TOWN OF LISBON ANNEX DOCUMENT

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

March 2023

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1. Introduction

1.1. Purpose of Annex

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

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

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

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

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

the Multi-Jurisdictional HMCAP with more specific detail for Lisbon and is not to be considered a standalone document.

1.2. Hazard Mitigation and Climate Adaptation Goals

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

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

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

2. Community Profile

Lisbon is a rural community in the north-central region of New London County that was settled as early as 1698 and incorporated in 1786. The community has since grown to a population of 4,069 as of the 2000 census. Additional growth over the next decade brought the total population of the town to 4,338 as of the 2010 census. The town is approximately 16.7 square miles in area and includes the village of Newent which is the Town Center. The Town is bordered by Norwich and Sprague to the west, Canterbury to the north, Griswold to the east, and Preston to the south.

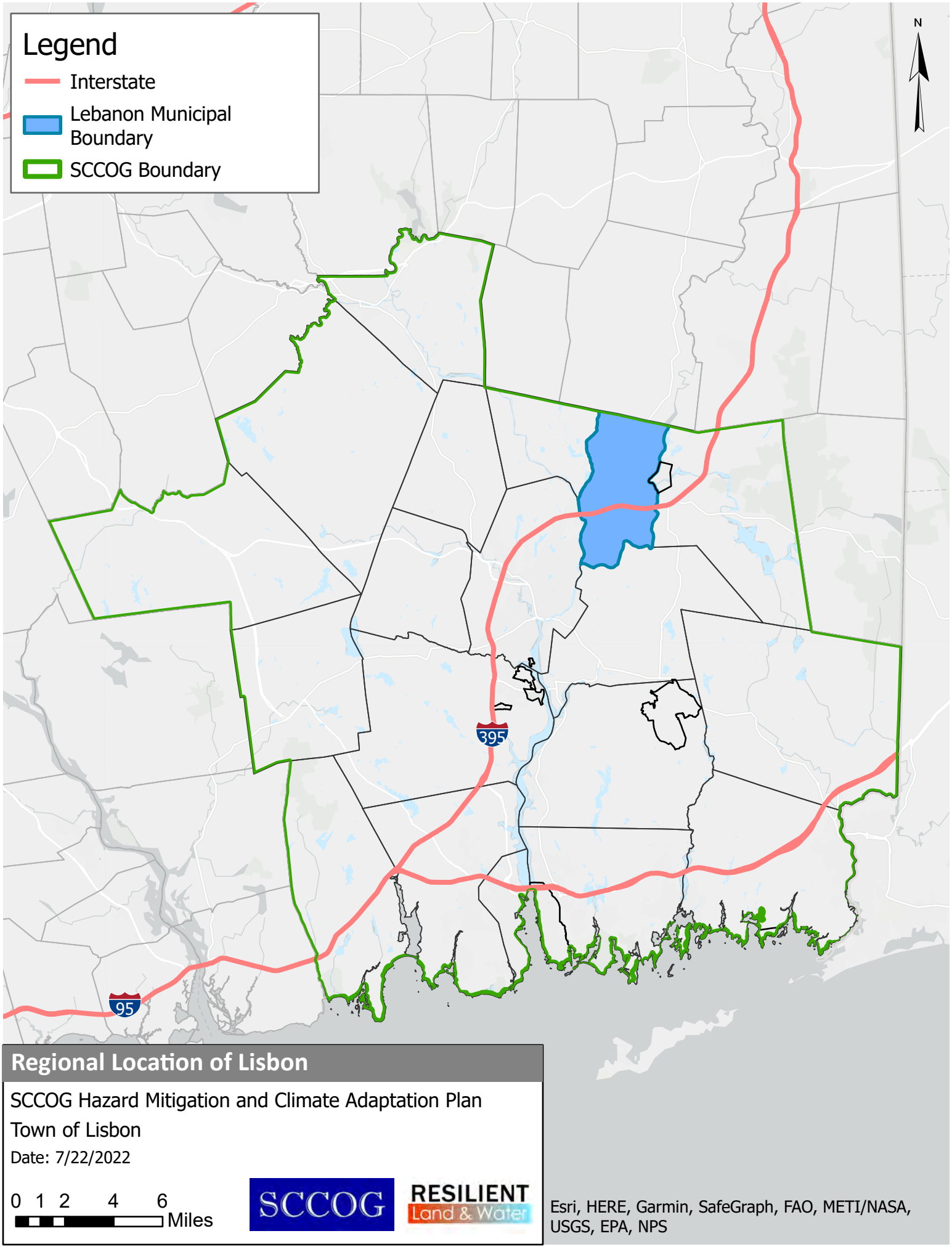
Several major transportation corridors traverse the town. Major roads include Interstate 395, Route 12, Route 138, and Route 169. Rail lines that travel through the town include two tracks belonging to the Providence/Worcester line: One runs along the Quinebaug River from Norwich into Jewett City, and the other enters from Versailles (Sprague), travels just south of Newent, and then turns northeast to follow the Quinebaug River into Canterbury. The rail lines allow residents and goods to travel between communities throughout southeastern Connecticut and the eastern seaboard.

Major waterways include the Quinebaug River (which drains from Canterbury and forms the boundary of Lisbon with Griswold to the east and Preston to the south) and the Shetucket River (which drains from Sprague and forms the boundary of Lisbon and Norwich). The Quinebaug River reaches its confluence with the Shetucket River in southwestern Lisbon. Shipping is not conducted on these rivers due to the presence of dams downstream in Norwich.

2.1. Physical Setting

The Town of Lisbon is located in the north-central section of the SCCOG. Elevations range from approximately 30 feet near the confluence of the Quinebaug and Shetucket Rivers to just over 380 feet in north-central Lisbon. Commercial development is concentrated along Route 12 with other commercial areas located sporadically throughout the town with other areas being predominantly rural.

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 Lisbon. Lisbon contains two bedrock types. The majority of Lisbon is underlain by the Tatnic Hill Formation, while a narrow band parallel to the town's eastern boundary is underlain by the Quinebaug Formation. Each of these formations consists primarily of gneiss and schist which are relatively hard metamorphic rocks. Two inactive faults lie beneath Lisbon. One fault is located in the southern portion of the town and is oriented northwest-southeast, while the second fault is located at the boundary between the two bedrock formations and is defined as a thrust fault that is likely Devonian or Ordovician in origin.



Regional Location of Lisbon

SCCOG Hazard Mitigation and Climate Adaptation Plan

Town of Lisbon

Date: 7/22/2022

The Town's surficial geologic formations include glacial till and stratified drift. Refer to the Multi-Jurisdictional HMP for a generalized view of surficial materials. The majority of the Town is underlain by glacial till. Till contains an unsorted mixture of clay, silt, sand, gravel, and boulders deposited by glaciers as a ground moraine. Areas adjacent to the Quinebaug River, the Shetucket River, Blissville Brook, and Old Stone Mill Brook have fairly extensive areas underlain by sand, sand and gravel or floodplain alluvium. 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. Drainage Basins and Hydrology

All land in the town eventually drains to the Shetucket River, although approximately half of the town first drains to the Quinebaug River. The northwestern corner of Lisbon drains to the Little River in Sprague via Old Stone Mill Brook. The Little River is a major tributary of the Shetucket River. The northern section of Lisbon drains via an unnamed stream to Cory Brook in Canterbury. Cory Brook is a tributary of the Quinebaug River. Other notable bodies of water found throughout Lisbon include Aspinook Pond (a major impoundment of the Quinebaug River), Taftville Pond (an impoundment of the Shetucket River), the lower reach of the Little River in western Lisbon near Versailles, Lisbon Brook in the southeastern portion of town, and Blissville Brook, and Blissville Pond in the southwestern portion of Lisbon.

The headwater streams of the Shetucket River are heavily flood controlled such that widespread flooding is no longer an issue along this watercourse. Three significant dams are located on Shetucket River in Norwich at Occum, Taftville, and Greenville, but they do not offer any flood abatement capacities. The eastern edge of the Taftville dam is located in Lisbon, while the Occum dam is located just upstream of Lisbon.

Similar to the Shetucket River, the upper reaches of the Quinebaug River are also heavily flood controlled such that flooding along this watercourse is also not an issue in Lisbon. Aspinook Pond is formed by a significant dam utilized for hydropower that spans from Lisbon into Jewett City.

2.3. Land Cover

According to the 2016 1-meter resolution land cover developed by the NOAA Office of Coastal Management, Lisbon is predominantly comprised of mixed forest, with approximately 68.99% of the town classified as such. The second largest land cover type is developed open space, which covers about 8.11%, and next is developed impervious which is about 5.65% of land cover. All land covers and their percent coverage can be found in Table 2-1.

Table 2-1 Town of Lisbon Land Cover

Land Cover Type (2016)	% Coverage
Barren Land	0.83
Cultivated Crops	1.83
Developed, Impervious	5.65

Developed, Open Space	8.11
Grassland/Herbaceous	3.70
Mixed Forest	68.99
Open Water	2.78
Palustrine Aquatic Bed	0.28
Palustrine Emergent Wetland	0.84
Palustrine Forested Wetland	2.75
Palustrine Scrub/Shrub Wetland	0.11
Pasture Hay	2.97
Scrub/Shrub	1.16

2.4. Population, Demographics, and Development Trends

As of the 2020 Decennial Census, the population for the town is 4,195, which equates to about 258 people per square mile. According to the 2016 *Plan of Conservation and Development* (POCD), Lisbon was a rural community for most of its history. After World War II, the proliferation of the automobile and regional growth spurred Lisbon to become a bedroom community as the population of Lisbon doubled between 1950 and 1970. While the pace of growth slowed over the next two decades, the completion of Interstate 395 facilitated the creation of major commercial and industrial developments in the town such as a regional waste-to-energy facility and a regional commercial center.

Lisbon continues to be a relatively undeveloped residential community. The town center is located in the area referred to as Newent near the intersection of Routes 138 and 169. Several important buildings including the Town Hall, fire station and senior center are located in this area. Lisbon is also known for its historical sites such as the Bishop House Museum, Anshei Israel Synagogue, and the first railroad tunnel in America. Lisbon Meadows Park is near the town center with recreational fields for soccer and baseball and many hiking trails. Lisbon developed an Open Space Plan, approved on May 19, 2015, which lays out a strategy to achieve the goal of preserving 15% of all land area in Lisbon as open space.

The 2016 Lisbon POCD lists the Town's 2015 land use as 15% residential, 6% business, 1% committed open space, 1% institutional, and 8% agriculture. Based on the POCD, about 69% of the Town is considered undeveloped or underdeveloped. The main changes between the data provided in the 2016 POCD and the 2004 POCD are the conversion of residential land use to commercial, and re-categorization of land based on new land-use definitions (for example, many residential parcels were re-categorized as to "underdeveloped" or agriculture).

The majority of housing units in Lisbon are single family homes (83%). After accounting for zoning and development constraints such as steep slopes, wetlands, and floodplains, the 2004 POCD estimated that an additional 3,000 housing units could be constructed in the future, yielding approximately 8,000 additional residents. Such an increase would require a noticeable increase in municipal services, particularly with regard to emergency services. The amount of land available for housing development has not changed significantly since the 2004 POCD.

Local employment in Lisbon is approximately 800 non-agricultural jobs. These include construction and manufacturing, retail and wholesale, and service occupations. The most focused commercial area is located along Route 12 near Jewett City, but small commercial areas are also interspersed throughout the town.

