Minuca pugnax*	*
northern lobster, American lobster	*Homarus americanus*	***
northern rock barnacles	*Semibalanus balanoides*	
red-jointed fiddler crab	*Minuca minax*	*
rock crab	*Cancer irroratus*	**
spider crab	*Libinia emarginata* *Libinia dubia*	*
Phylum Cnidaria = stinging jellies, hydra, and coral		
Atlantic sea nettle	*Chrysaora quinquecirrha*	
cannonball jelly	*Stomolophus meleagris*	
frilled anemone	*Metridium senile*	
lined anemone	*Edwardsiella lineata*	
lion's mane jelly	*Cyanea capillata*	
moon jelly	*Aurelia aurita*	
Portuguese man o' war	*Physalia physalis*	
Phylum Ctenophora = comb jellies		
Beroe comb jelly	*Beroe cucumis*	
comb jellies	Many species	
northern comb jelly	*Bolinopsis infundibulum*	
sea gooseberry	*Pleurobrachia pileus*	
sea walnut (Leidy's comb jelly)	*Mnemiopsis leidyi*	
Phylum Echinodermata = sea stars, sea cucumbers		
common sea star	*Asterias forbesi*	*
sea cucumber	*Holothuroidea*	
Phylum Mollusca, Class Bivalvia = bivalve shellfish		
Atlantic bay scallop	*Argopecten irradians*	***
Atlantic jackknife clam	*Ensis leei*	
Atlantic surf clam	*Spisula solidissima*	
blood ark	*Lunarca ovalis*	
blue mussel	*Mytilus edulis*	**
common jingle shell	*Anomia simplex*	
eastern oyster	*Crassostrea virginica*	***

* = important in CT-WAP ** = very important in CT-WAP *** = most important in CT-WAP COMMON NAME	NIS = nonindigenous species SPECIES	STATUS
northern quahog	*Mercenaria mercenaria*	
ribbed mussel	*Geukensia demissa*	
soft-shell clam	*Mya arenaria*	**
Phylum Mollusca, Class Gastropoda = snails		
Atlantic slipper shell	*Crepidula fornicata*	
channeled whelk	*Busycotypus canaliculatus*	**
common periwinkle	*Littorina littorea*	NIS
eastern mudsnail	*Tritia obsoleta*	
knobbed whelk	*Busycon carica*	**
northern moon snail	*Euspira heros*	
oyster drill	*Urosalpinx cinerea*	
rough periwinkle	*Littorina saxatilis*	
salt marsh snail, coffee bean snail	*Melampus coffea*	
smooth (yellow) periwinkle	*Littorina obtusata*	
Phylum Mollusca, Class Cephalopoda = squid, octopus		
longfin inshore squid	*Doryteuthis (Amerigo) pealeii*	**
Phylum Porifera = sponges		
boring sponge	*Cliona*	
red beard sponge	*Clathria (Clathria) prolifera*	

5.1.3.3 Special-Status Species and Habitats

The upland and offshore areas of the project area, owing to the overall size and the range of habitats include numerous special-status species that may be affected by the proposed action. Listed species, and in some cases their habitats, are protected under the State and Federal Endangered Species Acts (16 U.S.C. §§ 1531–1544), Marine Mammal Protection Act (16 U.S.C. 1361), Magnuson-Stevens Fishery Conservation and Management Act (6 U.S.C. §§ 1801–1891(d)), the Bald and Golden Eagle Protection Act (16 U.S.C. § 668(a)-(d)), the Migratory Bird Treaty Act (16 U.S.C. §§ 703–712) and its associated Executive Order (Exec. Order No. 13,186), and C.G.S. 26-92 which protects wild birds other than game birds. Additional species considered here are proposed for listing or are candidate species for listing. See *Chapter 7* for details on these laws and relevancy to the proposed action.

5.1.3.3.1 Threatened and Endangered Species

There are a number of species protected pursuant to the Federal Endangered Species Act (ESA) that are present within or near the boundary of the proposed CT NERR and additional species identified for Connecticut and the North Atlantic that have not been observed in or near the reserve area (Table 5-28). These listed species have the potential to be impacted by the proposed action. Listed species within and around the project area were assessed in the U.S. Fish and Wildlife Service Environmental Conservation Online System for terrestrial species, which provides results from only the delineated project area. For species which fall solely under the jurisdiction of NOAA Fisheries, the Species Directory for Endangered Species Act Threatened and Endangered list for the broader New England / Mid-Atlantic region were compared to data on occurrence for the project area.

The State of Connecticut lists any species that are listed on the Federal Endangered Species List on the Connecticut State List of Endangered, Threatened and Special Concern Species and provides these species with state protection in addition to federal protection. However, addition of new, federally-listed species to the state list is not automatic (C.G.S. §§ 26-303 to -316).

In addition to considering threatened and endangered species, species proposed for listing, candidate species and species with an active petition for listing or designation of federally-designated ESA Critical Habitat (16 U.S.C. § 1532(5); 50 C.F.R. § 424.12) were also considered. The sections below discuss the species recognized under the Endangered Species Act that are found within or potentially near the project area.

Table 5-28: Threatened and Endangered Species

Federally listed threatened and endangered species known to occur or having the potential to occur within or near the proposed CT NERR are listed first, followed by species listed by USFWS and NOAA Fisheries as protected in the Connecticut area, but with no known observations in the proposed CT NERR. Connecticut River holds a federally-designated ESA Critical Habitat (16 U.S.C. § 1532(5); 50 C.F.R. § 424.12) Designation for Atlantic Sturgeon; no other species have federally-designated Critical Habitat in the reserve area. For "Use of Area", nesting indicates a breeding population of bird, resident indicates the species uses the habitat throughout the year or over multiple life stages, migrant indicates an occasional visitor during migration, foraging indicates the species is an occasional visitor who comes to feed to seek refuge, nearby indicates the species is found in the proximity of the proposed CT NERR and could occur but has not been observed in the reserve property.

COMMON NAME	SCIENTIFIC NAME	USE OF AREA	FEDERAL STATUS
SPECIES WITH KNOWN OCCURRENCE IN OR AROUND THE PROJECT AREA			
piping plover	*Charadrius melodus*	nesting	Threatened
red knot	*Calidris canutus*	migrant	Threatened
roseate tern	*Sterna dougallii*	foraging	Endangered
Atlantic sturgeon, New York Bight Distinct Population Segment	*Acipenser oxyrinchus oxyrinchus*	resident	Endangered
shortnose sturgeon	*Acipenser brevirostrum*	resident	Endangered
green turtle, North Atlantic Distinct Population Segment	*Chelonia mydas*	foraging	Threatened
Kemp's ridley turtle	*Lepidochelys kempii*	foraging	Endangered
leatherback turtle	*Dermochelys coriacea*	foraging	Endangered
loggerhead turtle, North West Atlantic Distinct Population Segment	*Caretta caretta*	foraging	Threatened
northern long-eared bat	*Myotis septentrionalis*	nearby	Threatened
SPECIES WITH NO KNOWN OCCURRENCE IN OR AROUND THE PROJECT AREA			
giant manta ray	*Manta birostris*	none	Threatened
oceanic whitetip shark	*Carcharhinus longimanus*	none	Threatened

COMMON NAME	SCIENTIFIC NAME	USE OF AREA	FEDERAL STATUS
blue whale	*Balaenoptera musculus*	none	Endangered
fin whale	*Balaenoptera physalus*	none	Endangered
North Atlantic right whale	*Eubalaena glacialis*	none	Endangered
sei whale	*Balaenoptera borealis*	none	Endangered
sperm whale	*Physeter macrocephalus*	none	Endangered

5.1.3.3.1.1 Endangered Species Act – Listed Species

Within the project area, there are multiple federally-listed endangered or threatened species that are known to occur or migrate through the proposed CT NERR (Table 5-28). Federally-designated ESA Critical Habitat (16 U.S.C. § 1532(5); 50 C.F.R. § 424.12) within Connecticut and The Sounds has only been designated for one species, the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), which uses the Connecticut River (Table 5-28).

A. Piping plover (Charadrius melodus) - Threatened

The Atlantic Coast population of piping plover was listed as threatened under the Federal Endangered Species Act in 1985 (USFWS 2001). The piping plover is a small, approximately starling-sized shorebird in the *Scolopacidae* family, approximately 6.7 to 7.0 inches in length from bill to tail. They nest on sandy beaches along the Atlantic Coast from North Carolina to the Maritime Provinces of Canada. Their habitat consists of sparsely vegetated sandy beaches above the high tide line with nearby sandy, silty or cobbly intertidal zones or mudflats within walking distance for non-flighted chicks. There is a small amount of suitable nesting habitat at Great Island itself, within the Roger Tory Peterson NAP. They have also been documented as occurring in subtidal habitats of the Connecticut and Thames Rivers.

Piping plovers are migratory and arrive in Connecticut in early March and remain into August or early September. They rely primarily on camouflage and speed for their survival and lay their eggs (up to four) in a simple nest directly on the ground above the high tide line in sparsely vegetated beaches. Their young are precocial and begin foraging for themselves within hours after hatching. Piping plovers are increasing in population in Connecticut. They have increased from 26 pairs in 1996 to more than 60 pairs in 2019, but only because of labor intensive conservation efforts to identify, fence and monitor nesting areas and provide predator exclosures around nests that allow the adult birds to come and go freely, while excluding most predators. Eight to ten pairs of piping plovers nest at and proximal to Bluff Point Coastal Preserve and Bluff Point NAP and in the vicinity of Roger Tory Peterson NAP at the mouth of the Connecticut River, where approximately eight to ten pairs have nested and likely use the area for foraging. Their diet consists of insects and small intertidal invertebrates.

Threats to piping plovers include coastal development, sea level rise, human disturbance, human commensal predators, and development of wintering areas. There are approximately 3,000 pairs of piping plover throughout their range. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

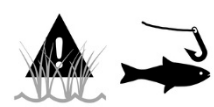
Summary by Boundary Alternative

Alternatives A and *D* include sightings and known breeding activity of this species in the Bluff Point complex, lower Connecticut River, and lower Thames River.

Alternatives B and *C* include sightings and known breeding activity of this species in the lower Connecticut River. The Bluff Point complex and lower Thames River, where additional individuals have been observed, are not included in these alternatives.

B. Red Knot (Calidris canutus) - Threatened

The *rufa* subspecies of red knot (*Calidris canutus rufa*) was listed as threatened under the Federal Endangered Species Act in 2014 (USFWS 2021f). The red knot is a small, approximately robin-sized shorebird in the *Charadriidae* family, approximately 9.0 to 10.5 inches in length from bill to tail. They do not nest in our area and are only found as uncommon passage migrants in spring and fall. Occurrences within the project area have been documented in the state Natural Diversity Data Base in subtidal areas of the Connecticut River and Roger Tory Peterson NAP and there are additional reports in eBird from Bluff Point Coastal Preserve and Bluff Point NAP (eBird 2021). They generally occur from mid-May to early June and from July to mid-September. They are a rare winter visitor in Long Island Sound and Fishers Island Sound. Habitat in migration includes tidal marshes, mudflats, and silty, sandy, or cobbly intertidal zones. They feed on horseshoe crab eggs and small intertidal invertebrates during spring migration and small intertidal invertebrates in the fall and winter. The red knots that pass through Connecticut nest in high Arctic Canada and the majority winter in southern South America, though some birds winter in the Southeast United States and occasionally as far north as Cape Cod.



Red knots are holarctic nesters, but the North American subspecies, *rufa*, is in serious decline. The primary threat to *rufa* subspecies of red knot is the decline of the horseshoe crab (*Limulus polyphemus*) in the Delaware Bay region as a result of overharvesting and habitat degradation. Red knots are heavily reliant on horseshoe crab eggs as a food source during spring migration and the population of the *rufa* subspecies of red knot has declined by as much as 75% in the past 20 years. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternatives A and *D* include sightings of this species in the Bluff Point complex and lower Connecticut River.

Alternatives B and *C* include sightings of this species in the lower Connecticut River. The Bluff Point complex, where individuals have been observed, is not included in these alternatives.

C. Roseate Tern (Sterna dougallii) - Endangered

The Northeast U.S. population of roseate tern was listed as endangered under the Federal Endangered Species Act in 1987 (USFWS 2021e). The roseate tern is a medium sized tern, closely resembling the common tern, Forster's tern, and Arctic terns. Their total length is 13 to 16 inches, including 5 to 9 inches of outer tail feathers. They are distinguished from their close relatives by having a longer tail, being overall more brilliant white, with a rosy cast in breeding plumage, having a black bill (that gains a blood red base in high breeding plumage), and having more streamlined body and wings with a contrasting dark leading edge in the primaries.

The vast majority of Long Island Sound's nesting roseate terns (approximately 1,000 pairs) nest on Great Gull Island off Southhold, NY, off the North Fork of Long Island. A smaller population (approximately 40 pairs) nest at the Falkner Island Unit of the Stewart B. McKinney National Wildlife Refuge off the coast of Guilford, Connecticut. They nest exclusively in larger common tern colonies where adequate cover (rock crevices or artificial shelters) is present for their young to hide. Foraging habitat includes open waters and embayments with large schools of forage fish, often in cases where the baitfish are chased to the surface by predatory fish from below. Roseate terns range widely in search of their preferred food, American sand lance (*Ammodytes americanus*), and utilize the open water areas of the project area as foraging grounds in the nesting season. They are particularly dependent upon sand lance in the breeding season, but adults will take other species of small fish as food. They have been documented within the project area in the state Natural Diversity Data Base as having occurred over subtidal habitats in Long Island Sound and Fishers Island Sound and subtidal areas of the Connecticut and Thames Rivers (DEEP 2021d).

They are highly migratory and occur in the project area from late April to August, when the majority of the Northeast's roseate terns gather off of Cape Cod to stage for migration. They winter off the coast of Brazil and northeastern South America. In addition to the Northeast U.S. population, there are breeding populations of roseate terns in the Caribbean, the Azores, Northeast Africa, South Asia, Southeast Asia and Australia. Northeast populations of roseate tern never fully recovered from market harvesting of the 19th Century and now nest on only a few major colonies from Long Island to the Maritime Provinces of Canada, with 90% of the nesting population concentrated in three major colonies: Great Gull Island, NY, and two colonies in Buzzards Bay, MA: Bird Island and Ram Island.

Their reliance on sand lance as a forage species in the nesting season may make them vulnerable to warming seas. Nearly the entire Northeast U.S. population concentrates off of Cape Cod in late summer and is at risk from contaminants like oil spills and strikes from wind turbines, especially if wind farms are poorly placed. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

Alternatives A and *D* include sightings in subtidal regions of Long Island Sound, Fishers Island Sound, lower Connecticut River, and lower Thames River.

Alternatives B and *C* include sightings in subtidal regions of Long Island Sound, Fishers Island Sound, and lower Connecticut River. The Bluff Point complex and lower Thames River, where individuals have been observed, are not included in these alternatives.

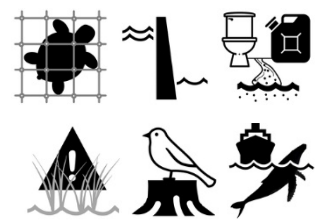
D. Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus), New York Bight Distinct Population Segment - Endangered

The Atlantic sturgeon, New York Bight Distinct Population Segment was listed as endangered under the Federal Endangered Species Act in 2012 (DEEP 2009a; NOAA Fisheries 2021h). A small breeding population of Atlantic sturgeon has been documented in the Connecticut River; as such, the Connecticut River is federally designated as Critical Habitat (16 U.S.C. § 1532(5); 50 C.F.R. § 424.12) for this species.

Atlantic sturgeon are found along the East Coast of North America from Labrador to northern Florida and are rarely seen in Connecticut. They are listed in the state Natural Diversity Data Base (DEEP 2021d) as having occurred in subtidal Long Island Sound and Fishers Island Sound habitats, subtidal habitats of the Connecticut and Thames Rivers and at Lord Cove Wildlife Management Area, Roger Tory Peterson NAP, DEEP Marine District Headquarters, UConn Avery Point and at Bluff Point CR. According to DEEP, "Adults live in saltwater and enter freshwater rivers during April-June (in the Hudson River) to spawn. Female Atlantic sturgeon move out of the rivers after spawning, whereas males will linger until fall. Young fish reside in river systems for 2 to 7 years before migrating to the ocean" (DEEP 2009a). Atlantic sturgeon feed at the seafloor and river floor, typically eating invertebrates such as insects, crustaceans, worms, and mollusks.

Adults can weigh from 70 to 100 pounds and can reach a length of more than 13 feet, but individuals in our area typically range from 25 to 47 inches. They are similar in appearance to the smaller shortnose sturgeon, but according to DEEP, they have a narrower mouth with a width less than 55% of the width between the eyes. They have 26 to 28 anal rays and may have 2 to 6 bony plates near the base of the anal fin. The snout is usually longer and more pointed in adults relative to shortnose sturgeon.

The most significant threats to Atlantic sturgeon are unintended catch in some commercial fisheries, dams that block access to spawning areas, poor water quality (which harms development of sturgeon offspring), degradation of habitat from dredging of spawning areas, water withdrawals from rivers, and vessel strikes. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).



Summary by Boundary Alternative

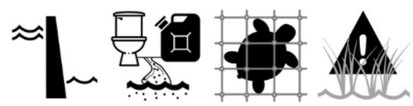
Alternatives A and *D* include sightings in subtidal regions of Long Island Sound, Fishers Island Sound, lower Connecticut River, and lower Thames River.

Alternatives B and *C* include sightings in subtidal regions of Long Island Sound, Fishers Island Sound, and lower Connecticut River. The Bluff Point complex and lower Thames River, where individuals have been observed, are not included in these alternatives.

E. Shortnose sturgeon (Acipenser brevirostrum) - Endangered

The shortnose sturgeon was listed as endangered under the Federal Endangered Species Preservation Act in 1966. There is a population of approximately 800 shortnose sturgeon in the Connecticut River, between the mouth and the Holyoke Dam (DEEP 2009c). They are found along the Eastern Seaboard from New Brunswick to northern Florida. The only self-sustaining population in the state is in the Connecticut River. Strays from Hudson River or Connecticut River stocks have occasionally been found in the Housatonic River and Thames River estuaries. There appear to be two sub-populations in the Connecticut River. One exists above the Holyoke Dam in Massachusetts and ranges as far north as Turners Falls Dam in Massachusetts. The other population ranges from beneath the Holyoke Dam to the estuary in Old Saybrook, Connecticut. To what extent these two sub-populations mix is unclear. They are listed in the state Natural Diversity Data Base (DEEP 2021d) as having occurred in subtidal Long Island Sound and Fishers Island Sound habitats, subtidal habitats of the Connecticut and Thames Rivers and at Lord Cove Wildlife Management Area, Roger Tory Peterson NAP, DEEP Marine District Headquarters, UConn Avery Point and at Bluff Point CR.

According to DEEP, these fish “prefer deeper waters of larger rivers, estuaries and bays. Although anadromous elsewhere within their range, Connecticut River shortnose sturgeon apparently remain within the river for most of their lives, although some occasionally enter Long Island Sound. Shortnose sturgeon spend most of the late summer through winter and early spring in more northern areas of the river. They spawn during April and May. Soon after spawning, most fish make a rapid migration to the estuary between Haddam and Old Saybrook, where they remain until June or July.” Shortnose sturgeon are bottom feeders, typically eating invertebrates such as insects, crustaceans, worms, and mollusks. Adults can weigh up to 34 pounds and range between 36 to 54 inches cm in length. They are similar in appearance to the larger Atlantic sturgeon, but according to DEEP, they have a wider mouth with the width greater than 60% of the width between eyes. They have 22 anal rays and no bony plates near the base of anal fin. The snout is usually shorter and blunter in adults relative to Atlantic sturgeon.



The most significant threats to the species are dams that block access to spawning areas or lower parts of rivers, poor water quality, dredging, water withdrawals from rivers leading to habitat degradation, and unintended catch in some commercial fisheries. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

All Alternatives include the lower Connecticut River, the habitat used by this species in the project area.

F. Green Turtle (Chelonia mydas), North Atlantic Distinct Population Segment - Threatened

The green turtle North Atlantic Distinct Population Segment was listed as endangered under the Federal Endangered Species Act in 1978 and was down-listed to threatened in 2016 (DEEP 1999b; USFWS 2015). Green turtles are occasional visitors to Long Island Sound and Fishers Island Sound, represented primarily by immature individuals. They occur along the North American coast from Massachusetts to Mexico and from British Columbia to California. Major nesting grounds are in Mexico, Costa Rica, Guyana, Suriname, and Ares Island off Dominica in the West Indies. In the United States, small nesting populations occur on the eastern coast of Florida. Green turtles are listed in the state Natural Diversity Data Base (DEEP 2021d) as having occurred in subtidal Long Island Sound and Fishers Island Sound habitats, subtidal habitats of the Connecticut and Thames Rivers and at Bluff Point CR. Their habitats in our area include shallow to deep open waters. They are large sea turtles, ranging from 220 to 440 pounds and can be 35 to 48 inches in length.

The Mystic Aquarium responds to strandings along the Connecticut and Rhode Island shorelines; their stranding data from 1976 to 2011 are available in OBIS-SEAMAP (Halpin et al. 2009). Within the period of 1990 to 2011, a total of 12 marine turtles (all species) stranded in New London County. Throughout Connecticut, the stranding total for green turtles was 2 (Smith 2013). Out of the four green turtle strandings for the entire area (RI and CT), three were dead.

Threats to their survival include fisheries as bycatch, illegal harvest of eggs and adults, loss and degradation of nesting habitat via coastal development, vessel strikes, pollution, marine debris, climate change, and disease (fibropapillomatosis). As with nearly all turtles, juvenile survival rates are very low and their population biology depends on adult longevity and the ability to lay many clutches of eggs over the years. Premature adult mortality can have an especially adverse impact to populations. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternatives A and *D* include sightings in subtidal regions of Long Island Sound, Fishers Island Sound, Bluff Point complex, lower Connecticut River, and lower Thames River.

Alternatives B and *C* include sightings in subtidal regions of Long Island Sound, Fishers Island Sound, and lower Connecticut River. The Bluff Point complex and lower Thames River, where individuals have been observed, are not included in these alternatives. These alternatives also lack the large Long Island Sound and Fishers Island Sound areas found in Alternatives A and D, supportive of this species.

G. Kemp's Ridley Turtle (Lepidochelys kempii) - Endangered

The Kemp's ridley was listed as endangered under the Endangered Species Conservation Act in 1970, and as endangered under the Federal Endangered Species Act in 1973 (DEEP 1999a; NOAA Fisheries 2021m). The Kemp's ridley turtle is the most endangered turtle species in the world. The Kemp's ridley ranges from Nova Scotia and Newfoundland south to Bermuda and west through the Gulf of Mexico. They are rare but regular visitors to Long Island Sound and Fishers Island Sound, particularly immature individuals. The waters of Long Island Sound and Fishers Island Sound may be an important nursery area for older juveniles of this species. Their occurrence is likely often overlooked, but their presence can become apparent with an early fall cold snap that can cause deceased individuals to wash ashore.

Kemp's ridley are listed in the state Natural Diversity Data Base (DEEP 2021d) as having occurred in subtidal Long Island Sound and Fishers Island Sound habitats, subtidal habitats of the Connecticut and Thames Rivers and at Bluff Point CR and Bluff Point NAP. Their habitats in our area include shallow to deep open waters. They have a wide ranging diet that includes various fish and other small animals and macroalgae. Adults can weigh 75 to 100 pounds and can be 23 to 28 inches in length and can be mistaken for the similar appearing loggerhead. Nearly the entire breeding population nests along the coast of the State of Tamaulipas, on the Gulf Coast of Mexico, just south of the U.S.-Mexico border. As with nearly all turtles, juvenile survival rates are very low and their population biology depends on adult longevity and the ability to lay many clutches of eggs over the years. Premature adult mortality can have an especially adverse impact to populations.

The Mystic Aquarium responds to strandings along the Connecticut and Rhode Island shorelines; their stranding data from 1976 to 2011 are available in OBIS-SEAMAP (Halpin et al. 2009). Within the period of 1990 to 2011, a total of 12 marine turtles (all species) stranded in New London County. Throughout Connecticut, the stranding total for Kemp's ridley turtles was zero (Smith 2013). Out of the nine Kemp's ridley strandings for the entire area (RI and CT), two were dead.

Threats to their survival include fisheries as bycatch, illegal harvest of eggs and adults, loss and degradation of nesting habitat via coastal development, predation of eggs and young at nest sites, vessel strikes, pollution, marine debris, and climate change. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternatives A and *D* include sightings in subtidal regions of Long Island Sound, Fishers Island Sound, Bluff Point complex, lower Connecticut River, and lower Thames River.

Alternatives B and *C* include sightings in subtidal regions of Long Island Sound, Fishers Island Sound, and lower Connecticut River. The Bluff Point complex and lower Thames River, where individuals have been observed, are not included in these alternatives. These alternatives also lack the large Long Island Sound and Fishers Island Sound areas found in Alternatives A and D, supportive of this species.

H. Leatherback Turtle (Dermochelys coriacea), North West Atlantic Distinct Population Segment - Endangered

The leatherback turtle, North West Atlantic Distinct Population Segment was listed as endangered under the Endangered Species Conservation Act in 1970, and as endangered under the Federal Endangered Species Act in 1973 (USFWS 2021c). Leatherbacks are rare visitors to Long Island Sound and Fishers Island Sound, often represented by deceased individuals washed ashore or seen floating on The Sounds. It is not known how many of these enter The Sounds alive and die here, or if they drift into The Sounds when already dead. Leatherbacks are listed in the state Natural Diversity Data Base (DEEP 2021d) as having occurred in subtidal Long Island Sound and Fishers Island Sound habitats, subtidal habitats of the Connecticut and Thames Rivers and at Bluff Point CR and Bluff Point NAP. They are a rare but uncommon summer visitor to pelagic waters off the coast of New England.

Foraging habitat in our area is typically deeper pelagic waters, though they will venture into estuarine waters. They feed primarily on jellyfish, but have been known to take other prey as well, including sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating macroalgae. Leatherbacks are the largest extant species of sea turtle and their length can exceed 6.5 feet. Females nest on tropical beaches and the U.S. Virgin Islands are an important nesting ground for this species. As with nearly all turtles, juvenile survival rates are very low and their population biology depends on adult longevity and the ability to lay many clutches of eggs over the years. Premature adult mortality can have an especially adverse impact to populations.

The Mystic Aquarium responds to strandings along the Connecticut and Rhode Island shorelines; their stranding data from 1976 to 2011 are available in OBIS-SEAMAP (Halpin et al. 2009). Within the period of 1990 to 2011, a total of 12 marine turtles (all species) stranded in New London County. Throughout Connecticut, the stranding total for leatherback turtles was 15 (Smith 2013). Out of the 176 leatherback strandings for the entire area (RI and CT), 162 were dead.

Threats to their survival include fisheries as bycatch, illegal harvest of eggs and adults, loss and degradation of nesting habitat via coastal development, vessel strikes, pollution, marine debris, and climate change. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternatives A and *D* include sightings in subtidal regions of Long Island Sound, Fishers Island Sound, Bluff Point complex, lower Connecticut River, and lower Thames River.

Alternatives B and *C* include sightings in subtidal regions of Long Island Sound, Fishers Island Sound, and lower Connecticut River. The Bluff Point complex and lower Thames River, where individuals have been observed, are not included in these alternatives. These alternatives also lack the large Long Island Sound and Fishers Island Sound areas found in Alternatives A and D, supportive of this species.

I. Loggerhead Turtle (Caretta caretta) - Threatened

Loggerheads were listed as threatened throughout its range under the Federal Endangered Species Act in 1978 (DEEP 2009b; USFWS and Puerto Rico Sea Grant n.d.). Loggerheads are occasional summer visitors to Long Island Sound and Fishers Island Sound and are the species most likely to be encountered in the project area. The loggerhead ranges through the North and South Atlantic, occasionally entering the Mediterranean Sea, from Newfoundland to the British Isles, and south to Argentina, the Canary Islands and the western coast of tropical Africa. The turtle formerly nested on Atlantic beaches from Virginia to the Gulf Coast. Today the breeding range extends from North Carolina to the east and west coasts of Florida. They have nested as far north as the Mid-Atlantic States. Nesting also occurs on some beaches and bays in the Caribbean. Loggerheads are listed in the state Natural Diversity Data Base (DEEP 2021d) as having occurred in subtidal Long Island Sound and Fishers Island Sound habitats, subtidal habitats of the Connecticut and Thames Rivers. Their habitats in our area include shallow to deep open waters. Their diet in our area consists primarily of crustaceans. They are a fairly large sea turtle ranging from 170 to 350 pounds and can be 31 to 45 inches in length. As with nearly all turtles, juvenile survival rates are very low and their population biology depends on adult longevity and the ability to lay many clutches of eggs over the years. Premature adult mortality can have an especially adverse impact to populations.

The Mystic Aquarium responds to strandings along the Connecticut and Rhode Island shorelines; their stranding data from 1976 to 2011 are available in OBIS-SEAMAP (Halpin et al. 2009). Within the period of 1990 to 2011, a total of 12 marine turtles (all species) stranded in New London County Throughout Connecticut, the stranding total for loggerhead turtles was 15 (Smith 2013). Out of the 63 loggerhead strandings for the entire area (RI and CT), 58 were dead.

Threats to their survival include fisheries as bycatch, loss and degradation of nesting habitat via coastal development, vessel strikes, illegal harvest of eggs and adults, pollution, marine debris, and climate change. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

Alternatives A and *D* include sightings in subtidal regions of Long Island Sound, Fishers Island Sound, lower Connecticut River, and lower Thames River.

Alternatives B and *C* include sightings in subtidal regions of Long Island Sound, Fishers Island Sound, and lower Connecticut River. The Bluff Point complex and lower Thames River, where individuals have been observed, are not included in these alternatives. These alternatives also lack the large Long Island Sound and Fishers Island Sound areas found in Alternatives A and D, supportive of this species.

J. Northern Long-eared Bat (Myotis septentrionalis) – Threatened, possibly present in project area

The northern long-eared bat is one of the bat species most impacted by the disease white-nose syndrome. Decline in populations related to the disease led to this species being federally listed in 2015 (USFWS 2021d). The northern long-eared bat is a medium-sized bat (0.2 to 0.3 ounces) with a wing span of 9 to 10 inches and as the name implies, long ears. The bat is found across much of the eastern and north central United States and all Canadian provinces from the Atlantic coast west to the southern Northwest Territories and eastern British Columbia. Northern long-eared bats spend winter hibernating in caves and mines, called hibernacula. During the summer, these bats roost singly or in colonies underneath bark, in cavities or in crevices of both live trees and snags (dead trees). As of March, 2019, the closest known hibernacula to the project area was in North Branford. There were no known maternity roost trees in Connecticut (DEEP 2019d). Rhode Island has no known hibernacula because the state lacks caves and mines (DEM n.d.), though more recent evidence suggests that bats may hibernate in underground World War II bunkers[17]. While no hibernacula have been found within New London County, this species has been observed in New London County and Middlesex County, though not within the project area (DEEP 2016a).

Threats to the species include the white-nose syndrome; no other threat is as severe or immediate as this disease. Other sources of mortality may include blockage of passage to hibernacula, human disturbance while hibernating, loss or degradation of habitat, and strikes from wind turbines. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

No alternatives host known populations or individuals of this species, though presence is possible based on the range of this species.

Species Listed for the North Atlantic, but Not Observed in the Project Area

A number of additional endangered or threatened fish and marine mammals are listed by NOAA Fisheries for the New England / Mid-Atlantic region, but are not known to occur in Long Island Sound or Fishers Island Sound and are unlikely to be found in the project area. Records were checked in iNaturalist, in the MGEL OBIS-SEAMAP Model Repository for cetaceans (MGEL 2021), and in the OBIS-

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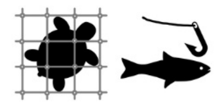
[17] *Personal communication*, K. Moran (DEEP).

SEAMAP (Halpin et al. 2009). Lack of right whale sightings was verified in the NOAA right whale sighting advisory system (NOAA Fisheries 2021f). Species not present include:

K. Giant Manta Ray (Manta birostris) – Threatened, not likely to appear in project area

In 2018, NOAA Fisheries listed the species as threatened under the Endangered Species Act. “The giant manta ray is the world’s largest ray with a wingspan of up to 29 feet. They are filter feeders and eat large quantities of zooplankton. Giant manta rays are slow-growing, migratory animals with small, highly-fragmented populations that are sparsely distributed across the world” (NOAA Fisheries 2021k). The nearest sightings of this fish are located at the edge of the continental shelf, 112 miles from Long Island Sound (Halpin et al. 2009).



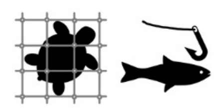
The main threat to the giant manta ray is commercial fishing, artisanal fishing, and harvest for international trade, with the species both targeted and caught as bycatch in a number of global fisheries throughout its range. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

No alternatives host known populations or individuals of this species, though presence is possible based on the range of this species.

L. Oceanic Whitetip Shark (Carcharhinus longimanus) – Threatened, not likely to appear in project area

In 2018, NOAA Fisheries listed the species as threatened under the Endangered Species Act. “Oceanic whitetip sharks are large sharks found in tropical and subtropical oceans throughout the world. Oceanic whitetip sharks are long-lived, late maturing, and have low to moderate productivity” (NOAA Fisheries 2021o). The nearest sightings of this fish are located off of New Jersey, at the edge of the continental shelf, and in Georges Bank (Halpin et al. 2009).



Bycatch in commercial fisheries combined with the rise in demand for shark fins is threatening oceanic whitetip sharks. They are frequently caught in pelagic longline, purse seine, and gillnet fisheries worldwide and their fins are highly valued in the international trade for shark products. Their populations have declined as a result. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

No alternatives host known populations or individuals of this species, though presence is possible based on the range of this species.

M. Blue Whale (Balaenoptera musculus) – Endangered, not likely to appear in project area

In 1970, NOAA Fisheries listed the species as endangered under the Endangered Species Conservation Act, and as endangered under the Endangered Species Act in 1973. “Blue whales are the largest animals ever to live on our planet. They feed almost exclusively on krill, straining huge volumes of ocean water through their baleen plates (which hang from the roof of the mouth and work like a sieve). Some of the biggest individuals may eat up to 6 tons of krill a day. The number of blue whales today is only a small fraction of what it was before modern commercial whaling significantly reduced their numbers during the early 1900s, but populations are increasing globally" (NOAA Fisheries 2021i).

The majority of sightings in the Northwest Atlantic occur off the coast of Nova Scotia, with a scattering of sightings in the Gulf of Maine (Halpin et al. 2009). The closest sightings to the project area occurred off Newport, RI (one sighting of a single animal in 1998) and south of Montauk, NY (three sightings of single animals in 1989-1990). These sightings were 46 to 65 miles from the project area.

The Mystic Aquarium responds to strandings along the Connecticut and Rhode Island shorelines; their stranding data from 1976 to 2011 are available in OBIS-SEAMAP (Halpin et al. 2009). No blue whales stranded in Connecticut during this time period.

The primary threats blue whales currently face are vessel strikes and entanglements in fishing gear. Additional possible threats to blue whales that are less understood include ocean noise, habitat degradation, pollution, vessel disturbance, and climate change. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

No alternatives host known populations or individuals of this species, though presence is possible based on the range of this species.

N. Fin Whale (Balaenoptera physalus) – Endangered, not likely to appear in project area

In 1970, NOAA Fisheries listed the species as endangered under the Endangered Species Conservation Act, and as endangered under the Endangered Species Act in 1973. "The fin whale is the second-largest species of whale. It is found throughout the world's oceans. Like all large whales, fin whales were hunted by commercial whalers, which greatly lowered their population. Whalers did not target them at first, because they were fast and lived in open ocean habitats. But, as whaling methods modernized with steam-powered ships and explosive harpoons, and whalers over-hunted other species of whales they had used for oil, bone, and fat, whaling turned to fin whales, killing a huge number during the mid-1900s—725,000 in the Southern Hemisphere alone. Whaling is no longer a major threat for this species. (Commercial whaling ended in the 1970s and 1980s, though some hunting continues today in Greenland through subsistence whaling allowances from the International Whaling Commission)" (NOAA Fisheries 2021j).

While not occurring within the project area, a large number of sightings have occurred south of Block Island Sound, south of Block Island and Montauk (Long Island), 37 miles from the project area. Closer to Long Island Sound, three sightings on the south side of Fishers Island were recorded, 6.2 miles from the project area: one each in 1985 (two animals), 1990 (11 animals), and 1993 (one animal) (Halpin et al. 2009).

The Mystic Aquarium responds to strandings along the Connecticut and Rhode Island shorelines; their stranding data from 1976 to 2011 are available in OBIS-SEAMAP (Halpin et al. 2009). Within the period of 1990 to 2011, a total of 16 cetaceans (all species) stranded in Connecticut with four of those strandings in New London County (Smith 2013). One fin whale stranded in Connecticut during this time period (Smith 2013), though this particular piece of data does not appear in the OBIS database and may have been included in error (Halpin et al. 2009).

Threats include entanglement in fishing gear, vessel strikes, lack of prey due to overfishing, and ocean noise. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

No alternatives host known populations or individuals of this species, though presence is possible based on the range of this species.

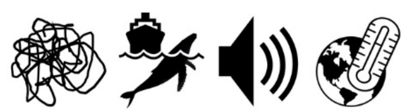
O. North Atlantic Right Whale (Eubalaena glacialis) – Endangered, not likely to appear in project area

North Atlantic right whales have been listed as endangered under the Endangered Species Act since 1970. “The North Atlantic right whale is one of the world’s most endangered large whale species, with less than 400 individuals remaining. Right whales are baleen whales, feeding on copepods (tiny crustaceans) by straining huge volumes of ocean water through their baleen plates, which act like a sieve. By the early 1890s, commercial whalers had hunted right whales in the Atlantic to the brink of extinction. Whaling is no longer a threat, but human interactions still present the greatest danger to this species. Researchers estimate there are fewer than 400 North Atlantic right whales, with fewer than 100 breeding females left. The number of new calves born in recent years has been below average. Since 2017, right whales have experienced an ongoing Unusual Mortality Event, with 46 individual right whales dead (n=32) or seriously injured (n=14). This represents more than 10% of the population, which is a significant impact on an endangered species where deaths are outpacing births” (NOAA Fisheries 2021n).

The greatest density of sightings occur in the Gulf of Maine and south to an area southeast of Cape Cod, MA. In 1980, a single whale was sighted just outside of the project area (two miles), north of Plum Island (Halpin et al. 2009). Beyond that single sighting, a few sightings have occurred southeast of Montauk, NY, 30 to 50 miles from the project area: eight sightings in total with six sightings (1 to 2 animals) in 1986-1988, one sighting (one animal) in 1993, and one sighting (one animal) in 2015. This species is unlikely to occur in the project area (NOAA Fisheries 2021f).

The Mystic Aquarium responds to strandings along the Connecticut and Rhode Island shorelines; their stranding data from 1976 to 2011 are available in OBIS-SEAMAP (Halpin et al. 2009). No right whales stranded in Connecticut during this time period.

Entanglement in fishing gear and vessel strikes are the leading causes of North Atlantic right whale mortality. Increasing ocean noise levels from human activities are also a concern since the noise may interfere with right whale communication and increase their stress levels. Climate change has modified prey abundance, which has been linked to a dip in whale births. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).



Summary by Boundary Alternative

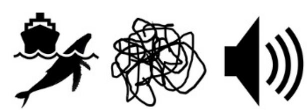
No alternatives host known populations or individuals of this species, though presence is possible based on the range of this species.

P. Sei Whale (Balaenoptera borealis) – Endangered, not likely to appear in project area

Sei whales have been listed as endangered under the Endangered Species Conservation Act since 1970, and as endangered under the Endangered Species Act since 1973. “Sei whales occur in subtropical, temperate, and subpolar waters around the world. The sei whale population has been greatly decreased by commercial whaling. During the 19th and 20th centuries, sei whales were targeted and greatly depleted by commercial hunting and whaling, with an estimated 300,000 animals killed for their meat and oil. Member countries of the International Whaling Commission agreed to cease sei whale catches in the North Pacific in 1975 and the Antarctic in 1979. Although whaling is no longer a major threat, some whaling of this species continues today in Japan” (NOAA Fisheries 2021p).

The vast majority of sightings of this whale occur on and around Georges Bank with a much smaller cluster of sightings south of Martha’s Vineyard, MA. The nearest sightings were south of Long Island, 30 to 40 miles outside of Long Island Sound (Halpin et al. 2009). Six sightings of single animals have been recorded in this area, four in 1981-1982, and one each in 2003 and 2017.

The Mystic Aquarium responds to strandings along the Connecticut and Rhode Island shorelines; their stranding data from 1976 to 2011 are available in OBIS-SEAMAP (Halpin et al. 2009). No sei whales stranded in Connecticut during this time period.



Vessel strikes and entanglement pose the biggest threat to sei whales today. Underwater noise threatens whale populations, interrupting their normal behavior and driving them away from areas important to their survival. Increasing evidence suggests that exposure to intense underwater sound in some settings may cause some whales to strand and ultimately die. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

No alternatives host known populations or individuals of this species, though presence is possible based on the range of this species.

Q. Sperm Whale (Physeter macrocephalus) – Endangered, not likely to appear in project area

Sperm whales have been listed as endangered under the Endangered Species Conservation Act since 1970, and as endangered under the Endangered Species Act since 1973. “Sperm whales are the largest of the toothed whales and have one of the widest global distributions of any marine mammal species. They are found in all deep oceans, from the equator to the edge of the pack ice in the Arctic and Antarctic. They are named after the waxy substance, spermaceti, found in their heads. Spermaceti was used in oil lamps, lubricants, and candles. Sperm whales were a primary target of the commercial whaling industry from 1800 to 1987. Whaling greatly reduced all sperm whale populations. While whaling is no longer a major threat, sperm whale populations are still recovering” (NOAA Fisheries 2021q).

Most sightings of this whale happen at the edge of the continental shelf, 115 miles from Long Island Sound. The closest sightings to the project area occurred east of Block Island and south of Long Island, both approximately 40 miles from the project area. Three sightings occurred east of Block Island, one sighting in 1981 (8 animals) and two sightings in 2015 (2 animals per sighting). A cluster of sightings occurred in 1987, south of Long Island, with four sightings of four animals per most sightings. This same area had two sightings in 1992 (four animals per sighting) (Halpin et al. 2009).

The Mystic Aquarium responds to strandings along the Connecticut and Rhode Island shorelines; their stranding data from 1976 to 2011 are available in OBIS-SEAMAP (Halpin et al. 2009). No sperm whales stranded in Connecticut during this time period.

Threats to sperm whales include vessel strikes, entanglement in fishing gear, ocean noise, marine debris, climate change, oil spills and contaminants. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

No alternatives host known populations or individuals of this species, though presence is possible based on the range of this species.

R. Candidate and proposed species for listing under the Endangered Species Act

There are no species proposed for listing under the Endangered Species Act in Connecticut (NOAA Fisheries 2021a; NOAA Fisheries 2021g; USFWS 2021b). There is one Candidate Species for listing under the Endangered Species Act within Connecticut: the monarch butterfly (*Danaus plexippus*) (Table 5-29).

Table 5-29: Proposed and Candidate Species for Listing

No species are proposed for listing in Connecticut. One Connecticut species is a candidate for listing (USFWS 2021a).

COMMON NAME	SCIENTIFIC NAME	STATUS	FEDERAL REGISTER NOTICE
monarch butterfly	*Danaus plexippus*	Candidate for listing	85 FR 81813 81822 79 FR 78775 78778

Monarch butterflies in Connecticut are the Eastern variety, which are slightly bigger and lighter-colored than the Western USA variety. Eastern monarchs come out of Mexico and travel as far as New England and Southern Canada. They stop in areas where common milkweed (*Asclepias syriaca*) is growing, lay eggs, and die (Rondeau 2020). Their offspring hatch then continue on north repeating the process. The fourth or fifth generational descendants of the butterflies that left Mexico are the monarchs in Connecticut. Common milkweed grows in sandy, clayey, or rocky calcareous soils. It occurs along the banks or flood plains of lakes, ponds, and waterways, in prairies, forest margins, roadsides, and waste places (USDA NRCS 2021).

Threats to the monarch butterflies include pesticides, habitat loss, and habitat degradation. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

Alternative A includes suitable habitat for common milkweed (a plant which supports the monarch butterfly), including pastures and open areas in Haley Farm State Park and the Bluff Point complex. Milkweed is not typically found in marshes, especially with salt exposure, so less habitat is available in the lower Connecticut River, though milkweed can likely be found in some areas.

Alternative B lacks the upland pastures of Alternative A and the brackish marshes of the lower Connecticut River are less suitable to milkweed, though some can likely be found. The addition of the freshwater areas and uplands found in Machimoodus State Park and Haddam Neck WMA likely support milkweed and by extension, monarch butterflies.

Alternative C lacks the upland pastures of Alternative A and the brackish marshes of the lower Connecticut River are less suitable to milkweed, though some can likely be found. This alternative also lacks the freshwater marshes and uplands included in Alternative B.

Alternative D is essentially the same as Alternative A, with the addition of Pine Island. The island likely hosts milkweed in the shrub areas found at the west and east end of the island and by extension, monarch butterflies.

5.1.3.3.1.2 Species of Concern

Several species in Connecticut have active petitions for listing or designation of ESA Critical Habitat (16 U.S.C. § 1532(5); 50 C.F.R. § 424.12) received by the U.S. Fish and Wildlife Service or NOAA Fisheries Service (Table 5-30). If under review for listing, these are species about which there are some concerns regarding status and threats, but for which insufficient information is currently available to indicate a need to list the species under the Endangered Species Act. An active petition does not carry any procedural or substantive protections under the Endangered Species Act.

SUMMARY BY BOUNDARY ALTERNATIVE

Alternative A - The leatherback turtle (*Dermochelys coriacea*), with an active petition for delisting, has been observed throughout all coastal areas of the project area. Coastal areas of the full project area are used as a foraging grounds by the roseate tern *(Sterna dougallii)*, a petition for listing ESA Critical Habitat (16 U.S.C. § 1532(5); 50 C.F.R. § 424.12) is under review. The golden winged warbler (*Vermivora chrysoptera)*, with a petition for listing, has been sighted as a migrant in the Bluff Point properties.

Alternative B is similar to Alternative A but lacks sightings of the golden winged warbler *(Vermivora).*

Alternative C is similar to Alternative A but lacks sightings of the golden winged warbler *(Vermivora).*

Alternative D is the same as Alternative A in terms of sightings.

Table 5-30: Species With Active Petitions for Listing, Delisting, or Designation of ESA Critical Habitat

A number of species listing Connecticut as part of their range have active petitions received by the U.S. Fish and Wildlife Service (USFWS 2021a) or NOAA Fisheries Service (NOAA Fisheries 2021g). List was updated May 20, 2021.

COMMON NAME (SCIENTIFIC NAME)	STATUS - REQUEST (PETITION TITLE)	COMMENTS
INVERTEBRATES		
regal fritillary (*Speyeria idalia*)	90 day petition finding Substantial on 09 / 18 / 2015 - Listing and Designation of Critical Habitat (Fritillary, Regal (*Speyeria idalia*))	Extirpated in Connecticut, nearest known locations are reintroduction sites in PA.
northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*)	Petition findings not yet made - designation of Critical Habitat (9 Northeast Species; designate Critical Habitat)	Extirpated in Connecticut, nearest known locations are in MA and MD.
yellow-banded bumble bee (*Bombus terricola*)	90 day petition finding Substantial on 03 / 16 / 2016 - Listing and Designation of Critical Habitat (Bumble bee, Yellow banded (*Bombus terricola*); list T / E w / Critical Habitat)	Not found in vicinity of the NERR boundary. Declining, last recorded in Connecticut in 2009 (Zarillo n.d.).
monarch butterfly (*Danaus plexippus*)	Petition findings not yet made - Petition for Rulemaking for a Section 4(d) Rule for the Monarch Butterfly	Found within the project area. (*Alternatives A*, *B*, *C*, *D*)
MAMMALS		
tricolored bat (*Perimyotis subflavus*)	90 day petition finding Substantial on 12 / 20 / 2017 - Designation of Critical Habitat (Tricolored Bat (*Perimyotis subflavus*))	Not currently known in the vicinity of NERR boundary, but future surveys may reveal presence within the project area. Presence documented in Salem, CT in 2017 (DEEP 2021d).
BIRDS		
golden winged warbler (*Vermivora chrysoptera*)	90 day petition finding Substantial on 06 / 02 / 2011 - Listing (Warbler, golden-winged (*Vermivora chrysoptera*); list)	Migrant only, a few records for Bluff Point (*Alternatives A and D*).
roseate tern (*Sterna dougallii*)	Petition findings not yet made - Designation of Critical Habitat (9 Northeast Species; designate Critical Habitat)	Forage throughout the NERR aquatic areas. (*Alternatives A*, *B*, *C*, *D*)

COMMON NAME (SCIENTIFIC NAME)	STATUS - REQUEST (PETITION TITLE)	COMMENTS
saltmarsh sparrow (*Ammospiza caudacuta*)	"The U.S. Fish and Wildlife Service is reviewing the saltmarsh sparrow's status and, by the end of September 2023, will make a determination of whether or not the saltmarsh sparrow warrants protection under the Endangered Species Act." This species is not in the species list of candidates, proposed, or petitions. https://fws.gov/northeast/saltmarsh-sparrow/	Breeds within the project area. (*Alternatives A*, *B*, *C*, *D*)
TURTLES		
leatherback turtle (*Dermochelys coriacea*)	Petition findings not yet made - Delisting (Sea Turtle, Leatherback, Northwest Atlantic DPS)	Observations within the NERR on iNaturalist & OBIS SEAMAP. (*Alternatives A*, *B*, *C*, *D*)

In addition to federally listed species, there are also numerous species identified as State Endangered, State Threatened, or State Special Concern (Table 5-31). The Connecticut Endangered Species Act, passed in 1989, recognizes the importance of Connecticut plant and animal populations and the need to protect them from threats that could lead to their extinction. Species are listed according to their level of risk, and their status is reviewed every five years (DEEP 2020c). Additionally, the Connecticut Wildlife Action Plan designates species with the greatest conservation need as Most Important, Very Important, and Important (see *Section 5.1.3*, page 130 for definitions of these terms).

Table 5-31: Connecticut Species of Concern—State Listed & Species of Greatest Conservation Need

This is a sub-sample of the state list for species of concern, focused on species that may occur in the project area based on NDDB results (DEEP 2021d), iNaturalist, and expert opinion and is not meant to be a complete inventory of what is found in the project area. Use of the area is indicated, referencing the likelihood the species will be found within the proposed CT NERR. "Use of Area" refers specifically to the use of the project area. Only species present, likely to be found, or found near the proposed CT NERR are included in this Table. State listing refers to the state designation for endangered, threatened, and species of concern. The Connecticut Wildlife Action Plan (CT-WAP) lists the species of Greatest Conservation Need by tier (most important, very important, important) (DEEP 2016b). Blank areas indicate the species are not state listed or not ranked as a species of Greatest Conservation Need. For the terrestrial arthropods (insects, spiders, scorpions, and mites), only the tiger beetle group is assessed in the CT-WAP and includes distribution information (DEEP 2015b). Species which are federally listed as Endangered (E) or Threatened (T) are noted following the common name. Within groups, species are sorted by common name.

