
BOROUGH OF STONINGTON ANNEX DOCUMENT

Southeastern Connecticut Council of Governments
Multi-Jurisdictional Hazard Mitigation and Climate Adaptation Plan Update

March 2023



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1. Introduction

1.1. Purpose of Annex

The planning process for the multi-jurisdiction hazard mitigation plan update commenced in April 2022 and ended in December 2022, spanning a period of nine months. The planning process included 24 jurisdictions (22 municipalities and two tribal governments) with two participating together (Griswold and Jewett City) for a net total of 23 local planning teams represented. For this 4th edition of the plan, SCCOG elected to link the planning process to a parallel planning process administered by the Connecticut Institute for Resilience and Climate Adaptation (CIRCA) that is known as “Resilient Connecticut 2.0” (stylized as *Resilient Connecticut*). The *Resilient Connecticut* program is described on CIRCA’s web site at <https://resilientconnecticut.uconn.edu/> and the expansion of the program into southeastern Connecticut is described at <https://circa.uconn.edu/2022/02/23/resilient-connecticut-expands-statewide/>.

The linkage of the two planning processes was advantageous for the following reasons:

- Incorporation of climate change into the hazard mitigation plan update
- Increased interest from the local communities, especially for those interested in developing climate adaptation strategies
- Direct incorporation of climate change vulnerability products developed by CIRCA including the Climate Change Vulnerability Index (CCVI) for flood and extreme heat vulnerabilities
- Direct incorporation of combined sea level rise and coastal flood inundation simulations from CIRCA
- Positioning of the SCCOG jurisdictions for new funding sources in Connecticut such as the new Department of Energy and Environmental Protection (DEEP) Climate Resilience Fund (DCRF)
- Consistency with the Governor’s Council for Climate Change (GC3) outcomes from the 2020-2021 planning process
- Positioning of the actions for incorporation on the State’s “resilience project pipeline” per Executive Order (EO) 21-3 issued at the end of 2021

The planning process commenced for the local communities on April 20, 2022 with a presentation to the SCCOG Board. During this presentation, the consultant and CIRCA described the planning process and the approach for incorporating the *Resilient Connecticut* program into the hazard mitigation plan update, and notified the chief elected officials that invitations to local planning meetings would follow at the end of April. Local planning team meetings commenced on May 23, 2022 and ended on July 8, 2022. Workshops with local coordinators were conducted in July and September 2022, and supplemental meetings with water utilities in the region and specific stakeholders continued through November 2022.

The purpose of this annex document is to provide an update to the hazard risk assessment and capability assessment provided in the previous HMP, and to evaluate potential hazard mitigation measures and prioritize hazard mitigation projects specific to mitigating the effects of hazards on the Borough of Stonington. Background information and the regional effects of pertinent hazards are discussed in the main body of the Multi-Jurisdictional Hazard Mitigation and Climate Adaptation Plan. Thus, this annex is designed to supplement the information presented in the Multi-Jurisdictional HMCAP

with more specific detail for the Borough of Stonington and is not to be considered a standalone document.

1.2. Hazard Mitigation and Climate Adaptation Goals

The primary goal of the previous hazard mitigation plans adopted in 2013 and 2018 was to identify risks to hazards and potential mitigation measures for such hazards in order to **reduce the loss of or damage to life, property, infrastructure, and natural, cultural, and economic resources**. This included the reduction of public and private damage costs. Limiting losses of and damage to life and property was also meant to reduce the social, emotional, and economic disruption associated with a natural disaster.

Coinciding with the incorporation of climate adaptation and the alignment of this HMCAP with the *Resilient Connecticut* planning process administered by CIRCA, five new goals were developed for this HMCAP:

- Ensure that critical facilities are resilient, with special attention to shelters and cooling centers.
- Address risks associated with extreme heat events, especially as they interact with other hazards.
- Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.
- Reduce losses from other hazards.
- Invest in resilient corridors to ensure that people and services are accessible during floods and that development along corridors is resilient over the long term.

2. Community Profile

The Borough of Stonington is a densely developed political subdivision of the municipality of Stonington, Connecticut. The Borough was first settled in 1753 and established as a borough in 1801. Residents of the Borough are also considered residents of the Town of Stonington (the remaining political subdivision of Stonington) and the two jurisdictions share many municipal services. The Borough is approximately 205 acres in area and had a population of 976 as of the 2020 census, which is an increase of about 50 over ten years. This population figure does not account for the seasonal influx of residents each summer; the population of the borough can increase as much as 25% during this time.

The borough is located in the southeastern portion of the Connecticut shoreline. It is bordered by the Town of Stonington to the north, Stonington Harbor to the west, and Little Narragansett Bay / Fishers Island Sound to the east and south. The borough can be accessed via Route 1A in Stonington, although State roads do not exist within the borough.

2.1. Physical Setting

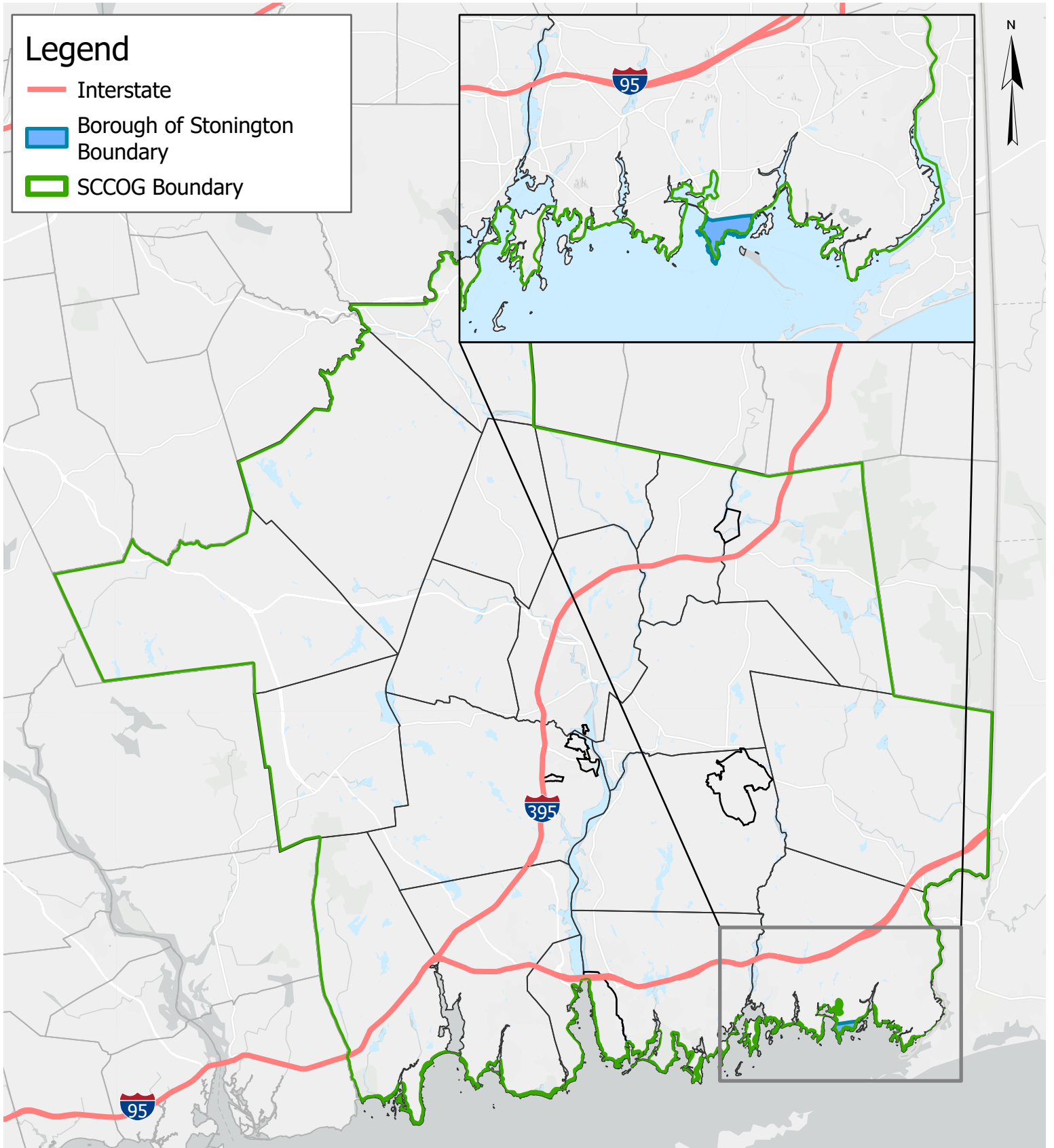
The Borough of Stonington is a coastal community located on the Connecticut shoreline. Elevations range from sea level to just over 30 feet in the northern portion of the borough. Two uninhabited islands also lie within the Borough limits.

Geology is important to the occurrence and relative effects of natural hazards such as earthquakes. Thus, it is important to understand the geologic setting and variation of bedrock and surficial formations in lands underlying the Borough of Stonington. The Borough lies above two bedrock types which trend southwest to northeast across the area. The majority of the borough is underlain by Rope Ferry Gneiss with a band of Hope Valley Alaskite Gneiss stretching northeast from Edwards Point. Each of these formations consists primarily of gneiss which is a relatively hard metamorphic rock. There are no faults mapped within or near the Borough of Stonington boundary.

The Borough's surficial geologic formations include glacial till, stratified drift, and coastal formations. Refer to the Multi-Jurisdictional HMCAP for a generalized view of surficial materials. The majority of the borough is underlain by glacial till. Till contains an unsorted mixture of clay, silt, sand, gravel, and boulders deposited by glaciers as a ground moraine. Most of the northwestern and northeastern portions of the borough are underlain by stratified drift, and a significant number of tidal wetlands are mapped in this area as well. Sandy Point, an uninhabited island in Little Narragansett Bay, is mapped as beach (a coastal formation). The amount of stratified drift present is important as areas of stratified materials are generally coincident with floodplains. The amount of stratified drift also has bearing on the relative intensity of earthquakes and the likelihood of soil subsidence in areas of fill.

Legend

- Interstate
- Borough of Stonington Boundary
- SCCOG Boundary



Regional Location of Stonington Borough

SCCOG Hazard Mitigation and Climate Adaptation Plan
Borough of Stonington
Date: 7/22/2022



Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS

2.2. Drainage Basins and Hydrology

The Borough lies within the southeast shoreline sub-regional watershed as delineated by the Connecticut DEEP. The western side of the borough drains directly to Stonington Harbor, while the eastern side drains into Little Narragansett Bay. The only notable water body in the borough that is not a tidal wetland is Island Road Pond located north of Bayview Avenue. This waterbody is impounded by a low-hazard dam registered with the Connecticut DEEP.

2.3. Land Cover

According to the 2016 1-meter resolution land cover developed by the NOAA Office of Coastal Management, Stonington Borough is predominantly comprised of developed impervious land cover, with approximately 39.14% of the borough classified as such. The second largest land cover type is developed open space, which covers about 18.19%, and next is mixed forest which is about 13.88% of land cover. All land covers and their percent coverage can be found in Table 2-1.

Table 2-1 Stonington Borough Land Cover

Land Cover Type (2016)	% Coverage
Barren Land	4.78
Developed, Impervious	39.14
Developed, Open Space	18.19
Estuarine Emergent Wetland	10.30
Estuarine Scrub/Shrub Wetland	0.23
Grassland/Herbaceous	2.29
Mixed Forest	13.88
Open Water	2.54
Palustrine Aquatic Bed	< 0.01
Palustrine Emergent Wetland	2.02
Palustrine Forested Wetland	0.09
Palustrine Scrub/Shrub Wetland	0.15
Scrub/Shrub	4.06
Unconsolidated Shore	2.34

2.4. Population, Demographics, and Development Trends

The Borough of Stonington is fully developed with the exception of a few areas of tidal wetlands. According to the 2012 *Plan of Conservation and Development* for the Borough, undeveloped land was equal to 13% of the overall land area of the borough. Much of the developed area of the borough was established by 1905, and the percentage of undeveloped land has remained almost constant since 1981. While it is possible that infill growth may occur, space does not appear to exist for larger developments such as subdivisions.

The Borough includes 5.41 miles of improved streets and 34 rights-of-way. A mix of residential and commercial development is found along the borough's shoreline, with the only industrial areas located north of the Amtrak-Metro North railroad. High and medium-density residential development

dominates the western peninsula, while low-density residential and undeveloped tidal wetlands are located in the eastern portion of the borough on Little Narragansett Bay. Open space and recreation areas are scattered throughout the borough.

According to the *2012 Plan of Conservation and Development*, approximately 24% of the housing units in the borough are seasonal, recreational, vacation or rental homes. Home values are fairly expensive in the borough, resulting in a decline in year-round residents and an increase in the overall age of the borough's population. The number of seasonal housing units has increased by 67% since 2000 and this trend is expected to continue in the future. As many housing units predate 1970, it is believed that most structures do not meet current building codes. Such structures may be more susceptible to damage from natural hazards. Fortunately, many homes have undergone recent renovation and many have installed flood and wind mitigation measures such as shutters and floodwalls.

Buildings and homes continue to undergo renovations and improvements, but new construction is rare. Three new homes have been built since 2000, with one on a vacant site and two on lots where homes were demolished. One more house is under construction as of winter 2022-2023 on a demolition site. Renovations often trigger the substantial improvement threshold in the Borough, resulting in structures that are less at risk of flood damage.

The only major opportunity for redevelopment in the Borough is the Old Velvet Mill. This could potentially become housing or a mixed use development, however, there is no specific plan in place. The property is in the SFHA and, assuming redevelopment triggers the substantial improvement threshold, its redevelopment could result in lower risk of flood damage.

Overall, development in the Borough includes only redevelopment and renovations, and therefore new development is not increasing risks to natural hazards and climate-driven hazards.

2.5. Governmental Structure

The Borough of Stonington is governed by the Board of Warden & Burgesses who are elected every two years in May as authorized by the Borough Charter of 1997. The Borough charter was revised in 2019 and there are now only four burgesses. The Warden is the chief executive officer of the Borough and is directly responsible for the administration of all departments, agencies, and offices. The Burgesses enact ordinances, adopt resolutions, undertake studies and investigations, provide for the administration of the Borough, determine rules of procedure, and take all steps necessary and proper for carrying out the powers given to the Borough. Together, Board of Warden & Burgesses review and approve all Borough business. Each Burgess acts as a Commissioner overseeing one or more aspects of government.

