MARSH CONSERVATION PLANNING FOR MATTITUCK CREEK, MATTITUCK NY

NEIWPCC

Final Report: June, 2021

DISCLAIMER

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Long Island Sound Study
A Partnership to Restore and Protect the Sound

ACKNOWLEDGEMENTS

Preparation of this document was organized by Jonathan Clough of Warren Pinnacle Consulting, Inc. with close oversight from Victoria O'Neill of NEIWPCC. Significant assistance in providing data sources was provided by John Sepenoski, Town of Southold, NY. Extensive writing assistance was provided by Cayla Sullivan of US EPA. The cover photo is courtesy of Alexa Fournier, NYSDEC.

Completion of this document would not have been possible without the assistance of our stakeholder group who provided us with material and feedback on drafts over several months of meetings:

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EXECUTIVE SUMMARY

Mattituck Creek currently hosts 60 acres of tidal wetlands. These wetlands have been designated as State Tidal Wetlands and support a number of fish and wildlife species.

The history of the Mattituck Creek shoreline includes significant historical manipulation and development, especially in the early 20th century. However, in terms of marsh-habitat stability, more recent marsh losses have been minimal. An analysis of marsh habitat from 1974 to 2005 estimated that total Mattituck Creek marsh area decreased by less than one percent.

While most current marsh resources are located on public lands, there are some marsh fringes along the creeks further south that are located on privately-owned lands. Looking at the modeling of marsh habitat through the year 2100, many private-land parcels have the potential for marsh habitat in the near future. This finding indicates that the management of the dry-land to wetland boundary will be an important topic in this region over the next several decades.

Mattituck-Creek marshes provide many important benefits, both to humans and natural systems. These include critical habitat for birds, including a number of endangered and threatened species, and habitat for invertebrates and small fish that form the basis for the near-shore ecological community. Other benefits provided by coastal marshes include protection of property from waves during storm events, the processing and reduction of nutrients in coastal waters, and local recreation and community access to ecological resources.

Mattituck-Creek marsh systems are subject to a number of threats, including encroachment from adjoining development, damage from excess nutrients, marine debris and microplastics, and impacts from other contaminants in marsh waters. Furthermore, the prospect of rising sea levels means that marshes may also need to move laterally to adjacent uplands to maintain their total acreage. Sea-level rise modeling suggests that Mattituck-Creek marshes will become flooded more frequently, changing their ecological niche, and will also have the potential to expand onto adjacent lands that are currently dry. The extent that this migration is possible, however, depends on the land use and policies governing adjacent lands.

To ensure that Mattituck Creek marshes are preserved for current and future generations, local governments, planners, and NGOs have several tools available. In general, these strategies fall into the categories of land purchases and easements, town, county, or state regulation, and marsh restoration. Education is also an important tool to ensure that community members recognize the critical ecological role of salt marshes and their impact on regional character. Modeling and data analysis can ensure that conservation plans have an eye towards anticipated future conditions.

Project Introduction

Conservation of coastal wetlands can provide a wide range of benefits to coastal communities, from increased resilience to storm events, to providing suitable habitats for animals and plants that are important ecologically and economically. Tidal wetlands are capable of sequestering carbon and other nutrients; they also filter upland and runoff waters from pollutants and sediments and provide a protective buffer to reduce shoreline erosion due to wave action. Marsh and natural areas can also be important for their social, historical, and recreational role within coastal communities.

Despite their value, tidal marsh areas have been degraded or lost over time as a result of human activities. In addition, changes in climatic and ecological conditions and pressures from infrastructure development complicate effective conservation planning and management. For example, the accelerating rate of sea-level-rise (SLR) due to climate change requires coastal managers to consider not only existing tidal flooding conditions, but also potential changes that may occur in the future. In particular, marshes can respond to increased inundation by migrating inland and colonizing areas that were previously at higher elevations. However, in many coastal communities, marsh migration can be complicated by the fact that land is not available or developed areas may require proper restoration. *(Background text courtesy of Propato et al. 2018)*

Objective

The objective of this project is to provide Long Island Sound municipalities, communities, and marsh-conservation groups with predicted changes to wetland habitat under a wide range of sea-level rise scenarios at select, large wetland complexes. These results are integrated with land-ownership information to assist in developing suitable marsh conservation plans that work towards increasing coastal resiliency.

Approach

This work leverages existing Sea Level Affecting Marshes Model (SLAMM) numerical and map based projections of the potential effects of sea-level rise on the wetland communities, for the entirety of coastal New York State (Clough et al. 2016), (Propato et al. 2018)).

To better assist communities in planning and decision making these data are summarized in fact sheets and a stakeholder interactive viewer that intersects marsh land cover projections and tax parcel information has been developed (http://warrenpinnacle.com/LIMaps/).

MATTITUCK CREEK MARSH RESOURCES

INTRODUCTION

Mattituck Creek is located on the north side of Long Island in Suffolk County, in the town of Southold in Mattituck New York. This document focuses on the benefits and the conservation of current tidal wetlands at the site, and the potential for future wetland expansion. Currently, most of the site's wetlands are located to the northeast of the study area (Figure 1). These 60 acres of tidal wetlands have been designated a Long Island Sound Stewardship Area and a New York State Significant Coastal Fish & Wildlife Habitat because the area supports a number of fish and wildlife species such as surf clams, hard clams, oysters, and blue mussels (Long Island Sound Study 2012).

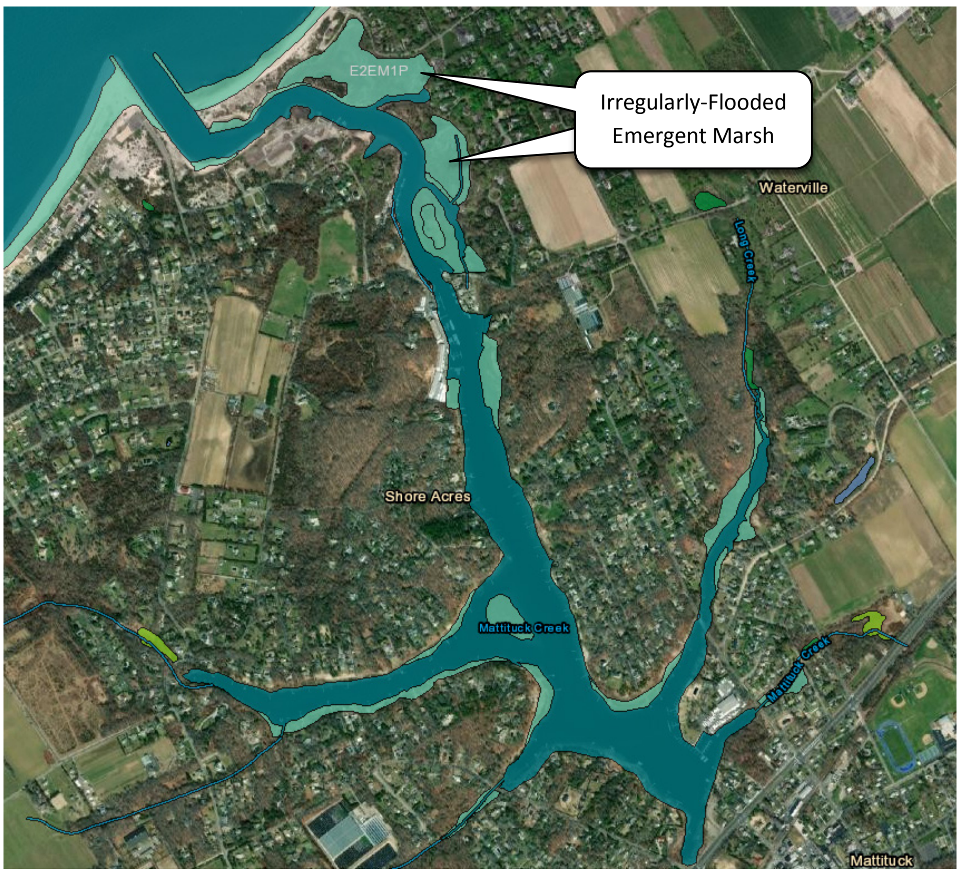

Figure 1. Mattituck Creek Tidal Wetlands as Blue Polygons, Source, National Wetlands Inventory Viewer, February 2021
Some of the larger marsh resources in Mattituck Creek include irregularly-flooded marshes to the northeast of the study area.

The history of Mattituck Creek includes significant historical manipulation and development. As shown in Figure 2, the inlet to the creek was relocated in 1914 (U.S. Army Corps of Engineers, 2021) and the creek is regularly dredged to allow for boat traffic. The south end of the creek was also filled to allow for additional development after 1954 (Figure 3). Currently there are at least 114 private docks located on the creek and over 13,000 feet of shoreline hardening such as jetties and bulkheads.