(E) = Federally Endangered (T) = Federally Threatened **COMMON NAME**	**SCIENTIFIC NAME**	**USE OF AREA**	**STATE LISTING**	**CT-WAP STATUS**
PLANTS				
American beachgrass	*Ammophila breviligulata*	present		Important
American hazel	*Corylus americana*	likely		Important
American reed	*Phragmites americanus*	present	Special Concern	
awl-leaved arrowhead	*Sagittaria subulata*	present	Special Concern	
bayberry	*Morella caroliniensis*	present		Important
bayonet grass	*Bolboschoenus maritimus ssp. paludosus*	present	Special Concern	
beach pinweed	*Lechea maritima*	likely		Important
beaked hazel	*Corylus cornuta*	likely		Important
big bluestem	*Andropogon gerardii*	likely		Important
bitter panicgrass	*Panicum amarum var. amarum*	possible	Threatened	
black bugbane	*Actaea racemosa*	nearby		Important
black oak	*Quercus velutina*	present		Important
bracted orache	*Atriplex glabriuscula*	present	Special Concern	
bushy frostweed	*Crocanthemum dumosum*	Believed Extirpated	Endangered	Important
butterfly milkweed	*Asclepias tuberosa*	likely		Important
Canada sand-spurry	*Spergularia canadensis*	present	Threatened	
clasping-leaved water-horehound	*Lycopus amplectens*	present	Special Concern	
common milkweed	*Asclepias syriaca*	likely		Important
common serviceberry	*Amelanchier arborea*	present		Important
common yarrow	*Achillea millefolium*	likely		Important
cutleaf water-milfoil	*Myriophyllum pinnatum*	present	Endangered	
dragon's-mouth	*Arethusa bulbosa*	Believed Extirpated	Special Concern	Important
dwarf chinkapin oak	*Quercus prinoides*	likely		Important
dwarf serviceberry	*Amelanchier spicata*	likely		Important
eastern prickly-pear	*Opuntia humifusa*	present	Special Concern	Important
Eaton's beggarticks	*Bidens eatonii*	present	Endangered	Very Important
fern-leaf false foxglove	*Aureolaria pedicularia*	likely		Important

(E) = Federally Endangered (T) = Federally Threatened **COMMON NAME**	**SCIENTIFIC NAME**	**USE OF AREA**	**STATE LISTING**	**CT-WAP STATUS**
field paspalum	*Paspalum laeve*	present	Threatened	
greater water dock	*Rumex britannica*	likely		Important
highbush blueberry	*Vaccinium corymbosum*	present		Important
hillside blueberry	*Vaccinium pallidum*	likely		Important
lilaeopsis	*Lilaeopsis chinensis*	present	Special Concern	
little bluestem	*Schizachyrium scoparius*	present		Important
lowbush blueberry	*Vaccinium angustifolium*	likely		Important
mudwort	*Limosella australis*	present	Special Concern	
New England blazing-star	*Liatris novae-angliae*	nearby	Special Concern	Very Important
oldfield-toadflax	*Nuttallanthus canadensis*	likely		Important
Parker's pipewort	*Eriocaulon parkeri*	nearby	Endangered	Very Important
pignut hickory	*Carya glabra*	present		Important
pin cherry	*Prunus pensylvanica*	likely		Important
pitch pine	*Pinus rigida*	likely		Important
post oak	*Quercus stellata*	present		Important
prairie cordgrass	*Spartina pectinata*	present		Important
purple milkweed	*Asclepias purpurascens*	present	Special Concern	Important
pygmyweed	*Crassula aquatica*	present	Endangered	
red cedar	*Juniperus virginiana*	likely		Important
salt marsh bulrush	*Bolboschoenus novae-angliae*	present	Special Concern	
saltpond grass	*Leptochloa fusca ssp. fascicularis*	present	Endangered	
scotch lovage	*Ligusticum scoticum*	present	Endangered	
scrub oak	*Quercus ilicifolia*	likely		Important
seabeach knotweed	*Polygonum glaucum*	present	Special Concern	Important
seabeach sandwort	*Honckenya peploides*	present	Special Concern	
sea-coast angelica	*Angelica lucida*	present	Endangered	
seaside crowfoot	*Ranunculus cymbalaria*	possible	Endangered	
seaside goldenrod	*Solidago sempervirens*	present		Important
showy orchid	*Galearis spectabilis*	nearby		Important
sickle-leaved golden-aster	*Pityopsis falcata*	nearby	Endangered	Important
smooth serviceberry	*Amelanchier laevis*	likely		Important
sugar maple	*Acer saccharum*	present		Important
sundial lupine	*Lupinus perennis ssp. perennis*	unknown		Important
swamp milkweed	*Asclepias incarnata*	nearby		Important
switchgrass	*Panicum virgatum*	present		Important
tidal spikerush	*Eleocharis aestuum*	likely		Important
violet wood-sorrel	*Oxalis violacea*	present	Special Concern	
Virginia copperleaf	*Acalypha virginica*	present	Special Concern	
white meadowsweet	*Spiraea alba*	likely		Important
white thoroughwort	*Eupatorium album*	present	Endangered	
whitlow-grass	*Draba reptans*	present	Special Concern	
whorled pennywort	*Hydrocotyle verticillata*	present	Endangered	
wild columbine	*Aquilegia canadensis*	likely		Important
wild lupine	*Lupinus perennis*	likely		Important

(E) = Federally Endangered (T) = Federally Threatened COMMON NAME	SCIENTIFIC NAME	USE OF AREA	STATE LISTING	CT-WAP STATUS
woolly beach-heather	*Hudsonia tomentosa*	present	Threatened	Important
yellow nutsedge	*Cyperus esculentus*	likely		Important
yellow thistle	*Cirsium horridulum*	present	Endangered	
yellow wild indigo	*Baptisia tinctoria*	likely		Important
ARTHROPODS, TERRESTRIAL				
coastal heathland cutworm	*Abagrotis nefascia benjamini*	present	Threatened	Very Important
coppery emerald	*Somatochlora georgiana*	possible	Threatened	Very Important
false heather underwing	*Drasteria graphica atlantica*	present	Threatened	Very Important
hairy-necked tiger beetle	*Cicindela hirticollis*	present	Special Concern	Important
midland clubtail	*Gomphus fraternus*	present	Threatened	Very Important
monarch	*Danaus plexippus*	present		Important
noctuid moth	*Sympistis perscripta*	present	Special Concern	
pink streak	*Dargida rubripennis*	present	Threatened	Very Important
saltmarsh tiger beetle, margined tiger beetle	*Ellipsoptera marginata* (formerly: *Cicindela marginata*)	present	Special Concern	Important
sand wainscot moth	*Apamea lintneri*	present	Special Concern	Important
scribbled sallow moth	*Sympistis perscripta*	present	Special Concern	Important
seaside goldenrod stem borer	*Papaipema duovata*	present	Threatened	Very Important
slender flower moth	*Schinia gracilenta*	present	Endangered	Most Important
spinose flower moth	*Schinia spinosae*	present	Special Concern	Important
ARTHROPODS, MARINE				
blue crab	*Callinectes sapidus*	present		Very Important
coastal mud shrimp	*Upogebia affinis*	present		Important
fiddler crabs	*Uca spp.*	present		Important
flat claw hermit crab	*Pagurus pollicaris*	present		Important
ghost shrimp	*Gilvossius setimanus*	present		Important
grass shrimp	*Hipppolyte spp.*	present		Important
green crab	*Carcinus maenas*	present		Very Important
horseshoe crab	*Limulus polyphemus*	present		Most Important
lady crab	*Ovapiles ocellatus*	present		Very Important
mantis shrimp	*Squilaa empusa*	present		Very Important
mud crabs	*Xanthidae spp.*	present		Important
northern lobster	*Homarus americanus*	present		Most Important
rock crab	*Cancer irroratus*	present		Very Important
sand shrimp	*Crangon septemspinosa*	present		Important
shore shrimp	*Palaemonetes spp.*	present		Important
spider crab	*Libinia emarginata*	present		Important
starfish spp. (sea stars)	*Asteriid spp.*	present		Important
MOLLUSCS, FRESHWATER				
brook floater	*Alasmidonta varicosa*	nearby	Endangered	Most Important
dwarf wedge mussel	*Alasmidonta heterodon*	nearby	Endangered	Most Important
eastern pearlshell	*Margaritifera margaritifera*	present	Special Concern	Important

(E) = Federally Endangered (T) = Federally Threatened **COMMON NAME**	**SCIENTIFIC NAME**	**USE OF AREA**	**STATE LISTING**	**CT-WAP STATUS**
eastern pondmussel	*Ligumia nasuta*	present	Special Concern	Important
lymnaeid snail	*Fossaria rustica*	present	Special Concern	Important
tidewater mucket	*Leptodea ochracea*	present	Special Concern	Very Important
woodland pondsnail	*Staginicola catascopium*	present	Special Concern	Important
yellow lampmussel	*Lampsilis cariosa*	present	Endangered	Very Important
MOLLUSCS, MARINE				
bay scallop	*Argopecten irradians*	present		Most Important
blue mussel	*Mytilus edulis*	present		Very Important
channeled whelk	*Busycotypus canaliculatum*	present		Very Important
common razor clam	*Ensis directus*	present		Important
eastern oyster	*Crassostrea virginica*	present		Most Important
knobbed whelk	*Busycon carica*	present		Very Important
longfin squid	*Loligo pealeii*	present		Very Important
soft shell clam	*Mya arenaria*	present		Very Important
AMPHIBIANS				
gray treefrog	*Hyla versicolor*	present		Important
marbled salamander	*Ambystoma opacum*	present		Important
mudpuppy	*Necturus maculosus*	present	Special Concern	Important
wood frog	*Lithobates sylvatica*	present		Important
SNAKES				
eastern racer	*Coluber constrictor*	possible		Important
eastern ribbon snake	*Thamnophis sauritus*	possible	Special Concern	Very Important
TURTLES (NOT SEA TURTLES)				
eastern box turtle	*Terrapene carolina carolina*	present	Special Concern	Very Important
northern diamondback terrapin	*Malaclemys terrapin terrapin*	present	Special Concern	Important
spotted turtle	*Clemmys guttata*	present	Special Concern	Very Important
SEA TURTLES				
green turtle (T)	*Chelonia mydas*	passage	Threatened	Very Important
Kemp's ridley turtle (E)	*Lepidochelys kempii*	passage	Endangered	Most Important
leatherback turtle (E)	*Dermochelys coriacea*	passage	Endangered	Most Important
loggerhead turtle (T)	*Caretta caretta*	passage	Threatened	Very Important
FRESHWATER FISH				
brown trout (wild)	*Salmo trutta*	passage / present		Most Important
chain pickerel	*Esox niger*	present		Very Important
golden shiner	*Notemigonus crysoleucas*	present		Important
largemouth bass	*Micropterus salmoides*	present		Important
pumpkinseed	*Lepomis gibbosus*	present		Important
redbreast sunfish	*Lepomis auritus*	present		Important
white sucker	*Catostomus commersoni*	present		Important
yellow perch	*Perca flavescens*	present		Important
ANADROMOUS FISH				
alewife	*Alosa pseudoharengus*	passage / present		Most Important

(E) = Federally Endangered (T) = Federally Threatened **COMMON NAME**	**SCIENTIFIC NAME**	**USE OF AREA**	**STATE LISTING**	**CT-WAP STATUS**
American eel	*Anguilla rostrata*	passage / present		Most Important
American shad	*Alosa sapidissima*	passage / present		Very Important
Atlantic salmon (E)	*Salmo salar*	passage		Very Important
Atlantic sturgeon (E)	*Acipenser oxyrinchus oxyrinchus*	passage / present	Endangered	Most Important
blueback herring	*Alosa aestivalis*	passage / present	Special Concern	Most Important
hickory shad	*Alosa mediocris*	passage / present		Very Important
rainbow smelt	*Osmerus mordax*	passage / present	Endangered *anadromous only*	Most Important
sea lamprey	*Petromyzon marinus*	passage / present		Very Important
shortnose sturgeon (E)	*Acipenser brevirostrum*	passage / present	Endangered	Most Important
MARINE FISH				
American sand lance	*Ammodytes americanus*	present		Very Important
Atlantic herring	*Clupea harengus*	present		Important
Atlantic menhaden	*Brevoortia tyrannus*	present		Important
Atlantic seasnail	*Liparis atlanticus*	present	Special Concern	Important
Atlantic silverside	*Menidia menidia*	present		Important
Atlantic tomcod	*Microgadus tomcod*	present		Most Important
bay anchovy	*Anchoa mitchilli*	present		Important
black seabass	*Centropristis striata*	present		Important
butterfish	*Peprilus triacanthus*	present		Important
clearnose skate	*Raja eglanteria*	present		Important
cunner	*Tautogolabrus adspersus*	present		Very Important
fourspine stickleback	*Apeltes quadracus*	present		Very Important
fourspot flounder	*Hippoglossina oblonga*	present		Important
hogchoker	*Trinectes maculatus*	present		Important
lined seahorse	*Hippocampus erectus*	present		Important
mummichog	*Fundulus heteroclitus*	present		Very Important
northern pipefish	*Syngnathus fuscus*	present		Important
northern searobin	*Prionotus carolinus*	present		Important
ocean pout	*Zoarces americanus*	present		Important
oyster toadfish	*Opsanus tau*	present		Important
radiated shanny	*Ulvaria subbifurcata*	present	Special Concern	Important
red hake	*Urophycis chuss*	present		Important
sand tiger shark	*Carcharias taurus*	present	Special Concern	Important
sandbar shark	*Carcharhinus plumbeus*	present		Important
scup	*Stenotomus chrysops*	present		Important
sea raven	*Hemitripterus americanus*	present		Very Important
sheepshead minnow	*Cyprinodon variegatus variegatus*	present		Important
silver hake	*Merluccius bilinearis*	present		Important

(E) = Federally Endangered (T) = Federally Threatened **COMMON NAME**	**SCIENTIFIC NAME**	**USE OF AREA**	**STATE LISTING**	**CT-WAP STATUS**
smooth dogfish	*Mustelus canis*	present		Important
spiny dogfish	*Squalus acanthias*	present		Important
striped bass	*Morone saxatilis*	migrant		Important
striped searobin	*Prionotus evolans*	present		Important
tautog	*Tautoga onitis*	present		Most Important
threespine stickleback	*Gasterosteus aculeatus*	present		Important
weakfish	*Cynoscion regalis*	present		Important
windowpane flounder	*Scophthalmus aquosus*	present		Very Important
winter flounder	*Pseudopleuronectes americanus*	present		Most Important
winter skate	*Leucoraja ocellata*	present		Important
BIRDS				
American bittern	*Botaurus lentiginosus*	migrant	Endangered	Very Important
American black duck	*Anas rubripes*	nesting		Very Important
American oystercatcher	*Haematopus palliatus*	nesting	Threatened	Very Important
American woodcock	*Scolopax minor*	nesting		Most Important
bald eagle	*Haliaeetus leucocephalus*	present	Threatened	Important
Baltimore oriole	*Icterus galbula*	nesting		Important
bank swallow	*Riparia riparia*	migrant		Very Important
barn owl	*Tyto alba*	migrant	Endangered	Most Important
black scoter	*Melanitta americana*	migrant		Important
black-and-white warbler	*Mniotilta varia*	nesting		Important
black-billed cuckoo	*Coccyzus erythropthalmus*	nesting		Very Important
blue-winged warbler	*Vermivora cyanoptera*	nesting		Most Important
bobolink	*Dolichonyx oryzivorus*	migrant	Special Concern	Very Important
broad-winged hawk	*Buteo platypterus*	migrant	Special Concern	Very Important
brown thrasher	*Toxostoma rufum*	present	Special Concern	Very Important
Canada warbler	*Cardellina canadensis*	migrant		Very Important
cerulean warbler	*Setophaga cerulea*	migrant	Special Concern	Very Important
chestnut-sided warbler	*Setophaga pensylvanica*	migrant		Very Important
chimney swift	*Chaetura pelagica*	nesting		Very Important
clapper rail	*Rallus crepitans*	nesting		Very Important
cliff swallow	*Petrochelidon pyrrhonota*	migrant		Important
common moorhen	*Gallinula chloropus*	nesting	Endangered	Very Important
common loon	*Gavia immer*	migrant	Special Concern	Important
common tern	*Sterna hirundo*	nesting	Special Concern	Important
eastern kingbird	*Tyrannus tyrannus*	nesting		Important
eastern towhee	*Pipilo erythrophthalmus*	nesting		Very Important
eastern wood-pewee	*Contopus virens*	nesting		Important
field sparrow	*Spizella pusilla*	nesting		Very Important
glossy ibis	*Plegadis falcinellus*	present	Special Concern	Important
golden-winged warbler	*Vermivora chrysoptera*	migrant	Endangered	Most Important
grasshopper sparrow	*Ammodramus savannarum*	rare migrant	Endangered	Most Important
great egret	*Ardea alba*	present	Threatened	Very Important
greater scaup	*Aythya marila*	migrant		Very Important
horned lark	*Eremophila alpestris*	migrant	Endangered	Most Important

(E) = Federally Endangered (T) = Federally Threatened **COMMON NAME**	**SCIENTIFIC NAME**	**USE OF AREA**	**STATE LISTING**	**CT-WAP STATUS**
indigo bunting	*Passerina cyanea*	nesting		Very Important
Ipswich sparrow	*Passerculus sandwichensis* ssp. *princeps*	migrant	Special Concern	Important
king rail	*Rallus elegans*	nesting	Endangered (nesting population only)	Very Important
least bittern	*Ixobrychus exilis*	nesting	Threatened	Very Important
least tern	*Sternula antillarum*	nesting	Threatened	Most Important
little blue heron	*Egretta caerulea*	present	Special Concern	Important
long-eared owl	*Asio otus*	migrant	Endangered	Very Important
marsh wren	*Cistothorus palustris*	nesting		Very Important
northern flicker	*Colaptes auratus*	nesting		Very Important
northern harrier	*Circus hudsonius*	present	Endangered	Most Important
northern saw-whet owl	*Aegolius acadicus*	migrant	Special Concern	Important
northern waterthrush	*Parkesia noveboracensis*	migrant		Important
osprey	*Pandion haliaetus*	nesting		Important
ovenbird	*Seiurus aurocapillus*	nesting		Important
peregrine falcon	*Falco peregrinus*	present	Threatened	Important
pied-billed grebe	*Podilymbus podiceps*	migrant	Endangered	Most Important
piping plover (T)	*Charadrius melodus*	nesting	Threatened	Most Important
prairie warbler	*Setophaga discolor*	present		Most Important
purple martin	*Progne subis*	present	Special Concern	Important
red-headed woodpecker	*Melanerpes erythrocephalus*	migrant	Endangered	Most Important
roseate tern (E)	*Sterna dougallii*	present	Endangered	Most Important
rose-breasted grosbeak	*Pheucticus ludovicianus*	nesting		Important
ruddy turnstone	*Arenaria interpres*	migrant		Important
saltmarsh sharp-tailed sparrow	*Ammospiza caudacuta*	nesting	Special Concern	Most Important
sanderling	*Calidris alba*	migrant		Very Important
Savannah sparrow	*Passerculus sandwichensis*	migrant	Special Concern	Important
scarlet tanager	*Piranga olivacea*	nesting		Very Important
seaside sparrow	*Ammospiza maritima*	nesting	Threatened	Very Important
semipalmated sandpiper	*Calidris pusilla*	migrant		Very Important
sharp-shinned hawk	*Accipiter striatus*	migrant	Endangered	Most Important
short-eared owl	*Asio flammeus*	migrant	Threatened (wintering populations only)	Important
snowy egret	*Egretta thula*	present	Threatened	Most Important
sora	*Porzana carolina*	nesting		Important
surf scoter	*Melanitta perspicillata*	migrant		Important
veery	*Catharus fuscescens*	nesting		Important
Virginia rail	*Rallus limicola*	nesting		Important
whip-poor-will	*Caprimulgus vociferus*	nesting	Special Concern	Most Important
white-eyed vireo	*Vireo griseus*	nesting		Important
white-winged scoter	*Melanitta deglandi*	migrant		Very Important
willet	*Tringa semipalmata*	nesting		Important

(E) = Federally Endangered (T) = Federally Threatened **COMMON NAME**	**SCIENTIFIC NAME**	**USE OF AREA**	**STATE LISTING**	**CT-WAP STATUS**
willow flycatcher	*Empidonax traillii*	nesting		Important
wood thrush	*Hylocichla mustelina*	nesting		Most Important
worm-eating warbler	*Helmitheros vermivorum*	nesting		Very Important
yellow-billed cuckoo	*Coccyzus americanus*	nesting		Very Important
yellow-breasted chat	*Icteria virens*	nesting	Endangered	Very Important
yellow-crowned night-heron	*Nyctanassa violacea*	present	Special Concern	Important
MAMMALS, TERRESTRIAL				
American water shrew	*Sorex palustris*	present		Very Important
big brown bat	*Eptesicus fuscus*	present		Most Important
deer mouse	*Peromyscus maniculatus*	possible		Very Important
Eastern small-footed bat	*Myotis leibii*	possible	Endangered	Most Important
hoary bat	*Lasiurus cinereus*	possible	Special Concern	Most Important
little brown bat	*Myotis lucifugus*	possible	Endangered	Most Important
long-tailed weasel	*Mustela frenata*	present		Important
meadow jumping mouse	*Zapus hudsonius*	present		Very Important
mink	*Mustela vison*	present		Important
muskrat	*Ondatra zibethicus*	present		Important
New England cottontail	*Sylvilagus transitionalis*	present		Most Important
northern long-eared bat (T)	*Myotis septentrionalis*	possible	Endangered	Most Important
red bat	*Lasiurus borealis*	possible	Special Concern	Most Important
short-tailed weasel	*Mustela erminea*	present		Important
silver-haired bat	*Lasionycteris noctivagans*	possible	Special Concern	Most Important
MAMMALS, MARINE				
harbor porpoise	*Phocoena phocoena*	passage	Special Concern	Very Important
harbor seal	*Phoca vitulina*	present		Important

5.1.3.3.1.3 Other Marine Mammals

All marine mammals are protected under the federal Marine Mammal Protection Act (16 U.S.C. §§ 1361—1423h). For additional information on the Marine Mammal Protection Act and its relevancy to the proposed action, see *Chapter 7*. In addition to the five marine mammals considered under the Endangered Species Act (which are unlikely to be found in the project areas), there are eight additional species of marine mammals that have been observed in the project area, but which are not protected under the Endangered Species Act (Table 5-32).

Table 5-32: Other Marine Mammals

All species listed are covered under the Marine Mammal Protection Act (MMPA) (16 U.S.C. §§ 1361—1423h). This list includes all North Atlantic species observed or expected in the project area based on the iNaturalist database; use of the area is indicated, referencing the likelihood the species would be found within the project area. None of the species likely to occur in the project area are federally listed as endangered or threatened. The CITES appendix column indicates the appendix in which the species is listed, blank areas indicate no listing. Species listed as "depleted" in the MMPA are noted. Asterisks denote the Connecticut Wildlife Action Plan (CT-WAP) status, where ** = very important and * = important. SSC indicates a State Species of Concern.

COMMON NAME	SPECIES NAME	USE OF AREA	CITES APPENDIX	MMPA DEPLETED
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	vagrant	II	
common bottlenose dolphin	*Tursiops truncatus*	vagrant	II	x
harbor porpoise** SSC	*Phocoena phocoena*	passage	II	
humpback whale	*Megaptera novaeangliae*	passage	II	
gray seal	*Halichoerus grypus atlantica*	winter		
harbor seal*	*Phoca vitulina*	resident		
harp seal	*Pagophilus groenlandicus*	vagrant		
hooded seal	*Cystophora cristata*	vagrant		

Atlantic White-Sided Dolphin (Lagenorhynchus acutus)

Atlantic white-sided dolphins are fast swimming, found in large social groups of five to fifty animals, and often engage in acrobatic activity. They feed on small schooling and bottom fish (e.g., cod, hake, herring, mackerel, smelt, sand lance), crustaceans (e.g., shrimp), and cephalopods (e.g., squid). These dolphins are found in the temperate waters of the North Atlantic Ocean, usually on or at the edge of the continental shelf in waters usually less than 330 feet deep and may also be found in relatively shallow oceanic waters. In the United States, they are found off the coast of North Carolina to Maine. The worldwide population of Atlantic white-sided dolphins is unknown, but scientists estimate there are at least hundreds of thousands. To manage Atlantic white-sided dolphins in U.S. waters, NOAA Fisheries has placed them into one stock: the western North Atlantic stock, estimated at 93,233 dolphins in the most recent survey.

The majority of species sightings occur southeast and east of Cape Cod (Halpin et al. 2009). Within the period of 1990 to 2011, a total of 16 cetaceans (all species) stranded in Connecticut with four of those strandings in New London County (Smith 2013). Three of these dolphins stranded in Connecticut during this time period, though not in New London County.

Threats include entanglement in fishing gear (e.g., driftnets, gillnets, trawls), ocean noise which interrupts their normal behavior and may cause hearing loss, and they have been directly hunted and killed for food and oil in the drive fisheries of the Faroe Islands, Greenland, Newfoundland (Canada), and Norway. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternatives A and *D* include over 40,000 acres of potential area where this species could visit, though sightings are relatively rare in the project area.

Alternatives B and *C* include less than half of the area of Alternatives A and D potentially suitable to this species. As with Alternatives A and D, sightings are rare.

Common Bottlenose Dolphin (Tursiops truncatus)

Common bottlenose dolphins are found throughout the world in both offshore and coastal waters, including harbors, bays, gulfs, and estuaries of temperate and tropical waters. They are easy to view in the wild because they live close to shore and are distributed throughout coastal and estuarine waters, but this increases their risk of human-related injuries and death. Bottlenose dolphins may travel alone or in groups, and the groups continually break apart and reform. Bottlenose dolphins can thrive in many environments and feed on a variety of prey, such as fish, squid, and crustaceans (e.g., crabs and shrimp).

While not usually observed within the project area, a large number of sightings have occurred south of Block Island Sound, south of Long Island, 37 miles from the project area, with a much larger concentration of sightings at the margin of the continental shelf, more than 120 miles from Long Island Sound (Halpin et al. 2009). No strandings of this species occurred in Connecticut during that time period (Smith 2013).

Threats include entanglement, illegal feeding and harassment, habitat degradation, noise, chemical contaminants, oil spills and energy exploration, disease, biotoxins, and vessel collisions. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternatives A and *D* include over 40,000 acres of potential area where this species could visit, though sightings are relatively rare in the project area.

Alternatives B and *C* include less than half of the area of Alternatives A and D potentially suitable to this species. As with Alternatives A and D, sightings are rare.

Harbor Porpoise (Phocoena phocoena)

They are most often seen singly, in pairs, or in groups of up to 10, although there are reports of aggregations of up to 200 harbor porpoises. Most seasonal movements appear to be inshore-offshore and may be influenced by prey availability or the presence of ice-free waters. Harbor porpoises mainly eat schooling fish, like herring and mackerel. Occasionally, they will eat squid and octopus.

This species is most frequently seen live off the coast of Maine with another dense cluster of sightings south of Long Island, more than 75 miles from the project area. Sightings in the project area are most often associated with strandings (Halpin et al. 2009), including 33 strandings in Rhode Island and six in Connecticut between 1990 and 2011 (Smith 2013).

Because they prefer coastal habitats, harbor porpoises are particularly vulnerable to gillnets and fishing traps, pollution, and other types of human disturbance, such as underwater noise. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternatives A and *D* include over 40,000 acres of potential area where this species could visit, though sightings are relatively rare in the project area.

Alternatives B and *C* include less than half of the area of Alternatives A and D potentially suitable to this species. As with Alternatives A and D, sightings are rare.

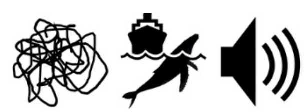
Humpback Whale (Megaptera novaeangliae)

Humpback whales were listed as endangered under the Endangered Species Conservation Act in 1970, and then under the Federal Endangered Species Act in 1973 (NOAA Fisheries 2021l). The International Whaling Commission's final whaling moratorium on commercial harvest, in effect since 1985, played a major role in the recovery of humpback whales. Currently, four out of the 14 distinct population segments are still protected as endangered, and one is listed as threatened (81 FR 62259, September 2016). Whales that feed in the western North Atlantic are part of the West Indies distinct population segment and managed as the Gulf of Maine stock, which was delisted in 2016 and is not considered depleted.

Humpback whales are a species of large rorqual baleen whale. They are seasonally common in the waters offshore of New England, especially on Jeffery's Ledge and Stellwagen Bank. They are highly migratory and New England's whales spend the winter in the warmer waters of the Caribbean and are found in our area from March to November. Their habitat in New England consists of shallow to deep oceanic and estuarine waters rich with prey items. Their diet consists of small schooling fish and their main prey in the project area is likely Atlantic menhaden (*Brevoortia tyrannus*), though the American sand lance has also been mentioned as a potential lure to the whales (*Ammodytes americanus*) (Hladky 2018).

These whales occur nearly annually in Western Long Island Sound, but confirmed sightings in the eastern Long Island Sound were absent until 2015 (Hladky 2018); since then, the whales have been seen annually off of New London, within the project area for all boundary alternatives (Dempsey 2020; Hladky 2018). No strandings of this species occurred in Connecticut during that time period.

Threats to humpback whales include entanglement in fishing gear, vessel strikes, vessel-based harassment, and underwater noise. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).



Summary by Boundary Alternative

Alternatives A and *D* include over 40,000 acres of potential area where this species could visit, though sightings are relatively rare in the project area.

Alternatives B and **C** include less than half of the area of Alternatives A and D potentially suitable to this species. As with Alternatives A and D, sightings are rare.

Gray Seal (Halichoerus grypus atlantica)

Gray seals are found in coastal waters throughout the North Atlantic Ocean. They gather in large groups during the mating / pupping and molting seasons. Outside of this, they often share their habitat with harbor seals. Gray seals can dive to 1,560 feet for as long as one hour. On average they can eat four to six% of their body weight in food each day, but do not eat during the mating / pupping or molting seasons. They eat fish (mostly sand eels, hake, whiting, cod, haddock, pollock, and flatfish), crustaceans, squid, octopuses, and sometimes even seabirds. There are three stocks of gray seals worldwide, the local stock is the western North Atlantic stock (eastern Canada and the northeastern United States).

This species is a common winter-time visitor to the project area, though some theorize that like the harbor seal, this seal may soon start breeding in eastern Connecticut waters and establish a year-round presence (Lynch 2017). Associated with the frequent visits, strandings are also high, with 97 strandings in Rhode Island and 10 in Connecticut between 1990 and 2011 (Smith 2013).

Threats include entanglement, harassment, chemical contaminants, oil spills and energy exploration, and vessel and vehicle interactions. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternatives A and *D* include over 40,000 acres of potential area where this species has been sighted. The eastern area closer to the Atlantic Ocean is a popular and rich foraging ground for seals and many more seals are seen closer to the eastern end of the project area compared to the area at the mouth of the Connecticut River.

Alternatives B and *C* include less than half of the area of Alternatives A and D potentially suitable to this species. Sightings occur in Alternatives B and C, but these alternatives have fewer sightings than the eastern end of the project area included in Alternatives A and D.

Harbor Seal (Phoca vitulina)

In the United States, NOAA Fisheries has identified 16 stocks of harbor seals; 15 are in the Pacific Ocean with the 16th being the western North Atlantic stock. Harbor seals haul out (rest) on rocks, reefs, beaches, and drifting glacial ice when they are not traveling or foraging at sea. They haul out to rest, regulate their body temperature, molt, interact with other seals, give birth, and nurse their pups. These seals also haul out in groups to avoid predators and spend less time being watchful for predators than those that haul out alone. The harbor seal’s diet consists mainly of fish, shellfish, and crustaceans.

This species is the most frequently seen seal in the project area, with seals often hauling out on the rock piles in eastern Long Island Sound and especially in western Fishers Island Sound during the winter and visible throughout the rest of the year. The species used to be a winter visitor, but now small numbers breed in Connecticut waters (Lynch 2017). Coincident with the large population of transient visitors and

year-round residents, a large number of strandings occur, including 30 in Connecticut between 1990 and 2011 (Smith 2013).

Threats include entanglement, illegal feeding and harassment, habitat degradation and loss, chemical contaminants, oil spills and energy exploration, vessel collisions, disturbance, and disease. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternatives A and *D* include over 40,000 acres of potential area where this species has been sighted. The eastern area closer to the Atlantic Ocean is a popular and rich foraging ground for seals and many more seals are seen closer to the eastern end of the project area compared to the area at the mouth of the Connecticut River. The eastern end also includes many mid-water rock clumps which are ideal hauling out locations for this species.

Alternatives B and *C* include less than half of the area of Alternatives A and D potentially suitable to this species. Sightings occur in Alternatives B and C, but these alternatives have fewer rock clumps and fewer sightings than the eastern end of the project area included in Alternatives A and D.

Harp Seal (Pagophilus groenlandicus)

Harp seals live throughout the cold waters of the North Atlantic and Arctic Oceans. Harp seals gather in large groups of up to several thousand to molt and breed. Three populations in the North Atlantic are grouped into a single North Atlantic stock by NOAA Fisheries for management purposes. They eat many different types of fish and invertebrates (more than 130 species). Their most common prey is smaller fish such as capelin, Arctic cod, and polar cod.

This species is more commonly found north of the Saint Lawrence River, off Newfoundland and Labrador, with a high number of sightings in the waters around Iceland. The seal is a rare sight but a regular visitor to eastern Long Island Sound and western Fishers Island Sound. Between 1990 and 2011, 189 seals stranded in Rhode Island and 82 in Connecticut with about half of the strandings being live animals (Smith 2013).

Threats include hunting, vessel strikes, entanglement, habitat degradation, overfishing, chemical contaminants, oil spills and energy exploration, and climate change. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternatives A and *D* include over 40,000 acres of potential area where this species could visit, though sightings are relatively rare in the project area. The eastern area closer to the Atlantic Ocean is a popular and rich foraging ground for seals and many more seals are seen closer to the eastern end of the project area compared to the area at the mouth of the Connecticut River.

Alternatives B and *C* include less than half of the area of Alternatives A and D potentially suitable to this species. As with Alternatives A and D, sightings are rare.

Hooded Seal (Cystophora cristata)

Hooded seals live in the cold waters of the North Atlantic and Arctic Oceans. Hooded seals are not social. They migrate and remain alone for most of the year except during mating season. They eat squid, starfish, and mussels. They also eat several types of fish, including Greenland halibut, redfish, Atlantic and Arctic cod, capelin, and herring. Newly weaned pups feed on pelagic crustaceans.

Like the harp seal, this species is more commonly found north of the Saint Lawrence River, off Newfoundland and Labrador, with a higher number of sightings in the waters around Iceland. The seal is a rare sight in the project area. Between 1990 and 2011, 24 hooded seals stranded in Rhode Island and eight in Connecticut with about two thirds of the strandings being live animals (Smith 2013).

Threats include hunting, entanglement, and climate change. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

Alternatives A and *D* include over 40,000 acres of potential area where this species could visit, though sightings are relatively rare in the project area. The eastern area closer to the Atlantic Ocean is a popular and rich foraging ground for seals and many more seals are seen closer to the eastern end of the project area compared to the area at the mouth of the Connecticut River.

Alternatives B and *C* include less than half of the area of Alternatives A and D potentially suitable to this species. As with Alternatives A and D, sightings are rare.

5.1.3.3.2 Essential Fish Habitat

Under the Magnuson-Stevens Fishery Conservation and Management Act, Fishery Management Councils identify Essential Fish Habitat for marine and anadromous species, as defined in 16 U.S.C. § 1855(b). See *Chapter 7* of this document for additional discussion on the Magnuson-Stevens Fishery Conservation and Management Act and its relevance to the proposed action.

Essential Fish Habitat (EFH) includes all waters and substrate necessary for fish for spawning, breeding, feeding, or growth to maturity. Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act, the marine water column and seafloor in and surrounding the project area of the proposed action have been designated as EFH, which supports various life stages of management unit species identified in the New England and Mid-Atlantic Fishery Management Council's plans as listed in Table 5-33.

In particular, the area of the proposed CT NERR, eastern Long Island Sound and western Fishers Island Sound, has been designated as a Habitat Area of Particular Concern (HAPC) for summer flounder. The HAPC for summer flounder is defined as all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH. In locations where native species have been eliminated from an area, then exotic species are included. The Habitat Area of Particular Concern designation does not confer additional protection or restrictions upon an area, but can help prioritize conservation efforts.

Threats include barriers to migration for anadromous fish, habitat disturbance and degradation through activities like dredging, pollution and marine debris, and the impacts on species distribution and food availability related to climate change. Overfishing of species should be minimized through proper management, but bycatch is an issue. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternatives A and *D* include over 40,000 acres of submerged area providing EFH. For most species, the whole project area is considered EFH. For albacore tuna and Atlantic cod, only the eastern portion of the project area is EFH. Spiny dogfish EFH includes all of the project area except for the Thames River and the area south of the river. The entire area is HAPC for summer founder but the eastern portion of the project area includes seagrass beds which are specifically identified as supportive of summer flounder.

Alternatives B and *C* include less than half of the area of Alternatives A and D, providing less overall EFH. In addition, no EFH for albacore tuna and Atlantic cod are included. These alternatives also lack submerged seagrass beds common in Alternatives A and D that are identified as a habitat supportive of summer flounder in the HAPC.

Table 5-33: Essential Fish Habitat

Essential Fish Habitat (EFH) in or near the proposed CT NERR as identified by NOAA (NOAA Fisheries 2021b). The proposed CT NERR also includes Habitat Area of Particular Concern (HAPC) for the summer flounder. Data were obtained from the NOAA EFH Mapper by selecting four areas within the project area for review https://www.habitat.noaa.gov/application/efhmapper/index.html).

COMMON NAME **(*SCIENTIFIC NAME*)**	**LIFESTAGES(S) FOUND**	**MANAGEMENT COUNCIL**	**FISHERY MANAGEMENT PLAN**
EFH THROUGHOUT PROJECT AREA			
little skate (*Leucoraja erinacea*)	Juvenile Adult	New England	Amendment 2 to the Northeast Skate Complex Fishery Management Plan
Atlantic herring (*Clupea harengus*)	Juvenile Adult	New England	Amendment 3 to the Atlantic Herring Fishery Management Plan
pollock (*Pollachius virens*)	Juvenile Adult	New England	Amendment 14 to the Northeast Multispecies Fishery Management Plan
red hake (*Urophycis chuss*)	Eggs Larvae Juvenile Adult	New England	Amendment 14 to the Northeast Multispecies Fishery Management Plan

COMMON NAME (*SCIENTIFIC NAME*)	**LIFESTAGES(S) FOUND**	**MANAGEMENT COUNCIL**	**FISHERY MANAGEMENT PLAN**
windowpane flounder (*Scophthalmus aquosus*)	Eggs Larvae Juvenile Adult	New England	Amendment 14 to the Northeast Multispecies Fishery Management Plan
winter flounder (*Pseudopleuronectes americanus*)	Eggs Larvae Juvenile Adult	New England	Amendment 14 to the Northeast Multispecies Fishery Management Plan
winter skate (*Leucoraja ocellata*)	Juvenile Adult	New England	Amendment 2 to the Northeast Skate Complex Fishery Management Plan
sand tiger shark (*Carcharias taurus*)	Neonate Juvenile	Secretarial	Amendment 10 to the 2006 Consolidated Highly Migratory Species Fishery Management Plan: Essential Fish Habitat
smoothhound shark complex (*Mustelus canis* & *Mustelus norrisi* (Atlantic stock))	ALL	Secretarial	Amendment 10 to the 2006 Consolidated Highly Migratory Species Fishery Management Plan: Essential Fish Habitat
bluefish (*Pomatomus saltatrix*)	Juvenile Adult	Mid-Atlantic	Amendment 1 to the Bluefish Fishery Management Plan
Atlantic mackerel (*Scomber scombrus*)	Eggs Larvae Juvenile Adult	Mid-Atlantic	Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan Amendment 11
longfin inshore squid (*Doryteuthis pealeii*)	Eggs Juvenile Adult	Mid-Atlantic	Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan Amendment 11
Atlantic butterfish (*Peprilus triacanthus*)	Eggs Larvae Juvenile Adult	Mid-Atlantic	Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan Amendment 11

COMMON NAME (*SCIENTIFIC NAME*)	LIFESTAGES(S) FOUND	MANAGEMENT COUNCIL	FISHERY MANAGEMENT PLAN
scup (*Stenotomus chrysops*)	Eggs Larvae Juvenile Adult	Mid-Atlantic	Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan
summer flounder (*Paralichthys dentatus*)	Juvenile Adult	Mid-Atlantic	Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan
black sea bass (*Centropristis striata*)	Juvenile	Mid-Atlantic	Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan
EFH IN PORTIONS OF PROJECT AREA			
albacore tuna (*Thunnus alalunga*), *east of Thames River*	Juvenile	Secretarial	Amendment 10 to the 2006 Consolidated Highly Migratory Species Fishery Management Plan: Essential Fish Habitat
Atlantic cod (*Gadus morhua*), east of Niantic Bay	Adult	New England	Amendment 14 to the Northeast Multispecies Fishery Management Plan
spiny dogfish, (*Squalus acanthias*), east and west end of project area, not Thames R. mouth	Sub-Adult Female Adult Male	Mid-Atlantic	Amendment 3 to the Spiny Dogfish Fishery Management Plan

5.1.3.3.3 Migratory Birds

Many migratory birds have been recorded as visiting the project area (Table 5-34). The U.S. Fish and Wildlife Service has statutory authority and responsibility for enforcing the Migratory Bird Treaty Act. *Chapter 7* describes in more detail the Migratory Bird Treaty Act and its relevancy to the proposed action. Numerous species protected under the Migratory Bird Treaty Act may be found within the project area and these species will be considered collectively for the impact analysis.

Many migratory birds could potentially be found in the project area (Table 5-34). According to the U.S. Fish and Wildlife Service Information for Planning and Conservation (IPaC) report, there are 64 migratory birds that could potentially be found in the affected environment, as listed by U.S. Fish and Wildlife Service’s Environmental Conservation Online System.

The largest threats to migratory birds are habitat loss and degradation. Climate change is altering food availability and water resources. Human commensal predators (including cats) are a problem for some species while nesting, as residents, or during migration. Collision hazards also kill large numbers of migratory birds and pesticides may directly harm them or their forage species. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternative A includes 1,870 acres of terrestrial properties and marshes, including salt marshes and uplands in the eastern portion of the project area and brackish marshes in the western portions of the project area. This alternative includes the Ramsar wetlands of the lower Connecticut River and the Bluff Point complex, known for its diversity of migrating birds.

Alternative B includes 1,555 acres of terrestrial properties and marshes, including the brackish and freshwater marshes in the western portions of the project area but lacking the salt marshes and coastal uplands in the eastern portion of the project area. This alternative includes the Ramsar wetlands of the lower Connecticut River and extends northward in the River to add Machimoodus State Park and Haddam Neck State Park, thus gaining some upland areas and freshwater marshes. However, this alternative lacks the Bluff Point complex, which means this alternative does not include salt marsh habitat.

Alternative C includes 934 acres of terrestrial properties and marshes, including the brackish marshes in the lower Connecticut River but lacking the salt marshes and uplands in the eastern end of the project area (Alternative A) and the freshwater marshes and uplands of Alternative B. This alternative includes the Ramsar wetlands of the lower Connecticut River but misses significant uplands, salt marshes, and freshwater marshes found in other alternatives.

Alternative D is similar to Alternative A for migratory bird uses.

Table 5-34: Migratory Birds Covered by the Migratory Bird Treaty Act

The list of migratory birds was output from the U.S. Fish and Wildlife Service's (USFWS) Environmental Conservation Online System for the project area.

The Migratory Bird Status USFWS categories (as defined by USFWS): **BCC Rangewide (CON)** = This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska; **Non-BCC Vulnerable** = This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities; **BCC - BCR** = This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Federal Status: **E** = endangered, **T** = threatened, **AR** = at risk.

State Status: **E** = endangered, **T** = threatened, **SC** = species of concern.

An **X, R, W, S,** or **B** indicates the bird has been recorded in the properties shown, typically through the state NDDB (DEEP 2021d) survey or eBird (eBird 2021). **X** = observed (>9 months / y); **R** = observed but rare; **V** = vagrant; **W** = more observations in winter; **S** = more observations in summer; **B** = may potentially breed in the area, based on timing of occupation relative to breeding season.

All properties refer to both the aquatic and terrestrial areas within the general region of that property. For example, Bluff Point / Haley Farm indicates the terrestrial, marsh and nearshore subtidal area near those properties. Long Island Sound / Fishers Island Sound refers to the deeper areas up to the mean higher high water line of properties adjacent to these bodies of water not included in the other categories.

COMMON NAME	*SCIENTIFIC NAME*	MIGRATORY BIRD STATUS	FEDERAL STATUS	STATE STATUS	Bluff Point / Haley Farm	Thames River / Avery Point	Lower Connecticut River	Salmon River	Long Island Sound / Fishers Island Sound
					ALTERNATIVES				
					A,D	A,D	A,B C,D	B	A,B C,D
American oystercatcher	*Haematopus palliatus*	BCC Rangewide (CON)		T	XB	XB	XB		XB
bald eagle	*Haliaeetus leucocephalus*	Non-BCC Vulnerable		T	XB	XB	XB	XB	XB
black scoter	*Melanitta americana*	Non-BCC Vulnerable			X	X	X		X
black skimmer	*Rynchops niger*	BCC Rangewide (CON)			S	S	S		
black-billed cuckoo	*Coccyzus erythropthalmus*	BCC Rangewide (CON)			SB			SB	
black-legged kittiwake	*Rissa tridactyla*	Non-BCC Vulnerable				W			W
bobolink	*Dolichonyx oryzivorus*	BCC Rangewide (CON)		SC	X		X	X	

COMMON NAME	*SCIENTIFIC NAME*	MIGRATORY BIRD STATUS	FEDERAL STATUS	STATE STATUS	Bluff Point / Haley Farm	Thames River / Avery Point	Lower Connecticut River	Salmon River	Long Island Sound / Fishers Island Sound
					ALTERNATIVES				
					A,D	A,D	A,B C,D	B	A,B C,D
Bonaparte's gull	*Chroicocephalus philadelphia*	Non-BCC Vulnerable			X	X	X	X	X
bridled tern	*Onychoprion anaethetus*	Non-BCC Vulnerable							RS
brown pelican	*Pelecanus occidentalis*	Non-BCC Vulnerable					V		V
buff-breasted sandpiper	*Calidris subruficollis*	BCC Rangewide (CON)			R	R	R		
Canada warbler	*Cardellina canadensis*	BCC Rangewide (CON)			S	S	S	S	S
cerulean warbler	*Setophaga cerulea*	BCC Rangewide (CON)		SC	S		S	S	
clapper rail	*Rallus crepitans*	BCC - BCR			SB		SB		SB
common eider	*Somateria mollissima*	Non-BCC Vulnerable			X	X	X		X
common loon	*Gavia immer*	Non-BCC Vulnerable		SC	X	X	X	X	X
common murre	*Uria aalge*	Non-BCC Vulnerable				W			W
common tern	*Sterna hirundo*	Non-BCC Vulnerable		SC	SB	SB	SB		SB
Cory's shearwater	*Calonectris diomedea*	Non-BCC Vulnerable							R
double-crested cormorant	*Phalacrocorax auritus*	Non-BCC Vulnerable			XB	XB	XB		XB
dovekie	*Alle alle*	Non-BCC Vulnerable			R	R			R
dunlin	*Calidris alpina arcticola*	BCC - BCR			X	X	X		X

COMMON NAME	*SCIENTIFIC NAME*	MIGRATORY BIRD STATUS	FEDERAL STATUS	STATE STATUS	Bluff Point / Haley Farm	Thames River / Avery Point	Lower Connecticut River	Salmon River	Long Island Sound / Fishers Island Sound
					ALTERNATIVES				
					A,D	A,D	A,B C,D	B	A,B C,D
eastern whip-poor-will	*Caprimulgus vociferus (Antrostomus vociferus)*	BCC Rangewide (CON)		SC	XB	XB	XB	XB	
evening grosbeak	*Coccothraustes vespertinus*	BCC Rangewide (CON)			R		R	R	
golden eagle	*Aquila chrysaetos*	Non-BCC Vulnerable					RW	RW	RW
golden-winged warbler	*Vermivora chrysoptera*	BCC Rangewide (CON)	AR	E	R				
great black-backed gull	*Larus marinus*	Non-BCC Vulnerable			XB	XB	XB	XB	X
great shearwater	*Puffinus gravis (Ardenna gravis)*	Non-BCC Vulnerable				R			R
gull-billed tern	*Gelochelidon nilotica*	BCC Rangewide (CON)			X	X			X
herring gull	*Larus argentatus*	Non-BCC Vulnerable			XB	XB	XB	XB	XB
Hudsonian godwit	*Limosa haemastica*	BCC Rangewide (CON)			R	R	R		R
Leach's storm-petrel	*Oceanodroma leucorhoa*	Non-BCC Vulnerable							R
least tern	*Sternula antillarum*	BCC - BCR		T	SB	SB	SB		SB
lesser yellowlegs	*Tringa flavipes*	BCC Rangewide (CON)			X	X	X		X
long-eared owl	*Asio otus*	BCC Rangewide (CON)		E	R		R	R	
long-tailed duck	*Clangula hyemalis*	Non-BCC Vulnerable			W	W	W		W

COMMON NAME	*SCIENTIFIC NAME*	MIGRATORY BIRD STATUS	FEDERAL STATUS	STATE STATUS	Bluff Point / Haley Farm	Thames River / Avery Point	Lower Connecticut River	Salmon River	Long Island Sound / Fishers Island Sound
					ALTERNATIVES				
					A,D	A,D	A,B C,D	B	A,B C,D
manx shearwater	*Puffinus puffinus*	Non-BCC Vulnerable							RS
Nelson's sparrow	*Ammodramus nelsoni*	BCC Rangewide (CON)					RW		RW
northern gannet	*Morus bassanus*	Non-BCC Vulnerable			W	W	W		W
parasitic jaeger	*Stercorarius parasiticus*	Non-BCC Vulnerable			R	R	R		R
pomarine jaeger	*Stercorarius pomarinus*	Non-BCC Vulnerable			R	R	R		R
prairie warbler	*Setophaga discolor*	BCC Rangewide (CON)			SB	SB	SB	SB	SB
purple sandpiper	*Calidris maritima*	BCC Rangewide (CON)			W	W	W		W
razorbill	*Alca torda*	BCC Rangewide (CON)			W	W	W		W
red phalarope	*Phalaropus fulicarius*	Non-BCC Vulnerable					R		R
red-breasted merganser	*Mergus serrator*	Non-BCC Vulnerable			X	X	X	X	X
red-headed woodpecker	*Melanerpes erythrocephalus*	BCC Rangewide (CON)		E	W		W		
red-throated loon	*Gavia stellata*	BCC Rangewide (CON)			W	W	W	W	W
ring-billed gull	*Larus delawarensis*	Non-BCC Vulnerable			X	X	X	X	X
roseate tern	*Sterna dougallii*	Non-BCC Vulnerable	E	E	SB	SB	SB		SB
royal tern	*Thalasseus maximus*	Non-BCC Vulnerable			S	S	S		S

COMMON NAME	*SCIENTIFIC NAME*	MIGRATORY BIRD STATUS	FEDERAL STATUS	STATE STATUS	Bluff Point / Haley Farm	Thames River / Avery Point	Lower Connecticut River	Salmon River	Long Island Sound / Fishers Island Sound
					ALTERNATIVES				
					A,D	A,D	A,B C,D	B	A,B C,D
ruddy turnstone	*Arenaria interpres*	BCC - BCR			X	X	X		X
rusty blackbird	*Euphagus carolinus*	BCC Rangewide (CON)			W	W	W	W	
seaside sparrow	*Ammospiza maritima*	BCC Rangewide (CON)		T	SB	SB	SB		SB
semipalmated sandpiper	*Calidris pusilla*	BCC Rangewide (CON)			S	S	S	S	S
short-billed dowitcher	*Limnodromus griseus*	BCC Rangewide (CON)			S	S	S		S
snowy owl	*Bubo scandiacus*	BCC Rangewide (CON)			W	W	W	W	W
sooty tern	*Onychoprion fuscatus*	Non-BCC Vulnerable				R	R		R
surf scoter	*Melanitta perspicillata*	Non-BCC Vulnerable			W	W	W		W
whimbrel	*Numenius phaeopus*	BCC Rangewide (CON)			S		S		S
white-winged scoter	*Melanitta deglandi*	Non-BCC Vulnerable			X	X	X		X
willet	*Tringa semipalmata*	BCC Rangewide (CON)			SB	SB	SB		SB
Wilson's storm-petrel	*Oceanites oceanicus*	Non-BCC Vulnerable			X	X			X
wood thrush	*Hylocichla mustelina*	BCC Rangewide (CON)			SB	SB	SB	SB	SB

5.2 Human Environment

5.2.1 Prehistoric, Historic, and Recent Human Uses

5.2.1.1 Prehistoric Setting

The area of Long Island Sound and Fishers Island Sound and the neighboring islands (including Long Island) were shaped by the Wisconsinian Glaciation Episode, when the Laurentide ice sheet covered New England, 25,000 years ago (Lynch 2017). This glacial epoch started about 85,000 years ago, reached its peak 25,000 years ago, and ended for Connecticut's coastline about 16,500 years ago. The terminal moraine of the glacier, or the point of farthest advance of the ice sheet, can be seen in the huge pile of boulders, rocks, and sand that form the central spine of Long Island, stretch along the south fork, and extend eastward to Block Island and beyond. As the glacier was retreating from the terminal moraine, a cooling period resulted in the stalling of withdrawal and the formation of a recessional moraine, running along the north shore of Long Island, Orient Point, Fishers Island, and the current coastline of Rhode Island. Additional recessional moraines are evident in coastal Connecticut, stretching west to east just north of the I-95 corridor, the Norwalk Islands-Old Saybrook moraine (approximately 20,300 years ago) and the Hammonasett-Ledyard Moraine (approximately 20,200 years ago). Glacial Park in Ledyard provides a chance to walk through history, in the form of a glacial boulder train located in an immense kettle hole.

As the glacier was retreating (approximately 20,300 years ago), Glacial Lake Connecticut formed within the approximate footprint of today's Long Island Sound (Lynch 2017). Sea level was 300 feet lower and the Atlantic coast was approximately 75 miles to the south. While sea levels were rising, the glacial meltwater was slowing as the glacier retreated northward. By approximately 17,900 years ago, Glacial Lake Connecticut had largely drained to the Atlantic, leaving Long Island Sound a relatively dry basin. The history of glaciation in the region resulted in the removal of fine silt and sediment from the watershed, carried away to the depths of current-day Long Island Sound and out to the Atlantic Ocean. This scouring of sediments from the land left behind rock and cobble, leaving most of Connecticut poor land for farming.

5.2.1.2 Tribal Lifeways

Dr. Lucianne Lavin, one of the foremost authorities on the archaeology and anthropology of Connecticut, recently published a compendium of the current knowledge in her book, *Connecticut's Indigenous Peoples* (Lavin 2013). The information was based on archaeological evidence, oral traditional knowledge, and historical accounts. All of the material in this section on tribal lifeways is based on Dr. Lavin's writings, but it should be noted that a few pages do not begin to approach the level of detail provided in her book. Earlier dates, including pre-history through the Middle Ages, are noted as B.P., before present. The unit B.P. refers to the number of years before 1950, often based on radiocarbon dates.

Oral tradition and written histories provide insight into the spiritual, cultural, political, economic, social, and medical practices of indigenous peoples during the last few hundred years with the potential to shed insight into behaviors and practices over the last 800 to 1,000 years. Dr. Lavin provides insight to these traditions in her book, beyond what is possible to capture here (Lavin 2013). The book includes information on sociopolitical structure, spirituality, oral storytelling, trade, festivals, medical practices, stone markers and petroglyphs, ornamentation, and burial rites. A few of these topics are highlighted in this document. The topics of inter-group Indigenous conflict, fortified Indian settlements, and conflicts between Tribes and European settlers were not covered in this document, similar to how warfare and violent conflicts are not covered in the following section on European-era history. This section focuses on history in the context of human interactions with the natural environment.

5.2.1.2.1 Paleo-Indian Period (15,000 B.P. to 9,000 B.P.)

Around 15,000 years ago, Paleo-Indian period hunter-gatherers likely moved into the area now submerged under present-day Long Island Sound, though the first radiocarbon-dated evidence of human habitation in southern New England dates from approximately 10,000 years ago (Lavin 2013). The potential for these submerged sediments to contain evidence of early inhabitants led to the designation of possible Holocene-era submerged sediments as a significant area for archaeological sensitivity or significance in the Long Island Sound Blue Plan (DEEP 2019b). This includes a location just eastward and offshore from the mouth of the Connecticut River all proposed CT NERR alternatives include this location (see Figure 5-17 in *Section 5.2.1.4 - Cultural and Historic Resources*, page 220).

The landscape was a treeless arctic-alpine tundra dominated by mosses, grasses, sedges and other low-growing plants and shrubs (Lavin 2013). The area was likely inhabited by small multifamily communities of Paleo-Indians. By about 12,000 B.P., the tundra started to transition to a fir-boreal forest dominated by spruce, white pine, fir, and larch. This environment supported large mammals, including mastodon, mammoth, horse, giant beaver, giant ground sloth, moose-elk, caribou, musk-ox, and elk (Lavin 2013).

By 10,215 B.P., as the climate continued to warm, small pockets of oak, maple and hickory appeared on the landscape amidst the fir-boreal forest (Lynch 2017). Only six Paleo-Indian sites have been found in Connecticut, two located close to the project area: (1) the Hidden Creek site overlooks the Great Cedar Swamp, a glacial lake basin on the Mashantucket Pequot Reservation near Ledyard, Connecticut (>10 miles from the proposed CT NERR); (2) Baldwin Ridge is located in Groton on a ridge overlooking the Thames River (>1.5 miles north of the proposed CT NERR. More sites may still exist, submerged beneath Long Island Sound. Most settlements of this time period were inland, near swamps and streams and away from the riverine floodplains. The coastal zone was heavily scoured by fast-flowing glacial meltwaters. Coupled with rapidly rising sea levels and the relative newness of the coastal zone, habitats common today had not yet developed. “Botanical, faunal, and climatic information depicts the river valleys and coasts as harsh, relatively barren environments that were distinctly unpleasant for human habitation” (Lavin 2013).

5.2.1.2.2 Early Archaic Period (9,000 B.P. to 8,000 B.P.)

Climate continued to warm and sea level continued to rise during the Early Archaic period. Long Island Sound was now an estuary, albeit with a smaller footprint as sea levels were still lower than today. Between 10,000 B.P. and 8,900 B.P., vegetation shifted to white pine, yellow birch, grey birch, and oak; as spruce, fir, and larch were pushed out by the drier, warmer climate (Lavin 2013). These new forests supported a new suite of game, including white-tailed deer, moose, elk, black bear, wolf, fox, lynx, marten, wolverine, turkey, migratory birds, fish, turtles, and freshwater mussels (Lavin 2013).

These drastic habitat changes impacted the culture of local communities, creating a shift in the tribal lifeways which characterized the overall Archaic period. Settlements generally became larger and tool types became more diverse. Archaeologists and anthropologists interpret the evidence to indicate a regionalization of indigenous communities, with groups moving between sites to access different resources throughout the year. One such short-term camp is located near the project area, the Dill Farm site in the uplands of East Haddam, >2 miles east of Machimoodus State Park. A second, the Sandy Hill site located on the Mashantucket Pequot Reservation, dating from 9,340 B.P. to 8,470 B.P., was in part, a contemporary of the Dill Farm site. However archaeologists interpret the site to demonstrate a distinct culture from inhabitants of the Dill Farm site. The site included basin-shaped, semi-subterranean pit houses, 13 by 20 feet in size; the subterranean style indicated these residences may have been occupied year-round.

5.2.1.2.3 Middle Archaic Period (8,000 B.P. to 6,000 B.P.)

By 7,500 B.P., the forest had shifted to oak and hemlock, supporting the same suite of mammals as the Early Archaic period. However, relatively little evidence is available on human habitation between 7,200 B.P. and 5,200 B.P., which has been interpreted as fewer people in the area. Population change or movement may have been triggered by the warm and dry period. The oak tree, tolerant of warmer temperatures, became dominant. These environmental changes greatly impacted the local communities. "In fact, there is a cultural gap at Great Cedar Swamp [on the Mashantucket Pequot Reservation] between 7000 and 5000 B.P., during which no Native American settlements were inhabited. Soil corings in the swamp next to the Dill Farm site also suggest this. The shrinking interior wetland environments and drying up of the smaller ones will have created a domino effect on resources: less water, less vegetation, and fewer fishes, amphibians, and reptiles, along with fewer mammals, including humans" (Lavin 2013).

Peoples of this time were more regionalized, calling a larger territory home. Native people likely had a large settlement along inland lakes and rivers and seasonally utilized camps within their territory for hunting, fishing and foraging. This period is characterized by tools of ground stone and the presence of large axe heads, indicating heavy woodcutting activities. Felled trees were used for making dugout canoes. While the earliest physical evidence of fishing comes from the Late Archaic period in Connecticut, people were likely engaged in fishing during the Middle Archaic Period. The acidic soils of Connecticut will likely destroy the traditional tools of fishing, particularly those made from organic materials (bone, antler, and plant fibers).

5.2.1.2.4 Late Archaic Period (6,000 B.P. to 3,800 B.P.)

The climate continued an overall trend of warming interspersed with little ice ages, including cooler and wetter periods around 4,330 B.P. and 3,290 B.P. (Lavin 2013). As climate approached modern conditions, new species appeared in the area, including beech, butternut, elm, and maple, as well as a variety of forbs, including berries. The dominant forest was oak, hickory, and pine.

Archaeological evidence indicates this was a time of diversity in resource use, with prey including white-tailed deer, raccoon, rabbit, squirrel, birds, freshwater and saltwater fish, reptiles, and snakes. The number, size, and variety of settlements increased in this period, supported by the abundant resources available in the area. Plants were an important part of their diet. Fish commonly eaten included fresh, marine and diadromous species: herring, salmon, sturgeon, eel, shad, lake trout, striped bass, bluefish, cunner, tautog, and scup, as well as a variety of shellfish.