The net gain in housing units between 2005 and 2010 was 40. The most densely developed areas include the Kimball Road area near Canterbury and the area surrounding Blissville Pond which includes densely developed homes and a trailer park. Since the last HMP was written in 2012, development has continued to be relatively slow. Approximately four new subdivisions have been constructed over the past five years. Two commercial developments that were being planned in 2012 were abandoned and remain incomplete. Currently, the Barber Farm Road development, between Mell Road and River Road, is beginning construction on 32 one- to five-acre residential lots.

No new industry has been developed in the past five years.

The Town of Lisbon acquired two tracts of land for open space preservation since the previous HMP:

- Lisbon Country Club Property: 48 acres of land off of Kendall Road adjacent to Kendall Pond. This property is partially within the floodplain of Blissville Brook.
- Old Burnham Tavern Property: 98 acres off of North Burnham Highway. This includes the historic Old Burnham Tavern Building.

The 2020 American Community Survey 5-year estimates identified the annual average median income for Lebanon to be $86,641, with an average of 23.8% of the population holding a bachelor's degree or higher, and an average unemployment rate of 4.4% throughout the city.

2.5. Governmental Structure

Lisbon is governed by a Town Meeting and Board of Selectmen form of government. The authority of Town officials is granted by Connecticut General Statutes. The Town Meeting is the legislative body of the Town and the Board of Selectmen is responsible for the administration of Town policies. The First Selectman is the chief elected official and is responsible for the day-to-day administration of the Town. The First Selectman serves as Highway Superintendent overseeing the building and maintenance of all roads including plowing and sanding in the winter. In addition to the First Selectman, the Building Department, Public Works, and the Volunteer Fire Department also have an active role in hazard mitigation.

The Town of Lisbon has several commissions that can take an active role in hazard mitigation, including the Conservation Commission, the Planning and Zoning Commission, and the Zoning Board of Appeals. Departments and commissions common to all municipalities in SCCOG and were described in Section 2.8 of the Multi-Jurisdictional HMP. More specific information for the departments and commissions of the Town of Lisbon is noted below:

- The Building Official reviews plans for new development and significant redevelopment and inspects the work to ensure it meets current building codes. The Town of Lisbon utilizes the Connecticut Building Code.

- The Conservation Commission is the Inland Wetlands Regulatory Agency for the Town of Lisbon and reviews plans for compliance with said regulations and maintains the Town's inland wetlands map.
- The Planning & Zoning Commission reviews land use applications, zoning regulation amendments, planning and development projects, and grant opportunities to ensure that development and growth in the town is consistent with existing land use, environmental policy, and the objectives of the *Plan of Conservation and Development*. They are assisted by the Zoning Enforcement Officer. SCCOG provides town planning services.
- The Public Works Department consists of a Road Foreman and several staff overseen by the First Selectman. They provide services including safe, efficient and well-maintained infrastructure of roads, bridges, snow removal and deicing on roads; tree and tree limb removal in rights-of-way; and maintain and upgrade storm drainage systems to prevent flooding caused by rainfall.
- The Lisbon Volunteer Fire Department provides fire suppression, fire prevention, rescue, emergency medical services, and hazardous materials response services to the town. Patients are transported to Backus Hospital in Norwich.
- The Zoning Board of Appeals reviews projects that were denied by the Planning & Zoning Commission or were cited by the Zoning Enforcement Officer, as well as those that require variances.

The roles of Town departments have not changed since the time of the previous HMP. Thus, the Town of Lisbon remains technically, financially, and legally capable of implementing mitigation projects for natural hazards to the extent that funding is available.

2.6. Review of Existing Plans and Regulations

The Town 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,* Zoning Regulations, Subdivision Regulations, and Inland Wetland Regulations. The Zoning and Subdivision Regulations were both recently updated to incorporate new NFIP requirements.

Emergency Operations Plan

The Town has an Emergency Operations Plan (EOP) that is updated and certified by the First Selectman annually. This document provides general procedures to be instituted by the First Selectman and/or designee and the Fire Department in case of an emergency. The Town has a volunteer Emergency Management Director who is only activated during emergencies. Emergencies can include but are not limited to natural hazard events such as hurricanes and nor'easters. The EOP is directly related to providing emergency services prior to, during, and following a natural hazard event.

Plan of Conservation and Development (2016)

The POCD was most recently updated in 2016 with contributions from local boards, commissions, committees, citizens and citizen groups. The Plan seeks to be a statement of policies, goals and standards for the physical and economic development of the City and recommends the most desirable use types and population densities in various parts of the municipality.

The 2016 Town of Lisbon POCD includes the following items:

- **The POCD states that efforts are underway to acquire more open space in flood hazard zones, referencing the 2012 Hazard Mitigation Plan's recommendation.**
- The town maintains storm drainage systems to prevent flooding during rainfall.
- The POCD acknowledges that the town does not have a backup shelter for the Lisbon Center School shelter. If additional space was needed, the town would have residents seek refuge in a regional Red Cross shelter.
- The Plan outlines areas that cannot be built upon due to natural features that restrict development.
- Future development will seek to strengthen the Newent area, with residential development occurring on large lot sizes outside of this village area.

The Lisbon POCD is considered consistent with the current goals and actions of the hazard mitigation plan, although it does not directly address several of the hazards such as winter storm hazards and wind hazards. The next update to the POCD (scheduled for 2026, within the life of the current hazard mitigation plan) will continue to incorporate the elements of the hazard mitigation plan.

Zoning Regulations

The Zoning Regulations of the Town of Lisbon were last revised in January 2022. The most recent updates do not address hazard mitigation. Previous updates include updated NFIP regulations associated with the recent release of the FIS and DFIRM for New London County in July 2011 and 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. The regulations meet the minimum requirements required under the NFIP.

In addition to the Special Flood Hazard Area Regulations (Section 10.15), the Zoning Regulations contain several other entries applicable to hazard mitigation. For example, flat roofs are not allowed in business village districts for certain commercial facilities. The buildable areas of any lot excludes wetlands, watercourses, water bodies, the 1% annual chance floodplain, wetland buffer areas (50 foot minimum), detention areas, slopes in excess of 20%, rock or ledge outcrops, easements, rights-of-ways, and other setback areas, reducing the potential development density. Certain types of development, such as commercial and industrial areas, must locate utilities underground. Mobile home upgrades must have sloped shingled roofs and meet all Connecticut Building Codes for mobile homes, providing an additional level of protection for these vulnerable structures.

Subdivision Regulations

The Subdivision Regulations of the Town of Lisbon were last updated on January 4, 2022 This most recent update added a requirement in Section 7.5 that "all new utilities necessary for the development of the site shall be installed underground." Several other design standards are pertinent to hazard mitigation, including encouraging the creation of through streets, avoidance of steep grades for new roads, and that new facilities are designed to minimize flood damage. New developments are also required to set aside open space.

Inland Wetland and Watercourses Regulations

The Inland Wetlands and Watercourses Regulations in the Town of Lisbon were last amended on April 1, 2012. The regulations require a permit for certain regulated activities which take place within 100 feet of a wetland or watercourse or that may impact a wetland or watercourse. These regulations build on the preventative flood mitigation provided by the Zoning and Subdivision regulations by preventing fill and sedimentation that could lead to increased flood stages.

2.7. Critical Facilities, Sheltering Capacity, and Evacuation

The Town of Lisbon considers several facilities to be critical to ensure that emergencies are addressed while day-to-day management of the Town continues. Critical facilities are presented on figures throughout this annex and summarized in Table 2-2. No critical facilities are located within the 1% annual chance floodplain. These facilities are described in more detail below.

Table 2-2 Town of Lisbon Critical Facilities

Facility	Address or Location	Emergency Power	Shelter	Cooling Center	In SFHA
Emergency Services					
Resident State Trooper	23 Newent Rd				
Volunteer Fire Department*	7 Newent Rd	✓			
Municipal Facilities					
Lisbon Central Elementary School	15 Newent Rd	✓	✓		
Public Works Garage	486 River Road				
Town Hall	1 Newent Rd				

* Emergency Operations Center

Emergency Operations Center

The Lisbon Office of Emergency Management operates during times of emergency out of the Lisbon Fire House (the Emergency Operations Center).

Public Works Garage

Since the previous edition of the HMP in 2012, the Town Public Works garage has been relocated to a building that had previously been a Connecticut Department of Transportation facility. This is located at 486 River Road, at the southern end of the Town. Through an agreement between the Town of Lisbon and the CT DOT, Lisbon has assumed use of the property while ownership continues to lie with the State.

The Public Works garage had previously been located in a building behind Lisbon Central School. While that facility was located centrally, space constraints and shared access with Lisbon Central School created a need to relocate. The old site is now used as storage by the Senior Center, the Fire Department, Parks and Recreation, and Town Offices.

The current location has the space and access necessary for all its functions. It is used for vehicle and equipment storage and also houses the Town's salt and sand supply.

Since the 2012 edition of the HMP, the Public Works department has purchased a new $120,000 work truck.

Resident State Trooper

Lisbon participates in the Connecticut Resident State Trooper program to meet its law enforcement needs. The trooper's office is located in a building behind the Lisbon Central School.

Town Hall

The Lisbon Town Hall houses records, plans, and other documents important for administering the Town. It does not have emergency backup power. The 2016 POCD indicates that the Town Hall does not have sufficient space to meet its needs for meeting spaces, storage, and other typical municipal uses. The Town has begun to use the old Public Works garage for storage. That POCD also indicates the building's HVAC system requires replacement.

Lisbon Volunteer Fire Department

The Lisbon Fire Department provides fire suppression, rescue, and emergency medical services. The Fire Department operates out of a station in Newent this is part of the municipal complex. This building also includes the Town's Emergency Operations Center and has a generator for emergency power. The Fire Department utilizes Blissville Pond to fill and empty the fire trucks of water.

The 2016 POCD notes that the fire station continues to experience space shortages for the purposes of training programs and records management. The department has begun to use the old Public Works garage for additional storage.

Additionally, although adequate for the equipment and supplies currently in use, additional or larger new equipment as the community grows will require expansion or relocation of the fire station.

Shelters

Lisbon Central Elementary School is the Town's shelter and can hold approximately 150 people. The school has a generator, and the shelter is American Red Cross certified. The Town does not have a secondary or backup shelter. If additional space was needed, the Town would send people to a regional American Red Cross Shelter.

Communications

The Town's communication capability is considered adequate for most circumstances. Emergency communications are good except during long power outages. The Town relies on radios, cellular phones and email for much of its communications. The Town is also part of the CT Alerts "Everbridge" Reverse 9-1-1 system for emergency notification of residents. Typically, Town personnel post notifications on bulletin boards and on the Town website prior to major storms and also utilize local media (newspapers, television, and radio) to pass information during and after storms. Residents can also contact the First

Selectman directly with comments related to natural hazards or emergency response or can use a contact tool on the Town's website.

Communication was difficult during the power outages following Hurricane Irene and Winter Storm Alfred due to downed trees and power outages at the nearby cellular towers. Town personnel made personal contact with residents by going door-to-door during the outage to pass along necessary information.

Health Care and Senior Living Facilities

The Town does not have any convalescent or nursing homes, senior homes, or complexes. The Town has one doctor's office and one physical therapy center, but no walk-in medical facilities. None of these facilities are considered by the Town to be critical facilities.