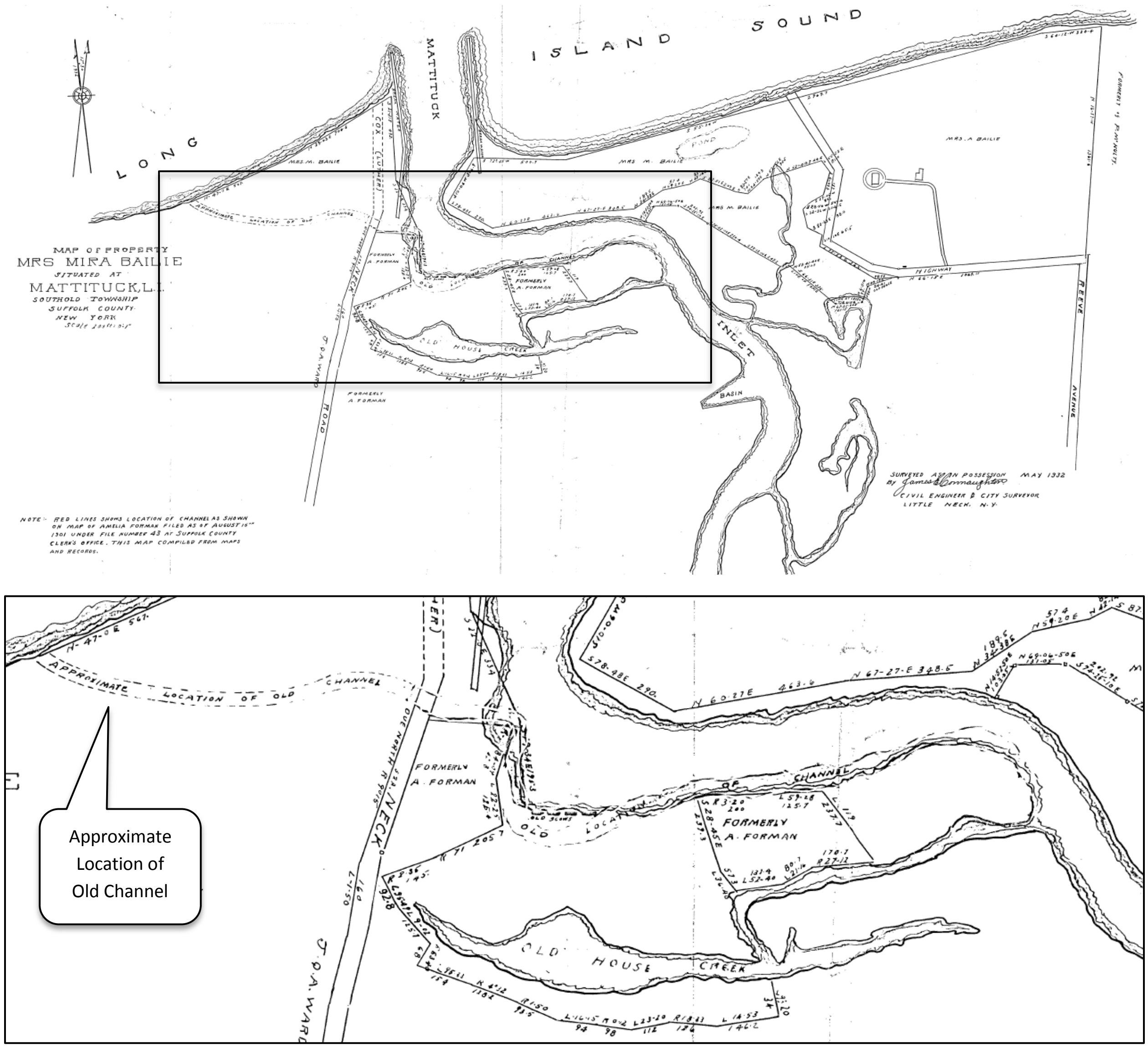

Figure 2. Historical Location of Original Channel into Mattituck Creek (Source, John Sepenoski, Town of Southold Highway Map Book, 1932)

In terms of marsh-habitat stability, more recent marsh losses have been minimal. An analysis of marsh habitat from 1974 to 2005 estimated that total Mattituck Creek marsh area decreased by less than one percent (Table 1). However, this stability will not necessarily hold into the future as these marshes are subjects to the threats of additional development density adjacent to the creek and sea-level rise (see *Threats to Mattituck Creek Marshes* below).

Table 1. Marsh-Loss Trends analysis for Mattituck Creek (Cameron et al. 2015)

1974 Intertidal Marsh Area (acres)	1974 High Marsh Area (acres)	1974 Phragmites Area (acres)	1974 Coastal Fresh Marsh Area (acres)	2005/2008 Intertidal Marsh Area (acres)	2005/2008 High Marsh Area (acres)	2005/2008 Phragmites Area (acres)	2005/2008 Coastal Fresh Marsh Area (acres)
41.48	13.31	3.01	0.00	41.11	16.30	3.45	0.00

Figure 3. Mattituck Creek South End, 1954 (top) vs. 2016 (bottom). (Source, John Sepenoski, Town of Southold)

PUBLIC VS. PRIVATE OWNERSHIP

While most current marsh resources are located on public lands (Figure 4), there are some marsh fringes along the creeks further south that are located on privately-owned lands. Additionally, the potential for marsh expansion given future sea-level rise suggests that many more privately-owned dry lands will have the potential for marsh habitat within this century (Figure 5).

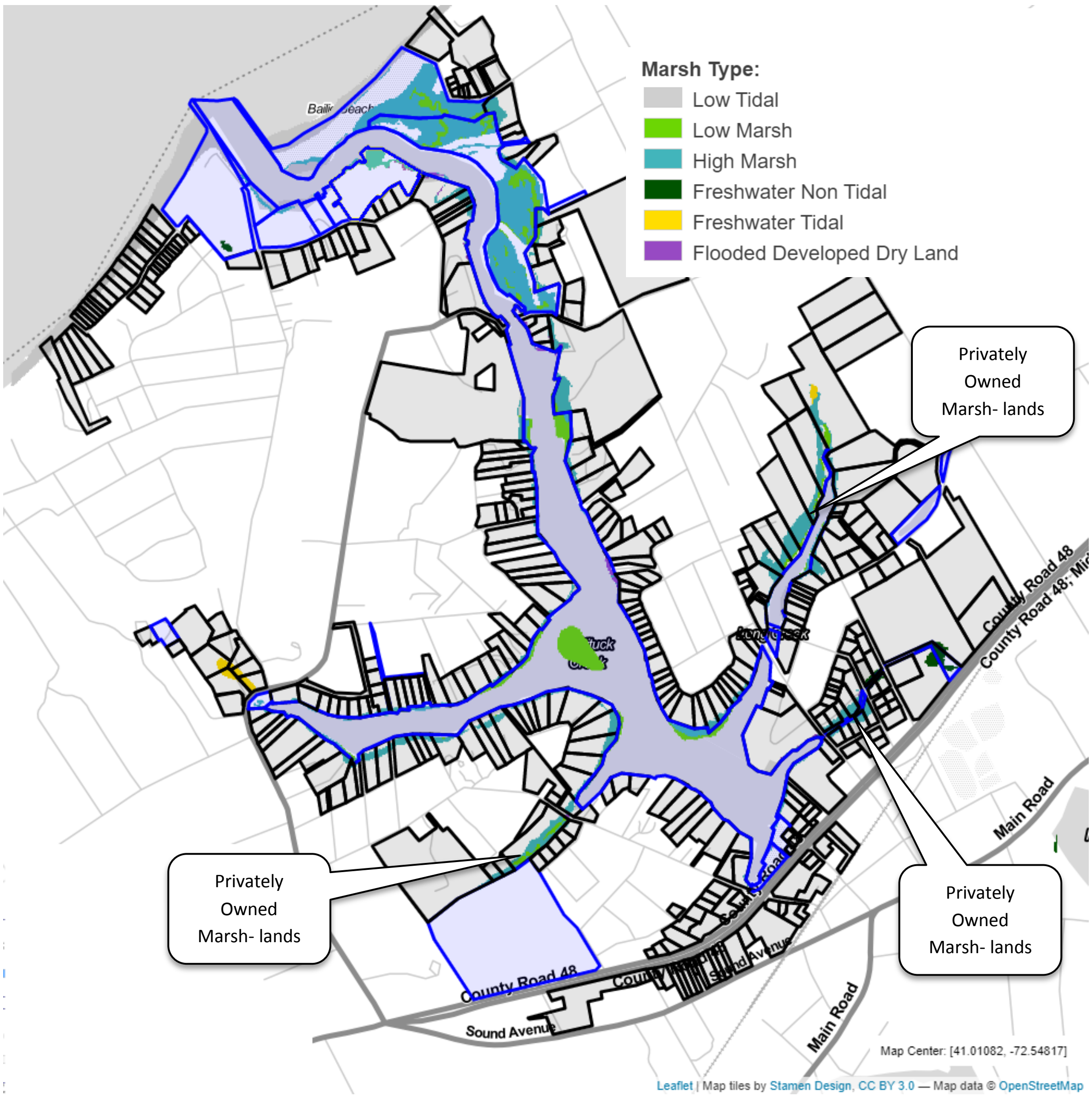

Figure 4. Public vs. Private Ownership of Land Parcels with Current Marsh Habitat in Blue and Green. Public-parcel polygons are outlined and shaded in blue.