Two cultural traditions are represented by sites from this time period: the Laurentian tradition (believed to originate in Canada) and the Narrow Point tradition (believed to originate in the mid-Atlantic). The sites from the lower Connecticut River and eastern coastal Connecticut largely follow the Laurentian tradition. Laurentian settlements included a large permanent or semi-permanent base camp near reliable and productive food sources (e.g., Bliss-Howard site in Old Lyme), temporary (overnight) special-purpose camps usually consisting of rock overhangs or caves (e.g., Ames Rock Shelter in Old Lyme), and small activity-based short-term open air camps overlooking wetlands (e.g., Arbucci site in Old Lyme) (Lavin 2013).

Connecticut's earliest known fisheries appear in this time period. Brush and stone fish weirs were once evident along the state's coastline, found in embayments and river mouths. Fishermen trapped salmon, shad, herring, and non-anadromous nearshore fish like flounder and smelt (Lavin 2013). Twenty fish weirs have been reported within the Quinebaug River watershed, a tributary of the Thames River. Some of these fish weirs still exist. The Lebeau site, in Killingly, hosted a large stone fish weir and a neighboring camp site, still evident today (Lavin and Banks 2008). Other local evidence of fishing can be found in the Tubbs Shell Heap in Niantic, where bone fishhooks have been recovered. The earliest known shellfish collecting site is located at the Harrison's Landing site, at the head of a cove on the Thames River in New London. Inhabitants during earlier periods were also very likely to have utilized shellfish as a food source, but those midden heaps will be submerged beneath Long Island Sound.

5.2.1.2.5 Terminal Archaic Period (3,800 B.P. to 2,700 B.P.)

This period's climatic conditions were similar to today's climate. The coastal habitats of today were in existence and sea level rise had slowed due to reduced melting of glaciers and the polar ice cap combined with the rebound (rising) of crustal material relieved from the weight of the glaciers. These conditions allowed for a more stable and habitable coastal environment and as such, some inland communities shifted their base camps to the floodplains of the large river valleys (Lavin 2013).

As with the previous periods, this period is characterized by two distinctive artifact traditions. The Narrow Point tradition continued from the previous period, but the Laurentian tradition was replaced by the Broad Spear tradition. The Narrow Point tradition was a band society, which was more mobile and frequently broke up into smaller family, multifamily, and gender- or age-specific work groups to take advantage of resources. This group used a semi-stable or stable base camp, temporary shelters, and longer occupancy camps. Archaeologists believe the Narrow Point economies were more broad-spectrum (utilizing a greater range of resources) than the Laurentian economies. This promoted growth of stable and enduring communities across Connecticut for the Narrow Point tradition. The Dibble Creek 1 site, located 0.75 miles northwest of the Haddam Neck WMA, is representative of this tradition (Lavin and Banks 2010). The Narrow Point settlements continued to be largely constrained to uplands and no settlements were contemporary with the Broad Spear tradition in riverine areas, suggesting discrete territories for each group.

The Broad Spear tradition of artifact styles are found from Georgia to Maine. The earliest examples of Broad Spear points in Connecticut were found in the Museum A site on the Mashantucket Pequot Reservation, dating to 3,840 B.P. People of the Broad Spear tradition visited estuaries, as evidenced by shell heaps, including one in the project area in Old Lyme. They maintained multi-season base camps within large river valleys, close to the floodplain. This concentration of settlement suggested to experts that these communities had relatively limited mobility within the region. The food remains of Broad Spear settlements included hickory nuts, acorns, hazelnuts, seeds of goosefoot and pigweed, and bones from deer, dog, and other small mammals. Taken together, this evidence suggested a narrow-spectrum economy, reliant on relatively few sources of foodstuff, even more so than the Laurentian communities of the previous period. Habitation sites represented a small, localized floodplain community that came together for social and spiritual gatherings. This community was under stress, as rising sea level flooded their territory and saltwater intruded further into the river. By 2,750 B.P. to 2,600 B.P., the Old Lyme area they inhabited switched from an oak-hickory floodplain woodland to newly created salt marsh. This intrusion of the sea eroded their economic base.

5.2.1.2.6 Early Woodland Period (2,700 B.P. to 1,650 B.P.)

A little ice age occurred in the region between 2,680 B.P. and 2,550 B.P., leading to a shift in forest species to fir, hemlock, and white pine, interspersed with hickory and butternut (Lavin 2013). The loss of the food staple of acorns and other nut-bearing trees will have impaired the economies of local communities, as well as impacting deer and turkey populations. Archaeologists have inferred a decline in population and a possible collapse during this period, based on the fewer number of settlements. Between 2,900 B.P. and 2,700 B.P., all evidence of the Broad Spear traditions faded from the archaeological record. As noted in the previous period, this community was likely experiencing hardships due to salinity intrusion as a result of rising sea level coupled with higher overall populations in the area prohibiting expansion of their territory. The little ice age added to the stress on this community. The people of the Broad Spear tradition may have migrated, died off, or joined the Narrow Point peoples.

The Narrow Point traditions and lifeways continued in much the same fashion as in the Archaic period, but their territory broadened out from the upland areas to include more riverine and estuarine sites, with five of eight Early Woodland sites located in riverine-coastal settings in the Connecticut River valley. By this time period, salt marshes were well-established along the coast, providing a nursery for animals important to the indigenous peoples and producing large amounts of edible plants. The salt marshes became a hot zone of biogeochemical cycling, trapping and recycling nutrients locally and supporting a diverse and abundant web of life which in turn supported the indigenous peoples. Brackish and freshwater marshes subsequently developed upstream (after 2,600 B.P.), further increasing the productivity of the riverine and coastal zone. The brackish tidal marsh at Lord Cove (included in all proposed CT NERR *Alternatives*) was dated to 1,515 B.P.

During this time period, in the Midwest in particular, a momentous change in religious and sociopolitical change occurred, evidenced by elaborate and extensive mortuary rites and the establishment of Burial Cults. The Ohio Adena culture, participating in the Hopewellian interaction sphere[18], had an impact on Connecticut communities, but not as great an impact as seen in other areas of the Northeast. Tentative suggestions by experts indicate smoking may have been introduced by the Adena culture during this time period, as part of a burial practice or sociopolitical ceremony.

5.2.1.2.7 Middle Woodland Period (1,650 B.P. to 950 B.P.)

Climate in this period stabilized with no evidence of change until the Late Woodland period. Sea level continued to rise, but at a slow enough pace that marshes were able to match the rise through peat-building. Several major cultural changes occurred, including the decline of influence of the Ohio Adena

[18] The Hopewellian Interaction Sphere was centered around mysterious burial mounds in what is today southern Ohio. The Hopewell tradition, an affiliation of many Native American tribes, flourished from around 1,550 B.P. to 950 B.P. In some cases, the Hopewell tradition is referenced in connection with the Eastern Burial Cult, and had societal influences throughout North America.

culture. Mid-Atlantic artifacts become more prevalent in Connecticut sites, indicating expanding trade with neighbors to the south.

In the lower Connecticut River valley, communities carried on with their seasonal rounds and increased their reliance on tidal marshlands and riverine wetlands. In a significant departure from the previous period, the upland seasonal and base camps were abandoned in favor of temporary camps and more people lived along the rivers. The presence of Pennsylvania jasper used in the making of small, thin points indicated the introduction of the bow and arrow, likely introduced from the Mid-Atlantic. Populations continued to increase and large seasonal and multi-seasonal camps with longer periods of occupation were present along the Connecticut River valley. For example, the Mago Point site on Niantic Bay, had a large shell midden indicating repeated occupation.

The Military Academy site in the Niantic section of East Lyme (Camp Niantic Army National Guard Base) included a Middle and Late Woodland site. Identifiable animal remains included white-tailed deer, turkey, sand tiger shark, tautog, scallop, oyster, soft-shell clam, and a few quahog. The most exciting find at the site was an oblong pole-frame structure, 23 by 38 feet, located between two hearths. Middle 18th century wigwams on the Nehântic Indian Reservation on Black Point, just south of the site, exhibited similar construction.

5.2.1.2.8 Late Woodland Period (950 B.P. [ca. A.D. 1000] to A.D. 1524)

The Late Woodland period is marked by several notable changes. A climatic warming period of approximately 1°C occurred around 950 B.P. (circa A.D. 1,000) and lasted for a few hundred years, allowing southern tree species to expand into Connecticut, including sourwood and black walnut (Lavin 2013). Maize became widespread throughout New England and was sometimes grown with beans, squash, pumpkins, Jerusalem artichoke, and sunflowers. Long Island Sound communities engaged in relatively little maize horticulture until the end of the Late Woodland period, with large-scale adoption occurring after European contact. Native peoples continued their seasonal rounds and continued to collect wild plants, process nuts and acorns, and harvest shellfish and fish including shad, salmon, rainbow smelt, alewife, and blueback herring. They hunted waterfowl and other birds, deer, black bear, beaver, squirrel, raccoon, cottontail rabbit, red fox, turtles, and snakes.

The Blackhall site (also called the Old Lyme shell heap site) at the confluence of the Connecticut River and Black Hall River, is submerged (included in *All Alternatives*). This site was used as a shellfish camp; shellfish were opened, the meats retained, and the shells discarded at the camp, creating a large midden. The shells originated from oyster (85%), quahog (10%), and scallop (2%). The presence of codfish at this site and swordfish vertebrae at the Davis Farm site in Stonington indicated the community engaged in deep-sea fishing.

5.2.1.2.9 Final Woodland Period (A.D. 1524 to 1633)

In A.D. 1524, the first contact with Europeans occurred in New York and Narragansett. Lifeways of the American Indian peoples were similar to those of the Late Woodland Period. Records from this time period illustrate the stewardship practiced by the indigenous peoples. They engaged in controlled burns to create edge habitats and optimized resources for their prey animals to consume. Indigenous hunters avoided killing female animals with young. Indigenous peoples were the first naturalists, zoologists, botanists, and geologists of the land now known as Connecticut.

Native New England communities were a diverse group, with different economic and settlement systems, different languages, and different sociopolitical structures. Coastal communities exhibited social stratification, with grand sachems and subsachems wielding relatively more power within their Tribe relative to their counterparts in egalitarian societies located further inland.

Early interactions with European colonists were generally peaceable and perceived to be mutually beneficial, as both sides were interested in trade. As immigration of the colonists continued to occur, the English colonists began to transform the landscape through overhunting and farming practices. These changes caused the near-extinction of deer, bear, and other fur-bearing animals in the region. The loss of these prey animals meant that indigenous peoples relied more heavily on western-style clothing. By 1698, Connecticut had passed an act restricting deer hunting. By the 1800s, there were virtually no deer or wild turkeys in Connecticut. The economy shifted from subsistence gathering to hunting of fur-bearing animals and the manufacture of wampum during the Final Woodland period.

5.2.1.3 Arrival of Europeans

When the first Europeans arrived in Connecticut in the early 1600s, an estimated 90,000 people from many Native American Tribes were living in coastal New York and southern New England (Lynch 2017). Population estimates are imprecise and likely an underestimate, as no census was conducted prior to the impact of European diseases on the local population. In most of New England, up to 95% of the native inhabitants of the land perished from smallpox, measles, plague, and other diseases within a decade of European arrival. As noted in previous sections, Dr. Lavin's book provides an overview of the many injustices perpetrated on the indigenous peoples in the post-contact era and reviews major court battles and current status of local Tribes in Connecticut.

Five tribes are currently recognized by the State of Connecticut as sovereign, independent nations (and were also recognized by the Connecticut Colony, prior to Statehood): the Schaghticoke Tribal Nation, the Golden Hill Paugussett, the Mohegan Tribe, the Mashantucket Pequot Tribal Nation, and the Eastern Pequot Tribal Nation. The Mohegan Tribe and the Mashantucket Pequot Tribal Nation are also federally recognized. Additional tribes not recognized by the State but extant in southeastern Connecticut include the Western Nehântick Tribal Nation, Hammonasset Tribe, Wappinger Tribe, and Wangunks Tribe (Figure 5-15). It should be noted that this represents a snapshot in time of tribal territories which were in flux as tribes migrated into and out of the area.

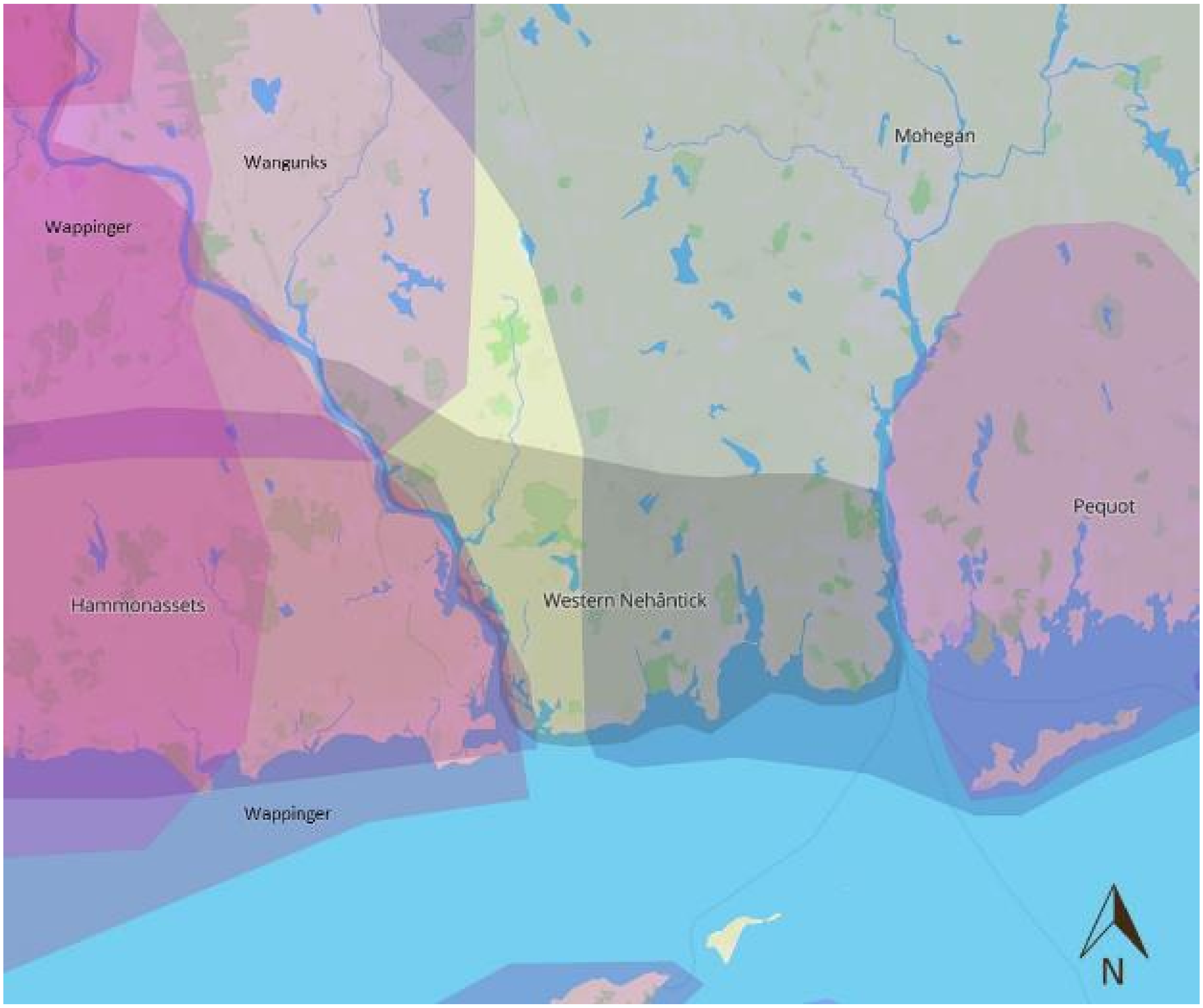


Figure 5-15: Connecticut's Indigenous Peoples by Tribe
Traditional Tribal lands within the project area are noted by Tribal name over shaded areas. The map was provided by Native Land Digital (https://native-land.ca/), a Canadian not-for-profit organization, incorporated in December 2018. From the website: "This map does not represent or intend to represent official or legal boundaries of any Indigenous nations. To learn about definitive boundaries, contact the nations in question."

Summary by Boundary Alternative

Alternative A: The boundaries of this alternative include traditional lands of the Mashantucket Pequot Tribal Nation, Mohegan Tribe, Western Nehântick Tribal Nation, Hammonasset Tribe, Wappinger Tribe, and Wangunks Tribe.

Alternative B: The boundaries of this alternative include traditional lands of the Mohegan Tribe, Western Nehântick Tribal Nation, Hammonasset Tribe, Wappinger Tribe, and Wangunks Tribe.

Alternative C: The boundaries of this alternative include traditional lands of the Mohegan Tribe, Western Nehântick Tribal Nation, Hammonasset Tribe, Wappinger Tribe, and Wangunks Tribe.

Alternative D: The boundaries of this alternative include traditional lands of the Mashantucket Pequot Tribal Nation, Mohegan Tribe, Western Nehântick Tribal Nation, Hammonasset Tribe, Wappinger Tribe, and Wangunks Tribe.

5.2.1.3.1 Post-European Settlement (A.D. 1633 to present)

Not surprisingly, the habitat in the early 1600s looked much different than today, in terms of water quality and the diversity of organisms found. Colonial records indicate oysters were plentiful along the coastline, with the Quinnipiac River "paved for its last three miles with a solid bed of oysters" and shallows and mudflats full of clams and scallops (Lynch 2017). A harder sight to imagine was a landscape populated with beavers, where estimates indicate they were almost as plentiful as the grey squirrel is today. "The ubiquitous beaver shaped a watery landscape in which every river, stream, and creek was dammed, creating ponds and marshes that covered the lowlands for miles" (Pastore 2014).

The Dutch explorer and merchant Adriaen Block was the first European to describe Long Island Sound in detail (Lynch 2017). While Dutch fur traders established a settlement near Hartford in 1623, by the mid-1600s, the English came to dominate the area. English settlements were established further west in Long Island Sound with a small settlement, the Saybrook Colony, established at the western mouth of the Connecticut River (1636-1776). The large Thames River and Connecticut River barred land travel from eastern Connecticut west to New Amsterdam (the previous name for Dutch-controlled New York City). As a result, east-west travel was limited to ships. This led to a strong maritime tradition that persists today in eastern Connecticut cities like New London, Mystic, and Stonington. Sailing ships, then steamships, were the primary form of travel within Long Island Sound and Fishers Island Sound. New Yorkers will take the Long Island Railroad to Greenport, board a steamship, and carry on to Boston by sea. The rail line in southeastern Connecticut, built in the 1850's, led to the impoundment of estuarine waters and destruction of fringing salt marshes. In 1893, the New Haven Railroad connected New York to Boston, making travel easier, safer, and faster than combined rail, ferry and steamboat travel, especially in winter when conditions in Long Island Sound, but especially around Cape Cod, could be perilous (PAL 2001). As rail lines were expanding, ferries were used to take railcars over the Thames River and Connecticut River. Bridges were built over the Thames River in 1889 and over the Connecticut River in 1907.

The rocky soils left by the receding glaciers were not ideal for row crop farming, although areas around the flood plains of the rivers, especially the Connecticut River were quite fertile, renewed with nutrient rich sediments during spring flooding events. As a consequence, much of the coastal margin that was under agricultural production was focused on farming sheep (Cronon 2003; Ebbin 2015).

With the advent of the Industrial Revolution in 1750, Connecticut began to transition to a landscape of mills and dams. The ability to transport food to the local area by railway enabled Connecticut residents to transition from agriculture to industry, a boon as much land in Connecticut was difficult to farm due to the boulder and cobble and lack of fine sediments resulting from the history of glaciation (Lynch 2017). In addition, 1830 marked the completion of the Erie Canal, opening up fertile lands in western New York state to eastern markets. Ultimately, this led to the abandonment of much of Connecticut's marginal farming lands and led to reforestation of much of the state, which at the peak of agricultural production had been depleted of an estimated 75% of its original forest cover.

The many small streams and rivers along Connecticut's coast provided energy for mills and manufacturing processes. Unfortunately, blocking of the rivers led to the loss of habitat for anadromous fish, including the currently endangered Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*) and Atlantic salmon (*Salmo salar*), as well as striped bass (*Morone saxatilis*), alewife (*Alosa pseudoharengus*), and American shad (*Alosa sapidissima*). These species continued to decline until recovery efforts began in the 1970s.

In addition to the physical barriers of dams, contaminants from manufacturing processes began to pour into The Sounds. In the 1830s, Connecticut was the center of the American brass trade, a metal used for many common household items. Waste copper from the manufacturing process was delivered to rivers, streams and Long Island Sound and Fishers Island Sound. Industrial dumping into The Sounds escalated between 1850 to 1975, transitioning from brass to mercury, used in a booming felt hatting industry (Van Patten 2002), and polychlorinated biphenols (PCBs), a component of many compounds including machine lubricants, pesticides, adhesives, capacitors, transformers, and plastics (Lynch 2017). These contaminants are still found in sediments of certain harbors in Long Island Sound, especially in the Western Sound (Anatone et al. 2020; Hancock 2020). The Federal Clean Air Act of 1970 (42 U.S.C. § 7401 *et seq.*) and the Federal Clean Water Act of 1972 (33 U.S.C. § 1251 *et seq.*) ushered in an era of improving water quality in Long Island Sound and Fishers Island Sound.

The coastal cities of the project area were bases of commercial fishing and shellfishing, beginning in colonial times, with some fisheries booming then collapsing while others recovered from past collapses. New London, known as "The Whaling City," was one of New England's largest whaling ports. In 1799, 200 whales were counted off of Stonington, Connecticut. Whalers ventured no further than Georges Bank to find whales through the early 1800s, after which they went further afield as whale numbers declined due to overfishing (Lynch 2017). Whaling picked up in 1810 in response to need for product and improvements in the whaling fleet which allowed for longer voyages. The local industry saw peak years in harvest from 1845 to 1860, declined rapidly during the Civil War, and the industry eventually collapsed around 1900 as whale oil was replaced by petroleum products. By the early 1970s, the United States had listed eight whale species as endangered and officially outlawed whaling in 1971.

The northern lobster (*Homarus americanus*) fishery in Long Island Sound and Fishers Island Sound never achieved the prosperity nor visibility of the whaling industry, but was a significant fishery for The Sounds until its collapse in 1999. The Connecticut lobster take increased steadily from 1981 to 1999, from about 0.8 million lobster harvested to about 3.5 million lobster harvested, following the overall population trends of lobster in The Sounds (LISS 2021c). Between 1999 and 2002, the lobster population decreased substantially and continued to decrease, reaching the current low level by 2012. The declining population was primarily linked with warming water temperatures in The Sounds, where lobsters are at the southern limit of their distribution, though pesticides had also been implicated in their decline (Jack and Nancy 2005; LISS 2021c; Lynch 2017). In 2013, Connecticut banned two pesticides thought to impact lobster, methoprene and resmethrin, both used to control mosquitos carrying West Nile virus (Lynch 2017). Today, commercial lobstering is still ongoing, but at a significantly reduced capacity compared to the industry's peak.

Unlike whales and lobster, eastern oysters (*Crassostrea virginica*) have seen ups and downs in harvest and are still a viable industry in Long Island Sound and Fishers Island Sound. By the Civil War, oyster harvesting was a booming industry, supplying markets in New York City and across the country, employing thousands along coastal Connecticut (Lynch 2017). But by the 1880s, poor water quality coupled with a lack of understanding, or neglect of the facts, led to many fatalities associated with consumption of contaminated shellfish from Long Island Sound. A series of incidents around 1924 caused the collapse of the oyster business in The Sounds; 1,500 people along the East coast and in Chicago developed typhoid fever after eating contaminated New Haven oysters, with 150 fatalities (Anderson 2004). Following the passage of the Clean Water Act in 1972, Long Island Sound started to see improving water quality in response to efforts to reduce nitrogen pollution to coastal waters. The oyster industry is much smaller today, but Connecticut is a leading U.S. producer of oysters and clams and is host to natural shellfish beds (UConn 2021), including substantially sized beds located in the lower Connecticut River (DEEP 2019b). Commercial oyster aquaculture saw a resurgence in the 1980s and 1990s due to successful culture practices with a peak in 1992 of approximately 894,000 bags in Connecticut, followed by a decline to less than 100,000 bags per year from 2000 to 2006, with the sudden decline largely due to MSX, a parasitic disease (LISS 2021d). Since 2007, oyster harvest in Connecticut has ranged from approximately 133,000 to approximately 351,000 bags per year with an annual economic value of just under $18 million dollars.

The Industrial Revolution ushered in an era of rapid population growth, bringing with it the nutrient pollution associated with human waste, fertilizer applied to lawns and agricultural fields, and increasing nutrient pollution to the atmosphere which then falls as nutrient rich rain, snow, and dust. Nitrogen entering coastal waters fertilizes the growth of primary producers, similar to fertilizing a lawn. In marine waters, this excess nitrogen fertilizes seaweed and microscopic plant-like organisms (phytoplankton) which collectively are called algae, and in some cases, causes them to grow to levels that are problematic. This growth constitutes an overall increase in the rate of supply of organic matter to the ecosystem, where organic matter refers to the biomass of the living algae and the organisms that feed on that algae and break it down once it dies. This process is termed eutrophication (Nixon 2009). Living algae respire, drawing down water column oxygen, as do the other organisms living in the submerged areas. When living organisms die, bacterial respiration of the organic matter uses more oxygen, often occurring in the top layers of the sediment but also occurring in the water column. If the demand for oxygen surpasses the oxygen supplied by primary producers and by reaeration of water from the atmosphere and via horizontal advection, oxygen can drop to a level where sensitive species are no longer able to survive, a state called hypoxia, defined for Long Island Sound as waters ≤ 3 mg / L dissolved oxygen (LISS 2021a).

In response to widespread hypoxia, the states of Connecticut and New York, and the USEPA adopted a Total Maximum Daily Load (TMDL) for nitrogen in 2000 (DEEP 2019c) per guidance from the Clean Water Act (33 U.S.C. § 1313). To reduce nitrogen to the levels necessary to improve dissolved oxygen concentrations and meet water quality standards, the TMDL established a 58.5% nitrogen reduction target from the early 1990s baseline levels, to be attained by 2017. The TMDL assigned nitrogen load reduction targets to both point sources (wastewater treatment plants) and nonpoint sources (stormwater, septic systems). Management strategies to reduce nitrogen loading to Long Island Sound included regulatory and non-regulatory efforts. In the 1800s, early sewer systems consisted of raw sewage conveyed to Long Island Sound (Lynch 2017). Today, all wastewater treatment facilities have been upgraded to secondary treatment and many were further upgraded to reduce nitrogen output in order to achieve the 2020 TMDL targets.

Looking at all current sources of nitrogen to the project area, about 51% originates from human waste, 25% from atmospheric deposition, and 24% from fertilizer, with 87% of the total nitrogen load originating from the Connecticut River (Figure 5-16). Considering only human waste, about 58% of the nitrogen pollution from human waste entering the project area was sourced to wastewater treatment facilities, with 42% coming from human waste traveling through septic systems. While the eastern basin of Long Island Sound and western Fishers Island Sound are acknowledged as having good water quality, as evidenced by the presence of eelgrass (*Zostera marina*), the embayments of the eastern Long Island Sound and Fishers Island Sound often exhibit diel hypoxia and other symptoms of eutrophication, such as massive seaweed blooms (Vaudrey et al. 2015) and other types of harmful algal blooms. The 2020 TMDL mandated a 58.5% reduction of nitrogen load to Long Island Sound. However, the Long Island Sound community recognizes that further reductions are necessary. Research and analyses are underway to establish the next target for nutrient reduction required to support the trend of improving water quality in Long Island Sound and Fishers Island Sound.

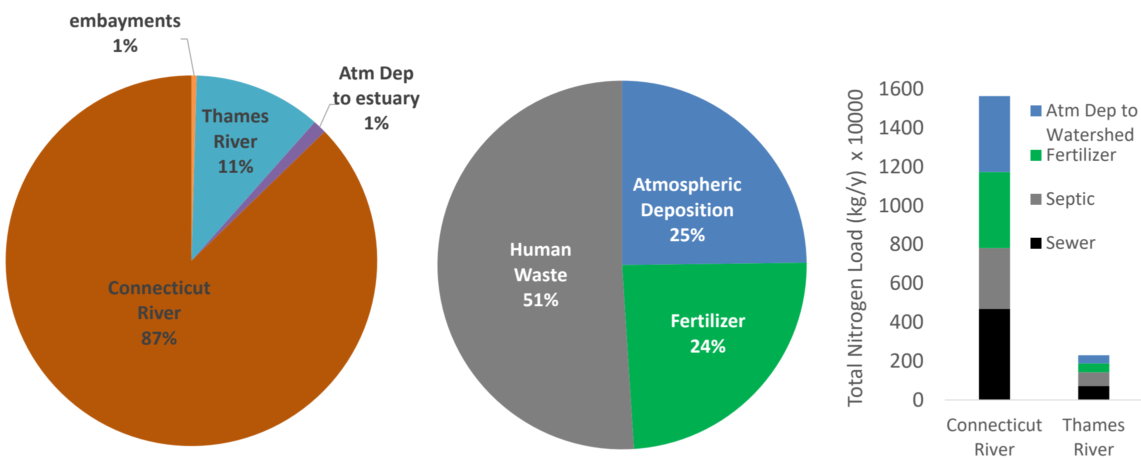


Figure 5-16: Source of Nitrogen Load to the Project Area

Load to embayments in the project area were determined using a nitrogen loading model based on land use, population, and wastewater treatment facility reported loads (Vaudrey et al. 2015). Loads from the Connecticut River and Thames River were calculated based on published results from the USGS SPARROW model (Moorman et al. 2014). Atmospheric deposition to estuary refers to direct deposition of rain, snow, and dust to the aquatic areas of the project area, including Long Island Sound, Fishers Island Sound, the lower Thames River, lower Connecticut River, and the embayments included in the project area. The pie charts represent total load by geographic source and type. The bar chart includes only the source by type for the two rivers, the major contributors of nitrogen to the project area.

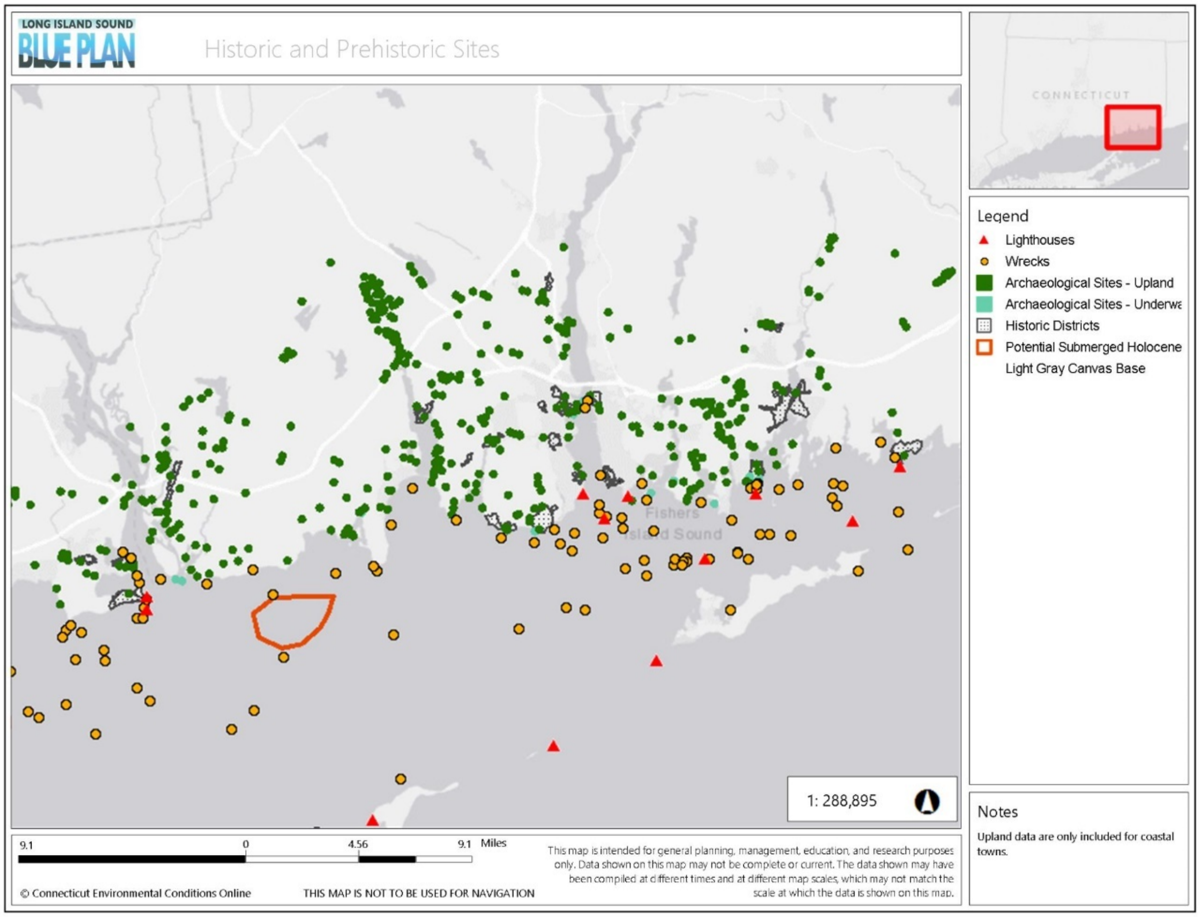


Figure 5-17: Historic and Prehistoric Sites in the Area

Locations of archaeological finds, both historic and prehistoric, are shown as green points for the upland sites and orange points for shipwrecks. The upland archaeological sites include both significant sites with many artifacts recovered as well as sites where single artifacts were recovered. The Blue Plan only maps upland sites within coastal towns, thus project areas in the north section of Lord Cove and areas north of this point in the lower Connecticut River are not shown on this map (the boundary is just north of the northern-most point in the Connecticut River). Holocene-era sediments have been mapped in Long Island Sound. These sediments may contain evidence of the early inhabitants of the area. Historic districts and lighthouses represent historically significant areas, often from a socio-political viewpoint (versus the interaction of humans and the natural environment, which was the focus of this section). Map generated using the online Long Island Sound Blue Plan Viewer (CTECO 2021a).

5.2.1.4 Cultural and Historic Resources

Figure 5-17 provides an overview of historic and prehistoric sites in the project area and the surrounding area of southeastern Connecticut. Historic districts and lighthouses represent concentrations of sites and neighborhoods important in a socio-political context. The number of shipwrecks reflects the maritime tradition of the area; many of these are popular dive locations. Upland and submerged archaeological sites may represent the location of a single artifact or may indicate significant excavations of thousands of artifacts. Given that sea level was once much lower, underwater archaeology is key to accessing prehistoric sites. The UConn Maritime Studies Program, headquartered on the Avery Point campus offers a minor in Maritime Archaeology and many of the neighboring colleges and universities also offer similar programs or classes. The Office of State Archaeology is located at UConn and is the official repository for the State's collection of over 500,000 anthropological and archaeological artifacts. The Office of State Archaeology coordinates with the State Historic Preservation Office (SHPO), a state office in the Connecticut Department of Economic and Community Development.

State Archaeological Preserves are an important mechanism for protecting Connecticut's archaeological heritage. Many agencies and private citizens work together to preserve that heritage, including the State Historic Preservation Office, the Historic Preservation Council, the Office of the State Archaeologist at UConn, Connecticut's archaeological community, non-governmental organizations (such as Connecticut Landmarks, local and regional historical societies), and concerned citizens and property owners. Two State Archaeological Preserves are located in the project area (Table 5-35). Archaeological excavation was conducted at a pre-historic site within the project area, the Blackhall site (Table 5-35). Holocene-era sediments have been identified in Long Island Sound. These areas are sensitive archaeological areas as they may contain evidence of the early inhabitants of the region.

Table 5-35: Summary of Significant Archeological Sites in the Project Area

The location and inclusion in the various proposed CT NERR alternatives are provided for each property. A short overview of the site is provided. Readers are referred to the citations for a more thorough history.

SITE	LOCATION & ALTERNATIVE	HISTORY
STATE ARCHAEOLOGICAL PRESERVES		
Pine Island Archaeological Site	Pine Island, Groton *Alternative A* *Alternative D*	Variety of uses through time, including: haying, residence, harvest of seaweed, fish processing factory for fish oil transitioning to fertilizer production, recreational use, and military operations. The island hosts a Revolutionary War veteran's gravesite. (Ebbin 2010)
Midway Railroad Roundhouse Archaeological Complex	Bluff Point State Park, Groton *Alternative A* *Alternative D*	In 1912, the New York, New Haven and Hartford Railroad (commonly known as "The New Haven") was operating over 2,000 miles of tracks in the region. The Midway yard and specifically the turntable were upgraded in 1917 to accommodate all of the different types of engines that were used by the New Haven. By 1926, as other yard facilities were constructed along the New Haven Line, Midway lost its status as the preeminent yard. For a few years, the yard was used for storage until the Great Depression made keeping the yard staffed unfeasible. (Mascia n.d.)

SITE	LOCATION & ALTERNATIVE	HISTORY
ARCHAEOLOGICAL DIG SITES – PAST & POTENTIAL		
Blackhall site, or Old Lyme Shell Heap site at the confluence of the Connecticut River and Black Hall River. Submerged.	off Griswold Point, Old Lyme *Alternative A* *Alternative B* *Alternative C* *Alternative D*	Shell midden used during the Terminal Archaic, Middle Woodland and Late Woodland periods. Extended at least 800 feet along the coast and ranged in overall width from eight to over 100 feet. In addition to shellfish, over 3,000 faunal remains have been found, as well as many tools. Artefacts suggest finfishing occurred at the site, including deep sea fishing of cod. A single seal bone indicated that marine mammals were also exploited. referenced in: (Lavin and Banks 2008)
Holocene-era sediments have been identified in Long Island Sound.	Long Island Sound *Alternative A* *Alternative B* *Alternative C* *Alternative D*	The potential for these submerged sediments to contain evidence of early inhabitants led to the designation of possible Holocene-era submerged sediments as a significant area for archaeological sensitivity or significance in the Long Island Sound Blue Plan, including this location just eastward and offshore from the mouth of the Connecticut River. (DEEP 2019b; Lavin 2013)

Some of the terrestrial properties of the project area beyond the two identified as State Archaeological Preserves have a history of human occupation (Table 5-36). The project area sites with upland, non-marsh areas have written histories available. The marsh sites, as expected, have been used by humans for the services that can be obtained by harvesting resources (haying, fishing, hunting, and livestock grazing), but are not often sites of human habitation and the associated historical events.

Table 5-36: Brief History of Upland Properties in the Project Areas

The location and inclusion in the various proposed CT NERR alternatives are provided for each property. A short overview of the site is provided; readers are referred to the linked references for a more thorough history.

SITE	TOWN & ALTERNATIVE	HISTORY
Pine Island	Pine Island, Groton *Alternative A* *Alternative D*	Starting in 1651, fields on the island were harvested for salt hay. It was used as a residence; James Baley (died 1788) is buried on the island. Around 1835, the right to harvest 50 tons of rockweed annually was granted to an individual. At the start of the Industrial Revolution, it hosted factory production of fish oil, then fertilizer. The island became part of wealthy industrialist Morton Plant's Branford House estate (now, UConn's Avery Point campus) and was utilized for military operations during World War II, and has since been largely untouched. The site is a State Archeological Preserve. https://opencommons.uconn.edu/wracklines/54/

SITE	TOWN & ALTERNATIVE	HISTORY
MARSHES: Roger Tory Peterson NAP Lord Cove Wildlife Management Area (WMA) Nott Island WMA Haddam Neck WMA Great Meadows (Essex Land Trust) and Thatchbed Island WMA Ragged Rock Creek WMA Ferry Point Marsh WMA	Old Lyme, Lyme, East Haddam, Essex, Old Saybrook *Alternative A* *Alternative B* *Alternative C* *Alternative D*	Little information on the marshes of the lower Connecticut River was available. Uses starting in colonial times may have included harvesting of salt hay for livestock, hunting for waterfowl and small mammals. Marshes have been actively managed by the State since the 1930s, to promote use of the habitat by wildlife. A site south of Griswold Point includes a prehistoric archaeologically important shell midden used during the Terminal Archaic, Middle Woodland and Late Woodland periods. Historically, the marshes of the lower Connecticut River (as is typical of many tidal wetlands across the state) were ditched in the early part of the 20th century as part of mosquito control techniques. During the mid-1980s, restoration programs sought to cease this activity in favor of more ecologically sound techniques that encouraged the restoration of pre-ditching hydrology. https://portal.ct.gov/DEEP/Wildlife/BNR-150th-Anniversary/BNR-Historical-Timeline
Haley Farm State Park	Groton *Alternative A* *Alternative D*	Historic farmland. Includes many stone walls with massive boulders moved around the property, foundations from farm buildings, a small graveyard, and Race Track Pond (used as a cranberry bog and surrounded by a carriage race track). https://www.gosaonline.org/haley-farm-state-park/
Bluff Point State Park, Bluff Point NAP, Bluff Point Coastal Preserve	Groton *Alternative A* *Alternative D*	Includes several Native American camp sites, the foundation of Connecticut Governor Winthrop's residence (circa 1700) 16-room mansion which was occupied for over 150 years, and the foundation of a 75-foot train turntable from the Midway Railroad Yards which is now a State Archaeological Preserve. The area was the site of a summer vacation colony in the early 1900s with over 100 small rental cottages, destroyed during the 1938 hurricane. https://www.gosaonline.org/bluff-point-state-park-and-coastal-reserve/

SITE	TOWN & ALTERNATIVE	HISTORY
Machimoodus State Park	East Haddam *Alternative B*	The name Machimoodus derives from Native Americans who referred to the area as "the place of bad noises," now identified by modern science as the echoes of microearthquakes. The park was created when the Echo Farm dairy farm was purchased by the state in 1998.

The largest threat to cultural and historic resources is disturbance by humans, either unintentional or intentional removals of cultural artefacts or damage to historic sites. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternative A includes the traditional lands of the Mashantucket Pequot Tribal Nation, Mohegan Tribe, Western Nehântick Tribal Nation, Hammonasset Tribe, Wappinger Tribe, and Wangunks Tribe. The area hosts six historic lighthouses, including one located on the Avery Point campus, with a view of three additional lighthouses located outside the project area. Shipwrecks in the area (approximately 69) date from the 17th to the 20th centuries. Haley Farm State Park, Bluff Point complex, and Pine Island have a rich history of human occupation and use. The other terrestrial properties, mostly marsh, were not as hospitable for human occupation, though resources from these properties were likely harvested. Archaeologically significant areas include two Archaeological Preserves, one at Pine Island, and a second at the Midway Railroad Roundhouse in Bluff Point State Park. A prehistoric shell midden (Blackhall site, or Old Lyme Shell Heap site) is submerged at the mouth of the Connecticut River. Submerged Holocene-era sediments off the mouth of the Connecticut River may yield additional evidence of prehistoric habitation. New London and Mystic were significant ports throughout history from both a socio-political and economic perspective.

Alternative B includes the traditional lands of the Mohegan Tribe, Western Nehântick Tribal Nation, Hammonasset Tribe, Wappinger Tribe, and Wangunks Tribe. The area hosts two historic lighthouses, other lighthouses are not visible from this alternative. Shipwrecks in the area (approximately 21 total) date from the 17th to the 20th centuries. The terrestrial properties, mostly marsh, were not as hospitable for human occupation, though resources from these properties were likely harvested. This alternative includes Machimoodus State Park, which has recent human use as a dairy farm. The area lacks the historical use of the uplands seen in Alternative A and also lacks the two Archaeological Preserves of Alternative A. The prehistoric shell midden (Blackhall site, or Old Lyme Shell Heap site) found in Alternative A is also included in this alternative, submerged at the mouth of the Connecticut River, as are the submerged Holocene-era sediments off the mouth of the Connecticut River. The nature of the Connecticut River did not allow for the development of a major port at the mouth, thus this alternative lacks the historic seaport towns present in Alternative A.

Alternative C includes the features mentioned for Alternative B with the exception of the exclusion of Machimoodus State Park. An expansion of the offshore area compared to Alternative B also expands the number of shipwrecks included (approximately 27 total).

Alternative D includes the features mentioned for Alternative A with the exception of three fewer shipwrecks (approximately 66 total) due to changes in the offshore boundary.

5.2.2 Human and Economic Setting

Data and descriptions for this section use the U.S. Census-based American Community Survey (ACS) metropolitan / micropolitan district area of Norwich / New London for approximating the regional geographic basis of the proposed CT NERR (Figure 5-18).

5.2.2.1 Population

The following paragraphs highlight several common demographic statistics that describe the Norwich / New London area during the 5-year period of 2014-18. These, as well as additional information, are available from the ACS 5-Year Narrative Profile and are incorporated for reference (United States Census Bureau 2021).

Population, Density, Households / Families: The Norwich / New London region encompasses an area of approximately 665 square miles with a population of 268,881, and a population density of roughly 404 people per square mile. There were 107,402 households, with an average size of 2.4 people. Roughly two-thirds of the households were families (defined as married or other families). The remaining one-third consisted of single residents or non-family respondents.

Gender and Age: There was a nearly equal split between males and females. The median age was 41.4 years. Approximately 20% of the population was under 18 years, 34% was 18 to 44 years, 29% was 45 to 64 years, and 17% was over 65.

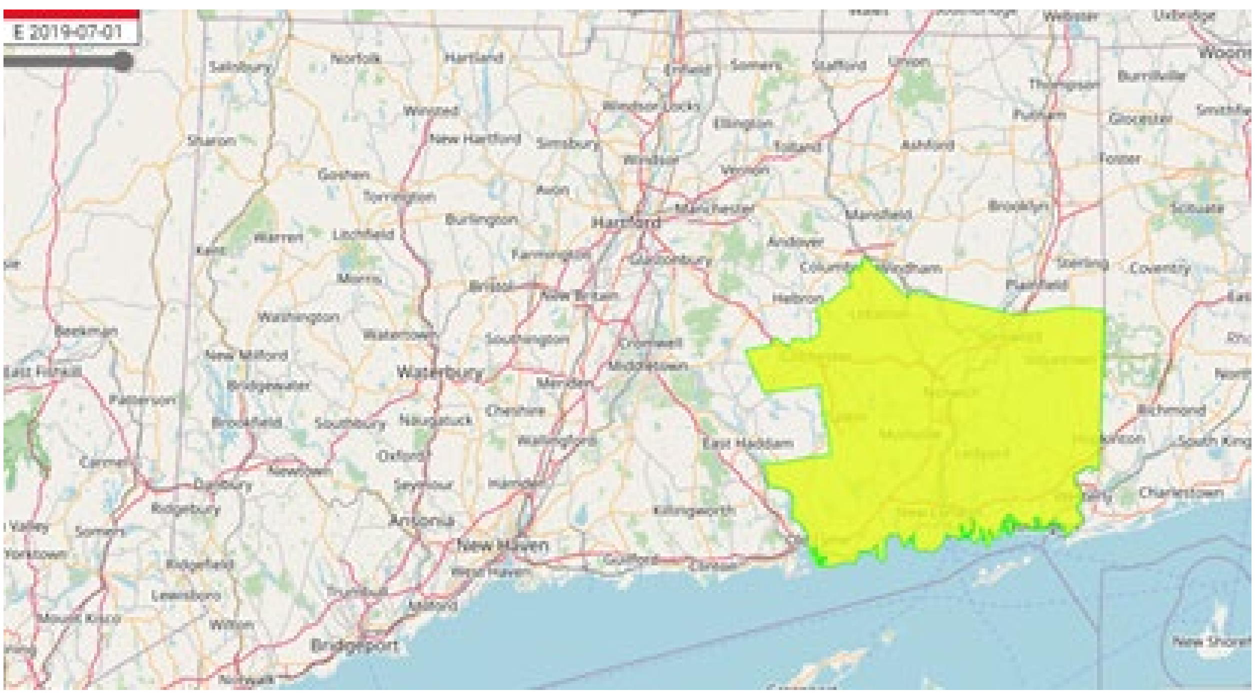


Figure 5-18: Norwich / New London Area Map

The metropolitan / micropolitan district area of Norwich / New London from American Community Survey (ACS) (City Population 2021).

Race and Ethnicity: For people reporting one race alone, 80.7% were White; 5.8% were Black or African American; 0.6% were American Indian and Alaska Native; 4.1% were Asian; 0.0% were Native Hawaiian and Other Pacific Islander, and 3.3% were some other race. An estimated 5.3% reported two or more races. An estimated 10.6% of the people were Hispanic. An estimated 75.7% of the people were White non-Hispanic. People of Hispanic origin may be of any race.

Nationality: An estimated 92% of the Norwich / New London population were U.S. natives, with 52.0% living in the state where they were born. Of the roughly 8% of foreign-born residents, nearly 75% come from Asia and Latin America (37% and 36%, respectively) with Europe, Africa, Northern America, and Oceania making up the remaining percentage.

Environmental Justice: The Environmental Justice movement has emerged in response to a growing body of evidence nationally and statewide indicating that low income, racial, and ethnic minority groups may be exposed to higher-than-average amounts of environmental pollution (DEEP 2021g). A summary of *Executive Order 12898 − Environmental Justice* as it pertains to this project is provided in *Chapter 7*. The DEEP Environmental Justice Program incorporates principles of environmental justice into aspects of the Agency's program development, policy making, and regulatory activities. Effective January 1, 2009, C.G.S. § 22a-20a along with DEEP's existing Environmental Justice Policy, requires applicants seeking a permit for a new or expanded applicable facility proposed to be located in an environmental justice community, to file a Public Participation Plan with and receive approval from DEEP prior to filing any permit application. An applicable facility can include, but is not limited to, types of electric generation stations, solid waste incinerators, sewage treatment plants, and waste processing plants (DEEP 2021g). The term "environmental justice community" is so designated using the Connecticut Department of Economic and Community Development list of Distressed Municipalities. Updated annually, this identifies the state's 25 most fiscally and economically distressed municipalities and is used by state agencies to target funds for needs such as housing, insurance, open space, brownfield remediation, and economic development programs, among others. As of the most current list (2020), there are seven communities in the Norwich / New London area that are listed. None of the communities in the project area in Middlesex County were identified as distressed communities. Lower ranks reflect a higher degree of distress (Table 5-37) (DECD 2021).

Table 5-37: Distressed Municipalities

Connecticut Department of Economic Community Development, Distressed Municipalities in the American Community Survey (ACS) metropolitan / micropolitan district area of Norwich / New London.

DISTRESSED MUNICIPALITY	RANK (OUT OF 25)
New London	3
Sprague	11
Norwich	12
Montville	14
Griswold	15
Voluntown	16
Preston	22

5.2.2.2 Employment

The following paragraphs highlight several employment statistics that describe the Norwich / New London area during the five-year period of 2014-2018. These, as well as additional information, are available from the ACS 5-Year Narrative Profile and are incorporated for reference (United States Census Bureau 2021).

Employment Statistics:

Approximately, 60% of the population 16 and over were employed across a variety of industries (Table 5-38). Of the employed population,

- nearly 80% were private wage and salary workers,
- 15% were federal, state, or local government workers,
- 5% were self-employed in their own (not incorporated) business.

Table 5-38: Norwich / New London Employment Categories
Norwich / New London Industry Employment for employed workers (United States Census Bureau 2021).

INDUSTRY	PERCENT OF EMPLOYED WORKERS IN THIS FIELD (%)
agriculture, forestry, fishing and hunting, and mining	1
construction	6
manufacturing	13
wholesale trade	2
retail trade	11
transportation and warehousing, and utilities	4
information	2
finance and insurance, and real estate and rental and leasing	5
professional, scientific, and management, and administrative and waste management services	9
educational services, and health care and social assistance	24
arts, entertainment, and recreation, and accommodation, and food services	15
other services, except public administration	4
public administration	5

Several employers of note within the Norwich / New London area include (CT.gov 2021):

- General Dynamics Electric Boat (defense contracting) – Groton, CT
- Pfizer (pharmaceuticals) – Groton, CT
- US Foods (foodservice distribution) – Norwich, CT
- Lawrence Memorial Hospital (healthcare) – New London, CT
- Backus Hospital (healthcare) – Norwich, CT
- Foxwoods Casino (retail / entertainment) – Mashantucket, CT (within Ledyard, CT)
- Mohegan Sun Casino (retail / entertainment) – Uncasville, CT (within Montville, CT)

The median income of households in Norwich / New London was $71,368. An estimated 4.9% of households had income below $10,000 a year and 7.5% had income of $200,000 or more (Table 5-39).

Table 5-39: Norwich / New London Income Distribution
Distribution of the household income in the Norwich / New London area (United States Census Bureau 2021).

INCOME RANGE	HOUSEHOLDS WITHIN THE RANGE (%)	INCOME RANGE	HOUSEHOLDS WITHIN THE RANGE (%)
Less than $10,000	4.9	$50,000 to $74,999	18.6
$10,000 to $14,999	3.8	$75,000 to $99,999	13.5
$15,000 to $24,999	7.5	$100,000 to $149,999	17.7
$25,000 to $34,999	7.0	$150,000 to $199,999	8.8
$35,000 to $49,999	10.7	$200,000 or more	7.5

5.2.2.3 Regional Economics

Previous sections have evaluated the geographic region defined by the U.S. Census based American Community Survey (ACS) metropolitan / micropolitan district area of Norwich / New London. Here we use the State of Connecticut county breakdown by Middlesex and New London counties to provide a look at some of the distinctive elements each area contributes to the region as a whole. Data on the percent contributed by each sector to the gross regional product of the country were available for New London County but not Middlesex County.

Middlesex County

Middlesex County data were available from the Lower Connecticut River Valley Council of Governments (RiverCOG). As of a 2016 report (Ninigret Partners and Fitzgerald & Halliday Inc. 2016), the RiverCOG region is home to approximately 4,100 businesses, the majority being small and mid-sized companies (52% having less than four employees and 25% with between 10 and 100 employees).

When considering the economic landscape, the data suggested this area is divided into four distinct economies. In order of importance: Manufacturing / Trade, Local, Lifestyle, Tourism.

MANUFACTURING / TRADE remains a mainstay of the regional economy. While it is the third largest sector in terms of direct employment with approximately 9,000 employees, it is a key economic driver in terms of wages. In 2014, manufacturing had $3.5 billion in wages. Including manufacturing supply and value chains, wholesale trade, and logistics, this adds approximately 13,000 more people and $850 million more in wages. Subsectors with the highest level of employment and wages include fabricated product metal manufacturing, machinery manufacturing, transportation equipment, and durable goods wholesalers.

THE LOCAL ECONOMY supports roughly 21,000 jobs that are connected to local resident's financial health and spending through businesses such as healthcare, social services, government, etc.

LIFESTYLE ECONOMY. Because the region supports a high quality of life, many people choose to work and live in the region. From second home residents to employees of professional / technical companies whose services can be performed anywhere, an estimated 13,000 to 15,000 jobs and nearly $450 million in wages can be attributed to the so-called "lifestyle" economy.

TOURISM focuses on assets surrounding culture, water-centric activities, and natural resources. General estimates suggest this economy supports in the neighborhood of 5,000 to 7,000 jobs with payrolls totaling close to $150 million.

New London County

New London County data was available from the Southeastern Connecticut Economic Development District. In a 2017 report (The Southeastern Connecticut Enterprise Region et al. 2017), they highlight the region by using the following economic clusters:

TOURISM makes up 19% of the regional economy with 27,430 jobs in 2016 (increasing to 28% if an estimated 13,232 jobs related to the gaming industry are included). The region has considerable recreation amenities including three locations boasting millions of annual visitors: Mystic Aquarium, Mystic Seaport, and Olde Mistick Village. It is also home to two world-renowned resort casinos both with retail outlets, historic sites (including a new unique Heritage Park), numerous accommodations and diverse food service businesses, and outdoor and indoor recreational opportunities.

HEALTHCARE SERVICES account for a significant 14% of the regional economy with 20,846 jobs in 2016 and contribute about 8.4% or $1.22 billion to the entire region's gross regional product (GRP). The region is home to three hospitals with affiliations to larger healthcare organizations such as Yale New Haven, Hartford Healthcare, and Sloan Kettering. Note that industries such as pharmaceuticals, medical research, etc., while similar, are not included here but rather considered within the Bioscience category.

DEFENSE includes ship building driven by military ship and submarine manufacturing at Electric Boat and federal government military related employment driven by the federal military base. It currently makes up about 13% of the regional economy with 19,319 jobs in 2016 and contributes about 15% or $2.23 billion to the GRP, the largest of any category for New London County.

ENERGY / ENVIRONMENT was defined broadly for this analysis and includes all utilities related to:

- power generation;
- waste management;
- skilled trades typically relied upon including heating, plumbing, and electrical trades;

- manufacturing related to fuel / energy production including chemicals and fuel production, and equipment, machinery and devices;
- warehousing and distributions related to energy and environment; and
- professional services including engineering, testing, research and development, and consulting services.