The Borough has several departments that provide municipal services. Departments pertinent to natural hazard mitigation include the Clerk-Treasurer and the Fire, Planning, and Highway Departments. In addition, there are several boards and commissions that can take an active role in hazard mitigation, including the Harbor Management Commission, the Planning & Zoning Commission, and the Zoning Board of Appeals. The general roles of most of these departments and commissions are common to most municipalities in SCCOG and were described in Section 2.9 of the Multi-Jurisdictional HMP. More specific information for certain departments and commissions of the Borough of Stonington is noted below:

- The Stonington Borough Volunteer Fire Department has one relatively recently-constructed fire station and serves the Borough as one of six fire districts in Stonington, but also serves a small area in the Town of Stonington. The Department provides fire suppression, fire/ disaster prevention, rescue, hazardous materials, and disaster mitigation to the Borough. Public Water Service for fire protection is provided by the Aquarion Water Company. Emergency medical and ambulance services are provided by Stonington Ambulance in the Town of Stonington.
- The Harbor Management Commission oversees the development and use of the coastal waters in and around the Borough of Stonington. They maintain a combined Borough/Town Harbor Management Plan and oversee the Borough's mooring program.
- The Planning & Zoning Commission oversees orderly and appropriate use and development of residential, commercial, and industrial land and the conservation of natural resources. They review and approve a wide range of land use applications, zoning regulation amendments, planning and development projects, and grant opportunities to ensure that development and growth in the Borough is consistent with existing land use, environmental policy, and the objectives of the *Plan of Conservation and Development*. They are assisted by the professional staff of the Planning Department who administers the Borough's Zoning Regulations, administers the Coastal Management Program, performs planning studies, and provides technical assistance to developers. Building Inspection is provided by the Town of Stonington.
- Police services are provided by the Town of Stonington Police Department. One of the Burgesses acts as Police Commissioner and liaison to the Town Police Department.
- The Highway Department provides services including safe, efficient and well-maintained infrastructure of roads and rights-of-way, bridges and stormwater management. The Highway Department also conducts snow removal and deicing on roads; tree and tree limb removal in rights-of-way; and maintains and upgrades storm drainage systems to prevent flooding caused by rainfall.

The roles of Borough departments have not changed since the time of the previous HMP. Thus, the Borough of Stonington is technically, financially, and legally capable of implementing mitigation projects for natural hazards to the extent that grant funding is available. As discussed in the next section and the historic record throughout this annex, the Borough is densely developed and thus has vulnerability to certain types of natural hazards.

2.6. Review of Existing Plans and Regulations

The Borough has several Plans and regulations that suggest or create policies related to hazard mitigation. These policies and regulations are outlined in the Emergency Operations Plan, *Plan of Conservation and Development*, *Harbor Management Plan* and Ordinance, and Zoning Regulations. The *Plan of Conservation and Development* has incorporated information from the previous HMP.

Emergency Operations Plan

The Borough is included within the jurisdiction of the Town of Stonington Emergency Operations Plan (EOP) that is updated and certified by the Town Board of Selectmen annually. This document provides general procedures to be instituted by the Borough Warden and/or designee and the Fire Department in case of an emergency. Emergencies can include but are not limited to natural hazard events such as

hurricanes and nor'easters. The EOP is directly related to providing emergency services prior to, during, and following a natural hazard event.

Plan of Conservation and Development (2012)

The POCD was most recently updated in 2012 with contributions from local boards, commissions, committees, citizens and citizen groups. The Plan seeks to be a statement of policies, goals and standards for the physical and economic development of the Town and recommends the most desirable uses types and population densities in various parts of the municipality.

The 2012 Borough of Stonington POCD includes the following actions:

- The Borough works to limit development in flood prone areas, and works to protect coastal and inland wetlands. This is accomplished through the enforcement of the Special Flood Hazard Area requirements in the zoning regulations.
- The Borough recognizes the need to reduce congestion in the Village arterial road system in order to facilitate better passage for emergency vehicles.
- Increase coordination between elected officials and first responders to increase emergency preparedness and public safety.

Therefore, the Borough of Stonington POCD is considered somewhat consistent with the current goals and actions of the hazard mitigation plan, as it does not directly address several of the hazards such as emergency hazard response, wind damage and winter storm hazards, among others. The next update to the POCD (scheduled for 2022, during the life of the current hazard mitigation plan) will continue to incorporate the elements of the hazard mitigation plan.

Harbor Management Plan

The Stonington Harbor Management Plan, which was revised in 2020 and effective as of April 6, 2021, authorizes the Harbor Master to carry out harbor management directives and enforce all provisions of the Plan, including collecting fees for mooring permits and assigning mooring locations; standardizing mooring tackle requirements; and enforcing wake and speed, waterskiing, motor, noise, and refuse regulations. In particular, this ordinance allows the Borough to have a list of persons who currently have boats moored such that removal or emergency response can be coordinated. This plan also notes that storm surge was an issue of concern at the Town of Stonington Dock.

Zoning Regulations

The Zoning Regulations of the Borough of Stonington, Connecticut were last updated on March 2, 2020. They include a variety of preventative regulations pertinent to mitigating flooding hazards. These regulations are applied during the permitting process for new construction and during substantial improvement of existing structures.

- Section 3.31 discusses coastal area management and potential exemptions from local permitting. Construction of new homes within 100 feet of any tidal water body or watercourse or from coastal resource areas within the Coastal Area Management Boundary defined by the Connecticut DEEP requires a Coastal Site Plan.

- Section 3.32 of the regulations covers flood protection. The Borough utilizes the 1% annual chance Sfloodplain (commonly referred to as the "100-year" floodplain) to manage development in floodplains. The 1% annual chance floodplain is defined as that depicted on the DFIRM published in August 2013 (or as amended) by FEMA and includes areas in Zone AE and Zone VE. The degree of protection required by this regulation is greater than the minimum reasonable for regulatory purposes. Proposed subdivisions much locate public utilities and facilities to minimize flood damage.
- Development restrictions are placed on some districts based on the "increased burdens on Borough emergency and other services and to protect the health, safety and welfare of residents."

2.7. Critical Facilities, Sheltering Capacity, and Evacuation

The Borough of Stonington considers three facilities to be critical to ensure that emergencies are addressed while day-to-day management of the Borough continues. Critical facilities are presented on figures throughout this annex and summarized in Table 2-2.

Table 2-2 Stonington Borough Critical Facilities

Facility	Address or Location	Emergency Power	Shelter	Cooling Center	In SFHA	Hurricane Surge Zone
Emergency Services						
Fire Station	100 Main Street	✓		✓	✓	✓
Municipal Facilities						
Borough Hall & Highway Dept.	26 Church Street	✓			✓	✓
Water Pollution Control Facility	High Street				✓	✓
Other Infrastructure/Facilities						
Stonington Free Library	20 High Street			✓		

Emergency Operations Center (EOC)

The Borough of Stonington is included in the Town of Stonington's emergency operations protocols, and during emergencies operates out of the Town's EOC. The Borough Fire Department is used as a backup EOC as necessary.

Fire Department

The Borough of Stonington Fire Department is located on Main Street near the viaduct leading into the borough. It has a generator and is used as a backup EOC as needed. This building is partly floodproofed with flood barriers located at the building doors and flood vents in the outer walls of the structure. The Fire Department also provides service to a portion of the Town of Stonington. The Fire Department has a ladder truck, two pump trucks, and a van. If needed, the Fire Department could be used for cooling during an extreme heat event.

Borough Hall

The Borough offices and the Highway Department are located in a former fire house on Church Street. The Borough plans to acquire a generator for this facility.

SCCOG completed an assessment of critical facilities in the region in 2017, fulfilling an action listed in the 2012 edition of the multi-jurisdiction hazard mitigation plan. The Borough Hall and Fire Station were included in the assessment. The assessment determined that both faced current flood risks and would experience increasing flood risks. Recommendations are incorporated into the list of actions in Chapter 11 of this annex and summarized below. Since the 2017 HMP, the Borough has elevated the generator for Borough Hall.

Table 2-3 SCCOG Critical Facilities Assessment Summary for Stonington Borough

Facility	Address	Short-Term (0-20 years)	Long-Term (>20 years)
Fire House and EOC	100 Main St	No action needed	Increase height of floodproofing
Borough Hall and Highway Dept.	26 Church St	Dry floodproof the utility room	Wet floodproof all remaining lower areas

Water Pollution Control Facility

The Water Pollution Control Facility located adjacent to Stonington Harbor is considered a critical facility. It is operated by the Town of Stonington. This facility is a high priority for power restoration following any outage to prevent sewer backups.

Shelters

Stonington High School in the Town of Stonington is the Borough's shelter. This facility can shelter approximately 800 people, but is also the primary shelter for Town of Stonington residents. It has a generator and is staffed by the American Red Cross. Mystic Middle School is the Town of Stonington's backup shelter and has a generator, but it has a limited capacity. In addition, the American Red Cross and the Salvation Army help provide shelter and vital services during disasters and participate in public education activities.

Although it is privately owned, the Stonington Free Library could be used a cooling center for Borough Residents during a heat wave or extreme heat event. This facility is also located at one of the highest points in the borough and therefore has some of the lowest flood risk.

Communications

The Borough's communication capability is considered to be adequate. Most communication by Borough personnel is performed by telephone, cellular phone, or electronic mail. Emergency personnel can communicate between departments and with the Town of Stonington. The Borough has access to the Statewide CT Alerts "Everbridge" Reverse 9-1-1 system and can utilize it to contact residents during emergencies. A link to this service is located on the Borough's website. The Borough utilizes a fire alarm to announce emergencies to the public. When an evacuation is announced, Borough officials go door to

door to alert residents of how they should proceed. The Borough also has an email blast system allowing it to send mass emails to residents.

Other Facilities

No advanced care, health care, assisted living, or nursing home facilities are located in the Borough. Residents of the borough typically access Lawrence & Memorial Hospital in New London or Westerly Hospital in Westerly, Rhode Island for advanced care needs.

The Borough considers the Eversource Substation to be a critical facility.

Marine Transportation

There are several marinas of varying sizes located in Stonington Harbor. No major ferries operate out of the Borough.

Evacuation Routes

The borough has one vehicular evacuation route along Alpha Avenue via the viaduct to Route 1A in the Town of Stonington. The Borough considers this to be a critical facility and while Alpha Avenue is located in the 1% annual chance floodplain, the bridge itself is likely elevated above the associated base flood. Residents located north of the railroad tracks can access Route 1A via Elm Street or Cutler Street.

The Borough is planning a second mode of egress over the railroad tracks for Borough residents. This may be an "emergency-use-only" at-grade crossing of the railroad tracks. In the meantime, a pedestrian footbridge provides a second mode of egress over the railroad tracks at Elm Street. The concern regarding having only one egress out of the borough is heightened since the residents of Fishers Island, NY utilize the Town Dock in the borough to evacuate.

2.8. Repetitive Loss Properties

A repetitive loss (RL) property is defined as any insurable building that has had two or more claims exceeding \$1,000 that were paid by the National Flood Insurance Program (NFIP) within a ten-year period. As of June 2022, the Borough of Stonington has two RL properties; both of which are residential and affected by coastal flooding. The total insurance payments for these properties are \$141,398.29. This is the same number of RL properties as reported in the 2017 HMP.

2.9. Exposure to Climate-Affected Natural Hazards

Properties, people, historic resources, and critical facilities in the Borough are exposed to natural hazards affected by climate change (i.e., severe storms, coastal flooding, droughts) as well as hazards that are not affected by climate change (i.e., earthquakes). As an initial screening of exposure to hazards, areas of risk have been overlaid onto parcel and point data in a GIS to understand the maximum potential exposure to hazards. The results of this analysis are found in Table 2-4.

Table 2-4 Stonington Borough Exposure Analysis

Hazard	At-Risk Parcels		At-Risk Facilities		At-Risk Historic Assets	
	Value	Number	Value	Number	Value	Number
Hurricane/Tropical Storm	\$277,842,420	669	\$3,548,400	5	\$201,587,300	416
Severe Thunderstorm	\$277,842,420	669	\$3,548,400	5	\$201,587,300	416
Severe Winter Storm	\$277,842,420	669	\$3,548,400	5	\$201,587,300	416
Tornado	\$277,842,420	669	\$3,548,400	5	\$201,587,300	416
Drought	\$6,241,600	14	-	-	\$5,218,600	7
Flood						
1% Annual Chance	\$208,671,620	520	\$2,487,900	3	\$144,487,200	271
Coastal (VE)	\$107,650,600	259	-	-	\$80,687,300	121
0.2% Annual Chance	\$256,245,420	653	\$2,487,900	3	\$183,444,900	369
Storm Surge						
Category 1	\$88,268,100	151	1,640,000	1	\$67,393,200	84
Category 2	\$150,229,000	334	1,640,000	1	\$109,033,300	189
Category 3	\$227,326,120	521	\$2,487,900	3	\$159,278,000	306
Category 4	\$241,993,820	558	\$2,487,900	3	\$171,806,900	334
Earthquakes	\$277,842,420	669	\$3,548,400	5	\$201,587,300	416
Wildfire	\$6,241,600	14	-	-	\$198,052,300	413

2.10. Community Climate Change Challenges

As is with all of the SCCOG communities, Stonington Borough has several concerns regarding climate change challenges. Most communities in the region are typically most concerned with the impacts of increased flooding and extreme heat events, however, there are often concerns about other climate driven hazards. The following summary sheet identifies the top flooding, heat, and other climate change concerns for the borough, along with the hazard mitigation and climate adaptation actions that will work to address these concerns.

Climate Change Summary Sheet for Borough of Stonington

What are the Borough's Top Climate Change Concerns?

Flooding: All of the Borough is faced with coastal flood risks, which is predicted to worsen over time as sea level rises.

Extreme Heat: Like other communities, the Borough wishes to maintain access to its cooling centers for vulnerable populations such as the elderly.

Others: One of the three WWTPs in Stonington is located in the Borough. Coastal flood risks are a concern for long-term function of the plant.

Which Hazard Mitigation and Climate Adaptation Actions Will Address Climate Change Concerns?

Flooding: Floodproof the utility room in the Borough Hall; and upgrade stormwater collection and discharge systems to keep up with rising sea level with particular attention to those areas of concern identified in the stormwater assessment.

Extreme Heat: Utilize the library and Fire Department as cooling centers for instances when the High School cannot be reached. This may require expanded hours and access to these two facilities, as well as standby power for the library.

Others: Work with the Town of Stonington to conduct a critical equipment inventory at the WWTF to design solutions and ensure that the Facility is protected from coastal flooding and storm surge.

3. Extreme and Severe Storms

3.1. Climate Change Impacts

Climate change projections indicate varying changes in the frequency and intensity of severe storms and their relative hazards like precipitation and wind. It is expected that as global mean temperatures continue to rise, storms like hurricanes, tropical storms, and severe thunderstorms may become more frequent and more intense. The degree to which these events might change, and the confidence levels in the models, vary by event type.

Hurricanes and tropical storms are likely to be accompanied by higher wind speeds and an overall increase in intensity. Warm water and air temperatures are essentially the fuel source for the storm, therefore warmer temperatures mean an increase in fuel which can produce more intense winds and high precipitation levels.

While the future behavior of tornado and high wind events is a little more challenging to predict in comparison to hurricanes, it has been noted that the number of days of tornadic activity has decreased in recent decades, though the number of tornadoes in a single day has increased.¹ There is a similar lack in confidence when projecting severe thunderstorm and wind events. Because these events are short-lived and relatively small-scale, monitoring and modeling are more challenging. Overall, however, future climate conditions are likely to become more conducive to the development of such events, therefore increasing the potential for occurrence.

Severe winter storm events, similar to hurricanes, are expected to become more intense under future climate conditions, however they are expected to become less frequent. These storms will continue to be capable of producing large amounts of precipitation, though in future decades this precipitation will consist of less snow and more wintry mix or rain.

These changes in storms could mean an increase in risk throughout the borough or for specific populations, more severe storm damages and impacts, or an increase in flooding occurrences.