Evacuation Routes

Lisbon does not have a published evacuation map; residents utilize State roads or local roads to exit the town. The highest capacity egress routes from Lisbon include Interstate 395 into Norwich or Griswold, Route 138 into Griswold or Sprague, Route 169 into Norwich or Canterbury, and Route 12 into Norwich or Griswold.

Additional Groups

Lisbon has one in-home day care but no commercial day-care centers. These are not considered to be critical facilities.

In addition to Town departments, the American Red Cross and the Salvation Army provide services related to mitigation and emergency management. The American Red Cross and the Salvation Army help provide shelter and vital services during disasters and participate in public education activities.

Space Needs and Future Changes

Lisbon has conducted an assessment of space needs for its municipal functions and generated an internal report titled "2011 Space Needs Assessment for Lisbon Public Safety Facility in Lisbon, CT." The relocation of the Public Works garage and reallocation of the old garage space as storage was one result of this assessment.

Based on the results of this assessment, the Town is pursuing construction of a Public Safety Complex. This project, expected to cost four to five million dollars, is currently in the design phase and is awaiting approval by residents. Completion of the project should improve all municipal functions, especially emergency management and response.

2.8. Repetitive Loss Properties

A repetitive loss (RL) property is defined as any insurable building that has had two or more claims exceeding $1,000 that were paid by the National Flood Insurance Program (NFIP) within a ten-year period. As of June 2022, the Town of Lisbon has no RL properties.

2.9. Exposure to Climate-Affected Natural Hazards

Properties, people, historic resources, and critical facilities in the Town are exposed to natural hazards affected by climate change (i.e., severe storms, coastal flooding, droughts) as well as hazards that are not affected by climate change (i.e., earthquakes). As an initial screening of exposure to hazards, areas of risk have been overlaid onto parcel and point data in a GIS to understand the maximum potential exposure to hazards. The results of this analysis are found in Table 2-3.

Table 2-3 Town of Lisbon Exposure Analysis

Hazard	At-Risk Parcels		At-Risk Facilities		At-Risk Historic Assets	
	Value	Number	Value	Number	Value	Number
Hurricane/Tropical Storm	$395,277,350	1,930	$9,024,880	4	$1,459,160	7
Severe Thunderstorm	$395,277,350	1,930	$9,024,880	4	$1,459,160	7
Severe Winter Storm	$395,277,350	1,930	$9,024,880	4	$1,459,160	7
Tornado	$395,277,350	1,930	$9,024,880	4	$1,459,160	7
Drought	$341,452,900	1,750	$9,024,880	4	$1,401,950	6
Flood						
1% Annual Chance	$30,570,750	213	-	-	-	-
0.2% Annual Chance	$44,134,220	221	-	-	-	-
Earthquakes	$395,277,350	1,930	$9,024,880	4	$1,459,160	7
Wildfire	$270,911,610	1,480	$9,024,880	4	$1,401,950	6

2.10. Community Climate Change Challenges

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

Climate Change Summary Sheet for Town of Lisbon

What are the Town's Top Climate Change Concerns?

Flooding: Newent Road flooded badly during the significant rain event of September 2022, revealing previously unapparent flood risks along this important corridor.

Extreme Heat: The Town has increasing concerns about the effects of extreme heat events on vulnerable populations such as seniors.

Others: Drought and wildfire risks are believed increasing in the town.

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

Flooding: Undertake an engineering study to identify flood risk reduction options along the Newent Road corridor.

Extreme Heat: Identify a permanent cooling center and ensure that standby power is available to operate the air conditioning; and ensure that transit or alternate transportation options are available for people to reach the cooling center.

Others: Extend public water systems from Norwich Public Utilities and Jewett City Water Company as needed to reduce drought impacts to properties currently served by private wells; and to provide fire protection.

3. Extreme and Severe Storms

3.1. Climate Change Impacts

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

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

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

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

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

3.2. Hurricanes and Tropical Storms

3.2.1 Setting and Recent Occurrences

Several types of hazards may be associated with tropical storms and hurricanes including heavy or tornado winds, heavy rains, and flooding. Flooding hazards are discussed in Section 3 of this annex. Wind hazards are widespread and can affect any part of the town. However, some buildings in the town are more susceptible to wind damage than others.

Hurricane Irene impacted the area in August 2011. Trees fell throughout the town and the region causing power outages that lasted up to seven days in Lisbon.

In late October 2012, Super Storm Sandy struck the area with high winds and heavy rains. The wind damaged trees and knocked out power in many areas. Town staff report power loss lasting up to 2.5 weeks in some areas.

[1] https://nca2018.globalchange.gov/chapter/2/

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

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

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

- July 9, 2021 (T.S. Elsa) – Elsa made landfall as a tropical storm in Florida and traveled along the eastern seaboard. It passed through Southeastern New England bringing high winds and rainfall. Gusts were reported over 40 mph, and residents throughout the region and state were left without power.
- August 19, 2021 (Extratropical Storm Fred) – This tropical event passed north of the state bringing heavy rain to some areas in Connecticut; there was a reported 5.14 inches in West Hartford. Fred also produced an EF-0 tornado in Windham County.
- August 22, 2021 (T.D. Henri) – Hurricane Henri made landfall in Rhode Island as a tropical storm and then traveled northwest across the State of Connecticut. While the impacts for Henri were projected to be more severe than they actually were, the storm did result in heavy rainfall and thousands of power outages.
- September 1, 2021 (Extratropical Storm Ida) – Though Hurricane Ida made landfall in Louisiana as a category 1, the storm moved south of Long Island as an extratropical storm and is reported to be costliest storm even since Hurricane Sandy a decade earlier. Ida caused major flooding across Connecticut and the Southeastern Region. For the first time, a statewide flash flood warning was issued. Several communities in the state, including the City of Norwich, warned residents to have minimal contact with surface waters due to the discharge of untreated sewage. There were reports of 7 to 8 inches of rainfall in the Southeastern Region, and as high as 8.58 inches in Uncasville. Lisbon experienced some road closures due to flooding including Route 169 at Ames Road which had water over the roadway. Part of Route 169 also washed out at the Lisbon/Canterbury line.

3.2.2 Existing Capabilities

Wind loading requirements are addressed through the state building code. The Connecticut State Building Code was most recently adopted with an effective date of October 1, 2022. The code specifies the design wind speed for construction in all the Connecticut municipalities. The basic design wind speed for Lisbon ranges from 115 to 140 miles per hour, and the ultimate design wind speed is 125 miles per hour; speed used in design depends 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.

Lisbon has adopted the Connecticut Building Code as its building code. The building official makes information on wind-resistant construction techniques available to all building permit applicants.

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 town. Lisbon has a Tree Warden who can post notifications and schedule tree removal. The Public Works staff also monitors trees as part of their normal rounds, performs informal inspections for the tree warden, and has a small budget for minor tree maintenance. The Town hires outside contractors for larger jobs and those near power lines.

The Tree Warden coordinates tree removal and maintenance with Eversource, the local power utility. In response to the major power-outages caused by Tropical Storm Irene and Hurricane Sandy, as well as significant winter storm events, Eversource has taken an aggressive approach to tree maintenance and has improved communication and coordination with municipalities. Municipal staff report that Eversource has enhanced its tree clearing efforts along power lines, has updated its facilities, and has been working to strengthen the power grid and build in redundancies. Communication and coordination have improved due to Eversource's liaison program.

Algonquin Gas also performs trimming near their utilities. AT&T and Comcast (telephone and cable) may also perform some trimming.

Every spring, and as needed after storm events, Lisbon collects fallen debris and brings it to the Public Works Garage. This has been sufficient up to this point, but the Town is interested in identifying and designating an additional brush disposal location.

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 Town 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 Town to activate its EOP and encourage residents to take protective or evacuation measures if appropriate. The Lisbon schools include wind hazard education in their general hazard education programming.

Prior to severe storm events, the Town ensures that warning/notification systems and communication equipment are working properly and prepares for the possible evacuation of impacted areas. Residents can sign up to receive warnings from the statewide CT "Everbridge" Reverse 9-1-1 system to receive critical information. Although hurricanes that have impacted Lisbon have historically passed in a day's time, additional regional shelters could be outfitted following a storm with the assistance of the American Red Cross on an as-needed basis for long-term evacuees.

Summary

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

3.2.3 Vulnerabilities and Risk Assessment

The entire Town is vulnerable to hurricane and tropical storm wind damage and from any tornadoes (Section 3.3) accompanying the storm, as well as inland flooding (Section 5.2). Of particular concern are the blockage of roads and the damage to the electrical power supply from falling trees and tree limbs. The Town had extensive outages in some areas because of tree damage to utility lines following Tropical Storm Irene in 2011, Hurricane Sandy in 2012, and Tropical Storm Isaias in 2020

Direct wind damage to newer buildings from hurricane or tropical storm-level winds is rare in the Town since the new buildings were constructed to meet or exceed current building codes. Many buildings in the Town are historic and many were built prior to the 1970s and do not meet current building codes. Older buildings in the Town (particularly within Newent) and the two mobile home parks (located east of Blissville Pond and on Tunnel Hill Road) are particularly susceptible to roof and window damage from high wind events. This risk to structures will be reduced with time as these buildings are remodeled or replaced with buildings that meet current codes.

The strength of a large hurricane could cause a moderate economic impact to the town. The potential economic effect of wind damage to SCCOG was evaluated in the Multi-Jurisdictional HMP. A separate analysis was not performed specifically for Lisbon.

3.2.3.1 Hazard Losses

The Town of Lisbon did not receive FEMA PA funds in the wake of Tropical Storm Isaias. Since 2012, the town has not received FEMA PA funds for any hurricane event.

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

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

Table 3-1 HAZUS-MH Hurricane Related Economic Impacts

Lisbon	Return Period	Residential	Commercial	Industrial	Others	Total
	10-year	$25,640	$0	$0	$0	$25,640
	20-year	$584,800	$50,110	$1,030	$7,790	$643,730
	50-year	$3,187,120	$381,980	$5,470	$52,570	$3,627,140
	100-year	$6,360,460	$1,263,530	$17,770	$470,700	$8,112,460
	200-year	$11,439,490	$2,949,710	$49,500	$969,740	$15,408,440
	500-year	$23,557,390	$7,418,700	$149,550	$2,394,410	$33,520,050
	1,000-year	$35,538,460	$11,530,860	$256,260	$3,146,880	$50,472,460

Table 3-2 HAZUS-MH Hurricane Related Building Damages

Lisbon	Return Period	Minor	Moderate	Severe	Destruction	Total
	10-year	1	0	0	0	1
	20-year	5	0	0	0	5
	50-year	67	4	0	0	71
	100-year	174	18	1	0	193
	200-year	305	48	3	1	357
	500-year	468	114	12	7	601
	1,000-year	551	167	24	13	755

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

Lisbon	Return Period	Debris Generated (Tons)	Households Displaced	Individuals Seeking Temporary Shelter
	10-year	5	0	0
	20-year	86	0	0
	50-year	872	0	0
	100-year	1,435	0	0
	200-year	2,396	0	0
	500-year	4,635	4	0
	1,000-year	6,471	12	4

3.3. Tornadoes and High Wind Events

3.3.1 Setting/Historic Record

Similar to hurricanes and winter storms, wind damage associated with severe thunder or summer storms and tornadoes has the potential to affect any area of the town. 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 town without harming another. Such storms occur in the town each year, although hail and direct lightning strikes to the town are rarer. For example, the NCDC reported that penny-sized hail was reported in Lisbon on June 26, 2009, but no other occurrences were reported.