It makes up between 3% and 4% of the regional economy with 5,513 jobs in 2016 and contributes 9% or $1.32 billion to the GRP.

Bioscience includes the industries of pharmaceutical manufacturing, medical device manufacturing, and research and development related to life sciences. It excludes healthcare and social services which are included within a separate healthcare category. It currently makes up about 2% of the regional economy with 2,994 jobs in 2016 and contributes about 8.5% or $1.24 billion to the GRP.

Agriculture / Fishing and Aquaculture / Food Production includes activities related to food production and distribution including crop and animal production and fishing and food and beverage related manufacturing, wholesale, and distribution. It excludes any retail and restaurant businesses. It consistently makes up between 1% and 2% of the regional employment with 2,144 jobs and contributes about 1% or $175 million to the GRP.

Creativity / Arts includes occupations in graphic design, teaching, advertising, news / media, etc. One of the smallest clusters, it makes up only about 1% of the regional economy with 1,928 jobs in 2016 and contributes less than 1% or $112 million to the GRP.

Manufacturing (Advanced) includes all manufacturing industries that require advanced technologies or skills. It excludes pharmaceutical and medical-related manufacturing, shipbuilding, and boat building as they are included in other categories. It makes up about 1% of the regional economy with 1,917 jobs in 2016 and contributes about 1.6% or $239 million to the GRP.

Maritime includes industries related to boat building (excluding defense ship building), boat dealers, marine transportation, scenic and sightseeing transportation, and marine cargo handling. It makes up less than 1% of the regional economy with 422 jobs in 2016 and contributes less than 1% or $48 million to the GRP.

In terms of population, jobs, and the regional economy, the overwhelming threat is related to climate change impacts on local communities, including sea level rise. Pollution and marine debris impairs water quality and may impact local recreational and tourism based activities. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternative A includes land within the towns of Groton, Old Lyme, and Lyme, all within New London County. The aquatic portions of the project area border on the New London County towns of Stonington, Groton, New London, Waterford, East Lyme, Old Lyme, and Lyme; and on the Middlesex County towns of Essex, and Old Saybrook. This alternative includes the New London and Groton areas, which have the greatest racial and ethnic diversity within the project region, as well as underserved communities as identified by the DEEP-listed economically distressed municipalities and DEEP-identified environmental justice communities. This alternative also includes the major employers in the area and has a wide range of economic levels within the population.

Alternative B includes land within the New London County towns of Old Lyme and Lyme; and the Middlesex County towns of East Haddam and Old Saybrook. The aquatic portions of the project area border on the New London County towns of Old Lyme and Lyme; and the Middlesex County towns of East Haddam, Old Saybrook, Essex, Deep River, Chester, and Haddam. These areas do not include economically distressed municipalities nor environmental justice communities. The racial and ethnic composition of the population is less diverse than Alternative A. None of the major employers are located in the project area of this alternative.

Alternative C includes land within the New London County towns of Old Lyme and Lyme; and the Middlesex County towns of Essex and Old Saybrook. The aquatic portions of the project area border on the New London County towns of Old Lyme and Lyme; and the Middlesex County towns of Old Saybrook and Essex. These areas do not include economically distressed municipalities nor environmental justice communities. The racial and ethnic composition of the population is less diverse than Alternative A. None of the major employers are located in the project area of this alternative.

Alternative D includes all features described for Alternative A.

5.2.3 Current Human Uses

Although these land and water areas support numerous ecological services, they also share space with a significant amount of human uses. It is important to note that despite their amount and distribution, the activities of boating, commerce, infrastructure, finfishing, shellfishing, etc., have long coexisted with various research and environmental conservation interests across Long Island Sound and Fishers Island Sound. The proposed CT NERR and the programs it would support would not be expected to alter the status quo, as it does not impose limits or other use-based restrictions. Similarly, in cases where new or existing water-dependent activities may be proposed, the provisions of the Connecticut Coastal Management Act and any other applicable existing state, Federal, or local statutes, regulations, and policies would continue to be applied regardless if an area is designated as a reserve or not. Therefore, current and potential water-based uses should be considered compatible with reserve goals and functions.

At this stage, a well-formed suite of ecosystem services specifically for the proposed CT NERR is not readily available. However, a broader look at Long Island Sound and its watersheds provides meaningful context. A recent valuation of the economic services provided by Long Island Sound estimated an asset value between \$690 billion and \$1.3 trillion (4% discount rate over 100 years) with an annual assets flow of \$17 billion to \$36.6 billion (Kocian et al. 2015). Of the 21 ecosystem services identified as possible for Long Island Sound, 14 were evaluated across nine land cover types (Table 5-40 and Figure 5-19). As stated by the authors, "*Benefit transfer methodology was applied using over 40 primary ecological economic valuation studies from the East Coast. Similar to valuations in financial markets, these studies made use of multiple valuation methodologies including market pricing, cost avoidance, replacement cost, travel cost, hedonic values, and contingent valuation. The range in values represents the lowest and highest possible values in the academic peer reviewed literature and can be used for comparison to other financial assets*" (Kocian et al. 2015).

Table 5-40: Ecosystem Service Classification

Twenty-one ecosystem services were identified for consideration in the Long Island Sound economic valuation. Fourteen of these had sufficient data and were evaluated (Kocian et al. 2015). Text in table copied from Kocian et al. (2015).

SERVICE	DESCRIPTION	EVALUATED
PROVISIONING SERVICES		
energy and raw materials	Providing fuel, fiber, fertilizer, minerals, and energy.	X
food	Producing crops, fish, game, and fruits.	X
medicinal resources	Providing traditional medicines, pharmaceuticals, and assay organisms.	
ornamental resources	Providing resources for clothing, jewelry, handicraft, worship, and decoration.	
water supply	Provisioning surface and groundwater for drinking, irrigation, and industrial use.	X
INFORMATION SERVICES		
aesthetic information	Enjoying and appreciating the presence, scenery, sounds, and smells of nature.	X
cultural and artistic inspiration	Using nature as motifs in art, film, folklore, books, cultural symbols, architecture, and media.	X
recreation and tourism	Experiencing natural ecosystems and enjoying outdoor activities.	X
science and education	Using natural systems for education and scientific research.	X
spiritual and historical	Using nature for religious and spiritual purposes.	
REGULATING SERVICES		
air quality	Providing clean, breathable air.	
biological control	Providing pest and disease control.	X
climate stability	Supporting a stable climate through carbon sequestration and other processes.	X
moderation of extreme events	Preventing and mitigating natural hazards such as floods, hurricanes, fires, and droughts.	X
pollination	Pollinating wild and domestic plant species.	X
soil formation	Creating soils for agricultural use and ecosystems integrity; maintaining soil fertility.	X
soil retention	Retaining arable land, slope stability, and coastal integrity.	

SERVICE	DESCRIPTION	EVALUATED
waste treatment	Improving soil, water, and air quality by decomposing human and animal waste and removing pollutants.	X
water regulation	Providing natural irrigation, drainage, groundwater recharge, river flows, and navigation.	
SUPPORTING SERVICES		
genetic resources	Improving crop and livestock resistance to pathogens and pests.	
habitat and nursery	Maintaining genetic and biological diversity, the basis for most other ecosystem functions; promoting growth of commercially harvested species.	X

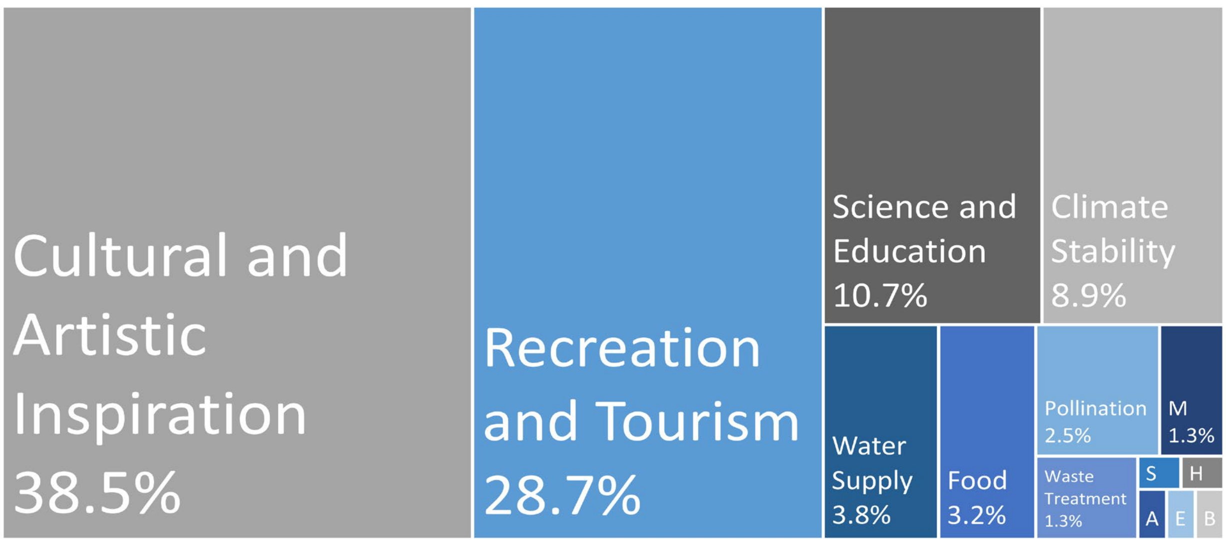


Figure 5-19: Economic Valuation of Long Island Sound

Squares represent the fraction of the annual asset flow of the $17 billion to $36.6 billion related to fourteen ecosystem services evaluated for Long Island Sound; modeled after Figure 11 in the project report (Kocian et al. 2015). The range in value is associated with the error of estimating the many numbers that enter into the calculation. Categories are described in Table 5-40. The area of each block represents the fractional worth of the service. M = moderation of extreme weather events. Five categories contribute <1% to the value: S = soil formation, H = habitat and nursery, A = aesthetic information, E = energy and raw materials, B = biological control. The valuation includes all of Long Island Sound and its watershed up to Canada.

5.2.3.1 Tourism and Recreation

Current land-based and shore-centric human-use activities within the site boundaries vary and can range from hiking, biking, swimming, pleasure boating / kayaking, diving, in addition to recreational fishing, shellfishing, and seasonally managed hunting which were covered in earlier sections.

As noted in *Section 5.2.2.3*, tourism in New London County makes up 19% of the regional economy with 27,430 jobs in 2016 (increasing to 28% if estimated 13,232 jobs related to the gaming industry are included) (The Southeastern Connecticut Enterprise Region et al. 2017). The region has considerable recreational amenities including three locations boasting millions of annual visitors: Mystic Aquarium, Mystic Seaport, and Olde Mistick Village (Figure 5-20). It is also home to two world-renowned resort casinos both with retail outlets, historic sites and a unique Heritage Park, numerous accommodations and diverse food service businesses, and outdoor and indoor recreational opportunities. Within Middlesex County, tourism focuses on assets surrounding culture, water-centric activities, and natural resources. General estimates suggest this economy supports in the neighborhood of 5000 to 7000 jobs with payrolls totaling close to $150 million (Ninigret Partners and Fitzgerald & Halliday Inc. 2016).

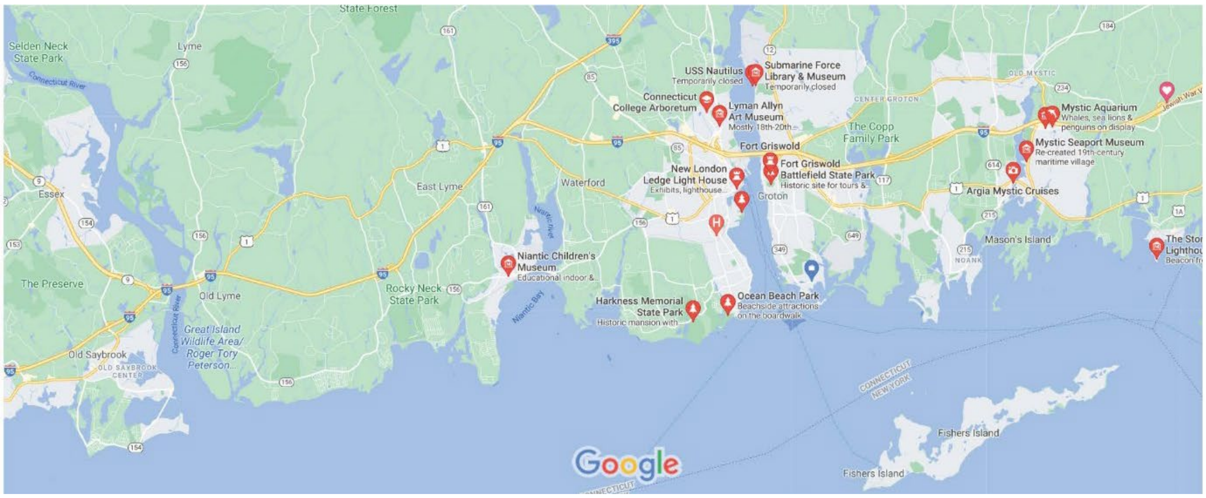


Figure 5-20: Popular Tourist Destinations

A Google search of popular tourist destinations highlights some popular attractions within the project area. Not visible in this extent are the two casinos, located further inland on the tribal lands of the Mashantucket Pequot Tribal Nation (Mashantucket, CT) and the Mohegan Tribe (Uncasville, CT).

The offshore area of the project area site in general is densely used by recreational and commercial boating, owing largely to the port facilities in the Thames River, numerous marinas and yacht clubs, and close proximity to the North Shore of Long Island, Fishers Island, and the open waters of the Atlantic Ocean (see also, *Section 5.2.3.4*) (Figure 5-21) (Longley 2013). These interests include both ad-hoc routes as well as dedicated areas and lanes for organized boat / yacht races (Longley-Wood 2015).

Boating in Fishers Island Sound. Fishers Island is in the bottom of the photo. Connecticut, to the north, is the land mass in the distance. Photo courtesy of Chantal Collier, The Nature Conservancy.

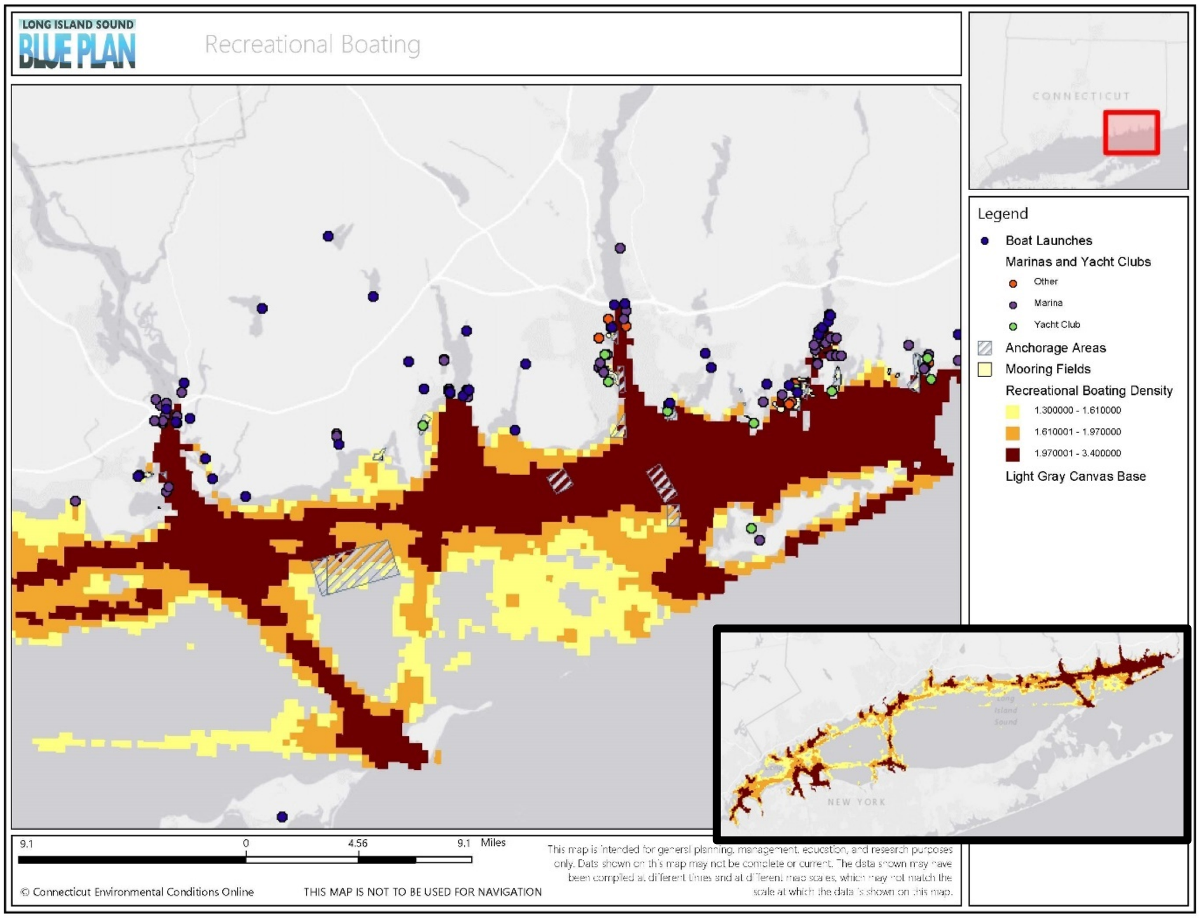


Figure 5-21: Recreational Boating and Marinas

Recreational boating data (Longley 2013) were obtained from the Northeast Ocean Data Portal and thresholds were chosen to highlight areas where boating density was higher than average for Long Island Sound and Fishers Island Sound. The inset map of Long Island Sound shows recreational boating density throughout The Sounds, illustrating the heavy use seen throughout the project area. This map was generated using the Long Island Sound Blue Plan Viewer (DEEP 2019b).

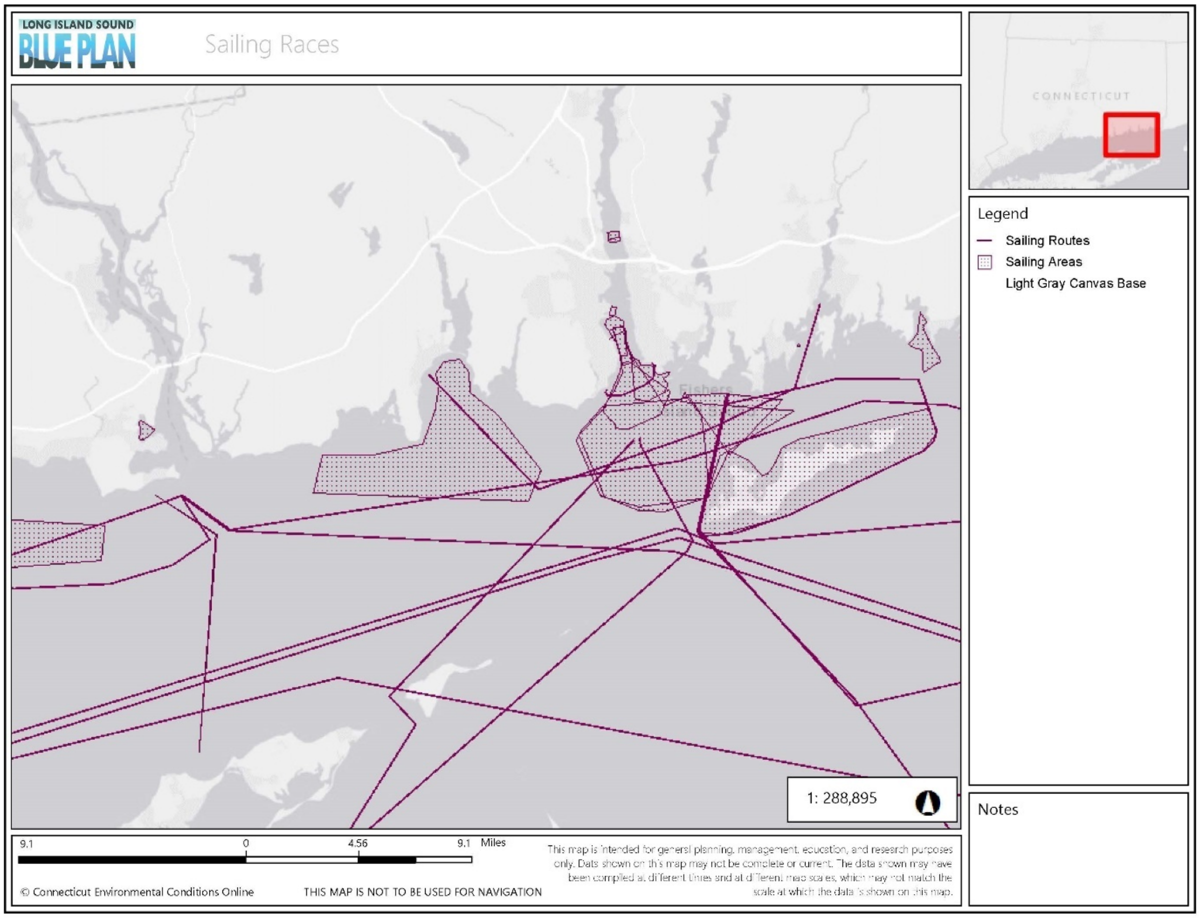


Figure 5-22: Sailing Routes and Sailing Areas

Sailing areas and race route data (Longley-Wood 2015) were obtained from the Northeast Ocean Data Portal. These are areas consistently used by organized clubs and associations. Including but not limited to racing and training areas, and long-distance sailing race routes. In particular, note the multiple overlapping areas in and outside the Thames River. The map was generated using the Long Island Sound Blue Plan Viewer (DEEP 2019b).

Diving is a popular sport in Long Island Sound and especially in Fishers Island Sound. Popular dive areas are heavily concentrated in the eastern portion of the project area with relatively few diving activities occurring near the Connecticut River (Figure 5-23).

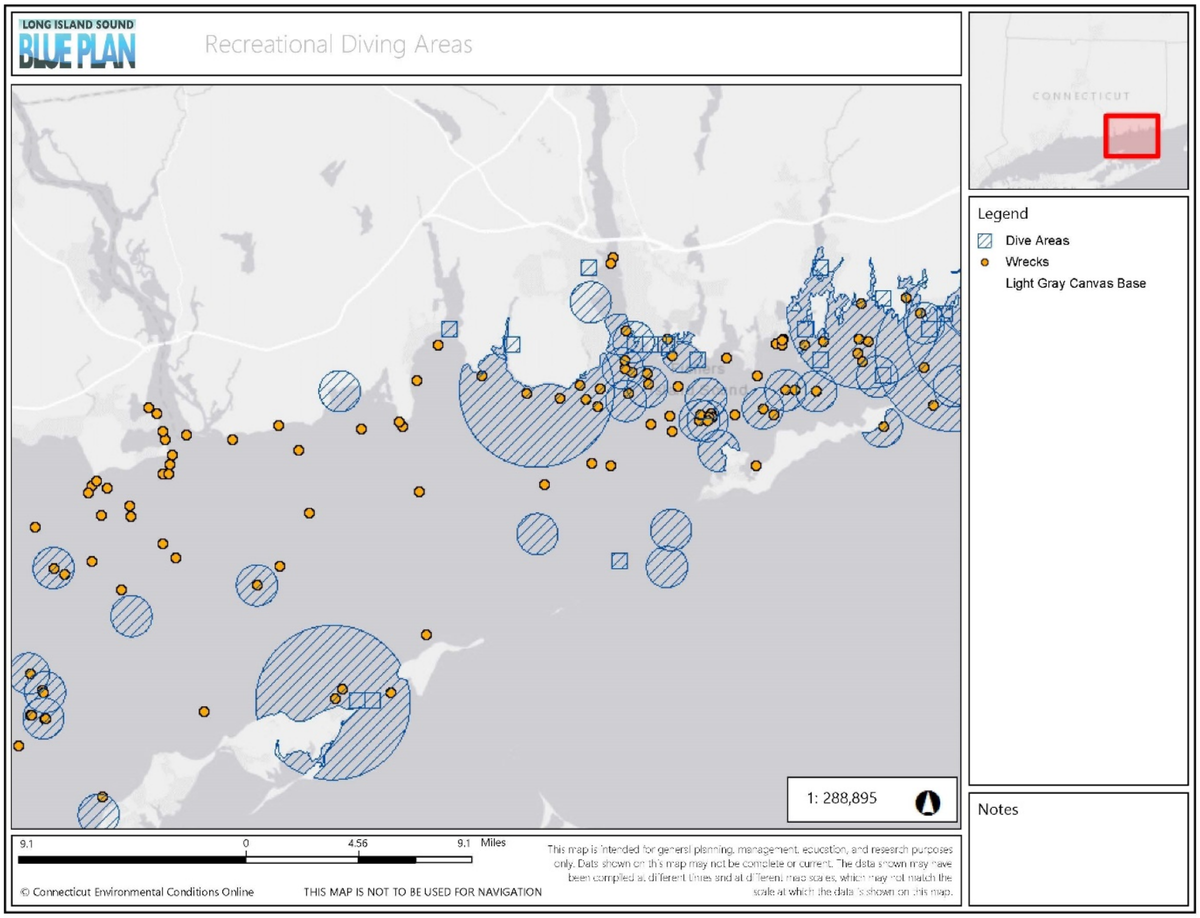
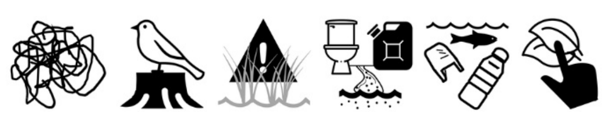


Figure 5-23: Popular Diving Areas and Locations of Shipwrecks

Data used in the Blue Plan mapping efforts included the 2015 Northeast Coastal and Ocean Recreational Use Characterization Study - SCUBA Activities (via Northeast Ocean Data Portal: https://www.northeastoceandata.org/data-explorer/) and the locations of dive sites provided through a participatory mapping exercise with stakeholders from the local diving community. The shipwreck data are provided for context, as many dives enjoy visiting shipwrecks. Shipwreck data were obtained from SHPO and from the NOAA navigational charts during the Blue Plan mapping process (DEEP 2019b). The map was generated using the Long Island Sound Blue Plan Viewer (DEEP 2019b).



Threats posed by reserve activities in relation to tourism and recreation (sailing, boating, diving) include the placement of scientific gear which may impede operations if encountered; entanglement is a potential issue for boating. Other threats relate to habitat loss, habitat degradation, pollution, and marine debris which can impact the desirability of visiting an area. In some cases, habitats may be closed to visitor access to minimize the impact of humans on sensitive species during important periods of their lifecycle. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

Alternative A includes concentrations of terrestrial tourist destinations relatively near the properties located in the eastern end of the project area, while there are relatively fewer tourist destinations near the terrestrial properties located around the lower Connecticut River. Recreational boating is heavy throughout the project area, but the area of greatest density is larger in the eastern end of the project area. Diving activity is heavily skewed towards the eastern end of the project area, indicating either better dive sites or closer proximity to diving services / access or both. Multiple sailing areas exist off the lower Thames River and Niantic Bay, but sailing routes are prevalent throughout the project area.

Alternative B does not include the eastern end of the project area which is included in Alternative A. Thus, tourism, diving, and sailing activities are expected to be lower in this alternative. Recreational boating activity is high throughout eastern Long Island Sound and western Fishers Island Sound, including the area within this alternative.

Alternative C is very similar to Alternative B, adding some additional areas to the east and west of the Connecticut River. Thus, activity is essentially the same as for Alternative B.

Alternative D is essentially the same as Alternative A, in the context of recreation and tourism.

5.2.3.2 Education

Within the Norwich / New London area (Figure 5-18, page 225) during the five-year period of 2014-18, the total school enrollment was 61,472 (United States Census Bureau 2021). Pre-K through 12th grade enrollment was 44,328. College or graduate school enrollment was 17,144. Nearly 92% of people 25 years and over had graduated from high school and 42% had an Associate's Degree or higher.

The region surrounding the proposed CT NERR is home to an economically and culturally diverse mix of people. Communities range widely in permanence, from North America's oldest Indian Reservation (the Mashantucket Pequot) to Ledyard and Groton, which experience high population turnover each year as a result of personnel movement into and out of Naval Submarine Base New London, Groton, CT. The cities of New London, Norwich, and Groton are ethnically diverse, with higher poverty rates relative to surrounding towns, while towns such as Lyme and Old Saybrook are relatively wealthy and homogenous (Table 5-41). Despite this diversity, communities in this region are connected by the estuary they share, and by common vulnerabilities to climate change and related environmental hazards.

Since the Sheff vs. O'Neill decision by the Connecticut Supreme Court in 1996 (Sheff v. O'Neill, 678 A.2d. 1267 (Conn. 1996)), Connecticut schools have been under court order to desegregate. As a result, public education in Connecticut is a complex mixture of traditional public school districts, magnet schools, charter schools, and independent schools. The result has ironically been a widening of the gap in how students are educated in urban vs. rural and suburban areas: most urban students attend magnet, charter, or independent schools, while most rural and suburban students attend traditional school districts. In the region of the proposed CT NERR, students in Norwich, Groton, and New London attend magnet schools for all or part of their educational career, while most students from other communities attend traditional public school systems. Despite the influx of magnet-related funding to Norwich,

Table 5-41: Community and School Demographics.

Demographic and school district data for communities in and adjacent to the proposed CT NERR. The first four columns show the boundary alternatives by school district. Connecticut's Next Generation Accountability System is a broad set of 12 indicators that help tell the story of how well a school is preparing its students for success in college, careers and life. The goal for the summary indicator is 75 or better (out of 100), Data provided are from the 2018-2019 school year. Connecticut Alliance districts are in bold and italicized. These districts also contain CT Title 1 (schoolwide) schools. Data bars in cells indicate the relative magnitude of the Next Generation Accountability Index (compare vertically, green bars), the percent of students who qualify for free or reduced lunch (compare vertically, pink bars), and the race or ethnicity of the student population at the time of enrollment for the 2019-2020 school year (read horizontally for each school district, yellow or blue bars; may also be read vertically for comparisons among school districts). Data were obtained from Connecticut's EdSight portal (DOE 2021).

ALTERNATIVE							Student Race / Ethnicity						
A	B	C	D	SCHOOL DISTRICT	NEXT GENERATION ACCOUNTABILITY INDEX (SCORE)	STUDENTS WHO QUALIFY FOR FREE OR REDUCED LUNCH (%)	AMERICAN INDIAN	ASIAN	BLACK OR AFRICAN AMERICAN	HISPANIC OR LATINO OF ANY RACE	NATIVE HAWAIIAN OF OTHER PACIFIC ISLANDER	TWO OR MORE RACES	WHITE
X			X	Stonington	81.9	27.0	*	2.1	1.3	6.0	*	4.2	85.9
X			***X***	***Groton***	***77.0***	***49.6***	***0.8***	***6.1***	***7.8***	***22.1***	***0.4***	***10.0***	***52.7***
X			***X***	***New London***	***63.2***	***81.1***	*	***1.2***	***17.6***	***52.1***	*	***11.5***	***16.8***
X			X	Waterford	81.6	31.1	0.3	4.7	2.8	11.5	0.3	4.7	75.7
X			X	East Lyme	81.3	22.8	*	8.9	1.6	7.6	*	5.3	76.3
X	X	X	X	Lyme-Old Lyme (Region. 18)	86.6	17.1	0.0	2.7	*	6.0	*	2.9	87.6
	X			East Haddam	82.2	25.8	*	1.5	*	3.7	0.0	2.0	91.6
	X			Haddam-Killingsworth	82.1	12.8	0.0	1.7	0.9	3.4	0.0	2.8	91.2
	X			Chester	87.0	22.0	0.0	*	*	8.1	0.0	3.2	87.6
	X			Deep River	81.8	36.6	*	*	*	6.8	0.0	5.5	83.8
X	X	X	X	Essex	91.1	22.7	0.0	*	*	7.6	0.0	5.1	84.9
X	X	X	X	Old Saybrook	85.4	27.5	0.0	3.6	*	12.6	*	2.8	79.8
				Ledyard	76.1	26.1	2.9	3.5	4.9	10.8	0.4	4.9	72.5
				Montville	77.9	45.5	*	7.7	3.0	14.1	*	11.8	62.4
				Norwich	***59.3***	***67.3***	***0.5***	***6.4***	***18.5***	***34.5***	***0.4***	***10.1***	***29.6***
				Norwich Free Academy	69.1	52.0	1.1	7.9	14.7	17.4	0.5	6.0	52.3

Groton, and New London school systems, these schools underperform across a variety of performance metrics compared to surrounding wealthier communities (e.g., Table 5-41). All three of these districts have been designated as Alliance school districts under C.G.S. § 10-262u, a designation reserved for the low-performing, underserved districts. Norwich and New London have additionally been designated as Opportunity Districts, a designation reserved for the ten lowest-performing districts in the state. Groton, New London, and Norwich are also the only school districts in the region that receive federal funding for

Title 1 schoolwide programs, a program designed to boost schools in which at least 40% of students are living in poverty.

The proposed CT NERR provides many opportunities for education and interpretation, including opportunities that would integrate research and stewardship activities affecting The Sound's estuaries and their watersheds. As mentioned previously, the area has a variety of habitat types including the last remaining significant piece of undeveloped land along the Connecticut coastline, and what is believed to be the largest expanse of tidal marshes that are adjacent to undeveloped upland habitat anywhere along the U.S. east coast from New York City to Maine.

The area has a long history of education and interpretation – both Bluff Point and the Connecticut River marshes are regular locations for school field trips and formal and informal nature programs, and submerged lands in both watersheds support active education and citizen science programs focused on water quality, aquatic and marine ecosystems, and benthic communities. The proposed CT NERR is in close proximity to an estimated audience of approximately 44,328 pre-K through twelfth-grade students, as well as multiple institutions of higher learning, and has a high potential for future development of education and interpretation programs based on a broad range of topics including ecology, physics / chemistry, geology, biology, archaeology, habitat restoration, coastal resource management, sustainability, and ecosystem services. There are multiple areas within the site properties that provide a variety of easy access via vehicle, boat and foot for targeted audiences that would include K-12 students, visitors, community members and local decision makers. Additionally, Haley Farm State Park and Bluff Point State Park include parking access and a trail system which is wheelchair accessible.

Threats to education are relatively minimal, as reserve activities are designed to be beneficial to education. In some cases, habitats may be closed to visitor access to minimize the impact of humans on sensitive species during important periods of their lifecycle. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

SUMMARY BY BOUNDARY ALTERNATIVE

Alternative A includes close proximity to the reserve to a greater proportion of Title I (schoolwide) schools, Alliance and Opportunity districts, and DEEP-defined environmental justice communities, which are identified as priority audiences in the *Draft Management Plan*. In addition, many environmental educational organizations are primarily located in the eastern portion of the project area.

Alternative B lacks the features of community and audience diversity found in Alternative A and does not offer anything new beyond what is found in Alternative A.

Alternative C has the same features of Alternative B in an educational context.

Alternative D has the same features of Alternative A in an educational context.

5.2.3.3 Research and Monitoring

The project area offers excellent opportunities for long-term research. The project area overall contains a mosaic of upland, transitional and subtidal habitats situated proximal to a variety of coastal uses, including significant recreational fishing and commercial and recreational boating. *Alternatives A* and *D* include developed waterfronts at the mouth of the Thames River as well as recreational and commercial shellfishing and aquaculture that are absent from *Alternatives B* and *C*.

This combination of resources and uses is reflected in a broad examination of research activities found in the both peer-reviewed and grey literature conducted to support the NERR Site Selection process. This meta-analysis identified close to 200 papers or projects on topics ranging from tidal wetland restoration, vegetative assessments, species predation patterns, population dynamics, invasive species identification and control, climate change, water quality impacts, nutrient loading effects, etc. The offshore areas of Long Island Sound and Fishers Island Sound have supported long-term research and monitoring efforts for physical oceanography, water quality, benthic habitats, and fisheries assessments (Figure 5-24).

The location of the UConn Avery Point campus is in close proximity to the natural habitats, minutes from Bluff Point by car or boat, and not much further to the lower Connecticut River. This campus provides world-class facilities and resources. As such, there are multiple opportunities and support for important research regarding estuary habitat dynamics, long-term ecosystem monitoring and trend analyses, as well as emergent areas of climate change, aquaculture best practices, etc.

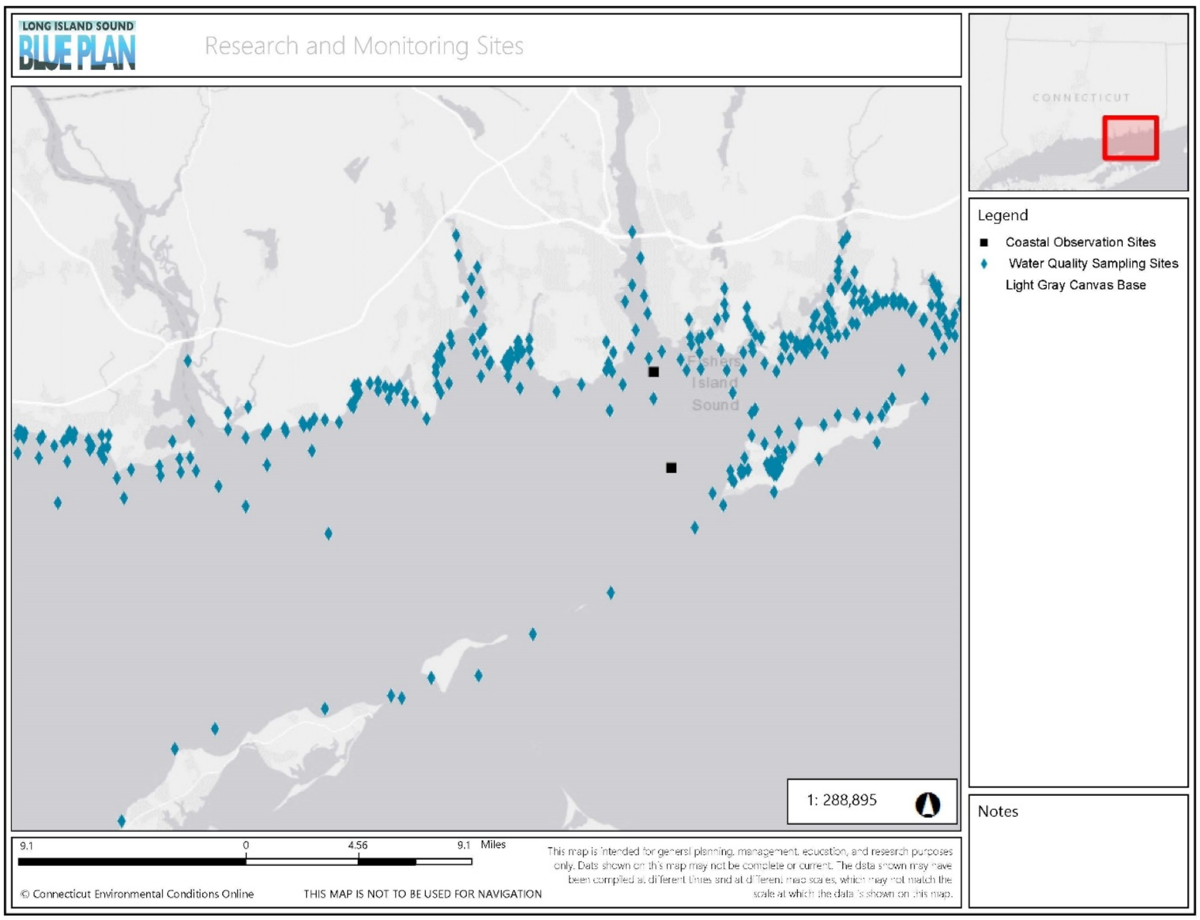


Figure 5-24: Research and Monitoring Sample Locations

The map was generated using the Long Island Sound Blue Plan Viewer (DEEP 2019b). Areas actively and consistently used for research activities, including but not limited to long-term monitoring sites, and Sound-dependent experiential educational programming.

The site also creates valuable opportunities for comparative research with other nearby estuary systems both within the Reserve System (e.g., Narragansett Bay) and without (e.g., numerous scientific and citizen science groups working in other areas of the Connecticut coast). The existing research institutions, organizations, research efforts, institutional collaborations, and partnerships offer a tremendous opportunity to further leverage resources, partnerships, and expertise in a synergistic manner.

Research and monitoring, by their very nature, are designed to help understand threats to habitats and humans. No threats to research and monitoring are posed by the establishment of a reserve and no external threats are expected.

Summary by Boundary Alternative

Alternative A already supports a wide diversity of research and monitoring. With more than double the area of Alternative B, the area of these activities is the largest of all alternatives. Alternative A also has the benefit of including the Avery Point campus in the middle region of the project area, making the campus a convenient base of operations for many research activities.

Alternative B also supports a wide diversity of research and monitoring. But with less than half the area of Alternative A, less diversity and range is possible within the project area boundaries. Alternative B is more distant from the Avery Point campus, making the campus less convenient as a base of operations for many research activities.

Alternative C has the same features of Alternative B in a research context.

Alternative D has the same features of Alternative A in a research context.

5.2.3.4 Transportation, Navigation, and Infrastructure

Uses include large-scale commercial and industrial water-dependent uses, most of which are centralized in the lower Thames River area and reflect its location as a center of maritime focus. The lower Thames River is included in *Alternatives A* and *D*, but not in *Alternatives B* or *C.*

The Bluff Point and Haley Farm locations included in *Alternatives A* and *D* are located in the town of Groton. Groton has a large population of about 39,000 (Cubit 2021). The surrounding landscape is considerably more developed relative to other areas of the project area. The Groton-New London Airport is located immediately on the western side of the project area boundary. The airport is a public-use, publicly owned general aviation airport with two runways: 4,000 feet and 5,000 feet long, and a supporting infrastructure that includes a taxiway system, aircraft parking aprons, hangar facilities, etc.). The FAA contract tower operating hours are 7 am to 10 pm daily. It serves general aviation, business, recreational, and tourist-related demand in southeastern Connecticut and also supports the Army National Guard's 1109th Theatre Aviation Sustainment Maintenance Group. This group assists in deployment and redeployment, and provides technical assistance in support of Army aviation (Connecticut Airport Authority 2021). Additionally, the Amtrak railway line runs adjacent to the northern boundaries of Bluff Point and the southern boundaries of Haley Farm. The adjacent and nearby lands reflect a higher degree of development than the lower Connecticut River, with neighborhoods, municipal, and commercial enterprises dominating the areas.

The lower Connecticut River, included in all boundary alternatives, is located in the towns of Old Lyme, Lyme, Essex, and Old Saybrook. The populations of the two river towns hosting land-based properties are relatively small - roughly 2,300 for Lyme and 7,500 for Old Lyme (Cubit 2021). As noted in the *Site Description Section (Chapter 4)*, the Connecticut River is the only principal river system in the Northeast that does not have a major port facility or operation at its mouth. While there are several prominent marina facilities on the western side of the Connecticut River in Old Saybrook and a transportation corridor containing Amtrak railway lines and the I-95 interstate within the boundaries, the majority of nearby land is rural in nature, including properties owned by land trusts or similar conservation organizations that are immediately adjacent to portions of both Lord Cove and Roger Tory Peterson NAP. Where nearby and adjacent lands have been developed, they tend to be dominated by neighborhoods and small beach communities.

There are several noteworthy aspects of the offshore area that bear mention, all of which are documented on NOAA Nautical charts. There are eight "special" and six "unrestricted" anchorage areas that support boating interests. One special anchorage area also doubles as a lightering area. There are two security zones on the western and eastern shores of the Millstone Power Station (located in the Niantic Bay region within the proposed offshore buffer area) and several corridors for submerged cable and pipelines in both the offshore and riverine areas of the Connecticut and Thames Rivers.

There are all or parts of 13 navigation channels – the Thames River Federal Navigation Channel being the largest – used by numerous vessels that are periodically maintained via dredging. There are three inactive open water dredge disposal sites but only one designated open water disposal site authorized to receive material (which may come from various public and private projects both within and outside of the project area, including out of state projects). When considering the activities of dredging and open water disposal, these are tightly regulated at the state and federal levels through provisions of the Clean Water Act; Marine Protection, Research, and Sanctuaries Act; and Connecticut coastal permit program. Further, the currently designated disposal site, the Eastern Long Island Sound Disposal Site, was authorized by a Final Rule from EPA in December 2016 (81 FR 87820) having completed the necessary environmental impact statement process (USEPA 2021e). The *Final Environmental Impact Statement* determined that, among three alternatives, the Eastern Long Island Sound Disposal Site provided the best characteristics to manage and monitor disposal to prevent potential adverse impacts to the marine environment. More specifically it concluded that the preferred alternative Eastern Long Island Sound Disposal Site (Louis Berger and University of Connecticut 2016):

- will serve as a containment site, which will support effective management and monitoring;
- addresses the preference to designate sites in areas used in the past (40 C.F.R. § 228.5(e)) (Louis Berger and University of Connecticut 2016) by being immediately adjacent to an existing location that has been used for dredged material disposal for over 30 years, for which site monitoring has determined that past and present management practices have been successful in minimizing short-term, long-term, and cumulative impacts to natural resources, including water quality and benthic habitat;
- is located entirely within waters of the State of Connecticut, which will have most of the need for open-water disposal of dredged material for the 30-year planning period; and
- is necessary for the eastern Long Island Sound region to support safe navigation and commerce by providing a capacity of 20 million cubic yards, sufficient to meet anticipated state (CT, RI, and NY) and federal needs over a 30-year planning period.

Additionally, the Final Rule set standards and procedures to promote the development and use of practicable alternatives to open-water disposal (USEPA 2021e). Accordingly, a standing, interagency Steering Committee and Regional Dredging Team for Long Island Sound were established. These groups are comprised of federal and state agency representatives who work together to identify, develop, and promote the use of practicable alternatives to open-water disposal of dredged material, such as using sand for beach nourishment. They also review dredging projects and offer recommendations to the U.S. Army Corps of Engineers regarding how the dredged material from such projects should be handled.

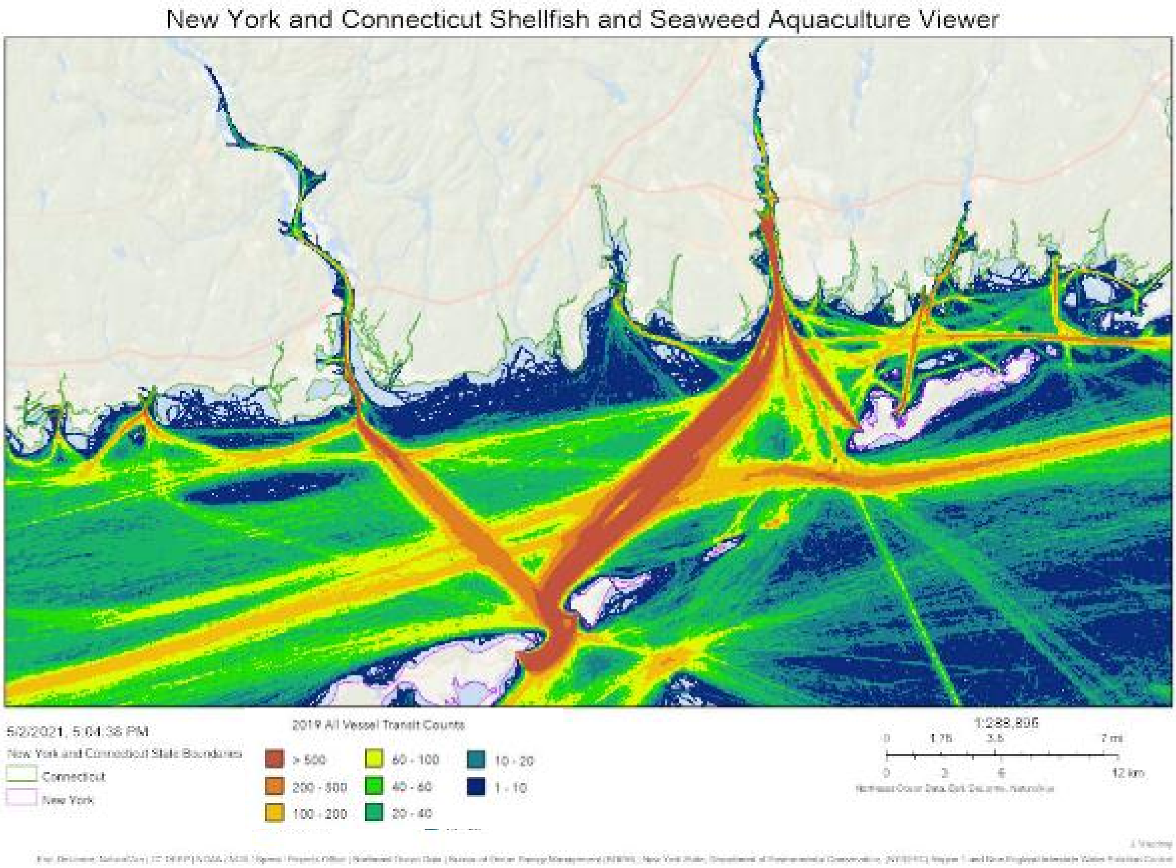


Figure 5-25: Vessel (AIS) Count Map

Annual sum of vessel occurrences from 2019 for all vessels that carry Automatic Identification System (AIS) transponders, U.S. Coast Guard data. AIS is a navigation safety device that transmits and monitors the location and characteristics of many vessels in U.S. and international waters in real-time. The data represent vessel transit counts in 100 meter grid cells. A single transit is counted each time a vessel track passes through, starts, or stops within each grid cell. Data were mapped in the New York and Connecticut Shellfish Aquaculture Viewer (Long Island Sound Study 2021). The layer includes these vessels: cargo, passenger, tanker, tug-tow, fishing, pleasure craft, and other.

High density vessel transit corridors emanate from Connecticut River (all boundary alternatives) and Thames River (*Alternatives A* and *D*) areas (Figures 5-25 and 5-26). The Connecticut River corridor is typically characterized by recreational vessels (Figure 5-26). The Thames River corridor supports both recreational and commercial traffic including regular ferries to several ports in both New York and

Rhode Island, Coast Guard vessels from the New London Coast Guard Station, and naval vessels moving to and from facilities located just north of but outside the proposed site boundaries (Figure 5-26). A smaller transit corridor primarily supporting recreational boating also intersects the far eastern side of the site originating from the Mystic River in neighboring Stonington, Connecticut (Figure 5-26).

Threats posed to navigation and transportation largely revolve around placement of scientific gear in the environment which could pose a risk of entanglement. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternative A includes the Thames River area, which is heavily used for navigation and commerce. The Thames River hosts the port city of New London which is close to the maritime harbors of Mystic and Stonington, both centers of commercial activity. Relatively little maritime commerce occurs on the Connecticut River, as there is no port city at the mouth of the river. Bluff Point is adjacent to the Groton-New London airport and the Amtrak railway line runs close to Bluff Point. Amtrak also crosses the Connecticut River, but does so further inland compared to the project area. This alternative includes a number of security zones around military-related industry and a nuclear power plant, as well as including the major navigational channel and turning basin the lower Thames River which require periodic maintenance dredging. The currently designated dredge material disposal site, the Eastern Long Island Sound Disposal Site, is located within this alternative. High-density vessel transit corridors emanate from the Connecticut River and Thames River, though the Connecticut River corridor is typically characterized by recreational vessels. The Thames River corridor supports both recreational and commercial traffic including ferries, Coast Guard vessels, and naval vessels. Overall, this site sees heavy navigational use and commercial use of the area.

Alternative B has much less commercial and transportation uses when compared to Alternative A, due to the lack of the Thames River area and being much further from the working waterfronts of Stonington and Mystic, located eastward of Alternative A. This alternative is not near the Groton-New London airport, though is within the sphere of influence of the Chester Airport (a smaller airfield and located five miles from the project area). Vessel traffic on the Connecticut River is primarily from passenger vessels, pleasure craft, and sailing vessels. Overall, this alternative lacks the impacts of commerce seen in Alternative A.

Alternative C is the same as Alternative B, in the context of transportation, navigation, and commerce.

Alternative D improves upon Alternative A by removing areas subject to new potential long-term human modifications (active disposal areas) and potential safety concerns (security zones) from within the boundary. The heavily used navigational channel leading into the Thames River and the turning basin in the lower Thames River are retained to reflect the characteristics of the riverine ecosystem they represent but are reclassified as buffer areas to acknowledge their degree of impact from human modifications (dredging and traffic impacts), versus being included as core as in Alternative A. Beyond these changes, all else is similar to Alternative A.

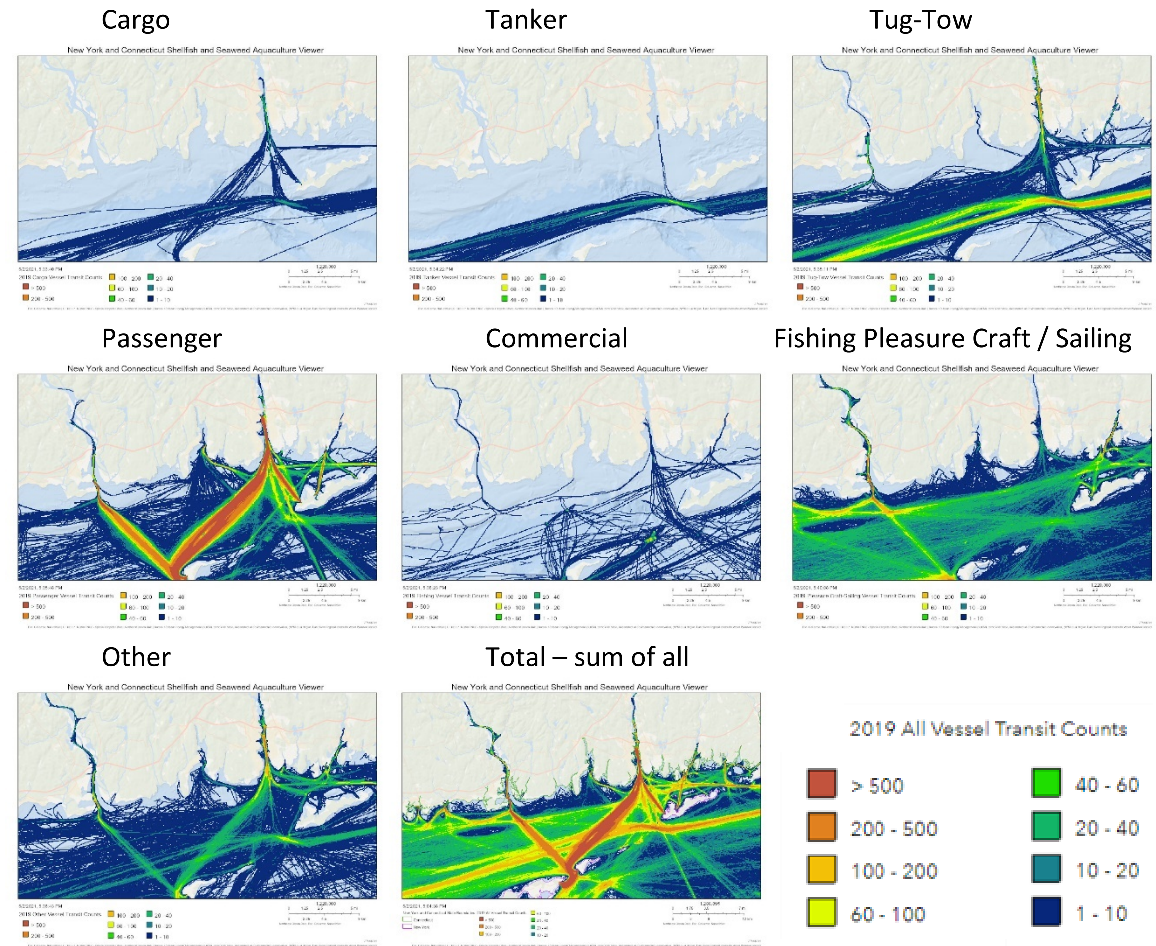


Figure 5-26: Vessel (AIS) Count Maps – All Classes

Sum of vessel occurrences from 2019 for all vessels that carry Automatic Identification System (AIS) transponders, by class; U.S. Coast Guard data. Vessel class is shown above each map. All maps use the same color scale. AIS is a navigation safety device that transmits and monitors the location and characteristics of many vessels in U.S. and international waters in real-time. The data represent vessel transit counts in 100 meter grid cells. A single transit is counted each time a vessel track passes through, starts, or stops within each grid cell. Data were mapped in the New York and Connecticut Shellfish Aquaculture Viewer (Long Island Sound Study 2021).