3.2. Hurricanes and Tropical Storms

3.2.1 Setting and Recent Occurrences

Several types of hazards may be associated with tropical storms and hurricanes including heavy winds, heavy rains, and flooding. Flooding and storm surge hazards are discussed in Section 5.2 and Section 4.2 of this annex. Wind hazards are widespread and can affect any part of the borough. However, some buildings in the borough are more susceptible to wind damage than others. Tropical Storm Irene and Super Storm Sandy, describe below, remain some of the most impactful storms in the past decade.

Tropical Storm Irene impacted the region in August 2011. Trees fell throughout the borough and the region, causing power outages that lasted up to six days. Debris removal took a few weeks since a significant number of trees were damaged.

¹ <https://nca2018.globalchange.gov/chapter/2/>

Super Storm Sandy impacted the region in later October 2012 with record breaking high tides and wave action was combined with sustained winds of 40 to 60 mph and wind gusts of 80 to 90 mph. Widespread significant statewide power outages of 667,598 lasted up to 8 days. The Borough lost power for about one week. Residents used the Fire Department for warming and for charging batteries. Borough staff report that the wind from Super Storm Sandy was not as significant as that experienced during Tropical Storm Irene. Nevertheless, the Borough received nearly \$50,000 in disaster relief from FEMA to cover the cost of damages from the storm.

Within the past five years, the Borough has experienced several other tropical events. On August 2, 2020 Tropical Storm Isaias swept through the State bringing severe winds which resulted in the highest number of outage events Connecticut has ever experienced. With over 620,000 outages reported by Eversource alone, the state's largest electric supplier, residents across the SCCOG region were without power, cable, and internet for extended periods of time. While this storm did not generate typical amounts of rainfall experienced during a tropical storm event, the wind damage exceeded expectations bringing down trees and power lines across the state.

In 2021, there were four tropical storm events that passed through, or within 50 miles of, the state. Some of these events, which are described in more detail below, resulted in flooding along several brooks and stream crossings, including roadway washouts.

The 2021 events included Elsa, Fred, Henri, and Ida.

- July 9, 2021 (T.S. Elsa) – Elsa made landfall as a tropical storm in Florida and traveled along the eastern seaboard. It passed through Southeastern New England bringing high winds and rainfall. Gusts were reported over 40 mph, and residents throughout the region and state were left without power.
- August 19, 2021 (Extratropical Storm Fred) – This tropical event passed north of the state bringing heavy rain to some areas in Connecticut; there was a reported 5.14 inches in West Hartford. Fred also produced an EF-0 tornado in Windham County.
- August 22, 2021 (T.D. Henri) – Hurricane Henri made landfall in Rhode Island as a tropical storm and then traveled northwest across the State of Connecticut. While the impacts for Henri were projected to be more severe than they actually were, the storm did result in heavy rainfall and thousands of power outages.
- September 1, 2021 (Extratropical Storm Ida) – Though Hurricane Ida made landfall in Louisiana as a category 1, the storm moved south of Long Island as an extratropical storm and is reported to be costliest storm ever since Super Storm Sandy a decade earlier. Ida caused major flooding across Connecticut and the Southeastern Region. For the first time, a statewide flash flood warning was issued. Several communities in the state, including the City of Norwich, warned residents to have minimal contact with surface waters due to the discharge of untreated sewage. There were reports of 7 to 8 inches of rainfall in the Southeastern Region, and as high as 8.58 inches in Uncasville.

3.2.2 Existing Capabilities

Wind loading requirements are addressed through the state building code. The Connecticut State Building Code was most recently adopted with an effective date of October 1, 2022. The code specifies

the design wind speed for construction in all the Connecticut municipalities. The basic design wind speed for the Borough ranges from 120 to 145 miles per hour, and the ultimate design wind speed is 129 miles per hour. Design speed used varies depending on the building use (for example, hospitals must be designed to the higher wind speed). Note that changes in design wind speed figures since the previous HMP are largely the result of a shift from "nominal" to "ultimate" wind speeds, for compatibility purposes; see the Connecticut Building Code or the American Society of Civil Engineers website for more information. The Borough has adopted the Connecticut Building Code as its building code.

Parts of trees (limbs) or entire tall and older trees may fall during heavy wind events, potentially damaging structures, utility lines, and vehicles. The borough receives electrical service from Eversource, which has an active tree pruning program. In the case of an extended power outage, residents would be directed to the shelter at Stonington High School in the Town of Stonington.

The Borough does not have any regulations regarding the location of utilities other than that they must be located to be protected from flooding damage. As such, utility lines are located underground in only a few areas of the Borough. Borough officials noted that there are no cost-effective opportunities to move utilities below-grade. The Borough Warden was involved with a cost-estimate conducted several years ago that found that it would cost \$30 million to place all Borough power lines below grade. Furthermore, coastal flooding is a more significant issue in the Borough than high winds, and burial of power lines may increase that utility's exposure to flood damage.

The Borough Tree Commissioner (one of the burgesses) can post notification and schedule tree removal for damaged or dangerous trees. The Borough conducted an inventory of public trees in 2008 and planned to conduct this inventory every ten years or so to evaluate the condition of trees and schedule long-term maintenance activities. As such, a new tree inventory was conducted in 2019. The Highway Department also monitors trees as part of their normal rounds and has a budget for minor tree maintenance. The Borough hires outside contractors for larger jobs such as tree removal.

In response to the major power-outages caused by Tropical Storm Irene and Super Storm Sandy, as well as significant winter storm events, Eversource has taken an aggressive approach to tree maintenance and has improved communication and coordination with municipalities. In 2014, Eversource conducted an evaluation with the Borough's Tree Commissioner and conducted some clearing. Municipal staff report that Eversource has enhanced its tree clearing efforts, has updated its facilities, and has been working to strengthen the power grid and build in redundancies. Communication and coordination has improved due to Eversource's liaison program.

Warning is one of the best ways to prevent damage from hurricanes and tropical storms, as these storms often are tracked well in advance of reaching Connecticut. The Borough can access National Weather Service forecasts via the internet as well as listen to local media outlets (television, radio) to receive information about the relative strength of the approaching storm. This information allows the Borough to activate its EOP and encourage residents to take protective or evacuation measures if appropriate. During Tropical Storm Irene, a voluntary evacuation notice was issued for the borough, and many people heeded the evacuation and moved inland. The Borough also has a "Hurricane Preparation" page on its website. This webpage encourages residents to be prepared for major storms,

encourages residents to check the Town of Stonington website which has more comprehensive information about preparedness and sheltering, and to sign up for the Special Needs Registry if additional assistance is necessary during an emergency or during an evacuation.

Prior to severe storm events, the Borough ensures that warning/notification systems and communication equipment are working properly and prepares for the possible evacuation of impacted areas. The statewide CT "Everbridge" Reverse 9-1-1 system can be utilized to warn coastal residents of an impending evacuation. Although hurricanes that have impacted the Borough have historically passed in a day's time, coordination with the Town of Stonington is important since many Borough residents will be utilizing the Town shelter. Additional shelters could be outfitted following a storm with the assistance of the American Red Cross on an as-need basis for long-term evacuees.

Summary

In general, municipal capabilities to mitigate hurricane damage have not increased significantly since the 2017 edition of the hazard mitigation plan was adopted. This is likely because the Borough increased its capabilities in response to the damage from Tropical Storm Irene in 2011 and Super Storm Sandy in 2012 and continue to operate at this level

3.2.3 Vulnerabilities and Risk Assessment

The entire borough is vulnerable to hurricane and tropical storm wind damage and from any tornadoes (Section 3.3) accompanying the storm, as well as inland flooding (Section 5.2) and coastal flooding and storm surge (Section 4.2). Of particular concern are the blockage of roads and the damage to the electrical power supply from falling trees and tree limbs. The borough is also susceptible to damage occurring in other areas damaging the electrical supply as occurred following Tropical Storm Irene.

Direct wind damage to newer buildings from hurricane or tropical storm-level winds is rare in the borough since the new buildings were constructed to meet or exceed current building codes. Many buildings in the borough are greater than 50 years old and do not meet current building codes. Older buildings in the borough are particularly susceptible to roof and window damage from high wind events, although this risk will be reduced with time as these buildings are remodeled or replaced with buildings that meet current codes. For example, many homes have been renovated recently and some property owners have installed shutters and other wind mitigation measures.

The strength of a large hurricane could cause a significant economic impact to the borough. The potential economic effect of wind damage to SCCOG was evaluated in the Multi-Jurisdictional HMCAP. A separate analysis was not performed specifically for the Borough of Stonington.

3.2.3.1 Hazard Losses

Since 2012, the borough has received \$97,371 in FEMA PA funds for project costs of \$129,828. This was all received for Super Storm Sandy. These funds were received for recreational and other uses, debris removal and protective measures. The Borough of Stonington did not receive FEMA PA funds in the wake of Tropical Storm Isaias. HAZUS-generated loss estimates for hurricanes and downscaled tropical storm losses based on the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document.

3.3. Tornadoes and High Wind Events

3.3.1 Setting and Recent Occurrences

Similar to hurricanes and winter storms, wind damage associated with severe thunder or summer storms and tornadoes has the potential to affect any area of the borough. Furthermore, because these types of storms and the hazards that result (flash flooding, wind, hail, and lightning) might have limited geographic extent, it is possible for a summer storm to harm one area within the borough without harming another. Such storms occur in the borough each year, although hail and direct lightning strikes to the borough are rarer. No tornadoes have occurred in the borough since the last HMP.

Some recent severe storm events include:

- On September 6, 2017 a cold front triggered severe storms in county and caused tree damage in multiple communities in the region. Nearby Colchester reported trees and wires down, and the Groton-New London Airport measured sustained winds at 44 mph and gusts of 56 mph.
- On April 13, 2020 a low pressure system resulted in high winds throughout New London County.
- On November 13, 2021 a tornado touched down only a few miles away in the Pawcatuck section of Stonington, and another further north in Plainfield. There were reports of uplifted trampolines, downed trees and powerlines, and an uplifted metal shed. This same storm also caused damage in other surrounding communities.

3.3.2 Existing Capabilities

Warning is the most viable and therefore the primary method of existing mitigation for tornadoes and thunderstorm-related hazards. The NOAA National Weather Service issues watches and warnings when severe weather is likely to develop or has developed, respectively. The Borough can access National Weather Service forecasts via the internet as well as listen to local media outlets (television, radio) to receive information about the relative strength of the approaching storm. This information allows the Borough to activate its EOP and encourage residents to take protective measures if appropriate.

Aside from warnings, several other methods of mitigation for wind damage are employed by the Borough as explained in Section 3.2 within the context of hurricanes and tropical storms. In addition, the Connecticut Building Code includes guidelines for the proper grounding of buildings and electrical boxes to protect against lightning damage.

Summary

In general, municipal capabilities to mitigate thunderstorm and tornado damage have not increased significantly since the 2017 edition of the hazard mitigation plan was adopted.

3.3.3 Vulnerabilities and Risk Assessment

Summer storms are expected to occur each year and are expected to at times produce heavy winds, heavy rainfall, lightning, and hail. All areas of the borough are equally likely to experience the effects of summer storms. The density of damage is expected to be greater near the more densely populated sections of the borough.

Most thunderstorm damage is caused by straight-line winds exceeding 100 mph. Experience has generally shown that wind in excess of 50 miles per hour (mph) will cause significant tree damage during the summer season as the effects of wind on trees is exacerbated when the trees are in full leaf. The damage to buildings and overhead utilities due to downed trees has historically been the biggest problem associated with wind storms. Heavy winds can take down trees near power lines, leading to the start and spread of fires. Such fires can be extremely dangerous during the summer months during dry and drought conditions. Fortunately, most fires are quickly extinguished due to the Borough's strong fire response.

Lightning and hail are generally associated with severe thunderstorms and can produce damaging effects. All areas of the borough are equally susceptible to damage from lightning and hail, although lightning damage is typically mitigated by warnings and proper grounding of buildings and equipment. Hail is primarily mitigated by warning, although vehicles and watercraft can often not be secured prior to the relatively sudden onset of a hailstorm. Lightning and hail are considered likely events each year, but typically cause limited damage in the borough. Older buildings are most susceptible to lightning and hail damage since they were constructed prior to current building codes.

Although tornadoes pose a threat to all areas of Connecticut, their occurrence is least frequent in New London County as compared with the rest of the State. Thus, while the possibility of a tornado striking the borough exists, it is considered to be an event with a very low probability of occurrence.

3.3.3.1 Hazard Losses

There are no reported losses for the Borough of Stonington related to thunderstorms and tornadoes. Downscaled losses based on the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document.

3.4. Severe Winter Storms

3.4.1 Setting and Recent Occurrences

Similar to hurricanes and summer storms, winter storms have the potential to affect any area of the borough. However, unlike summer storms, winter storms and the hazards that result (wind, snow, and ice) have more widespread geographic extent. In general, winter storms are considered highly likely to occur each year (major storms are less frequent), and the hazards that result (nor'easter winds, snow, and blizzard conditions) can potentially have a significant effect over a large area of the borough. Winter storms and nor'easters have affected the borough since the last HMP. Some of the more significant events in the past decade include two winter storms that resulted in disaster declarations in Connecticut:

- The year 2013 featured exceptional snow events that severely taxed snow removal abilities of towns in the region. The blizzard of 2013 in early February dumped one to two feet of snow on the region. Another snowstorm struck the region in mid-March 2013 dumping upwards of one to two feet of snow in some parts of the county.
- Multiple significant snow events in the winter of 2015 led to an excessive buildup of snow. Contractors were hired to move it, and permission was sought and obtained from CT DEEP to dispose of snow in marine waters.

Some of the more recent significant events include:

- A heavy storm came through the region on February 9, 2017 bringing blizzard conditions and heavy snowfall. The Town of Colchester reported 14.5 inches of snow, and 13 inches were reported along the coast in Groton.
- A late winter storm on March 12, 2018 resulted in 23 inches of snowfall in Oakdale, with reports of one to two feet in other parts of Northern New London County. The southern part of the region experienced 10 to 18 inches of snow, and strong wind gusts. There were also reports of downed trees throughout the region as a result of this storm.
- On January 28, 2022 the region was hit with a heavy snowstorm and blizzard like conditions. Parts of the region reported up to 22 inches of snowfall, and gusts up to 65 mph. There were also several hours of less than ¼ mile visibility. Snow drifts were also reported to be a challenge, with some areas experiencing drifts up to three and a half feet deep.

3.4.2 Existing Capabilities

Existing programs applicable to winter storm winds are the same as those discussed in Sections 3.2.2 and 3.3.2. Programs that are specific to winter storms are generally those related to preparing plows and sand and salt trucks; tree trimming and maintenance to protect power lines, roads, and structures; and other associated snow removal and response preparations.

As it is almost guaranteed that winter storms will occur annually in Connecticut, it is important to locally budget fiscal resources toward snow management. Snow is the most common natural hazard requiring additional overtime effort from Borough staff, as parking lots and roadways need constant maintenance during storms. This is particularly important in the Borough where off-street parking is often unavailable. Water Street, Main Street, and Elm Street are denoted as "Snow Emergency" routes where a parking ban is in effect for the entire street or one side of the street during and following snowfall. After the storm and the clearing of these routes, cars are allowed to park on these streets such that side roads can be cleared.