No tornadoes have occurred in the town since the last HMP was adopted in 2017. Severe storms have impacted the region, however, since the last update. Recent severe storm events include:

- On September 6, 2017, a cold front triggered severe storms in the county and caused tree damage in multiple communities in the region. Nearby Colchester reported trees and wires down, and the Groton-New London Airport measured sustained winds at 44 mph and gusts of 56 mph.
- On April 13, 2020, a low pressure system resulted in high winds throughout New London County.

- June 6, 2020, severe thunderstorms impacted Southern Connecticut, causing downed trees throughout the Town of Lisbon.
- September 9, 2021, a slow moving frontal boundary triggered severe thunderstorms in the area causing trees and power lines to come down Lisbon in addition to a transformer fire.
- On November 13, 2021, a tornado touched down in Pawcatuck, and another in Plainfield. There were reports of uplifted trampolines, downed trees and powerlines, and an uplifted metal shed. This same storm also caused damage in other surrounding communities.

3.3.2 Existing Capabilities

Warning is the most viable and therefore the primary method of existing mitigation for tornadoes and thunderstorm-related hazards. The NOAA National Weather Service issues watches and warnings when severe weather is likely to develop or has developed, respectively. The Town 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 Town 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 Town as explained in Section 3.2.2 within the context of hurricanes and tropical storms. In addition, the Connecticut Building Code includes guidelines for the proper grounding of buildings and electrical boxes to protect against lightning damage.

Summary

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

3.3.3 Vulnerabilities and Risk Assessment

Summer storms are expected to occur each year and are expected to at times produce heavy winds, heavy rainfall, lightning, and hail. All areas of the town 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 town, and mobile home parks and campgrounds are more vulnerable to summer storm damage.

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 town's strong fire response.

Lightning and hail are generally associated with severe thunderstorms and can produce damaging effects. All areas of the town 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 town. Older buildings and mobile homes are most susceptible to lightning and hail damage since many 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 town exists, it is considered to be an event with a very low probability of occurrence.

3.3.3.1 Hazard Losses

Since 2017, there have been two NOAA reported events associated with a severe thunderstorm and wind event. One event on June 6, 2020, resulted in downed trees causing a reported $2,000 in damage. The second on September 9, 2021 which caused downed trees, wires, and a transformer fire, resulted in a reported $8,000 in damages. A total of $11,500 in damages have been reported by NOAA since 2012 for thunderstorm related wind damages. Downscaled losses based on the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document.

3.4. Severe Winter Storms

3.4.1 Setting and Recent Occurrences

Similar to hurricanes and summer storms, winter storms have the potential to affect any area of the town. 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 town.

Some of the winter storms and nor'easters that have affected the town in the past decade, including two that resulted in disaster declarations, include:

- The winter of 2010-2011 produced significant snowfall in Lisbon. The Town checked all flat-roofed buildings and while the school was a concern, it was not cleared and did not experience any damage. Many residents also cleared their own roofs or hired contractors. Several mobile homes experienced roof damage related to snow loading.
- Winter Storm Alfred in late October 2011 caused minor to moderate tree damage, with power outages lasting up to three days.
- On February 8, 2013, a low pressure that formed along the northern Gulf coast by the morning of Thursday, February 7, 2013, moved northeast to near Cape Hatteras by the morning of Friday, February 8, 2013. The low then rapidly intensified while moving northeast to a position east of Cape Cod by the morning of Saturday, February 9, 2013, producing blizzard conditions and very heavy snowfall across southern Connecticut on February 8th and 9th. Groton Airport ASOS (KGON) reported at least 3 consecutive hours of blizzard conditions. Snowfall began at 7:40 am on February 8. Spotters reported an average snowfall of 6 inches by 7:50 pm. Total snowfall ranged from 15 inches in Stonington to as much as 23.6 inches in Old Lyme. Winds also gusted as high as 60 mph at Groton Airport.
- On February 9, 2017, a blizzard impacted the region, with frequent gusts of over 35 mph, and visibility of less than a quarter mile. Snowfall was over one foot and caused substantial travel disruptions throughout the region.

Some of the more recent significant winter events include:

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

3.4.2 Existing Capabilities

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

As it is almost guaranteed that winter storms will occur annually in Connecticut, it is important to locally budget fiscal resources toward snow management. Snow is the most common natural hazard requiring additional overtime effort from Town staff, as parking lots and roadways need constant maintenance during storms. The Public Works Department oversees snow removal in the Town and stores salt and sand at the Public Works Garage. The Town has established plowing routes that prioritize access to and from critical facilities. Overall, Lisbon feels its snow removal program is satisfactory.

The DPW has identified areas that are difficult to access during winter storm events. These include two privately-owned trailer parks and one small community at the end of a mile-long private dirt road. The DPW monitors the state of these roads in particular and is prepared to assist with emergency access to these areas and others during hazardous conditions.

The Connecticut Department of Transportation (DOT) plows State roads. Since the nearest Connecticut DOT facility is located nearby in Occum (Norwich), plowing is generally timely.

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 Town monitors the roofs of municipal buildings when snow loads accumulate and shovel if necessary, and many residents and businesses also shovel or plow their roofs.

Lisbon posts information on its website for Town residents about protecting themselves during cold weather and about mitigating icing and insulating pipes at residences.

Summary

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

3.4.3 Vulnerabilities and Risk Assessment

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

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

The majority of buildings in Lisbon were constructed within the past several decades and therefore not particularly susceptible to damage from heavy snow. While some Town buildings could be susceptible to heavy snow loads, they will be cleared quickly if safety is a concern. For example, Lisbon Central Elementary School has a flat roof which makes it more susceptible to snow load damage.

Icing is not a significant issue in the Town. In general, there are few steep slopes such that extra sanding and salting of the roadways in necessary locations alleviates any trouble spots. In addition, there are no issues with ice jams on any of the streams in the town. However, a few private roads in town are problematic for emergency response during the winter. For example, Pleasant View Cove Road is a nearly two-mile long unimproved road that includes a private railroad crossing. The road is very hilly and relatively narrow, making the road essentially one lane during winters with significant snow accumulation.

3.4.3.1 Hazard Losses

There have been no reported winter storm losses for the Town of Lisbon since 2017. In the past decade, the city has received FEMA PA funds in the amount of $69,757 for winter storms. Downscaled losses based on the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document.

4. Sea Level Rise

4.1. Climate Change Impacts

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

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

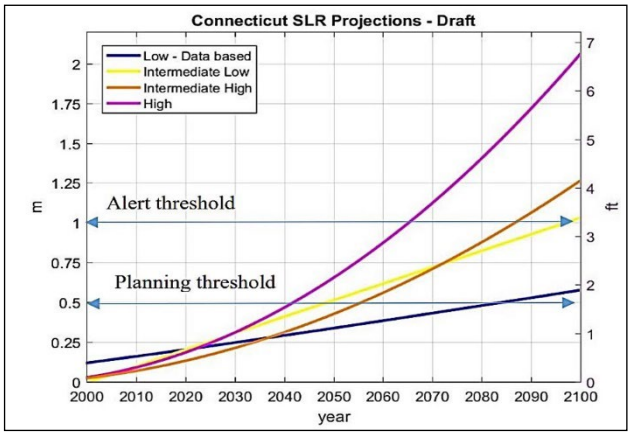


Figure 4-1 Four Localized Sea Level Rise Scenarios for

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

4.2. Coastal Flooding

4.2.1 Setting and Recent Occurrences

Lisbon is not located along the coastline nor is it located in a potential hurricane surge zone. As such, no coastal flooding or storm surge has affected the town since the last HMP. Therefore, the town is not considered to be affected by coastal flooding and storm surge.

4.2.2 Existing Capabilities

Due to the town not being on the coast, it does not have and/or need regulations to restrict development due to coastal flooding hazards.

4.2.3 Vulnerabilities and Risk Assessment

No areas of the town are vulnerable to coastal flooding or storm surge.

4.2.3.1 Hazard Losses

There are no reported losses for the Town of Lisbon related to coastal flooding.

4.3. Shoreline Change

4.3.1 Setting and Recent Occurrences

Lisbon is not located along the coastline nor is it located in a potential hurricane surge zone. Therefore, the town is not considered to be affected by shoreline change.

4.3.2 Existing Capabilities

Due to the town not being on the coast, it does not have and/or need regulations to restrict development due to shoreline change.

4.3.3 Vulnerabilities and Risk Assessment

No areas of the town are vulnerable to shoreline change.

4.3.3.1 Hazard Losses

There are no reported losses for the Town of Lisbon related to shoreline change.

5. Changing Precipitation

5.1. Climate Change Impacts

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

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

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

5.2. Riverine and Pluvial Floods

5.2.1 Setting/Historic Record

Flooding is the primary hazard that impacts the town each year as documented in the previous HMP. While riverine flooding is a concern, nuisance flooding and poor drainage have historically been the primary flooding issues at several locations in the town. Flooding is typically caused by heavy rainstorms, but can also be caused by relatively light rains falling on frozen ground. Flooding of roadways is more common than damage to structures. Nuisance flooding (basement flooding) is the most common type of flooding in Lisbon.

The March 2010 storms continue to be considered the event that caused the most widespread flooding in Ledyard since the town began participating in the multi-jurisdiction hazard mitigation plan. These floods caused roadway flooding and a significant amount of nuisance flooding as noted below. Structures were not directly affected by overbank flooding, including those located in the 1% annual chance floodplain.

- Drainage systems on Bundy Hill Road, Ames Road, Ice House Road, and Lower Blissville Road that pass Blissville Brook are considered by the Town to be undersized. These roads were all overtopped during the March 2010 floods.
- Homes in the Pleasant View Cove area adjacent to Aspinook Pond came close to flooding but did not flood.
- While the Town does not have records of the exact number of residents who needed their basements pumped out by the Fire Department's mobile equipment, the Town recalls that the number of homes affected exceeded any other storm in recent memory. Many homes that were affected had never needed pump outs previously.

The September 2018 rain event caused severe flooding throughout the state, with several communities in the SCCOG region receiving FEMA funding for the event. Neighboring towns received several inches of rainfall including Lebanon with a reported 6.79 inches and Norwich with 4.85.

A severe rainstorm event on September 5, 2022, caused flooding in some areas of town. Newent Road was heavily flooded as a result of this event as seen in the Twitter post in Figure 5-1. Other road closures included Route 138, in both directions, between Route 169 and Ross Road. This heavy rainstorm likely impacted areas of the region more severely due to the period of prolonged drought during the summer months.

Figure 5-1 Twitter Post Showing Flooding on Newent Road During a Severe Rainstorm

5.2.2 Existing Capabilities

The Town 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, acquiring floodprone structures, maintaining drainage systems, through education and outreach, and by utilizing warning systems. Many mitigation measures are common to all hazards and therefore were listed in Section 2.6. Additional mitigation measures have been put in place by the State and Federal government upstream of Lisbon that help to reduce flooding downstream, including several protection projects.