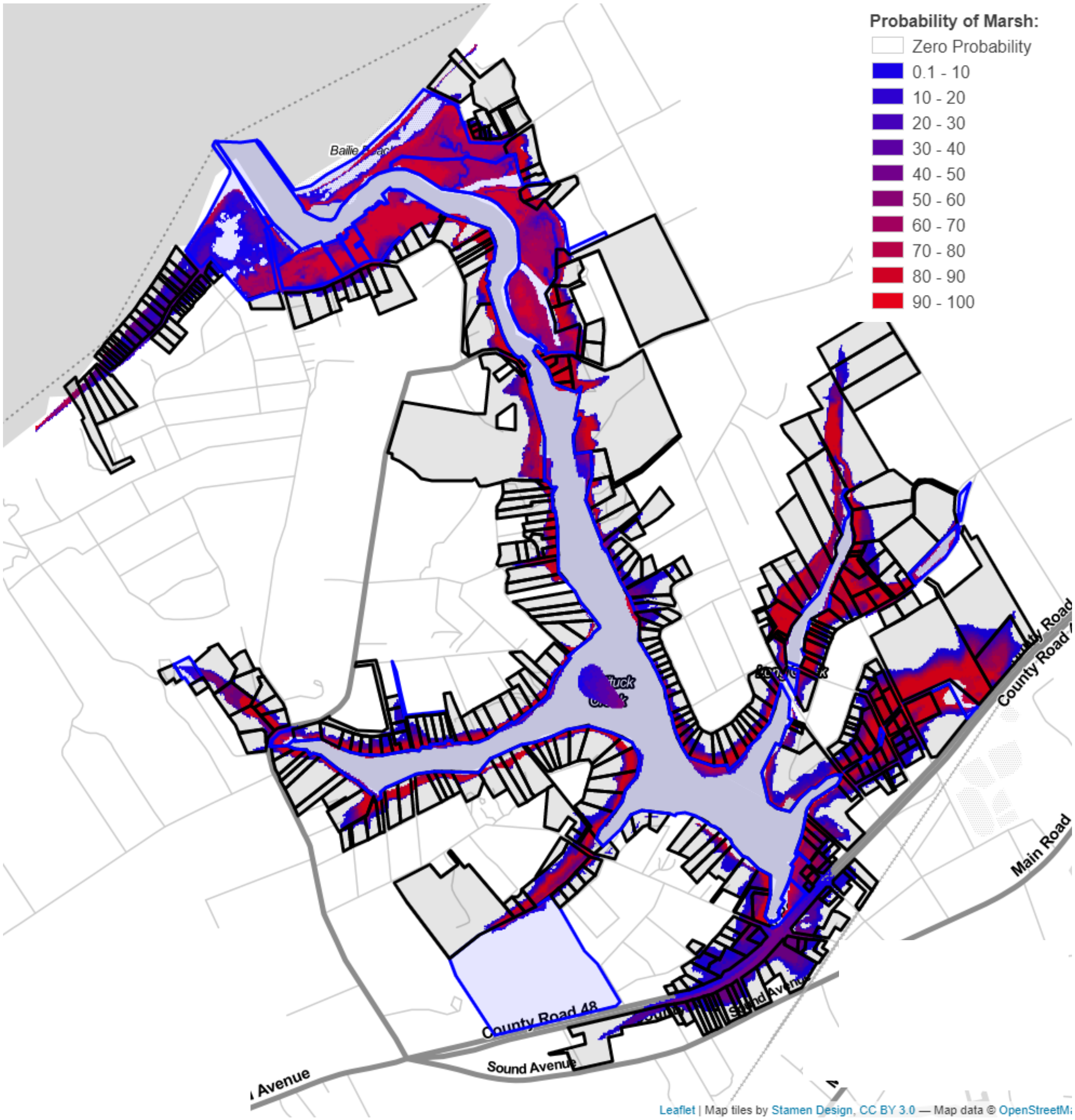

Figure 5. Public vs. Private Ownership of Land Parcels with Potential Marsh Habitat Shown vs. 2100 Potential Marsh Habitat

Figure 5 shows current public vs. private ownership for Mattituck Creek overlaid on marsh-fate modeling results. These model results show the possibility of marsh habitat due to sea-level rise by the year 2100, but also omit permanently flooded areas (areas too wet for marsh habitat). Model results take into account uncertainties in sea-level rise, elevation data, and marsh-accretion rates. A red area indicates a location where regular flooding is highly likely by 2100 making that zone a potential marsh habitat.

The extent of private lands that have potential marsh habitat in the future suggests that the management of the dry-land to wetland boundary will be an important topic in these regions over the next several decades.

BENEFITS FROM MATTITUCK CREEK MARSHES

The coastal marshes of New York provide benefits to humans and ecology alike. Recently, an expert and stakeholder panel developed an "ecosystem service list" for New York State marshes and defined the following categories of benefits that these marshes provide (Propato et al. 2018):

- Habitat
- Nutrient sequestration
- Recreation
- Wave attenuation/Flood damage reduction
- Political/Cultural/Historic value
- General preservation of natural areas

Discussion of some of these benefits, and specifically how they pertain to Mattituck Creek, follows.

HABITAT

Salt marshes are highly productive systems, and therefore provide a multitude of services and resources to various wildlife – including finfish, shellfish, birds, mammals, and other invertebrates. This immense productivity is driven by the high biomass and diversity of the marsh grasses. Smooth cordgrass (*Spartina alterniflora*) and saltmeadow cordgrass (*Spartina patens*) are the two dominant plant species that are the foundation of the system. Marsh grasses are considered ecosystem engineers which, by definition, are organisms that have the ability to alter or change the surrounding habitat, and therefore affect the livelihood of other organisms in the surrounding area (Jones et al. 1994, 1997). Marsh grasses produce detritus (decaying plant material), and this is stored in the organic matter of the sediment. This organic matter is rich with nutrients and minerals that cascade up the food chain, and provides energy to the upper-level species.

BIRDS

Marsh habitat is a critical component for the success of numerous bird species found throughout the Long Island Sound, including Mattituck Creek. Furthermore, a study of New York area bird colonization found that bird-species habitat increased with proximity to marsh, salt marsh, *Phragmites*, and protected areas (Benscoter et al. 2019). These species include various ducks, geese, cormorants, herons, egrets, and sparrow species (see Table 2 below). Salt marshes provide a foraging site for many bird species as marshes support the base of the estuarine food chain. While some birds directly feed on the marsh plants, most will feed on other organisms inhabiting the salt marsh – algae, invertebrates, shellfish, and finfish.

Predator species, such as ospreys (*Pandion haliaetus)*, form the top of the salt marsh food chain relying on fish and mammals found within these ecosystems. Osprey populations declined severely throughout their range prior to 1971 due to the use of DDT, an insecticide, that when ingested by the animal caused their egg shells to thin and break, reducing productivity. In 1972, the United States banned the use of the chemical and osprey populations slowly began to recover. Today, osprey pairs can be found throughout Long Island estuaries. Mattituck Creek has some of the highest density of osprey nests on Long Island. For example, in 2020, there were 14 active nests on the creek and these nests produced 32 young during that year (Figure 6).

