

HAZARD MITIGATION PLAN UPDATE ANNEX FOR THE CITY OF GROTON

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

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ADOPTED

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1.0 INTRODUCTION

1.1 Purpose of Annex

The purpose of this HMP annex is to provide an update to the natural hazard risk assessment and capability assessment provided in the previous HMP, and to evaluate potential natural hazard mitigation measures and prioritize natural hazard mitigation projects specific to mitigating the effects of natural hazards to the City of Groton. Background information and the regional effects of pertinent natural hazards are discussed in the main body of the Southeastern Connecticut Council of Governments (SCCOG) Multi-Jurisdictional Hazard Mitigation Plan. Thus, this annex is designed to supplement the information presented in the Multi-Jurisdictional HMP with more specific detail for the City of Groton and is not to be considered a standalone document.

The primary goal of this hazard mitigation plan annex is to identify risks to natural hazards and potential mitigation measures for such natural hazards in order to **reduce the loss of or damage to life, property, infrastructure, and natural, cultural, and economic resources**. This includes the reduction of public and private damage costs. Limiting losses of and damage to life and property will also reduce the social, emotional, and economic disruption associated with a natural disaster.

1.2 Setting

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).

1.3 Plan Development

The 2012 HMP and its annexes were developed through a series of meetings and the completion of written questionnaires, personal interviews, and workshops as described in the Multi-Jurisdictional HMP update. Since that time, the HMP has been available in local governmental offices and available to emergency personnel. Residents have been encouraged to contact the Emergency Management Director with any concerns regarding emergency response or potential projects related to natural hazard damage.

Based on the existing plan, existing information, and hazards that have occurred since 2012, SCCOG determined that the following data collection program would be sufficient to collect data to update the Multi-Jurisdictional plan and each annex.

- ❑ A data collection meeting was held with the City on November 8, 2016 to discuss the scope and process for updating the plan and to collect information. The City Planner coordinated the local planning team which included members of the building and highway departments. The meeting focused on reviewing each section of the existing hazard mitigation plan and annex, critical facilities, and various types of hazards that have affected the City and that should be addressed in the update.
- ❑ The SCCOG issued a press release on November 4th, 2016 announcing two public information meetings on the multi-jurisdictional HMP update. This press release was published in the Norwich Bulletin and The Day, as well as in relevant local "Patch" news websites. This notice was also posted on the SCCOG Facebook page and website. The public information meetings were held on November 28 and December 1, 2016, at the Town of Groton Library and the SCCOG office, respectively.
- ❑ A survey soliciting public input was hosted at www.surveymonkey.com/r/SCCOGHazard from October 17, 2016 through March 17, 2017. Topics addressed by the survey included the types of natural hazards that concern participants, the assets, infrastructure, and government services they feel are most at risk, and the types of mitigation measures they support. The survey link was publicized along with the public meetings in The Day, The Norwich Bulletin, and local *Patch* websites, and at all public meetings.
- ❑ The draft that is sent for State review will be posted on the City website (<http://www.cityofgroton.com/>) as well as the SCCOG website (<http://www.seccog.org>) for public review and comment. In addition, a hard copy will be made available in the SCCOG office in Norwich. A press release will announce the availability of the HMP for review. This will provide residents, business owners, and other stakeholders throughout the SCCOG region the opportunity to review and comment on a relatively complete draft with all annexes. Comments received from the public will be incorporated into the final draft where applicable following State and Federal comments.

The adoption of this HMP update by the City of Groton will be coordinated by SCCOG and the Planning Department. The HMP update must be adopted within one year of conditional approval by FEMA, or the City will need to update the HMP and resubmit it to FEMA for review. The adoption resolution is located in Appendix A of this annex.

1.4 Progress Monitoring

Following adoption, the Civil Preparedness Director (appointed by the Chief Executive Officer, currently the Police Chief) under the authority of the Mayor and City Council and will continue to be the local coordinator of the HMP. The City Planner will be the deputy local coordinator. The Civil Preparedness Director, with assistance from the City Planner, will coordinate with responsible departments as listed in Table 11-1 and ensure that the recommendations of this HMP are considered or enacted. Refer to Section 1.8 of the Multi-Jurisdictional HMP for a description of how the local coordinator will perform progress monitoring. The majority of recommendations in this annex can be accomplished within or with only a slight increase in the

operating budgets of the various departments. Projects that require capital improvements or additional funding will need to be approved by the City Council.

The HMP will be on file with the Civil Preparedness Director and at the Planning Department to assist in guiding growth decisions. See Section 2.5 for recommendations related to integrating the findings of this HMP into other City planning documents. The City will encourage residents to contact the Planning Department or Emergency Management Director with concerns related to natural hazards or emergency response via the City's website. Such announcements will also state that the HMP is available for public review at the Planning Department as well as available on the City's and the SCCOG's website.

The City of Groton will review the status of plan recommendations each year. The Civil Preparedness Director, along with assistance from the Planning Department or other Departments, will be in charge of overseeing recommended projects and coordinating an annual meeting with applicable departments (those listed in Table 11-1) and other interested departments. Refer to Section 1.8 of the Multi-Jurisdictional HMP for a list of matters to be discussed at the annual meeting, including a review of each recommendation and progress achieved to date, or reasons for why the recommendation has not been enacted. The Planning Department will keep a written record of meeting minutes and the status of the recommendations. These records of progress monitoring will form the basis for the next HMP update.

The City of Groton understands that the multi-jurisdictional HMP and this annex will be effective for five years from the date of FEMA approval of the first SCCOG jurisdiction regardless of the date of adoption by the City. The Planning Department will coordinate with SCCOG for the next HMP update which is expected to occur in 2022.

2.0 COMMUNITY PROFILE

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.

2.2 Land Use 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 2008 *Plan of Conservation and Development* for the City, remaining vacant developable land was equal to 3% 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. The majority of development has occurred in the northern part of the City near Electric Boat and in

Groton Heights. 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 2000 census population of the City was 9,288. Despite adding approximately 800 people through 2010, there have been no major changes in development since the last HMP in 2005. 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.

According to the 2008 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. Over 60% of all housing units in the City are renter-occupied.

2.3 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.

2.4 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, 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 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 2.8 of the Multi-Jurisdictional HMP. 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 administers the City's Zoning and Subdivision regulations, administers the Coastal Management Program, performs 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 31 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.

2.5 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.

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.

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.

Plan of Conservation and Development (2008)

The *Plan of Conservation and Development* was adopted on August 1, 2008 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. 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. Additional recommendations related to natural hazards include:

High Priority

- ❑ Implement the Harbor Management Plan since it allows the City to better control in-water activities (such as docks and moorings) and helps ensure in-water and upland activities are better coordinated. *This recommendation was enacted by the City in 2007 prior to the final publication of the Plan.*
- ❑ 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.
- ❑ Seek to identify and preserve any areas which are potentially high in passive recreational potential (including beaches, coastal bluffs and escarpments, tidal wetlands, or islands) as open space and as part of a waterfront pathway network.
- ❑ Strive to ensure that any open space acquired be preserved as open space in perpetuity.
- ❑ Modify the open space provisions in the subdivision regulations (Section 4.4) to require that every residential subdivision make some provision for open space either through deeding at least 10% of the land or by making a payment to the Open Space Fund.
- ❑ Consider expanding the open space set-aside requirement above to all other types of residential development.
- ❑ Require the underground installation of utilities for all new development and, when opportunities arise, put existing overhead utilities underground.
- ❑ In order to protect areas with marina uses (and preclude heavier marine commercial or industrial uses), consider establishing a new recreational boating zoning classification that would prevent replacing water-dependent uses with residential uses.

Moderate Priority

- ❑ Consider requiring the deduction of wetlands, watercourses, steep slopes greater than 20%, and floodplains from parcel area when determining residential density for multi-family developments.

- ❑ Support the Open Space Fund with an annual contribution from the City Budget so desirable land can be purchased when it becomes available.
- ❑ In the event of an expansion / redevelopment of the industrial Thames River area, promote such redevelopment so that non-water dependent uses are located further inland, public access and attractions along the waterfront are encouraged and supported, and scenic views are preserved to the extent possible.