The Highway Department oversees snow removal in the borough. The department has two employees that first clear the path from the Highway Department garage to the Fire House, and then clear other routes. Salt and sand is stored at the Town of Stonington Public Works facility. As no State roads exist in the borough, the Borough is responsible for clearing all roadways.

The Connecticut Building Code specifies that a pressure of 30 pounds per square foot be used as the base "ground snow load" for computing snow loading for roofs. The Borough did not experience snow load problems at its buildings during the heavy winter storms of 2010-2011, or any recent events, although some residents shoveled roofs. The Borough's two municipal buildings are not at risk of roof collapse.

Summary

In general, municipal capabilities to mitigate snowstorm damage have increased slightly since the 2017 edition of the hazard mitigation plan was adopted. This is because the Borough continues to experience heavy snow each winter.

3.4.3 Vulnerabilities and Risk Assessment

Severe winter storms can produce an array of hazardous weather conditions, including heavy snow, blizzards, freezing rain and ice pellets, flooding, heavy winds, and extreme cold. Further "flood" damage could be caused by flooding from frozen water pipes. Often, tree limbs on roadways are not suited to withstand high wind and snow or ice loads.

This section focuses on those effects commonly associated with winter storms, including those from blizzards, ice storms, heavy snow, freezing rain, and extreme cold. Warning and education can prevent most injuries from winter storms. This is particularly important as the average age of residents in the borough is increasing. Most deaths from winter storms are indirectly related to the storm, such as from traffic accidents on icy roads and hypothermia from prolonged exposure to cold. Damage to trees and tree limbs and the resultant downing of utility cables are a common effect of these types of events. Secondary effects can include loss of power and heat.

While some Borough buildings could be susceptible to heavy snow loads, they will be cleared quickly if safety is a concern. Some buildings in the borough have flat roofs which are more susceptible to damage from heavy snow than sloped roofs.

Icing is not a significant issue in the borough. In general, there are few steep slopes such that extra sanding and salting of the roadways in necessary locations alleviates any trouble spots.

The Borough has recently faced the challenge of snow removal during some recent events. Because of the dense development, heavy snow events can often make roads impassable, hampering local traffic and emergency access and egress. During recent events, the Borough hired local contractors to remove snow from the Borough to ensure roadway access.

3.4.3.1 Hazard Losses

There have been no reported winter storm losses for the Borough since 2017. In the past decade, the Borough has received \$60,680 in FEMA PA funds for projects totaling \$80,907. Downscaled losses based on the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document.

4. Sea Level Rise

4.1. Climate Change Impacts

Sea levels are rising at an increased rate across the globe. These rising waters are attributed to melting glaciers and ice sheets, as well as thermal expansion from warming ocean waters. Global sea level rise takes into account the major causes of rise, and the averages of rise around the world. Local sea level rise estimates consider the global changes, but also characterizes what is happening more locally such as changes in currents or land subsidence.

The University of Connecticut, Connecticut Institute for Resilience and Climate Adaptation (CIRCA) has, in accordance with state statute, developed local sea level rise projections for communities to use as a planning threshold (Figure 4-1). CIRCA recommends that communities plan for 0.5 meter (1.64 feet) of sea level rise above 2001 levels by 2050. CIRCA intends to revisit this estimate and update the planning thresholds in the lifespan of this plan (2023-2028).

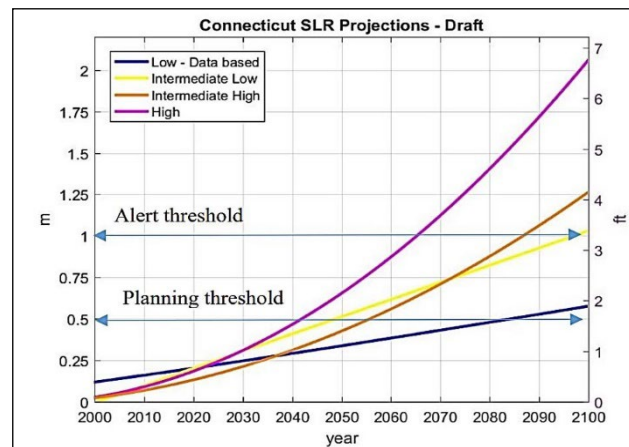


Figure 4-1 Four Localized Sea Level Rise Scenarios for Connecticut

Even though sea level rise occurs over a longer time period than other hazards, coastal communities are becoming increasingly concerned with the cascading impacts. Increased sea levels can cause a greater geographic reach for coastal flooding events, an increase in frequency or extent of “sunny day” flooding, an increase in storm surge extent, and saltwater inundation along the shoreline. All of these impacts can damage properties, deteriorate infrastructure, cause access and egress challenges, and exacerbate coastal erosion processes.

4.2. Coastal Flooding

4.2.1 Setting and Recent Occurrences

The coastal resources found in Connecticut and described by DEEP can be found in the Multi-Jurisdictional HMP and in DEEP resources. The shorefront of the Borough of Stonington contains modified bluffs and escarpments and developed shorefront along the western edge of the borough facing Stonington Harbor, beach resources at Stonington Point, and modified bluffs and escarpments, rocky shorefront, and beaches along the remainder of the borough. Stonington Harbor and the portion of Fishers Island Sound located adjacent to the eastern portion of the borough are considered to be estuarine embayments (defined as a protected coastal water body with a direct connection to Fishers Island Sound).

Homes, businesses, and industry are located in close proximity to the coastline along Fishers Island Sound. Structures and infrastructure in the southern section of the borough are closer to sea level than in northern areas and are therefore more susceptible to coastal flooding. Hurricanes and tropical

storms have the potential to induce coastal flooding and storm surge that can flood the majority of the borough and impact structures.

During Tropical Storm Irene, a walkway was eroded and waves crashed into seawalls that were near homes but only a few were directly damaged by coastal flooding. However, the Borough is also concerned with the potential long-term effects of sea level rise and its potential to exacerbate flooding conditions in the future.

In 2012, Super Storm Sandy, a hybrid storm with both tropical and extra-tropical characteristics, brought high winds and coastal flooding to southern New England. Record breaking high tides and wave action combined with sustained winds of 40 to 60 mph and wind gusts of 80 to 90 mph. Widespread significant statewide power outages of 667,598 lasted up to 8 days. The Borough saw significant coastal flooding, with damage to boats, docks, and structures. Wall Street, Orchard Street, and areas below the viaduct were flooded. The borough received just under \$50,000 dollars in federal assistance to aid in storm cleanup.

Though the Borough has experienced coastal storms in recent years, few major coastal flooding events have occurred in the last five to ten years. However, a significant coastal flood event occurred on December 23, 2022 during the final stages of the planning process for this document. The coastal water surface elevation at the New London tide gauge was reportedly the sixth highest on record. Numerous roads and structures experienced flooding in coastal southeastern Connecticut, including the borough.

4.2.2 Existing Capabilities

The Borough primarily attempts to mitigate coastal flood damage and flood hazards by controlling and restricting activities in areas of flood risk, encouraging the elevation of homes and roadways, maintaining hard structures in good condition, and providing signage and warning systems.

As noted in Section 2.6 and Section 5.2, the Borough utilizes the 1% annual chance floodplains delineated by FEMA. These consist of the 1% annual chance floodplain with elevations (Zone AE), and the 1% annual chance floodplain subject to wave velocity (Zone VE). As noted by the Zoning Regulations, building activities in these areas are restricted and new construction or substantial redevelopment must prove that the lowest horizontal member of the new construction will be above the base flood elevation. The Building Official is required to review and approve portions of applications that involve structures within FEMA Special Flood Hazard Areas.

The Borough is a Class 8 participant in the Community Rating System (CRS). The Borough has been active in the program since 2004, and this participation has helped sustain enhanced capabilities for flood risk management. As a CRS community, the Borough has conducted outreach to residents about flood mitigation but residents are generally not interested in acquisitions or FEMA-funded elevations. Instead, residents are typically more interested in elevating structures when this action can coincide with renovations, and the creation of hard structures such as floodwalls. As such, the Borough has attempted to streamline its redevelopment regulations through amendments to the Zoning Regulations, and through planning guidelines in the 2012 *Plan of Conservation and Development*. The Plan notes that over 62% of the borough is located within the 1% annual chance floodplain. The Borough has secured assistance from consultants in the past five years to help review complex proposals involving home

elevations and coastal structures, and this has resulted in a modest increase in capabilities for flood damage prevention.

The shoreline of the borough is lined with many coastal flood and erosion control structures. Small, private seawalls and bulkheads can be found in many of the residentially developed coastal neighborhoods such as on Stonington Point. Most of these structures were designed to retain land as well as protect against wave action, but have the secondary effect of reducing coastal erosion. Larger breakwater structures are in place in Fishers Island Sound to reduce the velocity of waves entering Stonington Harbor. Groins are also located along the beach at Stonington Point.

Community Coastal Resilience Plan

Like many communities, the Borough lacks existing policies and mitigation measures that are specifically designed to address sea level rise. However, the Borough of Stonington teamed with the Town to develop a Community Coastal Resiliency Plan in 2017. This plan includes information about risks due to climate change and sea level rise, lists vulnerabilities that exist in the Town, and recommends adaptation and resilience options (including regulatory changes) to implement in the future.

Prior to developing the Community Coastal Resiliency Plan, the Borough participated in a resiliency planning initiative with SCCOG and TNC in 2016-2017².

Historic and Cultural Resources Resiliency Planning

As explained in the Multi-Jurisdictional document and the previous edition of this annex, the State Historic Preservation Office (SHPO) embarked on a resiliency planning study for historic and cultural resources beginning in 2016. During winter 2016-2017, individual meetings were held with the shoreline SCCOG communities. Reports were issued to these communities in December 2017. The Stonington Town/Borough report outlines eight strategies that can be employed to make historic and cultural resources more resilient:

- Identify Historic Resources
- Revisit Historic District Zoning Regulations
- Strengthen Recovery Planning
- Incorporate Historic Preservation into Planning Documents
- Revisit Floodplain Regulations and Ordinances
- Coordinate Regionally and with the State
- Structural Adaptation Measures
- Educate

Subsequently, a best practices guide for planning techniques to make historic resources more resilient was distributed in September 2017.

Summary

Municipal capabilities to mitigate coastal flood damage have increased slightly since the 2017 edition of the hazard mitigation plan was adopted. As noted above, the Borough has secured assistance from

² <https://tnc.app.box.com/s/8nne60yjk2g3m1mgzkfa86rndxyjiawf>

consultants in the past five years to help review complex proposals involving home elevations and coastal structures, and this has resulted in a modest increase in capabilities for flood damage prevention.

4.2.3 Vulnerabilities and Risk Assessment

This section discusses specific areas at risk to coastal flooding within the borough. This flooding can be the result of astronomical high tides, hurricanes, nor'easters, or storm surge. As shown by the historic record, coastal flooding can impact roads and neighborhoods, potentially cause severe damage, and impede transportation in the borough. Refer to Figure 4-3 for a depiction of areas susceptible to coastal flooding storm surge from hurricanes.

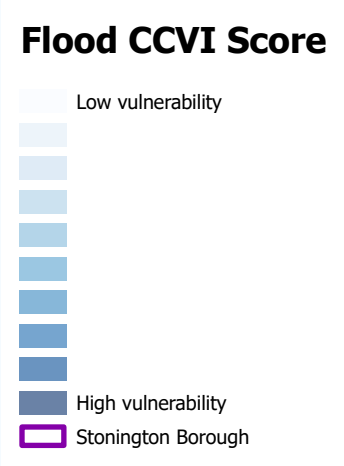
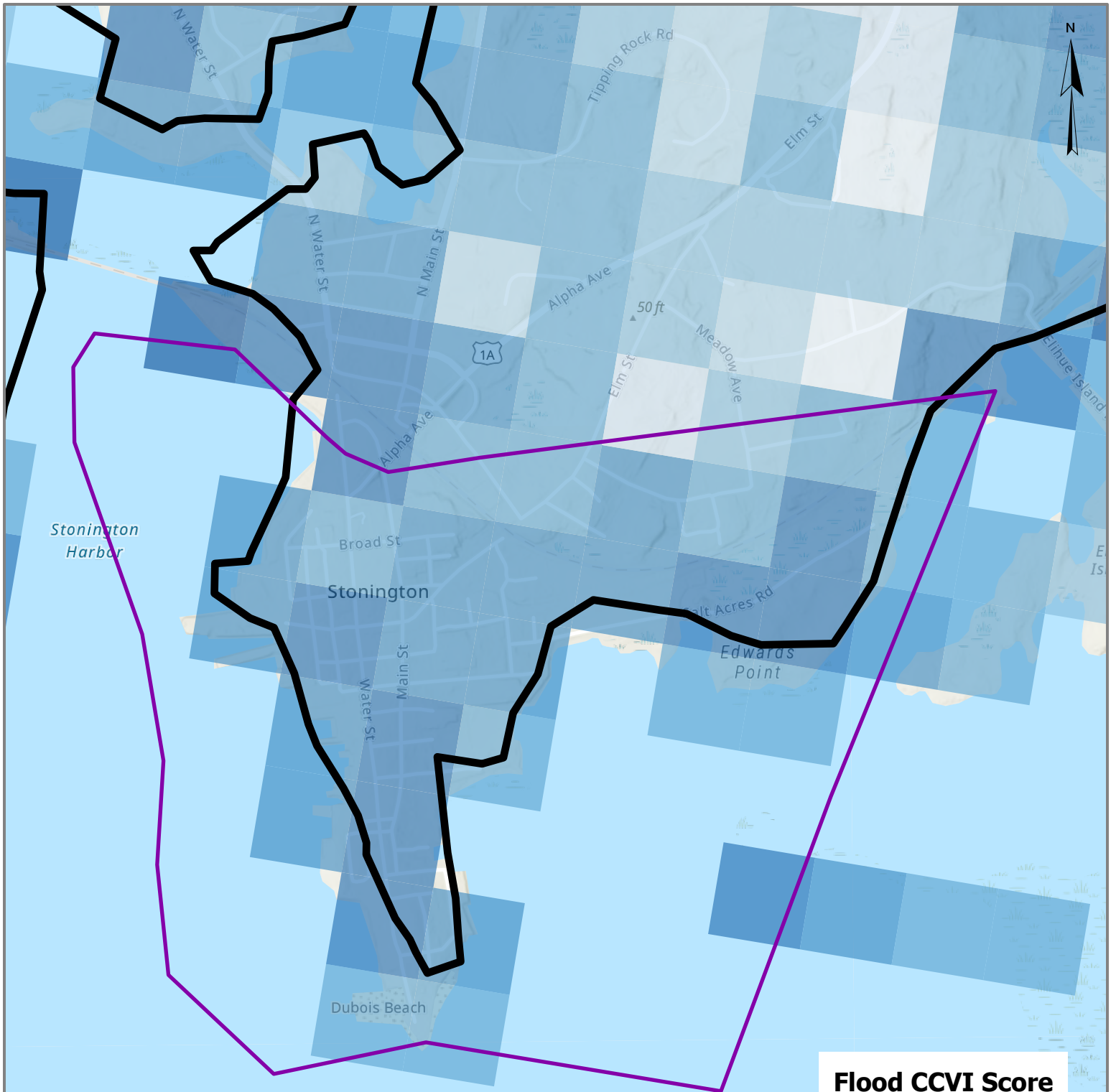
UConn CIRCA has developed a tool to aid in understanding flood vulnerability for communities across the state. This tool, known as the Climate Change Vulnerability Index (CCVI), is comprised of dozens of factors that contribute to a community's flood sensitivity, exposure, adaptive capacity, and ultimately the overall flood vulnerability. The CCVI has been used as a tool to characterize flood vulnerability for the Borough. The distribution of flood vulnerability throughout the community can be seen in Figure 4-2. The CCVI demonstrates that flood vulnerability in the borough ranges from moderate to high. Most of the vulnerability score is due to coastal flood exposure.