5.2.3.5 Military

A number of military facilities are located in southeastern Connecticut, near the project area (Figure 5-27). The Naval Submarine Base New London and the United States Coast Guard Academy are located within two miles of the project area boundary in the Thames River. The Connecticut National Guard Readiness Center in Groton works out of the Groton-New London Airport, less than half a mile from the Bluff Point complex of properties. The Connecticut National Guard Readiness Center and the Connecticut National Guard Camp Niantic in East Lyme are less than half a mile north of the project area of Niantic Bay. The National Guard camps have little impact on the aquatic or terrestrial portions of the project area. The Navy Base and Coast Guard Academy transit through the project area of the lower Thames River and into Long Island Sound and the Atlantic Ocean. While they contribute to the vessel traffic in this area, the vessel traffic in this corridor is already large, associated primarily with passenger vessels, pleasure craft, and sailing vessels (Figure 5-26, page 247). Additionally, General Dynamics Electric Boat division, which builds and services submarines, is located in the lower Thames River, within the project area, as is the U.S. Coast Guard Station New London.

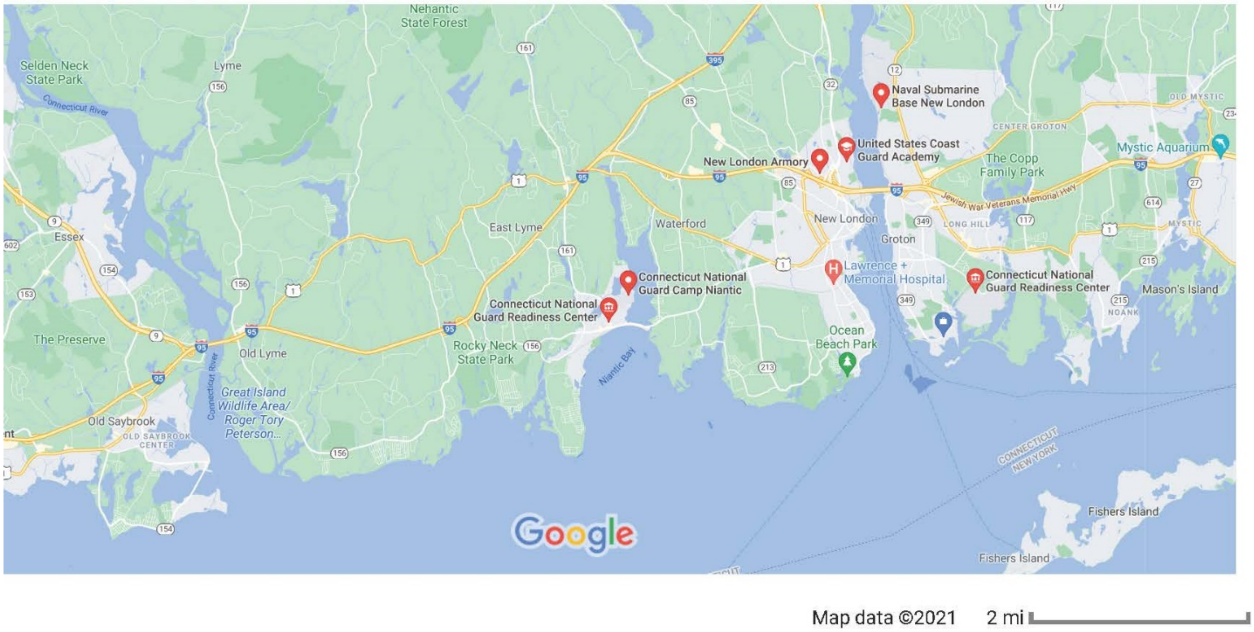


Figure 5-27: Military Facilities

Military facilities in southeastern Connecticut. None are within the project area but most are within 2 miles of the project area boundary. The U.S. Coast Guard Station New London is not shown on the map, it is located just northeast of Lawrence + Memorial Hospital.

Threats posed by reserve activities in relation to military activity include the placement of scientific gear which may impede operations if encountered; entanglement is a potential issue for boating. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternative A includes the Thames River area, including the U.S. Coast Guard Station in New London and General Dynamics Electric Boat, a defense contractor building and maintaining submarines located on the lower Thames River. The U.S. Naval Submarine Base New London in Groton and the U.S. Coast Guard Academy in New London are located outside and to the north of the alternative's boundary. As such, submarines and surface vessels transit regularly through the waters of the site to other parts of Long Island Sound and the Atlantic, though other forms of vessel traffic outweigh the military traffic.

Alternative B lacks the lower Thames River and the eastern section of the project area. Thus, the impact of military facilities is nonexistent.

Alternative C is the same as for Alternative B.

Alternative D includes the Thames River area, as for Alternative A, but excludes the security zone near General Dynamics Electric Boat from the boundary and makes much of the heavy vessel traffic area of the lower Thames River part of the buffer.

5.2.3.6 Commercial Aquaculture and Recreational Shellfishing

In Connecticut, shellfish are harvested both commercially and recreationally (Table 5-42, Figures 5-28 and 5-29). Aquaculture plays an important role in producing domestic seafood as well as supplying ornamentals such as corals, fish, and invertebrates that will otherwise be harvested from fragile reef ecosystems (UConn 2021). The state has three aquaculture-focused high schools located in Groton, New Haven and Bridgeport, as well as many Vocational-Agriculture centers that offer aquaculture instruction.

Table 5-42: Aquaculture and Shellfishing Areas

The assignment of property to alternative is presented in the first row. For the remainder of the table, the area of classified shellfish and aquaculture areas are noted (Long Island Sound Inventory and Science Subcommittee of the Blue Plan Advisory Committee 2019).

	eastern project area, ELIS & WFIS (New London & Groton)	**lower Thames River**	**central project area, ELIS (Waterford & East Lyme)**	**western project area, ELIS (Old Lyme & Old Saybrook)**	**western buffer, ELIS (Old Saybrook)**	**lower Connecticut River (mouth to north of Lord Cove)**	**upper Connecticut River (north of Lord Cove to Machimoodus)**
Boundary Alternatives Inclusive of each Property	A,D	A,D	A,D	A,B,C,D	C,D	A,B,C,D	B
COMMERCIAL AQUACULTURE							
leased shellfish beds (acres)	687	0	173	0	0	0	0
bottom cages in leased areas (acres)	26	0	7	0	0	0	0
kelp longlines (acres)	27	0	0	0	0	0	0
RECREATIONAL SHELLFISHING							
recreational shellfish beds (acres)	1415	0	6860	0	0	0	0
NATURAL SHELLFISH BEDS							
natural shellfish beds (acres)	0	0	0	0	0	109	0

Commercial Aquaculture

Shellfish aquaculture (typically, oysters, and quahogs or hard clams) is a longstanding and central component of the economy, culture, and ecosystems of Long Island Sound and Fishers Island Sound. Evidence suggests that shellfish harvesting is a pre-colonial activity and records exist for oyster farms dating to the early half of the 19th century (Boyle 2020; UConn 2021). Due to water quality issues, commercial shellfishing declined in the early 1900s. Commercial oyster aquaculture saw a resurgence in the 1980s and 1990s due to successful culture practices with a peak in 1992 of approximately 894,000 bags in Connecticut, followed by a decline to less than 100,000 bags per year from 2000 to 2006, with the sudden decline largely due to MSX, a parasitic disease (LISS 2021d). Since 2007, oyster harvest in Connecticut has ranged from approximately 133,000 to approximately 351,000 bags per year with an annual economic value of just under eighteen million dollars. Seaweed farming (sugar kelp and other species) in Long Island Sound is, however, a relatively new, but growing sector within the Connecticut commercial aquaculture industry. Taken together, shellfish (all locally harvested species) and seaweed aquaculture represent a multi-million dollar segment of the local economy that employs hundreds of individuals. In addition to the economic impacts, shellfish provide benthic habitat structures that support diverse communities of organisms and also filter pollutants and sediments that improve water quality (Long Island Sound Inventory and Science Subcommittee of the Blue Plan Advisory Committee 2019). For these reasons, it is crucial that shellfish and seaweed aquaculture efforts exist within the proposed CT NERR.

Connecticut's traditional oyster culture method involves harvesting small seed oysters from natural beds and then planting those shellfish on private cultivation beds called leases or license areas. From time to time, the oysters are culled and sorted by size and then replanted before they are finally harvested by dredge when they approach three inches (the state legal minimum harvest size). As with any farming activity, the practice involves occasional sea floor disturbance, but local studies conducted by NOAA's Milford Aquaculture Laboratory have demonstrated that the disturbance resulting from this activity is short-term and returns to baseline within weeks (Goldberg et al. 2014; Mercaldo-Allen et al. 2017; Meseck et al. 2014). It is important to note that harvest does not involve stripping the bottom. Farmers collect only harvest size product, and replant both shell and undersized shellfish. Also, they do not harvest intertidal and shallow subtidal areas as those are inaccessible with their work vessels. The unharvested shellfish naturally reproduce and recruit to intertidal and shallow subtidal areas that and therefore continue to build habitat in adjacent areas.

Shellfish farmers are advocates for clean water, as their existence depends upon it. Farmers are part of the state's water quality sampling program and often collect water and shellfish meat at fixed locations or provide their vessels for state environmental analysts to work from. It is an important partnership that helps the public understand how land-based runoff affects marine waters and facilitates sampling for the presence of harmful algal blooms and other potentially harmful contaminants.

Commercial aquaculture can be considered to modify conditions by methodologies used for harvesting (e.g., shellfish dredge) or through the installation and maintenance of various growing techniques (e.g., cages, bags, long lines) (Getchis et al. 2019). The most comprehensive and authoritative source of information relevant to the aquaculture industry in Connecticut, the Aquaculture Mapping Atlas (UConn CLEAR et al. 2018), provides the following characterization of current commercial aquaculture within the proposed CT NERR boundaries:

- areas approved for use are generally confined to the eastern half of the project area, from Niantic Bay to Mason's Island, and only in the areas of Long Island Sound, Fishers Island Sound, and minor rivers and embayments—the Connecticut River and Thames River do not currently support aquaculture operations (Figures 5-28 and 5-29);

- contain 43 state or town leases representing approximately 887 acres;
- include active authorized operations for bottom cages (depuration cages) for oysters and longlines for kelp comprising an approximate impact area of approximately 33 acres for bottom cages and approximately 27 acres for kelp longlines (Figures 5-28 and 5-29);
- remote set tanks are located on the Noank Aquaculture Cooperative property, the only non-water based operation within the Reserve (these do not contribute to the impact nor are they included in the area quantifications identified above); and
- farmers are restricted to the use of native species only—any product including eggs, larvae, seed, broodstock and shell must be sourced from Connecticut or Long Island, New York-based hatcheries, though special permission may be obtained from the Connecticut Department of Agriculture Bureau of Aquaculture to import aquaculture product.

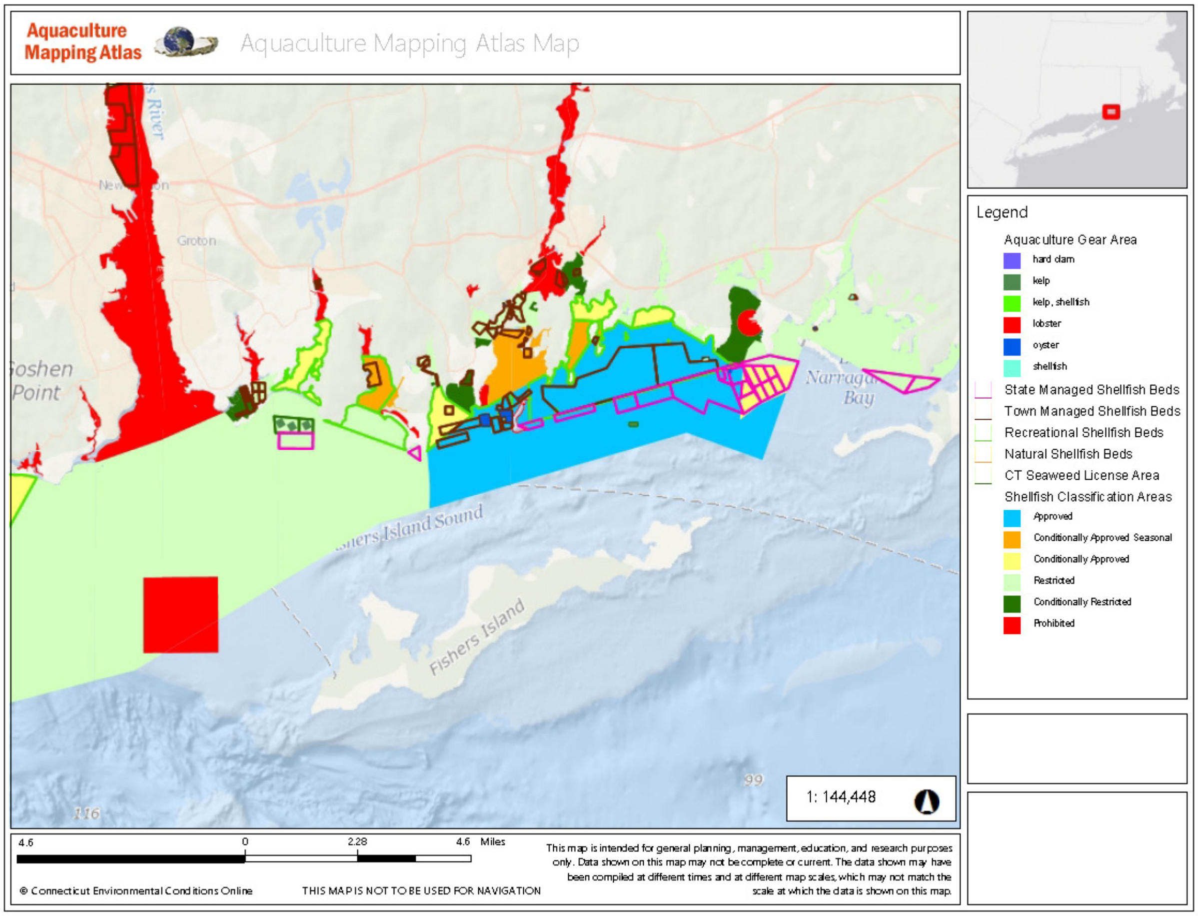


Figure 5-28: Commercial Aquaculture, Recreational, and Natural Shellfish Beds - East

Commercial aquaculture leases (state and town) and location of aquaculture gear are indicated according to the legend. Recreational shellfish beds are noted. There are no naturally occurring shellfish beds mapped in this figure. Areas are colored based on Connecticut shellfish classification areas. Classifications shown in the figure were current at the time this document was published; additional classification changes are pending for offshore waters of Groton during 2021 at which time the Aquaculture Mapping Atlas will be updated. Data were mapped in the Aquaculture Mapping Atlas (UConn CLEAR et al. 2018).

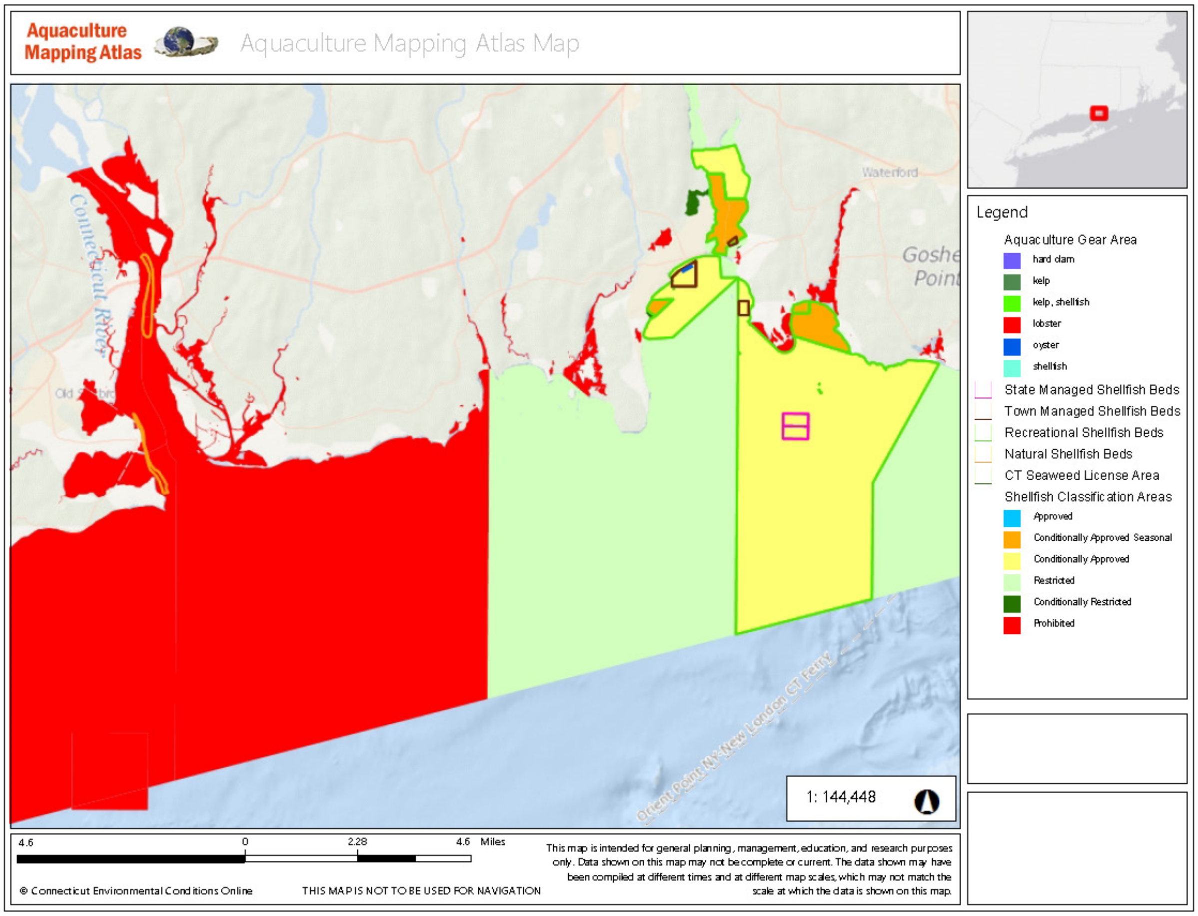


Figure 5-29: Commercial Aquaculture, Recreational, and Natural Shellfish Beds - West

Commercial aquaculture leases (state and town) and location of aquaculture gear are indicated according to the legend. Recreational shellfish beds and naturally occurring shellfish beds (in lower Connecticut River) are noted. Areas are colored based on Connecticut shellfish classification areas The offshore waters of East Lyme, Waterford, and Niantic Bay were reclassified in 2019 and 2020 per Connecticut Department of Agriculture Bureau of Aquaculture (*personal communication*, K. DeRosia-Banick); data in the Aquaculture Mapping Atlas will be updated in summer 2021. Data were mapped in the Aquaculture Mapping Atlas (UConn CLEAR et al. 2018).

Shellfish and seaweed aquaculture activities are actively managed at both the state and local levels to ensure the economic benefits do not outweigh any ecological impacts. In 1881, a line was established, referred to as the Commissioners Line, that divides the waters of the state into a northern and southern section. All beds south of this line are state beds and most beds north of this line are town beds (Figures 5-28 and 5-29).

The Connecticut Department of Agriculture Bureau of Aquaculture controls all the licensing and regulations north and south of the Commissioners Line, for example this bureau determines when an area will be closed to shellfishing due to a change in water quality and what licenses are needed to do certain work (Figures 5-28 and 5-29). Their responsibilities include leasing submerged state lands to shellfish producers, classifying shellfishing waters, monitoring water quality, identifying sources of pollution and seeking corrective actions, and the licensing of all commercial shellfish operations and research or educational activities. The Bureau has exclusive state authority for granting or denying aquaculture permits pursuant to C.G.S. § 22-11h, except for matters concerning discharges from marine aquaculture operations, water diversions, and placement of floating or submerged aquaculture structures in coastal waters that require other coastal permits. Aquaculture-related water discharges and in-water structures are regulated cooperatively at the state and federal levels with the Connecticut DEEP Land and Water Resources Division (LWRD) and the U.S. Army Corps of Engineers New England District. The Connecticut Department of Agriculture Bureau of Aquaculture is also authorized to grant licenses for seaweed production, although any in-water structures such as long-lines, buoys, platforms, etc., also require the appropriate authorizations from the LWRD coastal permitting program (DEEP 2019b).

Connecticut's municipal shellfish commissions are responsible for managing shellfish resources, shellfisheries and aquaculture in town waters which lie landward of the Commissioners Line (Figures 5-28 and 5-29). Town beds are leased, owned or managed through the local shellfish commission. If projects are proposed in municipal waters, the local shellfish commission is consulted. Each shellfish commission is required to develop a comprehensive management plan that includes a process for leasing commercial shellfish grounds and providing local review of applications for placement of aquaculture structures in town waters. Although these local decision makers do not have legal authority to directly permit aquaculture structures, the shellfish commissions play an important role in the review process for potential social and use conflicts, as well as potential effects on protected habitats or species caused by aquaculture activity (DEEP 2019b).

The aquaculture application and resulting review process are in place to ensure that aquaculture activity is compatible to the extent possible with existing human uses of Long Island Sound and that the final configuration will have minimal adverse impacts to navigation, protected marine species and essential fish habitat (Getchis et al. 2019). The review process involves an assessment of the potential for impacts to existing uses including established rights to fishing (as identified in C.G.S. § 26-204), wetlands, fish and wildlife, marine mammals, Endangered Species Act listed species, water quality, navigation, etc., as identified within 33 C.F.R. §§ 320.3–320.4. Policies are in place that restrict non-native species and that require a license, and impose restrictions, for use and transport of native species. If a proposed aquaculture project will result in unacceptable adverse effects to navigable waters or aquatic resources, permit authorization will be denied by local, state, or federal officials. Authorization from one agency does not indicate full authorization of the project. Authorization by federal, state, and town officials (if applicable) is required prior to the applicant conducting aquaculture activities in the State of Connecticut.

For the purposes of aquaculture operations as described above that occur within the proposed CT NERR boundaries, such activities, while involving some level of resource-related impacts (NOAA OCM 2013), nevertheless:

- are relevant and important to the economy and culture of Connecticut;
- do provide ecological benefits such as providing marine habitats and contributing to improved water quality (see Reserve System project further supporting this statement[19]);

[19] https://coastalscience.noaa.gov/project/shellfish-aquaculture-in-the-nerrs-ecosystem-services/

- are currently managed at multiple levels to ensure responsible operations, both now and into the future, that provide the necessary balance between implementation, impact management, and sustaining the estuarine environment; and
- expansion of shellfish aquaculture operations, when approved by relevant aquaculture permitting authorities, is consistent with the goals of the proposed CT NERR.

Recreational Shellfishing

Connecticut Sea Grant Extension has produced a guide for the public for recreational shellfishing along Connecticut's coast: *2020 Guide to Recreational Shellfish Harvesting in Connecticut* (Getchis et al. 2019). Harvesting is limited to "Approved" and "Conditionally Approved-Open" areas, excluding franchised or leased shellfish beds (Table 5-42, Figures 5-28 and 5-29). Recreational harvesters should contact the local health department serving the town in which they wish to harvest to determine the current description of Approved or Conditionally Approved shellfishing areas, local laws that pertain to this activity, and whether a local license is required. Recreational shellfishing in closed areas (Conditionally Approved-Closed, Restricted, and Prohibited areas) whether for bait or personal consumption is illegal. Individuals involved in such illegal activities are subject to fines and imprisonment, as well as putting their health in jeopardy.

Recreational shellfishing in Connecticut is limited to one-half bushel of shellfish (oysters, clams or mussels) per day taken during daylight hours. Implements to take shellfish, such as rakes or tongs, must have openings or spacing between the teeth or prongs of one (1") inch or greater. Hard shell clams less than one (1") inch in thickness or that will pass through a ring of one and one-half (1.5") inches internal diameter must be returned to the harvest area. Softshell clams (referred to as steamers or long clams) must be returned to the harvest area if they are less than one and one half (1.5") inches in length. Oysters less than three (3.0") inches in length must be returned to the harvest area.

Recreational shellfish are intended to be consumed by the harvester and family members. Recreational harvesters cannot offer their shellfish for sale or barter. Recreational harvesters must take care to properly handle their catch. Shellfish should be promptly refrigerated in a self-draining container. They should never be stored in water or hung overboard from a dock or boat since they are filter feeders and may concentrate contaminants from that new environment.

Recreational scalloping is limited to residents of one year or greater and is restricted by local laws, ordinances, or regulations which may require a town scallop license. Requirements vary on a town-by-town basis regarding the net size. Scallops must not be able to pass through a 2.0" diameter ring. No SCUBA diving or wading is allowed, scallops must be collected from a drifting boat. Harvesting season is generally from October 1 through March 31. Scalloping is not restricted to "Approved" or "Conditionally Approved-Open" shellfishing areas if only the adductor muscle is consumed. When shucked, the shellfish and entails must be properly disposed of and not returned to the waters of the State. If whole or roe-on scallops are to be consumed they may only be taken from waters classified as “Approved or Conditionally Approved-Open.”

In the interest of preventing the growth of non-indigenous species, disease and parasites, no shellfish taken from or originating from areas outside of Connecticut's Long Island Sound or Fishers Island Sound may be placed, planted or disposed of in Long Island Sound, Fishers Island Sound, and its tributaries without the written approval of the Connecticut Department of Agriculture Bureau of Aquaculture.

Threats posed by reserve activities in relation to commercial aquaculture and recreational shellfishing are similar to navigation – the placement of scientific gear which may impede operations if encountered. Other threats to shellfishing and aquaculture relate to habitat loss, habitat degradation, pollution, and marine debris (e.g., impact of microplastics on shellfish). Climate change, especially ocean acidification and warming waters, impact shellfish. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternative A includes commercial aquaculture and recreational shellfishing grounds, as well as natural shellfish beds. Given the scale and nature of commercial activities and the control measures in place by the State of Connecticut, commercial aquaculture is seen as a beneficial use of the environment. One area of concern is the interaction between shellfish gear and the benthic environment, including seagrass — but regulations are in place to protect the benthos (including specific language protective of eelgrass) while supporting aquaculture activities. Recreational shellfishing opportunities are plentiful off of East Lyme and eastward.

Alternative B lacks the commercial aquaculture activity seen in Alternative A, though it does include more than a hundred acres of natural shellfish beds in the lower Connecticut River. Recreational shellfishing is prohibited in this alternative.

Alternative C is the same as Alternative B, in the context of commercial aquaculture and recreational shellfishing.

Alternative D is the same as Alternative A, in the context of commercial aquaculture and recreational shellfishing.

5.2.3.7 Commercial Fishing

Commercial fishing encompasses two broad types of fishing activity – that which occurs in Long Island Sound and Fishers Island Sound, harvesting the resources of The Sounds, and that which has a home-base in The Sound's ports, but vessels leave The Sounds to harvest resources elsewhere.

During the creation of the Long Island Sound Blue Plan, Blue Plan authors analyzed the NOAA Fisheries landings data coupled with the fishing effort served through the Northeast Ocean Data Portal based on the Automatic Identification System (AIS), arriving at the conclusion that commercial fishing from these larger vessels with AIS transponders was a minor impact in Long Island Sound (Figure 5-30). While it is known that commercial fishing vessels currently transit through the eastern Long Island Sound and western Fishers Island Sound on their way to and from port, there appears to be little to no commercial fishing from these vessels within the project area (Long Island Sound Inventory and Science Subcommittee of the Blue Plan Advisory Committee 2019).

Locally-active commercial fisheries in Long Island Sound and Fishers Island Sound include 12 species of fish and crab as well as two additional species currently closed for commercial fishing (Table 5-43). In 2016, the date of the last NOAA Fisheries Economics Report, Connecticut posted $387 million in sales from the seafood industry, $83 million in income, and $137 million in value added (NOAA Fisheries 2018). In contrast, Connecticut's recreational fishing industry posted $430 million in sales,

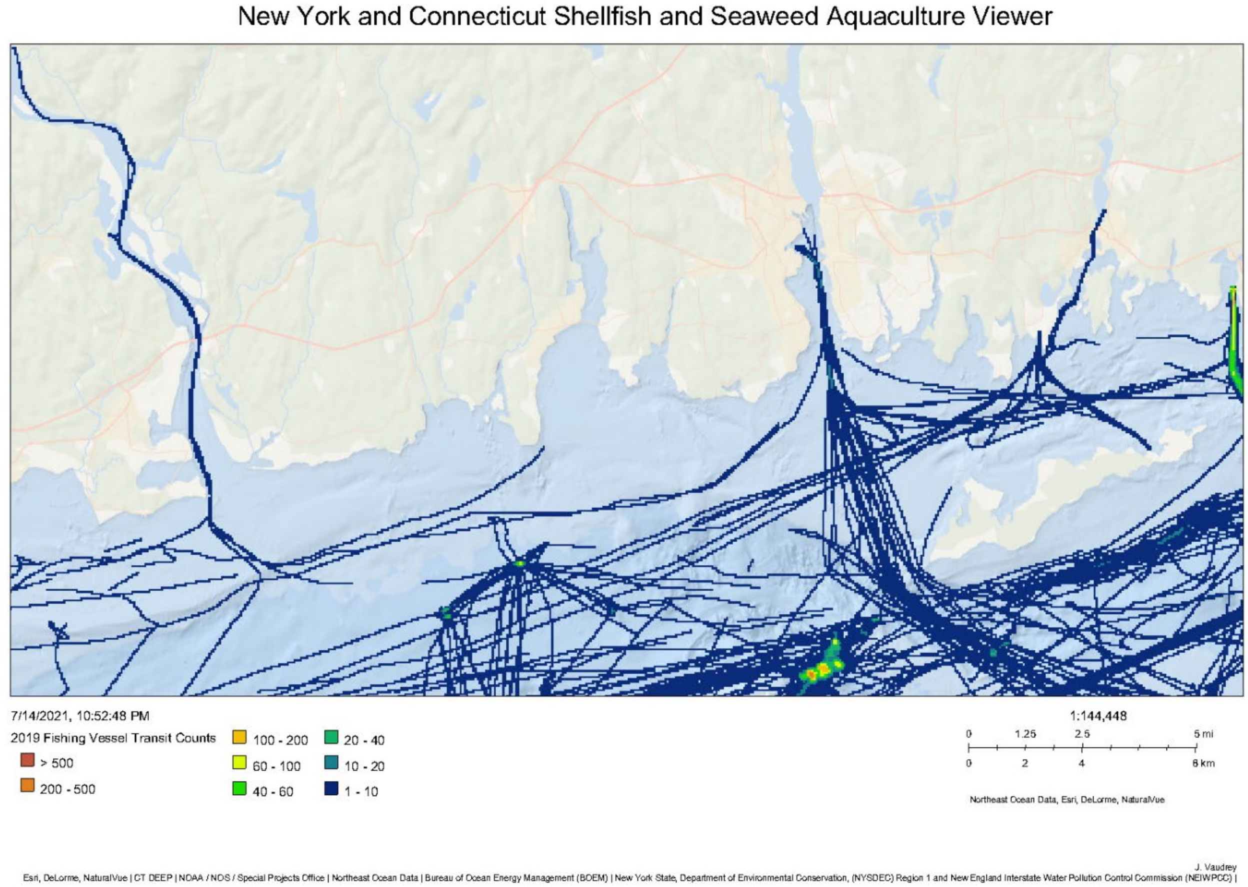
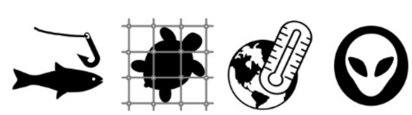


Figure 5-30: Commercial Fishing Vessel (AIS) Count Map

Annual sum of vessel occurrences from 2019 for fishing vessels that carry Automatic Identification System (AIS) transponders. AIS is a navigation safety device that transmits and monitors the location and characteristics of many vessels in U.S. and international waters in real-time. The data represent vessel transit counts in 100 meter grid cells. A single transit is counted each time a vessel track passes through, starts, or stops within each grid cell. Data were mapped in the New York and Connecticut Shellfish Aquaculture Viewer (Long Island Sound Study 2021).

$186 million in income, and $292 million in values added (from the same report). Key species for commercial fishing in Connecticut in descending order of economic revenue in 2016 include sea scallop, squid, American lobster, whelks and conch, silver hake, summer flounder, scup, goosefish, other flounder, and red hake. DEEP (2015c) collected additional fishery dependent statistics from harvesters and dealers on catch, harvest, fishing effort by gear type and season and then compiled and analyzed the data to provide information for quota monitoring, stock assessment, and development and evaluation of Fishery Management Plans and management measures.



The threats to fisheries are those which are universal and not related to establishment of a reserve, especially as the reserve designation does not institute new regulations on fisheries, relying on existing federal and state policies. Direct threats include overfishing and mortality due to bycatch. Indirect threats include climate change impacts on species distribution and food availability as well as the impact of nonindigenous or invasive species. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternative A appears to host the majority of commercial fishing activity within the eastern end of the project area, based on vessel traffic for vessels with AIS systems. This is consistent with the active working waterfronts found in New London, Mystic, and Stonington. No data are available on where or how commercial fishing is conducted in Long Island Sound and Fishers Island Sound, though we can assume that much of the commercial fishing activity is being conducted outside of The Sounds, based on the top earning species (sea scallop, squid, lobster), with vessels transiting through the area to reach port. The Long Island Sound Blue plan provides information on weight-landed (DEEP 2019b).

Alternative B likely hosts relatively little commercial fishing activity, as this area includes the lower Connecticut River and the mouth of the River. This area is not known for commercial fishing nor does it have a port suitable for supporting many large vessels.

Alternative C is similar to Alternative B for commercial fishing.

Alternative D is the same as Alternative A, in the context of commercial fishing.

Table 5-43: Commercial Fishery Possession and Landing Limits, 2021

The Marine Fisheries Program of DEEP issues guidance on commercial fisheries takes and quotas (DEEP 2021c). Information in this table is provided as an example and should not be used for reference or compliance with regulatory directives – visit DEEP Marine Fisheries for current information.

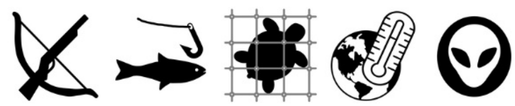
SPECIES	STATUS	LIMIT	COMMENTS
American lobster	**OPEN**	Minimum size is 3 3 / 8”	Lobster Pot Allocation required to take lobsters by pot. During the Closed Season: September 8 – November 28, both dates inclusive, possession of lobster taken from Long Island Sound (Lobster Management Area 6) is prohibited.
American shad	**OPEN**		Open: April 1– June 15, except weekends. American Shad may be taken in the Connecticut River only. Maximum gillnet soak time = 4 hours
Atlantic menhaden	**OPEN**	12,000 lb[1] 120,000 lb[1,2]	[1] Call-in required when in possession of more than 6,000 pounds. EnCon Police: 860-424-3503 [2] Taken from outside of Connecticut waters [3] The directed fishery is closed. The incidental fishery remains open with a 6,000 pound possession limit.
black sea bass	**OPEN**	150 pounds[1] 5 fish[2] ***quota = 60,900 pounds***	[1] Black Sea Bass License Endorsement required to take sea bass – INCLUDING from lobster traps. [2] Possession limit for the commercial harvest of black sea bass caught in lobster traps and when in possession of lobsters, no license endorsement required. Does not apply to personal use lobster license holders. Minimum size: 11”
bluefish	**OPEN**	1,200 pounds ***quota = 35,049 pounds***	Minimum size: 9”

SPECIES	STATUS	LIMIT	COMMENTS
horseshoe crab	**CLOSED**	25 crabs by trawl[1], 500 crabs by hand[1]	[1] Horseshoe Crab License Endorsement required. Open: May 22 – July 7, except weekends.
jonah crab	**OPEN**	Lobster Pot: No Limit Other Gear: 1000 crabs	Minimum size = 4.75 inch carapace length
scup	**OPEN**	1,000 pounds[2] ***quota = 251,848 pounds***	[1] No Scup License Endorsement letter is required to land scup during the Winter 1 and Winter 2 periods (January-April, October-December) [2] Scup License Endorsement required May 1 – September 30, EXCEPT: (A) Under a Restricted Commercial Fishing License: 60 fish limit (B) In the commercial Lobster Pot Fishery: 10 fish limit Minimum size: 9”
spiny dogfish	**OPEN**	6,000 pounds[1]	Atlantic States Marine Fisheries Commission allocation to New England region: 17,144,556 pounds [1] By fisherman agreement first dorsal fin must remain attached to the carcass as required by Atlantic States Marine Fisheries Commission fishery management plan.
smooth dogfish	**OPEN**	500 pounds[1] ***quota = 9,281 pounds***	[1] By fisherman agreement first dorsal fin must remain attached to the carcass as required by Atlantic States Marine Fisheries Commission fishery management plan.
summer flounder	**OPEN**	500 pounds[1] ***quota = 579,376 pounds***	[1] Summer Flounder License Endorsement required. [2] When required prior to departure and again before offloading, call EnCon Police at 860-424-3503 24 / 7 and provide vessel name, captain’s name, departure date, return date, port of landing and prior to offloading, the hail weight of fluke onboard. Minimum size: 14”
tautog*	**CLOSED***	10 fish[1] 3 fish[2]	[1] When fishing under a Limited Access Commercial Fishing License. [2] When fishing under Restricted Commercial Fishing Licenses. Open seasons are: April 1-30, July 1-August 31, October 8 - December 24. ***Tautog tagging program mandated for 2021** Minimum size: 16”
winter flounder	**OPEN**	50 pounds or 38 fish	State waters closed to harvest March 1 through April 14. Federally permitted vessels are permitted to land the higher federal limits of fish taken from federal waters. Minimum Size: 12 inches.
weakfish	**OPEN**	100 pounds	Minimum size: 16”

5.2.3.8 Recreational Fishing and Hunting

Similar to recreational boating activity, the current interests of recreational fishing are extensive, and can be considered to span the entire offshore area. In 2016, the date of the last NOAA Fisheries Economics Report, Connecticut posted $430 million in sales, $186 million in income, and $292 million in value-added for recreational fisheries. In contrast, commercial fisheries posted $387 million in sales from the seafood industry, $83 million in income, and $137 million in value added (NOAA Fisheries 2018). The most popular target fish species for Connecticut's recreational fishers (within The Sounds and offshore) are striped bass (*Morone saxatilis*), scup (*Stenotomus chrysops*), bluefin tuna (*Thunnus thynnus*), summer flounder (*Paralichthys dentatus*), and tautog (*Tautoga onitis*); black sea bass (*Centropristis striata*) were not available on the list of species included in the survey but are also a likely target species (Starbuck et al. 2012). In terms of number caught, key species for recreational fishing in Connecticut in descending order (both harvested and released) included porgies (scup), summer flounder, wrasses (tautog), striped bass, bluefish, little tunny, Atlantic cod, hickory shad, white perch, and winter flounder (NOAA Fisheries 2018). Only marine species are tracked by NOAA.

Public hunting is allowed in most of the state-owned properties in the lower Connecticut River, including in the Roger Tory Peterson NAP (all boundary alternatives), Lord Cove NAP (all boundary alternatives), and Ragged Rock Creek WMA (Alternatives B and C). Hunting is restricted to bow hunting only in Nott Island WMA (Alternatives B and C) and Haddam Neck WMA (Alternative B). Hunting is not allowed in Machimoodus State Park (Alternative B), Thatchbed Marsh WMA (Alternative C), and Ferry Point Marsh WMA (Alternatives B and C). Hunting is largely prohibited in the remainder of the properties, with no hunting allowed in the Bluff Point complex (except deer removal by DEEP staff), Haley Farm State Park, or Pine Island areas included in Alternative A and Alternative D.



The threats to recreational hunting and fishing are those which are universal and not related to establishment of a reserve, especially as the reserve designation does not institute new regulations, relying on existing federal and state policies. The major direct threat to recreational fishing and hunting are overfishing and mortality due to accidental catches of sensitive species, and over harvesting; though management of fish and wildlife stocks by DEEP should mitigate these impacts. Indirect threats include climate change impacts on species distribution and food availability as well as the impact of nonindigenous or invasive species. Descriptions of threats and potential impacts are included in Table 5-1 (page 75).

Summary by Boundary Alternative

Alternative A is similar throughout the area, in terms of recreational fishing. The eastern properties of this alternative do not allow hunting while the western properties do allow hunting.

Alternative B has about half the area of Alternative A, thus encompassing half the area utilized for recreational fishing. The properties located in the lower Connecticut River (around Lord Cove and south) allow hunting while a few of the properties in the northern portion of this alternative do not allow hunting (Machimoodus State Park and Ferry Point Marsh WMA) or only allow bow hunting (Nott Island WMA and Haddam Neck WMA).

Alternative C has about half the area of Alternative A, thus encompassing half the area utilized for recreational fishing. The properties located in the lower Connecticut River (around Lord Cove and south) allow hunting while a few of the properties added to this alternative do not allow hunting (Thatchbed Marsh WMA and Ferry Point Marsh WMA) or only allow bow hunting (Nott Island WMA).

Alternative D is the same as Alternative A in the context of recreational fishing and hunting.

5.2.3.9 Agriculture

Agriculture is not a major land use / land cover in Connecticut's coastal areas. High resolution (1 meter) land cover data for 2016 from the NOAA Office for Coastal Management's C-CAP program (CTECO 2021b) shows that approximately 3.8% of the land determined to drain directly to the proposed lower Connecticut River site is comprised of the three land cover categories that can indicate agriculture: cultivated land, pasture / hay, and grassland. Since not all of these areas will in fact be agriculture, this percentage can be seen as a maximum estimate. Similarly, these three categories comprise about 1.4% of direct drainage areas surrounding the Bluff Point complex. Agriculture in Connecticut tends to be small family-run farms. Nutrient inputs from these sites are not expected to greatly impact the project area.

One walk in Haley Farm State Park – multiple human uses of the area. Photos by Judy Benson / Connecticut Sea Grant. http://www.flickr.com/photos/ctnerr/ (CC BY-NC 4.0)

6 Environmental Consequences

This chapter describes the anticipated environmental impacts of implementing each of the action alternatives, and the No Action Alternative, as presented in *Chapter 4*. These potential impacts apply to the affected environment described in *Chapter 5*. This impact analysis includes a discussion of potential cumulative impacts, any unavoidable adverse impacts, the relationship between short-term uses and long-term productivity, and the irreversible and irretrievable commitment of resources.

Most impacts of designating the proposed land and waters as a National Estuarine Research Reserve, as well as implementing a reserve management plan, are expected to be environmentally beneficial and result in positive social, cultural, economic, and ecological impacts. From a national perspective, this action would result in the establishment of the 30th National Estuarine Research Reserve. The proposed CT NERR would fill a gap in the National Estuarine Research Reserve System, supporting a more complete network of estuarine systems representing the array of biologically and geomorphologically diverse estuaries found in the United States and its territories. The proposed CT NERR would focus estuarine research, local ecological knowledge, and educational opportunities toward improving our understanding of these unique estuaries. The proposed CT NERR could help Connecticut continue work toward achieving the goals set forth in the Connecticut Coastal Management Act—namely, to provide a stable environment for research and enhance public awareness and understanding of estuarine areas. The proposed CT NERR is planning to:

- conduct and coordinate applied research and long-term environmental monitoring;
- collaborate with local communities and institutions to develop training and educational programs that inspire and educate local communities about coastal ecosystems; and
- enhance stewardship activities that work to sustain the natural resources of the area.

Federal funds, along with matching funds provided by the UConn and DEEP, would support increased and more coordinated efforts with partners toward these goals and create opportunities to improve our understanding and appreciation of estuarine waters, coastal areas, and watersheds in relatively densely populated areas. Some of these activities may result in relatively minor adverse impacts, as discussed below.

6.1 Affected Resources and Potential Impacts

The National Environmental Policy Act (NEPA) requires federal agencies to prepare an *Environmental Impact Statement* for any action that may significantly affect the quality of the human environment. The Council on Environmental Quality regulations implementing NEPA state that an environmental impact statement should discuss the significance, or level of impact, of the direct and indirect impacts of the proposed alternatives (40 C.F.R. § 1502.16), and that significance is determined by considering both the context in which the action would occur and the intensity of the action (40 C.F.R. § 1508.27). Effects and impacts used in this environmental analysis are synonymous and may be direct, indirect, or cumulative. As presented in 40 CFR § 1508.8 and used to facilitate NEPA compliance, effects / impacts include aesthetic, historic, cultural, economic, social, and health, as well as ecological, such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems. For this analysis, the potential impacts, both beneficial and adverse, have been evaluated using the criteria or characteristics identified in Table 6-1 and subsequently described below. The criteria or characteristics of type, magnitude, duration, and the implementation of mitigation measures are used to determine whether an impact is significant under NEPA.

The assessment of the magnitude or intensity of potential impacts is based on a review of available and relevant references and resource materials, and is based on the professional judgment of NOAA staff using the criteria described in this section as well as the potential that mitigation measures can either avoid or reduce significant impacts.

Table 6-1: Environmental Consequences Evaluation Criteria

Summary of evaluation criteria and characteristics for environmental consequences.

TYPE OF IMPACT	MAGNITUDE OF IMPACT	QUALITY OF IMPACT	DURATION OF IMPACT	SIGNIFICANCE	MITIGATION
No Effect	Negligible	Beneficial	Short-term	Less than Significant	Reduce
Direct	Minor	Neutral	Long-term	Significant	Avoid
Indirect	Moderate	Adverse			
Cumulative	Major				

6.1.1 Types of Potential Impacts

Types of potential impacts refers to the various components of the affected environment in which the proposed action to designate parts of the project area as a reserve would occur. Direct and indirect impacts are defined in 40 C.F.R. § 1508.8, and are described below. Cumulative impacts are defined in 40 C.F.R. § 1508.7, and also described below as well as in *Section 6.4*. The categories of potential impacts to the affected environment used in the analysis include:

> **No Effect**: No known or potential impacts caused by the proposed action.
>
> **Direct Impacts**: Are known or potential impacts caused by the proposed action and occur at the same time and place. This could include impacts that are an immediate result of project-related activities (e.g., direct mortality of species or removal of vegetation and habitat) and are reversible or permanent and irreversible.
>
> **Indirect Impacts**: Are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. These effects tend to be diffuse, resource-specific, and less amenable to quantification or mapping than direct effects.
>
> **Cumulative Impacts**: Are the known or potential impacts on the environment that results from the incremental effects of the action when added to other past, present, and reasonably foreseeable

future actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time.

6.1.2 Magnitude and Quality of Potential Impacts

The magnitude or intensity refers to the severity of the impact and is defined on a spectrum ranging from negligible impacts to major impacts. For the purpose of this analysis, potential adverse and beneficial impacts are qualitatively assessed by their relative magnitude and quality according to the criteria defined below:

Negligible: No impact to resources or the impact would be at or below levels of detection.

Minor: A detectable change to resources. However, the impact would be small, localized, and of little consequence. Generally, minor impacts do not have the potential to satisfy the considerations of ‘significance’ set forth in regulations (40 C.F.R. § 1508.27) or NOAA guidance (N.A.O. 216-6A).

Moderate: A readily-apparent change to the resource that would not constitute a major change. Generally, moderate impacts could possibly be measured or quantified and do not have the potential to satisfy the considerations of ‘significance’ set forth in regulations (40 C.F.R. § 1508.27) or NOAA guidance (N.A.O. 216-6A).

Major: A substantial change to the character of the resource over a large area. Generally, major impacts are quantifiable changes that have the potential to satisfy the considerations of ‘significance’ set forth in regulations (40 C.F.R. § 1508.27) or NOAA guidance (N.A.O. 216-6A).

6.1.3 Duration of Potential Impacts

The duration of a potential impact or effect is defined by two periods of time (short-term or long-term) and refers to the temporal nature of the impact resulting from the proposed action. The duration of each potential impact is defined as:

Short-term: A known or potential impact of limited duration of 6 months or less depending on the specific impact and affected environment.

Long-term: A known or potential impact of extended duration of more than 6 months depending on the specific impact and affected environment.

6.1.4 Potential Impact Mitigation Measures

Mitigation measures refer to actions that either avoid or reduce potentially significant impacts. The general categories of mitigation approaches for impacts or effects described under this analysis are defined as:

Reduce: A mitigation approach used to lessen the significance of action’s impact to the natural or human environment.

Avoid: A mitigation approach used to preclude an action’s otherwise significant impact or effect on the natural or human environment.

6.1.5 Alternative Boundary Configurations

The subsequent sections in this chapter will evaluate the impacts associated with the implementation of each of the alternatives (previously discussed in *Chapter 4*). Figure 6-2 shows the boundaries side-by-side to serve as a visual reminder of different configurations for the action alternative.

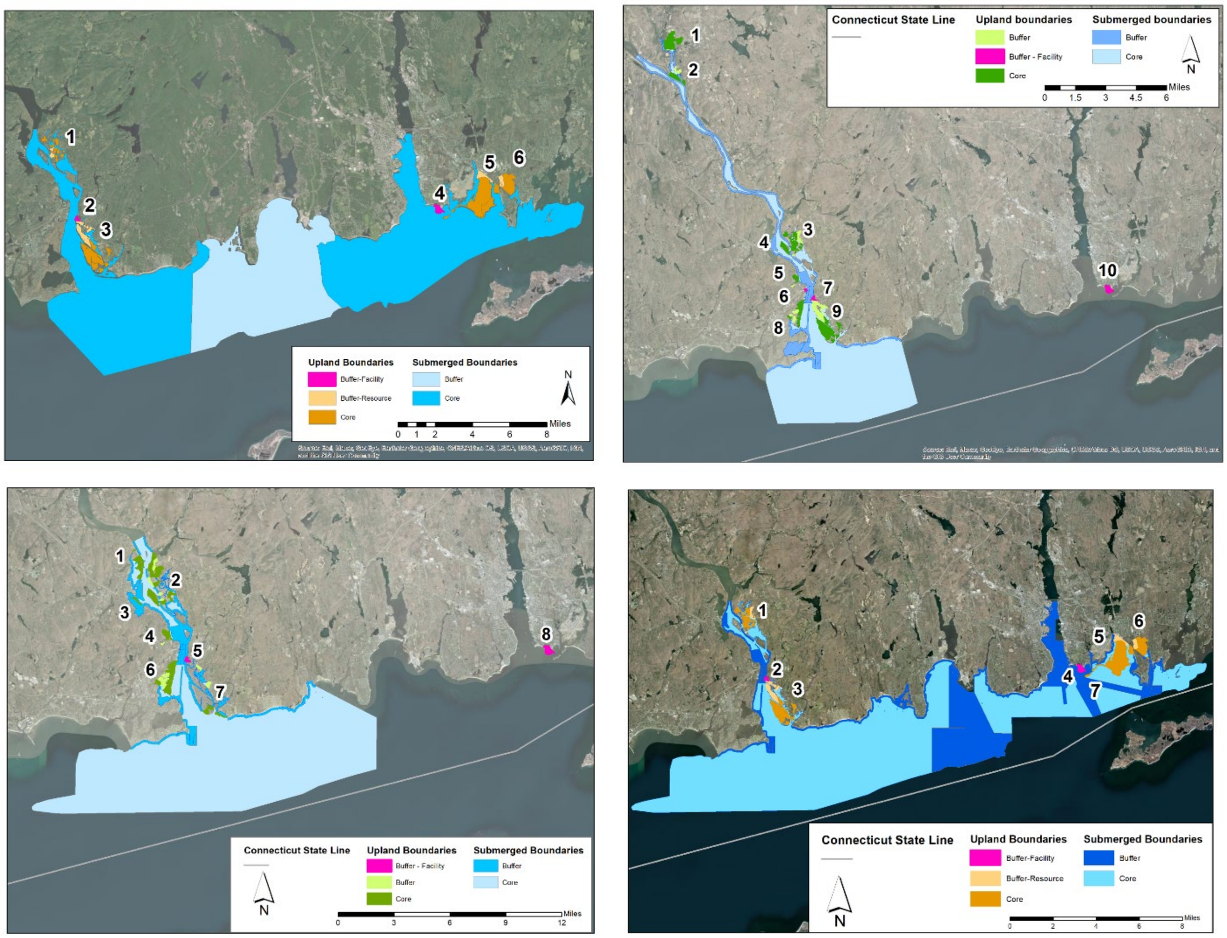


Figure 6-1: Proposed CT NERR Boundary Configurations

Upper left: Alternative A. Upper right: Alternative B. Lower left: Alternative C. Lower right: Alternative D. Numbers indicate the upland properties, as defined in figures in *Chapter 4*.

6.1.6 Summary of Impacts

Table 6-2: Summary of Impacts for Designation and Management Plan Implementation

The impact type, duration, magnitude, and significance are summarized here and fully described in the following sections. When a negative impact is expected, the mitigation technique is also included. The terminology used to summarize these impacts are provided in Table 6-1. For some categories, multiple types of impacts are expected. A clock icon indicates short-term impacts and a calendar icon indicates long-term impacts. The plus sign and minus sign icons indicate beneficial or adverse impacts, respectively. If the effect is negligible, no icons are shown. The relative size of the icons illustrate impact size.

