

# GROTON CITY ANNEX DOCUMENT

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

March 2023



**PREPARED FOR:**

City of Groton  
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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 4<sup>th</sup> 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.

## 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 City of Groton is an urbanized political subdivision of the municipality of Groton, Connecticut. The City of Groton was established as a borough in 1903 and incorporated as a city in 1964. It is approximately 3.2 square miles in area and had a population of 10,389 as of the 2010 census. It is located in the south-central portion of the southeastern Connecticut shoreline. It is bordered by the Town of Groton (the remaining political subdivision of Groton) to the north and east, the Thames River to the west, and Fishers Island Sound to the south. The City of Groton can be accessed by Interstate 95 and the Clarence B. Sharp Highway (State Route 349).

### 2.1. Physical Setting

The City of Groton is a coastal community located on the Connecticut shoreline. Elevations range from sea level along the Thames River and Fishers Island Sound to just over 150 feet in the northeastern corner of the City. Three islands also lie within the City limits; of these, only Hobs Island is inhabited (by one home).

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 City of Groton.

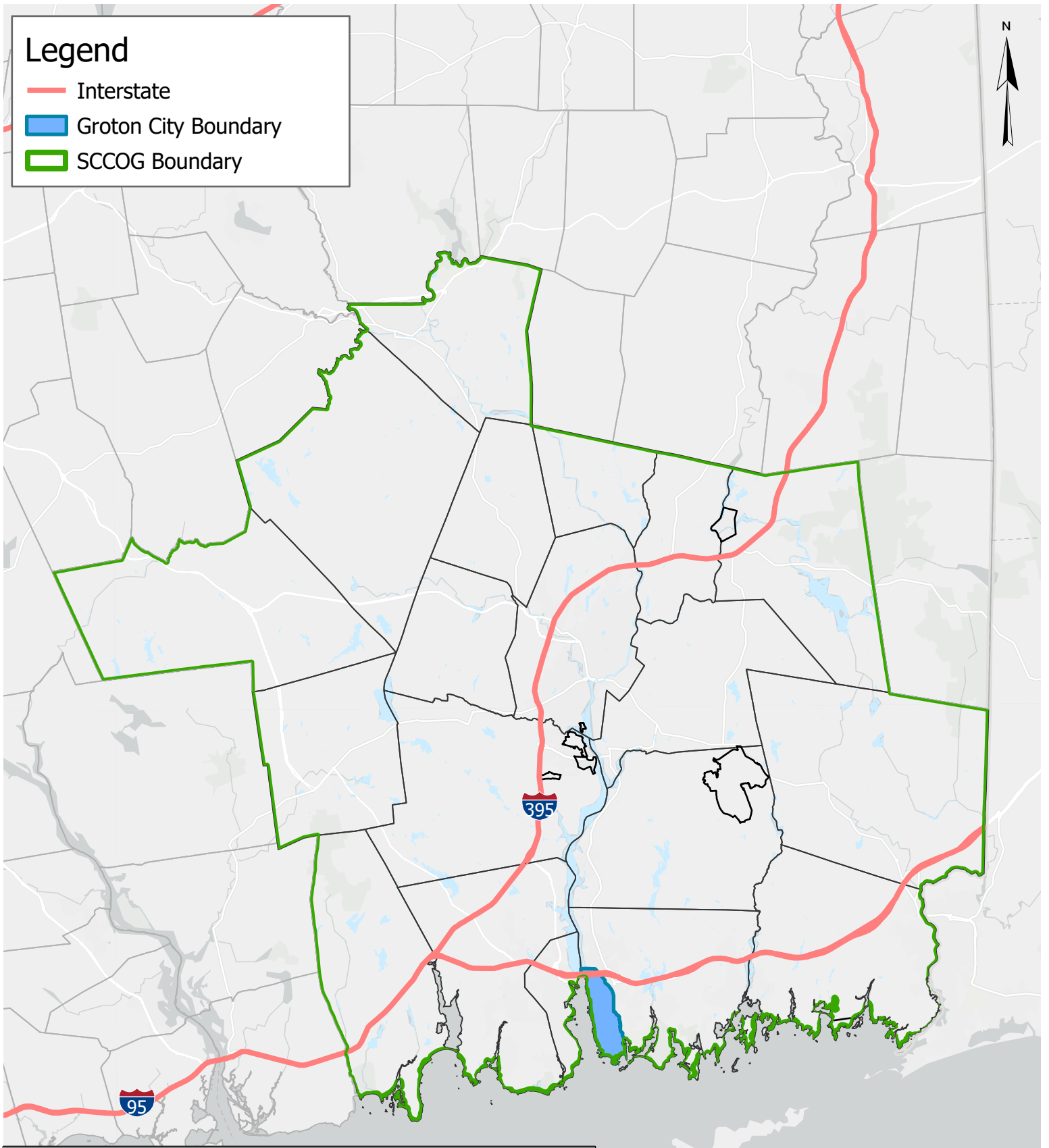
The City of Groton lays above four bedrock types which trend northwest to southeast across the area. The area near Interstate 95 is underlain by the Potter Hill Granite Gneiss, the Plainfield Formation, and the Mamacoke Formation, while the remainder of the City is underlain by New London Gneiss except for two small intrusions of Westerly Granite. Each of these formations consists primarily of gneiss, a relatively hard metamorphic rock except for the hard, igneous granite intrusions. There are no faults mapped within or near the City of Groton boundary.

The City's different surficial geologic formations include glacial till, stratified drift, and coastal formations. Refer to the Multi-Jurisdictional HMP for a generalized view of surficial materials. The majority of the City is underlain by glacial till. The exceptions are an area along the Thames River near Interstate 95 which is underlain by stratified drift; areas along Birch Plain Creek in which are underlain by alluvium, stratified drift, and swamp; and coastal beach and dune deposits along Shennecossett Beach located in the southwestern part of the City along Fishers Island Sound.

Till contains an unsorted mixture of clay, silt, sand, gravel, and boulders deposited by glaciers as a ground moraine. The amount of stratified drift present is important as areas of stratified materials are generally coincident with floodplains. These materials were deposited at lower elevations by glacial streams, and these valleys were later inherited by the larger of our present day streams and rivers. However, the smaller glacial till watercourses can also cause flooding. 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
- Groton City Boundary
- SCCOG Boundary

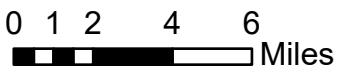


## Regional Location of Groton City

SCCOG Hazard Mitigation and Climate Adaptation Plan

City of Groton

Date: 7/22/2022



Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS



## 2.2. Drainage Basins and Hydrology

The City of Groton is divided among two sub-regional watersheds as delineated by the Connecticut DEEP. The western side of the City drains directly to the Thames River, whereas the remainder of the City drains to Fishers Island Sound. The northeastern section of the City drains to Fishers Island Sound via Birch Plain Creek and Bakers Cove. The City of Groton does not have issues with runoff entering from the Town of Groton.

In addition to the water bodies listed above, two unnamed coastal ponds located along Beach Pond Road and Shennecossett Road in the vicinity of Avery Point empty into the Thames River and Baker Cove.

## 2.3. Land Cover

According to the 2016 1-meter resolution land cover developed by the NOAA Office of Coastal Management, Groton City is predominantly comprised of developed impervious land cover, with approximately 36.98% of the city classified as such. The second largest land cover type is developed open space, which covers about 24.77%, and next is mixed forest which is about 29.75% of land cover. All land covers and their percent coverage can be found in Table 2-1.

Table 2-1 City of Groton Land Cover

| Land Cover Type (2016)         | % Coverage |
|--------------------------------|------------|
| Barren Land                    | 2.01       |
| Developed, Impervious          | 36.98      |
| Developed, Open Space          | 24.77      |
| Estuarine Emergent Wetland     | 0.34       |
| Estuarine Scrub/Shrub Wetland  | 0.07       |
| Grassland/Herbaceous           | 0.46       |
| Mixed Forest                   | 29.75      |
| Open Water                     | 2.66       |
| Palustrine Aquatic Bed         | 0.01       |
| Palustrine Emergent Wetland    | 0.05       |
| Palustrine Forested Wetland    | 0.83       |
| Palustrine Scrub/Shrub Wetland | 0.04       |
| Scrub/Shrub                    | 1.68       |
| Unconsolidated Shore           | 0.34       |

## 2.4. Population, Demographics, and Development Trends

The City of Groton is nearly fully developed with the exception of a few areas of dedicated open space. According to the 2019 *Plan of Conservation and Development* for the City, remaining vacant developable land was equal to 4% of the overall land area. The City includes 28.65 miles of improved streets and 4.9 miles of State of Connecticut highways.

A mix of residential, commercial, and industrial development is found along the City's shoreline, with predominantly residential development occupying the central area of the City. Much of the southern portion of the City is institutional land associated with the University of Connecticut's Avery Point

campus and undeveloped land associated with the Shennecossett Golf Course. Other open space properties include Fort Griswold State Park and George Washington Park in the northern section of the City and Birch Plain Creek Open Space located on the east side of the City.

The Thames River has played an important part in the development of the City of Groton. The city is well known as the home of General Dynamics - Electric Boat, a company that designs and builds submarines. Electric Boat and Pfizer, a pharmaceutical manufacturer, are the two largest employers in the city and are both located along the Thames River. The Hess Oil Corporation is also a large employer located adjacent to Pfizer. In addition to coastal and roadway access, a branch of the Providence/Worcester Railroad line passes through the northern part of the City with a spur entering from the east with a terminus at Electric Boat. The city hopes to focus redevelopment efforts on the Thames Street area in the near future.

The 2020 census population of the City was 9,146. This is only a decrease of 142 people since the 9,288 since the 2017 HMP which reported the 2000 census population numbers. As there are almost no developable properties remaining in the City, the only development has been small infill projects consisting of single and two-family homes along the shoreline. Large redevelopment projects are currently being undertaken on the Electric Boat and Pfizer campuses, although the footprints of existing buildings and the amount of impervious surfaces are not significantly changing. No new major developments or residences are currently proposed, and population growth is expected to be modest in the future.

Overall, new development and redevelopment in the city is not increasing risks to natural hazards. Redevelopment throughout the community offers significant opportunities for flood mitigation to be incorporated into buildings and stormwater management to be addressed on-site; and new development is constructed per the flood damage prevention, wind loading, and snow loading requirements in the State Building Code.

According to the 2019 Plan of Conservation and Development, approximately 36% of the housing units in the City are single-family detached units, approximately 36% are two- to four-family dwellings, and the remaining 28% are larger multi-family structures and apartments. More than half of the housing units were built in the 1950s through 1970s during the height of "Cold War" era submarine production at Electric Boat and as such do not meet current building codes. About 58% of all housing units in the City are renter-occupied.

As of the 2020 Decennial Census, the population for the city is 9,146, which equates to about 1,354 people per square mile. The 2020 American Community Survey 5-year estimates identified the annual average median income for Groton City to be \$68,104, with an average of 38.5% of the population holding a bachelor's degree or higher, and an average unemployment rate of 5.4% throughout the city.

## 2.5. Governmental Structure

The City of Groton is governed by a Mayor-City Council government as authorized by the City Charter of 1987. The Mayor is the chief executive officer of the City and is directly responsible for the administration of all departments, agencies, and offices. The six-member City Council consists of a

Deputy Mayor who administers the City in the Mayor's absence and five City Councilors. Together, the Mayor and the City Council review and approve all City business. The Mayor casts the deciding vote on Council business in case of a tie. The City does share some responsibilities with the Town; these are depicted in Table 2-2.

|  | Poquonnock Bridge                  | Center Groton | Mystic                             | Old Mystic | West Pleasant Valley | Noank                              | Groton Long Point | City of Groton | Navy Base   |
|--|------------------------------------|---------------|------------------------------------|------------|----------------------|------------------------------------|-------------------|----------------|-------------|
| <b>Overall Government</b>                | Town of Groton                     |               |                                    |            |                      | Town & Noank                       | Town & GLP        | Town & City    | Navy        |
| <b>Education</b>                         | Town of Groton                     |               |                                    |            |                      |                                    |                   |                |             |
| <b>Public Works</b>                      | Town of Groton                     |               |                                    |            |                      |                                    | GLP               | City of Groton | Navy        |
| <b>Police</b>                            | Town of Groton                     |               |                                    |            |                      |                                    | GLP               | City of Groton | Navy        |
| <b>Wetlands</b>                          | Town of Groton                     |               |                                    |            |                      |                                    | GLP               | City of Groton | Navy        |
| <b>Land Use Planning</b>                 | <b>Town of Groton</b>              |               |                                    |            |                      |                                    | GLP               | City of Groton | Navy        |
| <b>Zoning</b>                            | <b>Town of Groton</b>              |               |                                    |            |                      | Noank                              | GLP               | City of Groton | Exempt      |
| <b>Recreation</b>                        | Town of Groton                     |               |                                    |            |                      | Town & Noank                       | Town & GLP        | Town & City    | Town & Navy |
| <b>Ambulance, Rescue &amp; Paramedic</b> | Groton Ambulance Association (GAA) |               | Mystic River Ambulance Association |            | GAA                  | Mystic River Ambulance Association |                   | GAA            | Navy & GAA  |

Table 2-2 Public Service Responsibilities by Fire District for the City of Groton (From the Town of Groton 2016 POCD)

The City of Groton has several departments that provide municipal services. Departments pertinent to natural hazard mitigation include the Finance, Fire, Planning, Police, Public Works, Utilities, and Zoning & Building Departments. In addition, there are several boards and commissions that can take an active role in hazard mitigation, including the Conservation Commission, 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 HMCAP. More specific information for certain departments and commissions of the City of Groton is noted below:

- The Conservation Commission is the Inland Wetlands Regulatory Agency for the City of Groton and reviews plans for compliance with said regulations and maintains the City's inland wetlands map.
- The City of Groton Fire Department has two fire stations with career personnel on duty 24 hours per day as well as volunteer personnel. They provide Fire suppression, fire / disaster prevention, rescue, hazardous materials, disaster mitigation, and emergency medical services to the City.
- The Harbor Management Commission oversees the development and use of the coastal waters in and around the City of Groton. They maintain the City's Harbor Management Plan, work with the Harbor Master and City staff on emergent vegetation issues and oversee the City'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 City 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 administer the City's Zoning and Subdivision regulations, administer the Coastal Management Program, perform planning studies, and provides technical assistance to developers.

- The Police Department maintains the evacuation plan for the City in addition to providing law enforcement services. The City of Groton has a total of 29 officers and nine non-sworn staff members.
- The Public Works (Highway) Department provides services including comprehensive solid waste collection, recycling and disposal; safe, efficient and well-maintained infrastructure of roads, bridges and stormwater management. The Public Works 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.
- Groton Utilities provides electricity, potable water, cable television, high-speed internet access, and digital phone services to the City of Groton and the surrounding region. They maintain and test fire hydrants utilized by the Fire Department.
- The Zoning & Building Department performs inspections of new and existing development to ensure compliance with appropriate building codes and City regulations, including wetland regulations for the Conservation Commission.
- The Zoning Board of Appeals has jurisdiction over variances to the City's zoning regulations and has, for example, issued variances for special circumstances in flood plain zones.

In addition to the departments described above, the City of Groton has several other departments similar to surrounding municipalities, including Human Resources, attorneys, etc. The roles of City departments have not changed since the time of the previous HMP. Thus, the City of Groton is technically, financially, and legally capable of implementing mitigation projects for natural hazards. As discussed in the next section and the historic record throughout this annex, the City of Groton is densely developed and thus has particular vulnerability to certain types of natural hazards.

## 2.6. Review of Existing Plans and Regulations

The City 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, Zoning Regulations, Subdivision Regulations, Inland Wetland Regulations. The *Plan of Conservation and Development* and the Zoning Regulations have incorporated information from the previous HMP.

### Plan of Conservation and Development

The *Plan of Conservation and Development* was adopted on February 4, 2019, with contributions from local boards and commissions, citizens, and citizen groups. The purpose of the plan is to balance growth with maintaining the quality of life that citizens within the City embrace. Building on the information in the previous HMP, the Plan includes many strategies pertinent to hazard mitigation and climate adaptation. Recommendation strategies were noted as being high, moderate, or lower priority or being policies.

The Plan encourages the City to protect natural resources, preserve open space and scenic resources, and notes specifically that the City should continue to require setbacks and buffers from water resources and coastal resources, and that new development in coastal "V" flood zones should be minimized. The 2019 plan also focuses on addressing community issues relative to climate change, sea level rise, community facilities, and resiliency. Additional recommendations related to natural hazards include:

### **High Priority**

- Address issues associated with climate changes and sea level rise.