Marsh birds utilize the salt marsh in Mattituck Creek as predation refuge, breeding, mating, and/or nesting grounds, or a rest stop along the Atlantic Flyway. The diversity of marsh plant species increases the complexity of physical structure of the habitat, and therefore decreases competition by opening more niches for birds to utilize. Wading birds, such as great blue heron and black crowned night heron may feed within the mudflat and intertidal low marsh habitat consisting of smooth cordgrass (*Spartina alterniflora*), High marsh habitat consisting saltmeadow cordgrass (*Spartina patens*), spikegrass (*Distichlis spicata*), and black rush (*Juncus gerardii*), are especially important bird habitat for several species – including the highly threatened saltmarsh sparrows (*Ammospiza caudacuta).* Species like the saltmarsh sparrow rely on the high marsh habitat for nesting. Due to sea level rise caused by climate change, saltmarsh sparrow populations have been in rapid decline, with 80% of the population disappearing in the past 15 years (Atlantic Coast Joint Venture). Additionally, in the Long Island Sound, the invasive plant species, common reed (*Phragmites australis)*, provides habitat for some bird species (Benoit and Askins 1999)

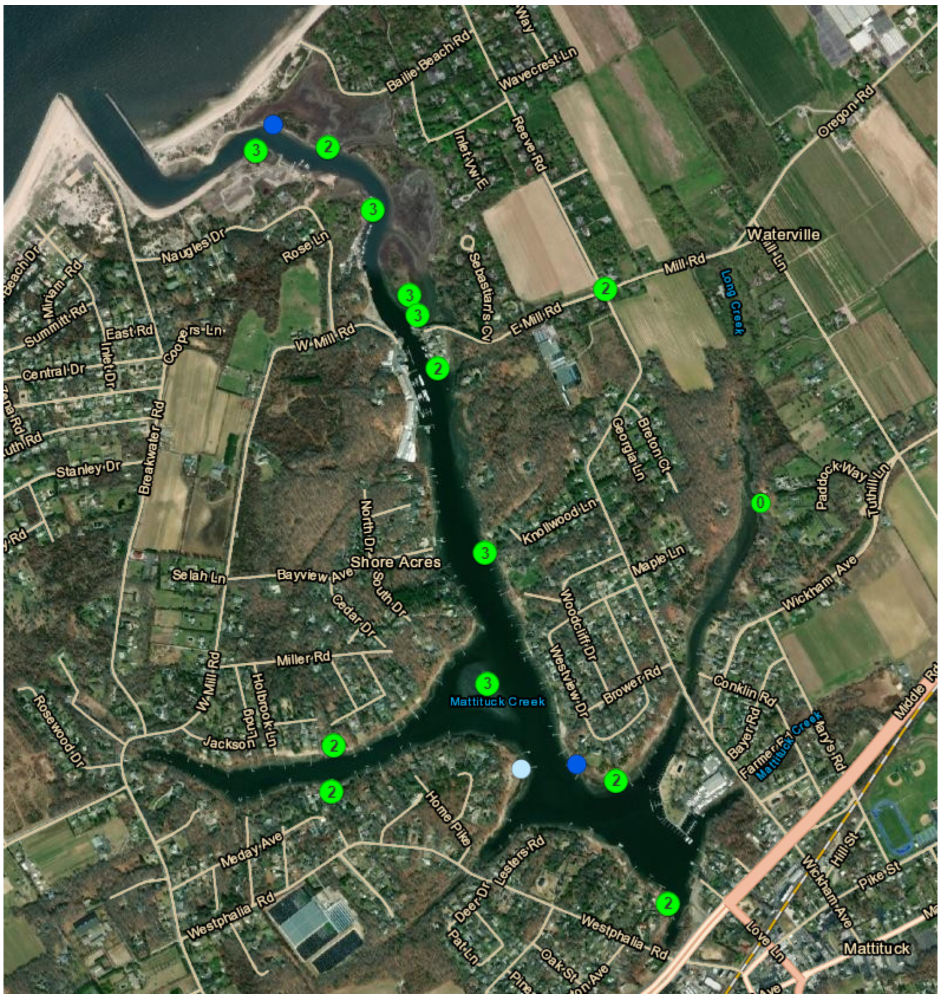

Figure 6. Mattituck Creek Osprey Nesting Sites in 2020 (green circles) with number of young (numbers in circles). Source, Town of Southold, NY Osprey Map Public Viewer 2021

Mattituck Creek is a unique location as it includes both vegetated marsh and breakwater beach habitat. Because of this, several "Federally Endangered and Threatened" migratory shorebird species greatly rely on the area, including the piping plover (*Charadrius melodus*), least terns *(Sternula antillarum)*, and red knots (*Calidris canutus*). Breakwater beaches, like the one found at Mattituck Creek, reduce erosion by acting as a barrier to overwash and wind (Schupp et al. 2013). These habitats are ideal for beach nesting shorebirds.

Table 2. Partial List of Notable Mattituck Creek Bird Species as Identified from eBird, with a Focus on Threatened and Endangered Species

Species	**NY Status** (State Endangered Species Act)	**Audubon Watch List**	**NY SGCN Status** (Species of Greatest Conservation Need)	**Breeding Status**
American Black Duck			High Priority SGCN	
Piping Plover	Endangered	Red	High Priority SGCN	Confirmed
Roseate Tern	Endangered	Yellow	High Priority SGCN	
Black Tern	Endangered		High Priority SGCN	
Least Tern	Threatened	Red	SGCN	Confirmed
Common Tern	Threatened		SGCN	Possible
Northern Harrier	Threatened		SGCN	
Bald Eagle	Threatened		SGCN	
Lesser Scaup			SGCN	
Common Eider			SGCN	
Surf Scoter			SGCN	
White-winged Scoter			SGCN	
Black Scoter			SGCN	
Long-tailed Duck			SGCN	
Common Goldeneye			SGCN	
Ruddy Duck			SGCN	
Horned Grebe			SGCN	
Black-bellied Plover			SGCN	
Ruddy Turnstone			SGCN	
Purple Sandpiper			SGCN	
Greater Yellowlegs			SGCN	
Willet			SGCN	Probable
Bonaparte's Gull			SGCN	
Laughing Gull			SGCN	
Great Egret			SGCN	
Snowy Egret			SGCN	
Black-crowned Night-Heron			SGCN	
Glossy Ibis			SGCN	
Osprey	Special Concern			Confirmed
Sharp-shinned Hawk	Special Concern			
Cooper's Hawk	Special Concern			
Sanderling		Yellow	Potential	
Semipalmated Sandpiper		Yellow		
Iceland Gull		Yellow		
Canada Goose				Confirmed
Mute Swan				Probable
Wood Duck				Probable
Mallard				Probable
Killdeer				Probable
Red-winged Blackbird				Probable
Great Blue Heron				
Green Heron				
Snow Goose				

Source John Sepenoski, Town of Southold, NY

NEKTON HABITAT

Nekton are aquatic organisms that are able to swim in the water column, independent of currents or wind energy – including zooplankton, invertebrates, fish, reptiles, and mammals. Nekton communities adjacent to salt marshes heavily rely on the marshes for foraging, predation refuge, and breeding sites. Important fishery species rely on the marsh as a nursery habitat for their young. Salt marsh edge vs. interior is considered especially important habitat. For example, Peterson and Turner (1994) found that "shorelines adjacent to marsh habitat are critical to various life history stages of ecologically- and commercially-important species."

Shellfish species, including Atlantic ribbed mussels, blue mussels, and eastern oysters, are found in marshes either attached to hard substrates, or even in some cases on the root structure of smooth cordgrass. Salt marshes are an important habitat for shellfish recruitment, settlement and survival as the water column provides necessary nutrients and substrate for the larvae. Shellfish larvae are a type of nekton species, in which they spend part of their life cycle swimming within the water column until settlement. Once settled and anchored down, they feed by filtering nutrients from the water column.

Marshes are also inhabited by many important recreational and commercial fishery species. Some species reside in the marsh system throughout their life (mummichog, striped killifish, sheepshead minnow, Atlantic silversides), some reside as young (winter and summer flounder, tautog, and black sea bass), some migrate in from open water for long term refuge (American eel), and some migrate in from the open water to spawn (American shad, alewife, striped bass). These migrating spawning species are called diadromous fish, in which they will migrate from salt water environments into the marshes to reproduce in the freshwater reaches of tidal rivers and streams. In this case, salt marshes provide a connector pathway for these fish species to complete their migration in order to successfully reproduce.

Another species that relies on tidal-wetland habitats is the diamondback terrapin (*Malaclemys terrapin*). This small brackish-water turtle is endemic to tidal wetlands, estuarine embayments, tidal flats, and tidal creeks from Massachusetts to the Gulf Coast of the United States. Adult terrapin feed on shellfish and crustaceans within tidal marsh systems and nest on coastal sandy beaches near tidal marshes during the summer nesting season. Juvenile terrapin reside in the upper reaches of tidal creeks and tidal marshes until adulthood (Ernst et, 1994). As the only brackish water turtle found in North America, diamondback terrapin are a key member of Long Island's tidal ecosystems, including Mattituck Creek. Terrapin populations are in decline or unknown throughout their range (Seigel and Gibbons, 1995) and, as a result, the taking of terrapin is prohibited in New York State (NYSDEC).