Vulnerability Analysis of Areas Along Coastal Waters

The low-lying shoreline areas of the borough are subject to periodic flooding. As the borough generally lacks defined watercourses, there are no tidally-influenced watercourses in the borough. FEMA has defined 1% annual chance and 0.2% annual chance floodplains associated with coastal flooding, as well as 1% annual chance floodplains with wave velocity for the borough.

Nearly the entire shoreline of the borough is exposed to the wave action from Fishers Island Sound. A particular concern is that East Grand Street / Salt Acres Road could be exposed to wave action, isolating several homes on Edwards Point. Salt Acres Road crosses the tidal wetland area separating Edwards Point from the main portion of the borough. Fortunately, these homes are located above the 1% annual chance floodplain. An additional concern for this area of the borough is that the Metro-North railroad is also below the 1% annual chance flood elevation and is vulnerable to overtopping.

The Borough of Stonington has identified several roads that could potentially be partially or fully inundated during the 1% annual chance flood. These roads are listed in Table 4-1 Roadways in the 1% Annual Chance Floodplain in the Borough of Stonington. The majority of these roads are fairly interconnected with few extensive dead ends.



Flood CCVI Score

SCCOG Hazard Mitigation and Climate Adaptation Plan
 Stonington Borough
 1/17/2023

Esri Community Maps Contributors, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/

Table 4-1 Roadways in the 1% Annual Chance Floodplain in the Borough of Stonington

Roads		
Alpha Avenue	Elihu Street	Miller Street
Ash Street	Elm Street	Northwest Street
Broad Street	Front Street	Orchard Street
Cannon Square	Gold Street	Pearl Street
Church Street	Grand Street	Salt Acres Road
Cliff Street	Hancox Street	South Street
Cross Street	Harmony Street	Summit Street
Cutler Street	High Street	Tanner Court
Denison Avenue	Hyde Street	Union Street
Diving Street	Main Street	Wall Street
East Grand Street	Matthews Street	Water Street

As each of the main roadways in the borough (Water Street, Main Street, and Elm Street) are located in the 1% annual chance floodplain, and with Alpha Avenue leading to the viaduct, Borough officials are interested in identifying an alternate route out of the borough during floods and other emergencies. At this time, only the Elm Street footbridge provides a second mode of egress from the main portion of the borough.

Nearly the entire borough is at risk to storm surge, although storm surge from a Category One hurricane would be limited to low-lying coastal areas. The areas affected by storm surge are predicted to be more widespread than the 1% annual chance floodplain for Category Three hurricanes, with Category Four hurricanes pushing storm surge even further inland. The timing of evacuations from the southern part of the borough prior to a hurricane event are therefore very important as the majority of the roads in this area may be flooded or even washed out by a major hurricane.

Vulnerability Analysis of Private Properties

Buildings located in flood hazard areas are primarily residential but also include some commercial and Borough-owned marinas and critical facility structures. Most of the structures that are threatened by flooding are located within the 1% annual chance floodplain, but some are also in the coastal velocity zone. Location in the velocity zone poses an increased threat to structures due to high wind and potential wave damage, as well as inundation by flood waters. Other areas located more inland or behind protective seawalls are only subject to coastal flooding without wave action. However, storm surge can cause damage to structures throughout the borough for even a Category One hurricane such that almost the entire borough is vulnerable to damage from storm surge.

At the time of the 2012 edition of the HMP, one repetitive loss property was located in the borough. This residential property is located in a low-lying area west of the large tidal wetland located north of Salt Acres Road. Claims were submitted following Tropical Storm Irene, the April 2007 heavy rains, and following "The Perfect Storm" Halloween Nor'easter of 1991. Thus, the property may be affected both by poor drainage and by storm surge. As stated above, coastal flooding is a particular concern in this and similar areas because these areas are low-lying and existing drainage systems do not operate effectively. As of the 2017 HMP, two repetitive loss properties were located in this area (the one listed

in 2012, plus an additional property). Currently, as of June 2022, two RL properties remain in the borough.

The Borough recognizes that many private properties may suffer coastal flood damage that is not reported because the structures are not insured under the NFIP, or because they choose to not report the damage. These residents and business owners are likely repairing structures on their own. Coastal flood mitigation as recommended in this HMP could help many of these property owners.

The Borough has no formalized program currently in place to identify the location or the number of structures that are susceptible to flooding. Such information would be valuable in directing hazard mitigation efforts to locations with the greatest risk. Borough planners should use the recently released DFIRM to identify the approximately 291 structures in the borough that are located in the 1% annual chance floodplain (80 of which are susceptible to wave velocity). This could provide a list of areas to inspect following a storm event and allow for the Borough to track building permits from repairs following a natural hazard. This information, in turn, would provide supporting data for future grant applications.

Vulnerability Analysis of Critical Facilities

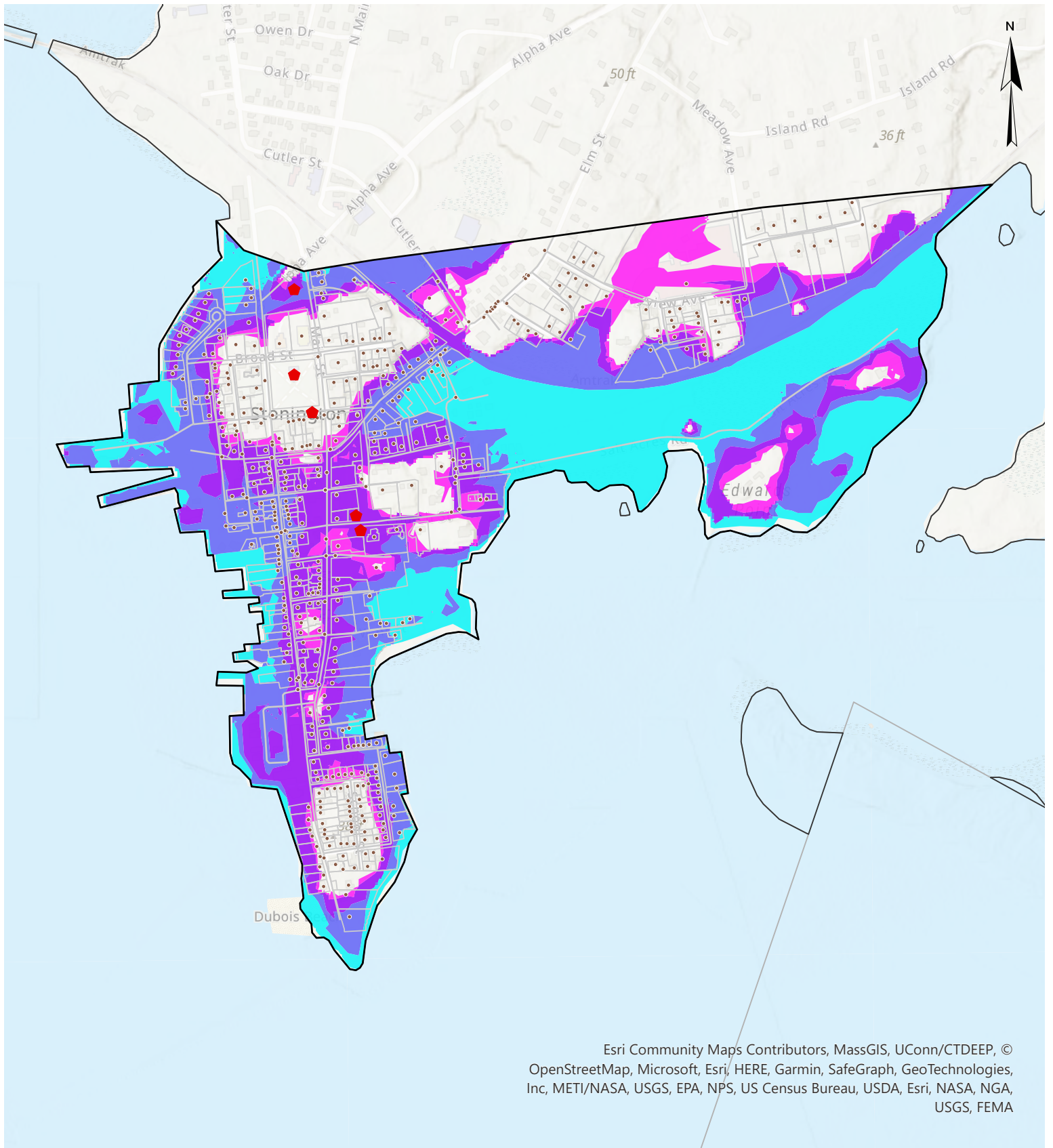
As shown on Figure 4-3, critical facilities located within the 1% annual chance floodplain include the Borough Hall, the Borough Fire Department, and the wastewater treatment facility. The wastewater treatment facility is vulnerable to wave velocity but is partially protected by a sea wall. It is understood that if the water level rose high enough the wastewater treatment facility would be rendered inoperable.

These critical facilities are also located in the storm surge zones. The wastewater treatment facility and the Fire Station are vulnerable to storm surge from a Category Two hurricane or greater storm, while the Borough Hall is susceptible to flooding from a Category Three or greater storm. As noted in Section 2.7, only the fire station is known to have specific mitigation measures installed to resist flood damage.

SCCOG completed an assessment of critical facilities in the region in 2017, fulfilling an action listed in the 2012 edition of the multi-jurisdiction hazard mitigation plan. The Borough Hall and Fire Station were included in the assessment. The assessment determined that both faced current flood risks and would experience increasing flood risks. Recommendations are incorporated into the list of actions in Chapter 8 of this annex and summarized below.

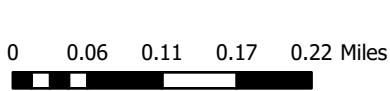
Table 4-2 SCCOG Critical Facilities Assessment Summary for Borough of Stonington

Facility	Address	Short-Term (0-20 years)	Long-Term (>20 years)
Fire House and EOC	100 Main St	No action needed	Increase height of floodproofing
Borough Hall and Highway Dept.	26 Church St	Dry floodproof the utility room	Wet floodproof all remaining lower areas



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Hurricane Storm Surge Inundation Areas
 SCCOG Hazard Mitigation and Climate Adaptation Plan
 Stonington Borough
 Date: 8/3/2022



Legend

- Historic Resources
- ⬠ Critical Facilities

Hurricane Category

- 1
- 2
- 3
- 4

4.2.3.1 Hazard Losses

There are no reported losses for Stonington Borough specifically related to coastal flooding. According to NFIP statistics, as of June 30, 2022, the Borough of Stonington has had a total of 56 flood related losses, with a total of \$907,626 paid towards the claims. It is likely that most of these are coastal flood losses, but it is possible that some are related to pluvial floods.

Table 4-3 presents the direct and business interruption related losses for the 100-year coastal flood event. Additional HAZUS-generated loss estimates for coastal floods and downscaled flood losses based on the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document.

Table 4-3 HAZUS-MH Coastal Flood Related Economic Impacts

Stonington Borough	2022 Results				
	Residential	Commercial	Industrial	Other	Total
Direct					
Building	\$44,550,000	\$7,690,000	\$1,450,000	\$240,000	\$53,930,000
Contents	\$38,780,000	\$23,740,000	\$2,710,000	\$1,400,000	\$66,630,000
Inventory	\$0	\$4,770,000	\$360,000	\$210,000	\$5,340,000
Subtotal	\$83,330,000	\$36,200,000	\$4,520,000	\$1,850,000	\$125,900,000
Business Interruption					
Income	\$730,000	\$21,230,000	\$90,000	\$390,000	\$22,440,000
Relocation	\$10,160,000	\$6,810,000	\$110,000	\$190,000	\$17,270,000
Rental Income	\$6,940,000	\$4,910,000	\$10,000	\$40,000	\$11,900,000
Wage	\$1,730,000	\$22,430,000	\$170,000	\$2,830,000	\$27,160,000
Subtotal	\$19,560,000	\$55,380,000	\$380,000	\$3,450,000	\$78,770,000
TOTAL	\$102,890,000	\$91,580,000	\$4,900,000	\$5,300,000	\$204,670,000

4.3. Shoreline Change

According to NFIP statistics, as of June 30, 2022, the Borough of Stonington has had a total of 56 flood related losses, with a total of \$907,626 paid towards the claims. Most of these are coastal flood losses. HAZUS-generated loss estimates for floods and downscaled flood losses based on the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document.

4.3.1 Setting and Recent Occurrences

Shoreline change is primarily a natural process caused by wind, waves, and currents, however it can also be attributed to human driven processes such as development, grading, and beach armoring or nourishment. As climate change impacts hazards such as severe storms, hurricanes and tropical storms, and sea level rise, shorelines have the potential to change at different rates than in decades past. As tidal ranges increase, and storm surge becomes higher and potentially more intense, these processes may become exacerbated. Rapidly changing shorelines can have an impact on coastal ecosystem (particularly those that provide natural buffers), erode natural shorelines resulting in encroaching seas onto developed land, and may alter those shorelines that have been hardened to protect development and infrastructure.

4.3.2 Existing Capabilities

Like many communities, the Borough does not have specific mechanisms to address the impacts of shoreline change, however, there are several regulatory standards and planning efforts that address smart shoreline development and conservation.

As discussed in Section 4.2.2, Stonington Borough participated in the Community Coastal Resilience Plan and Historic Resource Resilience planning; and maintains flood damage prevention regulations and flood control structures that can also limit shoreline change impacts.

In section 3.2.2.8 of the zoning regulations, certain considerations for variances are outlined. These considerations include the danger to life and property due to flooding or erosion damage, and the availability of alternative locations to not subject to erosion damage.

4.3.3 Vulnerabilities and Risk Assessment

In general, it is assumed that as sea level rises, the frequency and magnitude of coastal flooding in the borough will increase, with structures and roadways closest to existing sea level being affected more quickly. In addition, tidal marsh areas along Salt Acres Road will likely be eroded by constant inundation since the railroad tracks prevent further inland migration.

Coastal erosion is generally not a problem in the borough since the majority of the shorefront is either developed (particularly along Stonington Harbor) rocky shorefronts consisting of stones and boulders, or modified bluffs and escarpments consisting of seawalls, bulkheads, or revetments. The beach on Stonington Point is susceptible to coastal erosion but is protected by groins such that erosion has not been a major problem. A private beach on Edwards Point is also protected by groins. However, as sea level rises, the effectiveness of these structures may be undermined such that erosion will be able to occur landward of the walls necessitating expansion of the structures.