### **Moderate Priority**

- Continue to work with regional, state, and federal agencies and other organizations to address issues related to coastal vulnerability.
- Consider increasing regulatory standards relative to construction in vulnerable areas:
  - Limiting construction to habitable structures
  - Increasing freeboard requirements
  - Applying coastal "V" zone flood standards to areas which may be subject to such flooding in the future.
  - Update regulations to encourage or allow for increased structural integrity to the extent consistent with FEMA standards.
- Continue efforts to identify, avoid, reduce, mitigate, and recover from impactful events.

### **Lower Priority**

- Establish a working committee to evaluate community vulnerabilities associated with climate change and sea level rise.
- Conduct a thorough assessment of vulnerability to climate change and sea level rise including:
  - A database of "repetitive loss" properties
  - Detailed map showing areas subject to potential inundation in the future.
- Create and actions plan to prioritize actions relative to climate change and sea level rise including a conceptual capital improvement program to balance fiscal capacity with coastal issues/needs.
- Implement the hazard mitigation plan.
- Continue to protect steep slopes.

The City of Groton POCD is considered consistent with the current goals and actions of the hazard mitigation plan. It does directly address several of the hazards such as flood hazards, sea level rise, earthquake hazards, and wind hazards. The next update to the POCD should continue to incorporate more elements of the hazard mitigation and climate adaptation plan.

### **City of Groton Community Resiliency Plan**

In 2020 the City began developing a resiliency plan to respond to, and plan for, anticipated climate change impacts. Impacts include sea level rise, flooding, and changing storm frequency and intensity. The City received a grant from the National Fish and Wildlife Foundation's Long Island Sound Futures

Fund to help in plan development. The plan was developed with the hopes that it would guide decision making in the community.

A majority of the objectives and recommendations from this plan are consistent with the goals of hazard mitigation and climate adaptation. Some of these include:

**Objective 1: Reduce stormwater flooding from impervious surfaces**

A primary climate change concern for the City of Groton is an increasing risk of stormwater flooding exacerbated by the extensive impervious surfaces within the City. As climate change leads to more frequent severe precipitation events, the risk to the City from such events will rise, and even drainage infrastructure that has been upgraded in recent years may see its capacity exceeded.

Recommendations:

- Conduct comprehensive stormwater runoff studies
  - Conduct comprehensive studies and investigations to fully characterize stormwater sources and flow paths, catch basin watersheds, and the networks, capacities and conditions of the City’s drainage system. Fully understanding the stormwater system and stormwater runoff patterns will allow the City of Groton to effectively pursue runoff reduction and flood mitigation projects.
- Encourage reduction of stormwater runoff from private property
  - Much of the impervious surface within the City of Groton is located on private property. Reducing the risk of flooding from stormwater will require assistance from and collaboration with those property-owners.
- Fund municipal stormwater reduction efforts
  - Raise funds for stormwater reduction projects by pursuing grants and securing public support for municipal spending.
- Decrease impervious surface extent
  - Reduce the area generating stormwater runoff by replacing impervious surfaces with pervious land uses or permeable pavements. This will help reduce the risk of flooding from stormwater runoff as well as reduce the urban heat island effect.
- Implement retention, detention, and infiltration techniques
  - Slow or reduce the flow of stormwater drainage pipes through installation of cisterns, swales, ponds, and other measures, focusing on the use of green-infrastructure. This will reduce the stress on drainage systems and the risk of flooding, while creating additional environmental co-benefits such as improved habitat and increase presence of native plant species.
- Increase capacity of stormwater infrastructure
  - In coordination with stormwater runoff reduction measures, increase the capacity of the City’s stormwater drainage system with consideration of rising precipitation projections.

**Objective 2: Mitigate increasing urban heat island effect impacts.**

A significant portion of the City of Groton is at an elevated risk from extreme heat events due to relatively elevated urban heat island effects. This effect is concentrated in the more densely-developed parts of the City with more extensive impervious surfaces and exacerbated by lack of

tree coverage in these areas. As climate changes lead to ever- higher average annual temperatures these urban heat island areas will be especially at risk.

Recommendations:

- Enhance understanding of local heat risk and cost
  - Conduct a detailed heat vulnerability assessment and communicate results to community decision-makers and the public through public engagement and education. Improve local understanding of the risk that extreme heat events pose to health and wellbeing, infrastructure, ecosystems, and more. Use this information to inform municipal protocols, capital spending, and public behaviors.
- Develop a Citywide, Healthy Urban forest
  - Develop an aggressive and forward-thinking urban forestry program that will significantly increase the density of trees throughout the City. The program should: increase shading on public sidewalks; plant trees in the most densely developed parts of the City; and ensure equitable distribution, focusing on socially vulnerable residents and communities. A healthy urban forest at a city-wide scale can mitigate the urban heat island effect over a wider geography and provide benefits more equitably. Urban forest also reduces stormwater runoff, purify air, provide ecological benefits, and increase property values.
- Provide public access to cooling areas
  - Provide access to passive and active cooling areas for all residents. Passive cooling includes artificial shade structures, blue infrastructure (like spray parks and water fountains), and green corridors. Active cooling includes air-conditioned public comfort stations (spaces where the public can go to warm up, cool off, and charge electronic devices during protected power outage) and emergency shelters.
- Include heat consideration in the building code
  - Update the local building code to require residential buildings to be properly designed, equipped, and maintained to minimize negative effects of extreme heat events on residents. Requirements may address: airflow, window size & location, insulation, roofing materials & color, outside wall color, HVAC systems, and solar orientation.

### **Objective 3: Enhance Resilience of local Businesses**

City of Groton Business are vulnerable to the effects of climate change. The primary threats are:

- Direct damage to property or assets from coastal flooding and stormwater flooding
- Business interruption due to coastal or stormwater flooding, other storm events, or extreme heat events that affect access, supply chain, operations or customers engagement.

Operational local businesses are essential to recovery following a disruption and maintaining a resilient local business community will be essential to maintaining a resilient City of Groton.

Recommendations:

- Enhance Resilience of Small Businesses to Climate-related disruptions
  - Support efforts by local businesses, in particular small businesses, to become more resilient by developing continuity and recovery plans and protocols, and by making changes to their operations, physical layout, and organization. Business continuity efforts that address climate change related disruptions will help business owners be more resilient to non-climate disruptions, and vice versa.
- Support and encourage flood-proofing of commercial properties
  - Provide education, regulations, and funding to encourage commercial property owners to retrofit their buildings located along the City of Groton coastline to better withstand flooding. Retrofits may include preventing water from accessing the building interior (dry flood proofing), allowing water to enter the building while causing minimal damage (wet flood proofing), or elevating the building to be above flood levels (elevating).

**Objective 4: Create a flood- resilient shoreline.**

Coastal flooding is a concern along much of the City of Groton shoreline, with particular susceptible areas located in the southern part of the City, as well as along Thames Street. Homes, businesses, roadways, and other infrastructure are all at risk.

Recommendations:

- Focus development and investment in low risk areas
  - Identify and target low-risk areas of the City for future residential growth and other development, redevelopment, and investment. These areas would be “receiving areas” to which residents or businesses moving away from risk areas could relocate.
- Pursue Shore Avenue resilience strategies
  - Pursue a suite of nature-based, hybrid, or conventional coastal protection strategies along Shore Avenue and Eastern Pont Rd
- Evaluate long-term resilience options for Jupiter Point
  - Jupiter Point is one of the areas of the City most-at-risk of flooding. Due to the high level of risk and sensitive nature for long-term solutions that may involve significant changes, implementing a comprehensive, neighborhood-specific engagement, evaluation, and adaptation plan is recommended.
- Protect and increase coastal open space
  - Identify undeveloped coastline to be protected as open space and evaluate opportunities for increasing the amount of open space along the shoreline. Facilitating inland marsh mitigation with sea level rise should be a particular focus of such efforts.

**Objective 5: Improve resilience of the transportation network**

The potential impact of climate change related hazards on transportation has been identified as a concern for the City of Groton. With only a few key roadways leading in and out of the City of Groton, limited transportation options aside from personal vehicles, and a large commuter population, increasing the reliability of the City’s transportation infrastructure will be important to the City’s resilience.



Recommendations:

- Consider climate change in traffic and evacuation planning
  - Evaluate potential climate change impacts on traffic flow throughout the City of Groton and between the City and surrounding communities. In particular, evaluate how climate change impacts may affect emergency access and egress. Collaborate with the Town of Groton and Connecticut DOT to implement measures.
- Make roadways more flood-resilient
  - Protect critical roadways through elevation or structural protections, make non-critical roadways flood resistant through appropriate paving materials and drainage, and establish climate-informed protocols for maintenance and upkeep
- Coordinate with regional transit systems
  - Coordinate with the Southeast Area Transit District as well as the Groton public school bus program to identify gaps and opportunities for collaboration on providing access to resilience resources both during emergency and during everyday situations.

**Objective 6: Increase resilience of socially vulnerable populations**

Socially vulnerable groups in the City of Groton tend to have higher risk levels to climate change related hazards and disruptions. These groups often have less access to resources that might help them be resilient to the direct and indirect effects of climate change and extreme weather events.

Recommendations:

- Increase the capacity of community organizations
  - Increase the resilience of socially- vulnerable populations by focusing on the organizations and institutions that already support them. These trusted community groups already have the infrastructure and connections to reach vulnerable individuals. Improve their capacities by educating them about climate risks, informing them of municipal , regional m and state protocols and resources, and providing technical and financial assistance to support efforts

**Objective 7: Lead by Example ~ Municipal Resilience Actions**

It is critical for municipal operations and administration to be resilient if the community is going to be resilient. Actions taken at the municipal level can serve as a case study and example for further progress across the City of Groton.

Recommendations:

- Enhance the resilience of City-owned Assets
  - Assess the risk to, and protect municipal facilities as warranted from, climate hazards and disruptions. This includes protecting properties and assets from damage caused by climate hazards, as well as pursuing fleet electrification and local power generation in order to reduce the potential impacts of power outages caused by worsening storms.
- Enhance the resilience of municipal operations

- Ensure that the City of Groton is able to maintain essential services and operational through climate change disruptions. Evaluate City administration and operations to identify vulnerabilities relevant to climate change, such as supply-chain disruption or loss of access for municipal personnel. Address identified vulnerabilities as feasible.

### Emergency Operations Plan

The City has an Emergency Operations Plan (EOP) that is reviewed and certified by the Mayor annually. This document provides general procedures to be instituted by the Mayor and/or designee and other tasked departments including the Police Department, Fire Department, Groton Utilities, and Public Works 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.

The EOP also includes detailed instructions and timelines for evacuations and emergency response. There are timelines and milestones for 72-48 hours before an event, 24 hours, and 12 hours before. Evacuation scenarios developed by the city can be broad or targeted. There are also lists of especially vulnerable residents, such as those requiring medical equipment. These populations and their needs are considered 72 hours before an event.

While the EOP is reviewed annually, it undergoes a more thorough update on a five-year cycle. The EOP's five-year update was completed by the end of 2017.

### Harbor Management Plan

The Harbor Management Plan of the City of Groton, as enacted under City Ordinance 167 approved on March 5, 2007, 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 City to have a list of persons who currently have boats moored such that removal or emergency response can be coordinated.

### Zoning Regulations

The Zoning Regulations of the City of Groton, Connecticut was last amended in 2020, with an effective date of September 2, 2020. Updates since the 2017 HMP include revisions to Section 5.3 the Flood Protection Overlay Zone. Amendments made to the regulations were in response to the State of Connecticut Building Code revisions.

Section 5.2 discusses coastal area management and potential exemptions from local permitting. The City of Groton enforces a 25-foot setback from any tidal water body or watercourse or from coastal resource areas within the Coastal Area Management Boundary defined by the Connecticut DEEP. In addition, new single-family homes cannot be constructed within 100 feet of tidal wetlands, coastal bluffs and escarpments, or beaches and dunes.

Section 5.3 of the regulations covers flood protection. The City of Groton utilizes the 1% annual chance floodplain (commonly referred to as the "100-year" floodplain) to manage development in floodplains.

The 1% annual chance floodplain is depicted on the DFIRM published August 5, 2013, by FEMA and includes areas in Zone A, Zone AE, and Zone VE including floodways. The degree of protection required by this regulation is the minimum reasonable for regulatory purposes. In particular,

- All applications for building permits within the flood hazard area must include the base flood elevation data from the FIRM for the portions of the activity located within the flood hazard area. The Building Official will record as-built elevation of the lowest floor and lowest horizontal structural member (for VE zones) and keep this information on file.
- The applicant must demonstrate to the commission that the development is consistent with the need to minimize flood damage within floodprone areas and that the building sites will be reasonably safe from flooding. In addition to confirming that the design is consistent with the Connecticut Building Code, the Building Official must confirm that the development is designed and constructed so as to minimize flood damage prior to building permit approval. Electrical, heating, ventilation, plumbing, air conditioning, and other service facilities must be designed and/or located so as to prevent water from entering or accumulating within the components during flooding.
- The Planning and Zoning Commission will coordinate with neighboring communities, the Connecticut DEEP, and FEMA prior to approving any activity that alters or relocates a watercourse.
- New construction, substantial improvements, and manufactured homes must be elevated and anchored to resist floatation, collapse, or lateral movement.
- New construction and substantial improvements require that fully enclosed areas below the lowest floor must be wet-floodproofed and used solely for the parking of vehicles, building access, or storage. The area cannot be used as furnished living space. Utilities are prohibited in the space below the base flood elevation.
- In coastal VE zones, all new construction or substantial improvement must be located landward of the reach of the mean high tide and elevated so that the bottom of the lowest supporting horizontal member is located above the base flood elevation level. Fill may not be used as a structural support.
- Encroachment in floodways is not allowed unless the applicant can demonstrate that the proposed activity will result in no net increase in flood levels during the base flood discharge. The City can require floodway data be provided for watercourses without FEMA-established floodways.
- Substantial Improvement is defined as based on the cumulative cost of repairs, constructions, etc., occurring over the course of a one-year period.
- New construction and substantial improvements to residential structures must have the lowest floor elevated to the base flood elevation.
- New construction and substantial improvements to **non**-residential structures must have the lowest floor elevated or floodproofed to one foot above the base flood elevation.
- New construction and substantial improvements to **any structures in a VE zone** must have the bottom of the lowest floor elevated to one foot above the base flood elevation.

Other hazard-mitigation related zoning regulations include:

- Roads and driveways must be adequate in width, grade, and alignment to allow access by fire, emergency, and police protection (Section 7.5)
- New utilities shall be installed underground (Section 7.5)

#### Subdivision Regulations

The City of Groton Subdivision Regulations were last amended with an effective date of December 1, 2016. These regulations address developments near steep slopes, watercourses and wetlands. Specific design requirements for flood-prone areas are noted in Section 3.03 and are similar to the more specific requirements presented in the Zoning Regulations. In particular,

- Section 4.07 discusses storm drainage requirements, including that systems be designed to reduce exposure to flood hazards.
- Section 3.05 states that the Planning and Zoning Commission may require open space within a subdivision to be reserved for active recreation (parks and playgrounds) or for passive recreation; for the protection and buffering of wetlands and watercourses; or for preserving outstanding natural or historical features. The Planning and Zoning Commission may also collect a fee in lieu of requiring the open space to be set aside, with the money going into the City's Open Space Fund.

Section 4.08 states that underground utilities are required in all subdivisions unless the Commission determines an exception is warranted.

#### Inland Wetland and Watercourses Regulations

The Regulations for the Preservation of Inland Wetlands and Watercourses in the City of Groton were last amended on May 6, 2014. The regulations require a permit for certain regulated activities which take place within 200 feet of a wetland or watercourse. These regulations build on the preventative flood mitigation provided by the Zoning and Subdivision regulations by preventing fill and sedimentation that could lead to increased flood stages.

### 2.7. Critical Facilities, Sheltering Capacity, and Evacuation

The City of Groton considers several facilities to be critical to ensure that emergencies are addressed while day-to-day management of the City continues. In addition, locations with populations that may be at additional risk during an emergency are also considered to be critical. Critical facilities are presented on figures throughout this annex and summarized in Table 2-3.