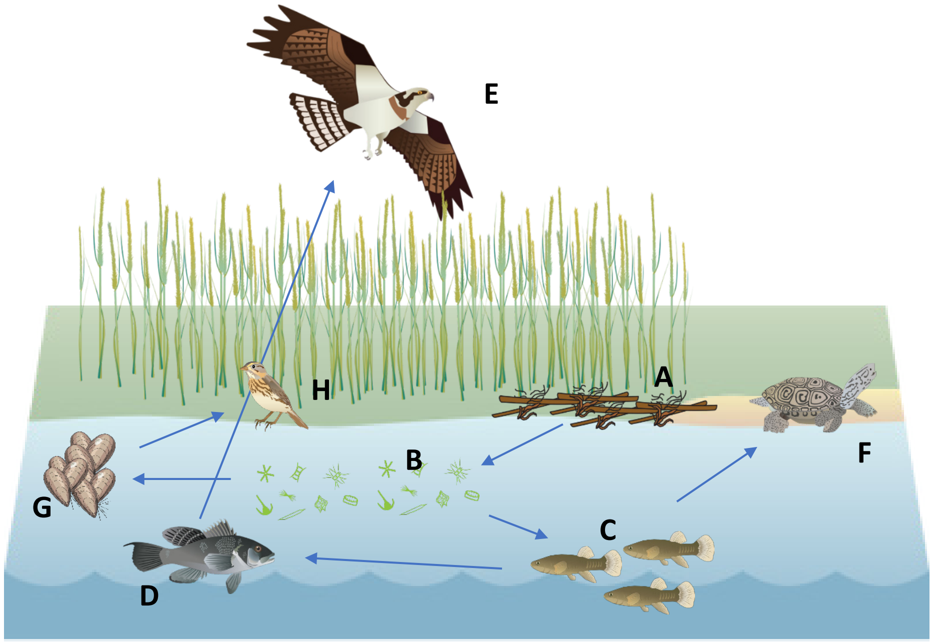

Figure 7. Conceptual Diagram of a Salt Marsh Food Web

The dominant salt marsh species, smooth cordgrass is the base of the food chain – providing organic matter in the form of detritus (A). The detritus is consumed by plankton species (B), which is then consumed by small fish species, such as striped killifish (C), and filter feeders, such as ribbed mussels (G). From there, two additional pathways are created, where smaller fish species are valuable food sources for larger predatory species, like black sea bass (D) and the diamondback terrapin (F). The black sea bass is then further consumed by the top of the food chain – the osprey (E). The other pathway of the food chain is from the ribbed mussels (G) who are consumed by the saltmarsh sparrow (H). Figure Courtesy of Cayla Sullivan, USEPA.

Avoidance of Marsh-Habitat Fragmentation

Larger-size marshes are especially important for bird and other wildlife habitat. A study of marsh utilization by birds in the Connecticut River found that colonization is directly related to the size of the marsh (Craig and Beal 1992). Furthermore, this study found that more rare birds were more likely to colonize larger rather than smaller marshes.

Wave Attenuation

One key ecosystem service provided by salt marshes is a reduction of the impacts of waves on coastal erosion. Wave action can be significantly reduced on coastal shorelines as marshes act as a buffer zone and absorb the energy. By stabilizing sediment through their above and belowground biomass, marshes have been shown to reduce coastal retreat. This service is especially beneficial to coastal communities that face great risks with climate change implications, including increases in extreme weather events (e.g., storms, hurricanes, etc.). The presence of marsh vegetation substantially mitigates infrastructure damage to the shoreline as relative structural loss is correlated to the percent of wetland cover (Sheng et al. 2021).

Nutrient Sequestration / denitrification

Tidal marshes are important for improving water quality. In particular they can sequester organic carbon and nutrients that may otherwise lead to additional climate disruption or eutrophication of estuarine systems (Loomis and Craft 2010).

Marshes have the ability to sequester, or store, nutrients in their biomass (above and belowground) and sediment, and therefore remove it from the water column. Nutrient sequestration includes carbon, nitrogen, and phosphorus. More specifically, salt marshes are hotspots for blue carbon storage, which are aquatic vegetated ecosystems that are able to store large amounts of carbon (Nellemann et al. 2009). In the United States, northeastern salt marshes have the ability to sequester about 41 to 152 g/m^2/year (Drake et al. 2013). This storage mechanism prevents carbon from being released into the atmosphere as carbon dioxide (CO_2) or methane (CH_4), which are dominant greenhouse gases. Blue carbon storage has the ability to mitigate global warming impacts, and prevent future increases in carbon emissions.

Denitrification is another nutrient-removal mechanism of salt marsh, in which excess nitrogen is removed from the ecosystem and released into the atmosphere. Bacteria that reside in marsh sediment convert nitrate (NO_3) – a form of nitrogen that can contribute to excess algae growth, into nitrogen gas (N_2) – which occurs naturally in the atmosphere. Denitrification rates can significantly vary regionally (Valiela et al. 2000), and are highest during the summer season (Velinsky et al. 2017). In the Long Island Sound, about 60% of the total nitrogen cycle is either buried in sediments or removed through denitrification (Vlahos et al. 2020).

Through nutrient sequestration and nutrient cycling, marsh habitat helps to create a stable and healthy environment for both wildlife and humans. For example, salt marsh nutrient cycling can prevent eutrophic conditions from occurring. Eutrophic conditions occur when there are excess nutrients, often in the form of nitrogen or phosphorus, in the water column. High nutrient conditions create hypoxic conditions, harmful low levels of dissolved oxygen, via algal blooms. Excessive algae growth and subsequent decomposition depletes the oxygen levels in water and can cause massive fish kills. Such die-offs cascade throughout the food chain and pose detrimental effects on many other marsh organisms.

Recreation and Natural-Area Proximity

Healthy marsh ecosystems provide a draw for human recreation, fishing, and wildlife viewing. Mattituck-Creek marshes are visible by boat traffic and kayaks, and local access is also possible from the Mattituck Creek Waterway Access Site (Figure 8). This site includes a fishing pier and a separate dock designated for kayaks and canoes. The facility also features picnic tables, privies, trail, interpretive materials, wildlife viewing and loading docks. All features and parking locations are accessible to people with disabilities.

Figure 8. Mattituck Creek Waterway Access Site
(source https://www.dec.ny.gov/outdoor/7780.html accessed February 2021)

THREATS TO MATTITUCK CREEK MARSHES

While the extent of Mattituck-Creek marshes has been relatively stable over the past fifty years (see Table 1), current marsh resources need to be managed to account for new threats arriving in the twenty first century. For example, development continues to encroach on the marshes and this places pressure on the habitats. Adjacent development can produce nutrient and household-chemical inputs, and reduces locations where marshes can expand. Exacerbating this threat, future sea-level rise has the potential to flood and displace wetlands making their future condition especially uncertain.

DEVELOPMENT

In the discussion on sea-level rise below, it is suggested that if sea-level rise continues to accelerate, much potential future habitat has the potential to overlap with existing developed areas. Furthermore, development adjacent to Mattituck Marshes has been rapid over the last several decades. For example, Figure 9 shows many new developments east of the marshes and the reduction of adjacent forests as well.

Figure 9. Aerial photography from 1984 (top) vs 2020 (bottom) showing the extent of new development and reduced forestation adjacent to Mattituck-Creek Marshes (Source County of Suffolk: https://gis3.suffolkcountyny.gov/gisviewer/)

Commercial development can have an impact on water quality and additional boat traffic can increase wave erosion on marsh edge habitats. As more marinas are added, additional docks encroach on habitat as well as increase incidents of accidental spills of chemicals. There is also a potential problem of boater discharges directly into the creek (not using pump-out stations).

WATER QUALITY INDICATORS

Mattituck Creek water quality is currently impacted by adjacent development, storm-water influences, and the potential for septic-system failures. Figure 9 shows that water quality has led to shellfish closures among part of the creek seasonally and year-round among the southern creeks.

