REPORT of FINDINGS

from a Study of the Effects of Sea Level Rise and Climate Change on Old Saybrook, Connecticut

December 2015

TOWN of OLD SAYBROOK

Sea Level Rise

Climate Adaptation Committee

Executive Summary

Acting on a recommendation of the Town's Natural Hazard Mitigation Plan (2014), First Selectman Carl Fortuna formed the Sea Level Rise Climate Adaptation Committee to study how the Town might adapt to and mitigate against the effects of climate change and the impacts of sea level rise on Old Saybrook in the near- and long-term. We immediately added to our charge to educate the townspeople on our findings. We gathered information through literature review and by hosting a variety of subject matter experts at its meetings.

We have found that sea level rise (SLR) and associated climate change may be the greatest challenge facing Old Saybrook in the coming decades. Modeling of SLR by the US Army Corps of Engineers (USACE) using current data from the National Oceanic and Atmospheric Administration (NOAA) predicts the potential increase in sea level of 1 to 5 ft. by the end of this century. A recent analysis of climate data, headed by Dr. James Hansen, NASA's former climate scientist, and 16 co-researchers, suggests sea level rise could be as much as 10 ft. by the end of the century. While we hope these models overestimate the amount of SLR, hope is not our strategy. One community cannot prevent SLR or climate change, however **we *can* plan for resiliency in considering where and how to best adapt, mitigate, or possibly retreat based on the predictions of SLR and climate change.**

While there are many recommendations in our "Report of Findings", it is imperative to make the best use of ever-limited resources. We bring forward these initiatives for implementation now:

- Charge an existing Town agency or a new Committee to continue the work started by this committee and to monitor changes to SLR forecasts based on new data or improved scientific models.
- Engage a consulting firm that specializes in coastal resilience planning to study the impacts and risks of SLR and climate change to identify areas of increased flooding, coastal erosion and shoreline change. The study should recommend specific adaptation and mitigation actions for the Town and residents.
- Consider SLR and climate change in long-range and current planning, particularly updates to the Town's existing Natural Hazards Mitigation and Coastal Management Plans and to guide, where appropriate, future updates to the Town's Plan of Conservation and Development.
- Budget for design and construction of physical solutions, especially those for which matching funds garner government or non-profit grants.
- Continue to keep SLR and climate change on the front burner of community dialog.

We live in a unique and wonderful area with many opportunities to enjoy our small New England community, especially the marshes and waters along 23 miles of Island Sound and the Connecticut River. Our shoreline is at risk and, therefore, our community, as we know it today. We need commitment from our residents and our local government to start now to prepare for changes in sea level and the climate.

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Introduction

Situated at the confluence of the Connecticut River and Long Island Sound, Old Saybrook has 23 miles of shoreline that make it unique ecologically, geologically, and culturally. Water and water-related activities are an integral part of life in the town – attributes that make Old Saybrook attractive to visitors and businesses alike. All of this is threatened by climate change and associated rising seas.

Sea level is rising worldwide. As the committee began its investigations, scientific estimates indicated that sea levels in this area could rise on the order of one (1) foot by midcentury and perhaps by as much as five (5) feet 50 years hence (see Appendix I for a brief discussion on sea level rise models and forecasts). In July 2015, one year into our study, a report was published by James Hansen, NASA's former lead climate scientist, and 16 co-authors, which suggests that melting glaciers in Greenland and Antarctica may result in a sea level rise of as much as 10 feet in as little as 50 years.[1] Said another way, a person buying a shoreline home today likely will see significant changes in sea level before their mortgage is paid.

While predicting the impacts of climate change or the timing of sea level rise (SLR) is not exact, what will happen is fairly obvious. Roads that currently flood at only the very highest tides will flood monthly or more often. Homes near the shore will see more frequent flooding. Low-lying areas may become permanently underwater. Increasingly intense rain storms will exacerbate inland flood risks in areas not previously affected. Our rivers and streams will overflow their banks more often. No part of Old Saybrook will be immune from the impacts of climate change or sea level rise.

Figure 1: Monthly high tide October 28, 2015, Bliss St.

[1] Atmos. Chem. Phys. Discuss. 15, 20059–20179, 2015. Ice melt, sea level rise and superstorms: evidence from paleoclimate data, climate modeling, and modern observations that 2^0C global warming is highly dangerous. J. Hansen (Climate Science, Awareness and Solutions, Columbia University Earth Institute, New York, NY 10115, USA) et al

As we experience these impacts, change is inevitable. Homes severely damaged by coastal storms may not be rebuilt or may be abandoned. Improvements to properties may require elevating structures or armoring the land. Property values may decline in coastal areas while at the same time the cost of maintaining coastal area infrastructure and providing services will rise. Higher sea levels will raise groundwater levels, and septic systems in low lying coastal areas may fail. Native plants and animals may fall victim to invasive species or disappear altogether due to loss of habitat. In short, as a result of climate change and sea level rise, Old Saybrook will look different 30, 50, 100 years in the future. The questions today include: How do we want our town to look? What can we do now to prepare for that future?

To facilitate its work, the SLRCAC chose to investigate three topical areas of life in Old Saybrook: Environment, Community and Economy. The Committee analyzed SLR and climate change impacts on the Environment by learning about Old Saybrook's atypical geology, and the impact of sea level rise and climate change on it and coastal plant and animal communities there; Community, by focusing on demographics, public health, and water-dependent recreation; and local Economy, by considering transportation and infrastructure, commerce and industry, and residences. The Committee first considered the current status of each to know the general vulnerabilities to and associated risks from SLR and climate change. In many cases, outside experts were invited to SLRCAC meetings to brief Committee members on their studies. The Committee invited the Directors of Town Departments to initial discussions of these topics, and many became regular attendees of meetings. The Committee requested a special session with the Planning Commission to identify potential inconsistencies between the Town's current course of future land use and the phenomenon of SLR and climate change. The Committee held two town-wide presentations before accommodating residents in a series of smaller venues such as beach associations and community organizations to gain insight and solicit ideas.

In the final analysis, the Town cannot do nothing. The Old Saybrook Sea Level Rise Climate Adaptation Committee suggests these proactive policies for adoption by the Town's leaders to deal with SLR and climate change:

- **To adapt** – accommodate these natural, dynamic processes;
- **To mitigate** – reduce impacts where feasible or prudent; or, as a last resort,
- **To retreat** – abandon areas permanently flooded or where the cost of adapting or mitigating is too high.

Sea Level Rise and Climate Change: What You Need to Know

Before discussing the potential impacts of SLR and climate change, it is important to understand what these terms mean. Climate change generally refers to a number of interrelated phenomena that are caused by a general long-term warming of the atmosphere. Local impacts of atmospheric warming include:

- More frequent and more intense rainfall events
- More frequent and more intense tropical cyclones – tropical storms and hurricanes
- More intense nor'easters
- Warmer average air temperatures
  - More summer days above 90 degree
  - Degradation in air quality
  - A northward movement of warm weather plant and animal species
  - Increase in length of the growing season with no life cycle die-off of certain species
- Warmer water temperatures in Long Island Sound
  - Greater areas of hypoxia
  - Increased risk of algal blooms
  - Northward migration of warm water aquatic species into LIS

Global SLR is the slow process of an increasing rise in mean sea level. In terms of climate change, it is caused primarily by atmospheric warming that 1) heats and expands the volume of ocean water and 2) melts glaciers and continental ice sheets adding to the volume of the oceans. In this part of the world, however, another factor affects sea level rise – the slow subsidence or sinking of the land itself due to natural geological processes. The combination of global SLR plus regional land subsidence results in a relative SLR along Connecticut's coast that exceeds global SLR values.

Figure 2: Saybrook Point at high tide

In the short term, slowly increasing sea level results in higher high tides and more frequent nuisance flooding. However, as baseline sea level increases, the impacts of coastal storms

becomes greater. As Figure 3 clearly shows, a rise in sea level will magnify the impacts of flooding and storm surge. Flood waters and waves will reach farther inland causing damages in places that previously, when sea level was lower, were beyond the reach of the water.

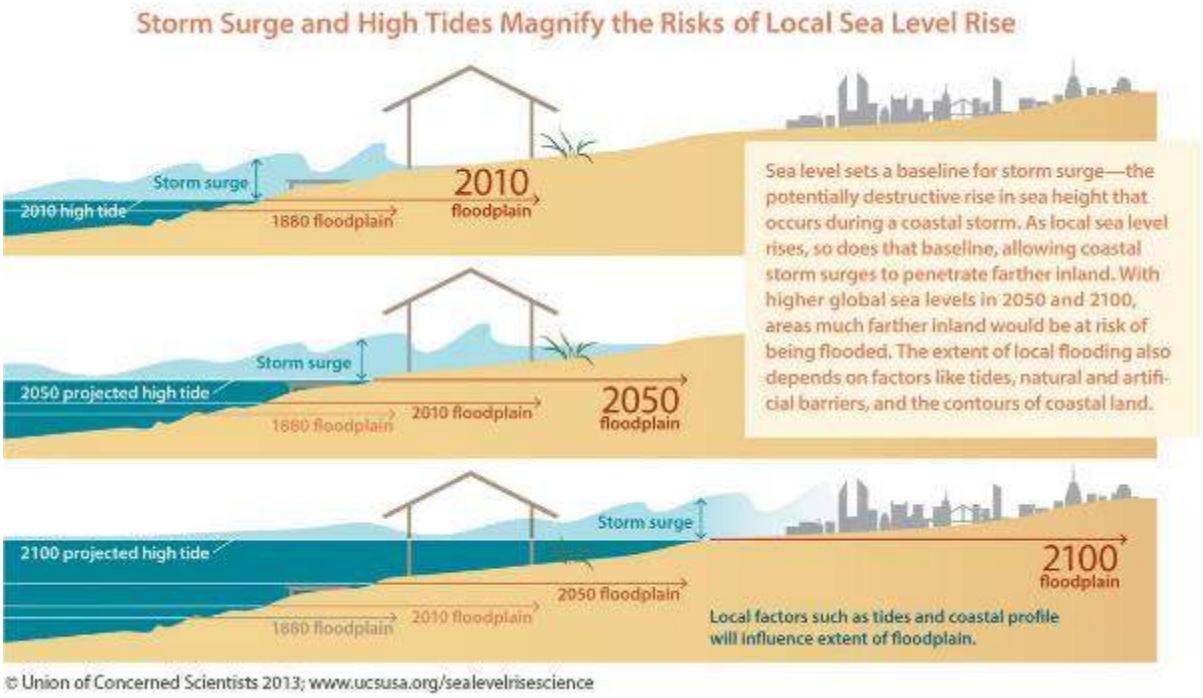

Figure 3: Impact of SLR on storm surge

Understanding the problem, determining how to adjust to these changing conditions, and planning for climate change and SLR is addressed in this Report, and remains the challenge before us.