*Table 2-3 City of Groton Critical Facilities*

| Facility | Address or Location | Emergency Power | Shelter | Cooling Center | In SFHA | Hurricane Surge Zone (Category #) |
|----------|---------------------|-----------------|---------|----------------|---------|-----------------------------------|
|          |                     |                 |         |                |         |                                   |

| <b>Emergency Services</b>   |  |   |   |  |   |   |
|---|--|---|---|--|---|---|
| Fire Station  | Broad Street                           | ✓ |   |  |   |   |
| Fire Station  | Benham Road                            | ✓ |   |  |   |   |
| <b>Municipal Facilities</b>                                       |  |   |   |  |   |   |
| City Hall (EOC, Police, Groton Utilities, Public Works, Shelter,) | 295 Meridian Street                    | ✓ | ✓ |  | * |   |
| Water Pollution Control Authority                                 | Thames Street                          | ✓ |   |  | ✓ | ✓ |
| Fitch High School (Shelter)                                       | Groton Long Point Road, Town of Groton | ✓ | ✓ |  |   |   |
| <b>Health Care/Senior Living</b>                                  |  |   |   |  |   |   |
| Avery Heights (Elderly Housing)                                   | 300 Brandegee Avenue                   |   |   |  |   |   |
| <b>Other Infrastructure/Facilities</b>                            |  |   |   |  |   |   |
| Pfizer  | Eastern Point Road                     | ✓ |   |  | ✓ | ✓ |
| Electric Boat   | Thames Street                          | ✓ |   |  | ✓ | ✓ |
| University of Connecticut at Avery Point                          | Shennecossett Road                     | ✓ |   |  | ✓ | ✓ |
| Bill Memorial Library   | 240 Monument Street                    |   |   |  |   |   |

\* Public Works is located within the 0.2% annual chance floodplain, but the City Hall building is not

### Municipal Complex

The Emergency Operations Center (EOC), Police Department, and Public Works (Highway) facility are all located on the same campus as the Municipal Building (City Hall) on Meridian Street. This building is also the headquarters for Groton Utilities, which provides electricity and drinking water to residents in the City and throughout the region. Groton Utilities has its own EOC to manage emergencies to its lands and infrastructure in this building. The campus is served by a generator and the City's secondary shelter is here as well. Approximately 250 people can be sheltered at this location. The EOC functions are located on the second floor of the Municipal Building to protect the EOC from nuisance basement flooding.

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 City Hall complex was addressed in this study. The assessment determined that the City Hall was not at risk to future riverine flooding but remained at risk to drainage-related flooding; and that the Public Works facility was at slight risk to riverine flooding, but the risk could increase as a result of climate change. Recommendations were offered for both facilities.

### Shelters

Fitch High School in the Town of Groton is the City's primary shelter. This facility can shelter approximately 1,260 people but is also the primary shelter for Town of Groton residents. It has a generator and is staffed by the American Red Cross.

The Groton City Hall can be utilized as a secondary shelter if needed, however, capacity is limited so this facility is not typically identified as a shelter. The Bill Memorial Library (City), the Groton Town Library, and the Senior Center (Town) can also be included as secondary shelters if needed. The Bill Library does not have backup power.

## Fire Department

The City of Groton has two fire stations located on Broad Street and Benham Road. They both have generators. The Broad Street Station underwent renovations and had a new generator installed in 2016.

## Water Pollution Control Authority

The Water Pollution Control Facility located along the Thames River is a critical facility, along with the ten or so sewer pumping stations located throughout the City. These facilities are a high priority for power restoration following any outage to prevent sewer backups.

## Private Facilities

Electric Boat, Pfizer, and the University of Connecticut Avery Point regional campus are each considered to be critical facilities. Each facility attracts a transient population in the thousands each day. Each has its own security/police detail and Electric Boat and Pfizer have their own Fire Departments. The City of Groton has mutual aid agreements with both Fire Departments. Each facility has limited backup power generation capability.

## Other Facilities

No advanced care medical facilities are located in the City. Residents of the City typically access Lawrence & Memorial Hospital in New London for advanced care needs.

Avery Heights Elderly Housing is located on Brandegee Road and provides federally subsidized, low-cost apartments to elderly and disabled residents. The facility includes 104 one-bedroom apartments.

## Marine Transportation

Two private marinas are located in the city – Pine Island and Shennecossett. The City does not consider the two private marinas to be critical facilities. No major ferries operate out of the City.

## Evacuation Routes

The Police Chief has an evacuation plan on file that considers an evacuation required because of an emergency at the Millstone Nuclear Power Plant in Waterford, a coastal flooding emergency, or a hurricane. The evacuation map includes evacuation routing connected to primary shelters in the City and the Town of Groton. Evacuation routes should not include roads that can become submerged during coastal storms and riverine flooding (See Section 4.2). Any changes in shelter status or shelter locations will necessarily require modifications to the evacuation map. In addition, any changes in routing will necessarily require modifications to the evacuation map.

## Additional Groups

In addition to City offices, The American Red Cross and the Salvation Army help provide shelter and vital services during disasters and participate in public education activities.

## Warnings and Emergency Communication

Groton City utilizes the Everbridge System as its primary method of alerting residents of impending hazard events or conditions. Information is also available through the City website and social media outlets. The Millstone Nuclear Plant emergency siren system also operates in the City and can potentially be used to warn residents.

The Everbridge System was recently updated to allow the City to notify residents if a parking ban is in place prior to a snowstorm, improving the City's ability to quickly clear streets.

The City is interested in updating and broadening its public communication capabilities.

In addition to electronic alerts, the city also has the capacity to conduct door-to-door alerts when an evacuation order is in effect. The information for evacuation and sheltering is delivered to residents, and they are also made aware of the risk of not evacuating.

## 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 City of Groton has four RL properties affected by inland flooding, and three affected by coastal flooding. All of the four inland RL properties are residential, and the total NFIP payments for these properties is \$125,781.10. Both coastal RL properties are residential. These two properties are impacted by the Eastern Point Bay and the Thames River. The previous HMP from 2017 reported four inland flooding RL properties and two residential coastal flooding RL properties. Total payments since 2017 have increased by \$788.

## 2.9. Exposure to Climate-Affected Natural Hazards

Properties, people, historic resources, and critical facilities in the City 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 City of Groton Exposure Analysis

| Hazard                          | At-Risk Parcels |        | At-Risk Facilities |        | At-Risk Historic Assets |        |
|---------------------------------|-----------------|--------|--------------------|--------|-------------------------|--------|
|                                 | Value           | Number | Value              | Number | Value                   | Number |
| <b>Hurricane/Tropical Storm</b> | \$1,554,464,260 | 2,351  | \$92,105,720       | 6      | \$151,870,670           | 216    |
| <b>Severe Thunderstorm</b>      | \$1,554,464,260 | 2,351  | \$92,105,720       | 6      | \$151,870,670           | 216    |
| <b>Severe Winter Storm</b>      | \$1,554,464,260 | 2,351  | \$92,105,720       | 6      | \$151,870,670           | 216    |
| <b>Tornado</b>                  | \$1,554,464,260 | 2,351  | \$92,105,720       | 6      | \$151,870,670           | 216    |
| <b>Drought</b>                  | \$23,199,540    | 31     | \$8,810,550        | 1      | -                       | -      |
| <b>Flood</b>                    |                 |        |                    |        |                         |        |
| 1% Annual Chance                | \$486,812,610   | 274    | \$81,262,580       | 2      | \$112,442,680           | 80     |

|                    |                 |       |              |   |               |     |
|--------------------|-----------------|-------|--------------|---|---------------|-----|
| Coastal (VE)       | \$397,967,560   | 182   | \$72,452,030 | 1 | \$104,871,480 | 58  |
| 0.2% Annual Chance | \$532,901,530   | 421   | \$85,912,190 | 3 | \$121,327,920 | 105 |
| <b>Storm Surge</b> |                 |       |              |   |               |     |
| Category 1         | \$394,349,120   | 184   | \$72,452,030 | 1 | \$101,626,280 | 55  |
| Category 2         | \$484,975,810   | 265   | \$81,262,580 | 2 | \$111,771,800 | 78  |
| Category 3         | \$497,123,960   | 310   | \$81,262,580 | 2 | \$115,158,750 | 88  |
| Category 4         | \$513,002,900   | 367   | \$81,262,580 | 2 | \$117,352,830 | 96  |
| <b>Earthquakes</b> | \$1,554,464,260 | 2,351 | \$92,105,720 | 6 | \$151,870,670 | 216 |
| <b>Wildfire</b>    | \$1,327,480     | 2     | -            | - | -             | -   |

### 2.10. Community Climate Change Challenges

As is with all of the SCCOG communities, the City of Groton 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 city, along with the hazard mitigation and climate adaptation actions that will work to address these concerns.



# Climate Change Summary Sheet for City of Groton

## What are the City's Top Climate Change Concerns?

**Flooding:** The City has several flood-related concerns including more frequent coastal road flooding, more frequent flooding in the Eastern Point Historic District, and widespread impervious surfaces that contribute to stormwater flooding.

**Extreme Heat:** The City has concerns about widespread and expansive impervious surfaces such as parking lots and roads that contribute to extreme heat risks. Locations for respite such as cooling centers are believed lacking.

**Others:** Due to its small geographic size and highly developed landscape, the City has unique opportunities to address stormwater and urban heat island challenges at the same time.

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

**Flooding:** Conduct feasibility studies for elevating Shennecossett Road, Thames Street, Eastern Point Road, and Shore Road. Develop regulations to promote home elevations in historic districts.

**Extreme Heat:** Ensure that cooling centers have appropriate access, standby power, and reliable means of public transit to utilize them. Develop an aggressive urban forestry program that will increase the density of trees throughout the City.

**Others:** Develop a green infrastructure plan and concept design for reducing the generation of stormwater in the watershed that includes Five Corners while providing co-benefits to reduce extreme heat; this plan may also include drainage improvement recommendations and heat respite.

## 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.<sup>1</sup> 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 equate to an increase in risk throughout the city, 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 0 and Section 4.2 of this annex. Wind hazards are widespread and can affect any part of the City. However, some buildings in the City are more susceptible to wind damage than others.

Tropical Storm Irene hit the City of Groton in August 2011. While trees fell throughout the City, power outages were limited to only a day or two because of the developed nature of area. Debris removal took three weeks, however, since a significant number of trees were damaged.

Still being one of the most remembered hurricane or tropical storm wind events to affect the City, Super Storm Sandy hit in October 2012. Sandy brought high winds and coastal flooding to the entire

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

Connecticut coastline. Mandatory evacuations were instituted in Groton. Power outages in some areas of the State lasted up to eight days. Groton City itself experienced only minor damage.

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. Power outages during these events, and other severe storms, were still a challenge for the city.

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 even since Hurricane 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 city ranges between 120 and 140 miles per hours. The ultimate design wind speed for the City of Groton is 128 miles per hour. Design speeds used vary 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 City of Groton 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. Utility lines are located underground in only a few areas of the City. The City has three tree wardens who can post notification and schedule tree removal. The Public Works staff also monitor trees as part of their normal rounds, and that department's budget includes money for minor tree maintenance. The City also hires outside contractors (for example, ASPLUNDH) for maintenance, especially when conditions call for a larger job, and Groton Utilities has contractors who trim feeder lines. The City is considering a City ordinance establishing a process for how to notify private property owners about dangerous trees and what their responsibilities and liability are should they fall and cause damage.

The Tree Warden coordinates tree removal and maintenance with the local power utility. In response to the major power-outages caused by Tropical Storm Irene and Hurricane 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. 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 have improved due to Eversource's liaison program.

The City of Groton receives utility service from Groton Utilities. Groton Utilities provides electric, cable and water service to the city (sanitary sewer operations fall under the jurisdiction of a separate city department). Groton Utilities has an active tree pruning program. In the case of an extended power outage, residents would be directed to the shelter at the municipal complex or to Fitch High School in the Town of Groton.

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 City 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 City to activate its EOP and encourage residents to take protective or evacuation measures if appropriate. The City is considering development of a plan to notify residents about approved areas for storage of boats during high wind events.

Prior to severe storm events, the City ensures that warning/notification systems and communication equipment are working properly and prepares for the possible evacuation of impacted areas. A procedure has been instituted to pull boats onto dry dock on land prior to the arrival of a major coastal storm. The statewide CT Alerts "Everbridge Community Notification" System can be utilized to warn coastal residents of an impending evacuation. Although hurricanes that have impacted Groton have historically passed in a day's time, 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 City increased its capabilities slightly in response to the damage from Tropical Storm Irene in 2011 and Hurricane Sandy in 2012 and has maintained that higher level of operation.

### 3.2.3 Vulnerabilities and Risk Assessment

The entire City 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 0) 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 City had very limited outages during Irene and Alfred as Groton Utilities continued to deliver power.

Direct wind damage to newer buildings from hurricane or tropical storm-level winds is rare in the City since the new buildings were constructed to meet or exceed current building codes. Many buildings in the City were built in the 1960s and 1970s and do not meet current building codes. Older buildings in the City are particularly susceptible to roof and window damage from high wind events, although this risk will be reduced with time as these buildings are replaced with buildings that meet current codes.

The strength of a large hurricane could cause a significant economic impact to the City. The potential economic effect of wind damage to SCSOG was evaluated in the Multi-Jurisdictional HMP. A separate analysis was not performed specifically for the City of Groton.

#### 3.2.3.1 Hazard Losses

The City of Groton did not receive FEMA PA reimbursements in the wake of Tropical Storm Isaias. Since 2012, the city has received \$485,472 in FEMA PA funds for project costs of \$575,295. This was all received for Hurricane Sandy. These funds were received for debris removal, power restoration efforts, emergency protective measures, and road, utility and other miscellaneous repairs.

FEMA HAZUS-MH 6.0 was used to develop losses associated with seven probabilistic hurricane scenarios from the 10 year to 1,000 year return period. Losses include economic loss, building damages, debris, and sheltering needs. Table 3-1 through Table 3-3 presents hurricane related damages for the City of Groton. Additional HAZUS-generated losses for the city and region can be found in the Multi-Jurisdictional document.

Downscaled tropical storm losses based on the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document.

Table 3-1 HAZUS-MH Hurricane Related Economic Impacts

| Groton City | Return Period | Residential  | Commercial  | Industrial  | Others      | Total        |
|-------------|---------------|--------------|-------------|-------------|-------------|--------------|
|             | 10-year       | \$139,380    | \$1,620     | \$400       | \$290       | \$141,690    |
|             | 20-year       | \$2,224,550  | \$81,320    | \$11,950    | \$20,180    | \$2,338,000  |
|             | 50-year       | \$13,408,170 | \$1,395,770 | \$313,770   | \$527,060   | \$15,644,770 |
|             | 100-year      | \$30,173,410 | \$4,479,870 | \$1,324,650 | \$1,725,730 | \$37,703,660 |
|             | 200-year      | \$55,867,000 | \$9,950,550 | \$3,193,150 | \$3,689,620 | \$72,700,320 |

|  |            |               |              |              |              |               |
|--|------------|---------------|--------------|--------------|--------------|---------------|
|  | 500-year   | \$107,119,090 | \$24,185,750 | \$7,323,080  | \$7,931,310  | \$146,559,230 |
|  | 1,000-year | \$146,942,310 | \$33,926,040 | \$10,855,840 | \$11,304,870 | \$203,029,060 |

Table 3-2 HAZUS-MH Hurricane Related Building Damage

| Groton City | Return Period | Minor | Moderate | Severe | Destruction | Total |
|-------------|---------------|-------|----------|--------|-------------|-------|
|             | 10-year       | 3     | 0        | 0      | 0           | 3     |
|             | 20-year       | 25    | 2        | 0      | 0           | 27    |
|             | 50-year       | 215   | 37       | 1      | 0           | 253   |
|             | 100-year      | 439   | 113      | 8      | 3           | 563   |
|             | 200-year      | 637   | 224      | 24     | 11          | 896   |
|             | 500-year      | 790   | 392      | 73     | 33          | 1,288 |
|             | 1,000-year    | 825   | 480      | 113    | 55          | 1,473 |

Table 3-3 HAZUS-MH Hurricane Related Debris and Sheltering Needs

| Groton City | Return Period | Debris Generated (Tons) | Households Displaced | Individuals Seeking Temporary Shelter |
|-------------|---------------|-------------------------|----------------------|---------------------------------------|
|             | 10-year       | 14                      | 0                    | 0                                     |
|             | 20-year       | 301                     | 0                    | 0                                     |
|             | 50-year       | 1,981                   | 2                    | 1                                     |
|             | 100-year      | 4,045                   | 10                   | 4                                     |
|             | 200-year      | 6,665                   | 31                   | 13                                    |
|             | 500-year      | 11,248                  | 108                  | 58                                    |
|             | 1,000-year    | 14,369                  | 193                  | 108                                   |

### 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 City. 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 City without harming another. Such storms occur in the City each year, although hail and direct lightning strikes to the City are rarer. No tornadoes have occurred in the City since the last HMP, although a funnel cloud was spotted on August 5, 2010, near Electric Boat in the City of Groton as reported to the NCDRC. The NCDRC also reported that strong straight-line thunderstorm winds overturned a boat at Eastern Point on July 31, 2009, causing minor damage.