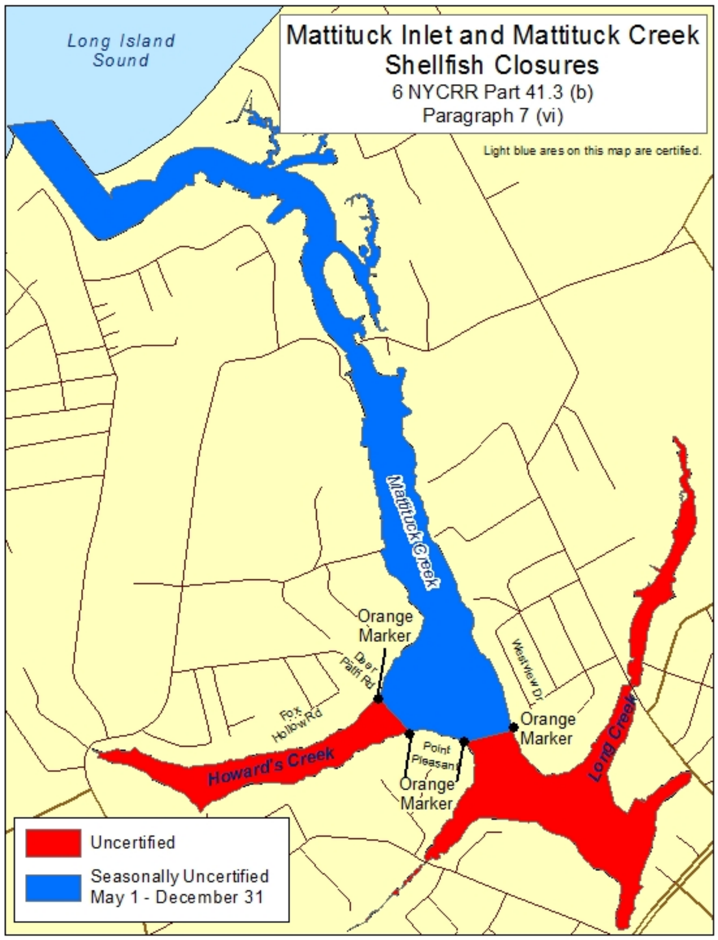

Figure 10. Mattituck Shellfish Closures, https://www.dec.ny.gov/outdoor/103483.html#12832

The Sound Health Explorer gave Mattituck Creek a water-quality grade of B- in 2019, indicating both room for improvement, but also limited degradation of the water quality resource at this time (Save the Sound, 2019). A summary of their findings follows:

- Seaweeds received a poor grade while all other indicators were a C or above in 2019.
- Extensive macrophytes are indicative of nitrogen contamination.
- Dissolved oxygen and water clarity were in good condition.

Marine Debris and Microplastics

Marine debris has become a leading threat to many different aquatic ecosystems as it amplifies degradation, reduces biodiversity, and suppresses ecosystem services. In salt marshes, marine debris is a prominent issue as it is known to get trapped in tidal wrack (Viehman et al. 2011), injure marsh grass (Uhrin and Schellinger 2011), and severely harm wildlife – either through consumption or entanglement. Marine debris is defined as human created waste that is either deliberately or accidentally released into marine environments. Additionally, any type of debris or litter can ultimately end up in marsh ecosystems through wind, rain, or runoff. Marine debris comes in all different forms, including metal, rubber, glass, cloth, paper, fishing gear, and most commonly – plastics.

Plastics are the most abundant and persistent types of marine debris; it takes hundreds of years for plastics to naturally degrade. Furthermore, once in the environment, many plastics do not completely disappear but break down into smaller fragments. In salt marshes, the most abundant types of litter are these smaller fragments of plastic of 0-5 cm (Viehman et al. 2011). Salt marshes act as a sink for these plastics, and release even smaller pieces called microplastics (Yao et al. 2019). Defined as smaller than 5 mm, microplastics affect salt marsh communities in various ways, and pose a great problem for the environment and society. Because they are so small, microplastics affect the estuarine food web from the bottom up – meaning they start at the base of the food chain and have harmful cascading effects. Omnivores, like small fish, crabs, marine worms, and birds, all directly consume microplastics (Piarulli et al. 2020). Additionally, there is evidence that filter feeders, such as bivalves (mussels, oysters, etc.), ingest microplastics that are floating in the water column (Khan and Prezant 2018). Predators of these organisms are also at risk through biomagnification – in which higher concentrations of microplastics are ingested in prey items. Humans are also potentially at risk from microplastics, as we consume many different fishery species that are found in the marsh food chain.

Figure 11. Plastic and Debris on Mattituck Creek Marshes. Photo Credit NYSDEC

Microplastics have also been shown to have an impact on microbial nitrogen cycling (Seeley et al. 2020). By altering marshes' ability to sequester and remove nitrogen from the habitat, this is another way that plastics can degrade the environmental quality of marsh ecosystems and their adjacent waters.

Sea-Level Rise and Changing Footprint

Recently, New York State funded an analysis of the potential impact of sea-level rise on coastal New York marshes (Clough et al. 2014; Warren Pinnacle Consulting, Inc. 2017). Figure 12 summarizes results for Mattituck Creek. These model results predict the location of wetland habitat given future sea-level rise and also take into account marsh accretion rates (increases of marsh elevation) due to additional flooding.

Further summary of Mattituck Creek and its vulnerability to sea-level rise can be found in Appendix A at the end of this document. In addition, Mattituck Creek is among the wetlands included in the marsh-fate interactive viewer: http://warrenpinnacle.com/LIMaps/. This website allows a user combine model results with tax-parcel information to assist conservation groups in defining and assessing various land-management alternatives.

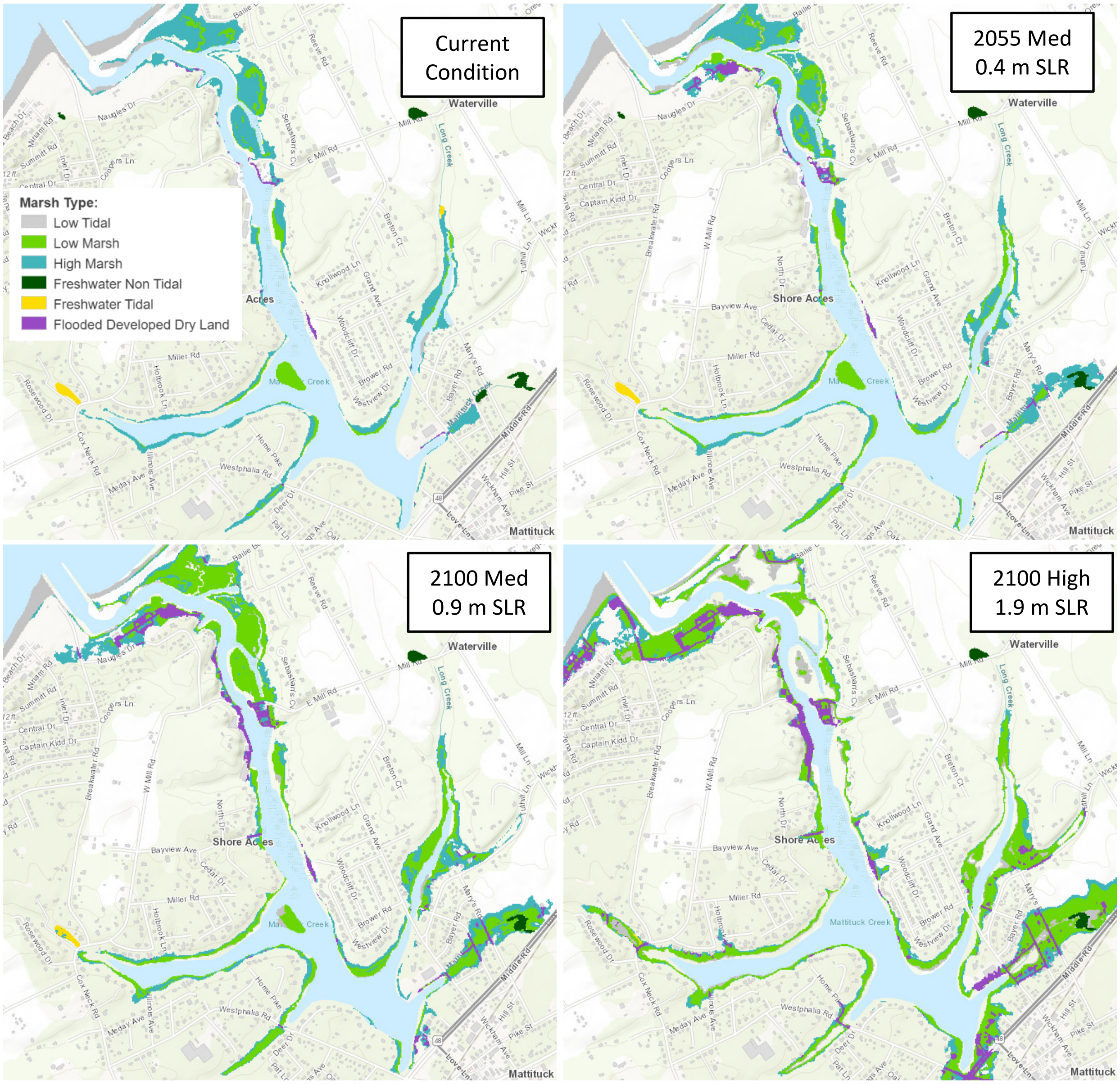

Figure 12. Mattituck Creek Marsh Fate Simulations under Various Sea-Level-Rise Scenarios.