IMPACTED RESOURCE	NO ACTION ALTERNATIVE	ALTERNATIVE A ***NOMINATED SITE***	ALTERNATIVE B ***CONNECTICUT RIVER SITE***	ALTERNATIVE C ***LOWER CONNECTICUT RIVER SITE***	ALTERNATIVE D ***REVISED NOMINATED SITE***
Weather and Climate	no effect, neutral	no effect, neutral	no effect, neutral	no effect, neutral	no effect, neutral
Climate Change	direct & indirect minor & moderate beneficial long-term significant	*no additional effect, same as No Action Alternative*	*no additional effect, same as No Action Alternative*	*no additional effect, same as No Action Alternative*	*no additional effect, same as No Action Alternative*
Air Quality	direct negligible adverse long-term less than significant	direct negligible adverse long-term less than significant	*same as Alternative A*	*same as Alternative A*	*same as Alternative A*
Water Quality > short-term	direct moderate adverse short-term significant reduce	*no additional effect, same as No Action Alternative*	*no additional effect, same as No Action Alternative*	*no additional effect, same as No Action Alternative*	*no additional effect, same as No Action Alternative*

IMPACTED RESOURCE	NO ACTION ALTERNATIVE	ALTERNATIVE A *NOMINATED SITE*	ALTERNATIVE B *CONNECTICUT RIVER SITE*	ALTERNATIVE C *LOWER CONNECTICUT RIVER SITE*	ALTERNATIVE D *REVISED NOMINATED SITE*
> long-term	direct & indirect minor beneficial long-term significant	direct & indirect moderate beneficial long-term significant	direct & indirect minor beneficial long-term significant	*same as Alternative B*	*same as Alternative A*
Hydrology	direct & indirect moderate adverse long-term significant	*no additional effect, same as No Action Alternative*	*no additional effect, same as No Action Alternative*	*no additional effect, same as No Action Alternative*	*no additional effect, same as No Action Alternative*
Geology	no effect, neutral	no effect	no effect	no effect	no effect
Terrestrial Habitats > long-term	no effect, neutral	direct & indirect moderate beneficial long-term significant	direct & indirect minor beneficial long-term significant	no effect	*same as Alternative A*
> short-term	no effect, neutral	direct minor adverse short-term significant reduce	direct negligible adverse short-term not significant reduce	no effect	*same as Alternative A*
Riparian & Freshwater Habitats > long-term	no effect, neutral	direct & indirect minor beneficial long-term significant	direct & indirect moderate beneficial long-term significant	no effect	*same as Alternative A*

IMPACTED RESOURCE	NO ACTION ALTERNATIVE	ALTERNATIVE A ***NOMINATED SITE***	ALTERNATIVE B ***CONNECTICUT RIVER SITE***	ALTERNATIVE C ***LOWER CONNECTICUT RIVER SITE***	ALTERNATIVE D ***REVISED NOMINATED SITE***
> short-term	no effect, neutral	direct negligible adverse short-term not significant reduce	direct minor adverse short-term significant reduce	no effect	*same as Alternative A*
Estuarine Habitats	direct major adverse long-term significant reduce	*same as No Action Alternative*	no effect	no effect	no effect
Flora – All Habitats	direct & indirect minor beneficial long-term not significant	direct & indirect moderate beneficial long-term significant	direct & indirect minor beneficial long-term significant	*same as Alternative* *B*	*same as Alternative A*
Fauna – All Habitats	direct & indirect minor beneficial long-term not significant	direct & indirect minor beneficial long-term significant	direct & indirect minor beneficial long-term significant	*same as Alternative* *B*	*same as Alternative A*
Threatened & Endangered Species	no effect, neutral	direct & indirect negligible beneficial long-term not significant	*same as Alternative A*	*same as Alternative A*	*same as Alternative A*

IMPACTED RESOURCE	NO ACTION ALTERNATIVE	ALTERNATIVE A ***NOMINATED SITE***	ALTERNATIVE B ***CONNECTICUT RIVER SITE***	ALTERNATIVE C ***LOWER CONNECTICUT RIVER SITE***	ALTERNATIVE D ***REVISED NOMINATED SITE***
Other Marine Mammals	direct & indirect minor beneficial long-term not significant	*same as No Action Alternative*	*same as No Action Alternative*	*same as No Action Alternative*	*same as No Action Alternative*
Essential Fish Habitat > long-term	indirect minor beneficial long-term not significant	*same as No Action Alternative*	*same as No Action Alternative*	*same as No Action Alternative*	*same as No Action Alternative*
> short-term	no effect, neutral	direct minor adverse short-term not significant	*same as Alternative A*	*same as Alternative A*	*same as Alternative A*
Migratory Birds > short-term	direct or indirect minor to moderate adverse short-term not significant	*same as No Action Alternative*	*same as No Action Alternative*	*same as No Action Alternative*	*same as No Action Alternative*
> long-term	no effect, neutral	indirect minor beneficial long-term significant	*same as Alternative A*	*same as Alternative A*	*same as Alternative A*

IMPACTED RESOURCE	NO ACTION ALTERNATIVE	ALTERNATIVE A *NOMINATED SITE*	ALTERNATIVE B *CONNECTICUT RIVER SITE*	ALTERNATIVE C *LOWER CONNECTICUT RIVER SITE*	ALTERNATIVE D *REVISED NOMINATED SITE*
Cultural & Historic Resources	no effect, neutral	indirect minor beneficial long-term significant	*same as Alternative A*	*same as Alternative A*	*same as Alternative A*
Population	no effect, neutral	direct minor adverse short-term not significant	*same as Alternative A*	*same as Alternative A*	*same as Alternative A*
Employment	no effect, neutral	direct negligible beneficial long-term not significant	*same as Alternative A*	*same as Alternative A*	*same as Alternative A*
Regional Economics	no effect, neutral	indirect negligible beneficial long-term not significant	*same as Alternative A*	*same as Alternative A*	*same as Alternative A*
Tourism & Recreation	no effect, neutral	direct minor adverse short-term not significant	*same as Alternative A*	*same as Alternative A*	*same as Alternative A*

IMPACTED RESOURCE	NO ACTION ALTERNATIVE	ALTERNATIVE A ***NOMINATED SITE***	ALTERNATIVE B ***CONNECTICUT RIVER SITE***	ALTERNATIVE C ***LOWER CONNECTICUT RIVER SITE***	ALTERNATIVE D ***REVISED NOMINATED SITE***
Education	no effect, neutral	direct & indirect moderate beneficial long-term significant	direct & indirect minor beneficial long-term not significant	*same as Alternative B*	*same as Alternative A*
Research & Monitoring	direct & indirect moderate beneficial long-term significant	direct major beneficial long-term significant	*same as Alternative A* (but less area)	*same as Alternative A* (but less area)	*same as Alternative A*
Transportation	no effect, neutral	direct minor adverse short-term not significant	*same as Alternative A*	*same as Alternative A*	*same as Alternative A*
Navigation	no effect, neutral	direct negligible adverse short-term not significant	*same as Alternative A*	*same as Alternative A*	*same as Alternative A*
Infrastructure	no effect, neutral	indirect minor beneficial short-term not significant	*same as Alternative A*	*same as Alternative A*	*same as Alternative A*

IMPACTED RESOURCE	NO ACTION ALTERNATIVE	ALTERNATIVE A *NOMINATED SITE*	ALTERNATIVE B *CONNECTICUT RIVER SITE*	ALTERNATIVE C *LOWER CONNECTICUT RIVER SITE*	ALTERNATIVE D *REVISED NOMINATED SITE*
Military > short-term	no effect, neutral	direct negligible adverse short-term not significant	no effect	no effect	*same as Alternative A*
> long-term	no effect, neutral	indirect negligible beneficial long-term not significant	no effect	no effect	*same as Alternative A*
Commercial Aquaculture	no effect, neutral	direct minor beneficial long-term significant	indirect negligible beneficial long-term not significant	*same as Alternative B*	*same as Alternative A*
Recreational Shellfishing	no effect, neutral	direct minor beneficial long-term significant	indirect negligible beneficial long-term not significant	*same as Alternative B*	*same as Alternative A*
Commercial Fishing	no effect, neutral	indirect minor adverse / beneficial long-term not significant	*Same as Alternative A*	*Same as Alternative A*	*Same as Alternative A*

IMPACTED RESOURCE	NO ACTION ALTERNATIVE	ALTERNATIVE A *NOMINATED SITE*	ALTERNATIVE B *CONNECTICUT RIVER SITE*	ALTERNATIVE C *LOWER CONNECTICUT RIVER SITE*	ALTERNATIVE D *REVISED NOMINATED SITE*
Recreational Fishing	no effect, neutral	direct minor beneficial long-term not significant	*same as Alternative A*	*same as Alternative A*	*same as Alternative A*
Hunting	no effect, neutral	indirect minor beneficial long-term not significant	*same as Alternative A*	*same as Alternative A*	*same as Alternative A*
Agriculture	no effect, neutral	*Same as No Action Alternative*	*Same as No Action Alternative*	*Same as No Action Alternative*	*Same as No Action Alternative*

6.2 Natural Environment

6.2.1 Physical Environment

6.2.1.1 Air (Atmosphere)

6.2.1.1.1 Weather and Climate

As described in *Chapter 5*, the coastal region of eastern Connecticut spanning the footprint of the project area can be generally characterized as a combination of Humid Subtropical and Temperate Ocean climates, bringing a mix of hot, humid summers with milder winters consisting of a mix of rain with infrequent snow. Resulting impacts to weather and climate from the range of alternatives analyzed are provided in Table 6-3.

Table 6-3: Impacts to Weather and Climate

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Weather and Climate	No direct or indirect impacts are expected.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) on the weather and climate of the area are expected because actions in the area of the reserve have negligible impacts on the day-to-day weather and the overall climate of the region. It is expected that any future changes to weather and climate will be the result of larger regional and global factors that are independent of the local conditions and changes.

Alternatives A, B, C, D

None of the alternatives analyzed are expected to result in any direct or indirect impacts (beneficial or adverse) on the weather and climate of the area because actions in the area of the reserve have negligible to no effect on the day-to-day weather and the overall climate of the region. It is expected that any future changes to weather and climate will be the result of larger regional and global factors that are independent of the local conditions and changes, described in the following section on climate change.

6.2.1.1.2 Climate Change

As noted in *Chapter 5 - Affected Environment*, potential changes to the environment associated with climate change in the region could include:

- sea level rise, resulting in salt-water intrusion into coastal aquifers, waterbodies, and wetlands;
- increased frequency of flooding;
- average temperature increases, which can stress vegetation and animals, alter habitat suitability, and lead to changes in species distribution;
- more frequent and hotter warm-weather events;
- decrease in the number of days with frost;
- increased risk of drought, plus increased frequency of extremely high precipitation events;
- less snow and more rain, but increased humidity will yield high snowfall events when temperatures permit;
- stronger winds and more precipitation associated with tropical cyclones, though projection for the change in frequency in these storm events are uncertain.

The Governor's Council on Climate Change (GC3) report listed 61 near-term action strategies to mitigate climate impacts in Connecticut, to be implemented in late 2021 and early 2022 (Governor's Council on Climate Change 2021b). They largely focus on energy reform, stewardship of natural habitats, education, training, and research. These activities would continue under the No Action Alternative.

Table 6-4: Impacts to Climate Change

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Climate Change	Direct and indirect minor and moderate beneficial long-term impacts are expected.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. Minor or moderate direct and indirect beneficial impacts on climate change are expected, based on Connecticut's commitment to reducing its carbon footprint. It is expected that any future changes to climate will be the result of larger regional and global factors that are independent of the local conditions and changes within the project area.

Alternatives A, B, C, D

Designation of a reserve and implementation of its management plan are not expected to result in significant changes to land management strategies. All the major resource management activities planned would occur under all alternatives. However, climate change could alter some of the effects of the land management strategies over time. In particular, climate change may cause certain environmental management strategies, such as managing low-lying areas, to become more difficult to sustain over time. The estuarine and brackish wetland plants are salt-tolerant, making them more resilient to sea-level rise, though the freshwater plants (marsh and submerged) may not do well if saltwater intrudes into their habitats in the Connecticut River freshwater areas. And while the estuarine and brackish plants may be salt-tolerant, their habitats, the marsh platforms, may not be able to accrete sediment at a rate that can keep pace with sea level rise, especially in the sediment-poor eastern Long Island Sound and western Fishers Island Sound.

The impacts of climate change could present possible areas of research for reserve partners and scientists affiliated with the reserve, especially given the focus on mitigation strategies identified by the GC3 report and Connecticut's continuing commitment to actively mitigate climate change at the source and the impacts it has on local communities. For example, research might address the extent to which species and ecosystems in the area might be able to adapt to climate change. It is possible that with additional funding or technical assistance for research, the reserve might be able to offer help to local partners for monitoring, anticipating, and planning for climate change impacts. This could contribute to climate resilience in the region, to the extent that it spurs adoption of new management strategies.

6.2.1.1.3 Air Quality

As described in *Chapter 5 - Affected Environment*, air quality is monitored by DEEP at two stations within or near the project area. For local point sources of contaminants, the Thames River area air quality is influenced by manufacturing processes (styrene and copper compounds) while the Connecticut River is more influenced by waste management processes (ammonia), though air flows throughout the project area in both directions, changing with seasonal wind patterns. Additional contributors to air quality are vehicle emissions and energy use for home and work place heating.

Southeastern Connecticut is meeting standards for particulates, but ozone levels, particularly in the summer, show nonattainment of the standards. Resulting impacts to air quality from the range of alternatives analyzed are provided in Table 6-5.

Table 6-5: Impacts to Air Quality

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Air Quality	Direct negligible adverse long-term impacts from road and boat traffic-related emissions in the area are expected.	Direct negligible adverse impacts from increased vehicle traffic as reserve activities and programs are implemented.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. However, continued negligible adverse impacts to air quality from vehicle emissions within the general area and from boat traffic are expected.

Alternatives A, B, C, D

Each of the proposed alternatives analyzed are expected to result in long-term negligible minor direct adverse impacts to local air quality as vehicle and boat traffic increases in the area in connection with reserve implemented activities and programs. All vehicles would be expected to be operated in accordance with applicable air quality requirements.

6.2.1.2 Water (Hydrosphere)

6.2.1.2.1 Water Quality

As described in *Chapter 5 - Affected Environment*, throughout the project area, the inner, more landward portions exhibit water quality issues while the main stem of Long Island Sound and Fishers Island Sound exhibits better water quality due to greater exchange with the Atlantic Ocean. Within the overall project area, water quality is supportive of aquatic life in 75% of the area and 46% of the area is supportive of shellfishing. Water quality supportive of recreation is not assessed for most of the deeper waters of the project area, including the midshore and offshore areas. Within the shore area, 13% is not supportive of recreation, with 42% of the area not assessed. These areas include the outer portions of embayments as well as areas with direct frontage on Long Island Sound and Fishers Island Sound. Within the inner embayments (inner estuary area), 34% is not supportive of recreation, with 19% of the area not assessed.

Water quality impairments are typically related to nutrient pollution (primarily nitrogen) stemming from human waste water (sewer and septic), atmospheric deposition, and fertilizer (See *Section 5.2.1.3.1*, page 219 for a summary of sources to the project area); sediment from surface flows and storm water systems; bacteria from fecal matter contamination; and toxins and emerging contaminants from industrial sources, household waste, and pharmaceuticals.

Indicators of water quality problems include nutrient concentrations in the water, blooms of algae (phytoplankton or seaweed), high bacteria levels, low water column oxygen (hypoxia or anoxia), and high turbidity (low water clarity). Eastern Long Island Sound and Fishers Island Sound hosts eelgrass (*Zostera marina*), an indicator of good water quality. Eelgrass is located in the eastern half of the project area, thus Alternative B has no eelgrass and Alternative C has just 12 acres compared to the more than 520 acres found in Alternatives A and D.

Threats to water quality include pollution (nutrients, bacteria, and other contaminants), rising temperatures (which impact respiration and production by marine organisms, impacting hypoxia), marine debris, and coastal development (increased stormwater runoff resulting from impervious cover, nutrient pollution, and the short-term impacts of dredging). A summary of the expected impacts to water quality from the range of alternatives analyzed is provided in Table 6-6.

Table 6-6: Impacts to Water Quality

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Water Quality	Changes to nutrient levels in receiving waters from potential manipulation and restoration activities. Short-term adverse moderate increases in sedimentation from harbor dredging, upland and estuarine habitat manipulations, or restorations. Beneficial long-term minor improvements to water filtration, infiltration, and retention of soils as a result of these activities.	Potential long-term moderate beneficial improvements through reduced pollution in the project area resulting from education, training, and outreach efforts and demonstration of BMPs for green development and nutrient management in reserve properties.	Similar to Alternative B, but anticipate lower level of benefits (minor) because upland WMA properties are not as popular as the State Parks included in Alternative A.	Same as Alternative B.	Same as Alternative A.

No Action Alternative

Under the No Action Alternative, the expected habitat manipulation activities by site partners such as those related to invasive species management and management of the State Parks would continue as planned. Areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. Currently, no restoration projects are planned, beyond the normal periodic invasive species monitoring and management.

The Thames River and Connecticut River conduct regular maintenance dredging. Increased turbidity and disturbance of bottom sediments from the dredging produces sedimentation impacts that affect local water quality over a short timeframe.

Development within the watershed of the project area is expected to continue. The watershed of the Connecticut River extends northward to Canada and the Thames River watershed extends northward to Massachusetts. These two rivers contribute the bulk of nitrogen delivered to the project area (see Figure 5-16, page 219 for a summary of sources to the project area). States within the watershed, including Connecticut, are working to reduce nutrient pollution from point and nonpoint sources, building on the success of the 2000 Long Island Sound TMDL to reduce nitrogen in support of hypoxia reduction, which required a 58.5% reduction in nitrogen sources relative to 1990s levels, achieved in 2016. A future revision of the Long Island Sound TMDL may include updated nitrogen allocations for both lower basin sources (Connecticut and New York) and upper basin sources (Massachusetts, New Hampshire, and Vermont).

Alternatives A and D

These alternatives include four embayments with some form of impairment, including Baker Cove, Poquonnock River, Mumford Cove and Palmer Cove. Other waterbodies with listed impairments include lower Thames River, Niantic Bay, Niantic River mouth, and the lower Connecticut River (including Lord Cove), though the east side of the Connecticut River mouth is unimpaired. Within the midshore areas, the far east and far west of these alternatives are unimpaired with impairments between, in areas off the Connecticut River eastward to the area off the Mystic River. All included offshore areas are unimpaired. The total tracked toxin load to the Connecticut River and Thames River areas are roughly equivalent, though the Thames River toxin load is dominated by copper compounds with some zinc and lead, while the Connecticut River load is dominated by ammonia.

Designation of a reserve under these boundaries could potentially result in minor to moderate beneficial impacts to the water quality within the affected environment. This would be achieved primarily through education of the public on best management practices to reduce pollution and disturbances to the sediment that lead to poor water quality. Research on emerging contaminants could result in creation of additional BMP recommendations. Education and training programs would more formally introduce people to these BMPs. Signage and demonstration projects, especially at the State Parks which receive a higher number of visitors, would serve as passive education and outreach to visitors.

Alternatives B and C

These alternatives encompass about half the area included in Alternatives A and B and thus lack many of the locations listed for Alternatives A and D, but include impairments in the lower Connecticut River (including Lord Cove), though the east side of the Connecticut River mouth is unimpaired. Alternative B extends northward to the Salmon River, which is listed as unimpaired. Within the midshore area, the area off the Connecticut River is listed as impaired. The absence of the Thames River from this alternative removes the direct impact of that toxin load to the proposed CT NERR, though the total loads to the two rivers were roughly equivalent, albeit of a different composition.

As with Alternatives A and D, designation of a reserve under these boundaries could potentially result in minor to moderate beneficial impacts to the water quality within the affected environment, achieved in the manner described for Alternatives A and D. The impact resulting from these boundary designations are likely to be less than for Alternatives A and D because these lack the very popular State Parks included in Alternatives A and D and thus fewer people are likely to see any outreach material and signage. In addition, these areas include less water and thus any impacts would not be as extensive as those potentially seen in Alternatives A and D.

6.2.1.2.2 Hydrology

As described in *Chapter 5 - Affected Environment*, the freshwater flow in the project areas includes two major rivers and a number of smaller rivers and streams that discharge directly to Long Island Sound or Fishers Island Sound. The lower Connecticut River landward components of the project area are primarily marshes with surface flow driven by freshwater and tidal inputs. The lower Thames River landward components of the proposed CT NERR, Bluff Point properties and Haley Farm State Park, comprise areas that are predominantly forested and have less upstream freshwater inflow than the lower Connecticut River landward components. The Connecticut River provides the majority of freshwater input to the area, and to Long Island Sound overall. The Thames River is also a major freshwater source for Long Island Sound, though it is 15% of the flow of the Connecticut River.

Threats to freshwater hydrology include diversion of water which can lead to habitat degradation, and changing precipitation patterns as a result of climate change which changes the magnitude and timing of freshwater recharge of groundwater. A potential impact of sea level rise is also migration and drowning of existing salt marshes. Water level will be higher in low lying ecosystems, as indicated by FEMA-designated flood risk. Pollution also impacts water quality of groundwater and surface waters. Sea level rise is causing saltwater intrusion into some freshwater systems.

Within the estuary, a semi-diurnal tidal cycle of two highs and two lows is present throughout the project area (NOAA 2018). Water temperatures vary from 32°F in the winter to 68°F in the summer, but are moderated daily by the large volume of water moving with the tide. Temperatures in the embayments are influenced by the temperatures in The Sounds, but also flushing rates, depths, and solar radiation. Salinity across most of the area is relatively constant, averaging 30-32 ppt (ppt = parts per thousand) at the bottom and 28-30 ppt at the surface. This horizontal and vertical gradient generates characteristic circulation patterns which continue throughout the tidal cycle. Both the Connecticut River and Thames River display salt wedge estuarine structure whereby river circulation creates a distinct boundary between a surface layer with lower salinity and a bottom layer with higher salinity.

Threats to estuarine hydrology are related to climate change impacts – warming temperatures may lead to changes in stratification (though salinity is the driving factor for stratification). Changes in the timing and amount of freshwater flow may alter hydrology, also related to climate change impacts. Sea level rise may lead to saltwater intrusion into groundwater aquifers and freshwater surface waters. A summary of the expected impacts to surface water hydrology, groundwater hydrology, and estuarine hydrology from the range of alternatives analyzed are provided in Table 6-7.

Table 6-7: Impacts to Hydrology

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Hydrology	Direct and indirect moderate adverse impacts are expected as a result of climate change.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) on the hydrology of the area are expected. It is expected that any future changes to hydrology will be related to climate change and thus, will be the result of larger regional and global factors that are independent of the local conditions and changes.

Alternatives A, B, C, D

None of the alternatives analyzed are expected to result in any direct or indirect impacts (beneficial or adverse) on the hydrology of the area beyond what is predicted for the No Action Alternative. It is expected that any future changes to hydrology will be related to climate change and thus, will be the result of larger regional and global factors that are independent of the local conditions and changes.

6.2.1.3 Land (Lithosphere)

As described in *Chapter 5 - Affected Environment*, the rock dominated coastline of the eastern section of the project area shows irregularities that reflect the shape of the underlying bedrock surface and the glacial history of the area. In contrast to the rock dominated coastline of the eastern portions of Alternatives A and D, the Connecticut River occupies a section of coastline that is sediment dominated. A summary of the expected impacts to geology from the range of alternatives analyzed is provided in Table 6-8.

Table 6-8: Impacts to Geology

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Geology	No direct or indirect impacts are expected.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to the geology of the area are expected.

Alternatives A, B, C, D

None of the alternatives analyzed are expected to result in any direct or indirect impacts (beneficial or adverse) to the geological conditions of the area.

6.2.2 Biological Environment

6.2.2.1 Terrestrial Habitats

As described in *Chapter 5 - Affected Environment*, the terrestrial areas include a variety of upland habitats. Focusing on only those areas which are above the mean higher high water line, the habitats include: coastal forests-woodland, coastal meadows / grassland, coastal shrublands, coastal beach and dune grasslands, and coastal bluff. Threats to terrestrial habitats include habitat loss and degradation, invasive species, pollution, coastal development, sea level rise, and climate change. A summary of the expected impacts to terrestrial habitats from the range of alternatives analyzed is provided in Table 6-9.

Table 6-9: Impacts to Terrestrial Habitats

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Terrestrial Habitats	No change to the habitat as site partners continue with the current management behaviors.	Long-term, moderate, direct and indirect beneficial impacts including enhanced habitat for native species, removal of certain invasive species, and increased biodiversity resulting from increased funding for stewardship and a dedicated staff member advocating for improvements in reserve properties.	Almost no terrestrial property is included in this alternative. Minor direct beneficial impacts for activities as described in Alternative A, to be carried out in Machimoodus State Park.	No direct or indirect impacts are expected because this alternative has no terrestrial property.	Same as Alternative A.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to the terrestrial habitat of the area are expected. Management of these areas include efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as invasive species control / restoration as needed, and management of human impacts.

Alternatives A and D

As detailed in the management plan, it is anticipated that reserve staff would potentially provide technical assistance, environmental monitoring or planning support, which would tie directly to the proposed reserve's ecosystem-based management research activities occurring within the terrestrial areas. Future reserve staff could potentially work with site partners to initiate monitoring programs during project implementation to allow for adaptive management of ongoing maintenance and restoration efforts, as needed. Environmental compliance reviews would be carried out in advance of each project, and all necessary permits and authorizations would be obtained.

With technical assistance or other support from reserve staff, we anticipate that the terrestrial habitat maintenance and restoration efforts could bring about, in the long-term, moderate, direct, beneficial impacts, particularly to species and ecosystems. For example, reserve staff could work with site partners to implement more effective restoration strategies as well as to identify and implement appropriate mitigation measures so that any future terrestrial habitat restoration activities would be achieved in a manner that minimizes negative impacts to sensitive environments and species. Mitigation measures may include working with site partners to ensure that the various projects are implemented using best management practices to minimize erosion and sediment loss (e.g., using erosion control blankets on steep-sloped areas during construction).

In addition to providing technical assistance and environmental monitoring support to site partners, it is anticipated that reserve staff would play a key role in coordinating external research, monitoring, education, and outreach efforts occurring throughout the terrestrial areas. Thus, reserve designation could improve coordination of these efforts, and thereby, provide support to the reserve and site partners' programs aimed at promoting understanding and improving terrestrial habitats. This support, in turn, is expected to provide long-term, moderate, indirect beneficial impacts to affected terrestrial habitats.

Implementation of the proposed CT NERR's education, and outreach programs could help site partners and key audiences improve their understanding of the ecological value of terrestrial habitats. Reserve outreach efforts are anticipated to result in increased participation in community restoration and stewardship activities intended to improve the ecological character and functionality of the terrestrial habitats. This increased participation, in turn, is expected to provide long-term, minor, indirect beneficial impacts to affected terrestrial habitats.

It is for these reasons that, if designated, the reserve's research, education, and outreach efforts would be expected to have long-term, moderate beneficial impacts and would not be expected to have any significant adverse impacts on affected terrestrial habitats.

Alternative B

The only terrestrial property included in this alternative is a forest in Machimoodus State Park, in the freshwater portion of the Connecticut River. Impacts are as described for Alternatives A and D, but the impact is classified a minor because of the small area of the terrestrial habitat.

Alternative C

No terrestrial habitat is included in this alternative, thus no impact is expected.

6.2.2.2 Riparian and Freshwater Habitats

As described in *Chapter 5 - Affected Environment*, properties located in the proposed CT NERR include freshwater coves and tributaries, freshwater ponds, and freshwater tidal and non-tidal marshes, and floodplain forests. The Connecticut River is an important riverine migratory corridor for fish within this region and is federally designated as ESA Critical Habitat (16 U.S.C. § 1532(5); 50 C.F.R. § 424.12) for the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). A few habitats have been identified by DEEP and in mapping efforts as federally-designated ESA Critical Habitats (16 U.S.C. § 1532(5); 50 C.F.R. § 424.12) within the project area. These include: beachshore, intertidal marsh, freshwater aquatic, poor fen, and floodplain forest (Barrett 2014).

Threats to riparian and freshwater habitats include habitat degradation, habitat loss, invasive species, pollution, coastal development, sea level rise and its impact on saltwater intrusion, and climate change. A summary of the expected impacts to riparian and freshwater habitats from the range of alternatives analyzed is provided in Table 6-10.

Table 6-10: Impacts to Riparian and Freshwater Habitats

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Riparian and Freshwater Habitats	No change to the habitat as site partners continue with the current manage-ment behaviors.	Relatively little freshwater and riparian habitat are included, though this alternative does include a rare sea-level fen and a poor fen. Long-term, minor, direct and indirect beneficial impacts including enhanced habitat for native species, removal of certain invasive species, and increased biodiversity resulting from increased funding for stewardship and a dedicated staff member advocating for improvements in reserve properties.	Substantial freshwater and riparian habitat are included. Short-term and long-term, moderate, direct and indirect beneficial impacts including enhanced habitat for native species, removal of certain invasive species, and increased biodiversity resulting from increased funding for stewardship and a dedicated staff member advocating for improvements in reserve properties.	No known riparian or freshwater habitat, so no impact is expected.	Same as Alternative A.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to the riparian and freshwater habitat of the area are expected. Management of these areas include efforts to sustain habitats at their present status, including some invasive species control and management of human impacts.

Alternative B

As detailed in the management plan, it is anticipated that reserve staff would provide technical assistance, environmental monitoring, or planning support, which would tie directly to the proposed reserve's ecosystem-based management research activities occurring within the riparian and freshwater areas. Future reserve staff could potentially work with site partners to initiate monitoring programs during project implementation to allow for adaptive management of these maintenance and restoration efforts, as needed. Environmental compliance reviews would be carried out in advance of each project, and all necessary permits and authorizations would be obtained. With technical assistance or other support from reserve staff, it is anticipated that the riparian and freshwater habitat maintenance and restoration effort could bring about, in the long-term, moderate, direct, beneficial impacts, particularly to species and ecosystems. For example, reserve staff could work with site partners to identify and implement appropriate mitigation measures so that any future habitat restoration activities would be achieved in a manner that minimizes negative impacts to sensitive riparian and freshwater environments and species. Mitigation measures may include working with site partners to ensure that the various projects are implemented using best management practices to minimize erosion and sediment loss (e.g., using erosion control blankets on steep-sloped areas during construction).

In addition to providing technical assistance and environmental monitoring support to site partners, it is anticipated that reserve staff would play a key role in coordinating external research, monitoring, education, and outreach efforts occurring throughout the riparian and freshwater areas. Thus, reserve designation could improve coordination of these efforts, and thereby, provide support to the reserve and site partners' programs aimed at promoting, understanding and improving these habitats. This support, in turn, is expected to provide long-term, moderate, and indirect beneficial impacts to affected terrestrial habitats.

Reserve-specific research and monitoring efforts would focus, at least initially, on developing baseline habitat and ecosystem service data related to all habitats. Designation of the proposed CT NERR would result in the installation and use of instruments for scientific research and data gathering. These instruments could include, for example, meteorological stations or soil monitoring systems. It is expected that their installation and use could result in temporary, direct, adverse impacts to riparian and freshwater habitats, such as negligible sedimentation, habitat loss, or habitat modification. These impacts are expected to be negligible because the instruments would be placed and used in a manner designed to minimize negative impacts to sensitive environments, and in compliance with all environmental, historic preservation, and other applicable mandates.

Implementation of the proposed CT NERR's education, and outreach programs could help site partners and key audiences improve their understanding of the ecological value these habitats provide. Reserve outreach efforts are anticipated to result in increased participation in community restoration and stewardship activities intended to improve the ecological character and functionality of these habitats. This increased participation, in turn, is expected to provide long-term, minor, and indirect beneficial impacts to affected habitats. It is for these reasons that, if designated, the reserve's research, education, and outreach efforts would be expected to have long-term, moderate beneficial impacts and would not be expected to have any significant adverse impacts on affected habitats.

Alternatives A and D

Without the extension of these properties northward in the Connecticut River found in Alternative B, these alternatives lack substantial riparian and freshwater resources. A few ponds exist in the properties. A small, rare sea-level fen has been documented in Bluff Point Natural Area Preserve and a 1.8 acre poor fen is located in Haley Farm State Park. This provides a unique opportunity for research. Most of the benefits and negative impacts detailed for Alternative B do not exist because there are relatively small amounts of these habitats present. The inclusion of the rare sea-level fen elevates the impact from no impact to a minor, indirect and direct impact for the reasons generally described for Alternative B. Protection of the fen and evaluation of how to best manage this habitat in the midst of a busy state park should be a priority for staff.

Alternative C

No impact is expected as this alternative has no riparian and freshwater habitat.

6.2.2.3 Estuarine Habitats

As described in *Chapter 5 - Affected Environment*, habitats within the project area include: tidal salt and brackish marshes, rocky intertidal, intertidal beaches, intertidal mud and sand flats, intertidal algae beds, subtidal hard bottoms, subtidal soft bottoms, and submerged aquatic vegetation (approximately 540 acres of eelgrass). Commercially leased and recreational shellfish beds are concentrated in the eastern end of the proposed CT NERR while two large natural shellfish beds are located in the lower Connecticut River (approximately 109 acres). Most of the terrestrial sites included in the proposed CT NERR include tidal salt marshes (or tidal brackish and freshwater marshes) along some part of their coastline. The offshore areas of the proposed CT NERR include an array of submerged aquatic vegetation, soft bottom, and hardbottom (reefs, bedrock / gravel zones, and rocky / boulder areas). A few habitats have been identified by DEEP and in mapping efforts as federally-designated ESA Critical Habitats (16 U.S.C. § 1532(5); 50 C.F.R. § 424.12) within the project area. These include: beachshore and intertidal marsh (Figures 5-10 through 5-12, pages 121 to 122). A summary of the expected impacts to estuarine habitats from the range of alternatives analyzed is provided in Table 6-11.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. An active dredge material disposal site and the dredging activity and heavy boat traffic in the lower Thames River and lower Connecticut River constitute moderate to major long-term impacts. While individual dredging activities and disturbances from individual boats are short-term, the cumulative and ongoing impact is long-term. In all other respects, management of these areas include efforts to sustain habitats at their present status, including management of human-use impacts. The impact of the dredge material disposal site is direct, major, adverse, long-term, and significant. Site assessments were used when choosing the disposal site, to minimize impacts on the local environment, and best management practices are employed to minimize the impact of placing dredged material in the disposal site.

Table 6-11: Impacts to Estuarine Habitats

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Estuarine Habitats	Direct major adverse impacts associated with the inclusion of the dredge material disposal site. All other impacts of the no action alternative on the estuarine habitat are captured in other categories.	Same as No Action Alternative. Includes roughly 337 acres of the habitat-forming species, eelgrass (*Zostera marina*) in the core area and 202 acres in the buffer area.	No adverse impacts are anticipated because this alternative does not include the dredge material disposal site nor does it include the heavily used navigational channel in the lower Thames River as core area. This alternative does not include eelgrass habitat.	Same as Alternative B except that appoximately 12 acres of eelgrass are included in the core area.	Same as Alternative A except that all of the roughly 540 acres of eelgrass are included in the core area.

Alternative A

As with the No Action Alternative, management of these areas include efforts to sustain habitats at their present status, including management of human impacts. This alternative includes all potential habitats present in the project area, including a significant extent of seagrass (approximately 540 acres; roughly 337 acres in the core area and 202 acres in the buffer area), complex hard-bottom, and an active dredge material disposal site. Impacts related to climate change and development were previously covered in the climate and water quality analysis. Impacts of dredging were previously covered in water quality and boat traffic will be addressed in transportation and navigation. The largest threat exclusive to this category is the inclusion of the dredge material disposal site, with the potential for disturbance to habitats caused by the placement and presence of dredged materials disposed at that site. The impact of the dredged material disposal site is direct, major, adverse, long-term, and significant. As noted in the No Action Alternative, site assessments were used when choosing the disposal site, to minimize impacts on the local environment and best management practices are employed to minimize the impact of placing dredged material in the disposal site.

Alternatives B and C

These alternatives lack the significant area of hard bottom and complex bottom types found in Alternative A, as well as the seagrass beds and the active dredge material disposal site (though Alternative B includes about 12 acres of eelgrass in the core area). As with the No Action Alternative, management of these areas includes efforts to sustain habitats at their present status, including management of human impacts. With the removal of the dredge material disposal site, no adverse effects on estuarine habitats are expected by the designation of a reserve.

Alternative D

This alternative includes the diverse range of habitats included in Alternative A, including a substantial amount of complex hard bottom and approximately 540 acres of seagrass beds (all within the core area). This alternative lacks the active dredge material disposal site. Alternative D includes the area off of Niantic Bay as core (versus as buffer, as in Alternative A), thus increasing valuable habitat types included in the core. This site includes the heavily used navigational channel in the lower Thames River as buffer versus core. With these changes, the designation of a reserve using these boundaries would have no effect on the estuarine habitats.

6.2.3 Living Resources

The discussions below analyze the potential impacts to living resources of the five alternatives evaluated. The management plan describes the types of activities that reserve partners are working on or planning that affect flora and fauna, as well as how reserve activities would support efforts to study different environments and species. Restoration activities beyond ongoing invasive species management are not currently planned. If there is any need for scientific collection or destructive sampling of living organisms, researchers might be required to obtain permits from DEEP. If there were a need for scientific collection or destructive sampling of Federally protected species, authorizations would be obtained, if needed, from the U.S. Fish and Wildlife Service and/or NOAA Fisheries.

Connecticut has a well-developed wildlife action plan which covers habitats, flora, and fauna (DEEP 2016c). The state has identified conservation opportunity areas and has identified specific strategies and best management practices for habitats and individual species. Conservation actions are divided into categories:

- Administration
- Planning
- Law and Policy
- Education and Outreach
- Technical Assistance
- Data Collection and Analysis
- Direct Management of Natural Resources
- Land and Water Acquisition and Protection

Activities in the proposed CT NERR would follow the methodology and practices outlined by Connecticut.

6.2.3.1 Flora – All Habitats

As described in *Chapter 5 - Affected Environment*, flora vary by habitat type and range from seaweed to vascular herbaceous plants, shrubs, and trees. Threats to flora include climate change impacts on stress levels, habitat loss and degradation, pollution, coastal development, human disturbance and collection, and invasive species.

Climate change impacts and some aspects of habitat loss and degradation resulting from saltwater intrusion were covered in the section on climate change. The impacts of coastal development on pollution were covered in water quality. The project area already consists of state-owned properties and properties owned by land conservation organizations, with all lands currently managed for conservation purposes. Establishment of a reserve would not provide additional protections to habitats, flora, or fauna beyond those that currently exist; thus, impact from human disturbance or collection would remain unchanged relative to the No Action Alternative. A summary of the expected impacts to terrestrial flora from the range of alternatives analyzed is provided in Table 6-12.

Table 6-12: Impacts to Flora – All Habitats

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Flora – All Habitats	Direct and indirect minor beneficial long-term impacts associated with invasive species control and management of the habitats.	Direct and indirect moderate beneficial long-term impacts from reserve support for research, planning, coordination, and monitoring which could support integration of BMPs and adaptive management into projects. Minor indirect benefits from reserve education efforts. Installing monitoring devices could cause short-term, negligible adverse impacts. Includes approximately 338 acres of the habitat-forming species, eelgrass (*Zostera marina*) in the core area and approximately 202 acres in the buffer area	Direct and indirect minor beneficial long-term impacts resulting from the reasons described for Alternative A. The impact is less because this alternative includes about half of the terrestrial area and one third of the aquatic area. Notably, less diversity in habitats supports less diversity in the flora found within this alternative.	Same as Alternative B.	Same as Alternative A except that all of the roughly 540 acres of eelgrass are included in the core area.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to the flora of the area are expected. Management of these areas include efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as invasive species control / restoration as needed, and management of human impacts.

Alternatives A and D

These alternatives are expected to include the same activities described in the No Action Alternative, plus additional support from reserve staff for research, planning, coordination, and monitoring, which could facilitate integration of best management practices, mitigation measures, monitoring, and adaptive management into projects, producing indirect and direct, moderate, beneficial, long-term effects. Additional indirect benefits would be expected to derive from reserve education efforts. New reserve initiatives could have negligible to minor adverse effects to some species from restoration, manipulation, or monitoring efforts. There could also be impacts to localized areas of developing spaces in which visitors could congregate; potential impacts of any such projects would be analyzed in the future, as part of the environmental compliance process. Overall, while there may be some short-term adverse impacts associated with restoration or facility development, the overall net effect would be long-term beneficial. These alternatives include unique flora found in approximately 540 acres of seagrass, grasslands, a sea-level fen, a poor fen, beach dunes, salt and brackish marshes, and rocky intertidal seaweed communities that are not included in Alternatives B and C.

Alternatives B and C

The consequences to flora in these alternatives would be similar to those described for Alternatives A and D, except that this alternative includes half of the terrestrial area and less than one-third of the aquatic area found in Alternatives A and D. Thus, less indirect beneficial impact is expected due to this reduction in area included in the reserve. Specifically, these habitats lack the unique habitats noted for Alternatives A and D (approximately 540 acres of seagrass, grasslands, a sea-level fen, a poor fen, beach dunes, salt and brackish marshes, and rocky intertidal). Additionally, Alternative B includes freshwater marshes not found in the other alternatives.

6.2.3.2 Fauna – All Habitats

As described in *Chapter 5 - Affected Environment*, the fauna found in terrestrial areas include a variety of mammals, reptiles, amphibians, birds, and invertebrates (insects, worms, etc.). Many of the species are common backyard visitors for southeastern Connecticut, in addition to occurring in larger tracts of natural lands. Threats to terrestrial fauna include climate change impacts on stress levels, habitat loss and degradation, pollution, coastal development, human disturbance, and invasive species. Hunting impacts prey species directly, but is managed by DEEP to preserve sustainable populations.

Marine mammals such as seals, porpoises, dolphins, and humpback whales have been observed transiting through the area. Wetlands throughout southeastern Connecticut provide vital breeding, foraging, resting, and migratory pathways for rare and diverse bird species. The lower Connecticut River contains the highest fish diversity in the region, in part due to the nutrient rich interface between freshwater and saltwater. Over 70 species of fish have been documented in the area. Invertebrates can be found from the intertidal to the offshore, the most visible species include crabs and lobster though many smaller species also occur. Shellfish are an important resource for the ecosystem services they provide (harvesting of shellfish is covered in the analysis of human use impacts). Threats to estuarine fauna include climate change, habitat loss and degradation, pollution, marine debris, coastal development, human disturbance, and invasive species. Fishing impacts prey species directly, but is managed by DEEP and regional fishery councils to preserve sustainable populations (as with shellfish, harvesting of fish is covered in the analysis of human use impacts).

A summary of the expected impacts to aquatic fauna from the range of alternatives analyzed is provided in Table 6-13.

Table 6-13: Impacts to Fauna

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Fauna – All Habitats	Direct and indirect minor beneficial long-term impacts associated with invasive species control and management of the habitats.	Direct and indirect minor beneficial long-term impacts from reserve support for research, planning, coordination, and monitoring which could support integration of BMPs and adaptive management into projects. Minor indirect benefits from reserve education efforts. Installing monitoring devices could cause short-term, negligible adverse impacts.	Direct and indirect minor beneficial long-term impacts resulting from the reasons described for Alternative A. The impact is less because this alternative includes about half of the terrestrial area and one third of the aquatic area. Notably, less diversity in habitats supports less diversity in the fauna found within this alternative.	Same as Alternative B.	Same as Alternative A.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. Direct or indirect minor beneficial impacts to the fauna of the area are expected. Management of these areas include efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as invasive species control / restoration as needed, and management of human impacts. Species are managed to sustain or promote their viability in Long Island Sound, Fishers Island Sound, and the terrestrial properties.

Some impacts on fauna have been covered in earlier sections of this impact analysis. The impact of climate change includes the impact on species in the area (*Section 6.2.1.1.2)*. The analysis of water quality impacts include the impact of development and pollution on the project area, including impact on fauna (*Section 6.2.1.2*). The dredged material disposal site and potential impacts of navigational dredging were addressed in the estuarine habitats section (*Section 6.2.2.3*).

Impacts not yet addressed in this section include direct interaction between animals and humans, the impact of vessels on animal behavior, and the presence of invasive species and their impact on the local fauna. Direct or indirect harassment of wildlife resulting from recreational uses of natural environments (terrestrial and aquatic) by humans have the potential to create minor adverse short-term effects on fauna, e.g., causing adverse behavioral changes or mortality to some fauna. Within Long Island Sound and Fishers Island Sound, invasive species have been intentionally and unintentionally introduced in the distant past, i.e., > 50 year ago. Examples include the common periwinkle (*Littorina littorea*) introduced as food by English colonials (CABI 2021), and codium (*Codium fragile*) introduced on the hulls of ships and attached to imported shellfish (Donohue 2006). More recent invasions include the Asian shore crab (*Hemigrapsus sanguineus*) and orange sheath tunicates (*Botrylloides violaceus*), likely introduced through ballast water (Getchis and Balcom 2007). While DEEP tracks and manages some terrestrial and freshwater aquatic invasive species, the marine species are primarily tracked but not managed as most species are widespread and established, making them nearly impossible to eradicate. Invasive species management has direct negligible to minor beneficial long-term impacts on native species. Best management practices covered in the state wildlife action plan are used to control invasives as necessary (DEEP 2016c).

Alternatives A and D

These alternatives are expected to include the same activities described in the No Action Alternative, plus additional support from reserve staff for research, planning, coordination, and monitoring, which could facilitate integration of best management practices, mitigation measures, monitoring, and adaptive management into projects, producing indirect and direct, minor, beneficial, long-term effects. Additional indirect benefits would be expected to derive from reserve education efforts. New reserve initiatives could have negligible to minor adverse effects to some species from restoration, manipulation, or monitoring efforts. There could also be impacts to localized areas of developing spaces in which visitors could congregate; potential impacts of any such projects would be analyzed in the future, as part of the environmental compliance process. However, increased signage, educational programs, and closer attention to stewardship of these areas are likely to have an overall beneficial impact on mitigating the impact of humans on fauna. Overall, while there may be some short-term adverse impacts associated with restoration or facility development, the overall net effect would be long-term beneficial.

Alternatives B and C

The consequences to fauna in these alternatives would be similar to those described for Alternatives A and D, except that this alternative includes half of the terrestrial area and less than one-third of the aquatic area found in Alternatives A and D. Thus, less indirect beneficial impact is expected due to this reduction in area included in the reserve. Specifically, these habitats lack much of the coastal upland shrub and forest habitats, as well as the submerged complex hard bottom found in Alternatives A and D;

thus, the diversity of organisms is likely to be less in these alternatives. While the areal extent is less, the impacts are still characterized as indirect and direct, minor, beneficial, long-term effects.

6.2.3.3 Special-Status Species and Habitats

The following discussions address species and habitats with special status pursuant to the Endangered Species Act and the Magnuson-Stevens Fishery Conservation and Management Act. The descriptions of effects relating to species protected under the Endangered Species Act and their designated Critical Habitat (16 U.S.C. § 1532(5); 50 C.F.R. § 424.12) use several terms defined by NOAA Fisheries and U.S. Fish and Wildlife Service. They are as follows:

> **No Effect**: The action would have no direct or indirect effect on the species or ESA Critical Habitat.
>
> **May Affect**, **But Not Likely to Adversely Affect**: All effects of the action on listed species or ESA Critical Habitat would be discountable, insignificant, or completely beneficial. With respect to ESA Critical Habitat, this determination applies if defined essential features of the ESA Critical Habitat are not present or if essential features are present, but the action cannot plausibly affect them.
>
> **Likely to Adversely Affect**: Adverse effects on listed species or ESA Critical Habitat may occur (including take) as a direct or indirect result of the proposed action, and the effects are not discountable, insignificant, or completely beneficial. This determination applies even if the overall effect of the proposed action is beneficial.
>
> **Insignificant Effects**: The action could plausibly affect species, but the effects cannot be meaningfully detected, measured, or evaluated. Any effect would not harm, harass, or otherwise result in take of a listed species. With respect to ESA Critical Habitat, insignificant effects may be temporary or minor, but cannot have a discernible impact on the conservation function of the essential features of the ESA Critical Habitat unit.
>
> **Discountable Effects**: Potential effects that are extremely unlikely to occur.
>
> **Completely Beneficial Effects**: All potential effects that might result to individual plants or animals are positive.

6.2.3.3.1 Threatened and Endangered Species

The current extent of threatened and endangered species within the project is reviewed in *Section 5.1.3.3.1.1 - Endangered Species Act – Listed Species* (page 168 to 182). That section also includes information on reasons for current distribution, reports of mortality (primarily for marine mammals and turtles), and summarizes the threats to the species. The reader is referred to *Chapter 5*; this section on impacts reviews only the impact on the species and does not attempt to cover the material already presented in *Chapter 5*.

Based on initial technical assistance from U.S. Fish and Wildlife Service and NOAA Fisheries, OCM does not anticipate that reserve designation would adversely impact endangered or threatened species potentially present in the study area. During the public comment period supporting development of the *Draft Environmental Impact Statement*, OCM plans to consult with NOAA Fisheries and U.S. Fish and Wildlife Service, pursuant to Section 7 of the ESA (16 U.S.C. § 1536). The results of the consultations would be published in the *Final Environmental Impact Statement* and information summarized herein would be updated, if needed.

If a reserve is designated, OCM would expect reserve staff to work with partners, members of the community, and visitors to ensure they are aware of best management practices to be followed when their activities could impact any threatened or endangered species. Both NOAA Fisheries and U.S. Fish and Wildlife Service distribute BMPs for species under their jurisdiction. Reserve designation could have beneficial effects on species protected under ESA by addressing recovery strategies that align with the proposed reserve's *Final Management Plan*. If a reserve is designated, future federal actions (including actions funded through NOAA cooperative agreements) would be evaluated individually to determine any necessary compliance activities pursuant to applicable mandates, including ESA. A summary of the expected impacts to threatened and endangered species from the range of alternatives analyzed is provided in Table 6-14.

Table 6-14: Impacts to Threatened and Endangered Species

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Threatened and Endangered Species	No effect. No action results in no effect beyond the current status.	Direct and indirect negligible beneficial long-term impact resulting from increased education efforts associated with reserve programming. BMPs protective of species are required, if proposed activities have the potential to impact the species.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

Based on technical assistance from U.S. Fish and Wildlife Service and NOAA Fisheries, OCM has identified a number of species (Table 6-15) listed as threatened or endangered under the ESA that could potentially be affected by the proposed action (even if they are not within the immediate project area). The anticipated effects to threatened and endangered species from reserve designation are summarized in Table 6-15, then discussed in greater detail below.

Table 6-15: Potential Effects of Reserve Designation on Listed Species and Candidates

LISTED SPECIES	POTENTIAL EFFECTS OF RESERVE DESIGNATION
piping plover	May affect, but is not likely to adversely affect.
red knot	May affect, but is not likely to adversely affect.
roseate tern	May affect, but is not likely to adversely affect.

Atlantic sturgeon, New York Bight Distinct Population Segment	May affect, but is not likely to adversely affect.
shortnose sturgeon	May affect, but is not likely to adversely affect.
green turtle, North Atlantic Distinct Population Segment	Completely beneficial effects.
Kemp's ridley turtle	Completely beneficial effects.
leatherback turtle	Completely beneficial effects.
loggerhead turtle, North West Atlantic Distinct Population Segment	Completely beneficial effects.
northern long-eared bat	May affect, but is not likely to adversely affect.
CANDIDATE FOR LISTING	**POTENTIAL EFFECTS OF RESERVE DESIGNATION**
monarch butterfly	May affect, but is not likely to adversely affect.

A. Piping plover (Charadrius melodus) - Threatened

Eight to ten pairs of piping plovers nest at and proximal to Bluff Point Coastal Preserve and Bluff Point NAP and in the vicinity of Roger Tory Peterson NAP at the mouth of the Connecticut River, where approximately eight to ten pairs have nested and likely use the area for foraging.

No Action Alternative

Known piping plover areas are currently cordoned off to prevent the public from intruding on their breeding habitats; this management activity would continue. Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected. Management of the habitat used by this species includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as invasive species control / restoration as needed, and management of human impacts.

Alternatives A, B, C and D

No habitat restoration activities are planned, thus impacts of a reserve designation include the same activities as for the No Action Alternative. Educational programs, monitoring, and signage resulting from reserve activities may enhance direct protection of the species and indirect protection though protection of habitat. Continuing efforts to improve water quality which in turn supports healthy habitats and food sources for this species would be supported by reserve activities, a beneficial impact. Thus reserve designation may affect, but is not likely to adversely affect this species.

B. Red Knot (Calidris canutus) - Threatened

Red knot do not nest in the project area and are only found as uncommon passage migrants in spring and fall. Occurrences within the project area have been documented in the state Natural Diversity Data Base in subtidal areas of the Connecticut River and Roger Tory Peterson NAP and there are additional reports in eBird from Bluff Point Coastal Preserve and Bluff Point NAP (eBird 2021). Red knots are heavily reliant on horseshoe crab eggs as a food source during spring migration.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected. Management of the habitat used by this species includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as invasive species control / restoration as needed and management of human impacts.

Alternatives A, B, C and D

No habitat restoration activities are planned, thus impacts of a reserve designation include the same activities as for the No Action Alternative. Educational programs, efforts to reduce disturbance, and signage resulting from reserve activities may enhance direct protection of the species and indirect protection though protection of habitat. Continuing efforts to improve water quality which in turn supports healthy habitats and food sources for this species would be supported by reserve activities, a beneficial impact. Thus reserve designation may affect, but is not likely to adversely affect this species.

C. Roseate Tern (Sterna dougallii) - Endangered

The vast majority of Long Island Sound’s nesting roseate terns (approximately 1,000 pairs) nest on Great Gull Island off Southhold, NY, off the North Fork of Long Island. A smaller population (approximately 40 pairs) nest at the Falkner Island Unit of the Stewart B. McKinney National Wildlife Refuge off the coast of Guilford, Connecticut. They nest exclusively in larger common tern colonies where adequate cover (rock crevices or artificial shelters) is present for their young to hide. No nesting tern have been observed in the project area.

Foraging habitat includes open waters and embayments with large schools of forage fish, often in cases where the baitfish are chased to the surface by predatory fish from below. Roseate terns range widely in search of their preferred food, American sand lance (*Ammodytes americanus*), and utilize the open water areas of the project area as foraging grounds in the nesting season.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected. Management of the habitat used by this species includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as invasive species control / restoration as needed and management of human impacts.

Alternatives A, B, C and D

No habitat restoration activities are planned, thus impacts of a reserve designation include the same activities as for the No Action Alternative. Research on prey species abundance and distribution, educational programs, and signage resulting from reserve activities may enhance direct protection of the species and indirect protection though protection of habitat. Continuing efforts to improve water quality which in turn supports healthy habitats and food sources for this species would be supported by reserve activities, a beneficial impact. Thus reserve designation may affect, but is not likely to adversely affect this species.

D. Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus) , New York Bight Distinct Population Segment - Endangered

A small breeding population of Atlantic sturgeon has been documented in the Connecticut River and the Connecticut River is federally designated as ESA Critical Habitat (16 U.S.C. § 1532(5); 50 C.F.R. § 424.12) for this species. They are listed in the state Natural Diversity Data Base (DEEP 2021d) as having occurred in subtidal Long Island Sound habitats, subtidal habitats of the Connecticut and Thames Rivers and at Lord Cove Wildlife Management Area, Roger Tory Peterson NAP, DEEP Marine District Headquarters, UConn Avery Point and at Bluff Point CR.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected. Management of the habitat used by this species includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as ensuring fish passage is available for upstream migration, invasive species control / restoration as needed, and management of human impacts.

Alternatives A, B, C and D

No habitat restoration activities are planned, thus impacts of a reserve designation include the same activities as for the No Action Alternative. Research, educational programs and signage resulting from reserve activities may enhance direct protection of the species and indirect protection though protection of habitat. Continuing efforts to improve water quality which in turn supports healthy habitats and food sources for this species would be supported by reserve activities, a beneficial impact. Thus reserve designation may affect, but is not likely to adversely affect this species.

E. Shortnose sturgeon (Acipenser brevirostrum) - Endangered

There is a population of approximately 800 shortnose sturgeon in the Connecticut River, between the mouth and the Holyoke Dam (DEEP 2009c). They are found along the Eastern Seaboard from New Brunswick to northern Florida. The only self-sustaining population in the state is in the Connecticut River. There appear to be two sub-populations in the Connecticut River. One exists above the Holyoke Dam in Massachusetts and ranges as far north as Turners Falls Dam in Massachusetts. The other population ranges from beneath the Holyoke Dam to the estuary in Old Saybrook, Connecticut.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected. Management of the habitat used by this species includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as ensuring fish passage is available for upstream migration, invasive species control / restoration as needed, and management of human impacts.

Alternatives A, B, C and D

No habitat restoration activities are planned, thus impacts of a reserve designation include the same activities as for the No Action Alternative. Research, educational programs, and signage resulting from reserve activities may enhance direct protection of the species and indirect protection though protection of habitat. Continuing efforts to improve water quality which in turn supports healthy habitats and food sources for this species would be supported by reserve activities, a beneficial impact. Thus reserve designation may affect, but is not likely to adversely affect this species.

F. Green Turtle (Chelonia mydas), North Atlantic Distinct Population Segment - Threatened

Green turtles are occasional visitors to Long Island Sound and Fishers Island Sound, represented primarily by immature individuals. Green turtles are listed in the state Natural Diversity Data Base (DEEP 2021d) as having occurred in subtidal habitats of The Sounds, subtidal habitats of the Connecticut and Thames Rivers and at Bluff Point CR.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected. Management of the habitat used by this species includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as efforts to improve water quality which in turn supports good habitat quality, and management of human impacts through education.

Alternatives A, B, C and D

As occasional visitors to Long Island Sound and Fishers Island Sound, no adverse impact of any activity is expected. Continuing efforts to improve water quality which in turn support healthy habitats and food sources for this species would be supported by reserve activities, thus a reserve designation is expected to have completely beneficial effects.

G. Kemp's Ridley Turtle (Lepidochelys kempii) - Endangered

Members of this species are rare but regular visitors to Long Island Sound and Fishers Island Sound, particularly immature individuals. The waters of the project area may be an important nursery area for older juveniles of this species. Kemp's ridley are listed in the state Natural Diversity Data Base (DEEP 2021d) as having occurred in subtidal habitats of The Sounds, subtidal habitats of the Connecticut and Thames Rivers and at Bluff Point CR and Bluff Point NAP.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected. Management of the habitat used by this species includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as efforts to improve water quality which in turn supports good habitat quality, and management of human impacts through education.

Alternatives A, B, C and D

As occasional visitors to Long Island Sound and Fishers Island Sound, no adverse impact of any activity is expected. Continuing efforts to improve water quality which in turn supports healthy habitats and food sources for this species would be supported by reserve activities, thus a reserve designation is expected to have completely beneficial effects.

H. Leatherback Turtle (Dermochelys coriacea) - Endangered

Leatherbacks are rare visitors to Long Island Sound and Fishers Island Sound, often represented by deceased individuals washed ashore or seen floating on The Sounds. It is not known how many of these enter The Sounds alive and die here, or if they drift into The Sounds when already dead. They are a rare but uncommon summer visitor to pelagic waters off the coast of New England. Foraging habitat in our area is typically deeper pelagic waters, though they will venture into estuarine waters.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected. Management of the habitat used by this species includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as efforts to improve water quality which in turn supports good habitat quality, and management of human impacts through education.

Alternatives A, B, C and D

As occasional visitors to Long Island Sound and Fishers Island Sound, no adverse impact of any activity is expected. Continuing efforts to improve water quality which in turn support healthy habitats and food sources for this species would be supported by reserve activities, thus a reserve designation is expected to have completely beneficial effects.

I. Loggerhead Turtle (Caretta caretta), North West Atlantic Distinct Population Segment - Threatened

Loggerheads are occasional summer visitors to Long Island Sound and Fishers Island Sound and are the species most likely to be encountered in The Sounds. Their habitats in our area include shallow to deep open waters. Their diet in our area consists primarily of crustaceans.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected. Management of the habitat used by this species includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as efforts to improve water quality which in turn supports good habitat quality, and management of human impacts through education.

Alternatives A, B, C and D

As occasional visitors to Long Island Sound and Fishers Island Sound, no adverse impact of any activity is expected. Continuing efforts to improve water quality which in turn support healthy habitats and food sources for this species would be supported by reserve activities, thus a reserve designation is expected to have completely beneficial effects.

J. Northern Long-eared Bat (Myotis septentrionalis) – Threatened, possibly in project area

Northern long-eared bats spend winter hibernating in caves and mines, called hibernacula. During the summer, these bats roost singly or in colonies underneath bark, in cavities or in crevices of both live trees and snags (dead trees). As of March, 2019, the closest known hibernacula to the project area was in North Branford; there were no known maternity roost trees in Connecticut (DEEP 2019d). Rhode Island has no known hibernacula because the state lacks caves and mines (DEM n.d.), though more recent evidence suggests that bats may hibernate in underground World War II bunkers[20]. While no hibernacula have been found within New London County, this species has been observed in New London County and Middlesex County, though not within the project area (DEEP 2016a).