The coastal areas of the Borough of Stonington have properties that are inhabited year-round. This intensifies risk to life and property in coastal areas. Beachfront properties are very susceptible to damage, not only as a result of flooding but also due to the velocity zones located along the shoreline. Although, shoreline erosion is a relatively minor concern for private property owners at this point in time since most have seawalls or rocky shorefront protecting their structures.

4.3.3.1 Hazard Losses

There are no reported losses for the Borough of Stonington related to shoreline change. Future editions of this plan will revisit this topic.

5. Changing Precipitation

5.1. Climate Change Impacts

Across the United States, annual precipitation has increased in the past century, however, this change *is* dependent upon the region. Here in the northeast, precipitation totals and intensity are believed to have increased, and are projected to continue to increase during spring and winter months. However, climate change has also been linked to a reduction in snow cover extent, and an earlier spring melt. Winter precipitation may also change from snow to a wintry mix or rainfall due to warmer temperatures; so, while precipitation may increase it may not necessarily be an increase in snow.

Changes in precipitation can also shift the frequency and severity of droughts. As the climate warms, surface soil moisture is likely to decrease as evaporation rates rise. This decrease in soil moisture, and potentially longer periods of time between intense precipitation events, could potentially mean longer and stronger droughts.

These changes in precipitation can have various types of impacts. With an increase in intense precipitation, flooding events may become more frequent, damages to crops may occur, and spring flood trends may shift with less snow and more rain. Droughts on the other hand can also cause damage to crops, stress livestock and agricultural operations, and also reduce drinking water supplies or private wells.

5.2. Riverine and Pluvial Floods

5.2.1 Setting and Recent Occurrences

There are no notable inland flooding issues due to a lack of watercourses in the borough. The primary inland flooding problem is due to drainage issues or nuisance basement flooding. Such flooding occurs at several times per year and is associated with heavy rainfall overwhelming drainage systems. Such types of flooding occurred during the April 2007 nor'easter and March 2010 heavy rains.

The region has, however, seen some severe rainstorm events since the 2017 plan, with many neighboring communities having experienced serious flooding as a result. The September 2018 rain event caused severe flooding throughout the state, with several communities in the SCCOG region receiving FEMA PA reimbursements for the event. Norwich received 4.85 inches of rainfall and Lebanon reported 6.79 inches.

Hurricane Ida, which produced several inches of rain across the state, caused flooding in many SCCOG communities. Norwich Public Utilities recorded 6.34 inches of rainfall and Groton-New London Airport recorded 2.05 inches. Washouts occurred as a result of flooding near the former State Hospital and the future Riverwalk development in the Norwich-Preston area.

After the severe flashy drought of summer 2022, a severe rainstorm event on September 5-6, 2022, caused flooding throughout southeastern Connecticut. Lebanon experienced road closures and washouts, while Norwich Public Utilities observed 5.85 inches of rainfall. There were flood and flash flood warnings throughout the region and across the state. Neighboring Rhode Island reported 11 inches of rainfall in some communities.

Notwithstanding the above events, the borough has not been significantly impacted by pluvial floods in the last ten years.

5.2.2 Existing Capabilities

The Borough attempts to mitigate flood damage and flood hazards by utilizing a wide range of measures including restricting activities in areas of flood risk, replacing and upsizing stormwater infrastructure and culverts, promoting flood insurance, advancing education and outreach, and by utilizing warning systems.

The Borough is a Class 8 participant in the CRS. The Borough has been active in the program since 2004, and this participation has helped sustain enhanced capabilities for flood risk management. As noted in Section 2.6, the Zoning Regulations of the Borough restrict development and require mitigation for projects constructed within the 1% annual chance floodplains as defined by FEMA. Such Special Flood Hazard Areas are delineated on the DFIRM published with the Flood Insurance Study for New London County that was released on August 8, 2013. Most of the SFHAs mapped by FEMA in the Borough do not appear to be associated with a watercourse and thus are more closely related to coastal flooding. The Borough requires new construction and substantial improvement be elevated or floodproofed to one foot above the base flood elevation (one foot of freeboard). It defines substantial improvement by individual project costs (rather than cumulatively over one or more years).

The Borough contracts to a private company to clean and inspect catch basins and culverts at least annually or more often if problems are noted. The Fire Department accesses weather reports through the National Weather Service, but personnel are not typically concerned about the effects of inland flooding except for the largest of storm events. When flooding occurs, the Highway Department or the Fire Department handle the complaints depending on the location. For example, the Highway Department would close roads, while the Fire Department responds to basement flooding issues.

As noted in the Multi-Jurisdictional HMCAP, the Borough of Stonington participates in the Community Rating System and has since 2004. The Community is currently rated a Class 9 which provides borough residents with a 5% discount on flood insurance. The Borough routinely posts a Flood Awareness Newsletter on its website; this newsletter is jointly developed with the Town of Stonington, and provides additional information on how residents can protect their homes and families, why drainage system maintenance is important, and encourages residents to purchase flood insurance.

As explained elsewhere in this HMCAP, the National Weather Service issues a flood watch or a flash flood watch for an area when conditions in or near the area are favorable for a flood or flash flood, respectively. A flash flood watch or flood watch does not necessarily mean that flooding will occur. The National Weather Service issues a flood warning or a flash flood warning for an area when parts of the area are either currently flooding, highly likely to flood, or when flooding is imminent. The Borough utilizes these warnings and forecasts to prepare emergency responders for flooding events.

Summary

In general, municipal capabilities to mitigate flood damage have increased somewhat since the 2017 edition of the hazard mitigation plan was adopted. This is because the Borough continues to participate in the FEMA CRS program. Additionally, the Borough has updated its stormwater master plan and assessment through consultant services in 2022, and this update can be used to help prioritize individual projects.

5.2.3 Vulnerabilities and Risk Assessment

This section discusses specific areas at risk to inland flooding within the borough. Areas at risk from coastal flooding are discussed in Section 4.2 of this annex. Inland flooding due to poor drainage and basement flooding in residential areas is the most common type of flooding experienced in the borough.

Vulnerability Analysis of Areas along Watercourses

There are no watercourses located within the Borough that are subject to inland flooding.

Vulnerability Analysis of Private Properties

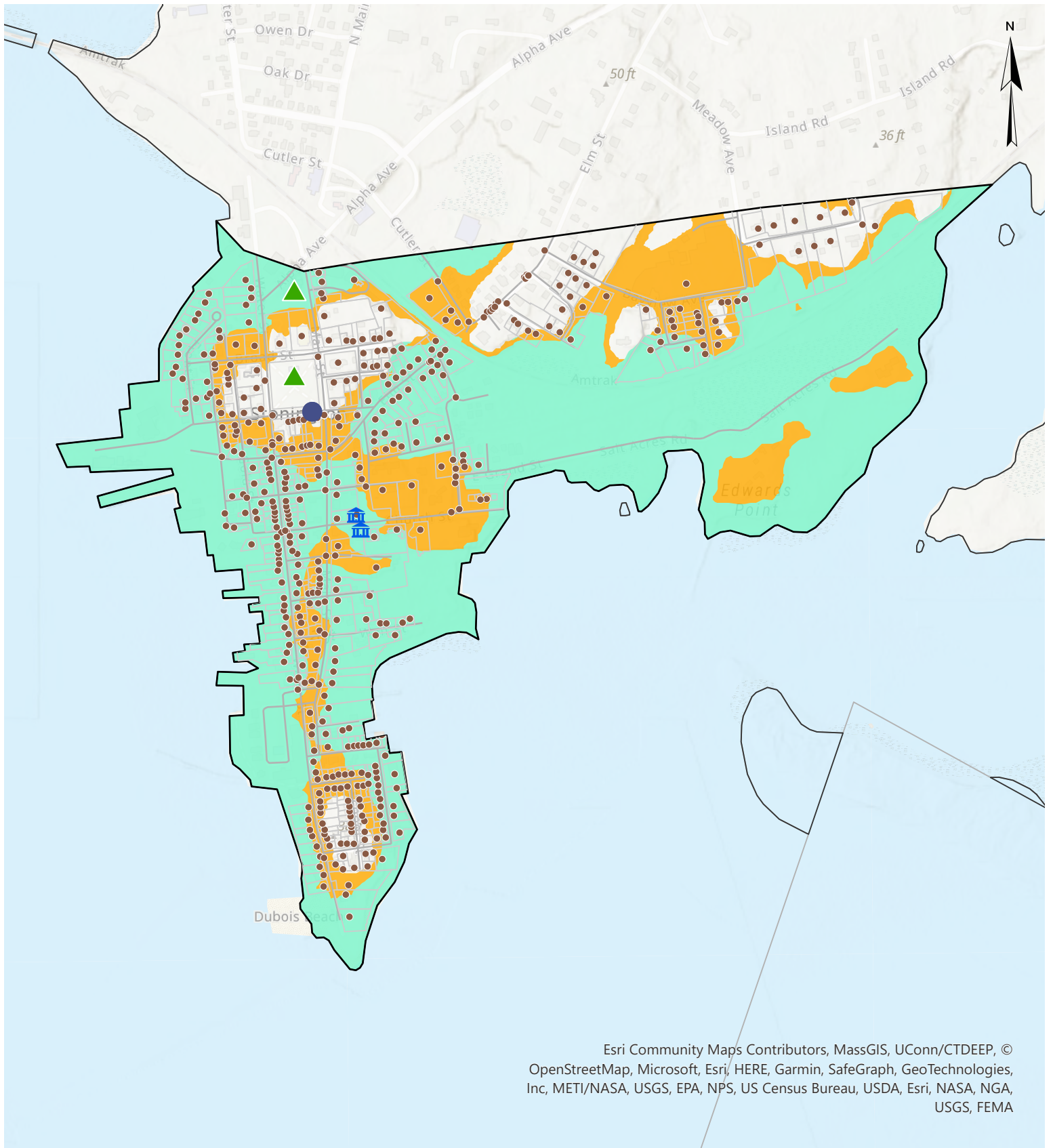
Nuisance flooding occurs several times per year as basements flood. Basement flooding is widespread throughout the Borough. In addition, drainage systems are undersized in several areas causing ponding during severe rain events. This can occasionally cause flooding of nearby yards, but only a few structures are directly affected by poor drainage flooding.

Vulnerability Analysis of Critical Facilities

As noted in Section 2.7, all three Borough-owned critical facilities located within the 1% annual chance floodplain. These facilities are affected by coastal flooding. Critical facilities in the borough do not normally have issues with inland flooding. The risk of inland flooding to critical facilities is therefore considered to be low.

5.2.3.1 Hazard Losses

According to NFIP statistics, as of June 30, 2022, the Borough of Stonington has had a total of 56 flood related losses, with a total of \$907,626 paid towards the claims. Most of these are coastal flood losses, but it is possible that some are related to pluvial floods.



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Critical Facilities and Historic Resources with Flood Zones

SCCOG Hazard Mitigation and Climate Adaptation Plan

Stonington Borough

Date: 8/1/2022

0 0.06 0.11 0.17 0.22 Miles



Legend

- Historic Resources
- Municipal
- Other Infrastructure and Facilities
- ▲ Shelter or Cooling Center
- 1% Annual Chance Flood Hazard Area
- .2% Annual Chance Flood Hazard Area

5.3. Drought

5.3.1 Setting and Recent Occurrences

A drought can occur during any season when there is a long, abnormally dry period of time. These events are naturally occurring during periods of limited precipitation. The effects of drought may vary throughout the Borough, with some sectors impacted more than others.

In recent years, droughts have become flashier and more frequent throughout the region. During recent events, there have been reports in southeastern Connecticut of wells going dry on residential and farming properties. Though the borough does not have any private wells or farms, its public water service provider (Aquarion Water Company) was heavily impacted by the droughts of 2016, 2020, and 2022. Some of the more severe and impactful events include:

- **2016** – a statewide drought that lasted almost two years and peaked in 2016, resulted in water conservation efforts throughout the southeastern part of the region, elevated fire risks in some areas, and was noted as the 11th driest spring on record.
- **2020** – From June to December, New London County experienced a moderate to severe drought, with the county being declared a Stage 3 by the Connecticut Interagency Drought Work Group.
- **2022** – During the development of this plan, the region was in an ongoing drought, with severe drought conditions in August 2022. New London County was declared a Stage 3 drought emergency on August 18.

5.3.2 Existing Capabilities

The Borough of Stonington, like many communities, does not have specific regulations geared toward drought mitigation. One of the main purposes of the Borough’s zoning regulations is however to facilitate the adequate provision of water throughout the Borough.

The U.S. Drought Monitor is a national resource that many state and local entities use to monitor regional conditions in relation to drought development. The weekly reporting issued by the partnership includes a drought intensity scale which includes five stages from “abnormally dry” to “exceptional drought”. While this resource is available to the Borough for determining drought conditions, the Connecticut Interagency Drought Workgroup (IDW) uses this and other resources to monitor drought conditions specifically for the state. Stonington Borough has this IDW and state-specific drought emergency declarations as a resource to prepare for, and respond to, droughts.

Aquarion Water Company’s Mystic System, which serves the borough, is highly vulnerable to droughts. Aquarion developed an interconnection with Groton Utilities in 2018-2019 subsequent to the last edition of this plan. The interconnection is used to purchase water from Groton Utilities and has increased drought resilience for the Borough of Stonington.

5.3.3 Vulnerabilities and Risk Assessment

The entire Borough is vulnerable to drought, but the degree of vulnerability varies. A majority of the properties in the Borough rely on Aquarion Water Company for their water supply. Those residents that rely on public water may be faced with water use restrictions during drought to conserve water supply in the system.

With the Borough being densely developed, with little agricultural land, the residents of the Borough likely rely on surrounding agricultural communities for fresh food. Droughts may impact these operations ultimately impacting food costs for residents.

5.3.3.1 Hazard Losses

There have been no reported drought losses for the Borough of Stonington. Any losses incurred by Aquarion Water Company have not been directly passed onto the Borough's municipal resources, although water users will eventually pay for water system improvements that reduce drought risks.

5.4. Dam Failure

5.4.1 Setting and Recent Occurrences

Dam failures can be triggered suddenly with little or no warning and often in connection with natural disasters such as floods and earthquakes. Dam failures can occur during flooding when the dam breaks under the additional force of floodwaters. In addition, a dam failure can cause a chain reaction where the sudden release of floodwaters causes the next dam downstream to fail. While flooding from a dam failure generally has a limited geographic extent, the effects are potentially catastrophic depending on the downstream population. No dam failures have affected the borough since the time of the last HMP.