Other recent severe storm events include:

- On September 6, 2017, a cold front triggered severe storms in the 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 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 City 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 City 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 City as explained in Section 0 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 City are equally likely to experience the effects of

summer storms. The density of damage is expected to be greater near the more densely populated area of the City.

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 are 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 City's strong fire response.

Lightning and hail are generally associated with severe thunderstorms and can produce damaging effects. All areas of the City 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 City. 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 City exists, it is considered to be an event with a very low probability of occurrence.

#### *3.3.3.1 Hazard Losses*

Since 2017, there has been one NOAA reported event associated with a severe thunderstorm and wind event. On September 6, 2017, a passing cold front which triggered severe thunderstorms cause downed trees in the city. A tree fell into a building on Crouch Street, there were several trees reportedly down across Eastern Point Road, and a utility pole and wires down on Thames Street. A reported \$10,000 in damages resulted from this event. 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 City. 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 City. Winter storms and nor'easters have affected the City since the last HMP, but the storms during the winter of 2010-2011 had a memorable, significant effect.

Some of the more recent significant winter 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 by 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 0 and 3.3. 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. The City informs residents of impending parking bans through its Everbridge system, allowing for more rapid road clearing.

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 City staff, as parking lots and roadways need constant maintenance during storms. The Public Works Department oversees snow removal in the City. Salt and sand are stored at the Public Works facility. The City has established plowing routes that prioritize access to and from critical facilities. The Connecticut Department of Transportation plows Route 349 and Interstate 95.

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 City did not have snowload problems during the winter of 2010-2011, although some residents shoveled roofs.

#### 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 City 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. 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.

The majority of City buildings are recently constructed and therefore not susceptible to damage from heavy snow. While some City buildings could be susceptible to heavy snow loads, they will be cleared quickly if safety is a concern. Many buildings in the City have flat roofs which are more susceptible to damage from heavy snow than sloped roofs.

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

#### *3.4.3.1 Hazard Losses*

There have been no reported winter storm losses for the City of Groton since 2017. In the past decade, the city has received FEMA PA funds in the amount of \$180,843 for winter storms. 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 (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).

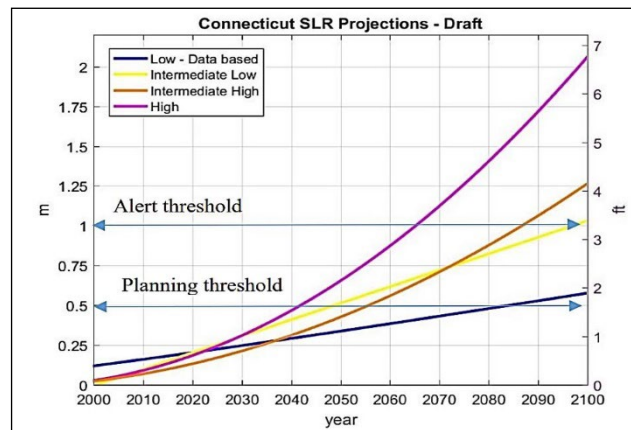


Figure 4-1 Four Localized Sea Level Rise Scenarios for Connecticut

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 shorefront of the City of Groton contains developed shorefront along the Thames River, areas of rocky shorefront and modified bluffs and escarpments near Eastern Point, Avery Point, and Jupiter Point, and beaches and dunes at Shennecossett Beach. The mapped islands include the uninhabited Pine Island (surrounded by rocky shorefront and a small beach and dune area) and Hobs Island that has one structure and is surrounded by rocky shorefront. In addition, the lower section of Birch Plain Creek is a State-regulated tidal wetland area, and Bakers Cove is an estuarine embayment (defined as a protected coastal water body with a direct connection to Fishers Island Sound). The coastal resources found in Connecticut and described by DEEP can be found in the Multi-Jurisdictional HMCAP.

Homes, businesses, and industry are located in close proximity to the coastline along the Thames River and Fishers Island Sound. Structures and infrastructure in the southern section of the City 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 impact structures.

Primarily, roadway closures have occurred due to coastal flooding. Only a few structures are known to have received damage by coastal floodwaters. However, the City is also concerned with the potential long-term effects of sea level rise and its potential to exacerbate flooding conditions in the future.

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, just offshore from the City's waterfront, was reportedly the sixth highest on record. Numerous roads and structures experienced flooding in coastal southeastern Connecticut, including roads in the City of Groton.

#### 4.2.2 Existing Capabilities

The City primarily attempts to mitigate coastal flood damage and flood hazards by controlling and restricting activities in floodprone areas, encouraging the elevation of homes and roadways, maintaining hard structures in good condition, and providing signage and warning systems. Many of the Existing Capabilities utilized in the City for inland flood mitigation (Section 0) are also applicable to coastal flood mitigation.

As noted in Section 0 and Section 2.6, the City 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 and the Subdivision Regulations, building activities in these areas are restricted and new construction or substantial redevelopment must ensure that the lowest horizontal member of the new construction will be at least one foot above the base flood elevation. The Planning and Zoning Commission, Planning Department, and the Zoning and Building Department are all required to review and approve portions of applications that involve structures within FEMA Special Flood Hazard Areas.

The City has conducted outreach to residents about flood mitigation but residents. In addition, the City has attempted to streamline floodplain restrictions in its regulations through its recent amendments to the Zoning Regulations, and through planning guidelines in the 2019 *Plan of Conservation and Development*. Recommendations from the Plan of Conservation and Development pertinent to coastal mitigation include:

- Continue to manage water-dependent industries/uses.
- Support improvements by maritime operations provided that negative impacts to local residents and businesses are minimized.
- Consider increasing regulatory standards relative to construction in vulnerable areas.

As explained elsewhere in this HMP, 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 City of Groton utilizes these warnings and forecasts to prepare emergency responders for flooding events.

Although the City of Groton lacks inland flood control structures such as dams and channelized sections of rivers, the shoreline of Groton contains many coastal flood control structures. Small, private seawalls

and bulkheads can be found in many of the residentially developed coastal neighborhoods such as on Jupiter Point. Larger seawall structures are associated with the University of Connecticut Avery Point Campus, groins along the privately-owned Shennecossett Beach, the seawall along Eastern Point, and the large stone riprap located along Pfizer. Electric Boat also has a variety of seawalls. 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.

The City of Groton has identified several secondary roads in the Eastern Point and Jupiter Point areas that can serve as alternate evacuation routes for these areas should main access roads be flooded during major storms. Mitchell Street is the primary evacuation route, and Tyler Avenue is the secondary route.

Like many communities, the City lacks existing policies and mitigation measures that are specifically designed to address sea level rise. The City participated in a resiliency planning initiative with SCCOG and TNC in 2016-2017<sup>2</sup>. However, the City has not yet embarked on detailed coastal hazard planning to the degree that nearby communities like Waterford and the Town of Groton have done. Although the City of Groton does not currently have a specific plan to address sea level rise, important pieces are in place in the form of the codes and regulations cited in this HMP that have been enacted to minimize storm, erosion, and flood damage.

As explained in Section 2 of the regional part of this multi-jurisdiction hazard mitigation plan, 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 City of Groton 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 practice 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 somewhat since the 2017 edition of the hazard mitigation plan was adopted. This is because the City has included coastal issues into the

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

2019 POCD and developed the Community Resilience Plan which addresses sea level rise and coastal flooding.

#### 4.2.3 Vulnerabilities and Risk Assessment

This section discusses specific areas at risk of coastal flooding within the City. 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 many roads and neighborhoods, potentially cause severe damage, and impede transportation in the City. Refer to **Error! Reference source not found.** for a depiction of areas susceptible to coastal flooding, and Figure 4-3 for areas susceptible to 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 City. The distribution of flood vulnerability throughout the community can be seen in Figure 4-2. The CCVI demonstrates that flood vulnerability in the city ranges from moderate to high. Most of the vulnerability score is due to coastal flood exposure.

##### Vulnerability Analysis of Areas along Coastal Waters

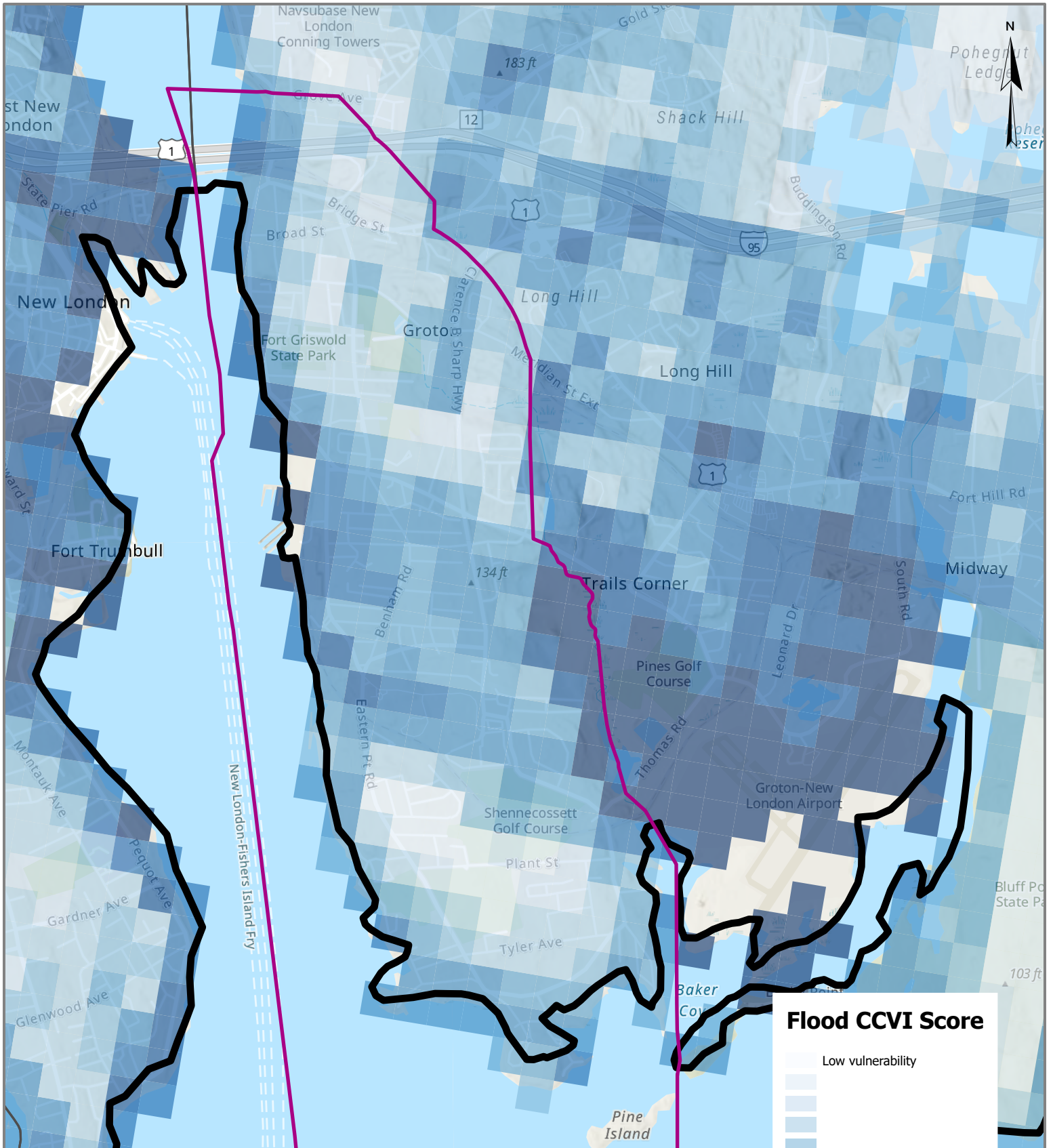
The low-lying shoreline areas of the city are subject to periodic flooding. Tidally influenced flooding also occurs along Birch Plain Creek and the Thames River. FEMA has defined 1% annual chance and 0.2% annual chance floodplains associated with coastal flooding, as well as 1% annual chance floodplains with wave velocity for the City.

The southern portion of the city is exposed to the wave action from Fishers Island Sound. An additional concern for this area of the City is that the primary roadways flood before structures are affected, making subsequent evacuation very difficult. The City of Groton has identified several roads in the Eastern Point and Jupiter Point areas that could potentially flood during major storms. These roads include the southern section of Eastern Point Road (Route 349) and Thomas Road. City officials have identified Mitchell Street and Tyler Avenue as alternate evacuation routes.

Residences are heavily concentrated along the coastline in the Jupiter Point neighborhood and located within velocity zone from Fishers Island Sound. During major storms or hurricanes these areas are also very susceptible to flooding and damage from wave action. Inland areas in this neighborhood are also located in the 1% annual chance floodplain. This area has experienced the most damage from coastal flooding in the past. Road closures from coastal flooding and poor drainage in this area occur at Jupiter Point Road and Pine Island Road, as well as on Bayberry Lane. City officials have expressed a need to improve drainage structures in the vicinity of Bayberry Lane, Jupiter Point Road, and Pine Island Road in order to prevent property and roadway damage.

Avery Point, located to the west of Jupiter Point, is a busy area where the University of Connecticut's regional campus is located. Most structures located at the Avery Point campus are above the base flood elevation; however, as noted above two sections of Shennecossett Road in the vicinity of the campus are at risk of being impassable during a major flood event. Therefore, these two sections in the flood



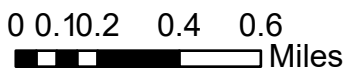


## Flood CCVI Score

SCCOG Hazard Mitigation and Climate Adaptation Plan

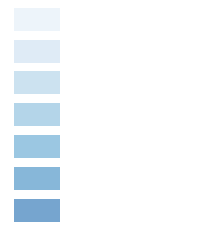
City of Groton

1/17/2023



## Flood CCVI Score

Low vulnerability



High vulnerability

City of Groton Boundaries

Esri, NASA, NGA, USGS, FEMA, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS,

zone could restrict emergency access to, and egress from, the Avery Point campus during an emergency. The city believes some of this flooding is attributed to drainage issues and restricted tidal flow. There are reportedly multiple connected waterways underneath Shennecossett and adjacent roadways that are crucial for allowing high tide and storm surge to flow. This area could benefit from a drainage study to better understand the flow dynamics during coastal flood events.

Homes in the vicinity of Eastern Point are also within the 1% annual chance floodplain, but they are protected from velocity action by the seawalls in the area. Roadways in this area flood prior to structures typically being affected, notably Shore Avenue, South Prospect Street, Tyler Avenue, Beach Pond Road, and Thomas Road. Water is generally a foot deep, and some vehicles can pass through, but evacuation would be difficult during a 1% annual chance flood event when depths of water could be significantly greater.

More specifically, Shore Avenue is flooded during extreme high tides partially exacerbated by drainage from the upstream golf course (as noted in Section 0). Tide gates on drainage pipes below Shore Avenue have been updated within the past decade; however, these alone are not able to mitigate flooding due to high tide and storm surge. There is also concern over the sea wall on Shore Avenue as there are vulnerable utilities protected by the wall. There is a 15" force main, gravity sewer mains, and a water main underneath the road. If the road or wall were to fail, there could be upwards of 1,000 gallons per minute of sewage flowing into the sound. The city is working to repair the wall to minimized impacts and failure.

A portion of Beach Pond Road in the Eastern Point area has been elevated due to the roadway repeatedly flooding; however, coastal flooding still occurs in the area away from the elevated portion of the road. A malfunctioning backwater valve is suspected to be exacerbating flooding conditions in the area. South Prospect Street is a dead-end road that is also often flooded during regular high tides and the road becomes impassable.

Upstream on the Thames River, both Pfizer and Electric Boat have areas located within the 1% annual chance floodplain, although only Electric Boat appears to have infrastructure located within velocity zones. Additional areas off of Thames Street moving north towards Interstate 95 are also within the velocity zone, with other areas within the 1% annual chance floodplain. In general, the floodplain in this area does not extend east of Thames Street.