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected. Management of the habitat used by this species includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as invasive species control / restoration as needed, and management of human impacts.

Alternatives A, B, C and D

No restoration activities are planned, thus impacts of a reserve designation include the same activities as for the No Action Alternative. Educational programs and signage resulting from reserve activities may enhance direct protection of the species and indirect protection though protection of habitat. Thus reserve designation may affect, but is not likely to adversely affect this species.

K. Giant Manta Ray (Manta birostris) – Threatened, not likely in project area

The nearest sightings of this fish are located at the edge of the continental shelf, 112 miles from Long Island Sound (Halpin et al. 2009).

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected, especially given that this species has not been observed in Long Island Sound. Management of the project area includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as efforts to improve water quality

[20] *Personal communication*, K. Moran (DEEP).

which in turn supports good habitat quality, and management of human impacts through education. While this species is unlikely to occur based on current distribution and movement patterns for the species, these activities will support healthy habitats with the potential to indirectly support this species as part of a healthier New England area (e.g., support of lower trophic level prey species, reduction of pollution).

Alternatives A, B, C and D

No effect, does not occur in the project area and is unlikely to occur here.

L. Oceanic Whitetip Shark (Carcharhinus longimanus) – Threatened, not likely in project area

The nearest sightings of this fish are located off of New Jersey, at the edge of the continental shelf, and in Georges Bank (Halpin et al. 2009).

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected, especially given that this species has not been observed in Long Island Sound. Management of the project area includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as efforts to improve water quality which in turn supports good habitat quality and management of human impacts through education. While this species is unlikely to occur based on current distribution and movement patterns for the species, these activities will support healthy habitats with the potential to indirectly support this species as part of a healthier New England area (e.g., support of lower trophic level prey species and reduction of pollution).

Alternatives A, B, C and D

No effect, does not occur in the project area and is unlikely to occur here.

M. Blue Whale (Balaenoptera musculus) – Endangered, not likely in project area

The majority of sightings in the Northwest Atlantic occur off the coast of Nova Scotia, with a scattering of sightings in the Gulf of Maine (Halpin et al. 2009). The closest sightings to the project area occurred off Newport, RI (one sighting of a single animal in 1998) and south of Montauk, NY (three sightings of single animals in 1989-1990); these sightings were 46 to 65 miles from the project area.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected, especially given that this species has not been observed in Long Island Sound. Management of the project area includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as efforts to improve water quality which in turn supports good habitat quality, and management of human impacts through education. While this species is unlikely to occur based on current distribution and movement patterns for the species, these activities will support healthy habitats with the potential to indirectly support this species as part of a healthier New England area (e.g., support of lower trophic level prey species and reduction of pollution).

Alternatives A, B, C and D

No effect, does not occur in the project area and is unlikely to occur here.

N. Fin Whale (Balaenoptera physalus) – Endangered, not likely in project area

While not occurring within the project area, a large number of sightings have occurred south of Block Island Sound, south of Block Island and Montauk (Long Island), 37 miles from the project area. Closer to Long Island Sound, three sightings on the south side of Fishers Island were recorded, 6.2 miles from the project area: one each in 1985 (two animals), 1990 (11 animals), and 1993 (one animal) (Halpin et al. 2009).

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected, especially given that this species has not been observed in Long Island Sound. Management of the project area includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as efforts to improve water quality which in turn supports good habitat quality, and management of human impacts through education. While this species is unlikely to occur based on current distribution and movement patterns for the species, these activities will support healthy habitats with the potential to indirectly support this species as part of a healthier New England area (e.g., support of lower trophic level prey species and reduction of pollution).

Alternatives A, B, C and D

No effect, does not occur in the project area and is unlikely to occur here.

O. North Atlantic Right Whale (Eubalaena glacialis) – Endangered, not likely in project area

The greatest density of sightings occur in the Gulf of Maine and south to an area southeast of Cape Cod, MA. In 1980, a single whale was sighted just outside of the project area (2 miles), north of Plum Island (Halpin et al. 2009). Beyond that single sighting, a few sightings have occurred southeast of Montauk, NY, 30 to 50 miles from the project area: eight sightings in total with six sightings (one to two animals) in 1986-1988, one sighting (one animal) in 1993, and one sighting (two animals) in 2015. This species is unlikely to occur in the project area (NOAA Fisheries 2021f).

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected, especially given that this species has not been observed in Long Island Sound. Management of the project area includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as efforts to improve water quality which in turn supports good habitat quality and management of human impacts through education. While this species is unlikely to occur based on current distribution and movement patterns for the species, these activities will support healthy habitats with the potential to indirectly support this species as part of a healthier New England area (e.g., support of lower trophic level prey species and reduction of pollution).

Alternatives A, B, C and D

No effect, does not occur in the project area and is unlikely to occur here.

P. Sei Whale (Balaenoptera borealis) – Endangered, not likely in project area

The vast majority of sightings of this whale occur on and around Georges Bank with a much smaller cluster of sightings south of Martha's Vineyard, MA. The nearest sightings were south of Long Island, 30 to 40 miles outside of Long Island Sound (Halpin et al. 2009); six sightings of single animals have been recorded in this area, four in 1981-1982, and one each in 2003 and 2017.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected, especially given that this species has not been observed in Long Island Sound. Management of the project area includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as efforts to improve water quality which in turn supports good habitat quality and management of human impacts through education. While this species is unlikely to occur based on current distribution and movement patterns for the species, these activities will support healthy habitats with the potential to indirectly support this species as part of a healthier New England area (e.g., support of lower trophic level prey species and reduction of pollution).

Alternatives A, B, C and D

No effect, does not occur in the project area and is unlikely to occur here.

Q. Sperm Whale (Physeter macrocephalus) – Endangered, not likely in project area

Most sightings of this whale happen at the edge of the continental shelf, 115 miles from Long Island Sound. The closest sightings to the project area occurred east of Block Island and south of Long Island, both approximately 40 miles from the project area. Three sightings occurred east of Block Island, one sighting in 1981 (eight animals) and two sightings in 2015 (two animals per sighting). A cluster of sightings occurred in 1987, south of Long Island, with four sightings of four animals per most sightings. This same area had two sightings in 1992 (four animals per sighting) (Halpin et al. 2009).

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected, especially given that this species has not been observed in Long Island Sound. Management of the project area includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as efforts to improve water quality which in turn supports good habitat quality and management of human impacts through education. While this species is unlikely to occur based on current distribution and movement patterns for the species, these activities will support healthy habitats with the potential to indirectly support this species as part of a healthier New England area (e.g., support of lower trophic level prey species and reduction of pollution).

Alternatives A, B, C and D

No effect, does not occur in the project area and is unlikely to occur here.

R. Monarch Butterfly (Danaus plexippus) – Candidate for Listing

Monarch butterflies rely on areas where common milkweed (*Asclepias syriaca*) is growing, in order to lay eggs such that their offspring have a source of nutrition upon hatching (Rondeau 2020). Common milkweed grows in sandy, clayey, or rocky soils. It occurs along the banks or flood plains of lakes, ponds, and waterways, in prairies, forest margins, roadsides, and waste places (USDA NRCS 2021).

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to this species are expected. Management of the habitat used by this species include efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as invasive species control / restoration as needed, and management of human impacts.

Alternatives A, B and D

No restoration activities are planned, thus impacts of a reserve designation include the same activities as for the No Action Alternative. Educational programs and signage resulting from reserve activities may enhance direct protection of the species and indirect protection though protection of habitat. Thus reserve designation may affect, but is not likely to adversely affect this species.

Alternative C

This alternative largely lacks the habitat supportive of milkweed, and by extension, monarch butterflies. Thus designation of this alternative would have no effect on the species.

6.2.3.3.2 Other Marine Mammals

There is no mention of plans for any marine mammal research or monitoring in the *Draft Management Plan* for the proposed CT NERR. However, there are a number of marine mammals that could occur in Long Island Sound or Fishers Island Sound. *Chapter 7* describes the responsibilities and restrictions that apply to persons and federal entities, respectively, with species protected under the ESA and the restrictions under the Marine Mammal Protection Act (MMPA) with respect to human interactions with any marine mammal. The MMPA makes it unlawful for any person subject to the jurisdiction of the United States to take (meaning to hunt, harass, capture, or kill) any marine mammal within U.S. waters or on the high seas (16 U.S.C. § 1372(a)). This MMPA no-take prohibition further defines harassment a as "any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering" (16 U.S.C. § 1362(13); (18)(A)). There are some exceptions to the prohibitions, including for directed research on marine mammals and a mechanism for obtaining authorization from NOAA Fisheries for "incidental," but not intentional, taking, of small numbers of marine mammals.

As discussed above, there exist a number of marine mammal species that are protected under the Endangered Species Act that could be present in Long Island Sound or Fishers Island Sound. Species discussed above in the section on Threatened and Endangered Species are not specifically addressed in this section. Rather, this section analyzes the potential effects of the alternatives on other marine mammal species that could be present in the project area.

The current extent of marine mammal species within the project is reviewed in *Section 5.1.3.3.1.3 - Other Marine Mammals* (page 192 to 198). That section also includes information on reasons for current distribution, reports of mortality, and summarizes the threats to each species. The reader is referred to *Chapter 5*; this section on impacts reviews only the impact and does not attempt to cover the material already presented in *Chapter 5*. According to NOAA Fisheries, the following marine mammals may be present in Long Island Sound or Fishers Island Sound:

- Atlantic white-sided dolphin (*Lagenorhynchus acutus*)
- common bottlenose dolphin (*Tursiops truncatus*)
- gray seal (*Halichoerus grypus atlantica*)
- harbor porpoise (*Phocoena phocoena*)
- harbor seal (*Phoca vitulina*)
- harp seal (*Pagophilus groenlandicus*)
- hooded seal (*Cystophora cristata*)
- humpback whale (*Megaptera novaeangliae*)

A summary of the expected impacts to unlisted marine mammals covered under the MMPA from the range of alternatives analyzed is provided in Table 6-16.

Table 6-16: Impacts to Other Marine Mammals

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Other Marine Mammals	No changes to human-marine mammal interactions in the project area. Restrictions under the MMPA make it unlikely that marine mammals will be taken in the project area. Improved water quality leads to improved habitat, greater food resources, and reduction in pollutants. Results are direct & indirect, minor, beneficial and long-term. The dredge material disposal site poses direct and indirect moderate adverse short-term impacts.	Same as No Action Alternative, with a greater coverage area than Alternatives B and C. Includes a dredge material disposal site which may have direct moderate adverse, short-term impacts when in use.	Same as No Action Alternative, with a lesser coverage area than Alternatives A and D. Lacks the dredge material disposal site of Alternative A.	Same as No Action Alternative, with a greater coverage area than Alternatives B and C. Lacks the dredge material disposal site of Alternative A.	Same as No Action Alternative, with a lesser coverage area than Alternatives A and D. Lacks the dredge material disposal site of Alternative A.

No Action Alternative

The MMPA already provides protection of The Sounds' marine mammals. Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. Indirect minor beneficial impacts to marine mammals are expected to have occurred as a result of improving water quality in Long Island Sound and Fishers Island Sound. Management of the project area includes efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as efforts to improve water quality which in turn supports good habitat quality, and management of human impacts through education. These activities support healthy habitats with the potential to indirectly support marine mammals as part of a healthier New England area (e.g., support of lower trophic level prey species, reduction of pollution).

The project area includes an active dredge material disposal site which has a direct impact via sediment in the water column and disturbance (noise, vessel traffic) to the area and an indirect impact on habitats and food resources associated with the disposal area. Impacts are mitigated through the use of BMPs and activities are governed by applicable permits and approvals.

Alternative A

The designation of a reserve using this alternative would have the same impact as for the no action alternative. This alternative includes rock clumps not included in Alternatives B and C, and thus impacts for seals may be more extensive. These rock clumps are used by seals for hauling out.

Alternatives B and C

The designation of a reserve using either of these alternatives would have the same impact as for the no action alternative but without the adverse impact associated with the dredge material disposal site. These two alternatives lack the rock clumps included in Alternatives A and D, and thus impacts for seal may be less extensive. Rock clumps are used by seals for hauling out.

Alternative D

The designation of a reserve using this alternative would have the same impact as for the no action alternative but without the adverse impact associated with the dredge material disposal site.

6.2.3.3.3 Essential Fish Habitat

As described in *Chapter 5 - Affected Environment*, all or portions of the project area have been designated as essential fish habitats for 19 species. In addition, the project area has been designated as a Habitat Area of Particular Concern (HAPC) for summer flounder. For more information about the Magnuson-Stevens Fishery Conservation and Management Act and EFH consultation requirements, see *Chapter 7*. In brief, federal agencies must consult NOAA Fisheries regarding actions proposed, authorized, funded, or undertaken that may adversely affect (i.e., reduces the quality or quantity of) EFH. A summary of the expected impacts to essential fish habitat from the range of alternatives analyzed is provided in Table 6-17.

No Action Alternative

The marine water column and seafloor in Long Island Sound and Fishers Island Sound, including all or part of the project area (depending on species), have been designated as EFH for 19 species and as HAPC for summer flounder. The above discussions of the no action alternative, estuarine habitats, flora, and fauna summarize the types of impacts on the project area from existing activities. Because that information is presented above, it is not summarized again here.

No planned activities which would impact EFH are included in the management plan nor are any known activities by partners planned at this time. Since an adverse effect on EFH is defined as any reduction in the quality or quantity of EFH, it is likely that there also are and would be adverse effects from ongoing and planned non-federal actions to EFH under the no action scenario (EFH consultation provisions only apply to federal actions.) It is beyond the scope of this analysis for OCM to provide a more thorough analysis of the impacts to EFH of activities under the no action alternative.

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. Management of the habitat used by these species include efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as invasive species control / restoration as needed, and management of human impacts.

Table 6-17: Impacts to Essential Fish Habitat

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Essential Fish Habitat	No impacts beyond those contributing to the current baseline. For information about the current baseline, see preceding sections on the estuarine environment.	Reserve designation and approval of the management plan are not expected to adversely affect EFH. There is insufficient information at this time to determine whether future in-water activities at the reserve would have any adverse effects on EFH. After federally supported projects within EFH are proposed and at other appropriate times, OCM would consult with NOAA Fisheries, when needed, to avoid, minimize, or offset any adverse effects on EFH. Installation of equipment may pose a direct minor adverse short-term impact.	Impacts would be similar to those in Alternative A, but within a smaller area correspond ing to the boundary of this alternative.	Same as Alternative B.	Same as Alternative A.

Alternatives A and D

Reserve designation and approval of the reserve management plan would not in and of themselves be expected to adversely affect EFH. OCM would review potential future activities that are federally funded or federally authorized to determine whether future activities associated with reserve implementation may adversely impact EFH. At this time, there is insufficient information to determine whether future in-water activities at the reserve would have any adverse effects to EFH, but some potential methods for securing access to and placement of equipment or personnel have the potential to adversely affect EFH, depending on how they are implemented. What is known is that designating a reserve would result in installing monitoring (and potentially other) equipment in support of research efforts. It has not been determined where and how equipment needed for research and monitoring would be installed. If a reserve is designated, reserve staff and partners would need to determine what in-water activities to propose and whether there is a need for equipment to be anchored in Long Island Sound or Fishers Island Sound (and whether that would require new moorings or could use existing moorings, pilings or piers). Because of the requirements of the Magnuson-Stevens Fishery Conservation and Management Act, reserve staff would be expected to seek options that would minimize or avoid potential adverse effects to EFH. Similarly, the specific details associated with future education, research, restoration and other efforts are unknown, so their potential impacts to EFH cannot be evaluated at this time. Once specific activities are proposed, they would be subject to environmental compliance reviews.

These alternatives would be likely to have some direct and indirect minor beneficial long-term impacts on EFH because the alternatives would result in enhanced coordination and scientific knowledge associated with restoring and enhancing EFH. After projects that are to be federally authorized, funded, or undertaken are proposed (and at other appropriate times), OCM would assess potential effects to determine whether consultation with NOAA Fisheries is needed and then initiate dialogue, as necessary. Information gleaned from EFH consultations would allow partners to avoid, minimize, or offset any adverse effects on EFH.

Alternatives B and C

Potential effects on EFH under Alternatives B and C are expected to be quite similar to those described for Alternatives A and D, but under Alternatives B and C, they would extend across a smaller area.

6.2.3.3.4 Migratory Birds

OCM analyzed potential effects of the alternatives on migratory birds. A summary of the expected impacts to migratory birds from the range of alternatives analyzed is provided in Table 6-18.

The Migratory Bird Treaty Act (MBTA) prohibits the take of migratory birds unless it is exempted by USFWS (16 U.S.C. §§ 703–704). In addition, USFWS can offer recommendations related to projects undertaken or funded by federal agencies. USFWS typically offers recommendations at the same time as it comments on Endangered Species Act consultation letters (*Chapter 7*). OCM will send out a consultation letter during the public comment period for the *Draft Environmental Impact Statement* and will identify any recommendations USFWS offers with respect to migratory birds in the *Final Environmental Impact Statement*. Nationwide standard conservation measures are provided by USFWS (USFWS n.d.).

No Action Alternative

Historically, development patterns, habitat alteration, and other human activities may have adversely affected the suitability of the areas along the coast of Long Island Sound and Fishers Island Sound for migratory birds. Most migratory birds that nest in the project area will likely nest on uninhabited islands, where there are fewer stressors, such as domesticated or feral animals and human interactions. Certain migratory birds sometimes forage in and along the project area. OCM's research indicates that feeding within the study area will be more likely than nesting. Under the no action alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. Restoration projects, as yet unplanned, could have potential beneficial impacts to any migratory birds for which the habitat is suitable for feeding or other behaviors. Other human activities in the study area could have minor to moderate direct or indirect adverse effects to foraging habitats for migratory birds, but would not be expected to cause direct migratory bird take. Future changes to migratory bird populations or ranges could result from larger regional or global factors, such as climate change.

Table 6-18: Impacts to Migratory Birds

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Migratory Birds	A range of human activities could have direct or indirect minor to moderate adverse effects on foraging habitats for migratory birds, but would not be expected to cause direct migratory bird take. Restoration of some environments (as yet unplanned) could benefit any migratory birds for which the habitat is suitable.	Reserve operation could have indirect, negligible adverse effects or negligible to minor beneficial effects on migratory birds, but would not be expected to cause migratory bird take. Potential indirect, minor beneficial benefits to migratory birds due to reserve education, monitoring, research and restoration projects that enhance their habitat. Potential negligible adverse effects from increased human use.	Same as Alternative A, although this alternative includes a smaller land area.	Same as Alternative A.	Same as Alternative B.

Alternatives A, B, C and D

Reserve operation could have negligible, indirect, adverse effects, or negligible to minor beneficial effects to migratory birds, depending on how exactly the reserve operations proceed. No new restoration or alteration of habitats suitable for migratory birds has been proposed under the reserve management plan. However, these activities could be catalyzed by reserve designation. Additional visitor use from reserve designation would not have any more than negligible adverse effects to migratory birds because the only migratory birds known to use the area forage, but do not nest, in the areas considered for inclusion within the reserve. If disturbed while they are foraging, birds could temporarily forage elsewhere until visitors leave the area. No migratory bird take would be expected to result from reserve operation, as described under the management plan. Potential impacts from future federal actions related to developing facilities for reserve staff and visitors, installing monitoring platforms or other reserve infrastructure, or otherwise addressing research needs would be analyzed once proposed to assess effects on migratory birds and ensure that they do not cause migratory bird take. Technical assistance and other support provided by the reserve and its affiliates for research, monitoring, education, and restoration projects related to migratory birds and their habitat could result in indirect, minor benefits to migratory birds. This is especially true if this support leads to incorporating additional ways to protect migratory birds into the proposed CT NERR's operational plans.

6.3 Human Environment

6.3.1 Cultural and Historic Setting

6.3.1.1 Cultural and Historic Resources

As described in *Chapter 5 - Affected Environment*, the project area and its immediate vicinity contain a diversity of cultural and historic resources including historic districts, lighthouses, shipwrecks, and archaeological sites. The project area itself contains two State Archaeological Preserves, and an archaeological excavation was conducted at a pre-historic site within the project area. Holocene-era sediments have been identified in Long Island Sound which may suggest possible archaeological areas as they may contain evidence of the early inhabitants of the Long Island Sound region.

Threats to cultural and historic resources may include anthropogenic impacts such as development or site disturbance, as well as from climate change – sea level rise in particular.

A summary of the expected impacts to cultural and historic resources from the range of alternatives analyzed is provided in Table 6-19.

Table 6-19: Impacts to Cultural and Historic Land Use

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Cultural and Historic Resources.	No direct or indirect impacts.	Minor, long-term indirect beneficial impacts from equity-related initiatives.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected under current regulations and policies and managed by the various site partners using current practices. No direct or indirect impacts (beneficial or adverse) to the cultural and historic resources of the area are expected.

Alternatives A, B, C and D

All alternatives include the traditional lands of the Mashantucket Pequot Tribal Nation, Mohegan Tribe, Western Nehântick Tribal Nation, Hammonasset Tribe, Wappinger Tribe, and Wangunks Tribe. Additionally, under all alternatives, the *Draft Management Plan* interweaves concepts of justice, equity, diversity, and inclusion throughout its programmatic areas. As such, efforts to reach out to and engage indigenous populations may serve to provide minor, long-term indirect beneficial impacts that may arise from increased awareness and interest in aspects of cultural and historic land use.

6.3.2 Human and Economic Setting

6.3.2.1 Population - Including Environmental Justice

As described in *Chapter 5 - Affected Environment*, during the five-year period form 2014-2018, the Norwich / New London region population numbered 268,881, with a density of roughly 404 people per square mile. There were 107,402 households, with an average size of 2.4 people. There was nearly an even split between males and females. The median age was 41.4 years, with approximately 20% of the population under 18 years, 34% between 18 to 44 years, 29% between 45 to 64 years, and 17% over 65.

For people reporting one race alone, 80.7% were White, 5.8% were Black or African American, 0.6% were American Indian and Alaska Native, 4.1% were Asian, 0.0% were Native Hawaiian and Other Pacific Islander, and 3.3% were some other race. An estimated 5.3% reported two or more races. An estimated 10.6% of the people were Hispanic. An estimated 75.7% of the people were White non-Hispanic. People of Hispanic origin may be of any race.

An estimated 92% of the Norwich / New London population were U.S. natives. Of the roughly 8% of foreign-born residents, nearly 75% come from Asia and Latin America with Europe, Africa, Northern America, and Oceania making up the remaining percentage.

The Environmental Justice movement has emerged in response to a growing body of evidence nationally and statewide indicating that low income; racial and ethnic minority groups may be exposed to higher than average amounts of environmental pollution (DEEP 2021g). The term "environmental justice community" is defined by the Connecticut Department of Economic and Community Development as the state's 25 most fiscally and economically distressed municipalities and is used by state agencies to target funds for needs such as housing, insurance, open space, brownfield remediation and economic development programs, among others. As of 2020, there were seven communities in Norwich / New London that are listed. None of the communities in the project area in Middlesex County were identified as distressed communities. A summary of the expected impacts to the human population from the range of alternatives analyzed is provided in Table 6-20.

Table 6-20: Impacts to Human Population

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Population	No direct or indirect impacts.	Minor, short-term, direct adverse impacts.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

No Action Alternative

Under this alternative, no direct or indirect impacts (beneficial or adverse) to the area's population are anticipated, and the lands and waters of the area would continue to be protected and managed by the various site partners currently.

Alternatives A, B, C and D

As outlined in the proposed CT NERR *Draft Management Plan* specific estuarine research, education, and stewardship activities are expected to occur within all alternatives. Additional traffic increases may be anticipated as a result of adults and school groups participating in reserve education and outreach programming. While boat congestion is unlikely, given parking constraints among all the locations, short-term, minor, direct adverse impacts to the area's population may be expected. Potential benefits include increasing public access to the shoreline, free programming, and research opportunities for underrepresented individuals supported by internship initiatives (see *Draft Management Plan*, available in Appendix A). A potential threat to these communities posed by the reserve designation is gentrification as the area becomes more recognized / desirable due to increased environmental quality and opportunities resulting from successful reserve activities and programing.

6.3.2.2 Employment

As described in *Chapter 5 - Affected Environment,* approximately 60% of the population 16 and over were employed across a variety of industries, with educational / healthcare, entertainment / recreation, manufacturing, and retail trade comprising nearly two-thirds (63%). Of those employed, nearly 80% were private wage and salary workers, 15% were federal, state, or local government workers, and 5% were self-employed in their own (not incorporated) business. Several large employers include General Dynamics Electric Boat, Pfizer, US Foods, Lawrence Memorial and Backus Hospitals, and the casinos at Foxwood and Mohegan Sun (CT.gov 2021).

The median income of households in Norwich / New London was $71,368. An estimated 4.9% of households had income below $10,000 a year and 7.5% had income of $200,000 or more. A summary of the expected impacts to employment from the range of alternatives analyzed is provided in Table 6-21.

Table 6-21: Impacts to Employment

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Employment	No direct or indirect impacts.	Minor beneficial impact from the hiring of reserve staff to support the implementation of reserve programs and activities. Negligible, long-term, direct beneficial impacts from new employment opportunities in fields dependent on well-functioning ecosystems.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) to employment in the area are expected. Future changes to area employment could occur because of changes in the size and activities of the area's largest employers or other factors that are independent of the local employment conditions.

Alternatives A, B, C and D

Designation of a reserve under all alternatives and implementation of the proposed CT NERR *Draft Management Plan* is expected to have minor long-term beneficial impacts to employment in the project area. The initial hiring of up to five reserve staff to implement the programs and activities described in the *Draft Management Plan* is expected to have the most direct impact to employment.

In the long-term, the reserve's activities to help address current watershed, water quality, habitat, and other local coastal management issues, as well as facilitating a better understanding of stewardship practices and an emphasis on developing environmental awareness, could lead to new employment opportunities in natural resources (i.e., fishing and aquaculture), ecotourism, and other fields dependent on a well-functioning estuarine ecosystem. Overall, these beneficial impacts to the employment of the project area are expected to be negligible and indirect over the long-term.

6.3.2.3 Regional Economics

As described in *Chapter 5 - Affected Environment*, the regional economic picture is broken down by the two major counties in the project area, Middlesex and New London. More rural Middlesex County, as of 2016 (Ninigret Partners and Fitzgerald & Halliday Inc. 2016), is home to approximately 4,100 businesses the majority being small and mid-sized companies (52% having less than 4 employees and 25% with between 10 and 100 employees). The overall economic landscape is subset into four distinct economies, in order of importance they are manufacturing / trade, local (healthcare / social services / government), lifestyle, and tourism. More urbanized New London County, as of 2017 is categorized into the following economic clusters, in descending order as a percentage of regional economy: tourism (19%), healthcare services (14%), defense contracting (13%), energy (3%), and bioscience (2%). Food services / production, arts, advanced manufacturing, and maritime industries; each contribute roughly 1% (The Southeastern Connecticut Enterprise Region et al. 2017). A summary of the expected impacts to regional economics from the range of alternatives analyzed is provided in Table 6-22.

Table 6-22: Impacts to Regional Economics

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Regional Economics	No direct or indirect impacts.	Negligible, indirect, long-term beneficial impacts.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) on the regional economy of the area (Middlesex and New London counties) are expected. Any potential future changes to the regional economy are expected to be the result of larger regional and global factors or other changes to local economic conditions.

Alternatives A, B, C and D

Under all alternatives, the designation of the proposed CT NERR's education, research, and training programs is expected to bring additional visitors (e.g., researchers, students, interested members of the public, etc.) to the site who are likely to patronize business establishments within the vicinity. This is anticipated to have negligible, indirect, beneficial impacts on the local economy over the long term.

6.3.3 Current Human Uses

6.3.3.1 Tourism and Recreation

As described in *Chapter 5 - Affected Environment*, current land-based and shore-centric human-use activities within the project area vary and can range from hiking, biking, swimming, pleasure boating / kayaking, diving, etc. Note that recreational fishing and shellfishing are covered in later sections.

Tourism in New London County makes up 19% of the regional economy with 27,430 jobs in 2016 (increasing to 28% if estimated 13,232 jobs related to the gaming industry are included) (The Southeastern Connecticut Enterprise Region et al. 2017). The region has considerable recreational amenities including three locations boasting millions of annual visitors: Mystic Aquarium, Mystic Seaport, and Olde Mistick Village. It is also home to two world renowned resort casinos both with retail outlets, historic sites and a new unique Heritage Park, numerous accommodations and diverse food service businesses, and outdoor and indoor recreational opportunities. The project area does include two state parks, which provide numerous avenues for active and passive recreation. Within Middlesex County, tourism focuses on assets surrounding culture, water-centric activities, and natural resources. General estimates suggest this economy supports 5,000 to 7,000 jobs (Ninigret Partners and Fitzgerald & Halliday Inc. 2016). The project area includes many specific locations designated as wildlife management areas or natural area preserves. These provide some measure of passive recreational opportunities, but are primarily managed to ensure sustainable habitat for wildlife. A summary of the expected impacts to tourism and recreation from the range of alternatives analyzed is provided in Table 6-23.

No Action Alternative

Under this alternative, project area lands and waters would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) on tourism and recreation within the area are expected. Future changes to tourism and recreation will be expected to be the result of targeted regional or state-wide efforts to boost tourism related activities within Middlesex and New London Counties.

Table 6-23: Impacts to Tourism and Recreation

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Tourism and Recreation	No direct or indirect impacts.	Negligible, long-term beneficial impacts to tourism; minor short-term, direct adverse impacts to recreation.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

Alternatives A, B, and D

Under these alternatives, the lands and waters of the proposed CT NERR would continue to be protected and managed by the various site partners. As a site within the larger national network of the Reserve System, knowledge of the proposed CT NERR is expected to increase at the national level. As a result, greater visibility of the reserve could potentially provide direct beneficial long-term impacts to tourism and recreation (including boating, sailing, and diving). However, these are likely negligible.

As outlined in the proposed CT NERR *Draft Management Plan*, specific estuarine research, education, and stewardship activities are expected to occur within all alternatives. Additional traffic increases may be anticipated because of adults and school groups participating in reserve education and outreach programming. This impact would be on the order of magnitude of a few dozen additional automobiles at the sites during relatively infrequent events or the presence of one or two buses a few dozen times throughout the year. Given this level of use, impacts to air quality are very likely to be undetectable. While boat congestion is unlikely, given automobile parking constraints among all the locations, short-term, minor, direct adverse impacts to recreation may be expected.

Alternative C

This alternative shares the same impacts as Alternatives A, B and D relative to tourism. However Alternative C contains no state parks designed to handle recreation as a primary operational component. As a result, the overall recreational opportunities are lessened. Additional traffic and use by adults and school groups participating in reserve education and outreach programming may increase by a few dozen automobiles at the sites during relatively infrequent events or the presence of one or two buses a few dozen times throughout the year. Given this level of use, impacts to air quality are very likely to be undetectable. Any boat or automobile-related traffic congestion is likely to have negligible short-term direct adverse impacts to recreation.

6.3.3.2 Education

As described in *Chapter 5 - Affected Environment*, the region surrounding the proposed CT NERR is home to an economically- and culturally-diverse mix of people. Communities range widely in permanence, from North America’s oldest Indian Reservation (the Mashantucket Pequot) to Ledyard and Groton, which experience high population turnover each year because of personnel movement into and out of Naval Submarine Base New London, Groton, CT. The cities of New London, Norwich, and Groton are ethnically diverse, with higher poverty rates relative to surrounding towns, while towns such as Lyme and Old Saybrook are relatively wealthy and homogenous. Despite this diversity, communities in this region are connected by the estuary they share, and by common vulnerabilities to climate change and related environmental hazards.

The proposed CT NERR provides many opportunities for education and interpretation, including opportunities that would integrate research and stewardship activities affecting Long Island Sound's and Fishers Island Sound's estuaries and their watersheds. The area is attractive for short- and long-term educational opportunities as it continues to demonstrate a presence of multiple uses, and has existing and potential opportunities with local organizations.

The area has a long history of education and interpretation – both Bluff Point and the Connecticut River marshes are regular locations for school field trips and formal and informal nature programs, and submerged lands in both watersheds support active education and citizen science programs focused on water quality, aquatic ecosystems, and benthic communities. A summary of the expected impacts to education from the range of alternatives analyzed is provided in Table 6-24.

Table 6-24: Impacts to Education

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Education	No direct or indirect impacts	Moderate long-term direct and indirect beneficial impacts	Minor long-term direct and indirect beneficial impacts	Same as Alternative B	Same Alternative A

No Action Alternative

Under the no action alternative, there would be no changes to the local partners' existing or planned activities and areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. Similarly, local partners' ongoing education and outreach efforts within the study area would persist. Therefore, no direct or indirect impacts are expected.

Alternatives A and D

As described in the *Draft Management Plan*, the proposed CT NERR would strive to achieve a number of goals and objectives in the first five years of operation. The *Draft Management Plan* identifies three main goals for the site, two of which relate to education, and are stated as follows:

Goal 2: Strengthen stewardship, protection, and management of estuaries and their watersheds through place-based approaches to training and education

Goal 3: Advance environmental appreciation and scientific literacy utilizing a place-based approach, enhancing people's ability to make science-based decisions that positively affect estuaries, watersheds, and coastal communities.

To achieve these, the plan identifies the following objectives:

- Educate the next generation of environmental stewards and environmentally literate citizens by providing hands-on, experiential, place-based learning opportunities in the NERR to students and teachers, particularly those from underserved and environmental justice communities.
- Promote environmental stewardship, environmental literacy, and science-based management and decision-making across a wide diversity of sectors, including businesses, municipalities, and the public.

With the existence of several independently organized educational programs in the area, the reserve would be expected to help the partners collaborate on and integrate their educational programs. In the long-term, it is expected that the reserve would build upon the existing resources, expertise, and facilities to create comprehensive educational programs that span the learning continuum and allow students to explore resource management and science research. Additionally, the reserve is expected to develop and implement the Reserve System's national educational programs such as K-12 Estuary Education Program (KEEP) and Teachers on the Estuary (TOTE) program. These additional educational efforts are expected to have moderate beneficial long-term direct and indirect impacts to educational resources through the development of new programs, reductions in program duplication across partners, improved efficiencies through collaboration and coordination, and the ability to leverage place-based locations in both New London and Middlesex counties that can be accessible to the largest number and widest range of student socio-economic classes.

Alternative B and C

As described in Alternatives A and D, the proposed CT NERR would still seek to implement the goals and objectives as stated, as well as partner with and collaborate with existing educational programs in the area to achieve the same outcomes and to implement the NERR national KEEP and TOTE programs. However, while the overall project area does include the same number and range of student socio-economic classes, this alternative lacks a place-based location within New London county. As a result, the proposed CT NERR may have more barriers (greater distances, additional transportation costs and logistics, etc.) to making place-based learning opportunities readily available to underserved and environmental justice communities. Thus, impacts to education may be expected to be minor beneficial, long-term, direct and indirect.

6.3.3.3 Research and Monitoring

As described in *Chapter 5 - Affected Environment*, the project area offers excellent opportunities for long-term research. The project area overall contains a mosaic of upland as well as transitional and subtidal habitats situated proximal to a variety of coastal uses, including significant recreational fishing and commercial and recreational boating. Alternatives A and D include developed waterfronts at the mouth of the Thames River as well as recreational and commercial shellfishing and aquaculture that are absent from Alternatives B and C.

This combination of resources and uses is reflected in a broad examination of research activities found in the both peer-reviewed and grey literature conducted to support the NERR Site Selection process. This meta-analysis identified close to 200 papers or projects on topics ranging from tidal wetland restoration, vegetative assessments, species predation patterns, population dynamics, invasive species identification and control, climate change, water quality impacts, nutrient loading effects, etc. The offshore areas of Long Island Sound and Fishers Island Sound have supported long-term research and monitoring efforts for physical oceanography, water quality, benthic habitats, and fisheries assessments.

The UConn Avery Point campus is in close proximity to the natural habitats, minutes from Bluff Point by car or boat, and not much further to the lower Connecticut River. This campus provides world-class facilities and resources. As such, there are multiple opportunities and support for crucial research regarding estuary habitat dynamics, long-term ecosystem monitoring and trend analyses, as well as emergent areas of climate change, aquaculture best practices, etc.

The site also creates valuable opportunities for comparative research with other nearby estuary systems both within the Reserve System (e.g., Narragansett Bay) and without (e.g., numerous scientific and citizen science groups working in other areas of the Connecticut coast.) The existing research institutions, organizations, research efforts, institutional collaborations, and partnerships offer a tremendous opportunity to further leverage resources, partnerships, and expertise in a synergistic manner.

A summary of the expected impacts to research and monitoring from the range of alternatives analyzed is provided in Table 6-25.

Table 6-25: Impacts to Research and Monitoring

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Research and Monitoring	Sustained research interest in the affected environment and associated habitats.	Major, long-term, direct, beneficial impacts to research and monitoring in the affected environment.	Same as Alternative A, but over a less diverse range of upland habitat types.	Same as Alternative B.	Same as Alternative A.

No Action Alternative

Under the no action alternative, there would be no changes to the local partners' existing or planned activities and areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. Similarly, local partners' ongoing research and monitoring efforts within the study area would persist. Largely because of the University of Connecticut's presence on Long Island Sound, the affected environment has been, and will continue to be, an area that attracts substantial research attention. In addition to UConn's broad research and monitoring interests and efforts in the coastal and estuarine areas of the affected environment, various divisions of CT DEEP have conducted various research and monitoring efforts relating to wildlife, habitat management, and coastal restoration. Refer to the *Draft Management Plan Section 11 - Reserve System Program Foundations* for additional information on these and other organization's research related efforts.

Alternatives A and D

Based on the experience and capacity of the 29 other sites included within the National Estuarine Research Reserve System, the designation of a research reserve would likely result in long-term, direct, major beneficial impacts to research and monitoring in the affected environment. As part of the national system of estuarine research sites, each reserve contributes to a nationwide effort of collecting long-term water quality, biotic, physical, and land use and habitat change information that represents an unprecedented effort to compare data across a network of sites.

As described in the *Draft Management Plan*, upon designation, the reserve would strive to achieve several goals and objectives in the first five years of operation. The *Draft Management Plan* identifies three main goals for the site, one of which relates to research and monitoring, and is stated as follows:

Goal 1: Increase our understanding of the effects of human activities and natural events to improve informed decision making and support adaptive management of coastal ecosystems.

To achieve this goal, the plan identifies four objectives:

- improve opportunities to support and conduct basic and applied research within the Reserve;
- contribute to status and trends assessments and forecasting of environmental quality by tracking short-term variability and long-term changes in abiotic and biological parameters within the Reserve through establishment of the System Wide Monitoring Program (SWMP);
- encourage and assist in a multi-agency approach to research, monitoring, and science-based ecosystem management; and
- provide coastal resource managers, the scientific community, and general education practitioners with appropriate scientific and technical information to foster informed decision-making.

Under these alternatives, the proposed CT NERR's research and monitoring programs would help facilitate increased knowledge and understanding of a wide range of intertidal, upland and subtidal habitats, based on expanded and more granular data generated which would characterize baseline conditions, and short and long-term ecological trends at multiple locations in the Connecticut River area as well as the Thames River / Groton area. Most of this information would not be produced in the absence of a reserve designation. Improved localized data such as those collected from the SWMP's instruments provide researchers and managers with valuable information on water quality and weather at near-real time intervals. Local coastal managers can use this timely, site-specific monitoring data to make informed coastal management decisions on issues of local or regional relevance.

In addition, reserve staff could play a key role in coordinating external research and monitoring efforts occurring throughout the site. Thus, reserve designation could improve the collection of data and distribution of results of these efforts in addition to Reserve-centric projects.

Alternative B and C

These alternatives would have the same overall impact as described in Alternatives A and D. However, the habitat composition is less diverse resulting in research and monitoring that is less diverse, though not necessarily less impactful. Alternative B lacks coastal bluffs, beaches, a sea-level fen, a poor fen, and coastal forests, though it does include riverine based wooded uplands. Alternative C lacks coastal bluffs, beaches, sea-level fen, poor fen, and forested or wooded uplands.

6.3.3.4 Transportation, Navigation, and Infrastructure

As described in *Chapter 5 - Affected Environment*, the lower Thames River area includes large-scale commercial and industrial water-dependent uses that reflect its location as a center of maritime focus, and a small regional public airport that also supports an Army National Guard Aviation Maintenance Group. The area of the lower Connecticut River is less industrialized but also has several prominent marina facilities that serve recreational boating interests. Running along the entire shoreline of the state and bisecting both areas around the lower Connecticut and Thames River, along with specific properties in the alternatives are Interstate 95 and an Amtrak railway line.

There are several noteworthy aspects of the offshore area that bear mention, all of which are documented on NOAA Nautical charts. There are eight “special” and six “unrestricted” anchorage areas that support boating interests. One special anchorage area also doubles as a lightering area. There are two security zones on the western and eastern shores of the Millstone Power Station and several corridors for submerged cable and pipelines in both the offshore and riverine areas of the Connecticut and Thames Rivers.

There are all or parts of 13 navigation channels – the Thames River Federal Navigation Channel being the largest – used by numerous vessels that are periodically maintained via dredging. There are three inactive open water dredge disposal sites but only one designated open water disposal site authorized to receive material (which may come from various public and private projects both within and outside of the project area, including out-of-state projects).

High-density vessels (cargo, passenger, tanker, tug-tow, fishing, pleasure craft, and others) transit corridors emanate from the Connecticut and Thames Rivers. Traffic in the Connecticut River corridor is typically characterized by recreational vessels. The Thames River corridor supports both recreational and commercial traffic including regular ferries to several ports in both New York and Rhode Island smaller transit corridor primarily supporting recreational boating also intersects the far eastern side of the site originating from the Mystic River in neighboring Stonington, Connecticut. (Note: the impacts to military vessel traffic are addressed in *Section 6.3.3.5*).

A summary of the expected impacts to transportation, navigation, and infrastructure from the range of alternatives analyzed is provided in Table 6-26.

Table 6-26: Impacts to Transportation and Navigation

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Transportation (land, air)	No direct or indirect impacts.	Minor, short-term, direct adverse impacts.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Navigation (water)	No direct or indirect impacts.	Negligible short-term direct adverse impacts.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Infrastructure (cables, pipelines, dredging)	No direct or indirect impacts.	Minor, long-term, indirect beneficial impacts.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

No Action Alternative

Transportation, Navigation, Infrastructure: Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners and through existing federal, state, and local management organizations. No direct or indirect impacts (beneficial or adverse) to transportation, navigation, infrastructure.

Alternatives A and D

Transportation: As outlined in the proposed CT NERR *Draft Management Plan,* specific estuarine research, education, and stewardship activities are expected to occur within these alternatives. Additional traffic increases may be anticipated because of adults and school groups participating in reserve education and outreach programming. While impacts to railway lines are not likely, given parking constraints at these alternatives, short-term, minor, direct adverse impacts to the area's transportation may occur.

Navigation: This alternative contains high-density vessel transit corridors (annual vessel occurrences per 100 meter grid cell registering in excess of 500 from 2019 Automatic Identification System transponder data) in both the Connecticut and Thames Rivers and out into Long Island Sound and Fishers Island Sound, with moderate density (20-60 annual vessel occurrences) in areas approximately 1.5 to 2 miles offshore, and less than 20 counts in the areas closer than 1.5 miles. As outlined in the proposed CT NERR *Draft Management Plan,* specific estuarine research, education, and stewardship activities are expected to occur within these alternatives. Additional boat traffic increases may be anticipated because of adults and school groups participating in on-water reserve education and outreach programming. The number and frequency are as yet unknown, but it is anticipated that any increases would only result in negligible short-term direct adverse impacts.

Infrastructure: As outlined in the proposed CT NERR *Draft Management Plan* specific estuarine research, education, and stewardship activities are expected to occur within these alternatives. As a result there may be minor, long-term, indirect, beneficial impacts through science and data that could help better site or locate infrastructure to avoid conflicts with resources or uses, or help advance the application of emerging techniques for beneficial reuse of dredged sediments to support habitat restoration and reduce open water disposal.

Alternative B and C

Transportation: Same as Alternatives A and D.

Navigation: This alternative contains high-density vessel transit corridors (annual vessel occurrences per 100 meter grid cell registering in excess of 500 from 2019 AIS transponder data) in the Connecticut River and out into Long Island Sound and Fishers Island Sound. East of the river mouth there is moderate density (20-60 annual vessel occurrences) in areas approximately 1.5 to 2 miles offshore, and less than 20 counts in the areas closer than 1.5 miles; west of the river mouth, counts in the 100-200 range occur almost immediately offshore. As outlined in the proposed CT NERR *Draft Management Plan,* specific estuarine research, education, and stewardship activities are expected to occur within these alternatives. Additional boat traffic increases may be anticipated because of adults and school groups participating in on-water reserve education and outreach programming. The number and frequency are as yet unknown, but it is anticipated that any increases would only result in negligible short-term direct adverse impacts. (Same as Alternatives A and D)

Infrastructure: Same as Alternatives A and D.

6.3.3.5 Military

As described in *Chapter 5 - Affected Environment*, several military facilities are located in southeastern Connecticut, near the project area. The Naval Submarine Base New London and the United State Coast Guard Academy are located within two miles of the project area boundary in the Thames River. The Connecticut National Guard Readiness Center in Groton works out of the Groton-New London Airport, less than half a mile from the Bluff Point complex of properties. The Connecticut National Guard Readiness Center and the Connecticut National Guard Camp Niantic in East Lyme are less than half a mile north of the project area of Niantic Bay. Additionally, General Dynamics Electric Boat division, which builds and services submarines, is in the lower Thames River, within the project area, as is the U.S. Coast Guard Station New London.

A summary of the expected impacts to the military activities in the area from the range of alternatives analyzed is provided in Table 6-27.

No Action Alternative

Under this alternative, the listed military facilities would continue managing and conducting operations in and near the project area. No direct or indirect impacts.

Table 6-27: Impacts to Military

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Military	No direct or indirect impacts.	Negligible short-term, direct adverse impacts from boating; negligible long-term beneficial impacts from Reserve outreach and educational opportunities.	No effect.	No effect.	No effect.

Alternatives A and D

These alternatives include areas of the Thames River and waters of Long Island Sound that are proximal to the Naval Submarine Base New London, the United State Coast Guard Academy, General Dynamics Electric Boat division, and U.S. Coast Guard Station New London. Vessels will regularly transit through the area to and from these locations. Reserve programming may likely result in an increase in boating uses, it is not expected to lead to congestion, and adverse impacts within this high-use marine transportation area are likely negligible, short-term, and direct. However, there may be negligible beneficial long-term impacts that result from participation in reserve outreach and educational opportunities that base residents or personnel may be exposed to or participate in.

Alternative B and C

The alternatives have no overlap or proximity to the listed military facilities from offshore areas as described in Alternatives A and D. Thus no direct impacts are expected. The influence and availability of reserve education and outreach programming would still be available and so negligible beneficial long-term impacts that result from participation in these opportunities by base residents or personnel may result.

6.3.3.6 Commercial Aquaculture and Recreational Shellfishing

As described in *Chapter 5 - Affected Environment*, shellfish aquaculture (typically, oysters and quahogs, or hard clams) is a longstanding and central component of the economy, culture, and ecosystems of Long Island Sound and Fishers Island Sound. Evidence suggests that shellfish harvesting is a pre-colonial activity and records exist for oyster farms dating to the early half of the 19th century. Since 2007, oyster harvest in Connecticut has ranged from approximately 133,000 to approximately 351,000 bags per year with an annual economic value of just under $18 million dollars. Seaweed farming (sugar kelp and other species) in Long Island Sound is, however, a relatively new, but growing sector within the Connecticut commercial aquaculture industry. Taken together, commercial shellfish (all locally harvested species) and seaweed aquaculture represent a multi-million dollar segment of the local economy that employs hundreds of individuals. Beyond the economic impacts, shellfish provide benthic habitat structures that support diverse communities of organisms and filter pollutants and sediments that improve water quality (Long Island Sound Inventory and Science Subcommittee of the Blue Plan Advisory Committee 2019).

Recreational shellfishing (oysters, clams, and mussels) also occurs in approved areas subject to local health and municipal licensing and regulation. These activities are typically limited to manual rakes or tongs and have conditions upon the size and quantity harvested. Scallops may be recreationally harvested subject to similar conditions, with the distinction that collection must be done from a drifting boat. Recreation shellfishing is intended for private, personal consumption and not as part of any sale or barter.

A summary of the expected impacts to commercial aquaculture and recreational shellfishing from the range of alternatives analyzed is provided in Table 6-28.

Table 6-28: Impacts to Aquaculture

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Commercial Aquaculture	No direct or indirect impacts.	Minor, direct, long-term beneficial impacts; negligible, direct, short-term adverse impacts.	Negligible, indirect long-term benefits.	Same as Alternative B.	Same as Alternative A.
Recreational Shellfishing	No direct or indirect impacts.	Minor, direct, long-term benefits; negligible, direct, short-term adverse impacts.	Negligible, indirect long-term benefits.	Same as Alternative B.	Same as Alternative A.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners and through existing state and local management organizations. No direct or indirect impacts (beneficial or adverse) on commercial or recreational aquaculture are expected.

Alternatives A and D

These alternatives may be expected to provide both adverse and beneficial indirect long-term impacts. The establishment of SWMP monitoring data and efforts of the research, education and training programs are expected to deliver additional data and information that could be used for adaptive management or to help improve the capacity for the restorative effects aquaculture can provide. It may be that any such information could be beneficial by helping sustain current stocks, help in siting of future beneficial locations, or address impacts such as changes to water temperature or acidification that may result from climate change. These are anticipated to yield minor, direct, long-term benefits. Conversely, the use of data provided through SWMP may cause adverse impacts if used to direct changes to allowable practices, such as the closure of locations or harvesting based on environmental criteria. Given that there are already numerous data measurements used by the organizations that manage commercial and recreational shellfish advisories, this is a negligible, direct, short-term adverse impact.

Alternative B and C

These alternatives do not contain any areas designated for commercial aquaculture operations, although they do contain two areas of natural shellfish beds in the lower Connecticut River. As a result there may be negligible, indirect long-term benefits to the commercial and recreational aquaculture industries through proposed CT NERR research and educational programming that may involve these resources.

6.3.3.7 Commercial Fishing

As described in *Chapter 5 - Affected Environment*, commercial fishing encompasses two broad types of fishing activity – that which occurs in Long Island Sound and Fishers Island Sound, harvesting the resources of The Sounds, and that which has a home-base in Long Island Sound or Fishers Island Sound, but vessels leave The Sounds to harvest resources elsewhere.

During the creation of the Long Island Sound Blue Plan, authors analyzed NOAA Fisheries landing data coupled with the fishing effort served through the Northeast Ocean Data Portal based on the Automatic Identification System (AIS). They determined that commercial fishing from larger vessels with AIS transponders was a minor impact in Long Island Sound (Figure 5-30). While it is known that commercial fishing vessels currently transit through the eastern Long Island Sound and western Fishers Island Sound on their way to and from port, there appears to be little commercial fishing from these vessels within The Sounds (Long Island Sound Inventory and Science Subcommittee of the Blue Plan Advisory Committee 2019).

Commercial fisheries active in The Sounds include 12 species of fish and crab as well as two additional species currently closed for commercial fishing (Table 5-43). In 2016, the date of the last NOAA Fisheries Economics Report, Connecticut posted $387 million in sales from the seafood industry, $83 million in income, and $137 million in value added.

A summary of the expected impacts to commercial fishing from the range of alternatives analyzed is provided in Table 6-29.

Table 6-29: Impacts to Commercial Fishing

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Commercial Fishing	No direct or indirect impacts.	Minor adverse and beneficial indirect long-term impacts.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

No Action Alternative

Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners and through existing fisheries management organizations. No direct or indirect impacts (beneficial or adverse) on commercial fishing are expected. Any potential future changes may be expected to result from impacts related to climate change or through changes implemented by existing fisheries management organizations.

Alternatives A, B, C and D

These alternatives may be expected to provide both adverse and beneficial indirect long-term impacts. The establishment of SWMP monitoring data and efforts of the research or education and training programs are expected to deliver additional data and information that could be used for adaptive management. It may be that any such information could be beneficial by helping sustain current stocks or address the impact of species shifts that may result from climate change, or adverse if used to direct changes to allowable practices. Given the potential for both beneficial and adverse impacts that could result from the information generated by the proposed CT NERR, and the uncertainties associated with whether and to what extent these potential effects would occur, the impact of this proposed action on the fishing industry is difficult to quantify, but is generally expected to be minor.

6.3.3.8 Recreational Fishing and Hunting

As described in *Chapter 5 - Affected Environment*, the last NOAA Fisheries Economics Report (2016), shows that Connecticut posted $430 million in sales, $186 million in income, and $292 million in value added for recreational fisheries. Public hunting is allowed in most of the state-owned properties in the lower Connecticut River, including in the Roger Tory Peterson NAP (all alternatives), Lord Cove NAP (all alternatives), and Ragged Rock Creek WMA (Alternatives B and C). Hunting is restricted to bow hunting only in Nott Island WMA (Alternatives B and C) and Haddam Neck WMA (Alternative B). Hunting is not allowed in Machimoodus State Park (Alternative B), Thatchbed Marsh WMA (Alternative C), and Ferry Point Marsh WMA (Alternatives B and C). Hunting is largely prohibited in the remainder of the properties, with no hunting allowed in the Bluff Point complex (except for deer removal by DEEP staff), Haley Farm State Park, or Pine Island areas included in Alternatives A and D.

A summary of the expected impacts to recreational fishing and hunting from the range of alternatives analyzed is provided in Table 6-30.

Table 6-30: Impacts to Recreational Fishing and Hunting

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Recreational Fishing	No direct or indirect impacts.	Minor indirect long-term benefits.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Hunting	No direct or indirect impacts.	Negligible short-term direct adverse impact; minor long-term indirect benefits.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

No Action Alternative

Recreational Fishing and Hunting: Under this alternative, the various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) on recreational fishing or hunting are expected.

Recreational Fishing

Alternatives A, B, C and D

These alternatives are expected to provide minor indirect long-term benefits. The establishment of SWMP monitoring data and efforts of the research, education, and training programs are expected to deliver additional data and information that can be used by managers to help sustain current stocks or address the impact of species shifts that may result from changes in water temperatures from climate change.

Recreational Hunting

Alternatives A, B, C and D

Across these alternatives, hunting is allowed within some but not all reserve components. As outlined in the proposed CT NERR *Draft Management Plan*, specific estuarine research, education, and stewardship activities are expected to occur within all alternatives. Thus, increases to visitation are anticipated because of adults and school groups participating in reserve education and outreach programming. This may have a short-term, direct, adverse impact to hunting if activities are concurrent. This is expected to be negligible, however, as there are locations within these alternatives where hunting is not allowed or limited to specific time periods thus reducing opportunities for concurrent activities. There may also be minor long-term indirect benefits, as reserve education and outreach to the hunting community can result in greater awareness for environmental conservation and opportunities for cooperative efforts, such as participation in wildlife habitat research, observational monitoring, and funding.

6.3.3.9 Agriculture

As described in *Chapter 5 - Affected Environment*, little agriculture currently occurs in or adjacent to the project area. A summary of the expected impacts to agriculture from the range of alternatives analyzed is provided in Table 6-31.

Table 6-31: Impacts to Agriculture

	No Action	Alternative A	Alternative B	Alternative C	Alternative D
Agriculture	No direct or indirect impacts.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.	Same as No Action Alternative.

No Action Alternative

Since very small amounts of agriculture currently occurs, and only within the watershed and not in or adjacent to the project area, negligible direct or indirect impacts are anticipated.

Alternatives A, B, C and D

Same as No Action Alternative.

6.4 Cumulative Effects

6.4.1 Introduction to Cumulative Effects Analysis

For the purpose of this analysis, a cumulative impact is an "impact on the environment which results 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. Cumulative impacts can result from individually minor, but collectively significant actions taking place over time." (40 C.F.R. § 1508.7)

Although reserve designation and approval of the proposed CT NERR's *Final Management Plan* would be largely administrative actions, they would be followed by operation of a reserve, with associated education, research, stewardship, and monitoring opportunities and activities. These and other potential future management activities, including as yet unplanned restoration projects, within the boundaries of the proposed CT NERR would likewise be expected to have a variety of either beneficial or adverse impacts of varying magnitude and duration, as discussed previously. In addition, the proposed CT NERR would also be incorporated into the national Reserve System, which could bring additional research, restoration, education, and stewardship opportunities. Selection of any of the action alternatives would not trigger any changes in land ownership. Current uses of public and private lands and waters within the proposed reserve's boundaries would continue to be managed under existing regulatory and administrative authorities.