Environment: Coastal Geologic Processes

Old Saybrook's geomorphology varies considerably and includes: a low flat sandy coastal plain in the southwest, higher glacial moraines at Cornfield Point and portions of Fenwick, upland bedrock controlled areas of till north of the Amtrak Railroad and large tidal marshes at numerous locations mostly south of Interstate 95. To better understand current coastal processes along the shoreline, Ralph Lewis, former CT State Geologist and current Assistant Professor in Residence, Marine Sciences, University of Connecticut, was invited to a Committee meeting to discuss the geologic history of this area. Unlike much of Connecticut's coast, bedrock does not extend to Old Saybrook's shoreline, which instead is sediment dominated.

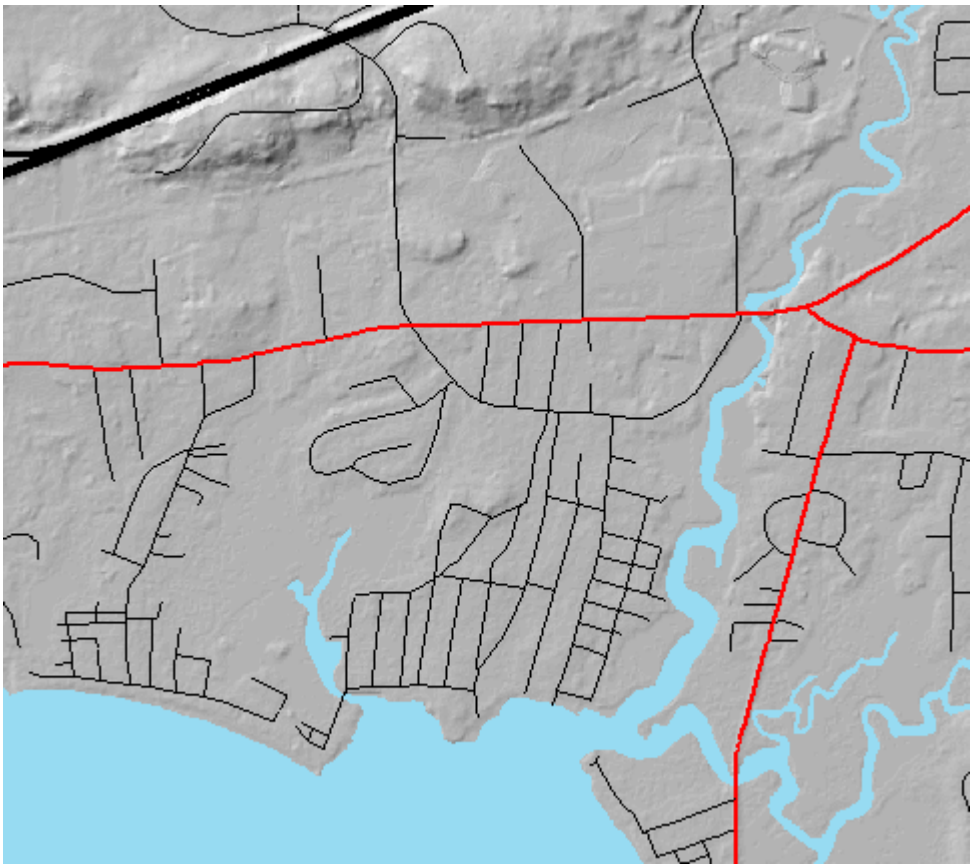

Figure 4: Shaded relief map depicting flat coastal plain – Chalker Beach, Indiantown and Saybrook Manor

Approximately 23,000 years ago, the last glacier retreated from the Connecticut shoreline leaving behind large sand and gravel deposits between the bedrock found further inland and what had been the furthest southern extent of glacier. As the glacier continued to melt, its meltwaters carried additional sediment toward the coast forming generally flat deltas upon which the marshes and wetlands that currently define much of our coastal area developed. Many of these wetlands and marshes now are in danger of being drowned by sea level rise (SLR). (See **Environment: Coastal Plant and Animal Communities**) An important characteristic of Old Saybrook's coastal area, particularly along the western side of town, is that much of the developed land is relatively flat and very low in elevation. This is especially true in the beach

communities of Chalker Beach, Indiantown and Saybrook Manor and along sections of Great Hammock and Plum Bank Roads. Figure 4 depicts the flatness of some of these areas. The shorefront in these areas typically is comprised of highly erodible sand. Over the years, most waterfront property owners have constructed seawalls or other hardened structures to protect their property. These areas are very susceptible to greater flooding and coastal erosion due to even small increases in sea level.

Groins and seawalls also have been constructed along much of Old Saybrook's Long Island Sound shoreline. Groins were placed between properties to trap sand to build up beachfronts. However, groins interrupt longshore currents causing sand to be deposited on the up-drift side of the groin but also causes beach erosion on the down-drift side. As shown in Figure 5, seawalls primarily function to protect residential properties from storm surges and waves. An unintended consequence of seawalls is that they can accelerate the loss of beach sand. When waves strike seawalls or other hardened protective structures, the wave energy is reflected back towards the beach causing beach erosion and loss of sand. With rising sea levels, the frequency of waves striking seawalls will increase thereby increasing the rate of beach erosion. Figure 6 depicts the locations of seawalls and groins along a portion of the shore at Chalker Beach. As can be seen in the figure, almost the entire section of shore in this area has been armored, and the groins have had a significant impact on some sections of the beach.

Figure 5: Seawall located in Fenwick

Figure 6: Groins and hardened structures along shoreline, Chalker Beach

Over the years, much of Old Saybrook's shoreline with Long Island Sound has been similarly armored. The Committee found in discussions with Jennifer O'Donnell, Associate Research Professor, Department of Marine Sciences, University of Connecticut, that there is a great deal of uncertainty as to how the developed shoreline will respond to SLR: will beach erosion rapidly accelerate? Will groins function (and how) when they become frequently overtopped?

Figure 7: Collapsed seawall in Fenwick caused by Tropical Storm Irene

Will seawalls become undermined and collapse, as in Figure 7? Will property owners seek to build higher and higher seawalls to protect against rising sea levels and more frequent and intense coastal storms? Should structures be removed to adapt or retreat from sea level rise? In 2012, the Connecticut General Assembly enacted a law prescribing a variety of structural and organic materials, such as tidal wetland plants, submerged aquatic vegetation, coir fiber logs, sand fill, artificial oyster reefs and stone as appropriate means to provide shoreline protection. Such "living shorelines" may include structural features in combination with these natural components to attenuate wave energy and currents. To plan for the future, the Town needs a better understanding of how its coastline physically will respond to SLR.

In keeping with the suggested policies to adapt to, mitigate against or retreat from the impacts of sea level rise on Old Saybrook's natural environment, the Committee recommends that the Town:

- **Master Plan for Our Coastline.** Engage a consulting firm that specializes in coastal resilience planning to study the impacts and risks of SLR and climate change to identify areas of increased flooding, coastal erosion and shoreline change. Results of this study should be used to update the Town's existing Natural Hazards Mitigation and Coastal Management Plans and to guide, where appropriate, future updates to the Town's Plan of Conservation and Development.
- **Tide Gauge.** Continue to support the recently installed USGS tide gauge and weather station located at the mouth of the Connecticut River.
- **Shoreline Softening.** Regularly inspect and investigate the efficacy of existing seawalls and groins and, where appropriate, consider their removal.
- **Living Shoreline.** Investigate the use of living shorelines as a means to protect, where appropriate, sections of Old Saybrook's shore.
- **Dune Enhancement/Restoration.** Investigate the value of undertaking physical improvement of natural features at appropriate locations along the shoreline.

Figure 8: Example of coastal dune erosion

Environment: Coastal Plant and Animal Communities

Old Saybrook's extensive tidal marsh borders the salt waters of Long Island Sound and the more brackish waters of the Connecticut River. In total, tidal marshes cover about 13% of the town (approximately 1,270 acres). These marshes provide many benefits such as critically important habitats and food for waterfowl, shorebirds, mammals, shellfish, finfish and other plants and animals, spawning grounds for many aquatic organisms, protection of upland property from damaging waves during coastal storms, and beautiful, seasonally changing scenic vistas at many locations throughout town. (See **Community: Culture** and Tidal Marshes map in Appendix II)

Figure 9: Tidal marsh to the west of Town Beach

A special characteristic of tidal marshes is their ability to withstand the daily ebb and flow of the tidal cycle. The plant and animal communities that live here are well-adapted to changes in water levels; in fact, they depend on it for survival. Very small differences in the elevation of the surface of a tidal marsh result in vastly different plant communities. For example, salt pannes, which are slightly depressed areas have elevated salinities where only extremely salt tolerant plants can live. Thus, small changes in either the marsh's surface elevation or average sea levels can have significant effects on the plant and animal communities living in the balance of tidal cycles.

Figure 10: Flooded tidal marsh west of Town Beach

Tidal marshes buffer upland plant and animal habitat, including that of humans, from the velocity of regular wave damage but especially during coastal storms. Marshes also serve as storage for stormwater runoff from upland areas during intense rainfall events, which are predicted to occur more frequently with climate change. As sea level increases, these tidal marshes will eventually drown – the beauty, habitat, and the function of the marsh to absorb storm energy will be lost.

