



# Local Hazard Mitigation & Climate Adaptation Plan



2021 Update  
Town of Sterling, MA



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## 2. ACKNOWLEDGEMENTS AND CREDITS

The Sterling Local Hazard Mitigation Plan is an updated version of the plan originally created by the Montachusett Regional Planning Commission (MRPC) established in 1968. MRPC was created under MGL Chapter 40B, Sections 1-8. The statute defines MRPC as a Regional “planning district” and a “public body corporate”, per section 3 of MGL Chapter 40B. The Montachusett Regional Hazard Mitigation Plan was created in 2008 then update in 2015. This plan was funded by the Federal Emergency Management Agency (FEMA), the Massachusetts Emergency Management Agency (MEMA) and the MRPC. This plan was created to reduce the loss of or damage to life, property, infrastructure, and natural and economic resources from natural disasters in the Montachusett Region.

The 2021 Update has been prepared for the Town of Sterling by Pare Corporation (Pare), under the direction of the Town. This update was funded by the Town of Sterling’s Planning Department and Town Administrator to go through the Municipal Vulnerability Preparedness (MVP) Planning program and Hazard Mitigation Plan update.

### **Credits**

Project Manager:	Domenica Tatasciore
Technical Consultant:	Pare Corporation

### Town of Sterling

EMA Director and Fire Chief:	Chief David Hurlbut
Fire Prevention Officer:	Lieutenant Thomas Kokernak
Town Administrator:	Kellie Hebert
Former Town Administrator:	Ross Perry
DPW Superintendent:	Paul Lyons
GM Sterling Municipal Light Department:	Sean Hamilton
Sustainability Advocate & Community Member:	Susan Aldrich
Senior Center Director:	Veronica Buckley

### 3. INTRODUCTION

#### *Planning Requirements under the Federal Disaster Mitigation Act*

The Federal Disaster Mitigation Act, passed in 2000, requires that after November 1, 2004, all municipalities that wish to continue to be eligible to receive FEMA funding for hazard mitigation grants, must adopt a local multi-hazard mitigation plan (LHMP). This planning requirement does not affect disaster assistance funding.

Massachusetts has taken a regional approach and has encouraged the regional planning agencies to apply for grants to prepare plans for groups of communities. The Montachusett Regional Planning Commission (MRPC) received a grant from the Federal Emergency Management Agency (FEMA) under the Pre-Disaster Mitigation (PDM) Program, to assist the Town of Sterling and twenty-one other communities to develop a regional multiple-hazard mitigation plan. The 2015 regional plan was used to create The Sterling Local Hazard Mitigation and Climate Adaptation Plan prepared under this grant, meets the requirements of the Disaster Mitigation Act.

#### *What is Hazard Mitigation?*

Natural hazard mitigation planning is the process of figuring out how to reduce or eliminate the loss of life and property damage resulting from natural hazards such as floods, earthquakes, and hurricanes. Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects, and other activities.

#### *What is Climate Adaptation?*

Climate adaptation planning is the process of predicting and preparing for projected changes in the regional climate patterns. This process considers natural hazards that impact the community, and how they will increase in intensity and frequency due to climate change. Climate adaptation implements strategies that allow a community to adapt to these changes and increase resilience to the impacts of more severe natural hazards. Long-term strategies for climate adaptation are similar to those of hazard mitigation, with consideration of the projected changes.

### 4. PLANNING PROCESS

#### *4.1 Sterling's Participation in Regional Committee*

Sterling's Natural Hazard Matrix was developed during the MRPC process of the original plan when participants discussed these hazards at the Sterling Local Hazard Mitigation Team Meeting held on June 28, 2012. This meeting was used to update the 2015 Regional Plan.

## 4.2 *The Local Hazard Mitigation Planning Team*

### 4.2.1 Team Members

The local Hazard Mitigation Planning team consists of the following members who make up the Core Team:

- Domenica Tatasciore, Town Planner
- Kellie Herbert, Town Administrator  
Ross Perry, Former Town Administrator
- Chief David Hurlbut, EMA Director and Fire Chief
- Lieutenant Thomas Kokernak, Fire Prevention Officer
- Paul Lyons, DPW Superintendent
- Sean Hamilton, Gen Manager – Sterling Municipal Light Department
- Susan Aldrich, Sustainability Advocate and Community Member
- Veronica Buckley, Senior Center Director

### 4.2.2 Team Meetings

The Core Team met in February 2020 and July 2020 to outline the primary goals and objectives for the MVP process, discuss integration with the LHMP and Town planning efforts, and plan for the right workshop format. After the public workshops another meeting was held in March 2021 to gather additional information for the Hazard Mitigation Plan.

## 4.3 *Public Meetings*

The MVP two-part virtual Community Resilience Building (CRB) Workshop was held on September 10, 2020 and September 17, 2020 from 9:00am-12:00pm via Zoom. After the workshop, a listening session was held on September 30<sup>th</sup>, 2020 at 9 AM to review the MVP process the summary of findings as indicated in the next section. Please see Appendix C for the workshop materials.

## 4.4 *Municipal Vulnerability Preparedness Plan*

The Town of Sterling has taken an important first step toward building societal, environmental, and infrastructure resilience within their community by participating in the Municipal Vulnerability Preparedness program executed through the Executive Office of Energy and Environmental Affairs (EEA). An MVP Planning Grant was awarded to the Town from the EEA, allowing Sterling to complete the planning steps required to earn designation as an “MVP Community” and begin the process of updating their Local Hazard Mitigation Plan. This approach to municipal resilience and climate adaptation planning will allow Sterling to undertake a comprehensive planning process that employs local knowledge to identify natural and weather-related hazards, recognize the community’s strengths and vulnerabilities, and prioritize actions to help mitigate damages and prepare them for the future. This successful MVP Planning effort results in a list of clear actions that Sterling can incorporate into the Town’s Master Plan,

the LHMP and work toward implementing to improve community resilience, thus reducing disaster recovery time and cost for the Town, the region, and the Commonwealth.

Domenica Tatasciore, the MVP Project Manager and Town Planner for Sterling, initiated the MVP planning process by assembling a Core Team to help lead the effort within the community. The Core Team met in February 2020 and in July 2020 to outline the primary goals and objectives for the MVP process, discuss integration with the LHMP and Town planning efforts, and plan for the workshop format. The original workshop format was planned to be a full-day in person workshop on April 2, 2020. The in-person workshop was postponed due to COVID-19 restrictions on in person gatherings. Throughout the spring of 2020 discussion among the Core Team and the Regional MVP coordinator led to the decision to host the workshop in a virtual format. With the assistance of Pare Corporation, a certified MVP Provider, the Town prepared for the workshop by developing a list of attendees, compiling community background resources and mapping data, and setting an agenda that meets the goals of the program.

Neighboring communities along with regional organization were invited as participants and given the chance to provide input to affect the plan's content. Regional and local invitees' examples include the Towns of; Boylston, West Boylston, Princeton, Holden, Chris McDermott from the Chamber of Commerce – North central MA, Marian Larson and Jim French from the Department of Recreation Commission, John Hume from the Montachusett Regional Planning Commission, Gerson Cintron from the North Central MA Housing Authority, Jassy Bratko from the North County Land Trust, and Collen Abrams from the Wachusett Greenway. Please see Appendix C for invitation list for the MVP and HMP process.

A two-part virtual Community Resilience Building (CRB) Workshop was held on September 10, 2020 and September 17, 2020 from 9:00am-12:00pm via Zoom. A total of 26 community stakeholders in addition to the core team participated in the CRB Workshop (see full list of Attendees in the MVP Summary of Finding Report in Appendix C), divided into five breakout groups. Pare Corporation with assistance from Linnean Solutions provided one facilitator and one scribe for each group, which were also supplied with PDF reference map package (see Appendix A). After an introductory presentation by the Lead Facilitator and the Town Administrator, the breakout groups dove into the main portion of the workshop. The workshop followed the CRB framework, guiding each of the breakout groups through the following steps in the planning process:

- Identify past, current, and future impacts from natural hazards (session #1)
- Determine the highest-priority hazards (session #1)
- Identify the infrastructural vulnerabilities and strengths (session #1)
- Identify societal vulnerabilities and strengths (session #1)
- Identify environmental vulnerabilities and strengths (session #1)
- Identify and prioritize infrastructural actions (session #2)
- Identify and prioritize societal actions (session #2)
- Identify and prioritize environmental actions (session #2)
- Identify highest-priority actions for Sterling (session #2)

Attendance included the Core team listed above along with the following participants:

- Sarah Culgin – Building Commissioner
- Arden Sonnenberg – Select Board
- Kimberly Archambault – Sterling Skilled Nursing
- Cathie Ryan – Resident
- Neal Davidson – Hope Chapel
- Peder Pedersen – OSIC
- Bob Kimball – Resident
- Janet Segur – Sterling Grange
- Gerson Cintron - North Central Mass Housing Authority - Director of Facilities
- Jim Emerton – Fire/EMT
- Linda Woodland – School Committee
- Lou Massa – Animal Control
- Phil Holman – First Church
- Pat Campbell – Library Director
- Matt Marro – Conservation Agent
- Kelley Freda – DCR
- Pete Monchamp – Resident
- John Kilcoyne – Select Board
- Weymouth Whitney – Sterling Housing Authority & Resident
- Dick Maki – Resident
- Joyce Hinkley – Resident
- Erik Ares – Fire/EMT
- Kristen Dietel – Recreation Director
- Everett Heller – Finance Committee
- Lacy Gillotti – NEADS, Inc.
- Bob Dumont – Master Plan Committee

#### *4.5 Local Hazard Mitigation Plan*

In accordance with the HMP program guidelines, a completed draft of the HMP for Sterling was completed after the September 30th, 2020 Public Listening Session for the MVP Summary of Findings Report. The stakeholders listed above represent the parties involved in discussing hazards in the town of Sterling.

The initial draft of the HMP included regional resources such as the State’s Hazard Mitigation Plan, FEMA flood insurance studies and published data on historical hazards. Local resources such as the town’s draft Master Plan, the Housing Production Plan and input from the core team. These documents were used for their data but also to see the historical growth in Sterling over the last few years since the Regional HMP was completed in 2015. Regional and local data was used for section 5 and local resources listed above were used for section 3 and section 8 to create the HMP draft report. Please see section 11 for more references.

The draft was presented to the core team members, which includes the listed members previously in acknowledgments, and the core team delivered comments back on February 9<sup>th</sup>, 2021. Significant comments were provided from Domenica Tatasciore the Town Planner. [The primary town agency responsible for regulating development in the town is the Planning Board. Feedback to the Planning Board was ensured through the participation of the Town Planner on the Core Team. In addition, MRPC which is the regional planning authority for Sterling, works with all agencies that regulate development in its region and provide support in planning document updates.](#) Comments were also provided by Matt Marro from the Conservation Commission and Lieutenant Thomas Kokernak from the Fire Department. Once final comments were integrated, the HMP was presented at a public listening session on March 30<sup>th</sup>, 2021 for town citizens to comment on the plan. At the Public listening session members from the core team in attendance included Kellie Hebert, Domenica Tatasciore, Dick Maki, Charles Plaisted, Susan Aldrich, Matthew Marro, Darren Borge and presenter Lance Hill. Participants of the meeting and all community members were given a survey to provide additional written feedback to be incorporated into the plan. Anyone who was not able to attend the public listen session was also provided a video link posted on the Town's website, to watch the public listening session and then use the survey link to provide any additional feedback. Comments from the meeting were incorporated into the plan, however no responses were received from the public from the 3-week posted survey. Once all final comments were incorporated the HMP was finalized on May 5<sup>th</sup>, 2021.

Once the HMP is adopted by the town officially, implementation strategies can commence. To continue plan updates and public participation in the plan, the town of Sterling's website will be updated with information to notify members of the community of grants received and mitigation project being implemented.

## 5. REGIONAL AND COMMUNITY PROFILE

### 5.1 *Regional Profile*

The following regional information was collected in the MRCP 2015 Regional plan and reflects the data collected in these communities at the time of the 2015 Update.

#### 5.1.3 Populations

The 2010 Census recorded 236,475 residents in the Montachusett Region, a 3.7% increase in its population from the year 2000. Since 1960, the Region's population as a whole has continued to grow. This trend can be seen to the right. Table 1 below indicates that the Region has been growing since 1960. Most communities have seen population increases in recent years. In fact, just three communities in the Region experienced a decrease in population between the years 2000 and 2010: Gardner, Townsend and Leominster. Communities that experienced the largest percentage increase in population since 2000 were Templeton (17.9%), Shirley (13.1%), Hubbardston (12.1%) and Groton (11.5%). Prior to the Devens Restructure in the 1990's, Devens military population was divided among the communities of Ayer, Harvard and Shirley. Devens is no longer an active military installation with any significant military population.

TABLE 1: HAZARD RISKS SUMMARY

Community	1960	1970	1980	1990	2000	2010	'80-90' %	'90-00' %	00-10%
							Change	Change	Change
<i>Sterling</i>	3,193	4,247	5,440	6,481	7,257	7,808	19.1%	12.0%	7.6%
<i>Regional</i>	182,077	199,296	202,557	223,865	228,005	236,475	10.5%	1.8%	3.7%

*Source: U.S. Census Bureau & Massachusetts 2010 Population and Housing Unit Counts, US Department of Commerce, Economics and Statistics Administration*

### 5.1.4 Employment

The Montachusett Region continues to undergo diversification of its economy. Following national and state trends, for decades, there has been an ongoing trend in the reduction in the number of manufacturing jobs and an increase in jobs in the service sector. In 2017, Sterling’s unemployment rate was 3.8 %, which was significantly lower than Worcester County’s unemployment rate (5.4 %) and the Massachusetts’s unemployment rate (5.5 %).

In addition, there have been local and Regional efforts to boost tourism in the Region. New types of manufacturing jobs are anticipated to be created in relation to markets yet to emerge and products related to electronics, biotechnology and nanotechnology. The types of sector jobs that are growing are in retail, entertainment, and agriculture.