Lower Priority

- ❑ To enhance public access to the Thames River, consider establishing a formal program to purchase strategically located waterfront parcels as they become available for open space or other municipal purposes.
- ❑ Undertake a study to determine the best way to address the long-term space needs of the Fire Department.

Policies

- ❑ Continue to protect watercourses, tidal and inland wetlands, steep slopes greater than 15%, and coastal and inland floodplains.
- ❑ Work with State and Federal agencies to ensure that flood protection regulations reflect current thinking and standards especially with regard to long-term rise in sea levels.
- ❑ Consider expanding street tree planting programs and recommend trees appropriate for each area (since tall-growing trees are not appropriate under overhead wires and flowering or fruit-bearing trees may not be appropriate in some locations).
- ❑ Encourage maintenance of street-side areas.
- ❑ Consider strategies to maintain and improve the capacity of Route 349 as the major roadway providing access to Electric Boat and Pfizer.
- ❑ Encourage Groton Utilities to continue to identify additional water supply sources in order to support existing uses in the service area and possible expansions.

The City of Groton POCD is considered somewhat consistent with the current goals and actions of the hazard mitigation plan. It does not directly address several of the hazards such as winter storm hazards, flood hazards, earthquake hazards, and wind hazards. The next update to the POCD (scheduled for 2018, during the life of the current hazard mitigation plan) should incorporate more elements of the hazard mitigation plan.

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 were last updated in 2016, with an effective date of December 1, 2016. The updates incorporate the recent release of an updated FIS and DFIRM for New London County dated August 5, 2013. They include a variety of preventative regulations pertinent to mitigating flooding hazards. These regulations are applied during the permitting process for new construction and during substantial improvement of existing structures.

Section 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 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.

2.6 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 2-1.

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 primary shelter is here as well. Approximately 250 people can be sheltered at this location.

Since the previous edition of this HMP, the EOC functions have been relocated from the basement to the second floor of the Municipal Building to protect the EOC from nuisance basement flooding.

**TABLE 2-1
Critical Facilities**

Facility	Address or Location	Emergency Power Supply?	Shelter?	In Floodplain or Coastal Flood Hazard Area?	In Surge Zones?
Emergency Services					
Fire Station	Broad Street	✓			
Fire Station	Benham Road	✓			
Municipal Facilities					
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	✓	✓		
Health Care and Senior Living Facilities					
Avery Heights (Elderly Housing)	300 Brandegee Avenue				
Other Infrastructure and Facilities					
Pfizer	Eastern Point Road	✓		✓	✓
Electric Boat	Thames Street	✓		✓	✓
University of Connecticut at Avery Point	Shennecossett Road	✓		✓	✓

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

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.

Backup Shelters

Fitch High School in the Town of Groton is the City's backup 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.

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). 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.

3.0 INLAND FLOODING

3.1 Setting/Historic Record

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.

3.2 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 December 2016, 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. 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). 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 is 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.

Summary

In general, municipal capabilities to mitigate flood damage have increased slightly since the 2012 edition of the hazard mitigation plan was adopted. This is likely because the City increased its capabilities in response to flooding of 2011 and 2012 associated with Tropical Storm Irene and Hurricane Sandy, which are discussed in later chapters. 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.

3.3 Vulnerabilities and Risk Assessment

This section discusses specific areas at risk to inland flooding within the City. Areas at risk from coastal flooding are discussed in Section 4 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.

Note that *HAZUS-MH*, FEMA's hazard loss estimation software, was utilized to calculate the potential damages to the City of Groton from a combined 1% annual chance riverine and coastal flood. Results were presented in Section 3.5.2 of the Multi-Jurisdictional HMP.

3.3.1 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).

As stated in Section 10, 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.

3.3.2 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, an increase from two in 2012, but three are associated with coastal flooding in the Jupiter Point and the Eastern Point areas. 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 (Figure 4-1). 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.

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.

As noted above, a drainage upgrade project was nearly complete at the time of this writing summer 2012. This project is expected to significantly reduce the frequency of flooding along Thames Street, Smith Street, and John Street. 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.

3.3.3 Vulnerability Analysis of Critical Facilities

As noted in Section 2.6, 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 Chapter 2, 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.

3.4 Potential Mitigation Strategies and Actions

General potential mitigation measures that can be taken to reduce the effects of inland flooding were discussed in Section 3.7 and in Section 11.2.2 of the Multi-Jurisdictional HMP. General recommendations pertinent to all natural hazards that could affect the City are listed in Section 11 of this annex, as well as general and specific measures pertinent to reducing inland flooding under the categories of prevention, property protection, emergency services, public education and awareness, natural resource protection, and structural projects.

4.0 COASTAL FLOODING AND SHORELINE CHANGE

4.1 Setting/Historic Record

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 HMP.

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 since 2005. 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.

4.2 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 3.2) are also applicable to coastal flood mitigation.

As noted in Section 3.2 and Section 2.5, 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 2008 *Plan of Conservation and Development*. Recommendations from the Plan of Conservation and Development pertinent to coastal mitigation include:

- ❑ In order to protect areas with marina uses (and preclude heavier marine commercial or industrial uses), consider establishing a new recreational boating zoning classification that would prevent replacing water-dependent uses with residential uses.
- ❑ Work with State and Federal agencies to ensure that flood protection regulations reflect current thinking and standards especially with regard to long-term rise in sea levels.

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.

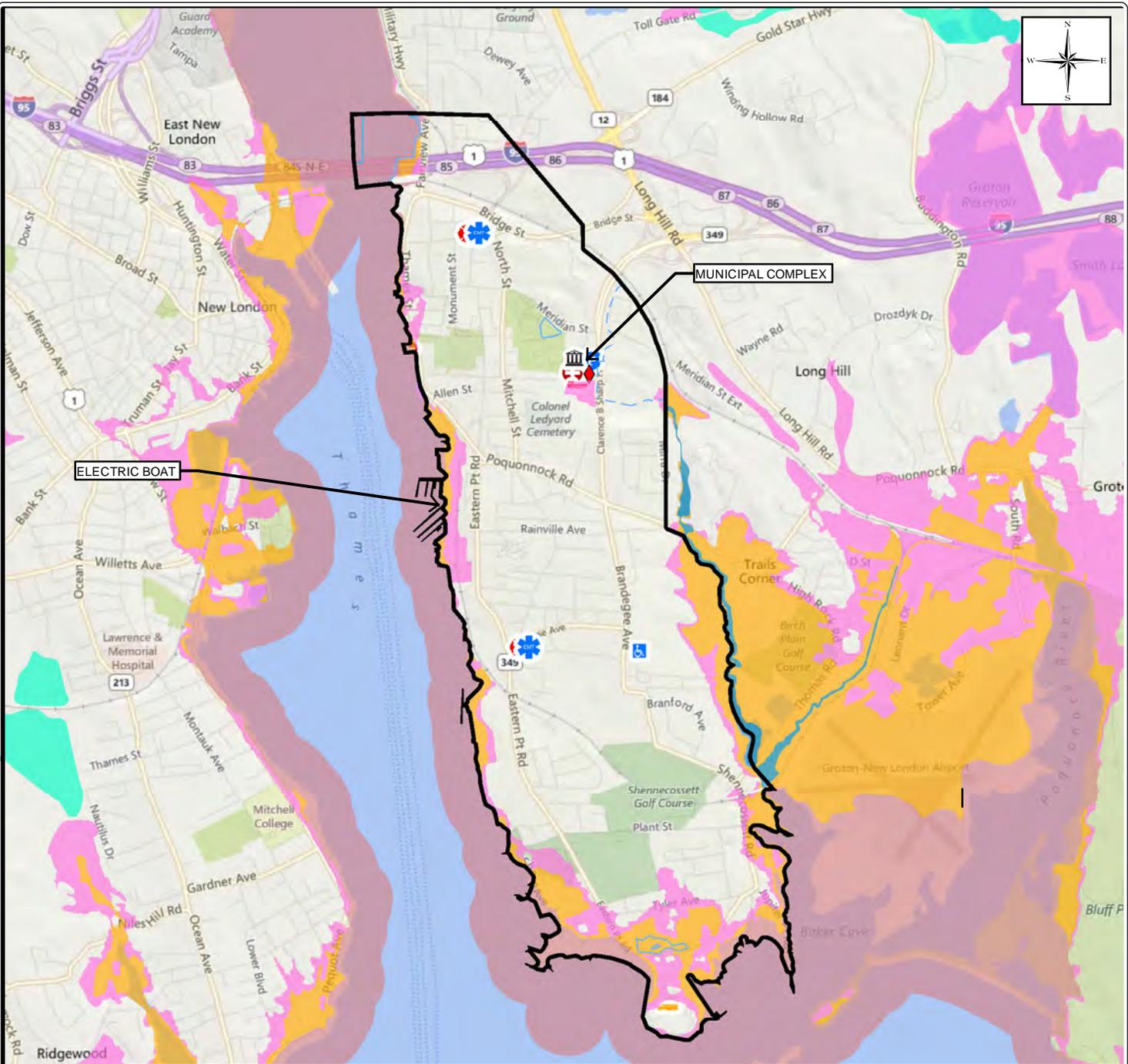
Although the City of Groton lacks inland flood control structures such as dams and channelized sections of rivers, the shoreline of Groton contains many coastal flood control structures. Small, private seawalls and bulkheads can be found in many of the residentially developed coastal neighborhoods such 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.