Flood Control Structural Projects

As noted in Section 3.3.3.1 of the Multi-Jurisdictional HMP, several significant flood control projects have been constructed by the USACE upstream of Lisbon on the Shetucket and Quinebaug Rivers. These flood protection projects were completed in the 1950's and 1960's and greatly reduce the incidence and severity of flooding in Lisbon.

Bridge Replacements, Drainage, and Maintenance

The Department of Public Works cleans and inspects catch basins and culverts at least annually or more often if problems are noted. As an example, in the summer of 2016 the DPW inspection uncovered drainage issues that led to the department repairing four catch basins and two culverts.

When flooding occurs, the Public Works department or the Fire Department handle the complaints depending on the location. For example, Public Works would inspect bridges and culverts and erect barricades to close roads, while the Fire Department responds to calls requesting help for flooded basements. The Town uses a message system on its webpage and fields phone calls related to drainage complaints. Drainage complaints are directed to the First Selectman.

Regulations, Codes, and Ordinances

The Town of Lisbon has planning and zoning tools in place that incorporate floodplain management. The Town has updated its flood protection regulations in both its Zoning and Subdivision Regulations in June 2011. The Town utilizes the 1% annual chance floodplain as defined by FEMA to regulate floodplain and floodway activities and requires 100 percent compensatory storage for any encroachment in the floodplain. FEMA is currently working on updating flood mapping in certain parts of the region, including in Lisbon. It is expected that new FEMA Flood Insurance Rate Maps (FIRMs) will be available in August 2023 and will be effective October 2025. These updates should then be incorporated into zoning regulations. The Town also requires new construction or substantial renovations to be located at an elevation greater than the base flood elevation.

The Town's Subdivision Regulations require that adequate drainage be provided to reduce exposure to flood hazards and that buildings and utilities be located to minimize the effects of flood damage. Regulations covering development in or within 100 feet of inland wetland or watercourse areas were last updated in 2012 and are enforced by the Town's Conservation Commission. The Town has also adopted a map prepared by the Conservation Commission which regulates building in wetland areas.

Acquisitions, Elevations, and Property Protection

The Town of Lisbon acquires open space as opportunities arise. Since the previous HMP, the Town has acquired two tracts of land for open space preservation. One of these, the Lisbon Country Club Property, is partially within the floodplain of Blissville Brook.

Property protection mostly focuses on preventive measures and maintaining and upgrading drainage systems.

Flood Watches and Warnings

The First Selectman and the Fire Department access weather reports through the National Weather Service and local media. The Town participates in the Statewide "Everbridge" Reverse 9-1-1 system. Residents are able to sign up to receive warnings when storms are imminent. The Town can telephone warnings into potentially affected areas, such as the 1% annual chance flood zone, using this system.

Public Education and Outreach

Lisbon displays FEMA-provided flood insurance brochures on the kiosk in the hallway of the Town Hall. When approached, the Town will encourage residents to purchase flood insurance if they are located in a Special Flood Hazard Area (SFHA), and will provide assistance to owners of non-residential structures regarding flood proofing techniques. Other education and outreach efforts include:

- Incorporation of the availability of flood insurance into all hazard-related public education workshops
- Encouraging residents to submit flood insurance claims following damage events.
- Encouraging builders, developers, and architects to become familiar with NFIP land use and building standards (performed by the building official)

Summary

In general, municipal capabilities to mitigate flood damage have increased since the 2017 edition of the hazard mitigation plan was adopted. This is because the Town has continued to make investments in public works projects, planning, and open space acquisition.

5.2.3 Vulnerabilities and Risk Assessment

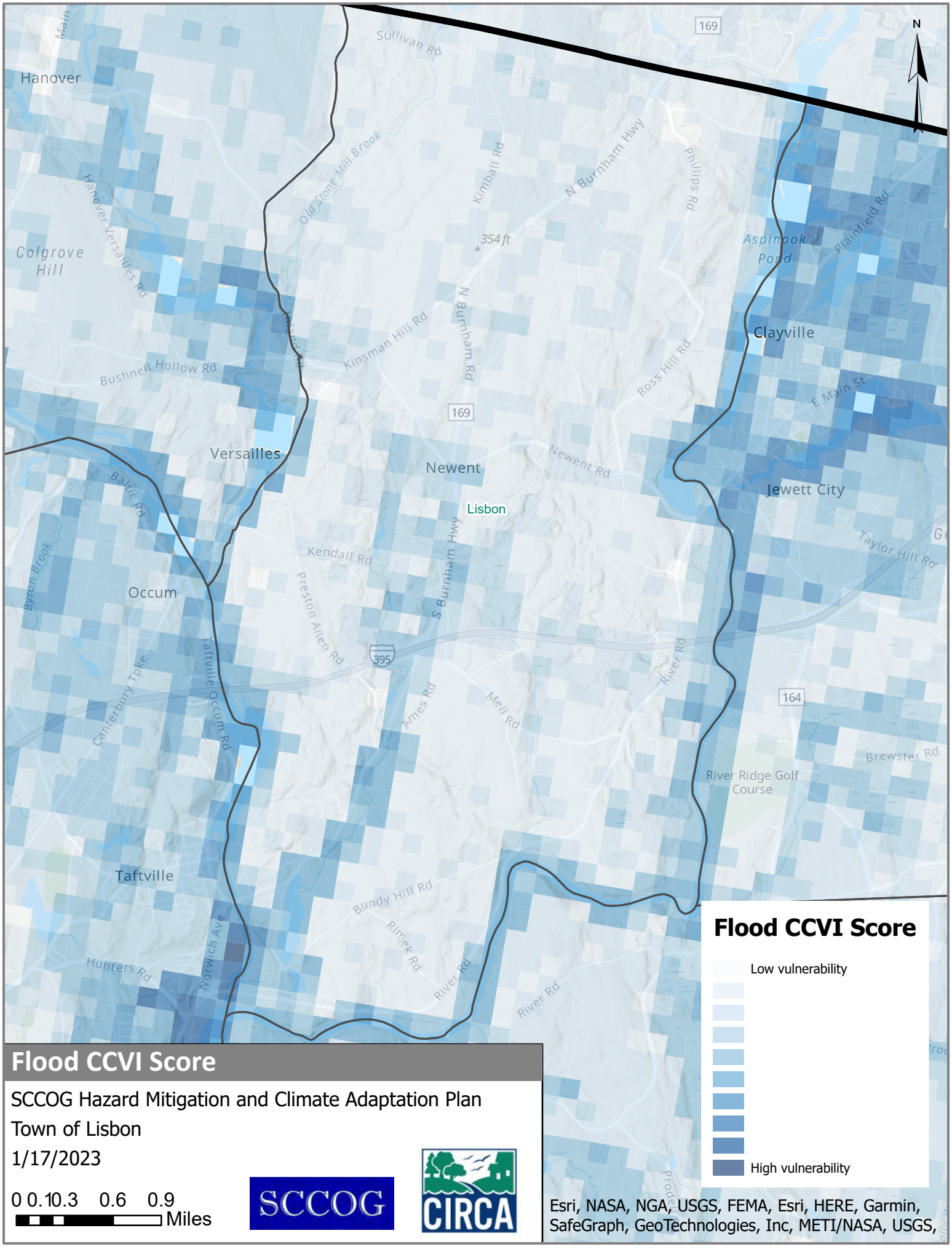
This section discusses specific areas at risk of inland flooding within the Town. Inland flooding due to nuisance flooding or poor drainage is the most common type of flooding experienced by the Town, although roadway inundation also occurs during more severe events.

UConn CIRCA has developed a tool to aid in understanding flood vulnerability for communities across the state. This tool, known as the Climate Change Vulnerability Index (CCVI), is comprised of dozens of factors that contribute to a community's flood sensitivity, exposure, adaptive capacity, and ultimately the overall flood vulnerability. The CCVI has been used as a tool to characterize flood vulnerability for the town. The distribution of flood vulnerability throughout the community can be seen in Figure 5-2. The CCVI demonstrates that flood vulnerability in Lisbon ranges from low to moderate.

Vulnerability Analysis of Areas along Watercourses

Major inland watercourses and water bodies in Lisbon have the 1% annual chance floodplain defined by FEMA. The Shetucket River, the Quinebaug River, and Blissville Brook are mapped as Zone AE, indicating that flood elevations are available. The headwaters of Blissville Brook are mapped as Zone A. These watercourses do not typically present flooding hazards to residents, buildings, or roadways, although it is understood that an extreme event could cause structures and roadways to flood. Refer to Figure 5-3 for the location of the 1% annual chance floodplains within Lisbon. In addition, ice jams have not previously been an issue along the rivers in Lisbon.

Lisbon has several major transportation routes including Routes 12, 138, and 169. The DFIRM mapping suggests that Route 12 near the Shetucket River, Route 138 (Town House Road) just west of Newent, and the crossings of Blissville Brook on Route 169 could be affected by extreme flooding. In addition to these major roads, several minor roads in the Town could also be impacted by an extreme flooding event, including Paper Mill Road from Versailles Pond (Little River) on the border with Sprague; and Mell Road, Ames Road, Schoolhouse Road, Bundy Hill Road, Ice House Road, and Lower Blissville Road along Blissville Brook. As noted in the previous HMP, a section of Phillips Road near the Quinebaug River has also flooded in the past. While floodplains are mapped adjacent to the two railroad lines, these structures are elevated and not considered to be at risk of overtopping.