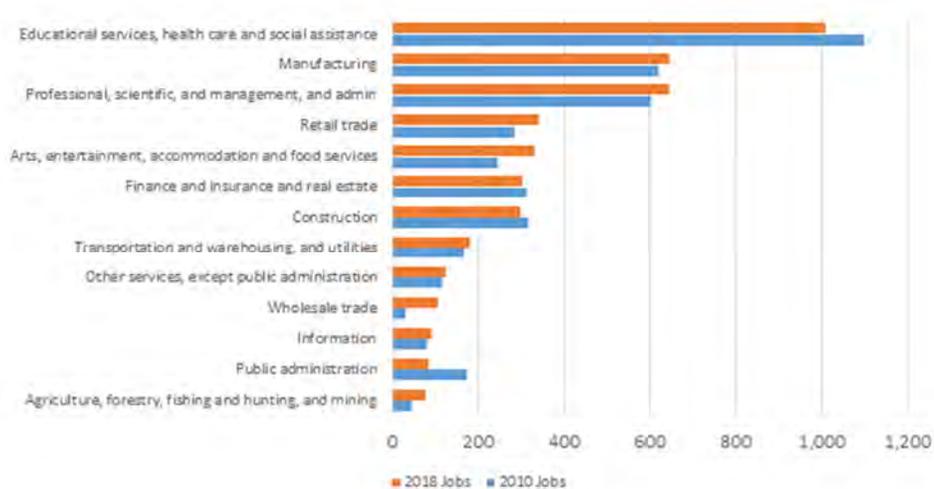


FIGURE 1: JOBS BY INDUSTRY IN 2010 AND 2018, TOWN OF STERLING

The figure above depicts the number of employed by sector according to the US Census, 2014-2018 American Community Survey, 5-Year Estimates. There are existing clusters of business in the Region. While the area once benefited from furniture and paper manufacturing, these sectors have given way to the emerging polymers, plastics, metals fabrication and food processing facilities supported by a business services cluster (e.g. finance, insurance and real estate). Education, healthcare, and social services account for the most jobs in the Region, at 24.6%. The Region is experiencing dramatic declines in

manufacturing, a sector that has been so important to our Region's history and economy, only accounting for 15.9% of all jobs in the Montachusett Region. In 1990, manufacturing jobs accounted for 29.4% of all jobs, and 24.4% in 2000. (1990 & 2000 U.S. Census)

The Region is experiencing an increase in jobs in Finance, Insurance, and Real Estate (5.7%, up from 5.0% in 2000, and 4.5% in 1990). Agriculture, Forestry, Fishing and Mining accounted for the least amount of jobs in the Region, coming in a just 0.7%, with Information at second-lowest, at 2.2%.

### 5.1.5 Transportation

The Montachusett Region is served by several state numbered routes that provide accessible links to all of the Region's communities. Of greatest importance to the area is Route 2, running east-west throughout the entire Region. This is one of two limited access east-west highways in the state and parallels the Massachusetts Turnpike in the center of the Commonwealth. This roadway provides the area with a direct link to I-495 and Boston in the east, and a connection in the west to I-91 and the western half of the state. Consequently, this highway is a major thoroughfare for the state as well as for the Region. Additionally, in the time of an emergency, Route 2 would function as a major evacuation route. The Region's major urban communities, Fitchburg, Leominster and Gardner, all border Route 2. The section of Route 2 from Phillipston to Athol in the MRPC Region was part of an ongoing Safety Improvement Study to improve the highway between Phillipston and Greenfield. Resulting improvements in the two communities included construction of climbing lanes, on and off ramp improvements, a truck weigh station in Athol and the installation of an innovative centerline treatment called "Qwick Kurb" along approximately 13 miles of Route 2 in Phillipston and Athol.

The completion of I-190 in the early 1980's added a second major limited access highway to the Region. This roadway provides direct access to Worcester, I-290 and the Massachusetts Turnpike. This highway has helped to reduce through traffic volumes on Route 12 by providing easier access to the Worcester area.

A second new limited access roadway was added to the Region's highway network with the completion of the Route 140 Bypass in Gardner, Westminster and Winchendon. Also constructed in the early 1980's as an alternative to the existing Route 140 layout, the Route 140 Bypass has enhanced traffic flow and alleviated some of the excess through traffic in Gardner City center. The MRPC and Central MA Regional Planning Commission (CMRPC) have worked with the communities of Sterling, Princeton, and Westminster on a Route 140 South Corridor Profile which has addressed safety concerns and made recommendations for improvements along the roadway from Route 2 south to I-190. A similar effort was undertaken by the MRPC along Route 140 North from Route 2 in Westminster north through Gardner and into Winchendon to Route 12. The Route 140 North Corridor Profile also identified potential improvements to address safety and access concerns in the three communities. Based upon information contained within this Corridor Profile, several safety improvements were implemented in Winchendon to Route 140 from the Gardner city line north to Teel Road. Also, on Route 12 in Sterling, new roundabouts were constructed by the Exit 6 on/off ramps of I-190 which were designed and constructed by MassDOT.

In Lunenburg, the two major roadways are Route 2A (Massachusetts Avenue) and Route 13 (Chase Road, Massachusetts Avenue and Electric Avenue). Route 2A is functionally classified as a Principal Arterial and is a major east/west road through both the town of Lunenburg and the Region as a whole. This road is under the Massachusetts Department of Transportation (MassDOT) jurisdiction through the town and the pavement condition varies from good to fair condition throughout. Route 13 is a north/south Principal Arterial originating in the City of Leominster towards the south through Lunenburg and the Town of Townsend in the north. Route 13 is almost completely town jurisdiction throughout Lunenburg with the exception of a short 0.1 mile section shared with Massachusetts Avenue (Route 2A) that is under MassDOT jurisdiction. Major improvements to Route 13 in North Leominster are expected to start in 2016 that will greatly improve congestion issues that users from Lunenburg attempting to access Route 2 and other commercial areas currently experience during AM and PM rush hours.

#### *Public Transportation:*

While there is no fixed route bus service in Sterling, the Region receives a wide array of public transportation services. At the forefront of the Region's public transportation is the Montachusett Regional Transit Authority (MART), which administers the local bus systems. The Town and MART provide service in Sterling through the Council on Aging that employs a paid coordinator funded jointly.

MART offers fixed route, demand response and special employment transportation services to the communities of Fitchburg, Leominster and Gardner. Limited intercity bus services are also available in Winchendon, Templeton, Phillipston, Athol and Orange. A majority of communities have transportation service for the elderly and disabled.

The Massachusetts Bay Transportation Authority (MBTA), based in Boston, provides commuter rail service to the Region. Four commuter rail stations are located in the Montachusett Region. Sterling is located approximately equidistantly between two commuter rail lines, the Fitchburg Rail Line which runs to North Station in Boston, and the Worcester/Framingham Rail Line which runs to South Station in Boston. The closest Worcester/Framingham line commuter rail station to Sterling is in Worcester, allowing residents access to the Worcester/Framingham Commuter rail line.

#### *Air Transportation:*

Within the Montachusett Region, there are three general aviation airports. Fitchburg Municipal Airport is located between the cities of Fitchburg and Leominster and the Gardner Airport in Templeton is located near the Gardner City Line. Both are publicly owned. The third airport is Sterling Airport in Sterling which is privately owned. All three airports are open to the public. The largest of the airports by far is the Fitchburg Municipal Airport. The airport sits on 335 acres and is classified as a General Aviation, General Utility Stage II airport by the National Plan of Integrated Airport Systems (NPIAS). This indicates that the airport can serve all small airplanes and accommodate some larger aircraft with a wingspan of less than 79 feet. Averages of 170 flights per day are handled on its two-runway system.

#### *Freight:*

Within the Montachusett Region, three major freight rail carriers operate: CSX Transportation, Pan Am Railways and the Providence & Worcester Railroad. In the Region rail operators own a total of

148.7 track miles. These lines operate as a regional freight hauler. Primary commodities handled include iron, cement, steel, food products, lumber, construction debris, limestone, chemicals and plastics, scrap metal, finished automobiles and aggregates.

### 5.1.6 Water Resources

The Region contains 1,181 lakes and ponds totaling 22,678 acres. The Region also has 4,277 wetlands, totaling 36,903 acres. The Region encompasses parts of four watersheds in the Montachusett Region's communities: Millers, Nashua, Merrimack, and Chicopee. The majority of the Region's communities are located in the Nashua River Watershed, followed by six communities in the Millers River Watershed, three in the Chicopee Watershed and a small portion of Ayer and Groton in the Merrimack River Watershed. All of these watersheds contain many smaller rivers and brooks, each with their own unique values, functions, and uses.

There are approximately 12 ponds and lakes fully located within Sterling, plus a portion of the Wachusett Reservoir which encompass about 737 acres of the town. Many of these water bodies are reserved for water supply and have limited access for recreational use. The three largest open water sources within the town are a portion of the Wachusett Reservoir and East and West Waushacum Lakes. The Wachusett Reservoir is in the southeastern corner of the town and has very limited recreational access due to its use as a for water supply. East and West Lake Waushacum are both listed as Great Ponds by Massachusetts with public right of access. West Lake Waushacum is the smaller of the two with shores free of development and lies within DCR's water supply protection lands. As a result, there are also limitations on recreation. East Lake Waushacum is much different from West Lake Waushacum, as it has a built-up shoreline with mostly residential units and a Town-managed beach and picnic area. East Lake Waushacum is a popular community location for swimming and boating.

## 5.2 Community Profile

The Town of Sterling is bordered by Leominster on the north, Lancaster and Clinton on the east, Boylston and West Boylston on the south, and Princeton and Holden on the west. Sterling is about 41 miles west of Boston, 12 miles north of Worcester, and 186 miles from New York City.

The town of Sterling covers an area of 31.61 square mile and has a resident population of 8,091, according to the 2019 US Census American Community Survey 5-Year Estimates, with a density of 256 people per square mile. The total number of housing units is 2,920, and the average household size is 2.73 people. The median age of Sterling residents is 47.

Sterling is a rural agricultural community that was incorporated in 1781. The town is named for the Earl of Stirling, a Scottish lord. At various times in its history, clocks, hats, cider, pottery and other goods were manufactured in Sterling, but most recently has been mostly a farming community of rolling hills, pastures and some spectacular views of Mount Wachusett. Sterling is the home of Mary Sawyer of "Mary Had a Little Lamb" fame. There is a statue of the lamb in the Town Common which attracts many visitors. Sterling is also the home of the Butterick dress pattern, which was originally designed and patented by Ebenezer Butterick in 1896. Residents enjoy the rural atmosphere of the town and also have easy access

to museums, plays, and skiing at Mount Wachusett. Each year in early September, the Sterling Town Fair attracts people from far and near who enjoy the many attractions of the fair; horse and oxen pulls, game booths, rides, good food, and music. Sterling’s largest employers are Northeast Polybag and Sterling Village.

### 5.2.7 Land use

The most recent land use statistics available from the state are based on aerial photography done in 2016. The table below shows the acreage and percentage of land in 20 categories. The highest percentage land use is forest at 31% of the total area. (See Appendix A Map 2 for mapping.)

**TABLE 2: LAND USE**

<b>Land Use</b>	<b>Percentage</b>
Deciduous Forest	31%
Evergreen Forest	22%
Forested Wetlands	9%
Developed Open Space	8%
Pasture/Hay	6%
Water	4%
Grassland	4%
Shrub	3%
Non forested wetlands	2%
Right of Way	2%
Cultivated	2%
Residential – Single Family	2%
Bare Land	<1%
Industrial	<1%
Other impervious	<1%
Commercial	<1%
Aquatic Bed	<1%
Residential -Others	<1%
Residential – Multi Family	<1%
Mixed Use -Other	<1%

### 5.2.8 Critical Facilities

In general usage, the term “critical facilities” is used to describe all manmade structures or other improvements that, because of their function, size, service area, or uniqueness, have the potential to cause serious bodily harm, extensive property damage, or disruption of vital socioeconomic activities if they are destroyed, damaged, or if their functionality is impaired.

Critical facilities commonly include all public and private facilities that a community considers essential for the delivery of vital services and for the protection of the community. They usually include emergency response facilities (fire stations, police stations, rescue squads, and emergency operation centers), custodial facilities (jails and other detention centers, long-term care facilities, hospitals, and other health

care facilities), schools, emergency shelters, utilities (water supply, wastewater treatment facilities, and power), communications facilities, and any other assets determined by the community to be of critical importance for the protection of the health and safety of the population. The adverse effects of damaged critical facilities can extend far beyond direct physical damage. Disruption of health care, fire, and police services can impair search and rescue, emergency medical care, and even access to damaged areas.

The number and nature of critical facilities in a community can differ greatly from one jurisdiction to another, and usually comprise both public and private facilities. In this sense, each community needs to determine the relative importance of the publicly and privately owned facilities that deliver vital services, provide important functions, and protect special populations. Source: Federal Emergency Management Administration, Risk Management Series, Design Guide for Improving Critical Facility Safety from Flooding and High Winds, FEMA 543, January 2007.

A list of the critical facilities within the community is shown in the table below. This data was obtained from the community's Comprehensive Emergency Management Plan (CEMP). The data was then reviewed by the Emergency Management Director. These facilities were digitized into GIS and used for determining vulnerability to the various hazards. A map of Critical Facilities for the Town of Sterling can be found in Appendix A Map 1.

TABLE 3: CRITICAL FACILITIES

Feature Type	Name	Address
Airports	Sterling	Greenland Road
Animal Shelters	Sterling Animal Shelter	17 Laurel wood Road
City/Town Halls	Sterling Town Hall	1 Park Street
Public Water Supply*	Sterling Nursery School	123 Rowley Hill Road
	Worcester Road Well 2a	Worcester Road
	Gp 4 Redemption Rock Trail Well	Redemption Rock Trail
	Worcester Road Well 2b	Worcester Road
	Worcester Road Well 2c	Worcester Road
	Gp 5 Redemption Rock Trail Well	Redemption Rock Trail
	Gp 3 Redemption Rock Trail Well	Redemption Rock Trail
DPW Facilities	Sterling DPW	171 Worcester Road
Early Education Childcare Facilities	Moroney, Jessica L.	76 Holden Road
	Abell, Helen	5 Walnut Drive
	Sterling Nursery School	123 Rowley Hill Road
	Jordan, Karyn	17 Jewett Road
	Amazing Kids	64 Leominster Road
	Hanson, Carol M.	110 Clinton Road
	Tremblay, Jennifer L.	175 Newell Hill Road
	Citro, Shannon	28 Sandy Ridge Road
	Shepardson, Joyce	14 Redstone Place
	Village Green Preschool	First Church

Elderly Housing	Sholan Terrace	7 Bird Street
Electric Substations	Sterling Light Department	40 Chocksett Road
	National Grid	29 Pratts Junction Road
Emergency Dispensing Sites	Chocksett Middle School	40 Boutelle Road
	Houghton Elementary School	32 Boutelle Road
Emergency Shelters	First Church	6 Meetinghouse Hill Rd.
	Houghton Elementary School	30 Boutelle Road
	Chocksett Middle School	40 Boutelle Road
	Saint Richard's of Chichester Church	4 Bridge Street
	Hope Chapel	35 Chocksett Road
	Butterick Municipal Building	1 Park Street
End Of Life Facilities	Miles Funeral Home	100 Worcester Road
	Reed Cemetery	13 Boutelle Road
	Oak Hill Cemetery	20 Clinton Road
	Hillside Cemetery	25 Clinton Road
	Legg Cemetery	43 Redemption Rock Trail
	Fairbanks Cemetery	112 Chace Hill Road
Emergency Operations Centers	Sterling Police Department	135 Leominster Road
	Sterling Fire Department	5 Main Street
Fire	Sterling Fire Department	5 Main Street
Hazmat Sites	Birch Point Paper	11 Dana Hill Road
	Colonial Wire and Cable	11 Dana Hill Road
	Comcast	163 Clinton Road
	Anderson Power Products	13 Pratts Junction Road
	Verizon Cell Tower	7 Chocksett Road
	Osterman Gas	22 Legate Hill Road
	Crop Production Services	18 Legate Hill Road
	Fiber optic Components	2 Spratt Technology Way
	Polyflow	100 Pratts Junction Road
	Verizon Switching Office	51 Main Street
	Mass Hwy. Dept.	14 Chocksett Road
	National Grid	29 Pratts Junction Road
	Northeast Grower Supply	150 Clinton Road
Long Term Care Facility	Sterling Village	18 Dana Hill Road
Other Critical Facilities	Justice Hill Receiver Site	Justice Hill Road
	Redemption Rock Trail Receiver Site	Redemption Rock Trail