Since the previous edition of this HMP, a number of tide gates on Shore Avenue have been upgraded. Additionally, the bulkhead protecting the Costa Property has been renovated and rebuilt.

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 2016-2017¹. 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.

¹ <https://tnc.app.box.com/s/8nne60yjk2g3m1mgzkfa86rndxyjjawf>



LEGEND		CRITICAL FACILITIES		FEMA Special Flood Hazard Areas	
	Groton City Boundary		Police		Open Water
	Watercourse		Governmental		1% Annual Chance Floodway
	Intermittent Water		Backup Shelter		1% Annual Chance Floodplain, with Wave Action, with Elevations
			Utility		1% Annual Chance without Elevations
			School		1% Annual Chance with Elevations
			Fire		0.2% Annual Chance Floodplain
			Shelter		
			Ambulance		
			Senior Housing		

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FEMA SPECIAL FLOOD HAZARD AREAS

SCCOG HAZARD MITIGATION UPDATE GROTON CITY ANNEX

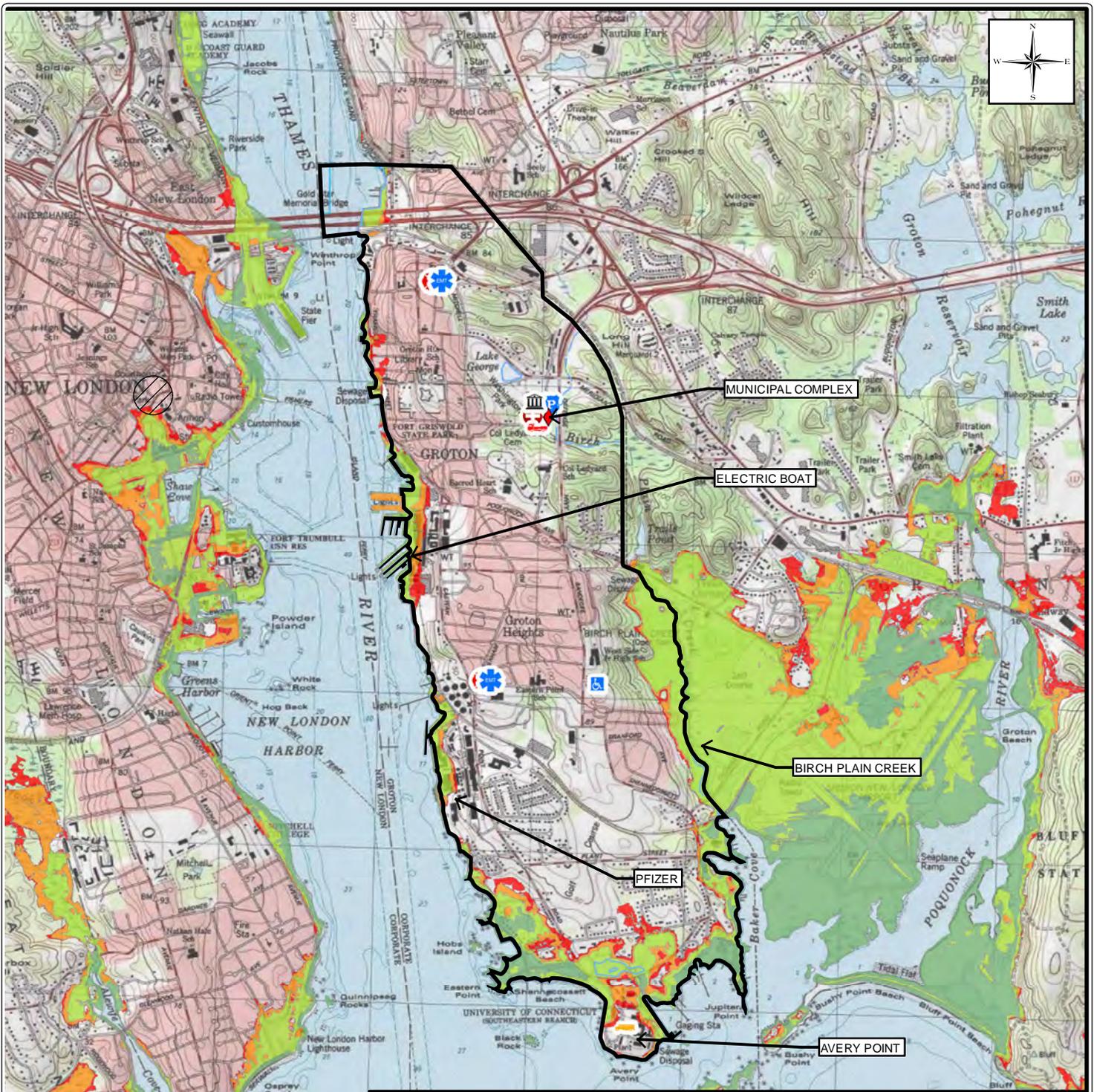
GROTON CITY, CONNECTICUT

SOURCE: NATIONAL FLOOD HAZARD LAYER, FEMA, 2017

DATE: JULY 26, 2017		
SCALE: 1"=3,000'		
PROJ. NO.: 3570-09		
DESIGNED SB	DRAWN PS	CHECKED DM

DRAWING NAME:

FIG. 4-1



LEGEND	CRITICAL FACILITIES	FEMA Hurricane Surge Inundation
Groton City Boundary	Police	Category One Hurricane
Watercourse	Utility	Category Two Hurricane
Intermittent Water	School	Category Three Hurricane
	Shelter	Category Four Hurricane
	Ambulance	
	Senior Housing	
	Governmental	
	Backup Shelter	
	Fire	

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POTENTIAL HURRICANE STORM SURGE

**SCCOG HAZARD MITIGATION UPDATE
 TOWN OF GROTON CITY ANNEX**

GROTON CITY, CONNECTICUT

SOURCE: HURRICANE SURGE INUNDATION LAYER; CTDEEP, 2012

DATE: JULY 26, 2017		
SCALE: 1"=3,000'		
PROJ. NO.: 3570-09		
DESIGNED SB	DRAWN PS	CHECKED DM

DRAWING NAME:

FIG. 4-2

As explained in Section 2.13 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 SCSOG 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 practices guide for planning techniques to make historic resources more resilient was distributed in September 2017.

Summary

Municipal capabilities to mitigate coastal flood damage have increased somewhat since the 2012 edition of the hazard mitigation plan was adopted. This is because the City participated in the historic resources resiliency planning and generally increased its capabilities in response to the flooding associated with storms Irene and Sandy in 2011 and 2012, respectively.