A few homes are located along Paul Revere Road and Nathan Hale Road that are located within the 1% annual chance floodplain of the tidally influenced section of Birch Plain Creek. While the connecting road (Madison Place) could be inundated, evacuation is uphill and to the west via either road and therefore not an issue in this area.

One roadway structure of concern near Jupiter Point and Baker Cove is the Thomas Road viaduct. Drainage structures in this area are old and need repair and are supposed to be maintained by the railroad company. In particular, the City notes the drainage system from Kamaha Street that flows beneath the railroad tracks to be a "structure of concern". Thomas Road is a primary thoroughfare into the Town of Groton and could be compromised during a major storm event since it lies below the base flood elevation of Birch Plain Creek. The railroad bridge located downstream is also potentially in need



of repairs. The railroad company should be encouraged to inspect, clear, and maintain this area regularly. While improvements in this area could improve egress and evacuation capability during flooding events less than the 1% annual chance flood event, the entire Thomas Road area in the Town of Groton would be impassable during a 1% annual chance coastal flood since it is all mapped floodplain. Thus, emergency evacuation improvements in this area should not be prioritized.

There are roads throughout these at-risk areas that the city would like to see elevated, however there is always concern about creating a “bowl effect” for the adjacent properties. Some of the roads that may need to be elevated have also been identified in the Community Resilience Plan. They include:

- Shennecossett Road
- Jupiter Point Road
- Pine Island Road
- Thames Street
- Eastern Point Road
- Shore Road

Areas of storm surge are generally coincident with the areas of coastal flooding described above. However, the areas affected by storm surge are predicted to be more widespread than the 0.2% annual chance floodplain for Category Two hurricanes, with stronger hurricanes pushing storm surge even further inland. Areas along the Thames River such as Electric Boat and Pfizer appear to be at particular risk, while storm surge presses north to the vicinity of Tyler Avenue from Fishers Island Sound in the southern part of the City. The timing of evacuations from the southern part of the City prior to a hurricane event are therefore very important as the majority of the roads in this area will be flooded or washed out by a major hurricane.

#### Vulnerability Analysis of Private Properties

The coastal areas of the City of Groton 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 City of Groton's shoreline.

Buildings located in flood hazard areas are primarily residential but also include some commercial, industrial, 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.

Three coastal repetitive loss properties are located in the City of Groton, a decrease of one as reported in 2017. Three are associated with coastal flooding in the Thames River and the Eastern Point areas. As stated above, coastal flooding is a particular concern in these areas because these areas are low-lying and existing drainage systems do not operate effectively. The City 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 HMCAP will likely help many of these property owners.

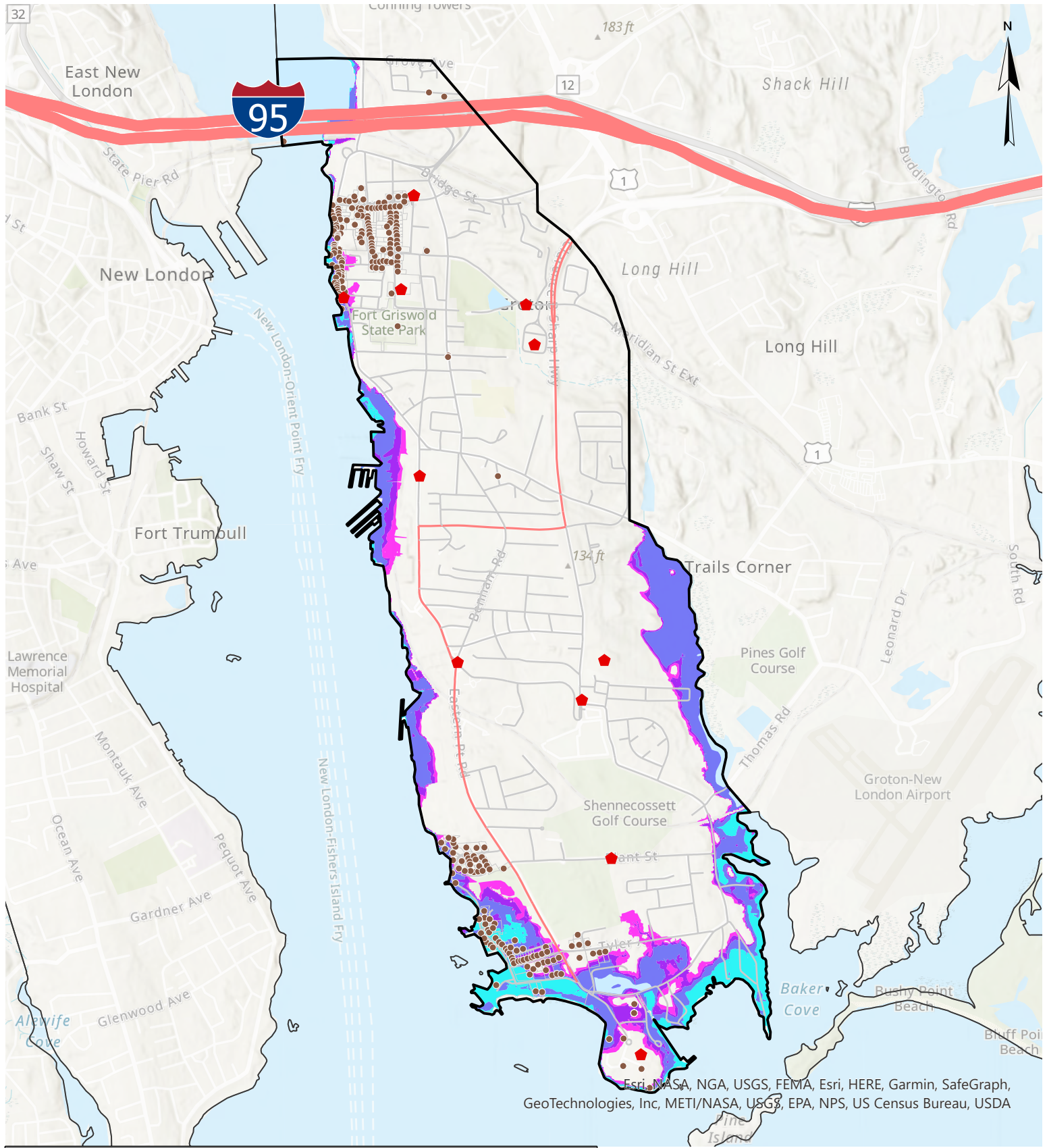
Jupiter Point, which is a highly populated area along the shore of Fishers Island Sound, is located to the east of Avery Point with Baker Cove bordering the eastern shoreline. Jupiter Point has many areas in the flood zone with structures that are susceptible to flooding including Pine Island Road, Jupiter Point Road, along Baker Cove, and Shennecossett Road near the intersection of Plant Street. Eastern Point also has a notable concentration of residential development in the flood zone. Roads with residential development in this area include Shore Avenue, Tyler Avenue, and Beach Pond Road. Several houses on Beach Pond Road are also in the flood zone.

The City of Groton 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. City planners should use the recently released DFIRM to identify the approximately 205 structures in the City that are located in the 1% annual chance floodplain (with and without wave velocity). This could provide a list of areas to inspect following a storm event and allow for the City to track building permits from repairs following a natural hazard. This information, in turn, would provide supporting data for future grant applications.

There are various scattered areas of commercial and industrial properties throughout the city that have been identified as being located within the 1% annual chance floodplain or the coastal velocity area and are considered to be susceptible to damage. Several of these buildings are owned by Pfizer and Electric Boat on the Thames River and include their offices of operation. Others include two marinas located between Avery Point and Jupiter Point, a few smaller buildings on the Avery Point Campus, a few non-residential buildings at Eastern Point, and several smaller commercial and industrial properties located along the Thames River upstream from Electric Boat.

#### Vulnerability Analysis of Critical Facilities

As shown on Table 2-3, critical facilities located within the 1% annual chance floodplain include the City's wastewater treatment facility on the Thames River and portions of the Electric Boat, Pfizer, and Avery Point campuses as described above. No additional facilities are located in hurricane storm surge zones as shown on Figure 4-3.





Esri, NASA, NGA, USGS, FEMA, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA

**Hurricane Storm Surge Inundation Areas**

SCCOG Hazard Mitigation and Climate Adaptation Plan  
 City of Groton  
 Date: 8/3/2022

0 0.15 0.3 0.45 0.6 Miles

**Legend**

- Historic Resources
- ⬠ Critical Facilities

**Hurricane Category**

- 1
- 2
- 3
- 4

#### 4.2.3.1 Hazard Losses

There are no reported losses for the City of Groton related to coastal flooding. As of June 30, 2022, the NFIP statistics show the City of Groton has had a total of 79 flood related losses, with a total of \$1,016,624 paid towards the claims to date. It is assumed that many of these are coastal claims given the communities proximity to the shoreline, and the absence of numerous inland watercourses.

Table 4-1 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 4-1 HAZUS-MH Coastal Flood Related Economic Impacts

| Groton City                  | 2022 Results        |                     |                    |                     |                      |
|------------------------------|---------------------|---------------------|--------------------|---------------------|----------------------|
|                              | Residential         | Commercial          | Industrial         | Other               | Total                |
| <b>Direct</b>                |                     |                     |                    |                     |                      |
| Building                     | \$7,600,000         | \$5,400,000         | \$590,000          | \$430,000           | \$14,020,000         |
| Contents                     | \$5,550,000         | \$18,390,000        | \$1,690,000        | \$3,010,000         | \$28,640,000         |
| Inventory                    | \$0                 | \$500,000           | \$220,000          | \$130,000           | \$850,000            |
| Subtotal                     | \$13,150,000        | \$24,290,000        | \$2,500,000        | \$3,570,000         | \$43,510,000         |
| <b>Business Interruption</b> |                     |                     |                    |                     |                      |
| Income                       | \$270,000           | \$14,150,000        | \$50,000           | \$2,110,000         | \$16,580,000         |
| Relocation                   | \$1,810,000         | \$4,740,000         | \$80,000           | \$900,000           | \$7,530,000          |
| Rental Income                | \$1,870,000         | \$3,540,000         | \$20,000           | \$130,000           | \$5,560,000          |
| Wage                         | \$650,000           | \$21,500,000        | \$80,000           | \$9,300,000         | \$31,530,000         |
| Subtotal                     | \$4,600,000         | \$43,930,000        | \$230,000          | \$12,440,000        | \$61,200,000         |
| <b>TOTAL</b>                 | <b>\$17,750,000</b> | <b>\$68,220,000</b> | <b>\$2,730,000</b> | <b>\$16,010,000</b> | <b>\$104,710,000</b> |

### 4.3. Shoreline Change

#### 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

As discussed in Section 4.2.2, the city works to regulate and minimize development and activities in the areas that are prone to coastal flooding. By reducing activity in these areas, less disruption occurs to the

existing environment and therefore potentially reducing future erosion and change. While not all erosions and shoreline change can be prevented, the city does work to mitigate excessive incidents. The recent Community Resilience Plan is one example of how the city is continuously working to develop with coastal hazards in mind.

#### 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 City will increase, with structures and roadways closest to existing sea level being affected more quickly. In addition, tidal marsh areas along Birch Plain Creek will either migrate inland or be eroded by constant inundation.

Currently, coastal erosion is generally not an issue in the City of Groton since the majority of the shorefront is either developed (particularly along the industrial areas of the Thames River), rocky shorefronts consisting of stones and boulders, or modified bluffs and escarpments consisting of seawalls, bulkheads, or revetments. Shennecossett Beach is susceptible to coastal erosion but is protected by groins such that erosion has not been a major issue. However, as sea level rises, the effectiveness of these structures will be undermined such that erosion will be able to occur landward of the walls necessitating expansion of the structures.

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 City of Groton related to shoreline change. Despite the record of past events, shoreline changes losses such as coastal erosion are difficult to quantify because they are not reported via the tools typically reviewed for plan updates such as the NCEI Severe Storm database and the NFIP. Shoreline change losses are not quantified in the 2019 Connecticut Natural Hazard Mitigation Plan.

One measure of shoreline change loss is the total unmet need associated with living shoreline project costs, beach nourishment, and coastal hardening. The City of Groton, as noted in Table 8-1 and in the Community Resilience Plan, is currently evaluating the needs along Shore Avenue as the seawall has slowly eroded and is need of repair to protect sewer mains. The city is anticipating a project cost of at least \$500,000 to \$1 million to protect the roadway and underlying infrastructure.

## 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, damage 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 watercourses in the City. The primary inland flooding problem is due to drainage issues on the western side of the City. Such flooding occurs at least twice per year and is associated with heavy rainfall overwhelming drainage systems. Recent examples include the March 2010 and March 2011 heavy rainfall and associated flooding. On July 4, 2014, as a cold front slowly moved across the area, moisture from Tropical Cyclone Arthur passing to the south and east converged along the boundary resulting in heavy rain and isolated flash flooding. A vehicle became trapped after four feet of water accumulated at the intersection of Thames Street and Eastern Point Road in Groton.

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 funding for the event. Neighboring Norwich received 4.85 inches of rainfall and Lebanon had a reported 6.79 inches.

In 2019 a heavy rainstorm caused a roadway and retaining wall to fail which effectively close the roadway and impacted Electric Boat. This occurred along Thames Street because of poor drainage in the Five Corners area.

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.



After a period of prolonged drought, a severe rainstorm event on September 5/6, 2022, caused flooding in some areas of region. Nearby 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.

### 5.2.2 Existing Capabilities

The City attempts to mitigate inland flood damage and flood hazards by utilizing a wide range of measures including restricting activities in floodprone areas, replacing bridges and culverts, promoting flood insurance, maintaining drainage systems, through education and outreach, and by utilizing warning systems.

As noted in Section 2.5, the Zoning and Subdivision Regulations of the City of Groton, updated most recently in September 2020, restrict development and require mitigation for projects constructed within the 1% annual chance floodplains as defined by FEMA. These updated regulations were reviewed and approved by the Connecticut State Floodplain Manager.

Special Flood Hazard Areas are delineated on the DFIRM published with the Flood Insurance Study for New London County that was released on August 5, 2013. Though there is an update Flood Insurance Study for the region which was published on April 3, 2020. Most of the SFHAs mapped by FEMA in the City of Groton do not appear to be associated with a watercourse and thus are more closely related to coastal flooding (Section 4.2). Birch Plain Creek is the only notable exception on the eastern edge of the City.

Public Works cleans and inspects catch basins and culverts at least annually or more often if problems are noted. The Civil Preparedness Director, Fire Department, and Police 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 inland flooding occurs, the Public Works department or the Fire Department would handle the complaints depending on the location.

The City of Groton completed the "John Street Drainage Study" with the goal of dividing the storm drainage that runs along John Street and Thames Street. This area has a recurring drainage problem (see below). This project was completed in summer 2012 and directs the flow of water into the Thames River to avoid flooding of Thames Street, Eastern Point Road, Mitchell Street, and John Street. Municipal staff report that this project has successfully decreased the frequency and severity of flooding in that area, but the drainage system is sometimes overwhelmed.

The city has been actively pursuing the expansion and development of an open space corridor along Birch Plain Creek to allow for open space along the creek, to connect the Groton Estates to the existing trail, and to promote park usage by city residents.

### Summary

In general, municipal capabilities to mitigate flood damage have increased slightly since the 2017 edition of the hazard mitigation plan was adopted. This is because the city is preparing and planning for future flooding by way of the Community Resilience Plan and the POCD. . City personnel have participated in

events of the Connecticut Association of Flood Managers in recent years and should continue to do so when time allows.

### 5.2.3 Vulnerabilities and Risk Assessment

This section discusses specific areas at risk of inland flooding within the City. Areas at risk from coastal flooding are discussed in Section 4.2 of this annex. Inland flooding due to poor drainage is the most common type of flooding experienced by the City. City staff cite undersized drainage infrastructure as a common challenge.