In 2013, The Nature Conservancy published "A Salt Marsh Advancement Zone Assessment of Old Saybrook, Connecticut" that summarized its investigation of the extent to which tidal marshes can migrate inland. The study looked at the time frame from the present to 2080 and used sea level rise assumptions from the Intergovernmental Panel on Climate Change (IPCC) 2007 report. Many upland sites most likely to receive and sustain tidal marsh advancement in Old Saybrook are constrained by the already-built environment—fill, roads, seawalls and other structures. To preserve Old Saybrook's coastal marshes and to protect the species reliant upon these habitats, the land surface of tidal marshes must either rise to keep pace with increases in the water's elevation, or the edge of marshes must migrate inland to higher upland areas. Therefore, it is essential to plan for tidal marsh migration by focusing on preserving those few places suitable as paths for tidal marsh advancement.

Of equal concern, non-native plants and animals are less likely to seasonally migrate or to succumb to seasonal die-off as sea level rises and the climate warms, which magnifies competition for limited food and habitat in and around tidal marshes and elsewhere. Old Saybrook has been a continual steward of the health of our tidal marshes by controlling invasive species of plants and animals and occasionally restoring native habitat to support indigenous species.

Figure 11: Spraying invasive Phragmites australis near Fort Saybrook Park

In keeping with the suggested policies to adapt to, mitigate against or retreat from the impacts of sea level rise on Old Saybrook's natural environment, the Committee recommends that the Town:

- **Master Plan for Our Coastline.** Previously mentioned - see **Environment: Coastal Geologic Processes**.
- **Living Shorelines.** Partner with Connecticut Institute for Resilience and Climate Adaptation to identify candidate sites for living shorelines to protect coastal habitat and to provide a storm buffer to developed areas.
- **Land Acquisition.** Acquire unprotected parcels most suitable for tidal marsh advancement, including those identified by The Nature Conservancy in its 2013 study.
- **Tidal Marsh Set-Aside.** For parcels adjacent to tidal marshes, investigate implementing regulatory standards to set-aside areas suitable for future upland migration of tidal marshes.
- **Marsh Nursery.** Recontour uplands around existing tidal marshes to facilitate marsh advancement.
- **Invasive Plant Eradication.** Expand programs successfully introduced by the CT DEEP, in collaboration with the Old Saybrook and Lynde Point Land Trusts, to remove and control invasive plant species in tidal marshes.
- **Lowland Accretion.** Assist tidal marshes to accrete at a rate consistent with sea level rise, by trapping sediment, reintroducing sediment, creating dunes, and planting submerged vegetation, which may reduce erosion.

Figure 12: 2010 late summer aerial image of the southeastern area of Old Saybrook. Along the Connecticut River, North and South Coves and Long Island Sound almost all the undeveloped areas are tidal marshes which are visible in the image.

Community: Culture

As one of the earliest settlements in Connecticut, the town of Old Saybrook is an icon of historic New England. Lifelong residents and newcomers alike cherish the cultural landscape where sites and structures evoke eras of the townspeople's living, working and playing along the 23 miles of the Connecticut River and Long Island Sound shorelines. Over the past 100 years a number of close-knit beach communities have been established that provide dynamic social interactions among residents in what originally were summer communities but increasingly have become year round neighborhoods.

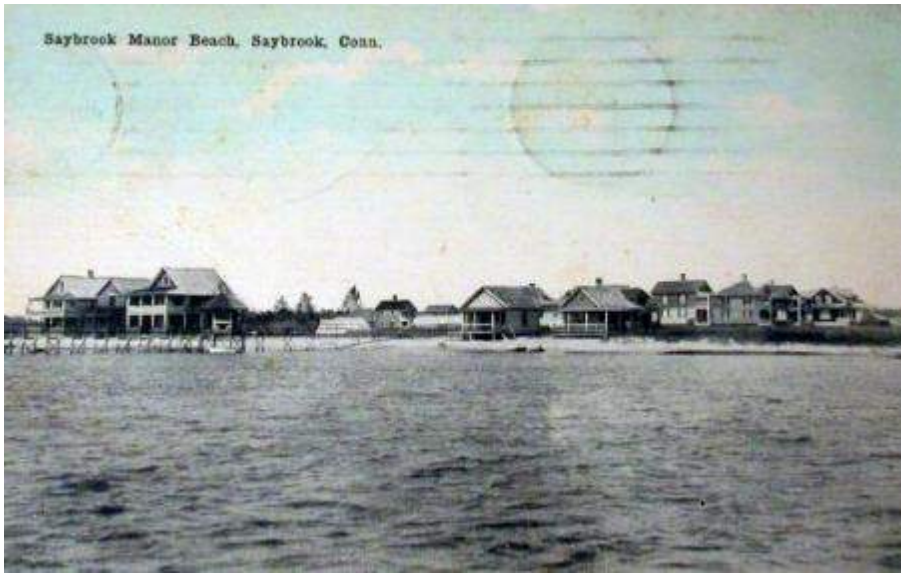

Figure 13: Old postcard of Saybrook Manor Beach

SLR adds to the challenges of supporting a vibrant and affordable community. Since 1980, the population of Old Saybrook has been relatively constant averaging about 10,300 residents. By 2025, however, the Connecticut State Data Center forecasts a population decline to about 9,300 people. While this is not enough to reduce public services in any specific manner nor in any specific place, it does means 10% fewer people over whom to spread the Town's cost of services and infrastructure. (See **Economy: Public Infrastructure**) The 2010 census reported the percent of Old Saybrook's population aged 65+ (retirement age) to

Figure 14: Old postcard of Cornfield Point

be 25.3% making it the second "oldest" town in Middlesex County (15.5%) and twice the national average of 13.0%. Having such a high proportion of residents, assumed to be on fixed incomes, may make it difficult to garner support for long-term capital improvements necessary to mitigate against future SLR and climate change.

SLR and climate change threaten the life span of many of the historic resources that characterize Old Saybrook. Much of the town's early settlement was in lying low areas. Now, years later, sea levels and climate change already hide the remains of some historic water-dependent uses such as old train/trolley crossings, shipbuilding in Gee's Pond and North Cove, and the beach at Saybrook Heights on South Cove. The North Cove and Fenwick local historic districts aim to preserve the architecture or history of significant groupings of waterfront structures. There are many other areas of Old Saybrook, just as representative of particular eras of our long history but not so purposefully preserved, that are equally at risk from SLR and climate change. The requirement to build to current flood standards, the use of modern building techniques and materials to withstand climate change (wind, salt, sun, temperature) and extreme weather (flooding and hurricanes, mostly) means a change in the character of buildings and, thus, the culture of the town. (See **Economy: Residences**) Walkable beach communities where neighbors would stop and chat on the front porch will be quite different after houses and porches become flood compliant and are elevated 10 plus feet above the ground.

Views of tidal marshes from atop Founders Memorial Park, the Causeway crossing South Cove, Plum Bank and Great Hammock Roads, or sections of the Boston Post Road near the Oyster River, are dominant visual components of Old Saybrook's identity. (See **Culture: Recreation**) If the marshes drown due to SLR, they greatly will alter the visual landscape and the visual character of Old Saybrook.

Figure 15: View from atop Founders Park

Figure 16: Then and Now - This image graphically shows how development has changed in the coastal area. The black and white image on the left is a 1934 aerial photograph of Cornfield Point while the image on the right depicts what currently is developed.

In keeping with the suggested policies to adapt to, mitigate against or retreat from the impacts of sea level rise on Old Saybrook's community, the Committee recommends that the Town:

- **Master Plan for Our Coastline.** Previously mentioned - see **Environment: Coastal Geologic Processes**.
- **Historic Preservation Plan.** Identifies sites, monuments, and historic dwellings that are vulnerable to SLR and climate change and prepare a plan for their preservation.
- **Local History.** Continue to promote the national-to-local significance of the town's history of development and the importance of reinforcing the town's identity as a New England shoreline community.
- **Architectural Design.** Encourage homeowners and developers to incorporate design features that mitigate against SLR and climate change in a manner that reflects the architectural vernacular of a New England beach or riverside community.
- **Water Access.** Maintain, improve and expand water access and nature trails to the maximum feasible.
- **Tidal Marshes.** Support efforts to protect tidal marshes as an important visual component of Old Saybrook's landscape.
- **Education**. Encourage our schools and community organizations to participate in activities related to SLR and climate change as a means of engaging the community in the educational process of the impending impact of SLR climate change.
- **Housing**. Prioritize housing development that appeals to a wider demographic that is compatible with SLR.
- **Aging Population**. Consider the needs of an aging population when determining future services and infrastructure planning.

Community: Public Health

A good quality of stormwater, groundwater and coastal waters is critical to the health of Old Saybrook's community. However, climate change increases pressure on the limited capacity of natural and manmade systems to collect, process and manage typical pollutants in each – sediment, sewage or salt – that potentially threaten public health.

According to the 2014 National Climate Assessment, the frequency and intensity of heavy precipitation events already has increased in the Northeast United States and likely will continue to so due to warmer atmospheric temperatures and changing meteorological patterns. Such storms will produce greater rainfall volumes that, without adequate controls, will carry more phosphates, nitrates and other man-made nutrients as well as contaminants (e.g. bacteria, pesticides, sediment, hydrocarbons, heavy metals, etc.) into the Connecticut River and Long Island Sound. Phosphates and nitrates support larger algae blooms that periodically occur in Long Island Sound. The eventual die off and decomposition of the algae causes hypoxia (depletion of oxygen in the water), effectively causing a "dead zone" and decimating aquatic life. Pesticides and herbicides used as part of normal lawn and gardening practices also are transported in stormwater runoff and have a direct adverse impact on the plants and wildlife found in our tidal marshes and coastal waters. The Town was an early-adopter in managing nonpoint source pollution under sponsorship by the Nonpoint Education for Municipal Officials program administered by UConn's Center for Land Use Education and Research); since 2001, this municipal initiative has informed property owners and developers of the need to decrease use of herbicides, fertilizers and pesticides and to manage and infiltrate on-site stormwater through the use of vegetated swales and buffers. The Town itself is especially concerned by the increased frequency and intensity of rainfall because it maintains a permit from the National Pollutant Discharge Elimination System (NPDES) to discharge stormwater from its roads and

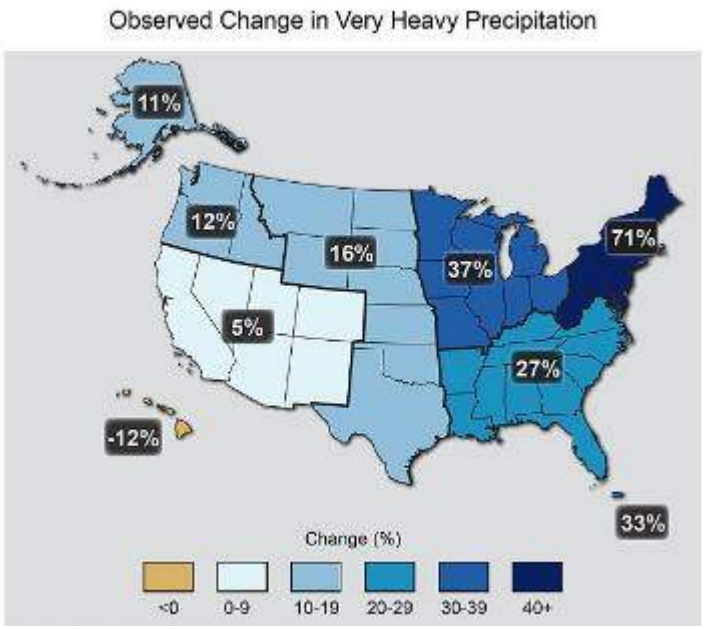

Figure 17: Heavy precipitation events have increased in the northeast much more than elsewhere in the US.

stormwater collection systems to surface waters of the State. NPDES is administered by the United States Environmental Protection Agency in partnership with the Connecticut Department of Energy and Environmental Protection.