Figure 12 suggests that:

- under a medium sea-level rise scenario in 2055 (0.4 meters of SLR in the upper right), some expansion of marsh habitat and additional marsh flooding is possible to the southeast of the study area in Mattituck creek by Farmer Road. Also, additional flooding of developed lands to the north of the study area is possible;
- under a medium sea-level rise scenario in 2100 (0.9 meters of SLR in the lower left), marshes to the north are predicted to be flooded more frequently, becoming subject to increased salinization and habitat changes. More flooding is predicted along Mattituck Creek and Long Creek as well.

- Under a high sea-level rise scenario by 2100 (1.9 meters of SLR in the lower right), extensive expansion of flooding and potential marsh habitat is predicted throughout the study area. More regularly-flooded (saline) marshes are expected to predominate.

MARSH CONSERVATION PLANNING

There are several tools available to local governments, planners, and NGOs that can be used to protect existing coastal wetlands and to ensure that adjacent habitat is protected for future marsh migration. In general, these strategies fall into the categories of land purchases and easements, local or state regulation, and marsh restoration. Education is also an important tool to ensure that community members recognize the critical ecological role of salt marshes and their impact on regional character. Modeling and data analysis can ensure that conservation plans have an eye towards anticipated future conditions.

LAND PURCHASES AND EASEMENTS

Private lands with current and future marsh habitats can be prioritized for purchase and future public ownership. Additionally, and often more economically, easements can be established to prevent future development on the parcels (or specifically on the portion of the parcels that have potential to become a marsh habitat). For Mattituck Creek, the Community Preservation Fund (CPF) is an important tool that can be used to facilitate these purchases. The CPF is a public program, managed by each of the five East End Towns of Suffolk County, and accumulates funds from a 2% real-estate transfer fee. The CPF may be used for the protection of farmland, open space, and community character. Since 2016, a portion of the CPF may also be invested towards water-quality improvement projects (which can also enhance marsh resilience).

Examining Mattituck Creek parcels that have current or potential future marsh habitat (shown in Figure 4) there are nine parcels, totaling 107 acres, that would be eligible for fee title or easement acquisitions via the CPF. To date, four other properties totaling 50 acres, have been protected via CPF acquisitions-- these purchases were all farmland development rights easements except for one acre of open space (Personal Communication, John Sepenoski, Town of Southold, March 2021). To prioritize future CPF expenditures, Mattituck Creek parcels can be examined using the marsh fate interactive viewer to estimate future marsh migration and marsh ecosystem services.

It is also important to note that government funds can often be leveraged, using additional sources of public and private capital, to maximize their impacts. Public and private partnerships can be key to conserving current and future marsh habitats.

LOCAL REGULATION

To benefit marsh conservation and expansion, local towns and planning boards can consider marsh-fate modeling within land-use planning and zoning decisions. Town comprehensive plans can prioritize the preservation of marshes due to their specific habitat services and their general enhancement of a town's unique character.

Local towns may also want to cite marsh vulnerability when creating water quality rules and considering septic upgrade regulations. As noted above, a portion of each town's CPF funds can be used towards water-quality improvement projects which could generally aid marsh habitats and resilience. Local efforts to reduce plastic contamination in marshes could also improve marsh ecosystem functioning and increase the ecological and recreational value of local wetlands.

Marsh Restoration

Marsh restoration is the process of modifying former wetland locations to promote current and future marsh habitation. This process is often undertaken to restore critical habitats or provide flooding protection, among other benefits. Over the past several decades, the design and implementation of salt marsh restoration projects in the northeast United States has been rapidly increasing (Niedowski, 2000).

Marsh restoration remains a top priority of state and local governments. For example, Theme 2 within the 2015 Long Island Sound Study Comprehensive Conservation & Management Plan aims to restore and protect the Sound's ecological balance in a healthy, productive, and resilient state for the benefit of both people and the natural environment. Within this Theme there is a "Tidal Wetland Extent Ecosystem Target" that commits to restoring 515 additional acres of tidal wetlands by 2035 from a 2014 baseline. To date, Long Island Sound Study partners have restored 79.7 acres of tidal wetland habitat and are 15.5% toward the 2035 goal. The New York State Ocean Action Plan also commits to protection and restoration of tidal wetland habitat. Goal 1 of the plan strives to ensure the ecological integrity of the ocean ecosystem and, within this goal (Objective A, Action 3) the plan proposes to monitor tidal wetland loss (trends), water quality, and implement restoration in estuaries and embayments. In 2000, New York State established salt-marsh restoration and monitoring guidelines to improve standards of practice and outcomes for these projects: https://www.dec.ny.gov/docs/wildlife_pdf/saltmarsh.pdf.

Within Mattituck Creek some habitat restoration has already been undertaken. For example, a barge removal and tidal-wetland restoration project was completed in 2010 north of the Mattituck Creek Waterway Access site (Figure 13). The marsh fate interactive viewer estimates that several publicly owned parcels north of the study area are likely to have water levels required to support marsh habitat in the near future (see Figure 5). This result suggests there is significant additional potential for marsh restoration on those lots in the near future.

Figure 13. Mattituck Creek Restoration Site Following Barge Removal with Plantings of Native Tidal Wetland Plantings (source Long Island Sound Study Habitat Restoration & Protection Database, Accessed March 2021)

Another location that has been identified for possible marsh restoration is the marsh island located in the center of Mattituck Inlet. This island is shown in the National Wetland Inventory as emergent marsh, but satellite imagery suggests it is regularly submerged with limited emergent-marsh habitat Figure 14. Locals familiar with this island have suggested that the marsh is subsiding and causing navigation issues for local boaters.

Figure 14. Marsh Island in the center of Mattituck Inlet. NWI indicates a regularly-flooded emergent marsh (lower left), but satellite photographs and local observations suggest that the island is subsiding and losing wetland habitat (lower right). Imagery from https://www.fws.gov/wetlands/data/mapper.html, accessed May 2021.

In addition to the strategies discussed above, additional outreach and education about the benefits of salt marsh habitats may help to bolster local support for efforts to preserve marsh habitats for current and future generations.

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Figure 15. Spring Shoots on Mattituck-Creek Marsh, Photo Credit NYSDEC

APPENDIX A: MATTITUCK CREEK MARSH MIGRATION FACT SHEET

PROJECTED INUNDATION AND LANDCOVER CHANGES DUE TO SEA LEVEL RISE

Currently (as of 2010, the most recent land cover data available), the Mattituck Creek area near Mattituck, NY includes approximately 95 acres of wetlands (marshes and unvegetated flats), of which **74** acres are vegetated marshes, while the rest are beaches or tidal flats. Under several possible sea level rise (SLR) scenarios, current marsh coverage is predicted to keep up with sea level. These marsh lands have relatively high elevations compared to sea levels so they can withstand some sea-level rise. However:

- Areas of high-elevation marshes are predicted to be replaced by lower marsh (more saline);
- Increasing areas of marsh may be lost to wetland flats and/or open water; and
- Dryland areas are predicted to be increasingly regularly inundated.

A total of 429 tax parcels, in and adjacent to the wetland area, may be affected by increased inundation. The State of New York, the Town of Southold and Mattituck Park District are the main landowners of the public land currently occupied by marsh, but many privately owned parcels could be affected by increased inundation.

ONLINE VIEWER
For more detailed information about each tax parcel, please visit our on-line viewer
http://warrenpinnacle.com/LIMaps/

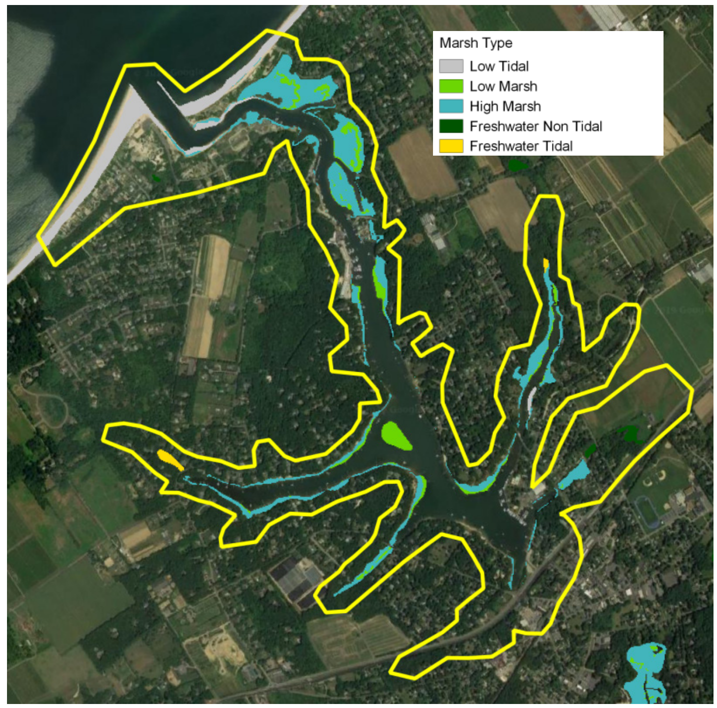

Figure 16. Satellite image of Mattituck Creek with current marsh coverage (Sources: NWI; Satellite imagery from Google).