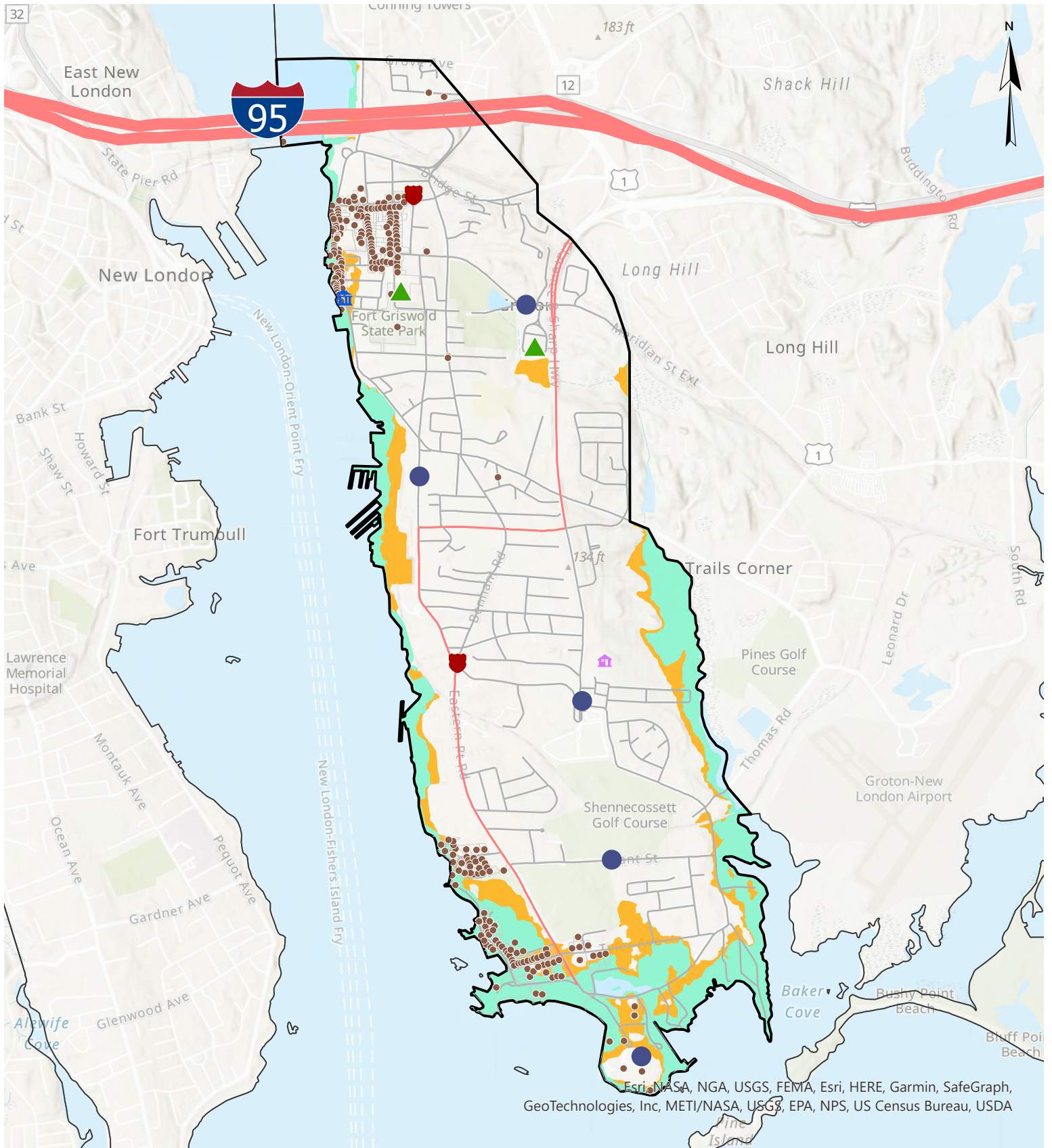
#### Vulnerability Analysis of Areas Along Watercourses

The major inland watercourse in the City of Groton is Birch Plain Creek on the eastern side of the City. This creek drains from the vicinity of the Interstate 95 past the municipal complex and then east into the Town of Groton. The watercourse re-enters the City of Groton at Poquonnock Road and forms the eastern boundary of the City until its confluence with Bakers Cove. Four homes are located within the 1% annual chance floodplain of Birch Plain Creek on Paul Revere Road, Madison Place, and Nathan Hale Road. An additional property on Thomas Road and a pump station are also in the 1% annual chance floodplain (refer to Figure 4-1 in the next Section). The city noted that the Creek is beginning to succumb to sedimentation at Thomas Road and under a railroad bridge; this will likely need to be addressed in the near future to ensure tidal flow is not impeded.

As stated in Section 5.4, a dam formerly owned by Electric Boat was removed by the State upstream of Poquonnock Road on Birch Plain Creek. The removal of the dam has increased the frequency of flooding on Poquonnock Road and along Birch Plain Creek. The State should be encouraged to clean, repair, and correct, as needed, the drainage across Poquonnock Road from the dam site in accordance with the approved plan to breach the dam.

In addition, many of the City's drainage systems are equipped with flapper valves near the shoreline. These valves allow water to pass in the downstream direction but close when tidal flow moves upstream. Many of the valves in the City are old and require repair or replacement to prevent exacerbating backwater flooding. A number of these valves along Shore Avenue have been updated since the previous HMP.





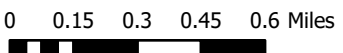
Esri, NASA, NGA, USGS, FEMA, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA

### Critical Facilities and Historic Resources with Flood Zones

#### SCCOG Hazard Mitigation and Climate Adaptation Plan

City of Groton

Date: 8/1/2022



### Legend

- Historic Resources
- 🏠 Senior Housing
- 🛑 Emergency Services
- 🏛️ Municipal
- Other Infrastructure and Facilities
- ▲ Shelter or Cooling Center
- 1% Annual Chance Flood Hazard Area
- .2% Annual Chance Flood Hazard Area
- 🌊 Floodway

## Vulnerability Analysis of Private Properties

In terms of inland flooding, very few structures are regularly affected in the City. Four repetitive loss properties are located in the City of Groton that are classified as being impacted by inland flooding. One of the repetitive loss properties is located slightly inland and may be affected by poor drainage flooding, since it is not near a watercourse.

City officials have indicated that the most frequent flooding issue occurs on Thames Street in the vicinity of Smith Street and John Street. City staff report that flooding begins near the Sacred Heart School and flows downhill along the road. The City (through GEI Consultants, Inc.) completed a drainage evaluation in 2004 that indicated that the storm drainage in this area could not pass a 10-year storm event without backing up. Drainage from this area (the roads and the Eastern Point Road parking lots) reportedly enters a vault and then makes a 90-degree turn and is funneled through pipes under the EB campus.

Heavy flows cannot be conveyed effectively by the 90-degree turn in the system. A project completed in 2012 has helped improve drainage capacity on this road.

Nearby Smith and John Street, the Five Corners still face drainage problems. The intersection of Poquonnock Road, Mitchell Street, Chicago Avenue, and Benham Road often floods during heavy rain events. The city has noted that there is a 42" drainage pipe just south of this location that is never more than half full during rain events. Public works feels that there are upstream drainage constrictions that are promoting the flooding and prohibiting proper drainage. Sheet flow from the Sacre Heart School and adjacent streets plays a large role in the challenges in this area.

According to City personnel, the parking areas at the Electric Boat facility near Thames Street have been repaved without comprehensive consideration to drainage impacts. This has exacerbated the effects of flooding from the inadequate existing storm drainage system components in this area. This flooding has posed a significant hazard during major storm events, with flood depths of 30 inches or more on the roadway being common during heavy rainfall events. The force of water rising through the manholes removes the covers, creating a more hazardous travel situation. City officials have estimated that a fifty-inch diameter storm drainage main would be necessary in order to handle the resulting storm water discharge.

However, an ongoing concern for the City is that Electric Boat utilizes steel rods in drainage pipes for security purposes. These rods also block debris and cause clogging such that additional maintenance needs to be performed.

An additional vulnerability occurs as the result of the diversion of an intermittent waterway performed many years ago at the Shennecossett Golf Course. The drainage work was reportedly not completed as designed, resulting in occasional flooding at private properties downstream. This drainage system has been upgraded since the previous HMP, mitigating that flood risk.

In addition, Grove Avenue on the City's northern boundary has flooding issues related to poor drainage and an intermittent stream in the area. In addition, culvert repairs and cleaning are reportedly needed in the vicinity of Shennecossett Beach.

## Vulnerability Analysis of Critical Facilities

As noted in Section 2.7, the only City-owned critical facilities located within the 1% annual chance floodplain is the waste water treatment facility on the Thames River. This facility, along with Electric Boat, Pfizer, and the University of Connecticut Avery Point Campus, is affected by coastal flooding.

Critical facilities in the City do not normally have issues with inland flooding, although City personnel note that the basement of the municipal complex was flooded during heavy rains and many records were destroyed. The basement of this facility is often damp.

As noted above in the Community Profile, 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 Groton City Hall complex was addressed in this study. The assessment determined that the City Hall was not at risk to future riverine flooding but remained at risk to drainage-related flooding; and that the Public Works facility was at slight risk to riverine flooding, but the risk could increase as a result of climate change. Recommendations were offered for both facilities.

### 5.2.3.1 Hazard Losses

According to NFIP statistics, as of June 30, 2022, the City of Groton has had a total of 79 flood related losses, with a total of \$1,016,624 paid towards the claims.

Since 2017 there has also been one NOAA reported flash flood event. On July 22, 2019, a flash flood event washed away the sidewalk and portion of Thames Street in front of Electric Boat. While NOAA did not report economic impacts from this event, damages were reported.

FEMA HAZUS-MH 6.0 was used to develop losses associated with the 100-year riverine flood event. Table 5-1 presents flood related damages for the City of Groton. Given that most flood risk for the city is coastal, riverine analysis results are not as robust as the HAZUS coastal results seen in Table 4-1. Additional HAZUS-generated losses for the city and region can be found in the Multi-Jurisdictional document.

Table 5-1 HAZUS-MH Riverine Flood Related Economic Impacts

| Groton City                  | 2022 Results     |                  |                 |                  |                    |
|------------------------------|------------------|------------------|-----------------|------------------|--------------------|
|                              | Residential      | Commercial       | Industrial      | Other            | Total              |
| <b>Direct</b>                |                  |                  |                 |                  |                    |
| Building                     | \$180,000        | \$30,000         | \$0             | \$0              | \$210,000          |
| Contents                     | \$100,000        | \$50,000         | \$0             | \$0              | \$160,000          |
| Inventory                    | \$0              | \$10,000         | \$0             | \$0              | \$10,000           |
| Subtotal                     | \$280,000        | \$90,000         | \$0             | \$0              | \$380,000          |
| <b>Business Interruption</b> |                  |                  |                 |                  |                    |
| Income                       | \$0              | \$180,000        | \$0             | \$60,000         | \$250,000          |
| Relocation                   | \$100,000        | \$10,000         | \$0             | \$20,000         | \$130,000          |
| Rental Income                | \$70,000         | \$10,000         | \$0             | \$0              | \$90,000           |
| Wage                         | \$0              | \$160,000        | \$0             | \$740,000        | \$910,000          |
| Subtotal                     | \$170,000        | \$360,000        | \$10,000        | \$830,000        | \$1,370,000        |
| <b>Total</b>                 | <b>\$450,000</b> | <b>\$450,000</b> | <b>\$10,000</b> | <b>\$830,000</b> | <b>\$1,750,000</b> |

## 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 city, 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. 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 11<sup>th</sup> 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, 2022.

### 5.3.2 Existing Capabilities

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

In Section 6.13 of the zoning regulations, Historic/Institutional Adaptive Reuse, there are certain considerations taken when deciding whether the proposed redevelopment is appropriate; one of these is determining whether the water supply to the location is adequate for the reuse. While this consideration does not necessarily directly reflect drought conditions, the consideration of future water supply and demands in a redevelopment project is a critical component of resilience and adaptation.

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 City for determining drought conditions, the Connecticut Interagency Drought Workgroup (IDW) uses this and other resources to monitor drought conditions specifically for the state. The City of Groton has this IDW and state-specific drought emergency declarations as a resource to prepare for, and respond to, droughts.

### 5.3.3 Vulnerabilities and Risk Assessment

The entire city of Groton is vulnerable to drought, but the degree of vulnerability varies. There are very few, if any, properties in the city that rely on private wells for their residential or commercial drinking water. If any do still exist, these private well users may face challenges relative to water supply during periods of drought. With public water supply throughout a major of the city, residents and businesses here face challenges associated with water use conservation and restrictions during droughts.

In addition, with most urban communities that rely on agricultural communities for fresh produce, the cascading impacts of a drought may result in reduced availability for locally grown produce or rising prices due to crop loss or lower yields.

The city reportedly feels that the water supply is relatively resilient given that during recent droughts water supply was at approximately 70% while surrounding systems reported capacity as low as 40%.

#### *5.3.3.1 Hazard Losses*

There have been no reported drought losses for the City of Groton. Downscaled drought losses from the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi Jurisdiction document.

## 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. A dam failure affecting the City of Groton is considered a possible event each year although the damage would likely be minimal. No dam failures have affected the City since the time of the last HMP.

### 5.4.2 Existing Capabilities

The City of Groton has no dams known to be inventoried with the Connecticut DEEP. The Lake George Dam in the northeast section of the city formerly impounded a small water body known as Lake George in George Washington Park. The park is located on Park Avenue and Meridian Street. The park has been developed to include athletic fields, necessitating the drainage of the pond. Recently the Eastern Connecticut Conservation District was awarded a Section 319 grant to design and construct a new detention/retention pond at Lake George. The improvement of this Lake good potentially help with the flooding in the nearby City Hall basement.

Electric Boat formerly had a dam in the Town of Groton on Trails Pond, an impoundment of Birch Plain Creek. This dam has been removed and the pond drained.

Dams in the region whose failure could impact the Thames River are under the jurisdiction of the Connecticut DEEP. 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.

### Summary

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

### 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. No inventoried dams are located in the City. In addition, there are no dams in adjacent municipalities whose failure would have an effect on the city.

While dams upstream in the Thames River basin could potentially cause a rise in water levels in the Thames River if they failed, their failure is expected to have a minimal effect on the City of Groton due to the distance involved and the significant ability of Long Island Sound and the Thames River to absorb flood waters.

#### *5.4.3.1 Hazard Losses*

There are no reported losses for the City of Groton related to dam failure. Downscaled losses from the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi Jurisdiction document.



## 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.<sup>3</sup>

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 experienced 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 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 are accompanied by high humidity. A heat wave typically lasts three or more days with temperatures over 90 degrees for those days.

Since 2012, as recorded at the Norwich Public Utilities weather stations, there have been 480 days over 85 degrees, 165 of which were over 90 degree days. During the summer of 2022, there were 45 days over 85 degrees, 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  |            |
|------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
|      | <i>GNL</i> | <i>NPU</i> | <i>GNL</i> | <i>NPU</i> | <i>GNL</i> | <i>NPU</i> | <i>GNL</i> | <i>NPU</i> | <i>GNL</i> | <i>NPU</i> |
| 2017 | 85         | <b>93</b>  | 89         | <b>94</b>  | 88         | <b>92</b>  | 87         | 89         | 86         | 89         |
| 2018 | 80         | <b>91</b>  | 87         | <b>90</b>  | 89         | <b>101</b> | 91         | <b>94</b>  | 90         | 92         |
| 2019 | 83         | 85         | 88         | <b>91</b>  | 94         | <b>96</b>  | 88         | <b>91</b>  | 87         | 84         |
| 2020 | 75         | 81         | 82         | <b>91</b>  | <b>92</b>  | <b>96</b>  | 89         | <b>92</b>  | 87         | 87         |
| 2021 | 88         | 87         | 86         | <b>96</b>  | 86         | <b>94</b>  | 88         | <b>96</b>  | 82         | 85         |
| 2022 | <b>93</b>  | <b>92</b>  | 85         | <b>92</b>  | <b>91</b>  | <b>96</b>  | <b>91</b>  | <b>94</b>  | <b>94</b>  | 85         |

<sup>3</sup> <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 city monitors National Weather Service and local forecasts for anticipated extreme heat event, and also monitors for NWS heat warnings and advisories. The City of Groton has identified the Senior Center (located in the Town of Groton) for cooling. In the event of a projected heat event or heat wave, the city is prepared to inform residents of the Senior Center's use for cooling.

The city is also working to increase green cover throughout the city to help combat urban heat island effect. The Community Resilience Plan, as discussed in Section 2.6, addresses the need for extreme heat mitigation, and has identified actions and strategies to help reduce heat emissivity in the city, particularly in some of the more impervious areas.

### Summary

In general, the capabilities of mitigating extreme heat have increased since the 2017 edition of this plan as the city has developed a Community Resilience Plan which addresses extreme heat mitigation.

## 6.2.3 Vulnerabilities and Risk Assessment

While the entire city 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 city are more vulnerable to extreme heat events, particularly when in-home cooling is not available. There are also several low-income housing developments in the city that may house residents that are at greater risk of heat effects or may not have in-home cooling capabilities. Those in the city with certain health conditions may also be more vulnerable to the health factors associated with extreme temperatures.