	West Sterling Uv Treatment Facility	Osgood Road
	J&J West Sterling Garage	240 Redemption Rock Trail
	Birch Point Paper	11 Dana Hill Rd
	Colonial Wire and Cable	11 Dana Hill Rd
	Hall Avenue Receiver Site	1 Hall Ave
	Lehigh Gas	205 Worcester Road
	Comcast	161 Clinton Road
	Northeast Grower Supply	150 Clinton Road
	Anderson Power Products	9-13 Pratts Junction Road
	Horace Mann Educational Association	153 Clinton Road
	Verizon Cell Tower	9 Chocksett Road
	Sterling Emergency Communications	135 Leominster Road
	Wireway Husky	150 Pratts Junction Road
	Osterman Gas	22 Legate Hill Road
	Uap Northeast	18 Legate Hill Road
	Pratt's Junction Road Receiver Site	27 Pratts Junction Road
	Fiber optic Components	2 Spratt Technology Way
	Polyflow	100 Pratts Junction Road
	Sprint Cell Tower	5 Pinewoods Lane
	Pinewoods Lane Base Antenna Site	5 Pinewoods Lane
	Apple Town Market	9 Main Street
	Verizon Switching Office	51 Main Street
	Seven Hills Foundation	1 Pheasant Hill Lane
	Sholan Park	5 Hall Avenue
	Institute Of Professional Practice	26 James Rd
	Institute Of Professional Practice	287 Redemption Rock Trail
	Davis Solar Farm	145 Redstone Hill Road
	Post Office	6 Clinton Road
	Maki Home Center	36 Worcester Road
	Wachusett Food Pantry	50 Worcester Road
	Sterling Village Skilled Nursing & Rehabilitation	18 Dana Hill Road
Other Government Buildings	Conant Public Library	4 Meetinghouse Hill Road
	Sterling DPW	171 Worcester Road
	Sterling Municipal Light Plant	50 Main Street
	DPW Fueling Station	171 Worcester Road
	Mass Hwy. Dept.	14 Chocksett Road
	Sterling Municipal Light Dept. Substation	Chocksett Road

	Osgood Road Water Tank	13 Osgood Road
	Tuttle Road Water Tank	11 Tuttle Road
	Fire Station Back-Up Antenna	5 Main Street
	Sterling Municipal Light Department Radio Antenna	50 Main Street
	Kendall Hill Water Tank	61 Kendall Hill Road
	Justice Hill Receiver Site	1 Roper Road
	Redemption Rock Trail Receiver Site	283 Redemption Rock Trail
	Sterling Emergency Communications	135 Leominster Road
	Pratt's Junction Road Receiver Site	27 Pratts Junction Road
Police	Sterling Police Department	135 Leominster Road
Pumping Stations	West Sterling Pumping Station	275 Redemption Rock Trail
	Worcester Road Pumping Station	109 Worcester Road
School	Houghton Elementary School	32 Boutelle Road
	Chocksett Middle School	40 Boutelle Road
	Sterling Nursery School	123 Rowley Hill Road
Sports And Cultural Areas	Sterling Academy Of Gymnastics	15 Industrial Drive
	First Church	6 Meetinghouse Hill Road
	Seventh-Day Adventist Church	82 Leominster Road
	Hope Chapel	35 Chocksett Road
	Saint Richard Of Chichester Church	4 Bridge Street
	LifeSource Fellowship Church	153 Clinton Road
	Town Common	Main Street
	Town Beach & Sholan Park	Hall Avenue (East Waushacum
	Griffin Road Soccer, Softball & Track Athletic Complex – 1 Griffin Road	Griffin Road
	Memorial Park & Gazeboe	4 Cross Street & 5 Waushacum
	Sterling Nationals County Club	33 Albright Road

### 5.2.9 Future land use and Facilities

The various land uses currently existing in the Town of Sterling are an asset that is currently at risk. The agricultural land and farming community is vulnerable to economic and environmental pressure to convert land away from agricultural uses. The open space and forested land are currently owned primarily by DCR and provide ecological value and community character. Preservation of the agricultural land and open space is currently in conflict with the Town's interest in encouraging and enabling residential and industrial growth. The previous historic Town Hall has been renovated and awaiting tenants for future uses such as offices, coffee shop, and potentially a performance center. The Town is continuing in their efforts for this development. Proper planning can set the Town of Sterling up for

success to preserve land uses important to the town and efficiently enable growth such a redeveloping existing facility as indicated previously.

## 6. OVERVIEW OF HAZARDS AND VULNERABILITY

### 6.1 *Overview of Hazards and Impacts*

The Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP) provides an in-depth overview of natural hazards and climate change impacts in Massachusetts. The SHMCAP indicates that Massachusetts is subject to the following natural hazards (listed in order of frequency); floods, heavy rainstorms, nor'easters, coastal erosion, hurricanes, tornadoes, urban and wildfires, drought and earthquakes. The plan also identifies significant impacts due to climate change in the form of precipitation, sea level rise, rising temperatures, and extreme weather. The state plan can be viewed online at: <https://www.mass.gov/service-details/massachusetts-integrated-state-hazard-mitigation-and-climate-adaptation-plan>

Table 5 summarizes the hazard risks for Sterling. Throughout this section the natural hazards are discussed, including Location, Extent, Previous Occurrences, Probability of Future Events, Impact, and Vulnerability.

Definitions associated with Probability of Future Events are as follows:

- Highly likely: 90 to 100 percent probability of occurrence in the next year or a recurrence interval of less than 1 year.
- Possible: 10 to 90 percent probability of occurrence in the next year or a recurrence interval of 1 to 10 years.
- Unlikely: Less than 10 percent probability of occurrence in the next year or a recurrence interval of greater than 11 years.

Definitions associated with Impact are as follows:

- Catastrophic: Immediate onset or extended duration of event, resulting in catastrophic damage and uninhabitable conditions.
- Critical: Fast speed of onset or long duration of event resulting in devastating damage and loss of services for weeks or months.
- Limited: Moderate speed of onset or moderate duration of event, resulting in some damage.
- Negligible: Slow speed of onset or short duration of event resulting in little to no damage.

Table 6 lists those federal disaster and emergency declarations for Worcester Counties.

**TABLE 4: HAZARD RISKS SUMMARY**

Hazard	Probability	Impact
Heavy Rain	Highly Likely	Limited
Bridges	N/A	N/A
Snow Melt	Possible	Limited
Dam Failure	Possible	Limited
Ice Jams	Unlikely	Negligible
Beavers	Highly Likely	Limited
Coastal Storms	N/A	N/A
Hurricane/Tropical Storms	Highly likely	Critical
Tornados	Possible	Critical
High Winds	Highly Likely	Critical
Severe Thunderstorm	Highly Likely	Limited
Winter Storms	Highly Likely	Critical
Climate Change	N/A	N/A
Wild Fires	Possible	Critical
Drought	Possible	Critical
Extreme Temperatures	Possible	Limited
Earthquakes	Possible	Limited
Land slides	Possible	Limited

TABLE 5: DISASTER AND EMERGENCY DECLARATIONS FOR WORCESTER COUNTIES

ID Number	Type	Date
3438	COVID -19 Pandemic	March 2020
4496	COVID -19 Pandemic	March 2020
4379	Severe Winter Storm and Snowstorm	March 2018
4214	Severe Winter Storm, Snowstorm, and Flooding	January 2015
4110	Severe Winter Storm, Snowstorm, and Flooding	February 2013
3362	Explosions (Terrorist Attack)	April 2013
4097	Hurricane (Sandy)	October 2012
4051	Severe Storm and Snowstorm	October 2011
3330	Hurricane (Irene)	August 2011
1994	Severe Storms and Tornadoes	June 2011
1959	Severe Winter Storm and Snowstorm	January 2011
3315	Hurricane (Earl)	September 2010
1895	Severe Storms and Flooding	March 2010
1813	Severe Winter Storm and Flooding	December 2008
1701	Severe Storms and Inland and Coastal Flooding	April 2007
1642	Severe Storms, Flooding	May 2006
1614	Severe Storms, Flooding	October 2005
3252	Hurricane (Katrina)	August 2005
3201	Snow	January 2005
1512	Flooding	April 2004
3191	Snowstorm	December 2003
3175	Snowstorm	February 2003
3165	Blizzard	March 2001
1364	Severe Storms, Flooding	March 2001
1224	Heavy Rain, Flooding	June 1998
1142	Severe Storms, Flooding	October 1996
1090	Blizzard	January 1996
3103	Blizzard	March 1993
920	Severe Coastal Storm	October 1991
914	Hurricane (Bob)	August 1991

## 6.2 Heavy Rain

### *Hazard Description*

Flooding can be defined as a rising and overflowing of a body of water onto normally dry land. Floods can be slow or fast rising but generally develop over a period of days. A high percentage of impervious surfaces and high groundwater levels do not allow heavy rain to be absorbed back into the ground. Basement, roadway, and infrastructure flooding can result in significant damages due to poor or insufficient storm water drainage. This not only causes flooding but also prevents groundwater recharge

and can threaten water quality, which can affect public drinking water supplies. Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss.

### *Location*

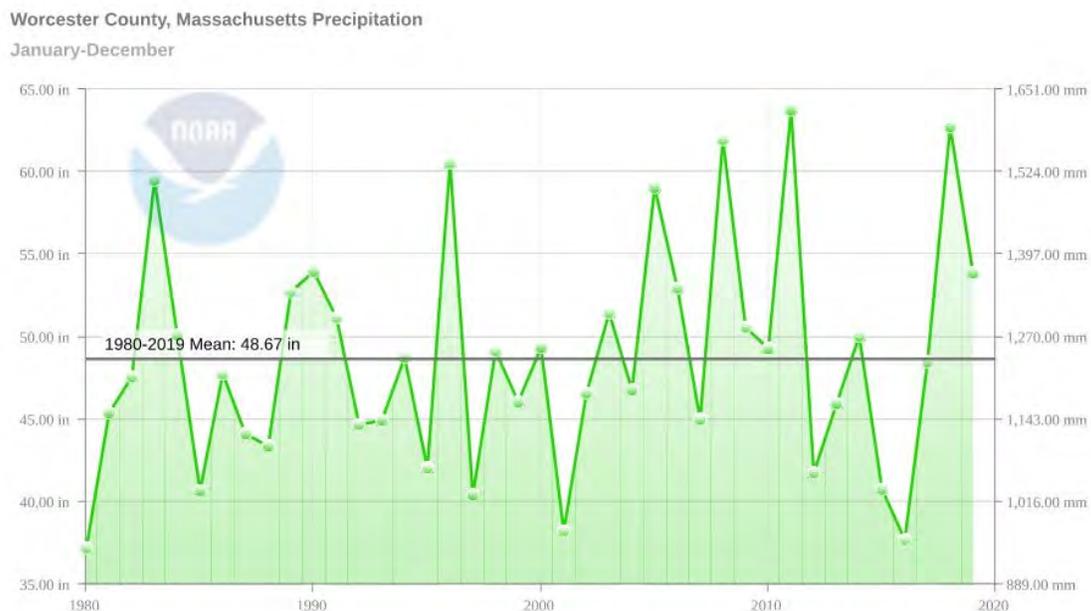
Heavy Rain fall events have caused areas of flooding in the past. This information can be found on Sterling's 2015 Local Hazard Map which is located in Appendix A Map 10. See Stormwater Map in Appendix A Map 6 for FEMA floodplain data for the town of Sterling.

### *Extent*

Based on data gathered from the National Climatic Data Center, the yearly precipitation total for the Worcester County has been experiencing a gradual rise over the last 33 years. This can be seen in the chart below. In fact, three of the years since 1980 with the highest inches of rainfall have occurred most recently: 2008 (62"), 2011 (64") and 2018(63"). This may in the future change flood patterns limits and extents of flooding in new areas.

### *Previous Occurrences*

Historic data for Worcester County, MA from the National Oceanic and Atmospheric Administration (NOAA).



**FIGURE 2: NOAA AVERAGE ANNUAL PRECIPITATION DATA FOR WORCESTER COUNTY, MA**

### *Probability of Future Events*

With the increase in yearly precipitation the Region is experiencing as well as the amount of development that is within the floodplain, Sterling is highly likely to experience increased amounts of flooding and damage.

### *Impact*

Since flooding can be caused by heavy rain it is estimated that flooding will have limited impact on Sterling.

### *Vulnerability*

Efforts to flood proof or relocate existing development within the floodplain, along with efforts to prohibit or limit new development, will decrease the potential for damage and losses in the future.

## **6.3 Bridges**

### *Hazard Description*

Typically, bridges with an AASHTO (American Association of State Highway and Transportation Officials) rating below 50 are considered structurally deficient. However, some bridges may be considered structurally deficient due to deterioration to one or more of its major components. Bridges are a Regional concern due to the multitude of bridges within the regional area with specific concerns for bridges crossing waterways.

### *Location*

There are 40 bridges identified in Sterling per the MassDOT Bridge Web Application. Out of the 40 bridges, only 2 are classified as structurally deficient as of July 12, 2018. The bridges are located at the intersection of I-190NB / I-190SB and Pratts Junction Road. These bridges are owned by MassDOT.

### *Vulnerability*

Transportation infrastructure is a regional concern and may affect the Town of Sterling traffic patterns in the future. The two bridges stated above should be coordinated this MassDOT to understand how traffic patterns may affect the Town in the future when repair work is in construction. Other regional bridges will require work in the future as well which may also affect Sterling's transportation network.

## 6.4 *Snow Melt*

### *Hazard Description*

Snow melt has the potential to cause flooding in Sterling. This can be a serious problem for areas that have received large amounts of snow throughout the winter season. When temperatures rapidly increase, so does the rate at which snow melts; frozen soil also increases the risk of flood as water from melting snow is not able to seep into the ground.

Snow melt flooding occurs when the major source of water involved in a flood is caused by melting snow. Unlike rainfall that can reach the soil almost immediately, the snowpack can store the water for an extended amount of time until temperatures rise above freezing and the snow melts. This frozen storage delays the arrival of water to the soil for days, weeks, or even months. Once it begins to melt and does reach the soil, water from snowmelt behaves much as it would if it had come from rain instead of snow by either infiltrating into the soil, running off, or both. Flooding can occur when there is more water than the soil can absorb or can be contained in storage capacities in the soil, rivers, lakes and reservoirs.

### *Location*

Snow melt events have caused areas of flooding in the past. This information can be found on Sterling's 2015 Local Hazard Map which is located in Appendix A Map 10. See Stormwater Map in Appendix A Map 6 for FEMA floodplain data for the Town of Sterling.