A 2012 study by the US Geological Survey investigated the effects of sea level rise (SLR) on ground water levels in New Haven, CT and found a direct correlation between higher sea levels and higher ground water levels. This is of concern to Old Saybrook because all properties in town dispose of sewage and gray water to on-site septic systems; it is of particular concern in the Waste Water Management Districts in coastal areas where the separation between the bottom of septic system leach fields and groundwater currently is just barely adequate to meet design and health code standards. As SLR causes a rise in groundwater levels it will saturate on-site septic systems, increase failure rates and exacerbate groundwater pollution problems. Residents are investing significant dollars to elevate and flood proof homes with the expectation that these areas will be livable; however, if groundwater levels become too high the use of on-site septic systems may become impossible. The future impacts of SLR in these areas needs to be more thoroughly investigated.

Coastal neighborhoods in Old Saybrook increasingly will be at risk from flooding due to SLR. Some areas already experience regular nuisance flooding during monthly astronomical high tides through residential yards and across local roads. As sea levels rise, the geographic extent of regular nuisance flooding adjacent to tidal marshes will expand further into these low lying areas. With a future 5 ft. increase in sea level, the majority of the homes in Chalker Beach will experience monthly flooding as will many homes in Indiantown, Saybrook Manor, homes along Great Hammock and Plum Bank Roads and along sections of Maple Avenue and College Street (see map titled "MHHW Inundation" in the Appendix). Frequent flooding may result in an increase in mold in buildings, which can have a significant health impact on residents.

Figure 18: Astronomical high tide, Plum Bank Road

Figure 19: Astronomical high tide, Chalker Beach

Bacterial contamination of coastal waters can occur after heavy rain or flooding and during the summer months can cause beach closures. Following heavy rain or flooding events the Town, through the Connecticut River Area Health District, collects and has tested water samples at all Town and beach associations beaches. These data are used to identify conditions when bacterial contamination is likely and protocols for timely beach closures, while awaiting water quality testing results, until the risk of contamination has decreased. Climate change will increase the frequency of heavy rainfall events and will produce higher LIS water temperatures, conducive to bacteria survival, which likely will cause more frequent beach closures.

In keeping with the suggested policies to adapt to, mitigate against or retreat from the impacts of sea level rise on Old Saybrook's community, the Committee recommends that the Town:

- **Master Plan for Our Coastline.** Previously mentioned - see **Environment: Coastal Geologic Processes**.
- **Nonpoint Source (NPS) Pollution Prevention.** Renew efforts to educate property owners to forgo or reduce the use of herbicides, fertilizers and pesticides, and to use pervious materials to landscape for on-site infiltration of stormwater.
- **Water Usage Reduction.** Provide guidance to homeowners and local businesses on ways to reduce water usage; remove barriers to the reuse of “gray” water to decrease the net amount of wastewater in subsurface sewage disposal systems.

- **Wastewater Management 2050.** Undertake a study to learn how SLR and climate change will affect the extent of the soil's ability to renovate sewage in the low-lying area of Old Saybrook and plan for the next era of wastewater management in Old Saybrook.
- **Water Quality Monitoring.** Continue to meet the requirements of the NPDES and the Connecticut Public Health Code. Monitor water quality from stormwater runoff at public beaches in the town following flooding or heavy rain events. Develop a program to similarly monitor water quality at private association beaches.

Community: Recreation

People choose to live in Old Saybrook in part because of the many opportunities provided by proximity and access to coastal waters. With over 23 miles of shoreline situated directly south from Hartford and approximately halfway between Boston and New York City, these opportunities are also enjoyed by many others who are not permanent residents – especially in the summer when the population of Old Saybrook doubles. Regardless of whether people are permanent residents, summer residents, visitors for the weekend or a just a day, they participate in many recreational activities, including walking along the shores, going to the beach, bicycling, fishing, boating, painting, visiting art galleries or the Katharine Hepburn Cultural Arts Center or having a meal overlooking the water.

The Town has two public beaches - Town Beach and Harvey's Beach - located off Plum Bank Road. There also are numerous private beaches that belong to neighborhood, beach, and condominium associations. Use of many of these popular beaches at high tide already is limited and will become more so as sea level becomes higher. At some point the beaches, as they exist today, will be permanently underwater due to the impacts of sea level rise (SLR) and climate change. Loss of our public beaches would have a negative impact on the enjoyment of many; therefore, maintaining our town beaches is a critical component for future planning.

Figure 20: High tide at Town Beach

The boating community makes use of over 1,100 moorings and boat slips at the many marinas located along the Connecticut River and to a lesser degree in the tidal estuaries along LIS. These facilities provide residents and non-residents alike with access to Long Island Sound for boating, fishing and other water-based recreation. That these facilities will be impacted by SLR is clear. However, the degree to which they will be impacted by SLR will need to be investigated.

The Town's Coastal Management Plan urges the Town to maintain and enhance existing recreational infrastructure that provides public access to and use of the shoreline. Similarly, the "Scenic Road" section of the Town Plan and the Region's Long Range Transportation Plan suggest the best way to maximize public access to the water for tourism and recreational

purposes is by increasing nature walking and bicycle trails along our shoreline should be expanded so that access to the natural beauty of our town is improved. Efforts should be started to secure land for these new trails as it becomes available.

Likewise, maintaining the ability to launch small boats, canoes and kayaks is important.

In keeping with the suggested policies to adapt to, mitigate against or retreat from the impacts of sea level rise on Old Saybrook's community, the Committee recommends that the Town:

- **Master Plan for Our Coastline.** Previously mentioned - See **Environment: Coastal Geologic Processes**.
- **Beach Access.** Consider where the Town might acquire land to make room for beach expansion at higher elevations.
- **More and Different Recreation.** Diversify the types and locations of public access to the water for tourists and inland residents of town alike, including a freshwater swimming facility.
- **Tourism Lifestyle.** Implement the viewing areas, walking paths, and biking paths identified in the Town's "Scenic Road" section of the Town Plan and the Region's Long Range Transportation Plan.
- **Boat Ramps.** Assess the need for improvements to public boat ramps due to SLR and climate change and establish a priority list for funding.
- **Car-top Put-ins.** Work with the local recreational boating community to identify and obtain new launch areas for kayaks and canoes in the river and marshes.
- **Marina Migration.** Encourage water-dependent businesses and private marinas to consider the impact of SLR and climate change in all plans going forward.

Economy: Private Residences

Sea level rise (SLR) and climate change will have a profound effect on Old Saybrook's residential properties south of Route 1 as more frequent flooding covers larger areas. The initial cost and anguish of responding to flood damage is felt by the property owners. It is soon followed by the entire town because the tax base provided by these properties, which increases in value closer to the water, is continually, and will be increasingly, off-line.

The Town's Natural Hazard Mitigation Plan (NHMP) identifies those areas of town that are particularly vulnerable to coastal flooding (e.g. Chalker Beach, Indiantown, and Saybrook Manor). Townwide, 35% of residential buildings are in the 100-year floodplain, which means a 1% chance of flooding in any given year, and an additional 21% of residential buildings are in the higher-elevation 500-year floodplain, which means a 0.02% chance of flooding in any given year. (See Floodplains Map in Appendix II)

As sea level rises, the 100- and 500-year floodplains will expand and encompass more residential buildings. A greater portion of the tax base will be vulnerable to future floods and, therefore, may result in more extensive and greater losses in income (tax revenue) to the town. The 35% of the town's residential buildings currently in the 100-year floodplain account for 33% of the town's total tax base. Based on current sea levels, 6% of Old Saybrook's tax base is vulnerable to a Category 1 hurricane and 52% of the tax base is vulnerable to a Category 4 hurricane.

Neither of the two most recent tropical cyclones, Irene (August 2011) or Sandy (October 2012), was of hurricane strength when it hit Old Saybrook. Yet, according to the National Oceanic and Atmospheric Administration (NOAA), Hurricane Irene is ranked as the costliest Category One storm in US History causing $15.8B in damages; Old Saybrook homeowners' claims for Irene were approximately $3.2M. Superstorm Sandy was the second costliest hurricane in US History; it resulted in approximately $ 9.7M in damages to our town. Claims data includes increased costs to repair or replace in keeping with current Federal Emergency Management Administration (FEMA) and Town construction standards for flood compliance.

The cost of living on the shoreline continues to increase. Congressionally mandated reforms to the National Flood Insurance Program have dramatically increased costs for flood insurance, which are likely to continue to rise in the future. New homes within the 100-year floodplain must be built to FEMA standards at significant costs. This requirement also applies to remodeling of existing homes when the cumulative value of repairs and or improvements over the past ten years equals or exceed 50% of the appraised value of the building. In addition to the cost of compliance with building regulations, the cost of septic system upgrades or replacement can also be significant.