4.3 Vulnerabilities and Risk Assessment

This section discusses specific areas at risk to 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 Figure 4-1 for a depiction of areas susceptible to coastal flooding, and Figure 4-1 for areas susceptible to storm surge from hurricanes.

Note that *HAZUS-MH*, FEMA's hazard loss estimation software, was utilized to calculate the potential damages to the City of Groton from a combined 1% annual chance riverine and coastal flood. Results were presented in Section 3.5.2 of the Multi-Jurisdictional HMP.

4.3.1 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 zone could restrict emergency access to, and egress from, the Avery Point campus during an emergency.

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 3.3). Tide gates on drainage pipes below Shore Avenue have been updated since the previous HMP; however, these alone are not able to mitigate flooding due to high tide and storm surge. 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 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.

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.

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.

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.

4.3.2 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. 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.

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.

Four repetitive loss properties are located in the City of Groton, an increase from two in 2012. Three are associated with coastal flooding in the Jupiter Point 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 HMP will likely help many of these property owners. 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.

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.

4.3.3 Vulnerability Analysis of Critical Facilities

As shown on Figure 4-1, critical facilities located within the 1% annual chance floodplain include the City's waste water 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 4-2.

4.4 Potential Mitigation Strategies and Actions

General potential mitigation measures that can be taken to reduce the effects of coastal flooding were discussed in Section 4.7 and in Section 11.2.2 of the Multi-Jurisdictional HMP. General recommendations pertinent to all natural hazards that could affect the City are listed in Section 11 of this annex along with general and specific measures pertinent to reducing coastal flooding under the categories of prevention, property protection, emergency services, public education and awareness, natural resource protection, and structural projects.

5.0 HURRICANES AND TROPICAL STORMS

5.1 Setting/Historic Record

Several types of hazards may be associated with tropical storms and hurricanes including heavy or tornado winds, heavy rains, and flooding. Flooding and storm surge hazards are discussed in Section 3 and Section 4 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 amount of trees were damaged.

The last major hurricane or tropical storm wind event to affect the City was Hurricane Sandy in October 2012. Sandy brought high winds and coastal flooding to the entire 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.

5.2 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, 2016. The code specifies the design wind speed for construction in all the Connecticut municipalities. The ultimate design wind speed for the City of Groton ranges from 125 to 145 miles per hour 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 monitors trees as part of their normal rounds, and that department's budget includes a 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. Since the previous HMP, CL&P has been acquired by Eversource. 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 has 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 increased somewhat since the 2012 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.

5.3 Vulnerabilities and Risk Assessment

The entire City is vulnerable to hurricane and tropical storm wind damage and from any tornadoes (Section 5) accompanying the storm, as well as inland flooding (Section 3) and

coastal flooding and storm surge (Section 4). 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 SCCOG was evaluated in the Multi-Jurisdictional HMP. A separate analysis was not performed specifically for the City of Groton.

5.4 Potential Mitigation Strategies and Actions

General potential mitigation measures that can be taken to reduce the effects of wind damage from hurricanes and tropical storms were discussed in Section 5.7 and in Section 11.2.3 of the Multi-Jurisdictional HMP. General recommendations pertinent to all natural hazards that could affect the City are listed in Section 11 of this annex along with general and specific measures under the categories of prevention, property protection, emergency services, public education and awareness, natural resource protection, and structural projects.

6.0 SUMMER STORMS AND TORNADOES

6.1 Setting/Historic Record

Similar to hurricanes and winter storms, wind damage associated with 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 NCDC. The NCDC also reported that strong straight-line thunderstorm winds overturned a boat at Eastern Point on July 31, 2009 causing minor damage.

6.2 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 5.2 within the context of hurricanes and tropical storms. In addition, the Connecticut Building Code includes guidelines for the proper grounding of buildings and electrical boxes to protect against lightning damage.

Summary

In general, municipal capabilities to mitigate thunderstorm and tornado damage have not increased significantly since the 2012 edition of the hazard mitigation plan was adopted.

6.3 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 is exacerbated when the trees are in full leaf. The damage to buildings and overhead utilities due to downed trees has historically been the biggest problem associated with wind storms. Heavy winds can take down

trees near power lines, leading to the start and spread of fires. Such fires can be extremely dangerous during the summer months during dry and drought conditions. Fortunately, most fires are quickly extinguished due to the 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.

6.4 Potential Mitigation Strategies and Actions

General potential mitigation measures that can be taken to reduce the effects of wind damage were discussed in Section 5.7 and in Section 11.2.3 of the Multi-Jurisdictional HMP. No additional recommendations are available specific to reducing damage from summer storms and tornadoes. Refer to Section 11 of this annex for recommendations related to wind damage and general recommendations related to emergency services. General recommendations pertinent to all natural hazards that could affect the City are also listed in Section 11 of this annex.

7.0 WINTER STORMS AND NOR'EASTERS

7.1 Setting/Historic Record

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 only the storms during the winter of 2010-2011 had a significant effect.

7.2 Existing Capabilities

Existing programs applicable to winter storm winds are the same as those discussed in Sections 5.2 and 6.2. Programs that are specific to winter storms are generally those related to preparing plows and sand and salt trucks; tree trimming and maintenance to protect power lines, roads, and structures; and other associated snow removal and response preparations. 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 is 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 2012 edition of the hazard mitigation plan was adopted. This is because the City continues to experience heavy snow each winter.

7.3 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.

7.4 Potential Mitigation Strategies and Actions

Potential mitigation measures for flooding caused by nor'easters include those appropriate for flooding that were discussed in Section 3.7 and Section 4.7 of the Multi-Jurisdictional HMP and Section 11 of this annex. However, winter storm mitigation measures must also address blizzards, snow, and ice hazards. General potential mitigation measures that can be taken to reduce the effects of wind damage were discussed in Section 5.7 and in Section 11.2.3 of the Multi-Jurisdictional HMP. General recommendations pertinent to all natural hazards that could affect the City are listed in Section 11 of this annex along with general and specific measures pertinent to reducing damage from winter storms under the categories of prevention, property protection, emergency services, public education and awareness, natural resource protection, and structural projects.

8.0 EARTHQUAKES

8.1 Setting/Historic Record

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.

8.2 Existing Capabilities

The Connecticut Building Codes include design criteria for buildings specific to each region as adopted by 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.

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.

8.3 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 nearby 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 HMP, dam failure has been addressed separately in Section 10.0. As noted previously, several types of utility infrastructure in the City is 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.

A *HAZUS-MH* analysis of the potential economic and societal impacts to the SCCOG region from earthquake damage is detailed in the Multi-Jurisdictional HMP. The analysis addresses a range of potential impacts from any earthquake scenario, estimated damage to buildings by building type, potential damage to utilities and infrastructure, predicted sheltering requirements, estimated casualties, and total estimated losses and direct economic impact that may result from various earthquake scenarios.

8.4 Potential Mitigation Strategies and Actions

Due to the low probability of occurrence, potential mitigation measures related to earthquake damage primarily include adherence to building codes and emergency response services. Both of these are mitigation measures common to all hazards as noted in Section 11 of this annex.

9.0 WILDFIRES

9.1 Setting/Historic Record

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.

9.2 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 2012 edition of the hazard mitigation plan was adopted.

9.3 Vulnerabilities and Risk Assessment

The risk for wildlife 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.

9.4 Potential Mitigation Strategies and Actions

Potential mitigation measures for wildfires include a combination of prevention, education, and emergency planning as presented in Section 11.

10.0 DAM FAILURE

10.1 Setting/Historic Record

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 affected the City since the time of the last HMP.

10.2 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.

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 2012 edition of the hazard mitigation plan was adopted. However, changes in the State's regulation of dams have increased Statewide capabilities.

10.3 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.

10.4 Potential Mitigation Strategies and Actions

Given the fact that the City of Groton is unlikely to be affected by flooding from dam failure, there are no mitigation measures recommended at this time.