### *Extent*

Due to the snow covering the extend of the town, when the snow melts, a delayed flooding will occur downgradient effecting the areas of concern for flooding as indicated in the Sterling 2015 Local Hazard Map in Appendix A Map 10.

### *Previous Occurrences*

Winter snow can cause flooding during times when temperatures can increase quickly/substantially particularly in the spring which has resulted in numerous previous occurrences. The winter of 1935-1936 was one of the worst cases of snow melt/ flooding. As of early March, that winter it was estimated that the snowpacks in New England averaged about 7.5 inches of water. In Southern New England, snow water equivalents of 3.5 inches were normal. On March 9, a warm, moisture-laden front moved into, and stalled over New England resulting in increased temperatures as well as heavy rainfall. The combination of heavy rain and melting snow resulted in severe flooding.

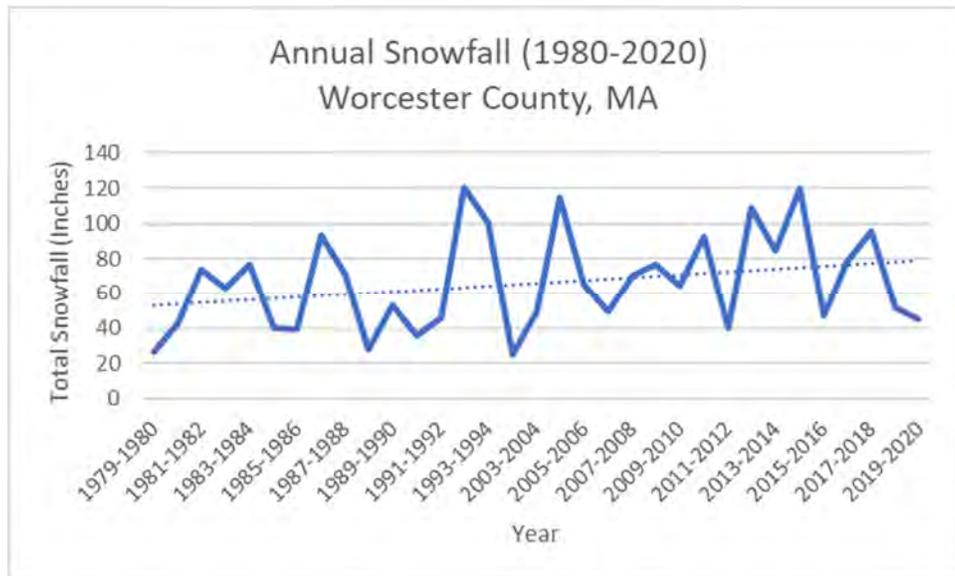


FIGURE 3: NOAA DATA FOR ANNUAL SNOWFALL

### *Probability of Future Events*

With the climatic conditions that occur in the Montachusett Region that impact the town of Sterling each year including an average of seven severe winter storms per year, snow melt will certainly continue into the future which can cause flooding during times when temperatures can increase quickly/substantially particularly in the spring. Probability of future events falls under the definition of probability as possible.

### *Impact*

Since flooding can be caused by snow melt it is estimated that flooding will have limited impact on the Town of Sterling.

### *Vulnerability*

The town of Sterling is vulnerable to snow melt; heavy snow fall, frigid temperatures followed by a sudden transition to warmer temperatures throughout the Northeast increase the chance of flooding from snowmelt potentially causing flood related damage to homes and businesses, roads and buildings particularly within the floodplain.

## 6.5 Dam Failures

### *Hazard Description*

Dam Failure is an uncontrolled release of water impounded by a dam. The Massachusetts Office of Dam Safety reports that the region's dams, like the other parts of New England infrastructure, are an aging infrastructure that is expensive to repair. Routine maintenance is necessary to control the growth of

trees and keep the area clear so defects can be detected. In addition to aging, the region's dams are often doing work beyond their original design. The increase in impervious surfaces leads to increased flows in some streams and rivers and thus greater demands are placed on the dams.

Dam failures may cause loss of life and property downstream, but they may also degrade the environment. Many dams act as a holding area for contaminated sediments. With a dam failure, these sediments are released and can damage wildlife and the ecology of the river system. An associated cost of dam failures is the potential for such destruction to affect fish ladders or culverts for directing water.

Dam failures are potentially the worst of flood events. Typically, a dam failure is the result of neglect, poor design, or structural damage caused by a major event such as an earthquake. When a dam fails, huge volumes of water are often released, causing widespread destruction and potential loss of life. Floods due to dam failures have occurred in New England in the past.

### *Extent*

Dams are classified by the Massachusetts Department of Conservation and Recreation using the criteria below. The classification required the dam owners to follow proper protocol. As displayed in the table below none of the dams located in Sterling are owned by the town themselves. This requires outreach to the towns associated with these dams or town citizens to allow Sterling to be up to date on any construction or maintenance plans for the dams.

#### **Hazard Potential Classification**

- High Hazard - Refers to dams located where failure will likely cause loss of life and serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s).
- Significant Hazard - Refers to dams located where failure may cause loss of life and damage home(s), industrial or commercial facilities, secondary highway(s) or railroad(s) or cause interruption of use or service of relatively important facilities.
- Low Hazard - Refers to dams located where failure may cause minimal property damage to others. Loss of life is not expected.

### *Location*

Sterling has dams located within the town. Some dams are classified as significant hazards and are required to be inspected. The table below displays the 19 dams located in Sterling, along with the classification and last inspections dates provided by the Massachusetts Department of Conservation and Recreation.

TABLE 6: DAMS IN STERLING, MA

Dam Name	Hazard Potential	Owner	Follow up Inspection	Follow up Inspection Status
Stuart Pond Dam	Non-Jurisdictional	Last known privately owned	N/A	N/A
Hycrest Farm Pond Dam	Significant	Privately owned	N/A	N/A
Heywood Reservoir Dam	Significant	Town of Clinton	2019/09/20	Poor
Fitch Basin Dam	Significant	Town of Clinton	2019/09/20	Poor
Upper Lynde Basin Dam	Significant	Town of Clinton	2019/09/20	Poor
Petruzzi Pond Dam	Non-Jurisdictional	Last known privately owned	N/A	N/A
John Tagg Pond Dam	Non-Jurisdictional	Last known privately owned	N/A	N/A
Tuttle Lake Dam	Non-Jurisdictional	Last known privately owned	N/A	N/A
Saddle River Dam	Non-Jurisdictional	Last known privately owned	N/A	N/A
Duck Pond Dam	Non-Jurisdictional	Last known privately owned	N/A	N/A
Pratts Pond Dam	Significant	Privately owned	2020/01/20	Poor
Thomas Pond Dam	Non-Jurisdictional	Unknown	N/A	N/A
Farm Pond Dam	Non-Jurisdictional	Last known privately owned	N/A	N/A
Old Mill Pond Dam	Non-Jurisdictional	Unknown	N/A	N/A
Lower Spring Basin Dam	Non-Jurisdictional	Last known Town of Clinton	N/A	N/A
Upper Spring Basin Dam	Non-Jurisdictional	Last known Town of Clinton	N/A	N/A
Lower Lynde Basin Dam	Low	Town of Clinton	N/A	N/A
West Waushacum Pond Outlet Works	Non-Jurisdictional	DCR	N/A	N/A
Waushacum Pond Dam - East	Non-Jurisdictional	DCR	N/A	N/A

*Source: DCR - Office of Dam Safety*

### Previous Occurrences

Historically, there have been no dam failure occurrences for the town of Sterling and has a low occurrence in the Montachusett Region. However, many of the dams within the Region are more than 100 years old, meaning the possibility of dam failure is not inconceivable.

### *Probability of Future Events*

Future occurrences of dam failure fall under the definition of probability as possible. Based upon the conditions shown in the above table, only 5 dams in Sterling are a significant hazard. It should be noted that this number could be higher as many dams are non-jurisdictional, thus they are not inspected by the Office of Dam Safety. Non-jurisdictional dams are defined as being less than 6 feet high and store less than 15 acre-feet of water.

### *Impact*

Since only 5 dams are classified as significant hazards, it is estimated that the impact on the Town of Sterling is limited.

### *Vulnerability*

Significant hazard dams must be inspected every five years, and low Hazards dams every 10 years. Owners of dams are responsible for having their dam inspected. MGL Chapter 253 and 302 CMR 10.00 requires that dam owners prepare, maintain and update Emergency Action Plans for all High Hazard Potential dams and certain Significant Hazard Potential dams.

Non-jurisdictional dams are not regulated by the Office of Dam Safety or under their jurisdiction. Typically, these dams are under 6 feet in height and/or under 15 acre-feet in storage and do not have an assigned 'Hazard Code'. Dams owned and regulated by the Federal Government are also typically non-jurisdictional but do have an assigned Hazard Code. Sterling should be aware of any vulnerabilities associated with these hazards and coordinate with the proper authorities to continue to be updated on dam conditions and any construction plans.

## **6.6 Ice Jams**

### *Hazard Description*

Ice jams occur in the winter or early spring when normally flowing water begins to freeze. There are two types of ice jams; a freeze up and a breakup jam. A freeze up jam forms in the early winter as ice formation begins. This type of jam can act as a dam and begin to back up the flowing water behind it. The second type, a break up jam forms as a result of the breakup of ice cover, causing large pieces of ice to move downstream potentially acting as a dam, impacting culverts and bridge abutments.

### *Location*

The table below indicates the Ice jam occurrences within the town of Sterling from 1913 to 2020. The table shows that there have not been ice jams within the town of Sterling in many years.

TABLE 7: ICE JAM REPORTS

Ice Jam Location in Sterling, MA	Date
Rocky Brook	2/25/1965
Rocky Brook	1/21/1964
Rocky Brook	3/31/1960
Rocky Brook	2/2/1953
Rocky Brook	2/7/1951
<i>Source: Ice Jam Database by CRREL</i>	

#### *Extent*

There have been reports of other ice jams that have occurred in the Montachusett Region between 1913 and 2020. The Millers River has been problematic within the communities of Athol, South Royalston, and Winchendon. Although this does not directly affect Sterling, these surrounding communities ice jams could potentially cause affects to the shared waterways.

#### *Previous Occurrences*

There have been a reported 5 ice jams that have occurred in Sterling between 1913 and 2020 as indicated in the table above.

#### *Probability of Future Events*

Sterling's probability for ice jams is unlikely. However, with the climatic conditions that occur in the Montachusett Region, ice jams may continue into the future causing damage to bridges and roads and buildings within the floodplain. To minimize ice jams, special consideration should be made during reconstruction of any bridges or dams which tend to be where ice jams are more likely to occur.

#### *Impact*

Since only a few ice jams have occurred in the past but not in recent years, it is estimated that the impact on the Town of Sterling is negligible.

#### *Vulnerability*

Sterling is somewhat vulnerable to ice jams according to the table above. Heavy snow fall and frigid temperatures throughout the Northeast increase the chance of flooding from snowmelt and ice jams. When river ice piles up at shallow areas, bends and islands it blocks the flow of water and may cause flooding of nearby homes and businesses. Ice jams that become lodged within the abutment of bridges can threaten the integrity of the structures. Heavy equipment, such as cranes with wrecking balls may have to be used to break up ice jams to reduce potential property and structural damages and losses.

## 6.7 *Beavers*

### *Hazard Description*

In local communities surrounding Sterling, beavers have been a concern. Beavers are a regional hazard for the Montachusett Region and have been discussed by many communities. It takes a great deal of time and expense to control their activities. This hazard relates directly to other hazards such as rain storms, hurricanes, floods, and winter related storms.

### *Location*

In Sterling there are many different areas around town where beavers have cause pinpointed issues. To see the various locations of beaver activity within Sterling, see the Sterling 2015 Local Hazard Plan in Appendix A Map 10.

### *Extent*

It was stated at all of the Montachusett Region individual Hazard and Vulnerability Sessions back in 2015 that beavers continue to pose a significant problem, therefore effecting many communities and waterways. This can cause waterway and flood patterns to be altered in the adjacent communities, which may further effect Sterling.

### *Previous Occurrences*

The beaver is a valuable component of Massachusetts' fauna. Beavers have played an active role in New England's ecology for thousands of years. Beavers are natural "engineers" of the land, they are agents of change, creating wetlands out of uplands and streams, and providing habitat for a variety of plants and animals. However, not long ago the beaver was absent from the Montachusett Region. In fact, it was absent from the late 1700s to the early 1900s. Intensive unregulated hunting and trapping, combined with deforestation to clear land for agriculture, led to the disappearance of beaver habitat and the beaver. In the early 1900's, forested habitat started to recover when many farmers abandoned their farms in order to take jobs in cities or to start new farms in the more fertile Midwestern United States. With the forests able to retake the landscape, the beaver was able to return and an important component of the Montachusett Region's native ecosystems was restored. However, beavers returned to a landscape that had been substantially altered by people.

### *Probability of Future Events*

Beaver activity will most certainly continue to persist throughout the Montachusett Region, as the factors that have allowed them to expand their range (increase in suitable habitat, wetland protection, and a decrease in hunting and trapping) are expected to remain constant over the next decade. Probability of future events falls under the definition of probability as highly likely.

### *Impact*

Since beaver activity will continue in the future, the impact on the Town of Sterling is limited.

### *Vulnerability*

When beavers in the Montachusett Region build their dams in areas where there is increased residential development, roads and agricultural use of the land, the flooding that results can cause serious public and private property damage, often threatening homes, septic systems, low-lying roadways, and other public infrastructure. It was stated at all of the Montachusett Region individual Hazard and Vulnerability Sessions back in 2015 that beavers continue to pose a significant problem. The state and local governments have responded to this crisis with a complex regulatory process. The process places its highest priority on protecting in-ground septic systems and road networks. Most of the regulatory process has been developed to respond to threats to the public health and safety.

## **6.8 Coastal Storms**

### *Hazard Description*

Coastal storms have not been addressed in this plan since Sterling does not have any coastline and is over 30 miles from the nearest coast.

## **6.9 Hurricanes/ Tropical Storms**

### *Hazard Description*

Both hurricanes and tropical storms can produce substantial damage from storm surge, waves, erosion and intense winds in coastal areas. While this type of coastal storm surge has been the number one cause of hurricane related deaths in the past, more people have died from inland flooding associated with tropical systems in the last 30 years. Since the 1970s, inland flooding has been responsible for more than half of all deaths associated with tropical cyclones in the United States. Inland flooding from hurricanes can occur hundreds of miles from the seacoast. Communities in the Montachusett Region and the Town of Sterling would not normally be affected by the strongest hurricane winds.

### **Hurricanes**

A hurricane is a type of tropical cyclone; an organized rotating weather system that develops in the tropics. Tropical cyclones are classified as follows:

- Tropical depression: An organized system of persistent clouds and thunderstorms with a low level circulation and maximum sustained winds of 39 mph or less.

- Tropical storm: An organized system of strong thunderstorms with a well-defined circulation and maximum sustained winds of 39-73 mph.

Tropical depressions and tropical storms, while generally less dangerous than hurricanes, can be deadly. The winds of tropical depressions and tropical storms are usually not the greatest threat. Heavy rains, flooding and severe weather, such as tornadoes, create the greatest problems associated with tropical storms and depressions.