Figure 21: House being elevated, Sea Lane

The alternatives for owners of existing "at risk" structures in the 100-year floodplain are limited and expensive. They can elevate the existing structure, tear down and rebuild it, abandon it, or sell it – which only transfers the choice-making to a new owner. Old Saybrook's Flood Plain Management Ordinance, Chapter 128 of the Town Code, establishes standards and regulations for new construction and renovations of structures within FEMA designated special flood hazard areas (100-year floodplains). Through this ordinance and established practices in the Land Use and Building Departments, the Town complies with and participates in the National Flood insurance Program (NFIP). However, whether voluntarily mitigating against the inevitable storm or recovering from a disaster, there is no official "how-to" guide available to the average homeowner that makes it any less difficult to coordinate architectural and engineering design, obtain health, flood, zoning and building permits, or line up contractors. Some property owners who chose to elevate existing structures early-on in the National Flood Insurance Program, or who built new homes within recent years, now find they no longer meet the current FEMA standards. Within coastal neighborhoods it is not unusual to see houses elevated to different heights that reflect the different elevation standards in place at the different times of home improvement. In an effort to help property owners who want to stay ahead of rising waters, the CT Shoreline Resiliency Fund makes financial assistance available to homeowners through its ShoreUp CT program. The program provides up to $300K in low interest loans to homeowners to elevate their homes to the 500-year floodplain

Figure 22: Recently elevated houses

standard, which is approximately 1.25 times the elevation requirement for construction in the 100-year floodplain.

Figure 23: Not only flood waters but sand can make roads impassable; Beach Road West following Storm Sandy

Even with the incremental successes of raising structures above flood hazards, public safety issues remain. Homeowners can be overly-confident about staying in an elevated home during a coastal storm only to become trapped by flooded roads and isolated from emergency responders. The Town has yet to invest proactively in making corresponding improvements to adjacent municipal infrastructure, such as stormwater collection or road infrastructure, simply because, like private property owners, it has to make some hard choices about what it can afford to do. (See **Economy: Public Infrastructure** and **Storm Surge** and **MHHW Inundation** maps in Appendix II)

To sustain the mitigate-prepare-respond-recover of FEMA's "disaster cycle", it has introduced Federal funding for acquisition of land in voluntary "buyouts" of private property as a permanent, structural solution to reducing a community's risk of flood hazards. Again, choices need to be made, so there are criteria that guide FEMA's funding in locations where flooding puts human life and safety at extreme risk, e.g., is located within extreme flood, wave action, and/or wind action risk zones, suffers repetitive damage, poses a threat to neighboring areas in the event of a storm (e.g., because of the movement of dislodged debris), would serve other environmental protection goals (e.g., natural resource preservation) or community goals (e.g., open space, parks), would serve other hazard mitigation or floodplain management goals (e.g., increasing floodplain storage capacity), is contiguous to open space or properties that will be acquired, and of course, is located in an area of the community that supports buyouts. The Town should consider the drawbacks of the high up-front costs of acquisition, the reduction in tax base, disruption of neighborhoods and limited effectiveness where participation is incomplete or too scattered to reduce corresponding infrastructure and services.

In keeping with the suggested policies to adapt to, mitigate against or retreat from the impacts of sea level rise on Old Saybrook's economy, the Committee recommends that the Town:

- **Master Plan for Our Coastline.** Previously mentioned - see **Environment: Coastal Geologic Processes**.
- **FEMA Programs.** Continue to participate as a community in meeting the construction standards of the NFIP; continue to implement the physical improvements to public infrastructure recommended by the NHMP.
- **Economic Diversity.** Maintain and grow our tax base in areas less prone to the impacts of sea level rise and climate change and less-reliant on residential development.
- **Self-resilience Movement.** Develop a community advisory group to provide educational materials for residents on the impacts of SLR and climate change on their homes and the community, to foster discussions and provide advice about resilience options, and to provide grants to property owners to improve their structures to be flood-compliant and more resilient to extreme weather events.
- **Less-Prone Development.** Continue to develop a range of housing types in upland/less vulnerable areas that provide those qualities which attracted current town residents (e.g. views, water access, outdoor activities, and small town ambiance); consider programs for homeowners at highest risk to relocate within Old Saybrook to areas of less risk.
- **Planned Infrastructure Withdrawal.** Identify those areas of Old Saybrook in which continued public investment is not prudent or feasible due to sea level rise and climate change.
- **Voluntary Buyouts.** Acquire properties in town that are not suitable for development due to SLR and climate change and hold in conservancy.

Economy: Public Infrastructure

Sea level rise (SLR) already results in nuisance flooding of Old Saybrook's public roads and bridges during normal tidal cycles, and climate change is causing more extreme weather events with increased rainfall that exceeds the design capacity of Old Saybrook's dams and stormwater systems. These conditions also threaten the critical facilities from which the State and the Town manage the safety and well-being of the community now, and will only become worse as SLR increases and intense storms become more frequent. Less essential, the risk to the Town's parks and recreation facilities are perhaps most indicative of the impacts of SLR and climate change on Old Saybrook's quality-of-life.

The Town's Natural Hazards Mitigation Plan (NHMP), most recently updated in 2014, identifies the numerous roads in Old Saybrook that the Town or the State need to improve or elevate due to the impacts of SLR. The capacity (arterial, collector or local traffic) and functions of these roads (evacuation, emergency response, commercial, residential, etc.) help to prioritize the allocation of capital resources to undertake the extensive engineering studies that will be needed to design for current problems and those presented by SLR in the future. To evaluate proposed hazard mitigation projects prior to Federal funding, FEMA requires a Benefit-Cost Analysis (BCA) to validate cost effectiveness – the benefits of a prospective hazard mitigation project are sufficient to justify the costs.

Figure 24: The Causeway, an important arterial State road, is at risk of flooding during coastal storms

What comes to mind immediately is the question of how to resolve the drainage/flooding problem caused by the Oyster River at the Elm Street Underpass between Route 1 and Exit 67 of Interstate 95? More than once, the Town has attempted to solve the now commonplace loss of access due to normal tidal cycles. Eventually, it seems that impassable roads become the new "normal" condition when, instead, there needs to be immediate consideration to accommodate emergency access and evacuation as far out as 2050.

Perhaps even more important, the Town's critical facilities, necessary to support government operations and emergency operations, need to be resilient to SLR and climate change. Recent tropical storms have prompted the Town to retrofit its facilities with permanent but short-term emergency power generation. The NHMP recommends the Town to consider more long-term solutions to capacity and functional issues due to the impacts of climate change.

Property owners expect smart infrastructure upgrades to protect them long-term. It is in everyone's interest to maintain or grow the tax base and that retreat from the shore does not result in tax escalation. Conversely, taxes should not increase beyond reason due to infrastructure upgrades, which may initiate a financial retreat.

The Capital Improvement Program should be reviewed annually and funds set aside for infrastructure improvements to adapt to SLR and climate change with the goal to avoid loss of life and property during natural hazard events. Residents need to see a recognition of the seriousness of SLR and a transparent commitment from the Town for action in the form of infrastructure upgrades – projects identified, resources allocated, and actions followed through.

In keeping with the suggested policies to adapt to, mitigate against or retreat from the impacts of sea level rise on Old Saybrook's economy, the Committee recommends that the Town:

- **Master Plan for Our Coastline.** Previously mentioned - see **Environment: Coastal Geologic Processes**.
- **Capital Projects.** Inform citizens on existing and proposed capital projects, including the contribution that SLR plays in the project. Information on legal, financial and policy implications specific to SLR should be available for easy access, review and updating.
- **Capital Improvement Program.** Ensure that the Town Capital Improvement Program's prioritization, weighting, and ranking factors include repetitive flooding, maintenance avoidance, and recurring severe storm restoration costs of town infrastructure.
- **Elevate Roads**. Establish a design basis for road elevations and other infrastructure based on the best available science and infrastructure life expectancy, and establish a prioritized list of upgrades.
- **Microgrid**. Investigate the design and construction of a microgrid to provide emergency power to Town Hall, Town Ambulance, the Emergency Operations Center and Fire and Police Departments. Have "shovel-ready" projects ready to implement when disaster funds become available and infrastructure damage has occurred.

Economy: Commerce and Industry

Commercial properties increasingly are at risk of flooding due to coastal storms and accelerating sea level rise (SLR). In addition to risks to property and inventory damage, flooding may cause release of hazardous materials used by local businesses and require extensive and costly environmental cleanup. Infrastructure such as roads will need to be upgraded in order to maintain, access, and serve local businesses.

Old Saybrook businesses are dependent on the local community and tourists drawn to town by virtue of its small, New England-town character and shoreline assets. These businesses include professionals, merchants, hoteliers, restaurants, inn keepers, and marinas, among others. Main Street storefronts are currently occupied with quality shops and restaurants drawing people to town. Changes to the population size, demographic makeup or character of the town due to SLR and climate change could impact business performance. (See **Community: Culture**)

Figure 25: Saybrook Point Inn and Marina, examples of marine dependent businesses

The Town's Economic Development Commission is aware of the potential impact of SLR and climate change and is working to encourage the establishment of new businesses and to improve desirability for existing businesses and their customers.

It is the town's best interest to grow a robust local economy for employers, taxpayers, and users of services by retaining, growing and seeking new commercial businesses while maintaining the character of the town and its shoreline assets as core qualities of Old Saybrook.

In keeping with the suggested policies to adapt to, mitigate against or retreat from the impacts of sea level rise on Old Saybrook's economy, the Committee recommends that the Town:

- **Master Plan for Our Coastline.** Previously mentioned - see **Environment: Coastal Geologic Processes**.
- **Partner with Businesses.** Identify and quantify the impacts of SLR and climate change on the town's existing businesses, potential new businesses and town residents and visitors.
- **Commercial Properties**. Identify and prioritize at-risk commercial properties and develop strategies for coping with flooding potential and SLR.
- **Marine-Dependent Businesses**. Prioritize investment in protecting our shoreline to protect existing marine-dependent businesses while maintaining the town's character and tourism.
- **Maintain Commerce and Tax Base.** Prioritize investment in infrastructure with the goal to maintain commercial activities and tax base.
- **Attract Businesses and Services**. Develop programs to attract businesses and services that can assist the Town and existing businesses to address the emerging issues of SLR and climate change.
- **Site Plan Review.** Town permitting agencies and public officials should assist businesses, through the site plan review process, to plan for, adapt to and mitigate against future SLR and climate change impacts.