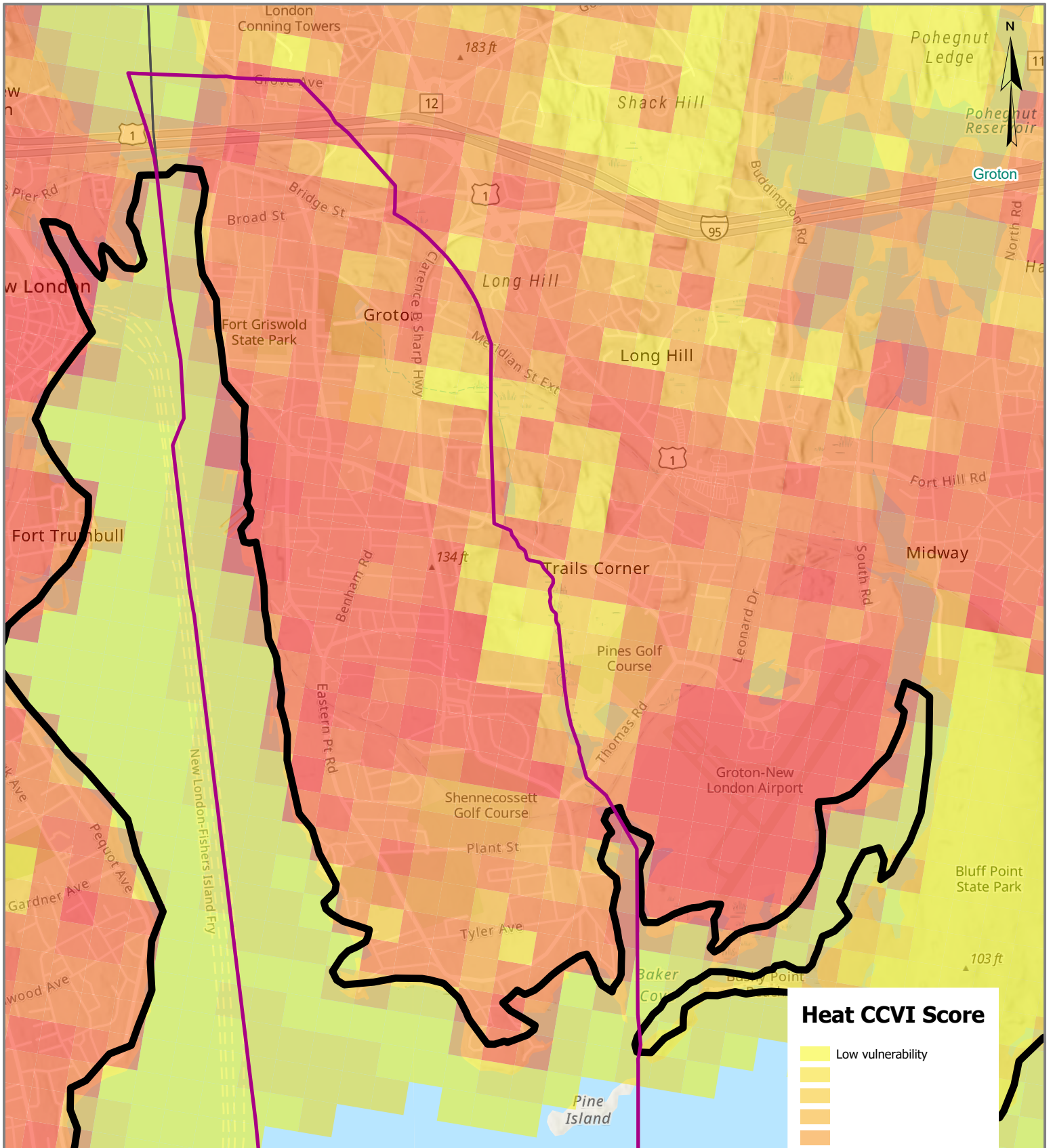
The UConn Connecticut Institute for Resilience and Climate Adaptation (CIRCA) has developed a tool to aid in understanding extreme heat vulnerability for communities across the state. This tool, known as the Climate Change Vulnerability Index (CCVI), is comprised of dozens of factors that contribute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

The City of Groton experiences high heat exposure and sensitivity, particularly along the developed Thames riverfront where there are significant expanses of impervious surfaces. Adaptive capacity is also relatively high, due to the access to water and a library that could serve as a cooling center. Therefore, the overall heat vulnerability for the City of Groton is high.

### 6.2.3.1 Hazard Losses

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



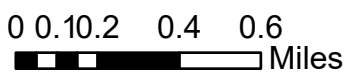


**Heat CCVI Score**

- Low vulnerability
- 
- 
- 
- 
- High vulnerability
- City of Groton Boundaries

**Heat CCVI Score**

SCCOG Hazard Mitigation and Climate Adaptation Plan  
 City of Groton  
 12/9/2022



New London-Block Island Fry  
 Esri, NASA, NGA, USGS, FEMA, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Fishers

## 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 City. Structural fires in higher density areas of the City are not directly addressed herein. No wildfires have occurred in the City since the last HMP.

### 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 City can access this information over the internet. The City 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 Fire Department goes to fires as quickly as possible in the City. Groton Utilities provides fire protection water. Fire pumps are tested and are considered to provide excellent pressure. Each hydrant is banded such that the Fire Department knows how much pressure is available. The City does not have any dry hydrants since public water service is available throughout the City.

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." Groton City has designated its Fire Chief as the 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 City.

#### 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

The risk for wildfire in the City is very low for several reasons. First, the City is mostly developed such that there are few outlying areas where a wildfire could advance undetected. As such, there have been no major fires in recent history. Secondly, all developed areas of the City have public water service provided by Groton Utilities. This public water service provides sufficient water volume and pressure to fight nearly any fire. Third, the Thames River and Fishers Island Sound are nearby if additional firefighting water was necessary. Fourth, there are few notable dead ends or one-way roads that are difficult to access in the City. Finally, the City has agreements with its neighbors to provide assistance in case of an emergency. Thus, if a wildfire did occur, it would likely be contained to within only a few acres.

#### *6.3.3.1 Hazard Losses*

There are no reported losses for the City of Groton related to wildfires. Downscaled losses from the 2019 Connecticut Natural Hazard Mitigation Plan using WUI acreage 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 Section 8 of the Multi-Jurisdictional HMP. Despite the low probability of an earthquake occurrence, earthquake damage presents a potentially catastrophic hazard to the City. However, it is very unlikely that the City would be at the epicenter of such a damaging earthquake. No major earthquakes have affected the City 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 the International Code Council. These include the seismic coefficients for building design in the City. The City has adopted these codes for new construction, and they are enforced by the Zoning and Building Department.

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

#### Summary

In general, municipal capabilities to mitigate earthquake damage have not increased since the 2012 edition of the hazard mitigation plan was adopted. This is because the hazard continues to pose a low risk of damage to the City.

#### 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, very few areas of the City are underlain by stratified drift. These areas are potentially more at risk of earthquake damage than the areas of the City 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 City 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.

No fault lines exist within or near the City of Groton. Unlike seismic activity in California, earthquakes in Connecticut are not associated with specific known active faults. In addition, 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 City primarily includes some more recent construction that is seismically designed. However, most buildings were built in the 1960s and 1970s 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 City 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. Fortunately, the City has relatively limited areas of steep slopes and the majority of developed areas have been reinforced. Thus, landslides are not a concern in the City.

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 HMCAP, dam failure has been addressed separately in Section 5.4. As noted previously, several types of utility infrastructure in the City are located above ground. A quick and coordinated response with Groton 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 City's and Groton Utilities' EOPs.

#### 7.2.4 Hazard Losses

There are no reported losses for the City of Groton 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 HMCAP. 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. Potential economic impacts can be seen in Table 7-1, with additional information developed in the Multi-Jurisdictional document.

*Table 7-1 HAZUS-MH Earthquake Related Economic Impacts*

| Groton City | Residential  | Commercial    | Industrial   | Others       | Total       |
|-------------|--------------|---------------|--------------|--------------|-------------|
|             | \$71,620,000 | \$100,790,000 | \$18,640,000 | \$26,970,000 | 218,020,000 |

## 8. Mitigation Strategies and Actions

### 8.1. Status of Mitigation Strategies and Actions

A total of 12 hazard mitigation actions were developed in the previous edition of this plan. The status of each is listed below.

| # | Mitigation Actions and Strategies for Groton City 2016 - 2021  | Status                      | Status Details   |
|---|--|-----------------------------|--|
| 1 | Incorporate the recently updated 1% annual chance and the 0.2% annual chance inland and coastal floodplains based on the current DFIRM into the CT Alerts Emergency Notification System to telephone warnings into potentially affected areas. | Remove                      | City is now using Everbridge; unknown whether CT Alerts is also in use. When there is an incoming storm and an evacuation order, the City delivers a notice door-to-door; residents can choose not to evacuate but emergency personnel may not be dispatched if residents choose to stay. It was recommended to drop this action, as the door-to-door protocol seems appropriate. City staff agrees with this recommendation. Additionally, the City participated in the DEMHS drill this week.  |
| 2 | Integrate additional elements of this HMP into the Plan of Conservation and Development during the next update of that plan.   | Complete                    | The POCD was updated in 2019; resiliency concepts were incorporated. This action is complete.  |
| 3 | Work with the Town of Groton to create an open space corridor along Birch Plain Creek (called the "Greenbreak") and add land to the existing Birch Plain Creek Park.   | Carry Forward with Revision | The City has made some progress working towards this goal, with a concept prepared in the Groton Resilience Plan earlier in 2022. The City is trying to tie this project to a larger connected trail vision and is working with Groton Estates to get a right-of-way through the estates to connect trails. Easements on private land will also be needed. Eventually the goal is to connect to city property and Washington Park. This idea was voted down once at City council but will be presented again. Birch Plain Creek is beginning to clog with sediment at Thomas Road and under the railroad bridge; this will likely need to be addressed in order to restore the tidal flow. This action should be carried forward, perhaps with adjusted wording to emphasize resilience. |
| 4 | If property owners become interested, consider elevation or acquisition of residential properties that suffer flood damage.  | Carry forward with Revision | There have reportedly been no property owners reaching out about this; Leslie notes that owning scattered excess property is not a desired outcome for the City. There is the question of whether the City should allow rebuilding of damaged properties on areas like Shore Road;   |



|   |   |                             |  |
|---|---|-----------------------------|--|
|   |   |                             | there has reportedly been no firm conclusion on this. The consultant asks whether the City would entertain accepting a FEMA grant to assist property owners; this remains a possibility. The city is looking at updating regulations for historic districts to make it easier to elevate houses.   |
| 5 | Ensure that the EOP provides up-to-date, detailed instructions regarding the timing of evacuations from the southern part of the City, since these roads will be significantly flooded or washed out by a major hurricane.            | Complete                    | The City has timelines for 72-48 hours out, 24, hours out, 12 hours out. Evacuations are sometimes broad and sometimes targeted. The City also has lists of especially vulnerable residents, such as those who require medical equipment; these are considered at the 72-hour mark. These protocols were practiced during Henri in summer 2021.  |
| 6 | Develop formalized guidance for culvert and bridge construction and replacement that requires utilization of the most up-to-date extreme rainfall data from <a href="http://precip.eas.cornell.edu">http://precip.eas.cornell.edu</a> | Carry Forward with Revision | Progress has been made. Whenever the city executes related projects, the goal is to design for the 25-year flood and/or sea level rise. An engineering study will likely be conducted in the future for specific at-risk culverts. Maybe revise to indicate a different standard than the Cornell figures that were available five years ago.  |
| 7 | Consider elevating Shennecossett Road immediately east of Avery Point above the 1% annual chance floodplain.  | Carry Forward with Revision | East of Avery Point this is a city-owned road, so this is within the city's jurisdiction. No progress or recent discussion on this has happened. There is a concern that elevating the roads might create a bowl effect for the houses along the roads. There are other roads that are lower than Shennecossett Road.<br>There are new opportunities for FEMA funding for studies that didn't exist before. The Mayor suggests adding other roadways to this action. Other mentioned roads include Jupiter Point Road, Pine Island Road. The City's new Resiliency Plan (2022) has other roads listed such as Thames Street, Eastern Point Road, Shore Road; check this plan to confirm. City staff discuss the need to develop a list of priorities.<br>The consultant suggested carrying this action forward but rewritten to instead make the goal conducting a feasibility study and including a specific list of roads or road segments. Attendees are in favor of this suggestion. |
| 8 | Repair and clean the culverts near Shennecossett Beach.   | Complete                    | Storm drains in this area have undergone some work to improve drainage and tidal flow. However, no specific culvert repair has happened,   |

|    |   |               |   |
|----|---|---------------|---|
|    |   |               | as the culverts might not be on City property. The Mayor notes that this area has multiple connected waterways that go under roads and the area is crucial for allowing room for storm surge. Action may need a drainage study or formal inventory. In other words, the intent of this action was met through maintenance, but a new action may be appropriate for further efforts.   |
| 9  | Groton City Hall: Pursue short-term recommendation that drainage improvements be designed and constructed to minimize future risks of stormwater entering the basement. | Carry Forward | There have been no structural changes to the municipal building. The Eastern CT Conservation District recently won a Section 319 grant to design and construct a new detention/retention pond at “Lake George”/Washington Park. Overflow of this area might contribute to some of the flooding in the City Hall basement, so this detention/retention project may address this concern. Ultimately basement storage at City Hall needs to be protected from flooding. |
| 10 | Groton Public Works: Pursue short-term recommendation that public works buildings be wet and dry-floodproofed.  | Carry Forward | There have been no structural changes to the public works buildings.  |
| 11 | Clearly mark Tyler Avenue as an alternate evacuation route with signage   |               | Unknown; check with Emergency Manager.  |
| 12 | Post and maintain signs signifying alternate evacuation routes from coastal areas.  |               | Unknown; check with Emergency Manager.  |

During the planning process, CIRCA and consultant staff facilitated a discussion with City staff to identify the greatest climate change concerns and challenges. The previous actions were re-evaluated in this context. Elements of six 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 City of Groton 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.

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:



- Develop formalized guidance for stormwater infrastructure, culvert, and bridge construction and replacement that requires utilization of the most up-to-date extreme rainfall data from NOAA Atlas 14 as it is updated to become NOAA Atlas 15.
- Develop a green infrastructure plan and concept design for reducing the generation of stormwater in the watershed that includes Five Corners; this plan may also include drainage improvement recommendations.

The City intends to focus on the above actions, along with the sole action about cooling centers:

- Ensure that cooling centers have appropriate access, standby power, and reliable means of public transit to utilize them.