- Hurricane: An intense tropical weather system with a well-defined circulation and maximum sustained winds of 74 mph or higher. The typical hurricane moves at an average speed of approximately 12 miles per hour. While in the lower latitudes, hurricanes tend to move from east to west. However, when a storm drifts further north, the westerly flow at the mid-latitudes tends to cause the storm to curve toward the north and east. When this occurs, the storm may accelerate its forward speed. This explains why some of the strongest hurricanes have reached New England.

#### *Extent*

Hurricanes can occur along the East Coast of the United States anytime in the period between June and November. Hurricane intensity and the potential property damage posed by a hurricane are rated from 1 to 5 according the Saffir-Simpson Hurricane Scale

**TABLE 8: SAFFIR-SIMPSON HURRICANE SCALE**

Category	Wind Speed
Tropical Storm	39–73 mph (63–117 km/h)
1	74–95 mph (119–153 km/h)
2	96–110 mph (154–177 km/h)
3	111–130 mph (178–209 km/h)
4	131–155 mph (210–249 km/h)
5	≥156 mph (≥250 km/h)
Source - National Weather Service, National Hurricane	

#### *Previous Occurrences*

Only two storms have had direct travel through the Town of Sterling. These hurricanes were both downgraded to Tropical Storms by the time they reached Sterling.

**TABLE 9: HURRICANES/TROPICAL STORMS**

Date	Type	Name	Wind Speed
9/28/1861	Tropical Storm	Unnamed	50
9/17/1999	Tropical Storm	Floyd	50
Source: NOAA Hurricane Track			

The National Oceanic and Atmospheric Administration (NOAA) has been keeping records of hurricanes since 1858. From 1858 to 2020 Worcester county has had six Tropical Storms, and 15 Hurricanes pass directly through the Region.

#### *Probability of Future Events*

Based upon past storm events and the geographic location of Sterling, the area will continue to be impacted by tropical storms and hurricanes. Moreover, it is speculated by many that future occurrences have the potential to be more severe with climate change. Probability of future events fall under the definition of probability as highly likely.

#### *Impact*

Due to the high winds and heavy rainfall this risk could have impacts on the town of Sterling that would be critical.

#### *Vulnerability*

According to NOAA, the tropical storm season lasts from June 1 to November 30, and an average of 10 tropical storms develop along the eastern seaboard each year. On average, five of these 10 become hurricanes capable of traveling northward towards New England which could expose Sterling to the risk of high winds and heavy rainfall.

## 6.10 *Tornados*

#### *Hazard Description*

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud with whirling winds of up to 300 miles per hour. These events are spawned by thunderstorms and occasionally by hurricanes, and may occur singularly or in groups. Tornadoes can occur at any time of the year, although they are rare outside of the warm season.

#### *Extent*

The peak months of "Tornado Season" occurs in the Northeast from May through September. August is the month of greatest tornado frequency. Most tornadoes are likely to occur during the mid-afternoon and evening hours (3-6PM). However, they can occur at any time, often with little or no warning. Tornados are rated based on the Enhanced Fujita Tornado Scale as shown on the table below.

TABLE 10: ENHANCED FUJITA TORNADO SCALE

EF-SCALE NUMBER	INTENSITY PHRASE	WIND SPEED	DAMAGE
EF0	Gale tornado	< 73 mph	Light Damage- Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
EF1	Moderate tornado	73-112 mph	Moderate Damage- Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
EF2	Significant tornado	113-157 mph	Considerable Damage- Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	Severe tornado	158-206 mph	Severe Damage- Roofs and some walls torn off well- constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
EF4	Devastating tornado	207-260 mph	Devastating Damage- Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
EF5	Incredible tornado	261-318 mph	Incredible Damage- Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yds.); trees debarked; incredible phenomena will occur.

### Previous Occurrences

The National Climatic Data Center reports data on tornado events since 1950. Worcester County has been an area of the state where a majority of significant tornadoes in Massachusetts have occurred. Since 1950, there have been 15 tornados in the Montachusett Region, the most recent of which occurred in 2015. Sterling has only experienced one Tornado to touch down within the town.

TABLE 11: TORNADO EVENTS (1950 -2015)

Date	Community	Property Damage	Category	Deaths/Injuries
7/10/1989	Sterling	\$50K-\$500K	EF1	0

*Source: The National Oceanic & Atmospheric Administration, 2015*

The last official tornado touchdown in Sterling occurred on July 10, 1989 when an EF-1 tornado pushed through West Sterling. There have been numerous other storms that have yielded damage, but none

that were officially classified as tornadoes.

#### *Probability of Future Events*

From 1950 to 2015 there has been, on average, one tornado every 4.3 years within the Montachusett region. With 9 of the 15 tornados being classified as a relatively weak F0 or F1 tornado, the remaining 6 tornados are classified as major F2 or higher tornados and can be expected approximately every 11 years. Probability of future events fall under the definition of probability as Possible.

#### *Impact*

Due to the high winds and destructive nature this risk could have impacts on the Town of Sterling that would be critical.

#### *Vulnerability*

Although the town of Sterling has only experiences one Tornado within the town, the Montachusett Region has experienced several Tornado occurrences between 1950 and 2015 indicating that the Region has good potential in terms of spawning tornados. In fact, Worcester County has been an area of the state where a majority of significant tornadoes in Massachusetts have occurred.

## 6.11 *High Winds*

#### *Hazard Description*

High winds could be defined as air moving (sometimes with considerable force) from an area of high pressure to an area of low pressure. High Wind Warning is a warning for sustained surface winds greater than 40 mph/64 kph lasting more than an hour or winds over 58 mph/93 kph over land that are either predicted or occurring for an unspecified period of time. When wind speed increases, pressure against an object increases at a disproportionate rate. For example, a 25- mile per hour wind causes about 1.6 pounds of pressure per square inch. When the wind speed increases to 75 miles per hour, the force on that object increases to 450 pounds per square inch. At a wind speed of 125 miles per hour, the force increases to 1,250 pounds per square inch. Wind-related hazards that can occur in the Town of Sterling include a variety of atmospheric related and winter related hazards described in this plan.

#### *Previous Occurrences*

Wind-related hazards that can occur in the Town of Sterling include hurricanes (tropical storms), and tornadoes, severe thunderstorms, Nor'easters, and Blizzards and high wind warnings accompany these events. Earlier occurrences of these events have been previously documented in this report.

#### *Probability of Future Events*

High winds accompany hurricanes (tropical storms), tornadoes, severe thunderstorms, Nor'easters, and Blizzards. The probability of future high wind events falls under the definition of probability as highly likely.

#### *Impact*

Due to the destruction high winds can cause the impacts on the Town of Sterling would be critical.

#### *Vulnerability*

Since high winds accompany hurricanes (tropical storms), tornadoes, severe thunderstorms, Nor'easters, and Blizzards as described in this plan, the Town of Sterling and all of its communities within the region are very vulnerable to high winds.

## 6.12 Severe Thunderstorms

#### *Hazard Description*

Massachusetts is regularly susceptible to flooding from severe rainstorms and thunderstorms throughout the warmer months. A thunderstorm is a rain shower during which you hear thunder. Since thunder comes from lightning, all thunderstorms have lightning. According to National Oceanic and Atmospheric Administration, a thunderstorm is classified as "severe" when it contains one or more of the following: hail three-quarter inch or greater, winds gusting in excess of 50 knots (57.5 mph), and/or tornadoes.

#### *Previous Occurrences*

The table below indicates that from 1996 to 2020 there were 4 severe storms in Sterling. The Montachusett Region averages 9.37 storms per year. Examining the thunderstorms indicates that 151 thunderstorms events occurred in Worcester County over the 24-year period.

**TABLE 12: THUNDERSTORM EVENTS (1996-2020)**

<b>Thunderstorm Date</b>	<b>Wind Speeds (knots)</b>
6/30/2001	54
9/9/2008	50
9/2/2014	50
9/6/2018	50
<i>Source: NOAA Storm Events Database</i>	

#### *Probability of Future Events*

Thunderstorms will undoubtedly continue to affect all municipalities of the Montachusett Region, including Sterling. Thunderstorms are more likely to occur between May and August. Over the past 24 years, the communities of Lunenburg, Athol, Leominster, and Fitchburg have more occurrences than

other MRPC municipalities. Probability of future events in Sterling fall under the definition of probability as highly likely.

#### *Impact*

Due to the high winds and hail that can cause damage the impacts on Sterling would be limited.

#### *Vulnerability*

Three basic ingredients are required for a thunderstorm to form: moisture, rising unstable air (air that keeps rising when given a nudge), and a lifting mechanism to provide the "nudge." With these ingredients having the ability to originate throughout the Montachusett Region and the town of Sterling. Severe storms can affect every community. Communities that stand out as having the highest number of thunderstorm events include Athol, Leominster, and Lunenburg. Hail has the potential to be a part of a thunderstorm and communities with the highest number of hail events include Gardner, Lunenburg, and Townsend. No relationship could be determined between the community's location in the Region and the number of severe storm events.

## 6.13 *Winter Storms*

#### *Hazard Description*

Hazards associated with Heavy Snow, Nor'easters, Blizzards, and Ice Storms can be similar in many ways and therefore have been categorized under Winter Storms although these hazard events are separately distinguished under Probability of Future of Events. A Winter Storm Warning is a statement made by the National Weather Service of the United States which means a winter storm is occurring or is about to occur in the area, usually within 36 hours. Generally, a Winter Storm Warning is issued if between 4 inches (10 cm) to 7 inches (18 cm) or more of snow or usually 3 inches (7.6 cm) or more of snow with a large accumulation of ice is forecast. In the Southern United States, where severe winter weather is much less common and any snow is a more significant event, warning criteria are lower, as low as 1 inch (2.5 cm) in the southernmost areas. (Thus, as you go from south to north the necessary accumulations get higher.) A warning can also be issued during high impact events of lesser amounts, usually early or very late in the season when trees have leaves and damage can result. Winter Storm Warnings are issued when winds are less than 35mph; if the storm has winds above this wind speed, it becomes a Blizzard Warning. Usually, a large accumulation of ice alone with little to no snow will result in an Ice Storm Warning, or in the case of light freezing rain, a Winter Weather Advisory, a Freezing Rain Advisory, or Drizzle Advisory.

Winter weather in Massachusetts and southern New England can be described as unpredictable. Days of frigid, arctic air and below freezing temperatures may be followed by days of mild temperatures in the 40s or 50s. Heavy snow, Nor'easters and ice storms are relatively common. MEMA monitors the NWS alerting systems during periods when winter storms are expected, and serves as the primary coordinating arm in the state-wide management of all types of winter storms. The local community is responsible for

the basic management of winter storm responses. When local resources for winter storm management are exhausted, assistance can be requested through MEMA's Area office.

### *Previous Occurrences*

As can be seen in the Table below, there have been 12 winter storm related federally declared disasters during the time frame of 1996 through 2020. One of the most significant for Worcester County occurred on December 11, 2008 when the county's dependence upon electricity was exposed when a winter storm brought significant sleet and a heavy layer of ice resulting in downed trees and power lines, blocked roads, and large-scale power outages causing the Governor to declare a State of Emergency. Within the Montachusett Region, there were over 43,264 households and businesses without power. The storm raised heavy controversy over the slow return of power; it wasn't until approximately December 24th when power was essentially restored to all of the Montachusett Region with utility workers from more than several states called in to provide essential repair services. A rare October snowstorm in the year 2011 also had a significant impact on the Montachusett Region with many households and businesses losing power for several days as tree limbs with leaves that were still green downed power lines and blocked roads.

**TABLE 13: SNOW RELATED DISASTERS (1996 TO 2020)**

<b>Disaster Name (Date of Event)</b>	<b>Disaster # (Type of Assistance)</b>
January Blizzard (January 1996)	FEMA-1090-EM (Public)
March Blizzard (March 2001)	FEMA-3165-EM (Public)
February Blizzard (February 17-18, 2003)	FEMA-3175-EM (Public)
December Blizzard (December 6-7 2003)	FEMA-3191-EM (Public)
January Blizzard (January 22-23 2005)	FEMA-3201-EM (Public)
April Nor'easter (April 15-25, 2007)	FEMA-1701-DR-MA (Public)
December Ice Storm (December 11, 2008)	FEMA-1813-DR-MA (Public)
January Snow Storm (January 11-12, 2011)	FEMA-1959-DR (Public)
October Snow Storm (October 29-30, 2011)	FEMA-4051-DR (Public)
February Blizzard (February 8-9, 2013)	FEMA-4110-DR (Public)
January Severe Winter Storm (January 26 – 29, 2015)	FEMA-4214-DR (Public)
March Sever Winter Storm (March 13-March 14, 2018)	FEMA -4379-DR(Public)

*Source: FEMA Declared Disasters*

### *Probability of Future Events*

Probability of future Blizzard, Nor'easters and severe winter storms is highly likely for the town of Sterling due to the nature of the climate and also projected storm.

It is also interesting to note that, similar to rainfall, there has been a gradual increase in the amount of snowfall since 1980 in Worcester County as depicted in the Figure 2.

### *Impact*

Due to the hazardous road conditions, power outages and freezing conditions that can cause damage, the impacts on the town of Sterling would be critical.

### *Vulnerability*

The town of Sterling has high of winter storms and heavy snow. It is also typical for the Montachusett Region to receive an ice storm when cold air in the valleys is "overridden" by milder, moist air from the Atlantic. Freezing rain causes dangerous traveling conditions. Bridges and overpasses, which typically freeze quicker than other surfaces, are particularly hazardous to drivers. Power outages are also common in an ice storm. The weight of the ice formed by freezing rain often causes downed power lines and tree limbs, leaving thousands in the affected area without electricity.

## 6.14 *Climate Change Impacts*

### *Hazard Description*

Natural hazards and the impacts of climate change were discussed during the MVP workshop, and four hazards were identified as the most likely to become more severe: extreme weather events, loss of biodiversity and agriculture, high intensity rainfall, and drought. The projected changes in each of these hazards due to climate change are outlined in the Climate Change Clearinghouse for the Commonwealth ([resilientma.org](http://resilientma.org)), and are summarized as follows:

- **Extreme Weather Events:** Extreme weather events have the potential to interrupt the functioning of critical infrastructure including transportation networks, communication, and utilities. The frequency and intensity of extreme weather events is projected to keep increasing across New England.
- **Loss of Biodiversity and Agriculture:** Temperature increases projected over time have the potential to change the growing seasons and types of wildlife and crops that are able to persist in Massachusetts. The number of days with temperatures above 90°F is projected to increase by 6 to 22 days by 2050. Diseases within the flora and fauna can threaten biodiversity and disrupt agriculture and natural resources.
- **High Intensity Rainfall:** Increased precipitation has the potential to exacerbate Sterling's issues with flooding as a result of infrastructure capacity. The number of days with over 1" of precipitation is projected to increase by 8-10 days by 2050.
- **Drought (Lowering of the Water Table):** Drought conditions present an increased risk of wildfires, threaten biodiversity, impact town wells (Water supply), impact the local agricultural economy, and put vulnerable populations at risk of exposure.