Conclusion: We Need to Adapt, Mitigate and Retreat

Sea level rise and associated climate change may be the greatest challenge facing Old Saybrook in the coming decades. Modeling, by the Army Corps of Engineers, of currently available data predicts a potential SLR of 1 to 5 ft. by the end of the century, with a recent analysis of climate data by Dr. James Hansen et al suggesting the increase could be much higher. Issues associated with SLR and climate change cannot be solved by one shoreline community. However, it is imperative that forward planning by our town and other communities on the shoreline take SLR and climate change into account. It is critical that our town and surrounding communities continue discussions on how to adapt or mitigate against these predicted changes in sea level and climate change. We urge the members of our community to stay informed, get involved, and help bring forward ideas on ways to make our community more resilient to the impact of SLR and climate change.

> **We *can* plan for resiliency in considering where and how to best adapt, mitigate, or possibly retreat based on predictions of SLR and climate change.**

The Committee has carefully reviewed the state of SLR and climate science and has made suggestions about what the Town can do. While the committee was made up of concerned Old Saybrook residents, its members are not scientists, engineers or planners well-versed in SLR and climate change impacts and solutions. The strongest recommendation that the committee can make, the one that begins the list of recommended actions in each section, is that the Town needs to engage an experienced consultant or consulting firm to conduct a thorough coastal resilience study that more completely informs and guides future Town actions to adapt to, mitigate against or retreat from SLR. We need solutions customized to our unique situations.

And lastly, the Town should reach out to other shoreline communities that share similar risks to **plan regionally**, access and share best practices, and look to acquire grants and funding to implement best practices.

Acknowledgments

The Committee would like to express our sincere thanks and appreciation for the help and support we received from the town staff members and the many technical experts who gave their time to educate us on the many, sometimes complicated issues facing our town. Without their efforts this report could not have been written.

Carl P. Fortuna, Jr. First Selectman

Walter K. Smith, Chairman, Conservation Commission

Sea Level Rise Climate Adaptation Committee

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Robert L. Yust - Vice Chairman
Michael R. Momparler - Secretary, Community Lead
Thomas A. Gezo, Economy Lead
Janice P. Holland, Environment Lead
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Christina Costa, Zoning Enforcement Officer
Stephen Mongillo, Program Coordinator, Old Saybrook Water Pollution Control Authority
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Jim Monopoli, Director of Health, Connecticut River Area Health District

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Appendix I: Forecasting Sea Level Rise

Climate change and the associated rise in sea level is an area of robust scientific inquiry. Almost daily new data about ocean warming, ocean circulation, glacial melting, etc. are being obtained from many diverse fields of study. As these new data are analyzed, the resulting SLR projections are an ever increasing cause for concern. Said another way; the more scientists understand the impacts that climate change is having on the world's water and ice systems, the higher their SLR predictions have become.

Because the Sea Level Rise Climate Adaptation Committee needed a place to start, we chose to use a 2013 report of the United States Army Corps of Engineers (USACE) (ref 1). That report uses data from the National Oceanic and Atmospheric Administration (NOAA) to develop "a detailed tool to help understand the effects of changing sea levels over time." Results of the USACE/NOAA model formed the basis for SLR estimates and the recommendations that appear in this report.

Other reports and studies used for this report are listed in the References section. That said, decision makers and interested residents (which the SLRCAC hopes is everyone) should seek out the latest scientific information. Our recommendations for adapting or mitigating the impacts of sea level rise must be adjusted as new and better data become available.

Reference 1: http://www.corpsclimate.us/Sandy/curvesNJNY2_detailed.asp

http://www.corpsclimate.us/ccaceslcurves.cfm

The images below show the online USACE SLR Curve Calculator and its output for this area. The Relative Sea Level Change Projections graph show the wide range of SLR forecasts to 2100. The SLRCAC recommends using the top curve – the USACE high estimates. It is better to err on the side of caution than be surprised if lower estimates are used and then "unexpectedly" exceeded.

USACE Sea Level Change Curve Calculator (2015.46)

Item	Display
SLC Curve Chart	☑
SLC Curve Table	☑
Gauge Datum Chart	☑
Gauge Datum Table	☑
SLC Curves	☑
SLC Table	☑
NOAA EWL Chart	☑
Gauge Map	☑

Project Name: Enter Project Name

Select NOAA Gauge: New London, CT

FEMA BFE (ft): ? Information 0.00 MSL Search for BFE here

Project Start Year: 1992

Interval Year: 5

Project End Year: 2100

Output Units: (•) Feet ( ) Meters

Output Datum: (•) LMSL ( ) NAVD88

Output Agency: (•) USACE ( ) NOAA ( ) Both

SLC Rate: (•) Published ( ) Regionally Corrected or User Entered: (ft/yr)

Display Data

EWL Type: (•) Highs ( ) Lows

EWL Source: NOAA Website (•) NOAA (GEV) ( ) USACE (Percentile) 100 yr difference (m) = 0.24

Chart Size: Height: 600 Width: 800 Display Data

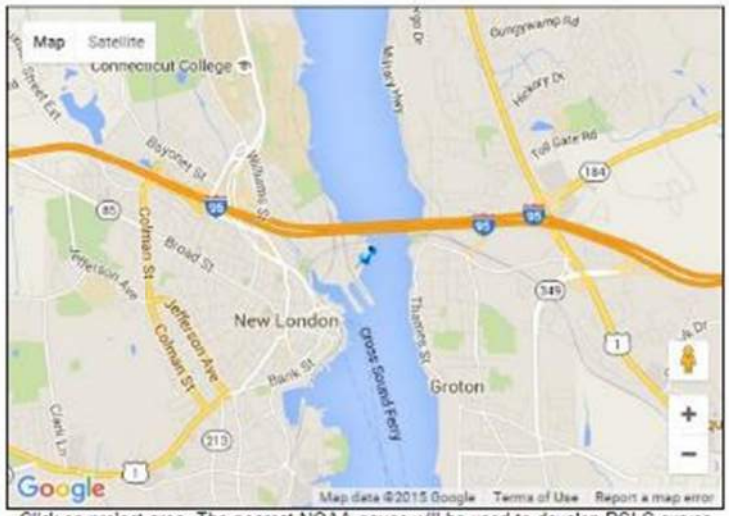
Plot EWL/BFE/Tides: None — Select Curve: USACE High

Critical Elevation #1 (ft): 0.00 MSL - Description:

Critical Elevation #2 (ft): 0.00 MSL - Description:

User's Index (ft): ? 0 Description:

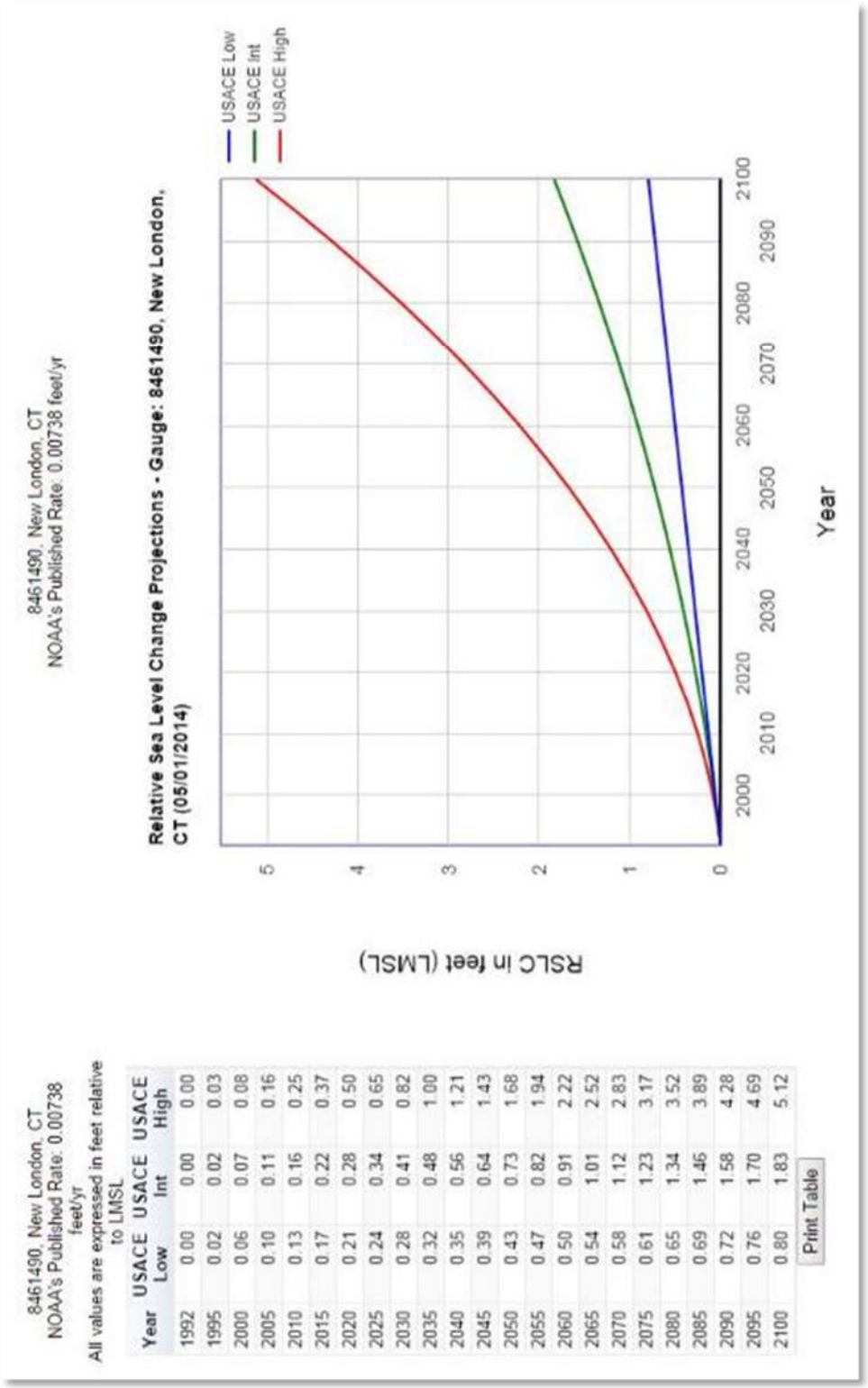
Datum Shift from NAVD88 to MSL: 0.30 feet