Flood CCVI Score

SCCOG Hazard Mitigation and Climate Adaptation Plan

Town of Lisbon

1/17/2023

0 0.10.3 0.6 0.9 Miles

SCCOG

CIRCA

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

Vulnerability Analysis of Private Properties

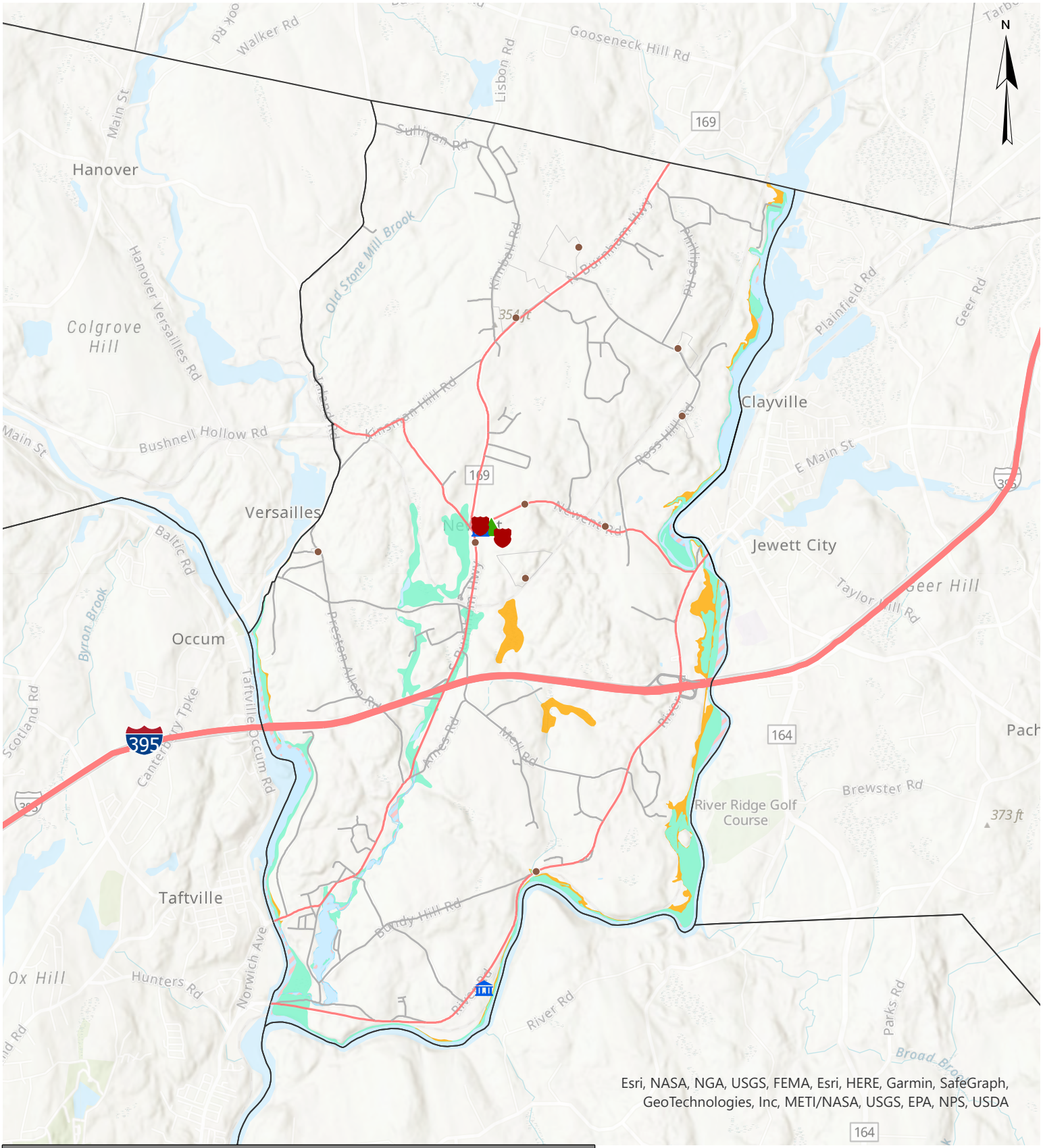
The majority of these structures in the SFHA are residential, but some commercial structures are also located in the floodplain.

Town personnel indicate that structures do not typically get flooded by overbank flooding. Recall that significant flood control structures have been created upstream of Lisbon to mitigate flooding along the Quinebaug and Shetucket rivers. Repetitive flood insurance claims have not been filed at any properties in Lisbon over the past twenty-five years. Nuisance (basement) flooding is an issue particularly during major rainstorms, but the structures affected usually do not lie within the 1% annual chance floodplain.

The Lisbon Mobile Home Park is located on the eastern edge of Blissville Pond. Several mobile homes are located on periphery of the 1% annual chance floodplain associated with Blissville Pond. While the trailer park has not flooded over the past several years, the previous HMP notes that this park has been evacuated due to flooding in the past.

Vulnerability Analysis of Critical Facilities

As noted in Section 2.6, no critical facilities in Lisbon are located within the 1% annual chance floodplain. However, given the relatively limited development in Lisbon the closure of roadways and major transportation routes due to flooding is a concern for emergency personnel. For example, flooding along Blissville Brook and Blissville Pond could potentially overtop several roads, resulting in detours through local roads that would lengthen the time for emergency response.



Critical Facilities and Historic Resources with Flood Zones

SCCOG Hazard Mitigation and Climate Adaptation Plan

Town of Lisbon

Date: 8/1/2022

0 0.35 0.7 1.05 1.4 Miles

SCCOG

RESILIENT Land & Water

Legend

- Historic Resources
- Emergency Services
- Municipal
- Shelter or Cooling Center
- 1% Annual Chance Flood Hazard Area
- .2% Annual Chance Flood Hazard Area
- Floodway

5.2.3.1 Hazard Losses

According to NFIP statistics, as of June 30, 2022, the Town of Lisbon has had a total of seven flood related losses, with a total of $15,576 paid towards the claims.

FEMA HAZUS-MH 6.0 was used to develop losses associated with the 100-year riverine flood event. Table 5-1 presents flood related damages for the Town of Lisbon. Additional HAZUS-generated losses for the town and region can be found in the Multi-Jurisdictional document.

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

Lisbon	2022 Results				
	Residential	Commercial	Industrial	Other	Total
Direct					
Building	$8,730,000	$7,370,000	$730,000	$530,000	$17,360,000
Contents	$4,060,000	$14,240,000	$850,000	$1,130,000	$20,280,000
Inventory	$0	$2,010,000	$140,000	$500,000	$2,650,000
Subtotal	$12,790,000	$23,620,000	$1,720,000	$2,160,000	$40,290,000
Business Interruption					
Income	$30,000	$13,760,000	$30,000	$410,000	$14,230,000
Relocation	$2,770,000	$4,430,000	$20,000	$250,000	$7,470,000
Rental Income	$1,090,000	$3,370,000	$0	$60,000	$4,520,000
Wage	$80,000	$9,800,000	$60,000	$3,730,000	$13,670,000
Subtotal	$3,970,000	$31,360,000	$110,000	$4,450,000	$39,890,000
Total	**$16,760,000**	**$54,980,000**	**$1,830,000**	**$6,610,000**	**$80,180,000**

5.3. Drought

5.3.1 Setting and Recent Occurrences

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

In recent years, droughts have become flashier and more frequent throughout the region. During recent events, there have been reports in the region of wells going dry on residential and farming properties. Some of the more severe and impactful events include:

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

- **2022 –** During the development of this plan, the region was in an ongoing drought, with severe drought conditions having occurred in August 2022. New London County was declared a Stage 3 drought emergency on August 18, 2022.

5.3.2 Existing Capabilities

The Town of Lisbon, like many communities, does not have specific regulations geared toward drought mitigation. One of the main purposes of the Town's zoning regulations is, however, to facilitate the adequate provision of water throughout the town and encourage the most appropriate use of the land. These purposes, when executed smartly, can all help to mitigate the impacts of drought and maintain healthy groundwater supplies.

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

5.3.3 Vulnerabilities and Risk Assessment

The entire Town of Lisbon is vulnerable to drought, but the degree of vulnerability varies. A majority of the properties in town rely on private wells for their residential or commercial drinking water. These private well users may face challenges relative to water supply during periods of drought.

5.3.3.1 Hazard Losses

There have been no reported drought losses for the Town of Lisbon since 2017 However, since 2012, one agricultural operation did receive financial assistance from the United States Department of Agricultural (USDA) for drought impacts. This payment totaled $1,496. Downscaled drought losses from the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi Jurisdiction document.

5.4. Dam Failure

5.4.1 Setting/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 floodwater. 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 Lisbon is considered a possible event each year with potentially critical effects. No dam failures have affected the town since the time of the last HMP.

5.4.2 Existing Capabilities

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. As noted in the Multi-Jurisdictional HMP, Lisbon is home to one Class B (significant hazard) dam, and six additional Class B or

Class C dams are located upstream of Lisbon whose failure could potentially lead to flooding within the town. All registered dams in Lisbon are listed in Table 5-2.

Table 5-2 Dams Registered with DEEP in the Town of Lisbon

CT Dam#	Dam Name	Dam Class	Owner Type
7307	Highway Pond	A	Private
7308	Lithuanian Scout Association Pond Dam	BB	Private
7309	Crossing At Lisbon Detention Dam	B	Private Corporation

Dams in the region whose failure could impact Lisbon 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 Emergency Action Plans (EAPs) for such dams. The Town of Lisbon owns two dams: the Blissville Pond dam (a low hazard dam) and the Lower Blissville Pond Dam (a significant hazard dam). The Town inspects these dams annually and they are believed to be in good condition.

The Town reports that an EAP has been developed and a dam failure inundation analysis has been performed for the Lower Blissville Pond Dam. The Town has incorporated the dam failure area for the Lower Blissville Pond Dam into its Everbridge Reverse 9-1-1 system, allowing it to alert residents within that area of an impending failure.

If approached and asked, Lisbon staff are ready to provide assistance to the owners of lesser ranked dams regarding resources available for inspection and maintenance.

Summary

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

5.4.3 Vulnerabilities and Risk Assessment

The potential impacts related to the failure of Class C and Class B dams within or upstream of Lisbon are described below. Where information was available, the descriptions below are based on information available at the Connecticut DEEP Dam Safety files.

- *Scotland Dam* – The Scotland Dam is a Class C dam located on the Shetucket River near the Windham, Scotland, and Franklin boundary that is privately owned and used for hydroelectric power generation. Failure of this dam would likely result in an inundation area similar to the 0.2% annual chance flood event for areas downstream along the Shetucket River from the dam to Occum Pond, with lesser impacts downstream in Lisbon. Flooding of the access road to the

trash to energy plant would be expected, as would the flooding of structures in the Lower Blissville Road and River Road (Route 12) area near Norwich.

- *Taftville Dam #4* – Taftville Dam #4 is a Class C dam located on the Shetucket River between Norwich and Lisbon and is privately owned. The dam impounds water for hydroelectric power generation. Failure of this dam would likely result in an inundation area similar to the 1% annual chance flood event for areas downstream along the Shetucket River from the dam to the Thames River. This would cause the inundation of several structures in Lisbon in the Lower Blissville Road and River Road (Route 12) area near Norwich.

- *Aspinook Pond Dam* – This privately-owned Class B dam impounds the Quinebaug River to provide hydroelectric power generation. Failure of this dam could cause a flood similar to the 1% annual chance flood downstream in Jewett City, Lisbon, and Griswold. Undeveloped areas of Preston could also be affected. As shown by the dam failure inundation analysis prepared by Louis Berger & Associates, Inc. in the late 1970's for the USACE, Newent Road (Route 138) could potentially flood, as could agricultural fields located along the Quinebaug River in Lisbon.

- *Lower Blissville Pond Dam* – This Class B dam is owned by the Town of Lisbon and located at the southwestern end of Lower Blissville Pond just upstream of Ice House Road. The dam is in good condition with major repairs occurring in 1988. While a formal dam failure inundation analysis is not believed to have been prepared for this dam, failure of this dam would likely overtop Ice House Road and Lower Blissville Road and cause flooding of structures along Lower Blissville Road in Lisbon. The Shetucket River would likely absorb the floodwaters without further damage to structures.