## 6.15 *Wildland Fires*

### *Hazard Description*

A wildfire can be defined as a naturally occurring, highly destructive, uncontrollable fire. Risk of wildfires has the potential to be significant in the Montachusett Region and the town of Sterling because of the many heavily wooded areas. Wildfire risk to developed areas is less, given the existing fire protection service and facilities. However, new construction in heavily wooded areas could pose a threat if vegetation is not managed properly.

### *Location*

Wildland fires or bushfires in the town of Sterling are common occurrences in the forest areas with large amounts of overgrowth. Records show multiple wildland fires over the area in the Redstone Holl Road area.

### *Extent*

The brushfires within the area are common due to the overgrowth in forest area and are caused during dry weather months. Regionally, the Cities of Fitchburg and Leominster have the highest number of fires.

### *Previous Occurrences*

In the town of Sterling the largest wildfire occurred on May 4, 1951 and consumed 433 acres between Leominster Road and Redstone Hill Road. The second largest wildfire occurred on May 12, 1939 and consumed 350 acres in an area between Route 140 and Holden Road. The third largest wildfire occurred on June 12, 1929 and consumed 150 acres between Maple Street and Redstone Hill Road.

Over the past 10 years the department has averaged between 5 and 35 brush fires per year. Our last big brush fire was on May 7, 2013 when about 4 acres or so burned just off of the rail trail near the Quag.

### *Probability of Future Events*

Fires within the Montachusett Region are highly dependent on moisture and underbrush. When the Region is in a drought, the chance of fire increases. It was stated at virtually all of the Montachusett Region individual Hazard and Vulnerability Sessions that wildfires are a much more significant problem for the communities than urban fires. Not only does substantial logging occur in some communities leaving behind lots of brush, stumps and debris but the devastating December 2008 Ice Storm brought down a tremendous amount of tree limbs throughout the entire Region which is a major contributor of fuel to any potential wildfire. Most of the Region is "ripe" for large wildfires due to the presence of old growth and tree limbs brought down by the 2008 ice storm. Moreover, many property owners may not understand the need to clear areas around properties to prevent losses. The Towns would have difficulty dealing with wildfires due to the lack of appropriate equipment and personnel. Probability of future events within the town of Sterling fall under the definition of probability as possible.

### *Impact*

Due to the intense nature of wildland fires, the impacts on the town of Sterling would be critical.

### *Vulnerability*

Wildfires are influenced by three major factors: weather, topography, and fuel. These three factors can combine in different ways to produce different levels of wildfire threats. Weather, in particular long periods of drought but also lightning strikes and winds influence the behavior of wildfires. Fire hazard is generally higher in the spring and fall when there are dry and windy conditions. Topography is a factor as steep slopes and gullies can act as a chimney for fires and the presence or lack of fuel – low shrubs and branches, wood, roofs, wood piles, etc. – can shape the resulting fire. The presence of railroads in a community can also increase susceptibility to wildfires. Trains can emit sparks, heat, and hot materials that can ignite nearby fuels. Possible sources of flame and/or heat include exhaust fumes, hot brake metal, and overheated wheel bearings. Railroad crews cutting, grinding, and welding track are also a source of some railroad fires.

It should be noted that about 67% of the Montachusett Region is made up of forest. Moreover, substantial logging occurs in some of the more rural communities leaving behind lots of brush, stumps and debris.

The December 2008 Ice Storm also brought down a tremendous amount of tree limbs throughout the entire Region substantially adding to the fuel for any potential wildfire.

## 6.16 *Drought*

### *Hazard Description*

Drought is a temporary irregularity and differs from aridity since the latter is restricted to low rainfall Regions and is a permanent feature of climate. Drought occurs in virtually all-climatic zones yet its characteristics vary significantly from one Region to another, since it is relative to the normal precipitation in that Region. The American Meteorology Society defines drought as a period of abnormally dry weather sufficiently long enough to cause a serious hydrological imbalance.

### *Location*

The town of Sterling does not have on specific area that drought is common, however regionally drought is an issue due to the effects it has on the aquifers shared regionally and effecting farmers crops. The entire Stillwater Aquifer and River Watershed is a designated as an Outstanding Resource Water due to its significance to the Wachusett Reservoir and the Sterling Wells.

The Wekepeke Aquifer is a broad band of gravelly deposits along Wekepeke Brook extending into Leominster and Lancaster. According to the USGS, the Wekepeke Aquifer can yield over two million

gallons per day. The City of Leominster presently has wells in the aquifer, and the Town of Lancaster has recently done exploratory drilling for a potential water source.

#### *Extent*

The National Climatic Data Center uses the Palmer Drought Severity Index (PDSI) to compute drought conditions. Beyond its role as a factor leading to wildfire, drought also has impacts on public safety for all firefighting activity, agricultural production, and economic vitality of large users such as golf courses or industrial processes.

#### Palmer Drought Severity Index (PDSI)

- D0 – Abnormally Dry
- D1 – Moderate Drought
- D2 – Severe Drought
- D3 – Extreme Drought
- D4 – Exceptional Drought

#### *Previous Occurrences*

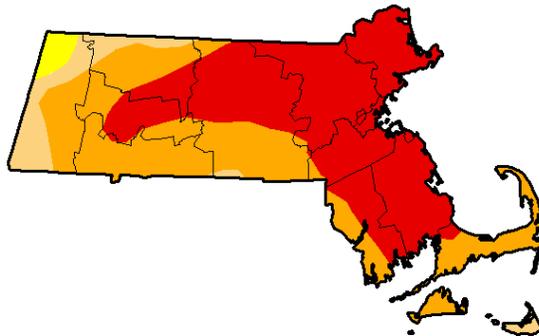
The Commonwealth of Massachusetts is often considered a “water-rich” state. Under normal conditions, Regions across the state annually receive between 40 and 50 inches of precipitation. However, Massachusetts can experience extended periods of dry weather, from single season events to multi-year events such as experienced in the mid-1960s. Historically, most droughts in Massachusetts have started with dry winters, rather than a dry summer.

Notable times of water stress were experienced in the Region during the 1960’s and more recently in the years 1999, 2000, and 2002. According to the Massachusetts Department of Conservation and Recreation, the Central Drought Region, of which the Montachusett Region is part, experiences 50 months of drought emergency per 100 years historically.

The U.S. Drought Monitor started in 2000. Most recently, the longest duration of drought (D1-D4) in Massachusetts lasted 48 weeks beginning on June 07, 2016 and ending on May 2, 2017. The most intense period of drought occurred the week of September 13, 2016 where D3 affected 52.13% of Massachusetts land.

### U.S. Drought Monitor Massachusetts

**October 4, 2016**  
(Released Thursday, Oct. 6, 2016)  
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0	D1	D2	D3	D4
<b>Current</b>	0.00	1.85	8.20	37.82	52.13	0.00
<b>Last Week</b> 9/27/2016	0.00	1.85	8.20	37.82	52.13	0.00
<b>3 Months Ago</b> 7/5/2016	0.70	44.31	25.34	29.65	0.00	0.00
<b>Start of Calendar Year</b> 1/2/2016	22.85	50.81	26.34	0.00	0.00	0.00
<b>Start of Water Year</b> 9/27/2015	0.00	1.85	8.20	37.82	52.13	0.00
<b>One Year Ago</b> 10/6/2015	22.34	63.95	13.81	0.00	0.00	0.00

Intensity:  
■ D0 Abnormally Dry      ■ D3 Extreme Drought  
■ D1 Moderate Drought      ■ D4 Exceptional Drought  
■ D2 Severe Drought

*The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.*

Author:  
Brian Fuchs  
National Drought Mitigation Center

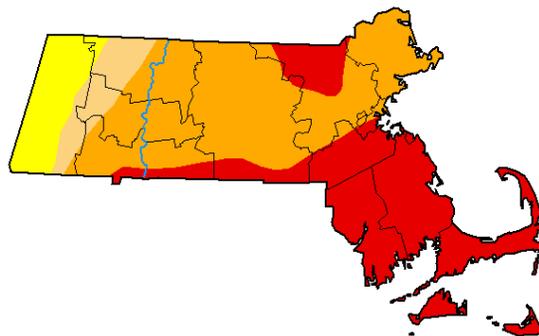


<http://droughtmonitor.unl.edu/>

FIGURE 4: 2016 DROUGHT IN MASSACHUSETTS

### U.S. Drought Monitor Massachusetts

**October 6, 2020**  
(Released Thursday, Oct. 8, 2020)  
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0	D1	D2	D3	D4
<b>Current</b>	0.00	9.79	7.04	46.56	36.61	0.00
<b>Last Week</b> 09-29-2020	0.00	4.04	12.79	54.67	28.50	0.00
<b>3 Months Ago</b> 07-07-2020	16.60	35.10	48.30	0.00	0.00	0.00
<b>Start of Calendar Year</b> 12-31-2019	100.00	0.00	0.00	0.00	0.00	0.00
<b>Start of Water Year</b> 09-29-2020	0.00	4.04	12.79	54.67	28.50	0.00
<b>One Year Ago</b> 10-08-2019	43.15	56.85	0.00	0.00	0.00	0.00

Intensity:  
■ None      ■ D2 Severe Drought  
■ D0 Abnormally Dry      ■ D3 Extreme Drought  
■ D1 Moderate Drought      ■ D4 Exceptional Drought

*The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>*

Author:  
Brian Fuchs  
National Drought Mitigation Center



[droughtmonitor.unl.edu](http://droughtmonitor.unl.edu/)

FIGURE 5: 2020 DROUGHT IN MASSACHUSETTS

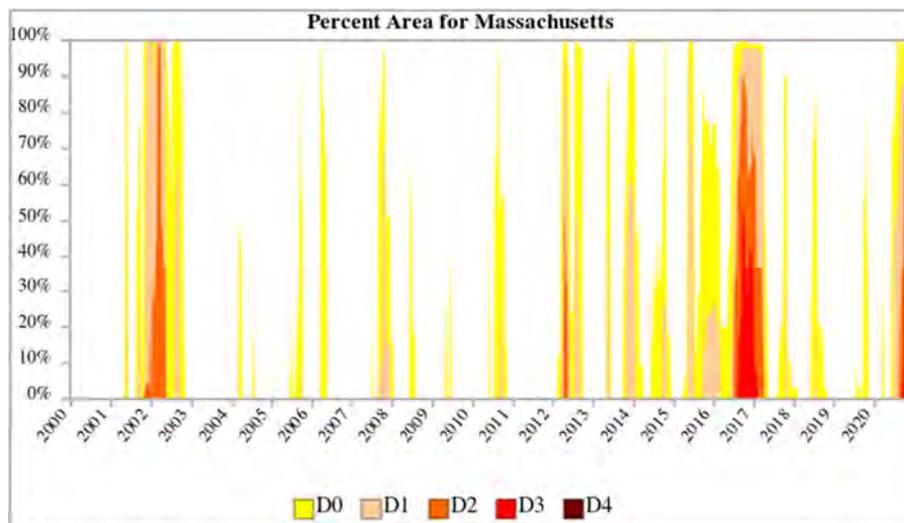


FIGURE 6: DROUGHTS EXPERIENCED IN MASSACHUSETTS (2000-2020)

### *Probability of Future Events*

The probability of future events falls under the definition of probability as possible for the town of Sterling. Droughts will continue to occur over time in the region as also evidenced in figured above. It will require vigilance to ensure that sufficient water supplies are available for human consumption and for maintaining base stream flow to support agriculture and aquatic wildlife.

According to the Massachusetts Drought Management Plan, “Municipal governments are critically important to managing drought situations and assessing the impact of drought situations.” To protect water supplies, local communities must carefully maintain and protect existing reservoirs and groundwater supplies, continue efforts to limit unnecessary water use through conservation measures, and control storm water runoff. Limiting or prohibiting new storm water discharges into municipal drainage systems and encouraging or requiring that storm water be contained on-site for groundwater recharge will help to maintain stream flow in drought conditions. Local water suppliers are also encouraged to develop Drought Plans that include drought indicators and drought triggers. Following the plan may lead to the institution of voluntary or mandatory water use restriction policies.

### *Impact*

Due to the depletion of water resources and unpredictable extents that drought can have on a community, the impacts on the town of Sterling would be critical.

### *Vulnerability*

Drought is a normal, recurrent feature of climate that occurs in all climatic zones across the northeast. However, as stated above, the Commonwealth of Massachusetts is often considered a “water-rich” state. The figures above verify that periods of drought can occur in the Montachusett Region. This is a particular

concern for the town of Sterling due to drought seasons expected to become more common with Climate Change.

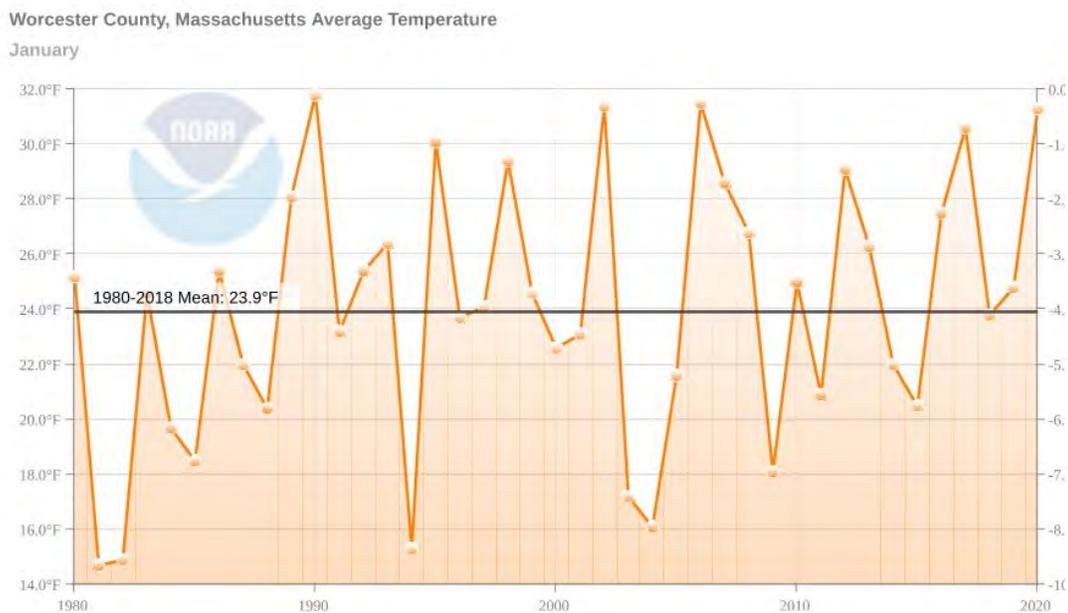
## 6.17 *Extreme Temperatures*

### *Hazard Description*

There is no universal definition for extreme temperatures. The term is relative to the usual weather in the region based on climatic averages. Extreme heat is usually defined as a period of 3 or more consecutive days above 90 °F. But more generally a prolonged period of excessively hot weather, which may be accompanied by high humidity. Extreme cold again is relative to the normal climatic lows in a region. Temperatures that drop decidedly below normal and wind speeds that increase can cause harmful wind- chill factors. The wind chill is the apparent temperature felt on exposed skin due to the combination of air temperature and wind speed.