11.0 MITIGATION STRATEGIES AND ACTIONS

11.1 Status of Mitigation Strategies and Actions

The previous edition of the SCCOG Multi-Jurisdictional HMP and City of Groton annex listed a suite of hazard mitigation actions applicable both locally and region-wide. These actions, along with commentary regarding the status of each, are listed in the tables in this section. Additionally, new actions were developed in the process of developing this HMP update. These are listed at the end of each hazard section below.

11.1.1 Actions Applicable to All Hazards

Actions Applicable to All Hazards		
Action	Status	Status
<u>Regional Coordination</u>		
Continue to promote inter-jurisdictional coordination efforts for emergency response.	Capability	<i>Completed through mutual-aid agreements, agreements with the Town of Groton, and SCCOG regional hazard management initiatives. This action is reclassified as a capability.</i>
Continue to promote local and regional planning exercises that increase readiness to respond to disasters.	Capability	<i>The City participates in regional and statewide exercises, and the Civil Preparedness Director (CPD) runs local planning exercises. This action is reclassified as a capability.</i>
Continue to evaluate communication capabilities and pursue upgrades to communication and ensure redundant layers of communication are in place within the City and with other SCCOG communities, New London County, and the State of Connecticut.	Capability	<i>Communication capabilities are strong within the City. The CPD reviews capabilities regularly. This action is reclassified as a capability.</i>
Continue to promote regional transportation planning through SCCOG to balance general transportation, shipping, and potential evacuation needs.	Capability	<i>This action is the responsibility of, and is being performed by, SCCOG. This action is redefined as a regional capability, and is dropped.</i>
Work with SCCOG to perform a regional study to identify the vulnerability of critical facilities that may be unable to withstand natural hazard damage. Emphasis should be placed on critical infrastructure, shelters and other sites to ensure structural integrity against various hazards and adequacy of backup supplies.	Complete	<i>This action is the responsibility of, and was performed by, SCCOG in 2017. The City of Groton municipal complex (City Hall and Public Works) was included in the study due to its position near Birch Plain Creek's 0.2% annual chance floodplain. Recommendations from the study are incorporated into this HMP.</i>
Work with SCCOG to develop regional evacuation scenarios that include but build upon the Millstone evacuation plan.	Capability	<i>This action is the responsibility of, and is being performed by, SCCOG. This action is redefined as a regional capability, and is dropped.</i>
<u>Local Emergency Response</u>		
Continue to review and update the City EOP at least once annually.	Capability	<i>Performed by Civil Preparedness Director. This action is reclassified as a capability.</i>
Continue to maintain emergency response training and equipment and upgrade equipment when possible.	Capability	<i>Performed by Civil Preparedness Director and the Fire Department. This action is reclassified as a capability.</i>

Actions Applicable to All Hazards		
Action	Status	Status
Encourage City officials to attend FEMA-sponsored training seminars at the Emergency Management Institute (EMI) in Emmitsburg, Maryland.	Capability	Staff attend locally-held seminars and participate in on-line trainings. For example, the Zoning Officer / Building Official and the Assistant Building Official attended a regional Floodplain Management Seminar in Old Lyme. 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. The City has not had the capacity to send any of its very limited staff to seminars at EMI. Staff attendance of local and online trainings is an ongoing policy, is considered sufficient for the City's needs, and is reclassified as a capability. Travel to EMI is dropped.
Continue to evaluate emergency shelters, update supplies, and check communication equipment.	Capability	Performed by Civil Preparedness Director and the Fire Department. This action is reclassified as a capability.
Continue to promote dissemination of public information regarding natural hazard effects and mitigation measures into local governmental and community buildings.	Capability	Information is available on the City Website and at City Hall. This action is reclassified as a capability.
Utilize the CT Alerts "Everbridge Community Notification" System to telephone warnings into potentially affected areas. Incorporate the 1% annual chance and the 0.2% annual chance inland and coastal floodplains based on the recent DFIRM.	Capability/ New	Everbridge is used to warn residents of hazards. This action is reclassified as a capability. Incorporating the SFHAs based on the most recent DFIRM is carried forward as a new action.
<u>Prevention</u>		
Integrate additional elements of this HMP into the Plan of Conservation and Development during the next update of that plan.	Carry Forward	The POCD is currently undergoing a 10-year update. This action is carried forward until the Update's completion.
Encourage the underground installation of utilities for all new development and, when opportunities arise, put existing overhead utilities underground.	Capability	Required for new developments. Burial is encouraged when possible. This action is reclassified as a capability.
Continue expanding street tree planting programs and recommend trees appropriate for each area (since tall-growing trees are not appropriate under overhead wires and flowering or fruit-bearing trees may not be appropriate in some locations). Encourage maintenance of street-side areas.	Capability	This action is reclassified as a capability.
Continue reviewing building plans to ensure proper access for emergency vehicles.	Capability	Required through zoning regulations, enforced by building official. This action is reclassified as a capability.
Continue to enforce the appropriate building code for new building projects.	Capability	This action is reclassified as a capability.
<u>Natural Resource Protection and Open Space</u>		
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	This action is complicated because it requires acquisition of private property; the City has not yet succeeded in completing it. This action is carried forward.
Continue to protect watercourses, tidal and inland wetlands, steep slopes greater than 15%, and coastal and inland floodplains.	Capability	This action is reclassified as a capability.

Actions Applicable to All Hazards		
Action	Status	Status
Consider requiring the deduction of wetlands, watercourses, steep slopes greater than 20%, and floodplains from parcel area when determining residential density for multi-family developments.	<i>Delisted</i>	<i>City officials do not feel this action is necessary given Groton City's development patterns. This action is dropped.</i>
Seek to identify and preserve any areas which are potentially high risk for flooding as recreational open space.	<i>Capability</i>	<i>This action is pursued by the Planning Department. This action is reclassified as a capability.</i>

Other mitigation actions performed by the City since the previous HMP include:

- The Benham Road Fire Station was upgraded and new emergency generator installed.
- The Zoning and Subdivision Regulations were both updated, and now reference the most recent edition of the FEMA DFIRM.

New mitigation actions developed during this HMP include:

- Incorporate the SFHAs as mapped by the most recent edition of the FEMA DFIRM to direct warnings through the Everbridge system.

11.1.2 Actions Applicable to Inland and Coastal Flooding

Actions Applicable to Inland and Coastal Flooding		
Action	Status	Status
<u>Prevention</u>		
Continue to regulate new development activities within SFHAs to the greatest extent possible within the local land use regulations.	<i>Capability</i>	<i>This action is reclassified as a capability.</i>
Require developers to demonstrate whether detention or retention of stormwater is the best option for reducing peak flows downstream.	<i>Delisted</i>	<i>The City enforces the current stormwater management regulations from the State. This includes no net increase in runoff from new development, and the requirement that an engineer sign off on new drainage plans. The City feels that these requirements sufficiently mitigate the risk of new runoff problems from new developments. This action is dropped.</i>
Review local Subdivision Regulations and evaluate the possibility of incorporating changes to place further limitations on areas of impermeable surfaces in new subdivision developments in flood prone areas. If warranted, make necessary changes to the Subdivision Regulations.	<i>Delisted</i>	<i>The Subdivision Regulations were reviewed and updated in 2016. Due to the City's density and lack of space for new development and creation of impermeable surfaces, The City does not feel that adding limits on impermeable surface creation would have a notable impact. This action is dropped.</i>
Conduct an annual inspection of floodprone areas that are accessible to City officials. Determine if potential flood damage is stormwater facility related and make recommendations as appropriate.	<i>Capability</i>	<i>Inspections are performed regularly. Remaining City flooding problems are primarily related to high tide or surge, not stormwater management. This action is reclassified as a capability.</i>