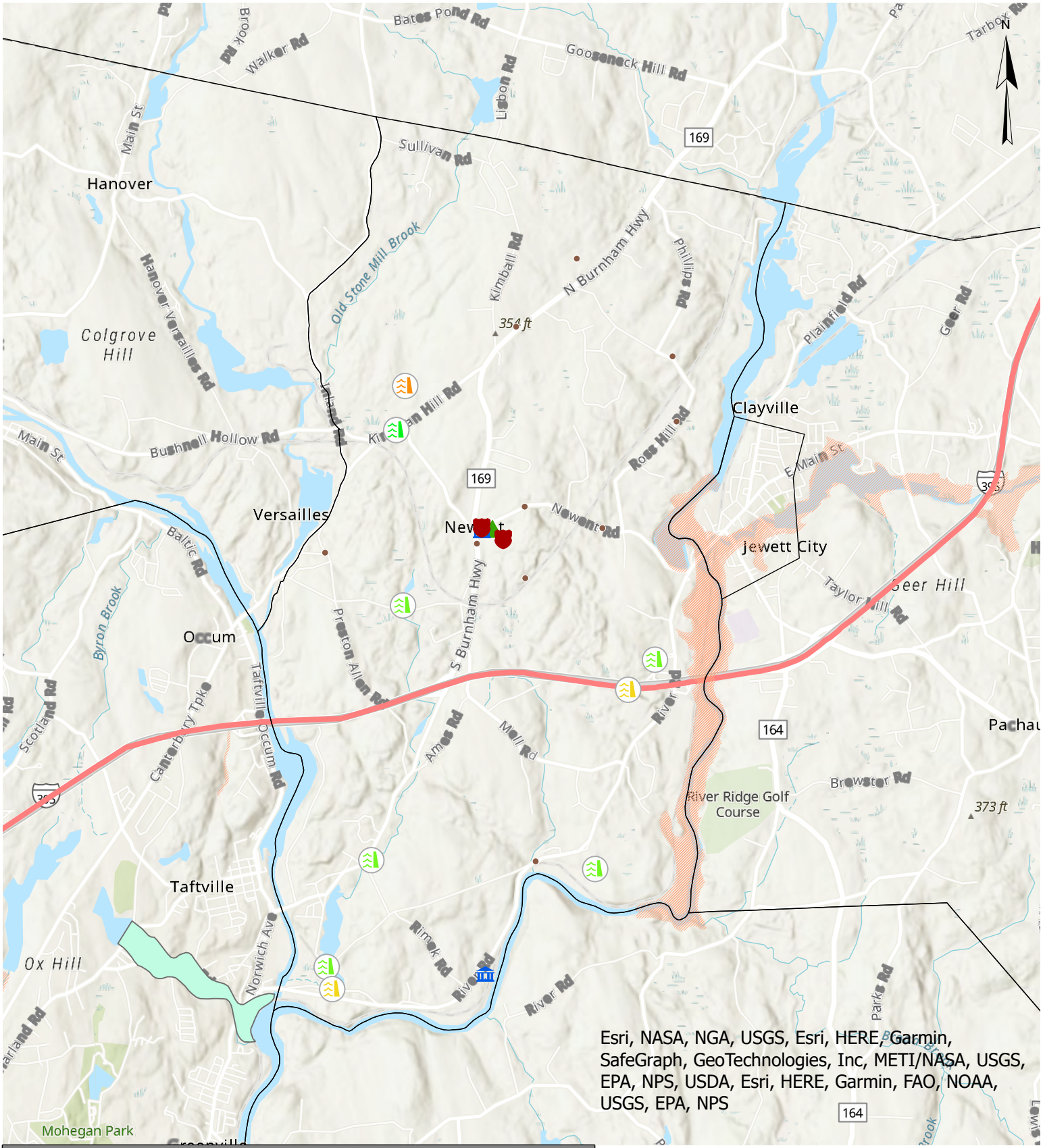
- *Paper Mill Pond Dam* – This Class B dam is privately owned and located in Sprague on the eastern end of Paper Mill Pond. The dam was created to impound the waters of the Little River for industrial purposes. According to a 1970's report by the USACE, failure of the Paper Mill Pond Dam would mostly cause flooding in Sprague upstream of the railroad, although the water level rise within Versailles Pond could also cause minor flooding along Paper Mill Road on the eastern edge of the pond in Lisbon.

- *Tunnel Dam* – This Class B dam that impounds the Quinebaug River is privately-owned and located between Preston and Sprague just upstream of the confluence with the Shetucket River. The dam was originally constructed to provide power for industrial purposes, but now is utilized for hydroelectric power generation. Failure of this dam would likely cause minor flooding along the Shetucket River downstream to Taftville Dam #4, with no structures being affected in Lisbon.

- *Versailles Pond Dam* – This privately-owned Class B dam that impounds the Little River was originally constructed for industrial purposes. Failure of this dam would cause significant impacts in Sprague, but only minor flooding along the Little River and Shetucket River in Lisbon with no structures being affected.

5.4.3.1 Hazard Losses

There are no reported losses for the Town of Lisbon related to dam failure.



Dams and Dam Failure Inundation Areas

Southeastern Connecticut Council of Governments

Town of Lisbon

Date: 2/23/2023

0 0.35 0.7 1.05 1.4 Miles

SCCOG

RESILIENT Land & Water

Legend

Dams

- Unknown/Unclassified
- A
- B
- BB

- Historic Resources
- Emergency Services
- Municipal
- Shelter or Cooling Center
- Dam Failure Inundation Area

6. Rising Temperatures

6.1. Climate Change Impacts

On average, the annual temperature across the U.S. has increased by 1.8 degrees Fahrenheit when looking at the entire period of record (1895-2016). Accelerated warming patterns between 1979 and 2016 have been observed with satellite and surface data, and paleoclimate records show that some of the recent decades have been the warmest in the past 1,500 years.[2]

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

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

6.2. Extreme Heat

6.2.1 Setting and Recent Occurrences

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

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

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

	May		June		July		August		September	
	GNL	*NPU*	*GNL*	*NPU*	*GNL*	*NPU*	*GNL*	*NPU*	*GNL*	*NPU*
2017	85	**93**	89	**94**	88	**92**	87	89	86	89
2018	80	**91**	87	**90**	89	**101**	91	**94**	90	92
2019	83	85	88	**91**	94	**96**	88	**91**	87	84
2020	75	81	82	**91**	**92**	**96**	89	**92**	87	87
2021	88	87	86	**96**	86	**94**	88	**96**	82	85
2022	**93**	**92**	85	**92**	**91**	**96**	**91**	**94**	**94**	85
GNL = Groton New London station & NPU = Norwich Public Utilities station										

[2] https://nca201758.globalchange.gov/chapter/2/

6.2.2 Existing Capabilities

Similar to the monitoring methods used for hurricanes, severe storms, and winter storms, the Town monitors National Weather Service and local forecasts for anticipated extreme heat event, and also monitors for NWS heat warnings and advisories.

Summary

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

6.2.3 Vulnerabilities and Risk Assessment

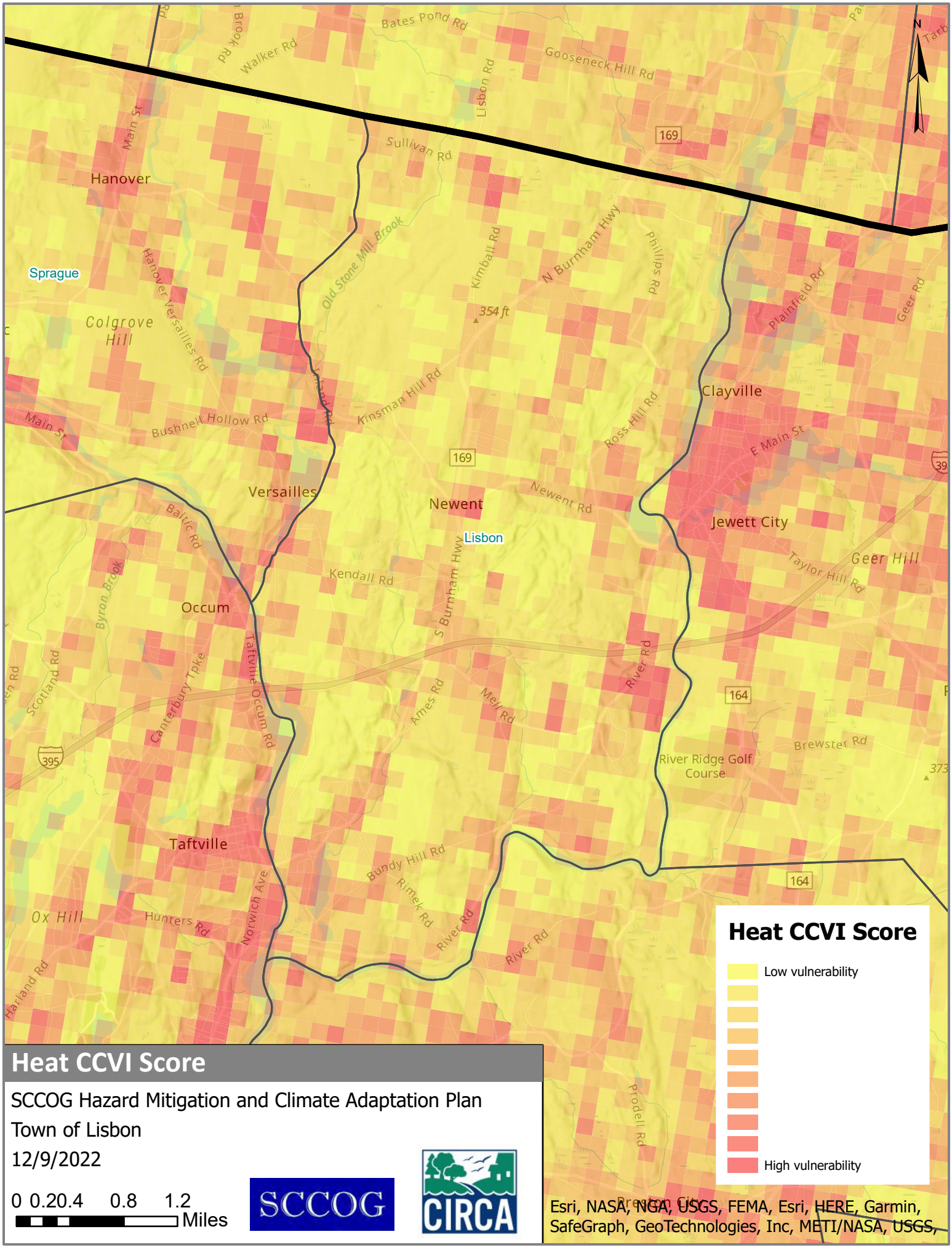
While the entire town is at risk of an extreme heat event, vulnerability can widely vary based on age, health, or the type of property owned in Lisbon. The elderly populations in town are more vulnerable to extreme heat events, particularly when in home cooling is not available. Also, those in town with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

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

With a largely undeveloped landscape and low social vulnerability, Lisbon has low heat exposure and sensitivity, with the exception of one developed complex south of I-395 on River Road. Adaptive capacity is bolstered by the abundant vegetation but might benefit from a cooling center. Therefore, the overall heat vulnerability for Lisbon is low to moderate depending on the location.

6.2.3.1 Hazard Losses

There are no reported losses for the Town of Lisbon related to extreme temperatures.


Heat CCVI Score
Low vulnerability
High vulnerability
Heat CCVI Score
SCCOG Hazard Mitigation and Climate Adaptation Plan
Town of Lisbon
12/9/2022
0 0.20.4 0.8 1.2
Miles
SCCOG
CIRCA
Esri, NASA, NGA, USGS, FEMA, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS,
Hanover
Sprague
Colgrove Hill
Versailles
Newent
Lisbon
Occum
Taftville
Clayville
Jewett City
Geer Hill
River Ridge Golf Course
Ox Hill
Bates Pond Rd
Gooseneck Hill Rd
Sullivan Rd
Walker Rd
Lisbon Rd
Main St
Hanover Versailles Rd
Old Stone Mill Brook
Kimball Rd
N Burnham Hwy
Phillips Rd
Plainfield Rd
Geer Rd
354 ft
Bushnell Hollow Rd
Kinsman Hill Rd
Ross Hill Rd
E Main St
Newent Rd
Baltic Rd
Byron Brook
Kendall Rd
S Burnham Hwy
Taylor Hill Rd
Scotland Rd
Canterbury Tpke
Taftville Occum Rd
Ames Rd
Mell Rd
River Rd
Brewster Rd
373
Bundy Hill Rd
Rimek Rd
Norwich Ave
Hunters Rd
Harland Rd
Prodell Rd
169
164
395
39

6.3. Wildfires

6.3.1 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 Lisbon. Structural fires in higher density areas of the town are not directly addressed herein.