Click on project area. The nearest NOAA gauge will be used to develop RSLC curves based on ER 1100-2-8162, Incorporating Sea Level Change in Civil Works Programs, 31 Dec 2013 and NOAA Technical Report OAR CPO-1, Global Sea Level Rise Scenarios for the United States National Climate Assessment, Dec 2012

*** note - there may be factors other than proximity to consider when selecting a gauge ***

Compliant
Inactive
< 40yrs



8461490, New London, CT
NOAA's Published Rate: 0.00738 feet/yr

All values are expressed in feet relative to LMSL

Year	USACE Low	USACE Int	USACE High
1992	0.00	0.00	0.00
1995	0.02	0.02	0.03
2000	0.06	0.07	0.08
2005	0.10	0.11	0.16
2010	0.13	0.16	0.25
2015	0.17	0.22	0.37
2020	0.21	0.28	0.50
2025	0.24	0.34	0.65
2030	0.28	0.41	0.82
2035	0.32	0.48	1.00
2040	0.35	0.56	1.21
2045	0.39	0.64	1.43
2050	0.43	0.73	1.68
2055	0.47	0.82	1.94
2060	0.50	0.91	2.22
2065	0.54	1.01	2.52
2070	0.58	1.12	2.83
2075	0.61	1.23	3.17
2080	0.65	1.34	3.52
2085	0.69	1.46	3.89
2090	0.72	1.58	4.28
2095	0.76	1.70	4.69
2100	0.80	1.83	5.12

Print Table

Appendix II: Tables and Maps

Table 1: CURRENT POTENTIAL IMPACTS: PARCELS & BUILDINGS

This table summarizes the number of parcels and buildings in Old Saybrook that are totally or partially in the FEMA 100-year floodplain. The analysis does not account for buildings that have been elevated.

	Number in flood zone	Townwide Total
Parcels	3165	6270
Buildings*	2020	5835

* Does not include garages and small outbuildings.

Table 2. CURRENT POTENTIAL IMPACTS: BASED ON FEMA FLOODPLAIN MAPS

This table summarizes the exposure of properties in Old Saybrook located in the FEMA 100-year floodplain. The analysis does not account for buildings that have been elevated.

Number of properties	$ Vulnerability
2020	$ 715,322,580

Total Assessed Value of all properties with buildings is $2,161,405,806 (does not include vacant land).

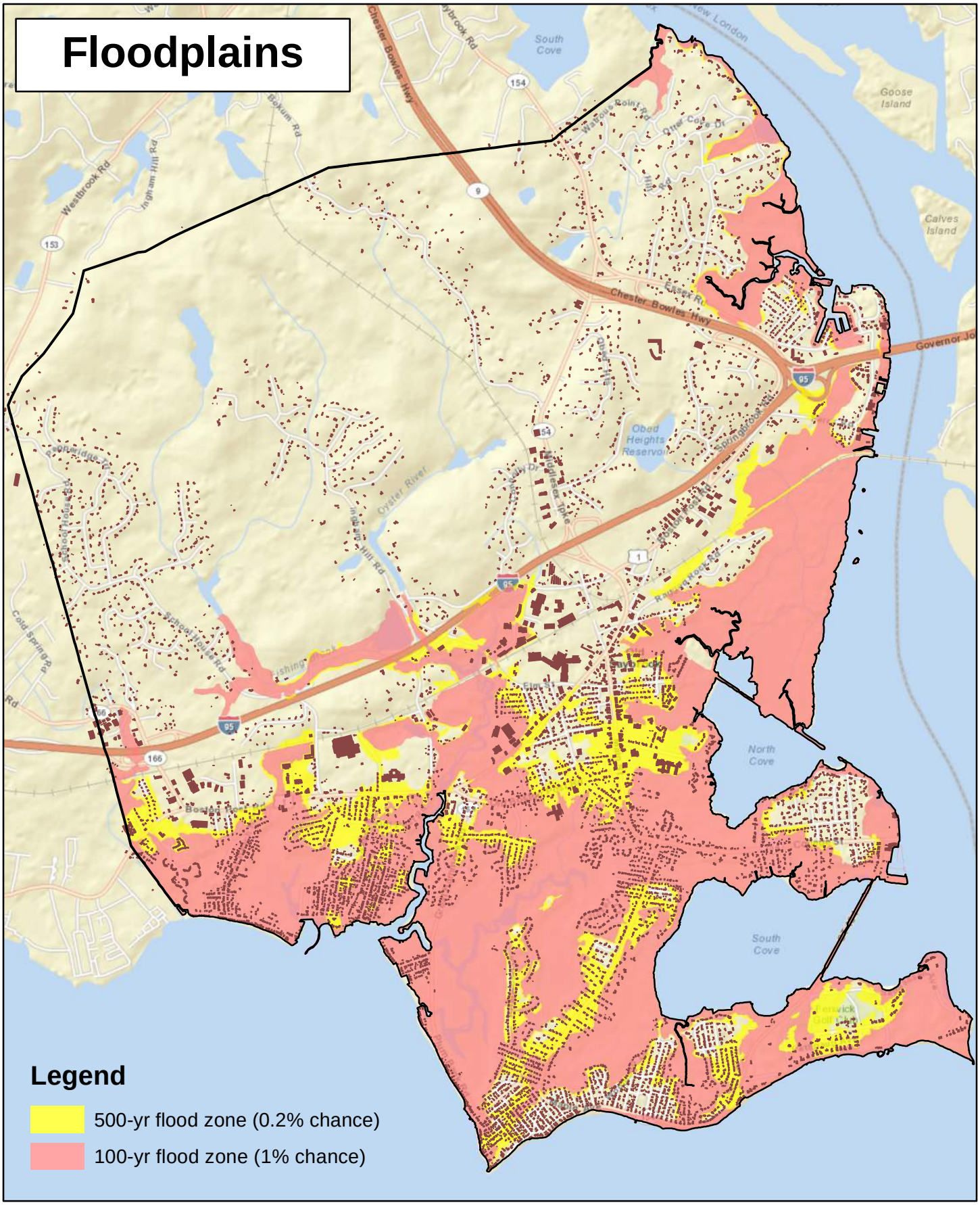
Table 3. CURRENT POTENTIAL IMPACTS: BASED ON SLOSH MODELING

This table summarizes the exposure of properties in Old Saybrook to hurricanes for categories 1 through 4. Vulnerability is based on the 2014 assessed value of each parcel and the mapped hurricane category that the building on each parcel falls into. This summary is based on current SLR conditions and uses a SLOSH model/map provided by the CT DEEP. SLOSH is an acronym for Sea, Lake and Overland Surges from Hurricanes.

Category Rank (# buildings)	$ Vulnerability/Cat	$ Sum of vulnerability
Hurricane Category 1 (373)	$129,611,720	$129,611,720 (cat 1)
Hurricane Category 2 (881)	$315,452,760	$445,064,480 (cat 1 + cat 2)
Hurricane Category 3 (1046)	$364,738,206	$809,802,686 (cat 1 + cat 2 + cat 3)
Hurricane Category 4 (756)	$312,865,630	$1,122,668,316 (cat 1 + cat 2 + cat 3 + cat 4)

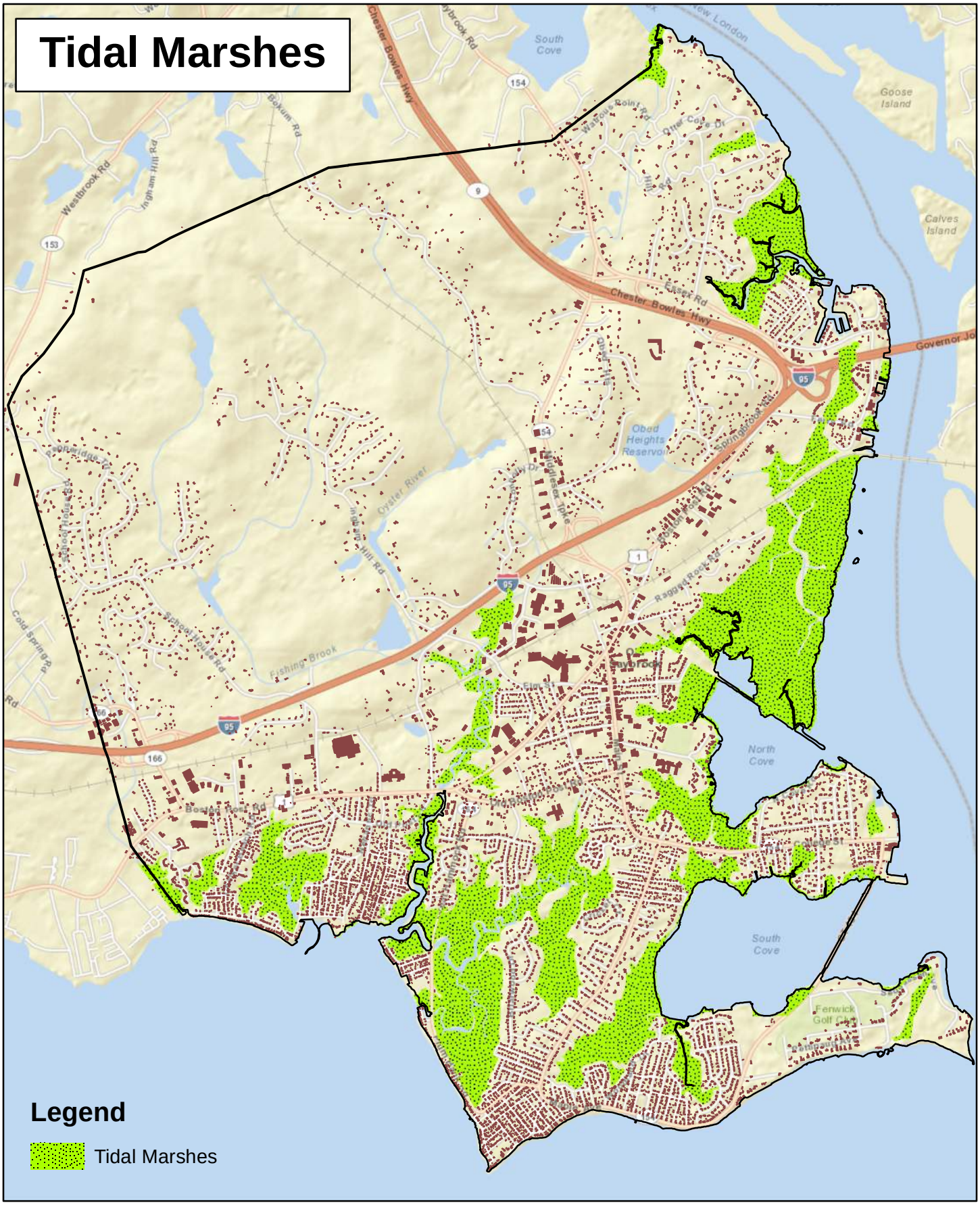
Total Assessed Value of all properties with buildings $ 2,161,405,806 (does not include vacant land).