If a reserve were designated, existing office space has been identified for it to use in its first few years of operation. A formal facilities needs assessment would be conducted, resulting in a prioritized list of needs, and then plans would likely begin to be outlined for the development of facilities to support proposed reserve activities outlined in the *Draft Management Plan*. The facilities needs assessment would be expected to identify the types of facilities needed (e.g., office space, laboratories, classrooms, visitors' center, resource library, and equipment storage), financial resources, and how existing site partners might be able to fill some of the needs by renovating existing facilities or building new ones. Future facilities, any future land acquisition proposals, and other future federal actions would be reviewed by OCM pursuant to applicable mandates (e.g., environmental and historic preservation laws, applicable executive orders, and other regulations, including Reserve System regulations) and potential Presidential budget requests, as well as within the context and scope of the analysis contained in this *Draft Environmental Impact Statement*. In general, future facilities would be expected to be developed in a manner designed to minimize adverse impacts to sensitive environments and species.

As discussed in *Sections 6.2* and *6.3*, designation and implementation of a proposed CT NERR, under all the alternatives analyzed, would not be expected to result in significant adverse impacts to either the natural or human environment. As shown in Table 6-2, many of the adverse effects would be expected to be short-term (e.g., during periods of active construction) and negligible to minor in intensity, whereas most beneficial effects would be expected to have minor to moderate impacts over the short-term and the long-term. This cumulative effects analysis notes that, even under the no action alternative, ongoing manipulation and restoration activities by local partners would be expected to have long-term beneficial impacts, which could be accompanied by (primarily minor) adverse effects. Existing and planned activities in the affected environment that are not directly connected to this action have been included in this cumulative effects analysis to the extent they are relevant.

The descriptors of intensity used earlier in this section (ranging from negligible to major) are not used throughout this discussion of cumulative impacts. They were retained in some places, but did not apply in other contexts. Where omitted, information in narrative form is presented to ensure the full range of consequences for the proposed action are considered.

According to the Council on Environmental Quality's guidance on "Considering Cumulative Effects under the National Environmental Policy Act," as part of determining whether cumulative effects are significant, it is appropriate to consider whether the affected environment can withstand the stress of cumulative impacts without crossing ecological thresholds (Council on Environmental Quality 1997). That guidance notes:

> *"The significance of cumulative effects depend on how they compare with the environmental baseline and relevant resource thresholds (such as regulatory standards)." Executive Summary*

> *"The analyst must determine the realistic potential for the resource to sustain itself in the future and whether the proposed action will affect this potential;" Chapter 4*

> *"By definition, cumulative effects analysis involves comparing the combined effect with the capacity of the resource, ecosystem, and human community to withstand stress." Chapter 5*

The spatial extent of the cumulative effects analysis is environment-specific and is broader for effects in some environments than it is for others. For instance, efforts to mitigate the impact of climate change focused on reducing release of carbon dioxide and other greenhouse gases are occurring on a state and regional level, as well as on the much broader national and international level. Similarly, New York State Department of Environmental Conservation, New York City Department of Environmental Protection, and Rhode Island Department of Environmental Management are also involved with water quality improvement initiatives, collaborating with Connecticut DEEP—the three states and the city share waterbodies in common and choices made by one entity have the potential to affect all others. To assess potential cumulative impacts related to climate change, water quality, and habitat integrity, OCM used a broader spatial extent (e.g., including impacts from all of Long Island Sound, Fishers Island Sound, all of Connecticut, and portions of New York and Rhode Island adjacent to The Sounds) to evaluate relevant impacts to the affected environments. For other types of impacts (including in terrestrial areas, riparian and freshwater areas, and estuarine environments), the spatial extent is more limited and focuses on known activities occurring or likely to occur in the project area.

Similarly, the temporal bounds of this analysis were selected intentionally. First, a few important "historical activities" are summarized. After that discussion, most assessments of past impacts in this section focus primarily on the 21st century. This time period was chosen because looking back over data reflecting conditions over the past five to fifteen years provides a baseline to which future scenarios can be compared. Similarly, this cumulative effects analysis is limited in the number of years it can look ahead. Research reserves have regular opportunities to revise their management plans to adapt to changing conditions and needs. As reserves operate, considerable new information can come to light about local conditions, constraints, and needs. Because of the potential for circumstances on the ground to evolve, federal regulations call for reserves to update their management plans every five years (15 C.F.R § 921.33(c)). Because of the many factors that are not well understood before reserve designation, this cumulative effects analysis looks ahead to the first five to fifteen years after reserve designation, in order to meet the mandate under NEPA to focus on future scenarios that are reasonably foreseeable.

6.4.2 Major Historic Activities Affecting the Current Environment

Table 6-32 highlights some of the long-term impacts of the activities that have affected the health and productivity of the environment of the project area. The environment has a history of increasing urbanization and commercial and recreational use of ecosystem resources. With rocky and organically poor sediment, agriculture was not a major influence in southeastern Connecticut. As soon as improvements in transportation allowed for the import of food to the region, the economy shifted from agriculture to industry, including a very active maritime industry. Shifts in water quality and overutilization of marine resources has led to changes in coastal and estuarine habitats through time. At present, climate change stressors are one of the largest threats facing the natural environment and also impacting coastal communities.

Table 6-32: Major Historical Activities and Trends in the Region

Summary of major impacts in the southeastern Connecticut region, Long Island Sound, and Fishers Island Sound. Some are beneficial, some negative, and some neutral.

HISTORICAL ACTIVITY	EXAMPLES OF IMPACTS
Settlement Post-1600s	lengthy process of increasing population in the area, by immigrants and their descendants
Urbanization	population increases along the New York-Boston corridor transportation (train and roadway) – impact of bridges on coastal areas

HISTORICAL ACTIVITY	EXAMPLES OF IMPACTS
Nitrogen Pollution Management & Management of Other Pollutants	Clean Air Act, 1963 Clean Water Act, 1972 Nitrogen TMDL for Long Island Sound, 2000 new efforts are being planned and implemented
Working Waterfronts	whaling – historic, does not presently occur commercial fishing – historic and present activity aquaculture – historic and present activity commerce – historic and present activity dredging – historic and present activity offshore wind energy construction support & energy transmission and storage – emerging
Species and Habitat Shifts	1800's – overhunting led to loss of deer & turkey in Connecticut, populations are now recovered 1890 to present – 27% loss of tidal wetlands in Connecticut (Basso et al. 2015), ongoing protections and efforts at restoration are underway 1930's – 95% of eelgrass in the North Atlantic died due to a wasting disease (Short et al. 1987), some eelgrass recovered from the disease, but recovery happened in an era of increasing nutrient pollution, hampering full recovery 1999 – collapse of Long Island Sound lobster fishery, related to shell disease (LISS 2021c), small recoveries in population but not the fishery – warming temperatures have hampered success of this species in The Sounds 2000 to 2006 – decline in oyster fishery related to disease (LISS 2021d), species is recovering and aquaculture is rebounding from the decline

6.4.3 Current Outlook

The activities, plans, and partners identified in the *Draft Management Plan* highlight major ongoing or planned activities that have the potential to contribute to a range of cumulative impacts that may have potential short-term and long-term effects on the affected environment. However, that is not to say that other ongoing, planned, and proposed projects do not contribute to potential cumulative effects. Accordingly, individual ongoing, planned, and proposed projects are summarized below. The following sections retain the general organization of earlier parts of this chapter by addressing, first, cumulative impacts to the natural environment, then cumulative impacts to the socioeconomic environment. This section concludes with a summary.

At present, no major restoration activities are planned within the project area. The various areas proposed for inclusion in a reserve would continue to be protected and managed by the various site partners. No direct or indirect impacts (beneficial or adverse) are expected. Management of these areas include efforts to ensure viable habitats that continue to support healthy ecosystems. This typically includes measures such as invasive species control / restoration as needed, and management of human impacts. A beneficial impact of the designation of a reserve would be an increase in education and outreach on the importance of natural habitats, an increase in research and monitoring in these systems which would lead to better understanding and incorporation of science into adaptive management, and an increased effort at stewardship within the project area.

6.4.4 Physical Environment

6.4.4.1 Climate Change

The State of Connecticut is actively pursuing efforts to mitigate climate change and to develop strategies to make Connecticut resilient and prepared while “considering racial, class, gender, geographic and generational equity in both costs and benefits” (Governor’s Council on Climate Change 2018b). The State of Connecticut’s Governor’s Council on Climate Change has established interim goals for reducing greenhouse gas emissions, requiring a 45% reduction in greenhouse gas emissions below 2001 levels by 2030 (Governor's Council on Climate Change 2018b); this puts Connecticut on the path towards achieving the 2050 goal of an 80% reduction relative to 2001 levels. This effort is largely targeted at green energy production, but also includes transportation and clean, efficient, and resilient buildings (Governor’s Council on Climate Change 2018a).

In September 2019, the Governor’s Council on Climate Change was re-established and expanded. In addition to continuing to address mitigation strategies to reduce greenhouse gases, the newly expanded Governor’s Council on Climate Change considered adaptation and resilience in the face of climate change impacts (Governor's Council on Climate Change 2021a). The Governor’s Council on Climate Change included public meetings structured around sub-working groups, including the “Working and Natural Lands” group. This sub-group is especially relevant to the proposed CT NERR as its charge was to, “evaluate the role of nature-based solutions (e.g., scaling up the preservation and restoration of forests and coastal wetlands, green and natural infrastructure, agricultural lands) in climate change mitigation and adaptation and how to best incorporate the economic, social, and environmental co-benefits of these solutions into Connecticut’s climate change planning strategies.” An additional charge to the Governor’s Council on Climate Change was to, “develop and implement adaptation strategies to assess and prepare for the impacts of climate change in areas such as infrastructure, agriculture, natural resources, and public health.” This included tasks such as: (1) conducting an inventory of vulnerable assets and operations; (2) revising and updating the 2011 Connecticut Climate Change Preparedness Plan; and (3) reporting on the alignment of climate change adaptation strategies incorporated into state agency planning processes and documents.

To meet the needs of reducing carbon emissions in order to combat climate change, the State of Connecticut, among other strategies, is pursuing clean energy sources. While solar farms and wind farms (referring specifically to offshore wind, construction support, and receiving lines and energy storage facilities on land) provide a net positive ecological impact, the structures have the potential to negatively impact wildlife and habitat. Thus, smart siting of these facilities and consideration of the impacts are included as part of the permitting process. The following is a summary (copied from the

DEEP website) of some of the green energy and infrastructure initiatives recently undertaken by DEEP and the State of Connecticut (DEEP 2021h):

Renewable Energy Procurements

2019 Offshore Wind Procurement - On December 5, 2019 DEEP announced its selection for the procurement of 804 MW of offshore wind power from Park City Wind Project, which will provide the equivalent of 14% of Connecticut's electricity supply.

Affordable and Reliable Electricity Procurement - Public Act 15-107, An Act Concerning Affordable and Reliable Energy, which authorizes the Commissioner of DEEP, in consultation with the state's procurement manager, the Office of Consumer Counsel, and the Attorney General, to issue multiple solicitations—either alone or in coordination with other New England states—for long-term contracts from providers of resources that can provide Connecticut's reasonable share of the investments New England needs to address the gas infrastructure challenge.

Shared Clean Energy

Shared Clean Energy Facility (SCEF) – An Act Concerning Connecticut's Energy Future, under Public Act 18-50 Section 7(c), that directs DEEP to develop program requirements and tariff proposals for statewide shared clean energy facility (SCEF) program.

Shared Clean Energy Facility Pilot Program (SCEF) – The Department of Energy and Environmental Protection, in consultation with Eversource Energy and The United Illuminating Company established the SCEF Pilot Program as a two-year initiative to support the development of SCEFs in Connecticut.

Related Initiatives and Programs

The Connecticut Green Bank offers incentives and innovative low-cost financing to encourage homeowners, companies, municipalities, and other institutions to support both renewable energy and energy efficiency. The links below allow you to follow the progress on DEEP's renewable energy related responsibilities to implement a wide range of renewable energy initiatives and programs.

Microgrid Grant and Loan Program – Connecticut created the Microgrid program under Public Act 12-148, Section 7 to help local distributed energy generation for critical facilities. A Microgrid generally operates while connected to the grid but can disconnect and operate in island mode on its own if there is a crisis such as a power outage or a major storm.

Siting Clean Energy on Connecticut Brownfields – Brownfields are particularly attractive for renewable energy because they require large sites for installation that usually have existing infrastructure needed to support development.

6.4.4.2 Water Quality

Water quality refers to the chemical, physical, biological, and radiological characteristics of water (DEEP 2017). It is a measure of the condition of water relative to the requirements of one or more biotic species or to any human need or purpose. It is most-frequently used by reference to a set of standards, the most common of which relate to health of ecosystems, safety for human contact and drinking water. Connecticut DEEP maintains a formal set of Connecticut Water Quality Standards (CTWQS) (R.C.S.A. §§ 22a-426-1 to -9) that function to convey policies regarding uses and classifications, and to provide the criteria needed to support them (DEEP 2019a). These standards are reviewed triennially.

Section 305(b) of the Federal Clean Water Act (3 U.S.C. § 1315(b)) requires states to monitor, assess and report on the quality of its waters relative to designated uses established in accordance with their water quality classification (DEEP 2021e). Section 303(d) of the Clean Water Act (33 U.S.C. § 1313(d)) requires each state to list waters not meeting water quality standards and prioritize those waters for Total Maximum Daily Load development (TMDL) or other management (DEEP 2021e). Total Maximum Daily Loads provide the framework for restoring impaired waters by establishing the maximum amount of a pollutant that a waterbody can receive without adverse impact to fish, wildlife, recreation, or other uses. Total Maximum Daily Loads can also be developed to protect waterbodies that are meeting water quality standards. Although a TMDL for Long Island Sound was implemented to address the excessive discharge of nitrogen, this TMDL is primarily focused in the western portion of the Sound and not in the vicinity of the project area. Within the context of 303(d), the state also maintains a list of impaired waterbodies which identifies those that do not fully support all designated uses. Reporting for Clean Water Act sections 305(b) and 303(d) is submitted to the USEPA every two years.

The USEPA National Estuary Program, the Long Island Sound Study, is a key partner to both Connecticut and New York in working to reduce the impact of nutrient pollution and other forms of water pollution in Long Island Sound and Fishers Island Sound. From the Long Island Sound Study's website (LISS 2021f):

> *"EPA is implementing a strategy to aggressively continue progress on nitrogen reductions, in parallel with the States' continued implementation of the 2000 Total Maximum Daily Load (TMDL), and achieve water quality standards throughout Long Island Sound and its embayments and nearshore coastal waters. The strategy recognizes that more work must be done to reduce nitrogen levels, further improve dissolved oxygen (DO) conditions, and address other nutrient-related impacts in Long Island Sound. The nitrogen reduction strategy complements the 2000 TMDL in important ways. Foremost, while the 2000 TMDL is premised on achieving water quality standards for DO in the open waters of Long Island Sound, the EPA strategy expands the focus to include other nutrient-related adverse impacts to water quality, such as loss of eelgrass, that affect many of Long Island Sound's embayments and nearshore coastal waters."*

In addition to the Long Island Sound Study's nitrogen reduction strategy, additional efforts include:

- DEEP is working on modeling ecosystem dynamics in all of Connecticut's embayments with the goal of setting nitrogen reduction targets for embayments,
- New York City Department of Environmental Protection is sponsoring development of an ecosystem model of Long Island Sound with a similar goal,
- Connecticut is coordinating with New York City with hopes to link the models together,
- DEEP is coordinating with Rhode Island Department of Environmental Management to model ecosystem dynamics in the Pawcatuck River and Little Narragansett Bay, a system heavily influenced by nutrient pollution,
- DEEP is coordinating with Millstone Environmental Lab, Dominion, to lead the Niantic Nitrogen Work group, to protect one of the few embayments in the area still hosting eelgrass (indicative of good water quality),

- New York State Department of Environmental Conservation launched LINAP – the Long Island Nitrogen Action Plan, and
- Suffolk County, New York launched a Subwatersheds Wastewater Plan which calls for the elimination of more than 253,000 cesspools countywide, to be implemented in four phases over the next 50 years.

Non-governmental organizations are also active, participating with the agencies listed and conducting outreach and education efforts to support state and county initiatives to reduce nutrient pollution.

Staff of the proposed CT NERR would enter a landscape of energized and active agencies and groups looking to reduce nutrient pollution and other forms of pollution to Long Island Sound and Fishers Island Sound. A key first step for staff would be developing an understanding of the history of nutrient pollution and management in the local area, the current activities, and developing relationships with groups working on these issues, both at the state and county levels and at more local levels, especially where relevant to the project area.

6.4.5 Biological Environment and Living Resources

6.4.5.1 Terrestrial Environment

Future Facilities and Infrastructure to Support Reserve Programming

If a research reserve were designated in Connecticut, the *Draft Management Plan* indicates that the administrative offices for the proposed CT NERR would initially be located in the Lowell P. Weicker Jr. Building and the Community and Professional Building on the UConn Avery Point campus. These offices would provide a base of operations and logistics support to get proposed CT NERR programs started. The facilities needs assessment, which would occur within the first five years after the reserve begins operating, would yield a prioritized list of facilities needs for the long term, some of which might be pursued as funds permit.

As noted previously, if the proposed CT NERR is designated, new infrastructure would likely be needed to support the various programmatic activities. *Chapter 7* of the *Draft Management Plan* describes the overall process for identifying future facility needs. Facilities would primarily be located in the "buffer areas" (not the reserve's core area) and would be implemented in ways intended to avoid adverse impacts to the reserve's resources and habitats. As noted, one possible site for future expansion is the UConn Avery Point campus, close to but not in the core area of the proposed reserve. As needs are assessed and projects identified and planned, OCM, UConn, DEEP, and reserve staff would work to conduct any required environmental reviews and obtain required clearances to implement such projects. Also, the site partners, given their missions, would be expected to implement activities that seek to minimize disturbances to sensitive habitats and species. In short, future reserve infrastructure development would be implemented to mitigate or reduce potentially adverse impacts and would promote efforts to maximize long-term benefits new facilities could offer with respect to supporting reserve programming and partner efforts. Reserve programmatic activities would be expected to draw additional visitors regardless of whether new facilities are developed.

Given available information, the cumulative impacts to terrestrial environments from current land uses by property-owners in terrestrial areas within the region and from potential future land use related to reserve designation are not expected to be significant. This is attributable in part to the many layers of government oversight (UConn, Groton Town agencies, state agencies, and federal agencies, as applicable) and permitting related to different types of potential land uses. Requirements for low-impact development, BMPs, and other mitigation measures would help keep cumulative impacts from reaching the level of significance.[21]

All future construction or acquisition projects using NOAA-sourced funds would be reviewed by OCM. The results of the facilities needs assessment would provide a sense of the array of future facilities needed, providing all reserve partners with a better idea of their potential cumulative effects. Future updates to the proposed CT NERR *Management Plan*, which would be subject to OCM review and approval, would also discuss future facility needs, allowing many opportunities for review and discussion before new reserve-related construction projects are undertaken. Once additional future facilities are proposed, OCM would conduct necessary NEPA and environmental compliance evaluations for work conducted with NOAA-sourced funds, including assessing how the proposed new facilities may affect the cumulative impacts analysis of this *DEIS*. In addition, OCM expects that all consultations, authorizations, and permits required for individual construction projects would be obtained. OCM's review role would also ensure that potential construction project impacts are scrutinized from many perspectives.

6.4.5.2 Estuarine Environment

Potential Future Boating Associated with Reserve Designation

As noted in *Section 6.3.3.4—Transportation, Navigation, and Infrastructure*, boating use of the eastern Long Island Sound and Fishers Island Sound is extensive, including recreational watercraft, working watercraft (charter boats, ferries, container / cargo / oil ships, and fishing vessels) and military craft (Navy and Coast Guard vessels). These uses are ongoing and would be negligibly impacted by reserve designation.

The amount of boat traffic to reserve properties along the Connecticut River, Bluff Point complex, and the embayments included in the reserve core may increase as a result of programming – both research and education. This is especially true for properties along the Connecticut River that are only accessible by boat and for quick access to the Bluff Point Beach and Bushy Point Beach in Bluff Point Coastal Reserve. The University of Connecticut has a fleet of small boats designed for research uses, which may also be used for stewardship activities, but which are unlikely to be used for educational purposes. The reserve staff would likely partner with educational organizations in the area who already have boats suitable for educational voyages. Through the educational programs of the NERR, boating activity is likely to increase, but consistent with the currently available resources among the potential strategic partners.

Regardless of vessel used, boat operators at UConn are required to hold a Connecticut Safe Boating Certification (or equivalent), First Aid and CPR certifications, and successfully complete an on-water skills checkout with the Department of Marine Sciences Vessel Operations, which includes boat docking and handling skills. Department of Marine Sciences Vessel Operations will be expected to inform individuals who go through its on-water skills checkout of the best management practices (BMPs) that must be followed while operating, docking, or anchoring a boat. Even with additional trips to transport reserve

[21] This threshold could be exceeded, theoretically, if landscapes or resources were not expected to be able to sustain themselves into the future or if it appeared resources might be pushed to the brink of undesirable tipping points.

staff and visiting researchers, the increase in activity would be comparatively small relative to the extensive vessel traffic within the project area. Reserve-related boating would therefore be unlikely to materially increase total boating activity in the project area.

6.4.6 Human Environment

6.4.6.1 Ocean Economy, Recreational Fishing / Shellfishing, Tourism, and Recreation

Major sectors boosting the ocean economy include tourism (and nearshore businesses, including restaurants), recreation, fishing, marine transportation services, and related businesses. Readily available information about tourism along (and within) The Sounds was summarized in *Chapter 5*, as well as in *Section 6.3.3.1—Tourism and Recreation* and *Section 6.3.3.4—Transportation, Navigation, and Infrastructure*. Proposed CT NERR designation and operation could result in small increases to the numbers of recreational users and tourists who visit the region. However, were that to occur, no cumulatively significant adverse effects would be expected to occur given the fact that areas that draw tourists and recreational users appear to still have adequate capacity to cater to a larger number of visitors and residents.

The marine environments of the project area are a primary driver of the ocean economy. Designation of the reserve in Connecticut would bring additional funds and attention to supporting water quality, combating climate change, protecting and restoring habitats (including the potential for increased beneficial use of dredged sediments for habitat restoration), and improving education across many sectors of the population. Such projects could lead to improved habitats and greater species abundance and diversity, which in turn, could make the area more appealing for fishing, tourism and recreational activities. Were a reserve designated, no new regulations or restrictions would be imposed on these ocean economy activities. However, new data about the status of fishery and aquaculture resources could be generated that could inform future management decisions. Over the medium- to long-term, these management decisions could either benefit or have adverse effects on commercial and recreational fishers or other resource users depending on the resulting management decisions. However, given the strong fishery and aquaculture management requirements already in place, and the robust ongoing research in the study area, it is not expected that the effects associated with improved management decisions derived from the work of the reserve would result in significant adverse cumulative effects on the ocean economy.

6.4.6.2 Education and Outreach

Information about the education environment and current efforts were presented in *Section 5.2.3.2—Education* and *Section 6.3.3.2—Education* and groups currently working in the area are detailed in *Chapter 11 of the Draft Management Plan* (included in this document as appendix A). *Chapter 7 in the Draft Management Plan (Facility Development and Improvement Plan)* also describes many of the organizations currently engaging in environmental education throughout Connecticut. The programs range from formal classroom instruction for students, to programs for school groups and community groups, to community engagement. In addition, numerous other entities also provide educational opportunities for children and adults to learn about many facets of local ecosystems. These contributions by non-governmental organizations, schools and universities, cultural and religious groups, government agencies, museums and aquaria, nature centers, and others contribute to informing the public about the interrelationships between ecosystems, the potential effects of human behaviors, and best practices for resource conservation, among other topics.

If established, the proposed CT NERR's educational objectives focus on two of the reserve goals:

Strengthen stewardship, protection, and management of estuaries and their watersheds through place-based approaches to training and education

Advance environmental appreciation and scientific literacy utilizing a place-based approach, enhancing people's ability to make science-based decisions that positively affect estuaries, watersheds, and coastal communities.

The reserve could also help its partners and others in the region collaborate on and integrate their educational programs. Finally, the proposed CT NERR would carry out its own education and outreach programs for teachers, K-12 students, and interested members of the coastal management community (through the Coastal Training Program). Despite years of grappling with coastal management challenges, an array of complex coastal issues still challenge communities in the region. This suggests there will continue to be a need for further community engagement about locally-relevant issues. Goals for the proposed CT NERR's educational and outreach activities might potentially extend beyond educating individuals towards bolstering community engagement and stewardship in the project area.

Even with added capacity from the proposed CT NERR, given growing interest in sustainability and growing awareness of the need to better understand environmental stressors, there will continue to be an enduring need for more formal education, field trips, interactions between researchers and the public, and other types of community involvement opportunities. The activities of the reserve are expected to support expanded educational and outreach opportunities in the area, and thus, are not expected to result in cumulatively significant adverse impacts in the next 10 to 15 years.

6.4.6.3 Research and Monitoring

A number of institutions (academic, governmental, and non-governmental) have active research and monitoring programs in the project area. A partial list of organizations is included in *Chapter 11 of the Draft Management Plan* (included in this document as appendix A) and the primary research topics are summarized on their websites. However, there are still many topics yet to be explored by researchers, information gaps with respect to areas being studied, and a large number of locations for which baseline data are not yet available.

If designated, the proposed CT NERR would collect baseline data about environmental conditions, including habitat and ecosystem service data. Research begins with the fundamental questions to be answered by the reserve, for example:

Climate Change: How are the dominant physical, ecological, and socio-demographic attributes that characterize reserves and their targeted watersheds affected by climate change?

Water Quality: What is the status of water quality in reserves? What are the natural and anthropogenic drivers that are causing water quality changes? What are the impacts of those changes on reserve ecosystems, including their associated human communities?

Habitat Protection: What is the magnitude and variability of ecosystem change in reserve targeted watersheds and their ecologically sensitive habitats? What are the relative influences of environmental and anthropogenic drivers in initiating and sustaining these changes? How do reserve ecosystems and reserve habitats respond to ecosystem change?

Reserve research and monitoring is expected to contribute a great deal to efforts to increase the awareness of community members and decision-makers about natural and anthropogenic processes, restoration efforts and their impacts, and key ecosystem services. Specifically, the reserve could help broaden and deepen community knowledge about key ecosystem attributes and services, their impacts, and management options. Reserve staff could also serve to facilitate collaboration among outside researchers and practitioners. Because of the many outstanding research needs associated with the project area as a whole, any cumulative adverse impacts related to research and monitoring in the study area would not be anticipated to be significant.

6.4.6.4 Stewardship

The *Draft Management Plan* (included in this document as Appendix A) articulates several goals for the proposed CT NERR, including that the reserve could be a center for integrating sound estuarine science with adaptive management across a variety of end users in Connecticut. Also, the reserve would seek to inform resource managers and local communities about ways to address key coastal issues. A key goal of the proposed reserve would help better connect decision-makers with the data and resources they need to effectively address key coastal issues like climate change, habitat restoration, and water quality. Ultimately, this could lead to more informed ecosystem-based management decisions that factor in many complex elements and interrelationships. Over time, the reserve would most likely serve as a clearinghouse for access to trusted sources for decision-makers facing resource management challenges, as well as for students and visitors to learn about The Sounds' uplands, marshes, and estuaries and the challenges facing them. As important as ongoing activities in this vein and reserve contributions would be, in looking at the considerations applicable to determining whether impacts are cumulatively significant, OCM judges that even the cumulative impacts of anticipated education, research, monitoring, and stewardship activities would not be significant.

6.4.7 Summary

In summary, this evaluation does not identify cumulatively significant adverse effects from designation and operation of the proposed CT NERR or from past, present, or reasonably foreseeable actions. For more detailed information, see preceding sections and the documents OCM considered as part of preparing this environmental impact statement (*Section 3.5—Documents that Influenced the Scope of the Draft Environmental Impact Statement*). All available information indicates that natural resources and human communities will be expected to continue to be able to sustain themselves into the future, despite the cumulative effects of stressors, without crossing ecological thresholds. However, there are some unknown or poorly-understood factors that could intervene, for example, climate change. Designation of the proposed CT NERR and the availability of reserve staff to coordinate with researchers and resource managers about ecosystem functioning should support the development of management strategies to address and, to the extent practicable, mitigate the cumulative effects of natural and anthropogenic stressors.

6.5 Relationship To Other Applicable State, Regional, Local Plans and Policies

It is anticipated that the establishment of the proposed CT NERR would not conflict with the objectives of federal, state, regional, or local land use plans, policies, or controls for the areas within the designated boundaries. The *Draft Management Plan* describes the activities that take place in and around the proposed reserve and the authorities that govern those uses (Appendix A). All the lands and waters comprising the proposed CT NERR are currently under public ownership by entities anticipated to become a party to a voluntary multi-partner *Memorandum of Understanding*, hereafter referred to as the MOU (included in Appendix B of the *Draft Management Plan*) that will describe the roles and responsibilities of each party within the administrative boundary of the proposed CT NERR. If designated, reserve staff would coordinate with UConn and DEEP, the landowning entities, to address any issues that may arise after the proposed reserve is designated. Any advice provided or action taken by the proposed reserve staff or signatory parties to the MOU is expected to be consistent with Reserve System, local, state, or federal statutes / regulations / policies and the roles and responsibilities detailed in the MOU. Proposed CT NERR staff would regularly meet with the future reserve advisory committee, various strategic partners, and key community leaders to share ideas, promote efficiencies, and resolve conflicts. Using a collaborative process, the reserve staff and its partners would ensure the implementation of the reserve's *Draft Management Plan*. The following paragraphs summarize some of the state, regional, and local plans that apply to the project area. *Chapter 5 of the Draft Management Plan* presents a more comprehensive listing of the state and local authorities and plans outlined below, including links where available.

STATE MANAGEMENT

DEEP exercises control of land and waters within its jurisdiction through a variety of existing statutory and regulatory mechanisms. The coastal permitting program regulates virtually all activities within the tidal, coastal, or navigable waters of Connecticut under the Structures, Dredging and Fill Statutes (C.G.S. §§ 22a-359 to 22a to -363f) and in tidal wetlands under the Tidal Wetlands Act (C.G.S. §§ 22a-28 to 22a-35, inclusive). The major objectives are to avoid or minimize navigational conflicts, encroachments into the state's public trust area, and adverse impacts on coastal resources and uses, consistent with the policies of the Connecticut Coastal Management Act (C.G.S. §§ 22a-90 to 22a-112, inclusive), pursuant to C.G.S. § 22a-98. On the matter of public trust under the common law public trust doctrine, coastal states as sovereigns hold the submerged lands and waters waterward of the mean high-water line in trust for the public. In addition to ownership, the public trust doctrine provides that, subject to applicable regulations and permits, the general public may freely use these lands and waters for traditional public trust uses. DEEP administers section 401 of the Clean Water Act (33 U.S.C. §1341) ensuring that discharges into navigable waters, including all wetlands, watercourses, and natural and man-made ponds are consistent with the Clean Water Act and the Connecticut Water Quality Standards. Separately, DEEP wastewater discharge permitting regulates discharges to state waters pursuant to R.C.S.A. §§ 22a-416 to -438; -430-1 to -7. Temporary and emergency authorizations for regulated activities may also be issued by DEEP if conditions are needed to prevent or mitigate an imminent threat to human health or the environment. Under the Regulations of Connecticut State Agencies, DEEP also regulates aspects related to boating safety (Title 15) and fishing and game (Title 26), which also includes Endangered and Threatened Species and Species of Special Concern. A special mention is given to those regulations that DEEP uses to manage the two types of properties it owns within the project areas as each property type is designed to support different uses. While both State Parks and Natural Area

Preserves generally support aspects of environmental conservation and recreation, the allowable uses for each are distinct. State Parks more broadly emphasize recreation whereas Natural Area Preserves have a greater emphasis on habitat and wildlife management. The general regulations for State Park properties are codified in R.C.S.A. § 23-4-1. The regulations for the management of state Natural Area Preserves and procedures for the adoption of a management plan for each preserve are codified in R.C.S.A. § 23-5c-1.

The various statutory and regulatory authorities described above span multiple organizational units within DEEP, but it should be noted that the Agency also operates its own environmental conservation police unit that is tasked with enforcing these as well as other applicable law enforcement and public safety measures.

DEEP is not the only state entity with authority over activities concurrent with the project area, however:

- The Connecticut Siting Council regulates the siting of land-based and offshore infrastructure facilities, including electric power facilities and transmission lines, hazardous waste facilities, and telecommunications towers and other technology via C.G.S. § 16-50k.
- As the lead state agency for aquaculture development in the state, the Department of Agriculture Bureau of Aquaculture (DA / BA) has exclusive authority for granting or denying aquaculture permits pursuant to C.G.S. § 22-11h. The DA / BA also licenses aquaculture producers of seaweed through C.G.S. § 22-11j. C.G.S. § 26-194 contains the authority for the DA / BA Shellfish Leasing Program and establishes procedures and regulations for leasing.
- The Department of Economic and Community Development, through the State Historic Preservation Office (SHPO), regulates archaeological resources pursuant to R.C.S.A. § 10-386. This states that no person may conduct an archaeological investigation on State lands or on a State Archaeological Preserve without a permit from SHPO. Further, if the proposed investigation includes ground disturbing activities on property managed by DEEP, the applicant must obtain a Special Use Permit from the DEEP Land Acquisition and Management Unit.
- UConn, which owns the Pine Island property, maintains a general policy of open access and use for that site. However, should any potential activities fall within jurisdictional boundaries of DEEP or other state agencies, those activities are governed by the appropriate authorities.

Local Management

The above-listed state management authorities identify aspects of state control for areas of jurisdiction related to upland properties and waters within the context of the project area. With respect to water areas, there are also overlapping areas of municipal management in two fundamental areas.

Pursuant to C.G.S. § 26-257a, municipal shellfish commissions manage shellfish resources, shellfisheries, and aquaculture in town waters. Although they do not have legal authority to directly permit aquaculture structures, they play a role in the review process for potential social and use conflicts, as well as potential effects on protected habitats or species caused by aquaculture activity.

Pursuant to C.G.S. §§ 22a-113k through 22a-113t, municipal harbor management commissions manage and monitor local developments that affect navigation and maritime uses, although they do not have direct regulatory authority. In municipalities with approved harbor management plans, the Stateappointed Harbor Masters supervise the allocation of moorings, respond to abandoned vessels, and carry out their other duties in accordance with the harbor management plan.

RELEVANT PLANS

Given the substantive expanse of the project area, there are several plans and related efforts whose themes, goals, and objectives are relevant to include.

Natural Area Preserve Management Area Plans: Currently, the Lord Cove NAP management plan is complete and will serve as a blueprint for maintaining its habitat conservation value and leveraging appropriate uses by the proposed CT NERR. As plans are developed and approved by DEEP for additional NAPs relevant to the proposed CT NERR, these would be included within management planning efforts.

Long Island Sound Blue Plan: C.G.S. § 25-157t calls for a marine spatial plan to guide future development and permitting of Long Island Sound's waters and submerged lands. Approved in May of 2021, the policies are enforceable pursuant to C.G.S. § 25-157t(h) and shall be considered in the review of applications under the applicable regulatory programs for DEEP, Connecticut Siting Council, DA / BA, and municipal shellfish commissions.

Connecticut Wildlife Action Plan (CT-WAP): Developed by DEEP, the 2015-2025 CT-WAP is a blueprint for the conservation of the state’s wildlife as part of a national framework for proactively conserving fish and wildlife, including their habitats, over a ten-year horizon.

Connecticut Forest Action Plan (CT-FAP): Developed by DEEP, the 2020 Connecticut Forest Action Plan aims to identify issues and prioritize important areas, values, and needs.

Statewide Comprehensive Outdoor Recreation Plan (SCORP): Developed by DEEP, the 2017-2022 Statewide Comprehensive Outdoor Recreation Plan identifies outdoor recreation issues of statewide significance and evaluates the supply of and the demand for outdoor recreation resources and facilities in Connecticut.

Connecticut Plan of Conservation & Development (Plan of C&D): The State Office of Policy and Management oversees the Plan of Conservation & Development and revises it on a recurring five-year cycle. Revisions are in turn submitted to the legislature for approval and adoption and once adopted, the Plan of Conservation & Development is then implemented by State agencies whenever they undertake actions specified by C.G.S. § 16a-31.

Watershed Planning: The DEEP Watershed Management Program assists in developing comprehensive watershed management plans to protect and restore water quality and conserve and manage water resources. DEEP prioritizes the development and implementation of plans that focus on addressing a specific nonpoint source impairment identified on DEEP’s Integrated Water Quality Report to Congress. Watershed plans that adhere to USEPA watershed planning guidance and are approved by the USEPA are eligible for funding under section 319 of the Clean Water Act for plan implementation.

Governor’s Council on Climate Change (GC3) Workgroup Plans: In 2019, the state re-established and expanded the membership and responsibilities of the GC3 originally organized in 2015. The GC3 included workgroups on several topics that are relevant for the proposed CT NERR including, but not limited to, Working and Natural Lands, Equity and Environmental Justice, and Science and Technology, and Adaptation Planning.

Statewide Energy Plans: DEEP is responsible for plans dealing with energy and climate change issues including the Comprehensive Energy Strategy, required by C.G.S. § 16a-3d(a), and modified by Public Act 18-82 to become a Comprehensive Climate and Energy Strategy by 2020, and the Integrated Resource Plan required by C.G.S. § 16a-3a, that assesses the state's future electric needs and develops a plan to meet those needs, which may require connections to offshore wind generation facilities through Long Island Sound, even if such facilities are themselves located elsewhere.

6.6 Irreversible and Irretrievable Commitment of Resources

NEPA requires an analysis of the extent to which the proposed action's direct and indirect effects would commit operational resources to uses that cannot be recovered or that future generations would be unable to reverse.

A resource commitment is considered *irreversible* when impacts from its use will limit future use options and the change cannot be reversed, reclaimed, or repaired. Irreversible commitments generally occur to nonrenewable resources such as minerals or cultural resources, and to those resources that are renewable only over long time spans, such as soil productivity.

A resource commitment is considered *irretrievable* when the use or consumption of the resource is neither renewable nor recoverable for use by future generations until reclamation is successfully applied. Irretrievable commitments generally apply to the loss of production, harvest, or natural resources and are not necessarily irreversible.

The designation of the proposed CT NERR and implementation of the *Draft Management Plan* (included as Appendix A of this document) should result in few irreversible or irretrievable commitments of resources. The action alternatives would require minor commitments of both renewable and nonrenewable energy and material resources for the management, research, education, and outreach activities associated with designation and operation of the proposed CT NERR. Designation of a reserve is also expected to result in the commitment of substantial resources, staff time, and funds associated with reserve activities. Nonrenewable resources that would be used during these activities include fuel, water, power, and other resources necessary to implement and operate a reserve. Ongoing operational funding is needed to plan, manage, and otherwise implement the proposed CT NERR. Once these operational funds are spent, they become irretrievable. Also, to the extent that any buildings or permanent infrastructure were to be installed in support of the proposed CT NERR's operations, those efforts would also effectively irretrievably commit resources unless the infrastructure were removed or the reserve were de-designated.

Under the no action alternative, the staff time invested in analyzing and planning for potential reserve designation and implementation would not result in an action that achieved the purpose and need for the proposed action. A team of individuals prepared the *Draft Management Plan* for the reserve, staff at NOAA thoroughly evaluated the proposed designation, the preparers of the report listed below prepared this *Draft Environmental Impact Statement*, and staff affiliated with a number of proposed partners have contributed time, effort, and information in support of a potential reserve designation. However, partner actions in furtherance of habitat manipulations and restoration activities or associated education and outreach could continue, even under the no action scenario. In addition, limited environmental change is anticipated or permitted through the NERR program (other than minor disturbances associated with research). The proposed CT NERR would be operated and managed with advice of the land holding partners or their lessees. Each of these partners has a vested interest in the reserve due to land ownership, existing activities, or their interest in conserving natural resources. This partnership is voluntary, executed through a multi-party MOU that provides structure for the long-term support of the proposed CT NERR. However, any partner, could, if it chose, withdraw from the partnership. The multi-party MOU details the relationships between partners and each partner's commitment to the proposed CT NERR. It has been developed by signatories and will be available in the *Draft Management Plan*.

Recreational and commercial fishing, aquaculture, and other traditional commercial uses of The Sounds are expected to continue under current regulatory authorities, and these activities are not directly tied to the proposed CT NERR's implementation or management. Regardless of whether a reserve is designated, it is expected that the site partner, DEEP, will continue stewardship activities and oversight of aquaculture and fishing activities within the project areas, albeit without the benefits associated with the coordination and resources afforded through the existence of a CT NERR. It is one of the goals of the proposed CT NERR to better understand the project area in order to provide decision-makers and the public with contemporary science knowledge. If a reserve is designated, the operational funding OCM awards to it each year could lead to irreversible or irretrievable commitments of resources in the study area.

6.7 Local Short-Term Uses of the Environment and Long-Term Productivity

NEPA requires consideration of the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. The short-term uses of the environment relating to the boundary alternatives are expected to result, generally, in overall improvements to the health and quality of the affected natural and socioeconomic environments by: (1) improving the scientific understanding of the ecological functioning of the area; (2) expanding opportunities for public education and outreach related to the estuarine system; and (3) providing future CT NERR staff to assist site partners in the conduct of their ongoing and planned management of the reserve and to help advise on ways to mitigate any associated adverse environmental impacts stemming from these site partner activities. As noted previously, most of the adverse effects from the designation of a reserve would be short-term (e.g., during any restoration or construction process) and particular to just some of the species present (e.g., invasive species). These predominantly short-term, adverse effects are expected to co-occur with long-term benefits to ecosystem services and productivity.

The long-term productivity related to the designation of a reserve is based on the goals of the proposed CT NERR and the *Draft Management Plan* designed to achieve these goals. This includes use of ecosystem-based management strategies as a driving force for habitat manipulation and restoration activities within the proposed reserve so as to improve understanding of the environmental services provided. This management approach is expected to result in substantial improvements to natural resources management in the project area in the long-term and to promote scientific investigations to improve informed decision-making, develop place-based education and training programs that inspire and educate the community, and create opportunities to practice and promote stewardship that sustains biological and natural resources while promoting the social values of diversity, equity, inclusion, and environmental justice throughout all aspects of the programming and the project area.

Under the no action alternative, it is expected the short-term improvements to the health and quality of the environment and the long-term productivity of the area as indicated by improved environmental services would be less pronounced. Although ongoing activities by site partners (UConn and DEEP) could be expected to provide some of these benefits without a research reserve designation, it is expected that, absent the coordinating function and resources provided by the Reserve System, these benefits would not be as great as those provided under the action alternatives.

7 Compliance With Other Environmental Review Requirements

In addition to compliance with NEPA, OCM complied with several other environmental and administrative review requirements, including those listed below, as part of its consideration of the proposed action to designate the CT NERR. If OCM decides to award funding to the CT NERR, OCM would conduct any additional environmental reviews required by law at that time.

7.1 Clean Air Act

The Clean Air Act (42 U.S.C. §§ 7401 *et seq.*) directs the USEPA 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). 42 U.S.C. § 7506(c) prohibits federal agencies from licensing, permitting, or approving any activity that does not conform to an approved State Implementation Plan issued to enforce the NAAQs.

7.2 Clean Water Act

The Clean Water Act (33 U.S.C. §§ 1251 *et seq.*) is the principal federal law governing pollution control and water quality of the Nation's waterways. Section 404, administered by the U.S. Army Corps of Engineers (USACE), authorizes a permit program for the discharge of dredged or fill material into navigable waters. Section 401 of the Clean Water Act requires applicants for federal licenses or permits for activities that may result in a discharge of pollution into navigable waters to obtain a certification of compliance with applicable water quality standards and goals from the appropriate state (or a waiver from the state).

7.3 Coastal Barrier Resources Act

The Coastal Barrier Resources Act, 16 U.S.C. §§ 3501-3508, encourages the conservation of hurricane prone, biologically rich coastal barriers by restricting federal expenditures that encourage development, such as federal flood insurance. The Coastal Barrier Resources Act designated relatively undeveloped coastal barriers along the Atlantic and Gulf coasts and made these areas ineligible for most new federal expenditures and financial assistance. The Coastal Barrier Improvement Act of 1990 (Pub. L. No. 101–591) reauthorized the Coastal Barrier Resources Act and expanded the system to include undeveloped coastal barriers along the Florida Keys, Great Lakes, Puerto Rico, and U.S. Virgin Islands, and also added a new category of coastal barriers to the system. The new category, "otherwise protected areas," includes undeveloped coastal barriers that are within the boundaries of an area established under federal, state, or local law, or held by a qualified organization, primarily for wildlife refuge, sanctuary, recreational, or natural resource conservation purposes.

7.4 Coastal Zone Management Act

The goal of the Coastal Zone Management Act (16 U.S.C. §§ 1451, *et seq.*) is to preserve, protect, develop, and, where possible, restore and enhance the nation's coastal resources. Under the Coastal Zone Management Act, NOAA's Office for Coastal Management supports implementation of federally-approved, state coastal zone management programs (CMP). Section 307 of the Coastal Zone Management Act, the "federal consistency" provision, requires any federal action inside or outside of a state's coastal zone that affects any land or water use or natural resources of the coastal zone to be consistent with the enforceable policies of an approved state CMP. The federal consistency regulations at 15 C.F.R. § 930 set forth detailed timeframes and procedures that must be followed. Subpart C of the regulations provides that for all federal agency activities, inside or outside the coastal zone, the federal agency must submit a Consistency Determination to the state if the federal agency determines the activity may have reasonably foreseeable effects on the state's coastal uses or resources. 15 C.F.R. § 930.34(a)(1) - federal agency activities must be consistent to the maximum extent practicable with the enforceable policies of the state's CMP. If there are no reasonably foreseeable effects, the federal agency may be required to provide a Negative Determination to the state. See 15 C.F.R. § 930.35.

7.5 Endangered Species Act

The Federal Endangered Species Act of 1973, as amended (16 U.S.C. §§ 1531, *et seq.*), provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and for the conservation of the ecosystems on which they depend. The Endangered Species Act directs all federal agencies to work to conserve endangered and threatened species and to use their authorities to further the purposes of the ESA. Under the ESA, NOAA's National Marine Fisheries Service (NOAA Fisheries) and the U.S. Fish and Wildlife Service (USFWS) (in this subsection, collectively, "the Services") publish lists of endangered, threatened, candidate, and other species with special status under the Endangered Species Act.

Section 7(a)(2) of the Endangered Species Act states that each federal agency shall, in consultation with the Secretary, insure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of ESA Critical Habitat for those species. The Endangered Species Act requires action agencies to consult or confer with the Services when there is discretionary federal involvement or control over the action. When a federal agency's action "may affect" a protected species or its ESA Critical Habitat, that agency is required to consult with NOAA Fisheries or USFWS. Informal consultation with the Services is sufficient for actions that "may affect but are not likely to adversely affect" listed species or federally designated ESA Critical Habitats. This finding can be made only if all of the reasonably expected effects of the proposed action would be beneficial, insignificant, or discountable. An action agency shall confer with the Services if the action is likely to jeopardize the continued existence of a proposed species or result in the destruction or adverse modification of proposed ESA Critical Habitat. Formal consultation with the Services and preparation of a biological assessment is required for actions that "may affect and are likely to adversely affect" listed species or federally designated ESA Critical Habitats. An action agency shall confer with the Services if the action is likely to jeopardize the continued existence of a proposed species or result in the destruction or adverse modification of proposed ESA Critical Habitat.

7.6 Farmland Protection Policy Act

The Farmland Protection Policy Act (Pub. Law 98-98, 7 U.S.C. §§ 4201 *et seq.*) is intended to minimize the impact Federal programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses. It assures that to the extent possible Federal programs are administered to be compatible with state, local units of government, and private programs and policies to protect farmland. Federal agencies are required to develop and review their policies and procedures to implement the Farmland Protection Policy Act every two years. The Farmland Protection Policy Act does not authorize the Federal government to regulate the use of private or non-federal land or, in any way, affect the property rights of owners. For purposes of the Farmland Protection Policy Act, farmland includes prime farmland, unique farmland, and land of statewide or local importance.

7.7 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (16 U.S.C. §§ 661 *et seq.*) provides for interagency consultation, particularly consultation with the USFWS and appropriate state wildlife agency, when federal agencies plan to conduct activities involving the impoundment, diversion, deepening, control, or modification of a body of water for any purpose, with only two exceptions. Interagency consultation allows federal agencies to incorporate recommended conservation measures intended to reduce potential project impacts on fish, wildlife, and the aquatic and terrestrial plant species upon which they depend.

7.8 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 104-297), established a program to promote the protection of Essential Fish Habitat (EFH) for federally-managed species 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, federal agencies are obligated to consult with NOAA Fisheries with respect to all actions, or proposed actions, authorized, funded, or undertaken by the agency that may adversely affect EFH. An adverse effect is defined as any impact that reduces quality or quantity of EFH.

7.9 Marine Mammal Protection Act

The Marine Mammal Protection Act of 1972 (16 U.S.C. §§ 1361 *et seq.*), as amended, prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, as well as the importation of marine mammals and marine mammal products into the United States. There are some exceptions to the prohibitions on taking marine mammals, including a mechanism for requesting authorization from NOAA Fisheries Office of Protected Resources for "incidental," but not intentional, taking, of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing or directed research on marine mammals) within a specified geographic region. The Marine Mammal Protection Act and regulations adopted thereunder restrict harassment – meaning any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal in the wild or that has the potential to disturb a marine mammal in the wild by causing disruption of behavioral patterns, including breathing, breeding, feeding, migration, and sheltering.

NOAA Fisheries Office of Protected Resources processes applications for incidental takes of small numbers of marine mammals. Authorization for incidental takes may be granted if NOAA Fisheries finds that the taking will be of small numbers, have no more than a “negligible impact” on those marine mammal species or stocks, and not have an “unmitigable adverse impact” on the availability of the species or stock for “subsistence” use. NOAA Fisheries issuance of an incidental take authorization also requires NOAA Fisheries to make determinations under NEPA and Section 7 of the ESA (for marine mammals also listed under the Endangered Species Act). Incidental harassment authorizations may be issued when the action has the potential to result in harassment only (i.e., injury or disturbance).

7.10 Migratory Bird Treaty Act and Executive Order 13186

The Migratory Bird Treaty Act (16 U.S.C. §§ 715 *et seq*.) implements the United States’ commitment to bilateral treaties, or conventions, with Great Britain, Canada, Japan, Russia, and Mexico for the protection of shared migratory bird resources. The Migratory Bird Treaty Act makes unlawful for anyone to pursue, hunt, take, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg or any such bird, unless authorized under a permit issued by the Secretary of the Interior. The Migratory Bird Treaty Act also regulates scientific collection and possession of migratory birds for educational purposes. The Migratory Bird Treaty Act does not specifically protect migratory bird habitat, but USFWS may suggest consideration of time of year restrictions for construction or remedial activities at sites where it is likely migratory birds may be nesting or project schedules that will avoid migratory bird nesting seasons. Executive Order 13186, “Responsibilities of Federal Agencies to Protect Migratory Birds,” directs federal agencies taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations to develop (within two years of the action) a Memorandum of Understanding with USFWS that promotes the conservation of migratory bird populations.

7.11 National Historic Preservation Act

The National Historic Preservation Act of 1966 (54 U.S.C. §§ 300.101 *et seq.*) requires federal agencies to take into account the effects of their undertakings on historic properties in accordance with regulations issued by the Advisory Council on Historic Preservation at 36 C.F.R. § 800. The regulations require that federal agencies consult with states, tribes, and other interested parties (consulting parties) when making their effects determinations. The regulations establish four basic steps in the National Historic Preservation Act 106 process: determine if the undertaking is the type of activity that could affect historic properties, identify historic properties in the area of potential effects, assess potential adverse effects, and resolve adverse effects.

7.12 National Marine Sanctuaries Act

Under the National Marine Sanctuaries Act (16 U.S.C. §§ 1431 *et seq.*), federal agency actions, internal or external to a national marine sanctuary, including private activities authorized by licenses, leases, or permits, that are likely to destroy, cause the loss of, or injure any sanctuary resource are subject to consultation with the Secretary of Commerce. Each federal agency proposing such an action must provide a written statement describing the action and its potential effects on sanctuary resources no later than 45 days before the final approval of the action. In addition, sanctuary permits may be required for certain actions that would otherwise be prohibited.

7.13 Rivers and Harbors Act

The Rivers and Harbors Act of 1899 (33 U.S.C. §§ 401 *et seq.*) regulates development and use of the nation's navigable waterways. Section 10 of the Rivers and Harbors Act (33 U.S.C. § 403) prohibits the unauthorized obstruction or alteration of any navigable waters of the U.S. This section provides that the construction of any structure in or over any navigable water of the U.S., or the accomplishment of any other work affecting the course, location, condition, or physical capacity of such waters is unlawful unless authorized by the U.S. Army Corps of Engineers. Activities requiring section 10 permits include structures (e.g., piers, wharfs, breakwaters, bulkheads, jetties, weirs, transmission lines) and work such as dredging or disposal of dredged material, or excavation, filling, or other modifications to the navigable waters of the U.S.

7.14 Executive Order 11988 – Floodplain Management

Executive Order 11990 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 mitigation measures if adverse impacts are unavoidable. Executive Order 11988 requires federal agencies to avoid, to the extent possible, long and short-term adverse impacts associated with the occupancy and modification of floodplains. Executive Order 13690 updates Executive Order 11988 and establishes a new federal flood risk management standard intended to reduce risks and costs associated with future flood disasters by requiring all federal investments in and affecting floodplains to meet higher flood risk standards. It also requires all future federal investments in and affecting floodplains to be resilient to flooding, including as it is anticipated to be exacerbated by climate change.

7.15 Executive Order 11990 – Protection of Wetlands

Executive Order 11990 requires federal agencies to avoid, to the extent possible, adverse impacts associated with occupying or modifying floodplains and wetlands, and to avoid floodplain or wetland development whenever there is a practical alternative. Executive Order 11988 requires federal agencies to avoid, to the extent possible, long- and short-term adverse impacts associated with the occupancy and modification of floodplains.

7.16 Executive Order 12898 – Environmental Justice

To be consistent with the President's Executive Order 12898 on Environmental Justice, Executive Order 12948 (Amendment to Executive Order 12898), and the Department of Commerce's Environmental Justice Strategy, applicants must ensure that their projects will have no disproportionately high and adverse human health or environmental effects on minority or low-income populations. Federal agencies must analyze the effects of proposed programs, policies, and activities on minority and low-income populations, including Indian Tribes.

7.17 Executive Order 13112 – Invasive Species

The purpose of Executive Order 13112 is to prevent the introduction of invasive species; respond to and control invasions in a cost-effective and environmentally sound manner to minimize their economic, ecological, and human health implications; and to provide for restoration of native species and habitat conditions in ecosystems that have been invaded. See also Executive Order 13751 (December 2016).

7.18 Executive Order 13158 – Marine Protected Areas

Executive Order 13158 requires federal agencies to identify actions that affect natural or cultural resources that are within MPAs. It further requires federal agencies, in taking such actions, to avoid harm to the natural and cultural resources that are protected by MPAs.

7.19 Executive Order 13175 – Consultation and Coordination With Indian Tribal Governments

"Consultation and Coordination with Indian Tribal Governments" requires federal agencies to establish procedures for meaningful consultation and coordination with tribal officials in the development of federal policies that have tribal implications. NOAA implements EO 13175 through the "NOAA 13175 Policy." Pursuant to the Policy, NOAA offers affected federally-recognized tribes government-to-government consultation at the earliest practicable time it can reasonably anticipate that a proposed policy or initiative may have tribal implications. "Proposed policies" that may have tribal implications include regulations, legislative comments, proposed legislation, and other policy statements or actions. The Policy provides guidance and procedures designed to ensure that NOAA effectively and consistently conducts required government-to-government consultations with federally-recognized tribes. If a proposed action may have tribal implications, the office proposing the action should, at the earliest time practicable, review the NOAA 13175 Policy to determine whether tribal consultation should be initiated.

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11 Appendix A: Proposed CT NERR Draft Management Plan, 2022-2027

[See attachment for the *Proposed CT NERR Draft Management Plan, 2022-2027*.]

12 Appendix B: Response To Public Comments On Draft Environmental Impact Statement and Draft Management Plan

[Included In *Final Environmental Impact Statement*]

13 Appendix C: Federal Consistency Determination

[Included In *Final Environmental Impact Statement*]

14 Appendix D: National Historic Preservation Act Consultation

[Included In *Final Environmental Impact Statement*]

15 Appendix E: Federal Response For Protected Resources Consultations

[Included In *Final Environmental Impact Statement*]

15.1 Endangered Species Act—NOAA Fisheries

15.2 Endangered Species Act—USFWS

15.3 Essential Fish Habitat

16 Appendix F: Best Management Practices For Protected Resources

[Included In *Final Environmental Impact Statement*]