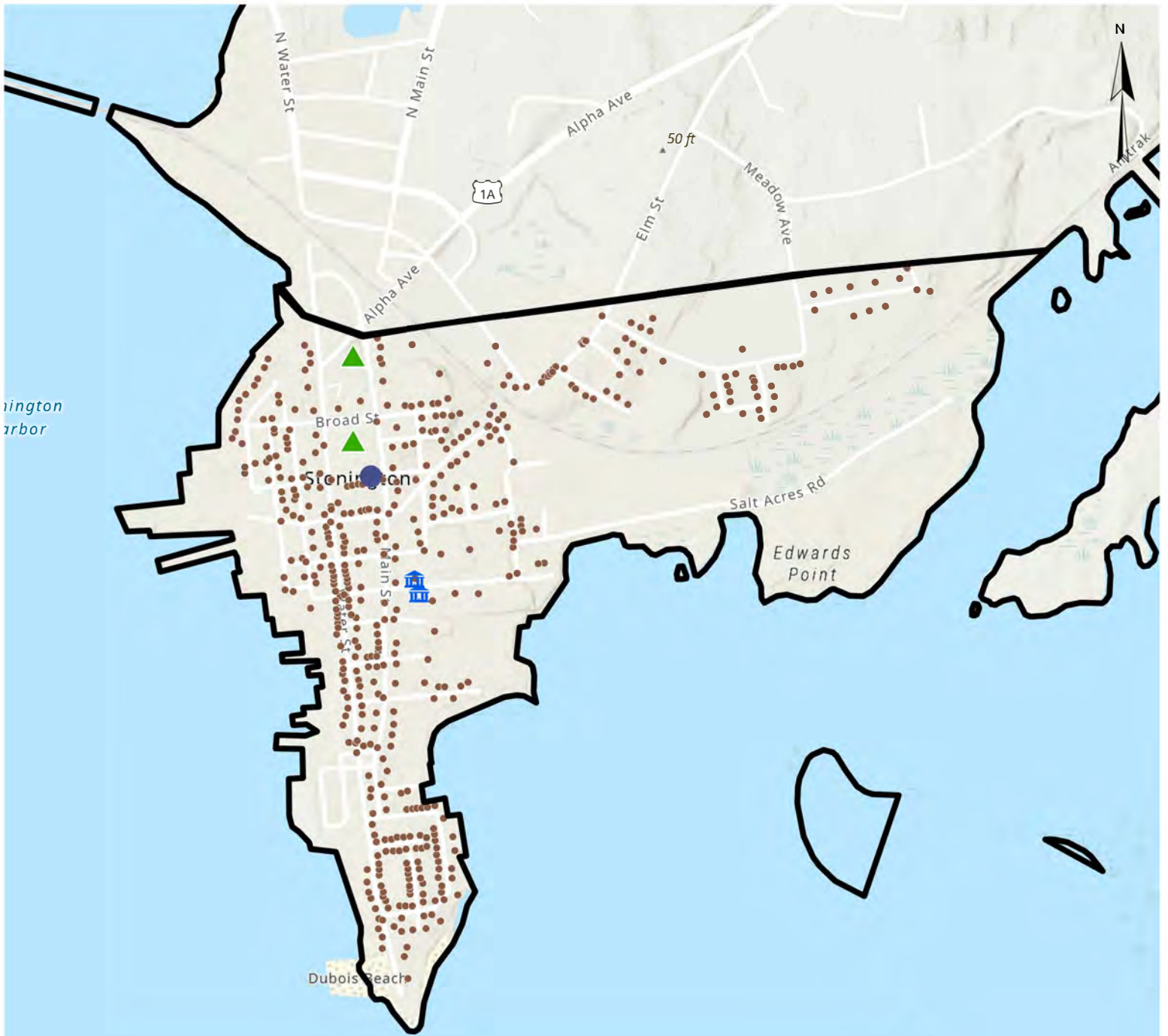
5.4.2 Existing Capabilities

The dam safety statutes are codified in Section 22a-401 through 22a-411 inclusive of the Connecticut General Statutes. Sections 22a-409-1 and 22a-409-2 of the Regulations of Connecticut State Agencies have been enacted, which govern the registration, classification, and inspection of dams. Dams must be registered by the owner with the DEEP according to Connecticut Public Act 83-38. Owners of high and significant hazard dams are required to maintain EAPs for such dams.

Only one dam exists in the borough and has ever been inventoried with the Connecticut DEEP. The Island Road Pond Dam impounds a small water body north of Bayview Avenue on the northern border of the borough. The pond is located next to an industry and under the jurisdiction of the Connecticut DEEP.

Summary

In general, municipal capabilities to mitigate dam failure damage have not changed since the 2017 edition of the hazard mitigation plan was adopted. However, changes in the State's regulation of dams have increased Statewide capabilities.



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Dams and Dam Failure Inundation Areas

Southeastern Connecticut Council of Governments
Stonington Borough

Date: 2/23/2023

0 0.06 0.12 0.18 0.24 Miles



Legend

- Historic Resources
- Municipal
- Other Infrastructure and Facilities
- ▲ Shelter or Cooling Center

5.4.3 Vulnerabilities and Risk Assessment

The Connecticut DEEP administers the Dam Safety Section and designates a classification to each state-registered dam based on its potential hazard as detailed in the regional plan. The Island Road Pond Dam does not have a hazard classification assigned but it is assumed to be a low hazard dam due to the small size of the pond and the level of the pond below the parking lot of the nearby industry. In addition, there are no dams in adjacent municipalities whose failure would have an effect on the borough.

5.4.3.1 Hazard Losses

There are no reported losses for the Borough of Stonington related to dam failure. Downscaled losses from the 2019 Connecticut Natural Hazard Mitigation Plan are not applicable to the Borough.

6. Rising Temperatures

6.1. Climate Change Impacts

On average, the annual temperature across the U.S. has increased by 1.8 degrees Fahrenheit when looking at the entire period of record (1895-2016). Accelerated warming patterns between 1979 and 2016 have been observed with satellite and surface data, and paleoclimate records show that some of the recent decades have been the warmest in the past 1,500 years.³

In general, periods of freeze and frost have decreased, therefore lengthening the period of time between the first winter freeze and spring thaw, since the early 1900's. These warming temperatures impact snowfall and accumulation, alter seasonal patterns, and can disrupt certain natural processes. In addition, warming temperatures can act as fuel for other natural hazards such as wildfires, droughts, hurricanes and severe storms, and also play a role in changing precipitation patterns.

In addition to exacerbating some natural hazards, extreme heat waves are becoming more frequent, which can also have a serious impact on public health. In recent years, the region has experience numerous heat waves, with several consecutive days of extremely hot temperatures and high heat indexes. Infrastructure can also be at risk during heat waves as some components, such as roadways or bridges, have not been designed to withstand ongoing, extreme temperatures.

6.2. Extreme Heat

6.2.1 Setting and Recent Occurrences

An extreme heat event can occur at any time during the warmer months, and can be defined as temperatures that hover 10 degrees or more above the average high temperature for the region. These events typically last for a prolonged period of time and is accompanied by high humidity. A heat wave typically lasts three or more days with temperatures over 90 degrees for those days.

Since 2012, 480 days over 85 degrees have been recorded at the Norwich Public Utilities weather stations, 165 of which were over 90 degrees. During the summer of 2022, 45 days over 85 degrees were recorded, 21 of which were at least 90 degrees. A majority of these high temperature days occurred in July and August, with some of these extreme temperatures occurring outside summer months in May and October. Table 6-1 presents the daily maximum temperatures recorded at the Groton New London Airport and Norwich Public Utilities weather stations. Those values that are bold are above 90 degrees.

Table 6-1 Daily Maximum Temperatures from May to September Since 2017

	May		June		July		August		September	
	GNL	NPU	GNL	NPU	GNL	NPU	GNL	NPU	GNL	NPU
2017	85	93	89	94	88	92	87	89	86	89
2018	80	91	87	90	89	101	91	94	90	92
2019	83	85	88	91	94	96	88	91	87	84
2020	75	81	82	91	92	96	89	92	87	87
2021	88	87	86	96	86	94	88	96	82	85
2022	93	92	85	92	91	96	91	94	94	85

GNL = Groton New London station & NPU = Norwich Public Utilities station

³ <https://nca201758.globalchange.gov/chapter/2/>

6.2.2 Existing Capabilities

Similar to the monitoring methods used for hurricanes, severe storms, and winter storms, the Borough monitors National Weather Service and local forecasts for anticipated extreme heat event, and also monitors for NWS heat warnings and advisories. The Borough of Stonington has identified the Library as the primary option for cooling, with the Fire Department acting as a secondary option. In the event of a projected heat event or heat wave, the Borough is prepared to urge residents to visit the cooling center, or if appropriate, open up the fire department for resident cooling use.

Summary

In general, the capabilities of mitigating extreme heat have increased since the 2017 edition of this plan as the Borough has identified cooling centers for use during an extreme heat event.

6.2.3 Vulnerabilities and Risk Assessment

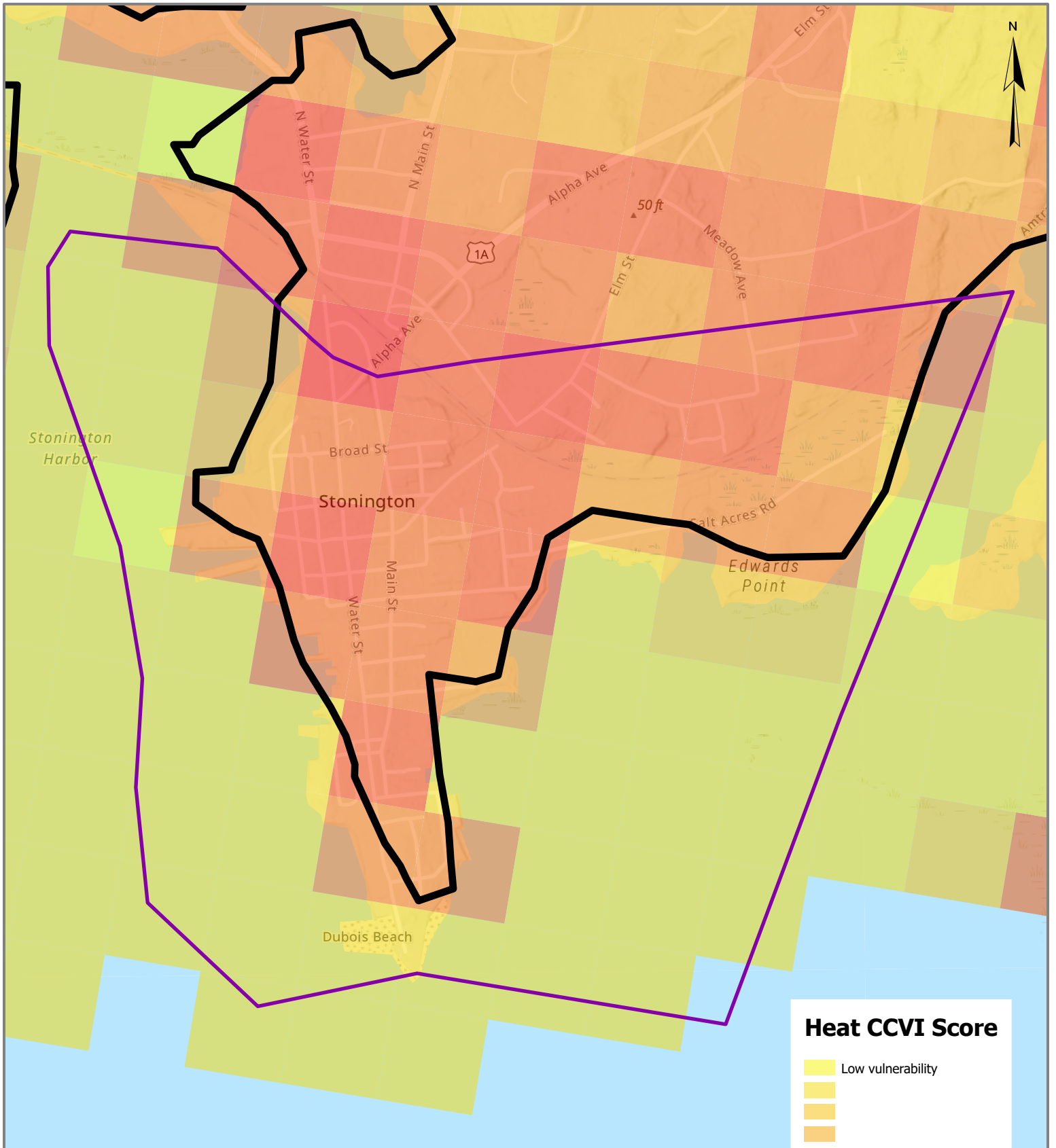
While the entire borough is at risk of an extreme heat event, vulnerability can widely vary based on age, health, or the type of property owned. The elderly populations in the Borough are more vulnerable to extreme heat events, particularly when in home cooling is not available, though most residents are assumed to have cooling options. Also, those in the borough with certain health conditions may also be more vulnerable to the health factors associated with extreme temperatures.

UConn CIRCA has developed a tool to aid in understanding extreme heat vulnerability for communities across the state. This tool, known as the Climate Change Vulnerability Index (CCVI), is comprised of dozens of factors that contribute to a community's heat sensitivity, exposure, adaptive capacity, and ultimately the overall heat vulnerability. The CCVI has been used as a tool to characterize heat vulnerability for the Borough. The distribution of heat vulnerability throughout the community can be seen in Figure 6-1.

Heat exposure and sensitivity in the Borough of Stonington is relatively high compared to the immediate surroundings due to the cluster of dense development in the Borough. However, the Borough also enjoys close proximity to coastal waters as well as multiple possibilities for cooling centers, and so adaptive capacity is also relatively robust. Therefore, the overall heat vulnerability for the Borough of Stonington is moderate to moderate-high.

6.2.3.1 Hazard Losses

There are no reported losses for the Borough of Stonington related to extreme temperatures. Future editions of this plan will revisit this topic.



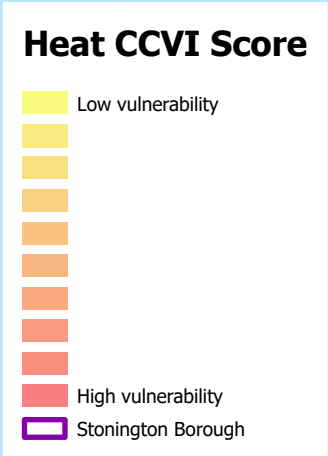
Heat CCVI Score

SCCOG Hazard Mitigation and Climate Adaptation Plan

Stonington Borough

12/9/2022

0 0.1 0.1 0.2
 Miles



Esri Community Maps Contributors, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/

6.3. Wildfires

6.3.1 Setting and Recent Occurrences

Wildfires are considered to be highly destructive, uncontrollable fires. The most common causes of wildfires are arson, lightning strikes, and fires started from downed trees hitting electrical lines. Thus, wildfires have the potential to occur anywhere and at any time in both undeveloped and lightly developed areas of the borough. However, the borough is small and developed and therefore does not typically experience wildfires. No major wildfires could be recalled in recent history. Structural fires in higher density areas of the borough are larger concern for the Borough, although these are not directly addressed herein.

6.3.2 Existing Capabilities

Monitoring of potential fire conditions is an important part of mitigation. The Connecticut DEEP Forestry Division uses the rainfall data recorded by the Automated Flood Warning system to compile forest fire probability forecasts. This allows the DEEP to monitor drier areas to be prepared for forest fire conditions. The Borough can access this information over the internet. The Borough also receives "Red Flag" warnings via local media outlets.

Existing mitigation for wildland fire control is typically focused on building codes, public education, Fire Department training, and maintaining an adequate supply of equipment. The Borough's Fire Department has a strong mutual aid relationship with the Town of Stonington and other municipalities to fight wildfires and structure fires. Fire protection water is obtained from the public water systems owned and maintained by the Aquarion Water Company. The Aquarion Water Company tests fire flows regularly and informs the fire department of the pressure available.