Actions Applicable to Inland and Coastal Flooding		
Action	Status	Status
In order to protect areas with marina uses (and preclude heavier marine commercial or industrial uses), consider establishing a new recreational boating zoning classification that would prevent replacing water-dependent uses with residential uses.	<i>Delisted</i>	<i>City has considered this action and not deemed it necessary. This action is dropped.</i>
Consider regulating development activities within potential storm surge areas as mapped by FEMA.	<i>Capability</i>	<i>City officials believe that the public would not support, and therefore prevent, implementation of such regulations. This action is dropped in favor of regulating with the SFHA, which take into account coastal floods.</i>
Work with State and Federal agencies to ensure that flood protection regulations reflect current thinking and standards especially with regard to long-term rise in sea levels.	<i>Delisted</i>	<i>City participates in regional, State, and Federal sea-level-rise studies and programs. Updates to regulations conform to State and Federal requirements. It is not felt that additional efforts with regards to flood protection regulations are necessary at this time. This action is dropped.</i>
Utilize the recently released DFIRM to compile a list of addresses with structures within the 1% annual chance floodplain. Track the cost of repairs to these properties following major storm events through outreach or building permits to develop a database of information for potential future grant funding.	<i>Delisted</i>	<i>Structures are addressed and costs tracked on a case-by-case basis. City does not have the staff to perform additional tracking and database development. It feels its current procedures are sufficient for its needs. This action is dropped.</i>
Encourage the railroad company to regularly inspect, clear, and maintain its culverts and bridges in the vicinity of Thomas Road.	<i>Delisted</i>	<i>This action is the responsibility of the railroad company. This action is dropped.</i>
Encourage the Town of Groton to complete or redo the drainage from the golf course down to Shore Avenue.	<i>Capability</i>	<i>This drainage system has been completed. This action is complete.</i>
Encourage the State 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.	<i>Capability</i>	<i>Electric Boat maintains this drainage area, regularly inspecting and cleaning it. The maintenance of this site by Electric Boat is reclassified as a capability.</i>
Property Protection		
Incorporate information on the availability of flood insurance into all hazard-related public education workshops as appropriate.	<i>Capability</i>	<i>The City runs a limited amount of hazard-related workshop and educational program, but flood insurance information is incorporated as appropriate. This action is reclassified as a capability.</i>
Make available FEMA-provided flood insurance brochures at public accessible places such as the local government buildings. Encourage residents to purchase flood insurance if they are located within a FEMA SFHA.	<i>Capability</i>	<i>Brochures are available at the City Administration Offices. Residents are encouraged to purchase flood insurance through realtors and if they request information from the City. This action is reclassified as a capability.</i>
Consider providing technical assistance to owners of non-residential structures that suffer flood damage regarding floodproofing techniques such as wet and dry floodproofing.	<i>Delisted</i>	<i>The City does not have this capability within its own staff, and other resources are available online (including through sites linked to the City website). This action is dropped.</i>
If property owners become interested, consider elevation or acquisition of residential properties that suffer flood damage.	<i>Carry Forward</i>	<i>No property owners have expressed interest. This action is carried forward.</i>

Actions Applicable to Inland and Coastal Flooding		
Action	Status	Status
Consider applying freeboard standards of one foot when requiring structure elevations for renovations and new construction in coastal A and V zones.	<i>Complete</i>	<i>This action is required through zoning regulations in VE zones. Freeboard is required to varying degrees based on building use, construction, and SFHA by the State Building Code enforced by the City.</i>
Consider reminding residents that their flood insurance rates will not increase if they make a claim since the insurance is federally subsidized and encourage them to submit claims following damage events.	<i>Delisted</i>	<i>The City does not feel this is necessary. This action is dropped.</i>
<u>Emergency Services</u>		
Identify alternative evacuation routes for the Jupiter Point, Avery Point, and Eastern Point areas to ensure residents can still evacuate if Route 349 is flooded.	<i>Complete</i>	<i>Mitchell Street is the primary evacuation route. The southern section of Route 349 (Eastern Point Road) gets flooded, and Thomas Road is often flooded. Tyler Avenue has been identified as an alternative evacuation route. This action is complete.</i>
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.	<i>Carry Forward</i>	<i>This will be incorporated into the current 5-year revision of the EOP. Carry forward until completion.</i>
Evaluate alternative evacuation methods for if residents are stranded after Route 349 begins to flood and include in the EOP.	<i>Complete</i>	<i>Identification of Tyler Avenue as an alternate evacuation route addresses this action. This action is complete.</i>
Investigate locations and necessary labor involvement for the pre-event stockpiling of sand bags for use in floodprone areas.	<i>Capability</i>	<i>Sandbags are not a primary flood control tool in Groton City. Nevertheless, stockpiling and use is the responsibility of the Groton City Highway Department. This action is reclassified as a capability.</i>
Pursue mutual aid agreements with such organizations as the American Red Cross and the Boy Scouts of America to provide volunteer labor prior to or during flood events to fill sand bags and assist with other response activities.	<i>Capability</i>	<i>Sandbags are not a primary flood control tool in Groton City. Response activities are done in-house. This action is deemed unnecessary and is dropped.</i>
Implement a roadway-specific warning system to alert motorists to the dangers present during times of flooding. Warning may take the form of dedicated signage or traffic control lights.	<i>Complete</i>	<i>This has been incorporated into the EOP. This action is complete.</i>
<u>Public Education and Awareness</u>		
Make flood information such as the risks of flood prone areas, mitigation and preparedness strategies, and contacts available at the Municipal Building and on the City's website.	<i>Capability</i>	<i>Information and links are available on the City website. This action is reclassified as a capability.</i>
Encourage builders, developers, and architects to become familiar with the NFIP land use and building standards.	<i>Capability</i>	<i>This is performed by both the Planning and Building Departments, especially during permitting process. This action is reclassified as a capability.</i>
<u>Natural Resource Protection</u>		
Encourage owners of Shennecossett Beach to conduct beach nourishment and vegetation replacement to keep up with erosion.	<i>Complete</i>	<i>Hurricane Sandy washed away sediment at this beach. The presence of the beach and vegetation was found to have helped reduce damage. Residents now understand the utility of beach nourishment and vegetation replacement. After Sandy, nourishment and vegetation planting was performed. This action is complete.</i>
<u>Structural Projects</u>		

Actions Applicable to Inland and Coastal Flooding		
Action	Status	Status
Encourage the use of floodplain storage, diversions, berms, dikes, and other flood control methods in new developments and at existing properties where appropriate.	<i>Capability</i>	<i>This action is required through Zoning and Subdivision regulations and through the Building Permit Process. This action is reclassified as a capability.</i>
Utilize recently available extreme rainfall data to determine existing sizing of culverts. Encourage bridge replacements and culvert replacements in areas found to be undersized.	<i>Capability/ New</i>	<i>It appears that extreme rainfall data is used for some projects, but the procedure has not been formalized. This action is dropped and replaced with that listed below this table.</i>
Continue to perform catch basin and culvert surveys to perform maintenance and cleaning and to identify and prioritize structures in need of replacement.	<i>Capability</i>	<i>Performed by public works department. This action is reclassified as a capability.</i>
Investigate funding sources and feasibility of improvements to mitigate frequent and repeated flooding problems. Improvements could include elevation of roads and replacement of storm drainage systems. Work with CT DOT to facilitate these actions if State roads are involved.	<i>Capability</i>	<i>City continually seeks out funding for projects. This action is reclassified as a capability.</i>
Determine the cause of flooding and dampness in the basement of the municipal complex and install measures to prevent future occurrences.	<i>Complete/ New</i>	<i>Items in storage have been placed on pallets above the floor. Additionally, items stored in basement have been rearranged so that the most flood-vulnerable items are higher up. The EOC has been relocated upstairs, out of the flood area. In the context of reducing damage, this action is complete. One recommendation from the Critical Facility Assessment conducted by SCCOG is to improve drainage at the site to reduce future risks.</i>
Evaluate the drainage in the vicinity of Bayberry Lane and make improvements to reduce the damage from coastal flooding.	<i>Complete</i>	<i>The flooding here is tidal, so drainage improvements will not help. This site is also under State jurisdiction. Drainage was evaluated and further action is dropped.</i>
Upgrade stormwater collection and discharge systems to keep up with rising sea level.	<i>Capability</i>	<i>This is performed on a case-by-case basis as stormwater infrastructure is upgraded. This action is reclassified as a capability.</i>
Maintain existing hard structures along the coast in good condition.	<i>Capability</i>	<i>This action is reclassified as a capability.</i>
Investigate funding sources and feasibility of elevating portions Shore Avenue with an emphasis on those needed for inland evacuation.	<i>Complete</i>	<i>Five seawall outlets on Shore Avenue have been elevated and new flap gates installed. The City feels this has addressed much of the flooding problem on this road. This action is marked complete.</i>
Work with the Connecticut DOT to elevate the intersection of Eastern Point Road & Shennecossett Road to the northwest of Avery Point. The University of Connecticut could be interested in providing some funding for this work.	<i>Delisted</i>	<i>This action is the responsibility of the State and is dropped from this plan.</i>
Consider elevating Shennecossett Road immediately east of Avery Point above the 1% annual chance floodplain.	<i>Carry Forward</i>	<i>Funding has not yet been available for this project. Carry Forward.</i>
Perform more frequent cleaning of the drainage systems near Electric Boat.	<i>Delisted</i>	<i>This action is the responsibility of Electric Boat, and is performed by that company. This action is dropped.</i>
Repair and clean the culverts near Shennecossett Beach.	<i>Carry Forward</i>	<i>Funding has not yet been available for this project. Carry Forward.</i>