Figure 6-2 April 2022 Brush Fire in Lisbon (photo credit: Josh Cingranelli NBC CT)

Lisbon typically experiences a handful of brush fires each spring and autumn. The largest fires burn two to five acres at maximum. In April 2022 firefighters battled a 3-acre brush fire (Figure 6-2)Figure 6-2 April 2022 Brush Fire in Lisbon (photo credit: Josh Cingranelli NBC CT) along route 12 in a heavily wooded area. Mutual aid was provided by Jewett City, Griswold, Voluntown, Baltic, and Preston City.

6.3.2 Existing Capabilities

Monitoring of potential fire conditions is an important part of mitigation. The Connecticut DEEP Forestry Division uses the rainfall data recorded by the Automated Flood Warning system to compile forest fire probability forecasts. This allows the DEEP to monitor drier areas to be prepared for forest fire conditions. The Town can access this information over the internet. The Town 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 Town’s EOP recommends a 30-50 foot cleared radius be maintained around homes and buildings to prevent wildfires. The Volunteer Fire Department supports public outreach programs, including through the school system, to increase awareness of forest fire danger, equipment usage, and home protection.

The Lisbon Volunteer Fire Company has a strong mutual aid relationship with its neighbors to fight wildfires. The Town has an off-road vehicle and a gator to access distant fires and goes to the fires as quickly as possible. Fire protection water is obtained through seven dry hydrants located throughout Lisbon. Areas along Route 169 and Route 12 have water service provided by Norwich Public Utilities or the Jewett City Water Company, respectively. These agencies test fire flows and inform the fire department of the pressure available.

In areas located far from available hydrants, the fire department drafts water from the various streams, ponds, and rivers in the town, and relies on pump trucks to carry water to distant areas. Blissville Pond is a primary source of fire protection water for such purposes. The amount of fire protection afforded by the existing hydrants and nearby water bodies is considered to be adequate for the development level of Lisbon. The Fire Department will continue to evaluate the level of risk and the need for additional hydrants as development continues in the future. The Fire Department regularly performs

maintenance and repairs on the Town's dry hydrants such that fire flows from these sources are unimpeded.

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." Lisbon has designated an Open Burning Official. Permit template forms were also revised that provide permit requirements so that the applicant/permittee is made aware of the requirements prior to, during, and after burn activity. The regulated activity is then overseen by the Town.

Summary

In general, municipal capabilities to mitigate wildfire damage have not increased significantly since the 2017 edition of the hazard mitigation plan was adopted, with continued public education and testing of dry hydrants; as well as the changes in the State's regulation of open burning.

6.3.3 Vulnerabilities and Risk Assessment

As Lisbon is largely forested, wildfires can occur almost anywhere due to the undeveloped nature of the town. Pleasant View Cove Road is a particular area of concern for emergency personnel since it is a long private road, and no dry hydrants are located nearby. Firefighters draft water from Aspinook Pond to provide firefighting water in this area. Other undeveloped areas that are not nearby public water service, dry hydrants, or water bodies are considered to be moderate risk due to the need to transport firefighting water, and the fact that off-road equipment must be utilized to fight fires. The remaining areas of the town that are located near water sources are considered to be a low-risk area for wildfires. Refer to Figure 3-6 in the Multi-Jurisdictional HMP for a general depiction of wildfire risk areas within Lisbon.

A particular concern for the Fire Department is that several of the dry hydrants need maintenance. The dry hydrants have been in place for many years and as such vegetation is impeding the intakes and reducing the volume of flow available.

6.3.3.1 Hazard Losses

There are no reported losses for the Town of Lisbon related to wildfires. Downscaled losses from the 2019 Connecticut Natural Hazard Mitigation Plan using WUI acreage are developed in the Multi-Jurisdictional document.

7. Earthquakes

7.1. Climate Change Impacts

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

7.2. Earthquakes

7.2.1 Setting/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 3.3.5 of the Multi-Jurisdictional document. Despite the low probability of an earthquake occurrence, earthquake damage presents a potentially catastrophic hazard to the town. However, it is very unlikely that the town would be at the epicenter of such a damaging earthquake. No major earthquakes have affected the town since the last HMP.

7.2.2 Existing Capabilities

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

Due to the infrequent nature of damaging earthquakes, Town land use policies do not directly address earthquake hazards, though they do indirectly limit residential development in areas prone to collapse or liquefaction. However, the potential for an earthquake and emergency response procedures is addressed in the Town's EOP.

Lisbon maintains backup supplies at its critical facilities in case of regional transportation and utility disruption caused by an event such as an earthquake.

Summary

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

7.2.3 Vulnerabilities and Risk Assessment

Surficial earth materials behave differently in response to seismic activity. Unconsolidated materials such as sand and artificial fill can amplify the shaking associated with an earthquake. As noted in Section 2.1, areas along the Shetucket River, Quinebaug River, Blissville Brook, and Old Stone Mill Brook

are underlain by stratified drift. These areas are potentially more at risk for earthquake damage than the areas of the town 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 Town 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.

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

The built environment in the town primarily includes some more recent construction that is seismically designed. However, most buildings were built before the 1990's and therefore are not built to current building codes. In addition, there are two mobile home parks and at least one campground with recreational buildings or shelters that may not be seismically designed. Thus, it is believed that most buildings would be at least moderately damaged by a significant earthquake. Those town 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. Lisbon has many areas of steep slopes and bluffs although the majority of these features occur in undeveloped areas. Thus, landslides are not a concern in the town.

Seismic activity can also break utility lines such as water mains, gas mains, electric and telephone lines, and stormwater management systems. Damage to utility lines can lead to fires, especially in electric and gas mains. Dam failure can also pose a significant threat to developed areas during an earthquake. For this HMCAP, dam failure has been addressed separately in Section 5.4. As noted previously, most utility infrastructure in the town is located above ground. A quick and coordinated response with Eversource 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 Town's and Eversource's 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.

7.2.4 Hazard Losses

There are no reported losses for the Town of Lisbon related to earthquakes. Downscaled losses from the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document. In addition, a *HAZUS-MH* analysis of the potential economic and societal impacts to the SCCOG region from

earthquake damage is detailed in the Multi-Jurisdictional HMCAP. The analysis addresses a range of potential impacts from any earthquake scenario, estimated damage to buildings by building type, potential damage to utilities and infrastructure, predicted sheltering requirements, estimated casualties, and total estimated losses and direct economic impact that may result from various earthquake scenarios. Potential economic impacts can be seen in Table 7-1, with additional information developed in the Multi-Jurisdictional document.

Table 7-1 HAZUS-MH Earthquake Related Economic Impacts

Lisbon	Residential	Commercial	Industrial	Others	Total
	$25,180,000	$100,810,000	$2,570,000	$22,090,000	150,650,000

8. Mitigation Strategies and Actions

8.1. Status of Mitigation Strategies and Actions

A total of 11 hazard mitigation actions were developed in the previous edition of this plan. The status of each is listed below.

#	Mitigation Actions and Strategies for Lisbon 2016 - 2021	Status	Status Details
1	Encourage Town officials to attend FEMA-sponsored training seminars at EMI or elsewhere	Capability	
2	Upgrade culverts along Blissville Brook to reduce the chance that roads will overtop during severe storm events		
3	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 (update to Zoning Regulations Appendix 1 S:2.1)	Carry Forward	
4	Repair the Schoolhouse Road Bridge, if funding can be secured (CT DEEP approved a grant for the project, but it has yet to be pursued because it has not been a high priority for the Town).		
5	Complete Bundy Hill Road bridge replacement. A grant has been secured for this project, and it is currently in the planning phase with the Town engineer. Residents have approved the project.		
6	Identify a location for a brush-disposal operation for dealing with debris following windstorms and determine potential reuse	Remove	Can use transfer station if needed
7	Consider surveying all Town-owned buildings to determine their ability to withstand wind loading	Remove	Not a concern for the town
8	Develop agreements with landowners and companies to chop/chip to ensure backup plans are in place for debris removal	Remove	Likely will not occur
9	Include structures within the dam failure inundation areas in the Reverse 9-1-1 contact database	Remove	The town has warning capabilities in place.
10	Create an EOP for Lower Blissville Pond Dam and submit it to DEEP		
11	Extend fire protection to future areas identified as being particularly at-risk, such as the Pleasant View Cove Road area	Carry Forward with Revision	

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

8.2. Prioritization of Specific Actions

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

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

- Develop formalized methodology for stormwater infrastructure, culvert, and bridge construction and replacement that requires utilization of the most up-to-date extreme rainfall data from NOAA Atlas 14 as it is updated to become NOAA Atlas 15.

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

- Identify a permanent cooling center and ensure that standby power is available to operate the air conditioning; and ensure that transit or alternate transportation options are available for people to reach the cooling center.

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

Table 8-1 Town of Lisbon Actions and STAPLEE and PERSISTS Scores

Number	Hazard Mitigation and Climate Adaptation Actions	Hazard Mitigation and Climate Adaptation Goal	Type of Action	Responsible Department	Approx. Cost Range	Potential Funding Sources	Timeframe	Priority	PERISTS Score	STAPLEE Score	PERSISTS x STAPLEE =
LI1	Identify a permanent cooling center and ensure that standby power is available to operate the air conditioning; and ensure that transit or alternate transportation options are available for people to reach the cooling center.	Ensure that critical facilities are resilient, with special attention to shelters and cooling centers.	Preparedness & Emergency Response	Office of the Chief Elected Official	$100,000 - $500,000	FEMA HMA; Other Preparedness Grants; STEAP	7/2023 - 6/2025	High	16	6	96
LI2	Undertake an engineering study to identify flood risk reduction options for the Newent Road corridor.	Invest in resilient corridors to ensure that people and services are accessible during floods and that development along corridors is resilient over the long term.	Structural Projects	Public Works	$25,000 - $50,000	DEEP Climate Resilience Fund; STEAP		High	18	5	90
LI3	Develop formalized methodology for stormwater infrastructure, culvert, and bridge construction and replacement that requires utilization of the most up-to-date extreme rainfall data from NOAA Atlas 14 as it is updated to become NOAA Atlas 15.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Structural Projects	Public Works	$0 - $10,000	SCCOG Municipal Services Funds; Municipal Operating Budget	7/2023 - 6/2024	Medium	21	12	252
LI4	Require floodplain manager and land use staff to take free training at https://portal.ct.gov/DEEP/P2/Chemical-Management-and-Climate-Resilience/Chemical-Management-and-Climate-Resilience to reduce risks of spills from businesses during floods.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Education & Awareness	Land Use Staff	$0 - $10,000	Municipal Operating Budget	7/2023 - 12/2023	Low	14	6	84
LI5	Extend public water systems from NPU and Jewett City Water Company to reduce drought impacts to properties currently served by private wells; and to provide fire protection.	Reduce losses from other hazards that are affected by climate change.	Water & Wastewater Utility Projects	Office of the Chief Elected Official	>$1M	DWSRF; STEAP; NPU CIP Budget	7/2026 - 6/2028	Low	13	6	78