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

Table 8-1 City of Groton 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 = |
|--------|--|---|-----------------------------------|--------------------------------------|-----------------------|--|-----------------|----------|----------------|---------------|----------------------|
| CG1    | For Groton City Hall, pursue recommendation from the Southeastern Connecticut Critical Facilities Assessment that drainage improvements be designed and constructed to minimize future risks of stormwater entering the basement.  | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.                                   | Property Protection               | Office of the Chief Elected Official | >\$1M                 | FEMA HMA; Municipal CIP Budget                                   | 7/2023 - 6/2025 | Medium   | 17             | 5             | 85                   |
| CG2    | For Groton Public Works, pursue recommendations from the Southeastern Connecticut Critical Facilities Assessment that public works buildings be wet and dry-floodproofed.  | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.                                   | Property Protection               | Public Works                         | >\$1M                 | FEMA HMA; Municipal CIP Budget                                   | 7/2023 - 6/2025 | Medium   | 18             | 6             | 108                  |
| CG3    | Ensure that cooling centers have appropriate access, standby power, and reliable means of public transit to utilize them.  | Ensure that critical facilities are resilient, with special attention to shelters and cooling centers [this action relates to objectives in the City's Community Resilience Plan] | Preparedness & Emergency Response | Office of the Chief Elected Official | \$100,000 - \$500,000 | FEMA HMA; Other Preparedness Grants; Transit District; IIJA BBFP | 7/2023 - 6/2025 | High     | 16             | 6             | 96                   |
| CG4    | Coordinate with the Southeast Area Transit District as well as the Groton public school bus program to identify gaps and opportunities for collaboration on providing access to shelters, cooling centers, and other key areas during emergency and during every-day situations. | Ensure that critical facilities are resilient, with special attention to shelters and cooling centers [this action relates to objectives in the City's Community Resilience Plan] | Preparedness & Emergency Response | Emergency Management                 | \$100,000 - \$500,000 | Transit District; Groton Public Schools                          | 7/2023 - 6/2025 | High     | 16             | 5             | 80                   |
| CG5    | Identify location for at least one new spray parks/spray pads.   | Address risks associated with extreme heat events, especially as they interact with other hazards [this action relates to objectives in   | Preparedness & Emergency Response | Recreation                           | \$100,000 - \$500,000 | Municipal CIP Budget   | 7/2023 - 6/2025 | Medium   | 15             | 2             | 30                   |

| 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 | PERISTS x STAPLEE = |
|--------|---|---|------------------------------|--------------------------------------|-----------------------|-------------------------------------|------------------|----------|---------------|---------------|---------------------|
|        |   | the City's Community Resilience Plan].  |                              |                                      |                       |                                     |                  |          |               |               |                     |
| CG6    | Work with the Town of Groton to create an open space corridor along Birch Plan Creek to increase flood capacity.  | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases the frequency and severity of floods [this action relates to objectives in the City's Community Resilience Plan]. | Natural Resources Protection | Office of the Chief Elected Official | >\$1M                 | DEEP Open Space Grants; Land Trusts | 7/2024 - 06/2028 | Low      | 19            | 2             | 38                  |
| CG7    | If property owners become interested, support the pursuit and acceptance of FEMA funding for home elevations.   | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.   | Property Protection          | Office of the Chief Elected Official | \$100,000 - \$500,000 | FEMA HMA                            | 7/2024 - 06/2028 | High     | 14            | 7             | 98                  |
| CG8    | Develop regulations to promote desired home elevations in historic districts.   | 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        | DEEP Climate Resilience Fund        | 7/2025 - 6/2026  | High     | 15            | 9             | 135                 |
| CG9    | Develop formalized guidance for stormwater infrastructure, culvert, and bridge construction and replacement that requires utilization of the most up-to-date extreme rainfall data from NOAA Atlas 14 as it is updated to become NOAA Atlas 15. | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases the frequency and severity of floods [this action relates to objectives in the City's Community Resilience Plan]. | Structural Projects          | Public Works                         | \$0 - \$10,000        | Municipal Operating Budget          | 7/2023 - 6/2024  | High     | 21            | 12            | 252                 |

| 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 | PERISTS x STAPLEE = |
|--------|--|---|-----------------------|------------------------|-----------------------|--|-----------------|----------|---------------|---------------|---------------------|
| CG10   | Develop a green infrastructure plan and concept design for reducing the generation of stormwater in the watershed that includes Five Corners; this plan may also include drainage improvement recommendations. | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases the frequency and severity of floods [this action relates to objectives in the City's Community Resilience Plan]. | Structural Projects   | Land Use Staff         | \$100,000 - \$500,000 | DEEP Climate Resilience Fund; CIRCA Resilient Connecticut; LISFF | 7/2023 - 6/2025 | High     | 23            | 9             | 207                 |
| CG11   | Conduct stormwater analysis of at least one drainage area to develop specific recommendations for modifications to the drainage system.  | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases the frequency and severity of floods [this action relates to objectives in the City's Community Resilience Plan]. | Structural Projects   | Public Works           | \$100,000 - \$500,000 | Municipal Operating Budget                                       | 7/2023 - 6/2025 | High     | 19            | 8             | 152                 |
| CG12   | Undertake at least one stormwater system capacity improvement project.   | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases the frequency and severity of floods [this action relates to objectives in the City's Community Resilience Plan]. | Structural Projects   | Public Works           | \$500,000 - \$1M      | Municipal CIP Budget   | 7/2024 - 6/2026 | Medium   | 17            | 6             | 102                 |
| CG13   | Conduct at least one community engagement event to demonstrate potential methods of reducing stormwater generation from private properties.  | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases the frequency and   | Education & Awareness | Land Use Staff         | \$0 - \$10,000        | Municipal Operating Budget                                       | 7/2023 - 6/2025 | Medium   | 16            | 6             | 96                  |

| 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 | PERISTS x STAPLEE = |
|--------|---|---|---------------------|--------------------------------------|-----------------------|----------------------------|-----------------|----------|---------------|---------------|---------------------|
|        |   | severity of floods [this action relates to objectives in the City's Community Resilience Plan].   |                     |                                      |                       |                            |                 |          |               |               |                     |
| CG14   | Evaluate feasibility of enacting a stormwater utility.  | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases the frequency and severity of floods [this action relates to objectives in the City's Community Resilience Plan]. | Structural Projects | Office of the Chief Elected Official | \$10,000 - \$25,000   | Municipal Operating Budget | 7/2023 - 6/2025 | Medium   | 18            | 7             | 126                 |
| CG15   | Identify one City-owned property and reduce the area of impervious surfaces.  | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases the frequency and severity of floods [this action relates to objectives in the City's Community Resilience Plan]. | Structural Projects | Land Use Staff                       | \$100,000 - \$500,000 | Municipal CIP Budget       | 7/2024 - 6/2026 | Medium   | 15            | 6             | 90                  |
| CG16   | Develop incentive program to encourage private property owners to convert impervious surfaces to land that generates less runoff. | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases the frequency and severity of floods [this action relates to objectives in the City's Community Resilience Plan]. | Structural Projects | Land Use Staff                       | \$0 - \$10,000        | Municipal Operating Budget | 7/2023 - 6/2025 | Medium   | 18            | 6             | 108                 |

| 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 | PERISTS x STAPLEE = |
|--------|--|---|-----------------------|------------------------|-----------------------|----------------------------|-----------------|----------|---------------|---------------|---------------------|
| CG17   | Identify one City-owned property and implement retention, detention, and infiltration techniques.  | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases the frequency and severity of floods [this action relates to objectives in the City's Community Resilience Plan]. | Structural Projects   | Public Works           | \$100,000 - \$500,000 | Municipal CIP Budget       | 7/2024 - 6/2026 | Medium   | 14            | 6             | 84                  |
| CG18   | Develop incentive program to encourage private property owners to implement retention, detention, and infiltration techniques.   | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases the frequency and severity of floods [this action relates to objectives in the City's Community Resilience Plan]. | Structural Projects   | Land Use Staff         | \$0 - \$10,000        | Municipal Operating Budget | 7/2023 - 6/2025 | Medium   | 18            | 8             | 144                 |
| CG19   | Conduct at least one community engagement event to foster awareness of extreme heat vulnerabilities. CIRCA's climate change vulnerability index (CCVI) viewer for heat vulnerability can be used as the mapping tool for this event.   | Address risks associated with extreme heat events, especially as they interact with other hazards [this action relates to objectives in the City's Community Resilience Plan].  | Education & Awareness | Land Use Staff         | \$0 - \$10,000        | Municipal Operating Budget | 7/2023 - 6/2025 | High     | 21            | 6             | 126                 |
| CG20   | Conduct at least one community engagement event to foster capacity-building for vulnerable populations through education about climate risks; and informing them of municipal, regional, and state protocols and resources, and providing technical and financial assistance to support efforts. | More than one goal [this action relates to objectives in the City's Community Resilience Plan].   | Education & Awareness | Land Use Staff         | \$0 - \$10,000        | Municipal Operating Budget | 7/2023 - 6/2025 | High     | 21            | 6             | 126                 |

| 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 | PERISTS x STAPLEE = |
|--------|---|---|------------------------|--------------------------------------|---------------------|----------------------------|------------------|----------|---------------|---------------|---------------------|
| CG21   | Develop an aggressive and forward-thinking urban forestry program that will significantly increase the density of trees throughout the City.  | More than one goal [this action relates to objectives in the City's Community Resilience Plan].   | More than one category | Office of the Chief Elected Official | \$500,000 - \$1M    | Municipal Operating Budget | 7/2023 - 6/2025  | High     | 18            | 4             | 72                  |
| CG22   | Partner with the Connecticut Green Bank to identify specific residential properties that can be retrofitted or constructed using new approaches for efficiency around cooling and reducing heat.  | Address risks associated with extreme heat events, especially as they interact with other hazards [this action relates to objectives in the City's Community Resilience Plan].  | Property Protection    | Office of the Chief Elected Official | \$500,000 - \$1M    | Connecticut Green Bank     | 7/2024 - 6/2025  | Medium   | 19            | 6             | 114                 |
| CG23   | Conduct at least one community business engagement event to foster awareness of steps to take for become more resilient by developing continuity and recovery plans and protocols, and by making changes to their operations, physical layout, and organization.  | More than one goal [this action relates to objectives in the City's Community Resilience Plan].   | Education & Awareness  | Land Use Staff                       | \$0 - \$10,000      | Municipal Operating Budget | 7/2023 - 6/2025  | Low      | 17            | 6             | 102                 |
| CG24   | Apply for funding to develop small business resiliency guidelines in southeastern Connecticut; partner with SCCOG for this purpose.   | More than one goal [this action relates to objectives in the City's Community Resilience Plan].   | Education & Awareness  | Land Use Staff                       | \$10,000 - \$25,000 | seCTer; SCCOG              | 7/2023 - 6/2025  | Medium   | 18            | 6             | 108                 |
| CG25   | Require floodplain manager and land use staff to take free training at <a href="https://portal.ct.gov/DEEP/P2/Chemical-Management-and-Climate-Resilience/Chemical-Management-and-Climate-Resilience">https://portal.ct.gov/DEEP/P2/Chemical-Management-and-Climate-Resilience/Chemical-Management-and-Climate-Resilience</a> to reduce risks of spills from businesses during floods. | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases the frequency and severity of floods [this action relates to objectives in the City's Community Resilience Plan]. | Education & Awareness  | Land Use Staff                       | \$0 - \$10,000      | Municipal Operating Budget | 7/2023 - 12/2023 | Low      | 14            | 6             | 84                  |
| CG26   | Repair seawall at Shore Avenue to protect sewer mains.  | Reduce flood and erosion risks by reducing vulnerabilities and  | Structural Projects    | Public Works                         | \$500,000 - \$1M    | CWSRF; Municipal CIP       | 7/2023 - 6/2025  | High     | 16            | 6             | 96                  |

| 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 | PERISTS x STAPLEE = |
|--------|--|---|---------------------|------------------------|----------------------|--|-----------------|----------|---------------|---------------|---------------------|
|        |  | consequences, even as climate change increases frequency and severity of floods.  |                     |                        |                      | Budget including bonds.                                    |                 |          |               |               |                     |
| CG27   | Conduct engineering studies of specific, at-risk culverts.   | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases the frequency and severity of floods [this action relates to objectives in the City's Community Resilience Plan].                 | Structural Projects | Public Works           | \$50,000 - \$100,000 | Municipal CIP Budget                                       | 7/2024 - 6/2026 | Medium   | 17            | 8             | 136                 |
| CG28   | Conduct a drainage study around Shennecossett Beach area to inventory drainage infrastructure, ownership, and need for repairs or capacity increase. | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases the frequency and severity of floods [this action relates to objectives in the City's Community Resilience Plan].                 | Structural Projects | Public Works           | \$50,000 - \$100,000 | DEEP Climate Resilience Fund; LISFF                        | 7/2024 - 6/2026 | Medium   | 16            | 4             | 64                  |
| CG29   | Conduct a feasibility study for elevating Shennecossett Road.  | 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 [this action relates to objectives in the City's Community Resilience Plan]. | Structural Projects | Public Works           | \$10,000 - \$25,000  | DEEP Climate Resilience Fund; LOTCIP; Municipal CIP Budget | 7/2024 - 6/2026 | Medium   | 20            | 5             | 100                 |
| CG30   | Conduct a feasibility study for elevating Thames Street  | Invest in resilient corridors to ensure that  | Structural Projects | Public Works           | \$10,000 - \$25,000  | DEEP Climate Resilience Fund;                              | 7/2024 - 6/2026 | Medium   | 20            | 5             | 100                 |



| 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 | PERISTS x STAPLEE = |
|--------|--|---|---------------------|------------------------|---------------------|---|-----------------|----------|---------------|---------------|---------------------|
|        |  | people and services are accessible during floods and that development along corridors is resilient over the long term [this action relates to objectives in the City's Community Resilience Plan].  |                     |                        |                     | LOTICIP; Municipal CIP Budget                               |                 |          |               |               |                     |
| CG31   | Conduct a feasibility study for elevating Eastern Point Road.            | 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 [this action relates to objectives in the City's Community Resilience Plan]. | Structural Projects | Public Works           | \$10,000 - \$25,000 | DEEP Climate Resilience Fund; LOTICIP; Municipal CIP Budget | 7/2024 - 6/2026 | Medium   | 20            | 5             | 100                 |
| CG32   | Conduct a feasibility study for elevating Shore Road.                    | 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 [this action relates to objectives in the City's Community Resilience Plan]. | Structural Projects | Public Works           | \$10,000 - \$25,000 | DEEP Climate Resilience Fund; LOTICIP; Municipal CIP Budget | 7/2024 - 6/2026 | Medium   | 20            | 5             | 100                 |
| CG33   | Clearly mark Tyler Avenue as an alternate evacuation route with signage. | 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 [this action relates   | Structural Projects | Emergency Management   | \$0 - \$10,000      | Municipal Operating Budget                                  | 7/2023 - 6/2024 | Medium   | 14            | 8             | 112                 |

| 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 | PERISTS x STAPLEE = |
|--------|--|---|------------------------|--------------------------------------|-----------------------|--|-----------------|----------|---------------|---------------|---------------------|
|        |  | to objectives in the City's Community Resilience Plan].   |                        |                                      |                       |  |                 |          |               |               |                     |
| CG34   | Develop traffic and transportation study to characterize how climate change impacts may affect emergency access and egress in the City and its adjacent communities. | 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 [this action relates to objectives in the City's Community Resilience Plan]. | More than one category | Office of the Chief Elected Official | \$100,000 - \$500,000 | DEEP Climate Resilience Fund; LOTCIP; Municipal CIP Budget | 7/2024 - 6/2026 | Low      | 22            | 4             | 88                  |
| CG35   | Post and maintain signs signifying alternate evacuation routes from coastal areas.   | 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 [this action relates to objectives in the City's Community Resilience Plan]. | Structural Projects    | Emergency Management                 | \$0 - \$10,000        | Municipal Operating Budget                                 | 7/2023 - 6/2024 | Medium   | 14            | 8             | 112                 |
| CG36   | Task subcommittee with identifying "receiving areas" and develop amendment to POCD.  | Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases the frequency and severity of floods [this action relates to objectives in the City's Community Resilience Plan].                 | More than one category | Office of the Chief Elected Official | \$0 - \$10,000        | Municipal Operating Budget                                 | 7/2024 - 6/2026 | Low      | 21            | 4             | 84                  |
| CG37   | Develop adaptation plan for Jupiter Point.   | Reduce flood and erosion risks by reducing vulnerabilities and  | More than one category | Office of the Chief Elected Official | \$25,000 - \$50,000   | FEMA BRIC Scoping; DEEP Climate                            | 7/2024 - 6/2026 | Medium   | 17            | 5             | 85                  |

| 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 | PERISTS x STAPLEE = |
|--------|---|--|------------------------|--------------------------------------|----------------------|----------------------------|------------------------------------|----------|---------------|---------------|---------------------|
|        |   | consequences, even as climate change increases the frequency and severity of floods [this action relates to objectives in the City's Community Resilience Plan]. |                        |                                      |                      | Resilience Fund; LISS      |                                    |          |               |               |                     |
| CG38   | 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                  |
| CG39   | Conduct direct outreach to property owners in repetitive loss areas with information about how to mitigation flood losses.  | 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 January | High     | 13            | 4             | 52                  |
| CG40   | Work with Groton Utilities to develop plan for fleet electrification and local generation.  | More than one goal [this action relates to objectives in the City's Community Resilience Plan].  | More than one category | Office of the Chief Elected Official | \$50,000 - \$100,000 | Municipal Operating Budget | 7/2024 - 6/2026                    | Low      | 18            | 6             | 108                 |
| CG41   | Charge the City's Coastal Vulnerability Working Group with evaluating City administration and operations to identify vulnerabilities relevant to climate change, such as supply-chain disruption or loss of access for municipal personnel. | More than one goal [this action relates to objectives in the City's Community Resilience Plan].  | More than one category | Office of the Chief Elected Official | \$0 - \$10,000       | Municipal Operating Budget | 7/2023 - 6/2025                    | Low      | 18            | 7             | 126                 |