Actions Applicable to Inland and Coastal Flooding		
Action	Status	Status
Repair or replace all flapper valves as appropriate.	Complete/ Capability	<i>This is performed as needed. Shore Avenue seawall flapper valve replacements are noted as an example. This action is reclassified as a capability.</i>
Investigate and remediate the malfunctioning backwater valve exacerbating flooding conditions near Shore Avenue.	Complete/ Delisted	<i>This valve has been investigated and it has been determined that it is not malfunctioning - it is in fact designed only to prevent debris ingress, not to act as a flood-control mechanism. This action is dropped.</i>
Ensure that the City's waste water treatment facility is adequately protected from coastal flooding and storm surge, and perform improvements if necessary.	Capability	<i>This is an ongoing activity. This action is reclassified as a capability.</i>

Other mitigation actions performed by the Town since the previous HMP include:

- A flood-protection retaining wall (made from Retamomg material; patent applied for) has been renovated and rebuilt
- The Bulkhead protecting the Costa Property has been renovated and rebuilt
- The Tide Gates on Shore Avenue have been upgraded

New mitigation actions developed during this HMP include:

- From the Critical Facilities Assessment completed by SCCOG in 2017:
 - Groton City Hall: Pursue short-term recommendation that drainage improvements be designed and constructed to minimize future risks of stormwater entering the basement.
 - Groton Public Works: Pursue short-term recommendation that public works buildings be wet and dry-floodproofed.
- Clearly mark Tyler Avenue as an alternate evacuation route with signage
- Develop formalized guidance for culvert and bridge construction and replacement that requires utilization of the most up-to-date extreme rainfall data from <http://precip.eas.cornell.edu>

11.1.3 Actions Applicable to Wind Damage from Hurricanes, Tropical Storms, Summer Storms, Tornadoes, and Winter Storms

Actions Applicable to Wind Hazards		
Action	Status	Status
<u>Prevention</u>		
Consider working with the State to locate NOAA weather radios in commercial buildings with large population clusters, and educating building managers on the proper use of the radios.	Delisted	<i>Many alternative methods of emergency alerts exist, and the City does not feel that lack of warning is an issue. They assist with requests from building managers or the State as needed. This action is dropped.</i>
Work with the City marinas to ensure that personal watercraft can be removed in a timely manner or brought out to sea prior to a hurricane or tropical storm event.	Complete	<i>The City has developed a plan and procedure for watercraft removal prior to storms. This action is complete.</i>

Actions Applicable to Wind Hazards		
Action	Status	Status
Develop a plan for notifying residents and businesses about approved areas for storing boats during high wind events.	<i>Complete</i>	<i>The City has developed a plan and procedure for watercraft removal prior to storms. This action is complete.</i>
Work with the SCCOG to develop a region-wide Marina Management Plan addressing wind damage mitigation. Share the plan with local marinas and yacht clubs and encourage them to develop plans on their own.	<i>Delisted</i>	<i>The City participates in regional hazard mitigation projects. Completion of this action is the responsibility of, and is being performed by, SCCOG. This action is redefined as a regional capability, and is dropped.</i>
Consider a City ordinance establishing a process for how to notify property owners about dangerous trees on private property and their responsibility and liability for addressing trees if they fall and cause damage.	<i>Capability</i>	<i>The Tree Warden is responsible for notifying private property owners about dangerous trees. This action is reclassified as a capability.</i>
<u>Property Protection</u>		
Promote the use of functional shutters for older buildings in the City to guard against window breakage which can result in structural failure. Investigate funding sources to promote this relatively inexpensive type of retrofitting on a large scale.	<i>Delisted</i>	<i>The City does not feel that window blowout is a significant issue, nor that functional shutters are necessary. This action is dropped.</i>
The Building Department should make information on wind-resistant construction techniques (such as hurricane straps) available to all building permit applicants where applicable.	<i>Capability</i>	<i>Performed by the Building Department. This action is reclassified as a capability.</i>
Consider encouraging commercial building owners or managers of buildings with large population clusters to not only develop emergency response plans, but also to identify mitigation opportunities for long-range planning.	<i>Delisted</i>	<i>Major commercial property owners (Pfizer, Electric Boat) have such plans. The City feels that building insurers can be responsible for encouraging further planning by owners. This action is dropped.</i>
<u>Emergency Services</u>		
Identify a location or locations in the City for a brush disposal operation for dealing with debris after wind storms. Determine how these trees can be reused within the City (chips, firewood, composting) to reduce costs of exporting.	<i>Complete</i>	<i>City has designated the fields at the municipal complex as an emergency brush disposal area. This action is complete.</i>
Consider surveying all City-owned buildings to determine their ability to withstand wind loading.	<i>Complete/ Delisted</i>	<i>The City Hall complex was evaluated relative to wind risks during the Critical Facilities Assessment, and actions were not necessary for those buildings. The City does not feel this action is warranted for additional buildings, and instead seeks to survey buildings on a case-by-case basis if problems are detected. This action is dropped.</i>
Consider developing agreements with land owners and with companies to chop/chip in order to ensure that plans are in place prior to damage and cleanup needs (as is done for snow plow operations).	<i>Delisted</i>	<i>Because Groton City is highly developed, debris is not a major issue, and the DPW is capable of addressing cleanup needs. This action is deemed unnecessary and is dropped.</i>
Prioritize any wind-related retrofitting for the City's shelters over other critical facilities. If analysis reveals that another City building is a more appropriate shelter space, consider relocating the shelter to that location.	<i>Capability</i>	<i>Civil Preparedness Director monitors and manages shelter needs. This action is reclassified as a capability.</i>

Actions Applicable to Wind Hazards		
Action	Status	Status
<u>Public Education and Awareness</u>		
Post and maintain signs signifying evacuation routes from coastal areas.	<i>Carry Forward / Modify</i>	<i>Evacuation route signs exist, but the City wishes to install additional signage, especially in the southern area where alternate evacuation routes have been designated in case primary routes are flooded. That action is listed in section 11.1.2. This action is carried forward.</i>
Explore ways to perform public outreach to the community regarding wind hazards and continue to provide educational information on wind-associated risks at the Municipal Building.	<i>Capability</i>	<i>Educational materials are available at the Municipal Building and through the City Website. This action is reclassified as a capability.</i>
<u>Natural Resource Protection</u>		
Consider acquisition of coastal shorefront land at risk of flooding and convert to open space.	<i>Delisted</i>	<i>The City will perform this action if approached by property owners, but is not interested in pursuing acquisition of additional municipal property. This action is dropped.</i>