### *Previous Occurrences*

The town of Sterling has four distinct seasons. The seasons have several defining factors, but temperature is the most important. The figure below shows the temperatures for July and January for Worcester County from 1980-2020. July is historically known for being the hottest month for Massachusetts and January is historically known for being the coldest months in Massachusetts.



**FIGURE 7: WORCESTER COUNTY, JANUARY AVERAGE TEMPERATURES (1980-2020)**

The figure above demonstrates January average temperatures for Worcester County from 1980-2020.

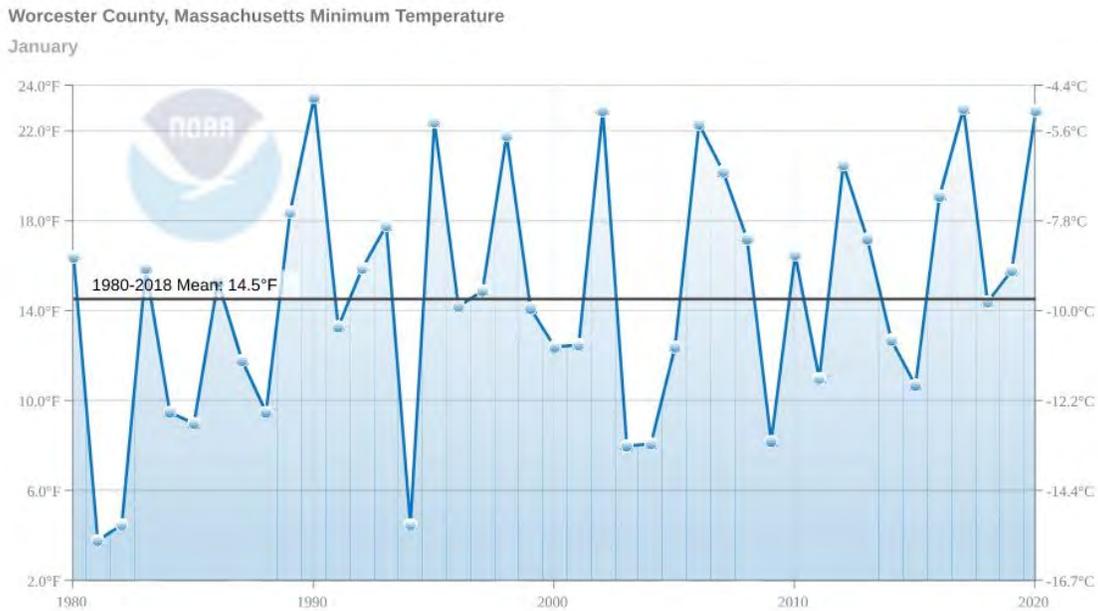


FIGURE 8: WORCESTER COUNTY, JANUARY MINIMUM TEMPERATURES (1980-2020)

The figure above demonstrates January minimum temperatures for Worcester County from 1980-2020, which shows the coldest days in Worcester County on record.

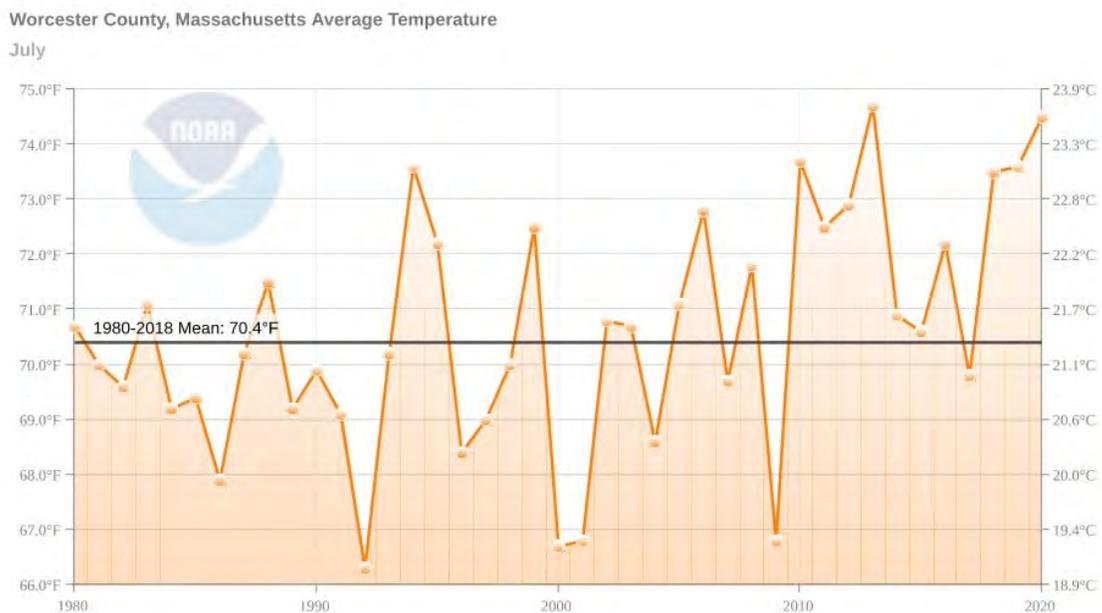
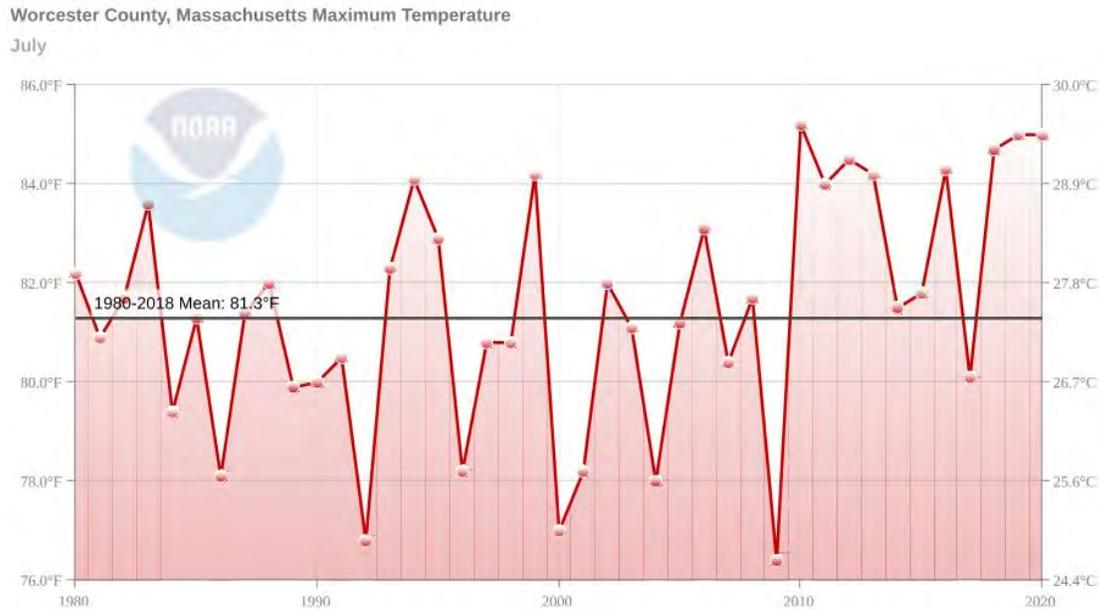


FIGURE 9: WORCESTER COUNTY, JULY AVERAGE TEMPERATURES (1980-2020)

The figure above demonstrates July average temperatures for Worcester County from 1980-2020.



**FIGURE 10: WORCESTER COUNTY, JULY MAXIMUM TEMPERATURES (1980-2020)**

The figure above demonstrates July maximum temperatures for Worcester County from 1980-2020, which shows the hottest days in Worcester County on record.

### *Probability of Future Events*

Extreme temperatures in Sterling fall under the definition of probability as possible. The vast majority of summers in the Worcester County experience high temperatures around 85°F and in the winter, temperatures drop decidedly below normal each year. With the climatic conditions that occur in the Worcester County, extreme temperatures will continue into the future for Sterling.

### *Impact*

Due to the variable nature of extreme temperatures, the impact of these conditions on the Town of Sterling is limited.

### *Vulnerability*

The Worcester County is highly vulnerable to extreme temperatures ranging from 85 F to 4 F, according to records documented in the figures above. Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter or who are stranded or who live in homes that are poorly insulated or without heat. Extreme Heat can also be dangerous and people should be aware of who is at the greatest risk and what actions can be taken to prevent a heat-related illness or death. At greater risk are the elderly, children, and people with certain medical conditions, such as heart disease. However, even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather. Some behaviors also put people at greater risk:

drinking alcohol; taking part in strenuous outdoor physical activities in hot weather; and taking medications that impair the body's ability to regulate its temperature or that inhibit perspiration.

## 6.18 Earthquakes

### *Hazard Description*

An earthquake is the sudden release of strain vibration, sometimes violent, of the earth's surface that follows a release of energy in the earth's crust. The exact earthquake mechanism is still unknown; however, New England's earthquakes appear to be the result of the cracking of the surface due to the compression and buckling of the North Atlantic Plate.

### *Extent*

Earthquakes are measured by the following standard for extent and intensity. The other geologic hazards listed do not have standard means of classification.

**TABLE 14: RICHTER MAGNITUDE SCALE**

<b>Magnitude</b>	<b>Earthquake Effects</b>
2.5 or less	Not felt or felt mildly near the epicenter, but can be recorded in seismographs.
2.5 to 5.4	Often felt, but only causes minor damage
5.5 to 6.0	Slight damage to buildings and other structures
6.1 to 6.9	May cause lot of damage in very populated areas
7.0 to 7.9	Major earthquake, serious damage
>8.0	Great earthquake, can totally destroy communities near the epicenter.

### *Previous Occurrences*

The Montachusett Region has been affected by relatively small earthquake events between 1978 and 2020. However, Sterling has not experienced an earthquake in town. The table below shows the locations of earthquake occurrences during this time period. There have been 12 earthquake events that have had their center in the Montachusett Region between 1978 and 2020. The earthquakes ranged from 0.6 to 2.4 on the Richter Scale.

TABLE 15: EARTHQUAKES (1978-2020)

Location	Date	Magnitude
South of Athol	11/09/1982	2.3
Northeast of Quabbin Reservoir	2/09/1983	2.0
Littleton	7/13/1993	1.6
West of Barre	10/02/1994	2.4
Quabbin Reservoir	9/20/1996	2.2
12KM South of Gardner	12/30/2012	0.6
Athol	09/06/2017	1.7
Harvard	11/28/2017	1.6
Templeton	12/21/2018	2.1
Gardner	12/21/2018	1.4
Gardner	12/23/2018	2.2
Gardner	01/26/2019	0.9
<i>Source: New England Seismic Network and USGS Earthquake GIS</i>		

#### *Probability of Future Events*

Based on the historic occurrences, which have been few and of limited severity, the probability of future events for earthquakes falls under the definition of probability as possible for Sterling.

#### *Impact*

Due to the historic occurrences and limited severity in the past the impacts on the town of Sterling would be limited.

#### *Vulnerability*

The figure below shows the Peak Ground Acceleration (PGA) zones for the Montachusett Region. PGA represents a model showing the probability that ground motion will reach a certain level. The model shows peak horizontal ground acceleration (the fastest measured change in speed, for a particle at ground level that is moving horizontally due to an earthquake) with a 2% probability of exceeding this percentage in 50 years. Essentially, PGA is a measurement that compares the shaking of the ground with the force of gravity. While the likelihood of a powerful earthquake in the Region is low, the impact of an earthquake is high because of how old the buildings are and because few structures have been built to withstand earthquakes. The town of Sterling is in the 4%g range of the PGA zones.

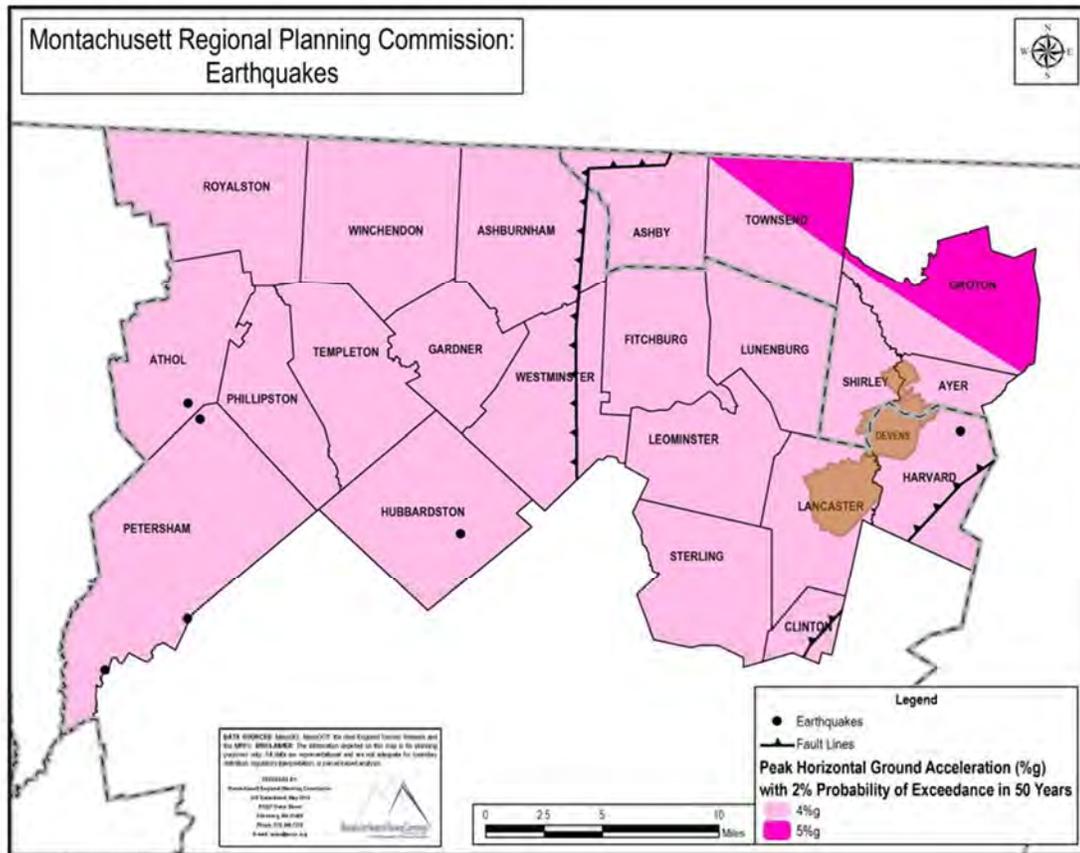


FIGURE 11: 2015 REGIONAL PLAN , EARTHQUAKE FIGURE.

### 6.19 Landslides

#### Hazard Description

Landslides include a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows.

#### Location

The data for landslides in Sterling is very limited therefore there are no reports for the town of Sterling of landslide occurrence as this time.