Floodplains



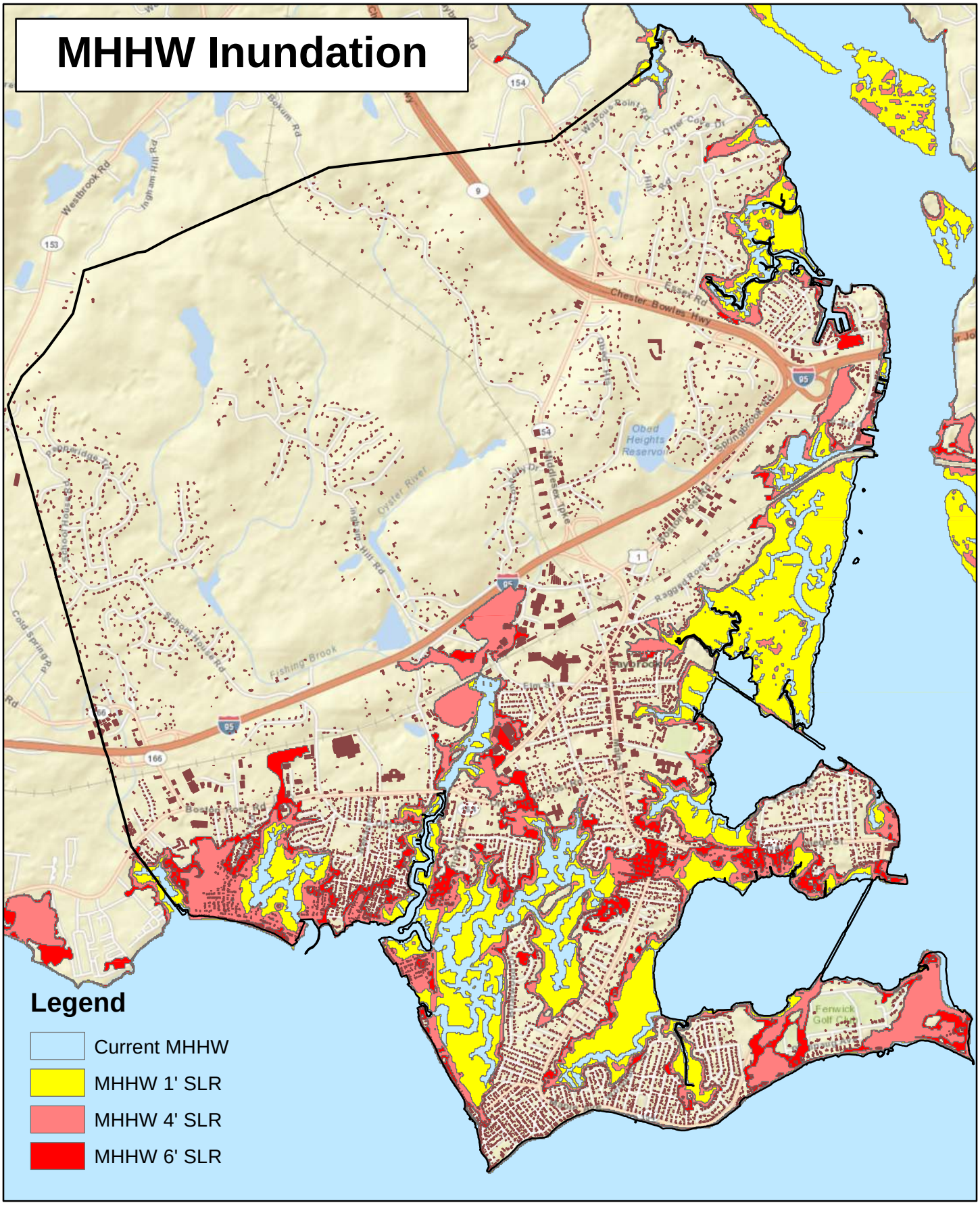
This map depicts the 100-year and 500-year floodplains mapped by FEMA. The 100-year floodplain includes areas that have a 1% chance of flooding in any given year. The 500-year floodplain includes areas that have a 0.2% chance of flooding in any given year. Sea level rise will increase the chance of floods and will enlarge the areas of both the 100- and 500-year floodplains.

Tidal Marshes



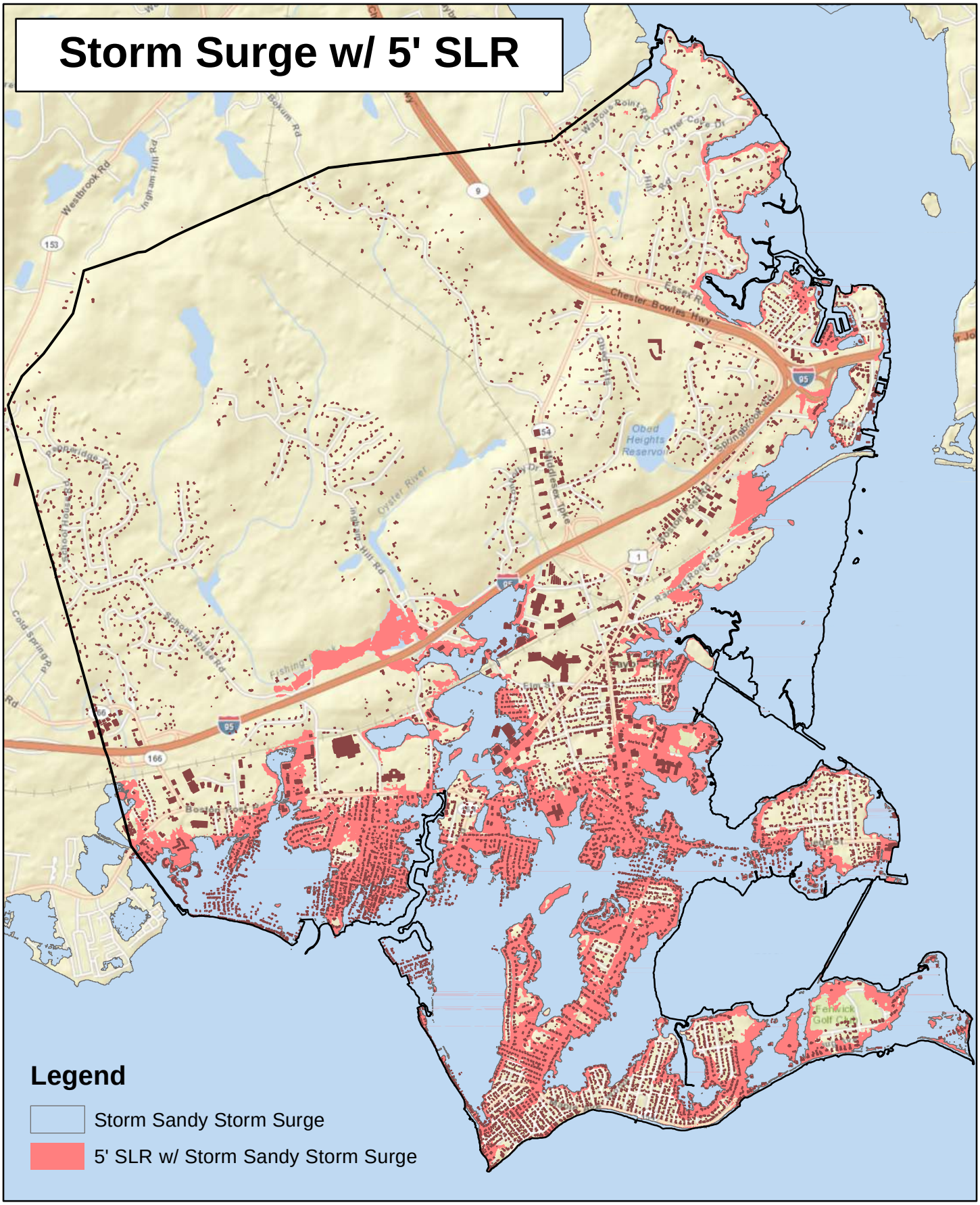
This map depicts the general locations of tidal marshes throughout Old Saybrook. Tidal marshes exist in close equilibrium with tidal cycles and sea level. Any increases in sea level will threaten the health and even the existence of tidal marshes which could be drowned and turned into mudflats.

MHHW Inundation



This map depicts the extent of innundation during mean high high water (MHHW) under current conditions and for SLR scenarios of 1, 4 and 6 feet. MHHW is the average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch. These data were prepared by NOAA and are suitable for general planning analyses. All inundation areas reflect flooding under non-storm conditions.

Storm Surge w/ 5' SLR



This map depicts the extent of storm surge that could occur in Old Saybrook under two scenarios. The areas shaded in blue show the approximate extent of the storm surge that occurred during Storm Sandy. The areas shaded in red show the extent of a comparable storm surge that would occur on top of SLR of 5 feet.

Produced by

TOWN *of* OLD SAYBROOK

Land Use Department

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Old Saybrook, Connecticut 06475
www.oldsaybrookct.gov