11.1.4 Actions Applicable to Other Damage from Winter Storms

Actions Applicable to Damage from Winter Storms		
Action	Status	Status
Consider drafting a written plan for inspecting and prioritizing the removal of snow from City-owned structures.	<i>Delisted</i>	<i>City does not feel a written plan is necessary - structures are inspected and snow removed as needed. This action is dropped.</i>
Continue making funding available to the Public Works Department each budget year for clearing snow from roads and parking lots.	<i>Capability</i>	<i>This action is reclassified as a capability.</i>
Continue to provide information for generally protecting City residents during cold weather and for mitigating icing and insulating pipes at residences.	<i>Capability</i>	<i>This information is available through the City website and at the Municipal building. This action is reclassified as a capability.</i>
Continue to identify areas that are difficult to access during winter storm events and develop contingency plans for emergency personnel.	<i>Capability</i>	<i>The City has not found any areas that are particularly difficult to access. Procedures are in place for assisting emergency response vehicles during winter storm events. This action is reclassified as a capability.</i>
Encourage the Connecticut DOT to remove snow from State roads in the City in a timelier manner.	<i>Capability</i>	<i>The City coordinates with the State during emergencies. This action is reclassified as a capability.</i>

11.1.5 Actions Applicable to Earthquakes

Action	Status	Status
Ensure that City departments have adequate backup supplies and facilities for continued functionality in case earthquake damage occurs to these buildings where these critical facilities are housed. This should be part of the regional critical facility study discussed in the Multi-Jurisdictional HMP.	<i>Capability</i>	<i>The City maintains backup supplies and participates in regional emergency planning efforts. This action is reclassified as a capability.</i>
Consider preventing residential development in areas prone to collapse such as below steep slopes or in areas prone to liquefaction.	<i>Delisted</i>	<i>There are not believed to be any slopes steep enough in the City.</i>

11.1.6 Actions Applicable to Wildfires

Action	Status	Status
Continue to evaluate fire flows, available water supply, and areas at risk of wildfire in the City.	<i>Capability</i>	<i>The City has no significant wildfire risk areas. The Fire Department continually evaluates water supply needs. The entire City is served by public water. This action is reclassified as a capability.</i>
Continue to support public outreach programs to increase awareness of forest fire danger, equipment usage, and protecting homes from wildfires. Educational materials should be made available online or at the Municipal Building.	<i>Capability</i>	<i>Educational material is available online and at the municipal building. This action is reclassified as a capability.</i>
Ensure that provisions of City regulations regarding fire protection facilities and infrastructure are being enforced.	<i>Capability</i>	<i>This action is reclassified as a capability.</i>

11.1.7 Actions Applicable to Dam Failure

None.

11.2 Prioritization of Specific Actions

As explained in Section 11.3 of the Multi-Jurisdictional HMP, the STAPLEE method was utilized in this annex to prioritize actions. Table 11-1 presents the STAPLEE matrix for the City of Groton. Each action includes the City department responsible for implementing the action, a proposed schedule, and whether or not the action is new or originally from the previous HMP. Refer to Section 2.7 for the list of previous plan actions and whether or not each action was carried forward into this HMP.

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Action or Strategy #	Table 11-1: Mitigation Actions and Strategies for City of Groton 2016 - 2021	Status	Responsible Department ¹	Fiscal Year					Cost	Potential Funding Sources ²	Weighted STAPLEE Criteria ³												Total STAPLEE Score	Priority for Community					
				7/2018-6/2019	7/2019-6/2020	7/2020-6/2021	7/2021-6/2022	7/2022-6/2023			Benefits						Costs												
											Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	STAPLEE Subtotal	Social	Technical (x2)	Administrative	Political			Legal	Economic (x2)	Environmental	STAPLEE Subtotal	
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.	New	EM		x				Low	OB	1	1	1	1	1	0.5	0	7.0	0	0	0	0	0	0	0	0.0	7.0	High	
2	Integrate additional elements of this HMP into the Plan of Conservation and Development during the next update of that plan.	Carried Forward	PL	x					Minimal	OB	1	1	1	1	1	0	0	6.0	0	0	0	0	0	0	0	0.0	6.0	Medium	
3	Work with the Town of Groton to create an open space corridor along Birch Plan Creek (called the "Greenbreak") and add land to the existing Birch Plain Creek Park.	Carried Forward	PL	x	x	x	x	x	High	CIB	1	1	1	1	1	1	1	9.0	0	0	0	0	0	-1	0	-2.0	7.0	High	
5	If property owners become interested, consider elevation or acquisition of residential properties that suffer flood damage.	Carried Forward	PL	x	x	x	x	x	High	CIB, HMA	0.5	1	1	1	1	1	1	8.5	0	0	0	0	0	-1	0	-2.0	6.5	Medium	
6	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.	Carried Forward	EM	x					Low	OB	1	1	1	1	1	0.5	0	7.0	0	0	0	0	0	0	0	0.0	7.0	High	
7	Develop formalized guidance for culvert and bridge construction and replacement that requires utilization of the most up-to-date extreme rainfall data from http://precip.eas.cornell.edu	New	DPW		x				Low	OB	1	1	1	1	1	0.5	0	7.0	0	0	0	0	0	0	0	0.0	7.0	High	
8	Consider elevating Shennecossett Road immediately east of Avery Point above the 1% annual chance floodplain.	Carried Forward	DPW				x		High	CIB	1	1	1	1	0.5	0.5	0.5	7.0	0	0	0	0	0	0	-1	0	-2.0	5.0	Low
9	Repair and clean the culverts near Shennecossett Beach.	Carried Forward	DPW			x			High	CIB	1	1	1	1	1	0.5	0.5	7.5	0	0	0	0	0	0	-1	0	-2.0	5.5	Low
10	Groton City Hall: Pursue short-term recommendation that drainage improvements be designed and constructed to minimize future risks of stormwater entering the basement.	New	DPW					x	Moderate	CIB	1	1	1	1	1	0	0	6.0	0	0	0	0	0	0	-0.5	0	-1.0	5.0	Low
11	Groton Public Works: Pursue short-term recommendation that public works buildings be wet and dry-floodproofed.	New	DPW	x					Moderate	CIB	1	1	1	1	1	0.5	0.5	7.5	0	0	0	0	0	0	-0.5	0	-1.0	6.5	Medium
12	Clearly mark Tyler Avenue as an alternate evacuation route with signage	New	EM			x			Low	CIB	0.5	1	1	1	1	0.5	0	6.5	0	0	0	0	0	0	0	0.0	6.5	Medium	
13	Post and maintain signs signifying alternate evacuation routes from coastal areas.	Carried Forward	EM				x		Moderate	CIB	1	1	1	1	1	0.5	0	7.0	0	0	0	0	0	0	-0.5	0	-1.0	6.0	Medium

¹Notes
DPW = Department of Public Works & Engineering
EM = Emergency Management
PL = Planning Department

²Notes
CIB = Capital Improvement Budget
EOC = EOC Grants
HMA = FEMA Grant Programs
OB = Operating Budget

³Notes
Beneficial or favorable ranking = 1
Neutral or Not Applicable ranking = 0
Unfavorable ranking = -1

Technical and Economic Factors have twice the weight of the remaining categories (i.e. their values are counted twice in each subtotal).

APPENDIX A

ADOPTION RESOLUTION

CERTIFICATE OF ADOPTION
CITY OF GROTON CITY COUNCIL

A RESOLUTION ADOPTING THE HAZARD MITIGATION PLAN UPDATE, 2017

WHEREAS, the City of Groton has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, dam failure, and wildfires*), resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Groton City Council approved the previous version of the Plan in 2012; and

WHEREAS, the Southeastern Connecticut Council of Governments, of whom the City of Groton is a member, has developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for its Hazard Mitigation Plan Update, 2017 under the requirements of 44 CFR 201.6; and

WHEREAS, committee meetings were held and public input was sought in 2016 and 2017 regarding the development and review of the Hazard Mitigation Plan Update, 2017; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedures for the City of Groton; and

WHEREAS, the Plan recommends several hazard mitigation actions that will provide mitigation for specific natural hazards that impact the City of Groton, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make the City of Groton eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the City Council:

1. The Plan is hereby adopted as an official plan of the City of Groton;
2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;
3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.
4. An annual report on the progress of the implementation elements of the Plan shall be presented to the City Council.

Adopted this _____ day of _____, 201_ by the City Council of Groton, Connecticut

Mayor

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of the City of Groton this _____ day of _____, 201_.

City Clerk