Because SLR and model inputs are uncertain, the map on the right shows an estimate of how likely an area may be to accommodate marsh habitat in 2100 (assuming land is made available or restored). *Red areas are more likely to be marsh at 2100 than blue ones*.

The model predicts marsh habitat based on the likelihood of regular inundation (e.g. at least once per month) given model, data, and SLR uncertainty. Hundreds of model simulations with different assumptions about model inputs and data error were aggregated to produce this map.

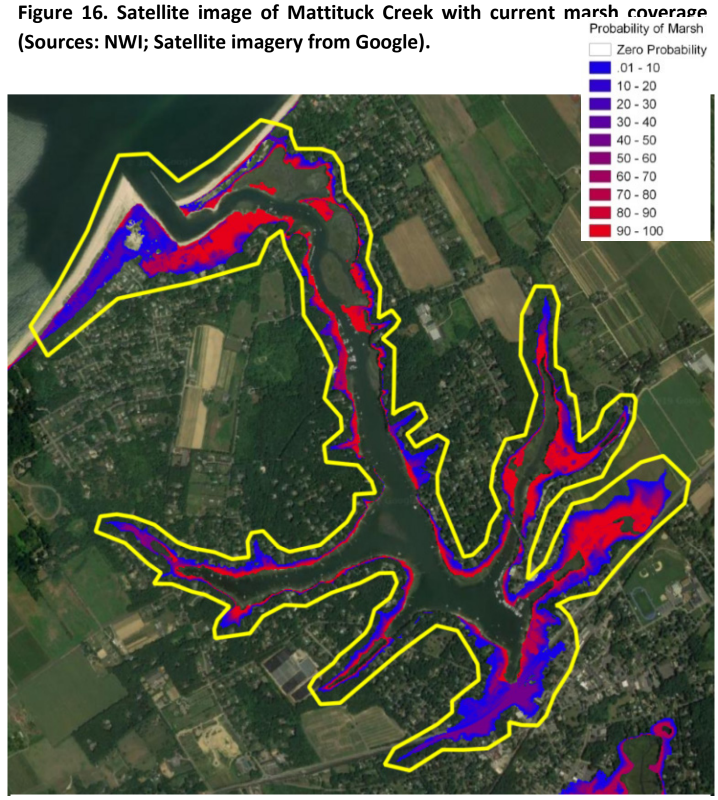

Figure 17. Probability of marsh habitat map, year 2100

WETLAND LOSSES

- Existing marsh area, currently covering **74** acres, is predicted to be reduced by **24** acres by 2100 (this is the average of all uncertainty-analysis simulations). However, an additional **36-48** acres of marsh could be converted to tidal flats or open water in the 10% most extreme scenarios (i.e. modeled scenarios with the highest sea level rises).
- In addition, approximately **7** acres of current tidal flats or beaches are predicted to become open water by 2055, increasing to **25** by 2100.

Table 3. Average marsh habitat predicted given SLR in the years 2055 and 2100. Private areas include also tax parcels with unknown owner type.

	Owner Type	2010	2055	2100
Existing marsh area (acres)	Public	45	41	27
	Private	29	28	23
Average new marsh area in undeveloped dry land (acres)	Public	0	12	28
	Private	0	20	56
Average new marsh area in developed dry land (acres)	Public	0	3	6
	Private	0	3	10
Total potential marsh area (acres)		74	108	150

POTENTIAL FOR MARSH MIGRATION

Wetland losses can be offset by **marsh migration** in areas that are currently dry land but predicted to become regularly inundated in the future.

- On average, **32** acres of new marsh could be expected to establish in current undeveloped dryland by 2055, or up to **84** acres by 2100. The maximum possible area of new marsh would be **168** acres under the highest SLR scenario.
- In addition, properly restored developed dry land could accommodate the establishment of an average **7** acres of marsh by 2055 and **17** acres by 2100, with a possible maximum area of **33** acres. (Note, some of these developed areas include roads that may be maintained as such in the future.)

The **74** acres of existing marsh (as of 2010) is likely to be reduced to **50** acres by 2100, and these marshes *could* be reduced to a total of **2** acres under the most extreme SLR scenarios. However, marsh losses could be offset by the migration of marshes onto newly-inundated dry lands. If **marsh migration** is allowed, an average of **39** acres of current dry land could accommodate new marsh by 2055 and **100** acres by 2100 (This number could stretch to **200** acres of new marsh under more extreme SLR scenarios).

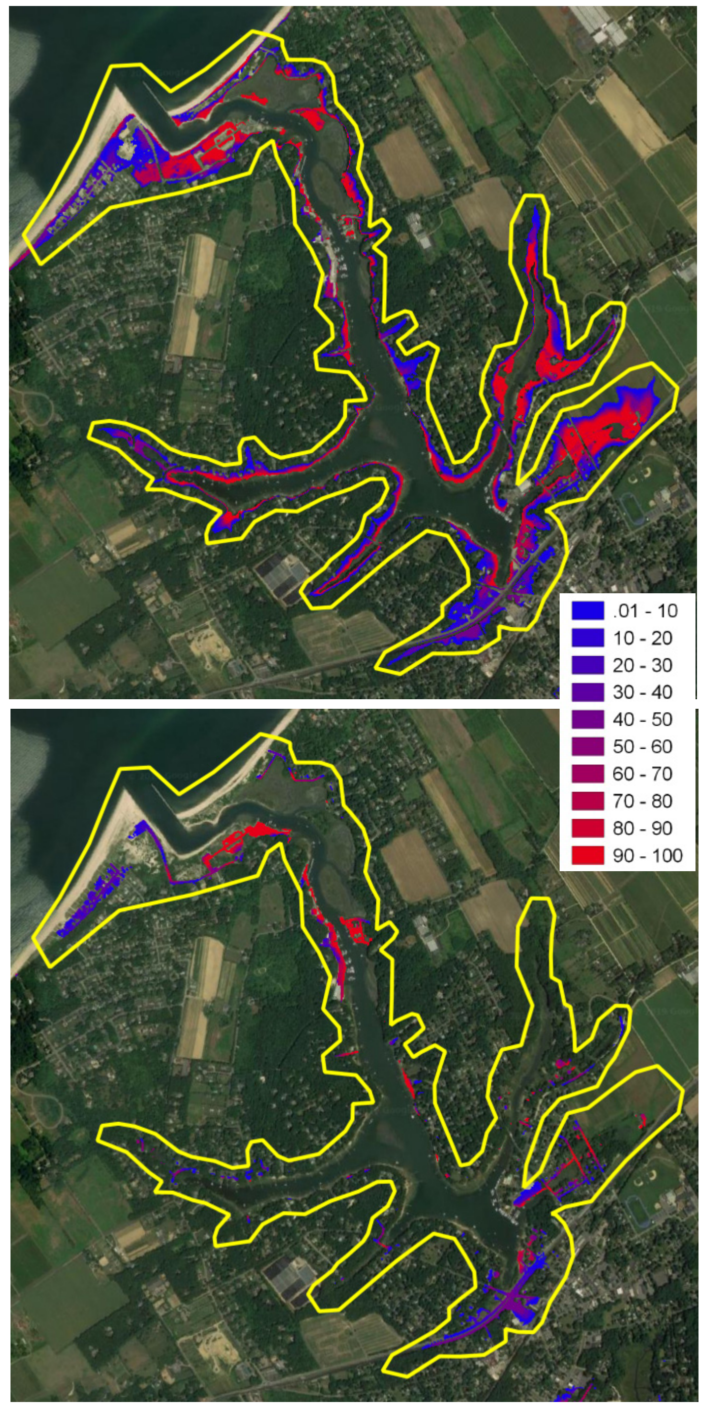

Figure 18. Areas that could accommodate marsh establishment by 2100. top: in currently undeveloped dry land areas, bottom: in developed ones.