The entire Borough has water service with the exception of the Salt Acres Road/Eastern Point area. The Borough fire trucks bring water to areas without public water service and goes to the fires as quickly as possible. The Borough has good access to most areas for fire-fighting. The level of fire protection afforded by the existing hydrants is considered to be good for the development level of the borough. The Fire Department will continue to evaluate the level of risk and the need for additional hydrants in the future.

The Connecticut DEEP has recently changed its Open Burning Program. It now requires individuals to be nominated and designated by the Chief Executive Officer in each municipality that allows open burning and to take an online training course and exam to become certified as an "Open Burning Official." The Borough has designated an Open Burning Official. Permit template forms were also revised that provide permit requirements so that the applicant/permittee is made aware of the requirements prior to, during, and after burn activity. The regulated activity is then overseen by the Borough.

The Borough supports public outreach programs to increase awareness of forest fire danger, equipment usage, and protecting homes.

Summary

In general, municipal capabilities to mitigate wildfire damage have remained consistent since the 2017 edition of the hazard mitigation plan was adopted.

6.3.3 Vulnerabilities and Risk Assessment

As the Borough of Stonington is almost fully developed, wildfires can only occur in a few areas. The most vulnerable area is the Eastern Point/Salt Acres road area since this area does not have public water service and is dominated by marsh grasses. Fortunately, the railroad in this area could act as a firebreak preventing flames from spreading north over the tracks. As such, even a large fire in this area would likely be contained to less than ten acres. The proximity to coastal water also provides a significant backup supply of water to fight the fires although it is not ideal to utilize salt water. This area is considered to be a low to moderate risk for wildfires.

Other undeveloped areas in the borough are generally less than one acre in size and are located adjacent to the public water system. These areas are considered to be a low-risk area for wildfires. Refer to Figure 3-6 in the Multi-Jurisdictional HMP for a general depiction of wildfire risk areas within the Borough of Stonington. The biggest issue related to emergency response in the borough is that many of the roads are narrow. This can present delays during navigation and access to the fire site.

6.3.3.1 Hazard Losses

There are no reported losses for the Borough of Stonington related to wildfires. Downscaled losses from the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document.

7. Earthquakes

7.1. Climate Change Impacts

Earthquakes are not a climate related hazard, therefore there are no expected impacts as a result of climate change. There are however secondary impacts that could be a concern and amplify the damages of an earthquake. The deterioration of infrastructure from extreme heat or salt water as a result of coastal flooding or sea level rise, may weaken certain components making them more prone to damage or collapse during an earthquake event. Flooding events can also leave some landscapes at a higher risk of landslides; an earthquake could potentially prompt a landslide in post-flooded areas.

7.2. Earthquakes

7.2.1 Setting and Recent Occurrences

An earthquake is a sudden rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. Earthquakes can cause buildings and bridges to collapse; disrupt gas, electric, and telephone lines; and often cause landslides, flash floods, fires, avalanches, and tsunamis. Earthquakes can occur at any time and often without warning. Detailed descriptions of earthquakes, scales, and effects can be found in the Multi-Jurisdictional HMCAP. Despite the low probability of an earthquake occurrence, earthquake damage presents a potentially catastrophic hazard to the borough. However, it is very unlikely that the borough would be at the epicenter of such a damaging earthquake. No major earthquakes have affected the borough since the last HMP.

7.2.2 Existing Capabilities

The Connecticut Building Codes include design criteria for buildings specific to each region as adopted by Building Officials and Code Administrators (BOCA). These include the seismic coefficients for building design in the Borough of Stonington. The Borough has adopted these codes for new construction, and they are enforced by the Building Inspector.

Due to the infrequent nature of damaging earthquakes, Borough land use policies do not directly address earthquake hazards. However, the potential for an earthquake and emergency response procedures is addressed in the Borough's EOP.

Summary

In general, municipal capabilities to mitigate earthquake damage have not increased since the 2017 edition of the hazard mitigation plan was adopted. This is because the hazard continues to pose a low risk of damage to the Borough.

7.2.3 Vulnerabilities and Risk Assessment

Surficial earth materials behave differently in response to seismic activity. Unconsolidated materials such as sand and artificial fill can amplify the shaking associated with an earthquake. As noted in Section 2.1, a few areas of the borough are underlain by stratified drift. These areas are potentially more at risk for earthquake damage than the areas of the borough underlain by glacial till. The best mitigation for future development in areas of sandy material is the application of the most stringent standards in the Connecticut Building Code, exceeding the building code requirements, or, if the

Borough deems necessary, the possible prohibition of new construction. The areas that are not at increased risk during an earthquake due to unstable soils are the areas underlain by glacial till.

Bedrock faults have not been mapped within the borough. Unlike seismic activity in California, earthquakes in Connecticut are not associated with specific known active faults. However, bedrock in Connecticut and New England in general is typically formed from relatively hard metamorphic rock that is highly capable of transmitting seismic energy over great distances. For example, the relatively strong earthquake that occurred recently in Virginia was felt in Connecticut because the energy was transmitted over a great distance through such hard bedrock.

The built environment in the borough primarily includes some more recent construction that is seismically designed. However, most buildings were built before the 1970's and therefore are not built to current building codes. Thus, it is believed that most buildings would be at least moderately damaged by a significant earthquake. Those residents who live or work in older, non-reinforced masonry buildings are at the highest risk for experiencing earthquake damage.

Areas of steep slopes can collapse during an earthquake, creating landslides. The borough is relatively flat such that seawalls at the shoreline represent the steepest slopes. Thus, landslides are not a concern in the borough.

Seismic activity can also break utility lines such as water mains, gas mains, electric and telephone lines, and stormwater management systems. Damage to utility lines can lead to fires, especially in electric and gas mains. Dam failure can also pose a significant threat to developed areas during an earthquake. For this HMP, dam failure has been addressed separately in Section 10.0. As noted previously, most utility infrastructure in the borough is located above ground. A quick and coordinated response with Connecticut Light & Power and other utilities will be necessary to inspect damaged utilities following an earthquake, to isolate damaged areas, and to bring backup systems online. This is covered in the EOPs for these entities.

7.2.4 Hazard Losses

There are no reported losses for the Borough of Stonington related to earthquakes. Downscaled losses from the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document. In addition, a *HAZUS-MH* analysis of the potential economic and societal impacts to the SCCOG region from earthquake damage is detailed in the Multi-Jurisdictional HMP. The analysis addresses a range of potential impacts from any earthquake scenario, estimated damage to buildings by building type, potential damage to utilities and infrastructure, predicted sheltering requirements, estimated casualties, and total estimated losses and direct economic impact that may result from various earthquake scenarios.

8. Hazard Mitigation and Climate Adaptation Strategies and Actions

8.1. Status of Mitigation Strategies and Actions

Ten hazard mitigation actions were developed in the previous edition of this plan. The status of each is listed below.

#	Mitigation Actions and Strategies for Stonington Borough 2016 - 2021	Status	Status Details
1	Integrate additional elements of this HMP into the Plan of Conservation and Development during the next update	In Progress	The Borough is in the process of updating the POCD.
2	Investigate feasibility of creating new egress from the Borough.	Carry Forward with Revisions	The Borough has been in communications with Amtrak for years, but this relationship is challenging. Amtrak put up a new fence a few years ago and has not yet given the Borough the keys to the pre-existing gate. This fence impedes a route for additional access and egress. Borough staff can cut the bolts and make the gate useable if needed.
3	Install an emergency generator at the Borough Hall	Complete	The generator is elevated due to its location in the SFHA.
4	Dry floodproof the utility room in the Borough Hall	Carry Forward with Revisions	Carry forward with revisions - Borough staff are not aware of any past flooding in the Borough Hall; it did not flood during Sandy. A small barrier has been added around the outside of the steps leading to the utility room.
5	Upgrade stormwater collection and discharge systems to keep up with rising sea level	Carry Forward with Revisions	The Borough is currently conducting an assessment of stormwater infrastructure using ARPA funds. The Borough has identified three specific areas of concern to its consultant, CLA. New actions could reflect recommendations of the study. Revise to be more specific
6	Implement recommendations of the Stonington Coastal Resiliency Plan as is appropriate	Carry Forward with Revisions	Carry forward with revisions if applicable projects are identified in the plan - This has not happened; many of the actions were large-scale and none of the specific projects were located in the Borough.
7	Work with the Town of Stonington to ensure that the Wastewater Treatment Facility is protected from coastal flooding and storm surge.	Carry Forward with Revisions	The Town of Stonington owns the facility and system. Recent work has included rerouting effluent that would be treated at the Mystic facility to the Borough to be enhance compliance with DEEP requirements and improve the Mystic plant capacity. No resilience work has occurred. Revise to be more specific
8	Explore the feasibility of large-scale flood protection projects such as construction of a seawall around the Borough.	Carry Forward	This feasibility study has not yet happened. The Borough administration understands that in the long run a seawall-type structure is the only way to completely protect the Borough from flooding, but this may not be feasible or constructable.

9	Revise local flood regulations as needed to clarify the exemptions and variances available to historic properties (refer to the Historic and Cultural Resources Resiliency Planning Report as needed)	Complete	The Borough uses variances rather than relying on a definition on substantial improvement that exempts historic structures. The Borough has granted some variances to historic properties. It does not sound like more revisions to regulations are needed.
10	Send Borough staff to a State Historic Preservation Office / Connecticut Trust for Historic Preservation training for local historic district commissioners and Certified Local Governments on managing historic districts in Connecticut	Carry Forward	There is still interest in this.

During the planning process, CIRCA and consultant staff facilitated a discussion with the Borough Warden and staff to identify the greatest climate change concerns and challenges. The previous actions were re-evaluated in this context. Elements of seven prior actions have been carried forward into the new hazard mitigation and climate adaptation actions.

8.2. Prioritization of Specific Actions

The proposed actions for the Borough of Stonington to undertake from 2023 through 2028 are listed in Table 8-1 on the next page. The full list of actions for the region with buildups for the PERSISTS and STAPLEE scores are available in the multi-jurisdiction document.

Due to the small geographic size of the Borough, some of the goals presented in Section 1.2 have been combined and addressed by actions that achieve multiple objectives. For example, action #1 has “Ensure that critical facilities are resilient, with special attention to shelters and cooling centers” as its primary goal, but it also addresses goals about extreme heat (because of the cooling center) and other hazards (for example, a severe storm could make Stonington High School inaccessible).

The actions with the highest PERSISTS score and the highest STAPLEE score are different, which is consistent with the intent of the two scores. PERSISTS scores tend to be higher for actions that maximize public safety while advancing climate science and being transferable to other communities, whereas STAPLEE scores tend to be higher for actions that are highly cost effective and technically feasible for reducing losses from hazards. The actions with the highest combined scores are:

- As recommended in the Southeastern Connecticut Critical Facilities Assessment, floodproof the utility room in the Borough Hall. Use the base flood elevation plus two feet freeboard plus 20 inches for sea level rise per PA 18-82.
- Upgrade stormwater collection and discharge systems to keep up with rising sea level with particular attention to those areas of concern identified in the stormwater infrastructure assessment.
- Work with the Town of Stonington to conduct a critical equipment inventory at the WWTF to begin design solutions and to ensure that the Facility is protected from coastal flooding and storm surge.

The Borough intends to focus on these three actions, along with the sole action about cooling centers:

- Utilize the library and Fire Department as local cooling centers for instances when the Stonington High School cannot be reached. This may require expanded hours and access to these two facilities, as well as standby power for the library.

This is consistent with the State’s emphasis on cooling center resilience.

Table 8-1 Stonington Borough Actions and STAPLEE and PERSISTS Scores

Number	Hazard Mitigation and Climate Adaptation Actions	Hazard Mitigation and Climate Adaptation Goal	Type of Action	Responsible Department	Approx. Cost Range	Potential Funding Sources	Timeframe	Priority	PERSISTS Score	STAPLEE Score	PERSISTS x STAPLEE =
BS1	Utilize the library and Fire Department as local cooling centers for instances when the Stonington High School cannot be reached. This may require expanded hours and access to these two facilities, as well as standby power for the library.	Ensure that critical facilities are resilient, with special attention to shelters and cooling centers.	Preparedness & Emergency Response	Office of the Chief Elected Official	\$100,000 - \$500,000	FEMA HMA; Other preparedness grants; STEAP	7/2023 - 6/2025	High	16	6	96
BS2	Investigate feasibility of creating new egress from the Borough.	Invest in resilient corridors to ensure that people and services are accessible during floods and that development along corridors is resilient over the long term.	Structural Projects	Office of the Chief Elected Official	\$50,000 - \$100,000	DEEP Climate Resilience Fund	7/2025 - 6/2026	Medium	18	3	54
BS3	As recommended in the Southeastern Connecticut Critical Facilities Assessment, floodproof the utility room in the Borough Hall. Use the base flood elevation plus two feet freeboard plus 20 inches for sea level rise per PA 18-82.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Property Protection	Building Official	\$100,000 - \$500,000	FEMA HMA; STEAP	7/2023 - 6/2024	Medium	20	7	140
BS4	Upgrade stormwater collection and discharge systems to keep up with rising sea level with particular attention to those areas of concern identified in the stormwater infrastructure assessment.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Structural Projects	Public Works	\$100,000 - \$500,000	Municipal CIP Budget	7/2023 - 6/2024	High	20	7	140
BS5	Work with the Town of Stonington to conduct a critical equipment inventory at the WWTF to begin design solutions and to ensure that the Facility is protected from coastal flooding and storm surge.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Water & Wastewater Utility Projects	Office of the Chief Elected Official	\$50,000 - \$100,000	CWSRF; WPCA CIP Budget	7/2023 - 6/2024	High	17	8	136

Number	Hazard Mitigation and Climate Adaptation Actions	Hazard Mitigation and Climate Adaptation Goal	Type of Action	Responsible Department	Approx. Cost Range	Potential Funding Sources	Timeframe	Priority	PERISTS Score	STAPLEE Score	PERSISTS x STAPLEE =
BS6	Evaluate the feasibility of large-scale flood protection projects such as construction of a seawall around the Borough. This should be accomplished by focusing on land, parcels, and easements potentially available. Future phases should focus on engineering aspects.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Structural Projects	Office of the Chief Elected Official	\$25,000 - \$50,000	FEMA HMA Scoping; Municipal CIP Budget	7/2024 - 6/2025	Low	14	2	28
BS7	Send Borough staff to a State Historic Preservation Office / Connecticut Trust for Historic Preservation training for local historic district commissioners and Certified Local Governments on managing historic districts in Connecticut	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Property Protection	Land Use Staff	\$0 - \$10,000	SHPO	7/2025 - 6/2026	Medium	13	8	104
BS8	Work with CT DEEP to update the list of repetitive loss properties and ensure that errors and updates are incorporated by FEMA.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Property Protection	Floodplain Manager	\$0 - \$10,000	Municipal Operating Budget	7/2023 - 12/2023	High	12	6	72
BS9	Conduct direct outreach to property owners in repetitive loss areas with information about how to mitigate flood losses, and coordinate with CRS activities.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Property Protection	Floodplain Manager	\$0 - \$10,000	Municipal Operating Budget	1/2024 and annually during this month	High	13	4	52