#### Previous Occurrences

The data for landslides in the Montachusett Region is very limited and there is nothing that can be presented in this report for the region or the town of Sterling at this time.

### *Probability of Future Events*

The data for landslides in the Montachusett Region it is very limited and therefore the probability of future is unlikely for the town of Sterling.

### *Impact*

Due to the unpredictable extents that a landslide can have on a community, the impacts on the town of Sterling would be limited.

### *Vulnerability*

Landslide occurrences in this region have little evidence. Due to this the effects of a landslide on the town of Sterling are vague. However, since building in the Region are not constructed with earthquakes and landslides in mind as a building factor, landslides could inflict damages if occurred.

## **7. CRITICAL INFRASTRUCTURE AND VULNERABILITIES**

### *7.1 Critical Infrastructure in Hazard Areas*

Critical infrastructure includes facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, hospitals, etc.) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). It also includes facilities that might pose a particular risk during a natural disaster such as a sewage treatment plant or chemical facility. Conditions that may affect the risks and vulnerabilities related to future development increases includes the current housing demand and the projected increase in population due to inland migration. Increased development will lead to more impervious surfacing that will lead to more stormwater runoff and increased flooding. This can lead to stormwater infrastructure requiring increased capacity, can more water quality treatment areas within town. These future development concerns relate to the mitigation measures discussing the top priority concerns of Sterling. Table 17 shows the relationship of these parcels to the mapped hazards for Flood Zone and are shown on Map 1 and Map 9 in Appendix A. The purpose of mapping the natural hazards and critical infrastructure is to present an overview of hazards in the community and how they relate to critical infrastructure.

TABLE 16: CRITICAL INFRASTRUCTURE WITHIN THE 100-YEAR FLOOD PLAIN

Feature Type	Name	Address
HazMat Sites	Fiber optic Components	2 Spratt Technology Way
Other Critical Facilities	Redemption Rock Trail Receiver Site	Redemption Rock Trail
	West Sterling UV Treatment Facility	Osgood Road
	Hall Avenue Receiver Site	1 Hall Ave
	Fiber optic Components	2 Spratt Technology Way
	Sholan Park	5 Hall Avenue
Other Government Building	Redemption Rock Trail Receiver Site	283 Redemption Rock Trail
Public Water Supply	Gp 4 Redemption Rock Trail Well	Redemption Rock Trail
	Gp 5 Redemption Rock Trail Well	Redemption Rock Trail
	Gp 3 Redemption Rock Trail Well	Redemption Rock Trail
Pumping Stations	West Sterling Pumping Station	275 Redemption Rock Trail

The purpose of the vulnerability assessment is to estimate the extent of potential damages from natural hazards of varying types and intensities. A vulnerability assessment and estimation of damages was performed for hurricanes, earthquakes, and flooding. The methodology used for hurricanes and earthquakes was the HAZUS-MH software. The methodology for flooding was developed specifically to address the issue in many of the communities where flooding was not solely related to location within a floodplain.

#### 7.1.10 Introduction to HAZUS-MH

HAZUS- MH (multiple-hazards) is a computer program developed by FEMA to estimate losses due to a variety of natural hazards. The following overview of HAZUS-MH is taken from the FEMA website. For more information on the HAZUS-MH software, go to <https://www.fema.gov/flood-maps/products-tools/hazus>

*“HAZUS-MH is a nationally applicable standardized methodology and software program that contains models for estimating potential losses from earthquakes, floods, and hurricane winds. HAZUS-MH was developed by the Federal Emergency Management Agency (FEMA) under contract with the National Institute of Building Sciences (NIBS). Loss estimates produced by HAZUS-MH are based on current scientific and engineering knowledge of the effects of hurricane winds, floods and earthquakes. Estimating losses is essential to decision-making at all levels of government, providing a basis for developing and evaluating mitigation plans and policies as well as emergency preparedness, response and recovery planning.*

*HAZUS-MH uses state-of-the-art geographic information system (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of hurricane winds, floods and earthquakes on populations.”*

*There are three modules included with the HAZUS-MH software: hurricane wind, flooding, and earthquakes. There are also three levels at which HAZUS-MH can be run. Level 1 uses national baseline data and is the quickest way to begin the risk assessment process. The analysis that follows was completed using Level 1 data.*

*Level 1 relies upon default data on building types, utilities, transportation, etc. from national databases as well as census data. While the databases include a wealth of information, it does not capture all relevant information. In fact, the HAZUS training manual notes that the default data is “subject to a great deal of uncertainty.”*

However, for the purposes of this plan, the analysis is useful. This plan is attempting to only generally indicate the possible extent of damages due to certain types of natural disasters and to allow for a comparison between different types of disasters. Therefore, this analysis should be considered to be a starting point for understanding potential damages from the hazards. If interested, communities can build a more accurate database and further test disaster scenarios.

#### 7.1.11 Estimated Damages from Hurricanes

For the purposes of this plan, a 100-year and 500-year storm was chosen to illustrate damages. The reason is to present more of a “worst case scenario” that would help planners and emergency personnel evaluate the impacts of storms that might be more likely in the future, as we enter into a period of more intense and frequent storms.

TABLE 17: HURRICANE ESTIMATED DAMAGES

	100 Year	500 Year
<b>Building Characteristics</b>		
Estimated total number of buildings	3,154	3,154
Estimated total building replacement value (2019 \$)	\$1,403,312,000	\$1,403,312,000
<b>Building Damages</b>		
# of buildings sustaining slight damage	33	300
# of buildings sustaining moderate damage	1	27
# of buildings sustaining extensive damage	0	1
# of buildings completely damaged	0	0
<b>Population Needs</b>		
# of households displaced	0	0
# of people seeking public shelter	0	0
<b>Debris</b>		
Building debris generated (tons)	4,596	16,156 tons
# of truckloads to clear debris (@ 25 tons/truck)	4	32 trucks
<b>Value of Damages (dollars)</b>		
Total property damage	\$5,692,980	\$20,874, 270
Total losses due to business interruption	\$29,520	\$756,230

### 7.1.12 Estimated Damages from Earthquakes

In order to assess damages from earthquakes, the HAZUS-MH earthquake module was used. For more information, see the description of the HAZUS-MH software above. The HAZUS earthquake module allows users to define a number of different types of earthquakes and to input a number of different parameters. The module is more useful where there is a great deal of data available on earthquakes. In New England, defining the parameters of a potential earthquake is much more difficult because there is little historical data. The earthquake module does offer the user the opportunity to select a number of historical earthquakes that occurred in Massachusetts. For the purposes of this plan a magnitude of 5.0 Earthquake was used.

TABLE 18: EARTHQUAKE ESTIMATED DAMAGES

	Magnitude 5.0
<b>Building Characteristics</b>	
Estimated total number of buildings	3,154
Estimated total building replacement value (2019 \$)	\$1,403,312,000
<b>Building Damages</b>	
# of buildings sustaining slight damage	934
# of buildings sustaining moderate damage	501
# of buildings sustaining extensive damage	135
# of buildings completely damaged	35
<b>Population Needs</b>	
# of households displaced	46
# of people seeking public shelter	24
<b>Debris</b>	
Building debris generated (tons)	28,000
# of truckloads to clear debris (@ 25 tons/truck)	1.120
<b>Value of Damages (dollars)</b>	
Total property damage	\$179,880,000
Total losses due to business interruption	\$23,384,400

### 7.1.13 Estimated Damages from Flooding

Flooding is a local occurrence for the Town of Sterling. Stormwater infrastructure and local riverine waterways can experience flooding due to maximum capacities, rainfall frequencies and intensity of storms. Rain fall patterns are predicted to increase with climate change and project more flooding in the future for the Town. Particular areas where the risk of flooding could occur were determined on June 28, 2012 at a meeting with the Sterling's Local Hazard Mitigation Team. This information can be found on Sterling's 2015 Local Hazard Map which is located in Appendix A Map 10. See Stormwater Map in Appendix A Map 6 for FEMA floodplain data for the town of Sterling. An analysis of the FIRM flood hazard area maps indicates that there is a total of 1135.56 acres of 100-year floodplain within Sterling. This amounts to 5.6% of the total towns area of 20,230 acres. Based on additional analysis, 911 acres (4.5%) of the floodplain are developed. Currently there are 113 structures in the floodplain which is about 3.58% of the total structures in the community. Since the initiation of the National Flood Insurance Program (NFIP), one flood insurance claim in the town of Sterling has been made totaling \$6,545.78 in payments. There are no repetitive loss properties in Sterling as of 2014. Statistics from the NFIP BureauNet indicate in the town of Sterling there are nine flood insurance policies in force. Since flooding is caused by hurricanes, nor'easters, heavy rain, and thunderstorms, it is estimated that in the future flood occurrences will be highly likely in the Town of Sterling. Since flooding is caused by hurricanes, nor'easters, heavy rain, and thunderstorms, it is estimated that flooding will impact the town of Sterling critically.

The town supports floodplain management activities in an effort to meet compliance of the National Floodplain Insurance Program. These efforts include:

- Implementing the MA Wetlands Protection Act and the town's Stillwater River Protection Bylaw regulating development and activity within the wetlands buffer zone and regulating stormwater and other point source discharge.
- Implementing the Town Flood Plain District Bylaw regulating development in the floodplain district.
- Continued maintenance of municipal stormwater drainage system which includes regular cleaning of catch basins, storm drains and culverts.
- Continued maintenance of public water bodies to reduce flooding caused by erosion and water displacement.

The Town is continuing to work with MEMA and FEMA for the Flood Insurance Map updates which are estimated to be released by FEMA later this year. This update would allow for a more accurate floodplain representation within the town's limits.

Flooding by town officials has also been reported due to insufficient stormwater infrastructure near Greenland Road that is within the flood plain and insufficient stormwater infrastructure at the intersection of Lower North Row and Route 12.

HAZUS-MH was not used to estimate flood damages in Sterling due to depth grid information being unavailable for the area. In Sterling, much of the flooding is due to deficiencies in the drainage system. In lieu of using HAZUS, a methodology was used to give a rough approximation of flood damages.

HAZUS uses an average value of \$444,930 per structure for the building replacement value. This was used to calculate the total building replacement value within the FEMA floodplain which is a total of \$50,277,090. The calculations were done for a low estimate of 10% building damages and a high estimate of 50% as suggested in the FEMA Local Mitigation Planning guide. The range of estimates for flood damages is \$5,277,090 - \$25,138,545. The development in the floodplain is common within three areas: The East Waushacum Pond which has 21 developments within the floodplain (Est. building damages range \$934,353 – \$4,671,765), The Stillwater River with 13 developments within the floodplain (Est. building damages range \$578,409 – \$2,892,045), and the Wilder Brook with 10 developments within the area (Est. building damages range \$444,930 – \$2,224,650). See Map 10 in appendix for locations.

## *7.2 Top Vulnerabilities to the Impacts of Climate Change*

During the CRB workshop, each group discussed vulnerabilities in each of the categories being addressed: infrastructure, society, and environment. Although there were vulnerabilities and strengths identified in each category by each group, there were three primary areas of concern that became evident during the discussion of the past impacts from natural hazards. These areas of concern, as identified by all workshop participants, are:

- **Wells and Water System:** The town of Sterling's Water system consist of 4 wells, 2 water towers, and 68 miles of water main throughout town. Approximately 80% of town is serviced by the public water system and 20% of town is serviced through private wells. Every year, water capacity and quality in town is a concern. Furthermore, as development in town expands, the permitted withdrawal rate through MassDEP is only projected to grow by 5% over time. The capacity, quality, and age of the infrastructure is a vulnerability for residents, especially for the fire protection system.
- **Roadways, Culverts and Stormwater Management:** The roadways throughout town are in degraded condition primarily as a result of drainage concerns. Culverts and drainage network throughout Town are inadequate and lack the capacity to convey stormwater resulting in flooding during rain events and erosion leading to degradation of roadway quality. Particular areas of concern are Kendall Hill Road, Chace Hill Road, Swett Hill Road, and the Town Beach. Storm events can leave local roads impassable and not only washes out portions of the road itself, but the runoff contributes to washouts downstream at the Town Beach.
- **Land Use:** The various land uses currently existing in Sterling are an asset that is currently at risk. The Farming Land and farming community is vulnerable to economic and environmental pressure to convert land away from agricultural uses. The open space and forested land are currently owned primarily by DCR and provide ecological value and community character. Preservation of the agricultural land and open space is currently in conflict with the town's interest in encouraging and enabling residential and industrial growth. Proper planning can set Sterling up for success to preserve land uses important to the town and efficiently enable growth.

### *7.3 Future Development in Hazard Areas*

There is no record or indication of any future development within hazard areas at this time. Developments that propose work within the 100-year flood plain are required to go through the conservation commission for an order of conditions as required by the Wetland Protection Act. This review is to ensure that impacts on the land and mitigation strategies are proposed and have rough proportionality to the impacts. However, there are no such projects in review nor have there been any inquiries of future work.

Conditions that may affect the risks and vulnerabilities related to future development increases includes the current housing demand and the projected increase in population due to inland migration. Increased development will lead to more impervious surfacing that will lead to more stormwater runoff and increased flooding. This can lead to stormwater infrastructure requiring increased capacity, can more water quality treatment areas within town. The map provided in Appendix A has information on existing structure in hazard areas. This is provided so that planners can ensure that development proposals go through the conservation commission for an order of conditions as required by the Wetland Protection Act so that careful attention is paid to drainage issues for these existing developed parcels in the future.

## 8. EXISTING MITIGATION MEASURES

The original inventory of hazard mitigation actions which the Montachusett communities undertook for the 2015 Montachusett Region Hazard Mitigation Plan was reviewed and updated by each community at a meeting held in each community with Pare and the community’s Local Hazard Mitigation Planning Team. The following matrices depict the updated inventory of what is currently being done to mitigate hazards by listing the programs and activities already in place. It includes a description of the protection measure, who is responsible, and improvements and changes that may be needed. This inventory was used by the Planning Team/Emergency Management Committee to identify gaps in existing protections that were then addressed through the development of this plan update.

**TABLE 19:STERLING’S EXISTING MITIGATION MEASURES FROM MRCP-2015**

Type of Existing Protection	Description	Area Covered	Implementation Resources and Funding*	Improvements or Changes Needed
<b><u>Flood Related Hazards</u></b>				
Storm water management standards	State Regulation under the Wetlands Protection Act to regulate storm water and other point source discharge	Town-Wide	Enforced by the Sterling Conservation Comm. (Wetlands Protection Act) staffed by the municipal Conservation Agent and Sterling Planning Board (Subdivision Control Law and site plan review) staffed by the Town Planner.	Storm water management standards are and continue to be enforced. No improvements or changes needed.
Wetlands Protection Act (state)	State law regulating development and activity within wetland buffer zone	100-foot state buffer around wetland area; 200 foot buffer around river front areas.	Enforced by the Sterling Conservation Commission staffed by the municipal Conservation Agent.	No improvements or changes needed.

Stillwater River Protection District Bylaw (local)	Local law regulating development and activity within the buffer of the Stillwater River	100-foot state buffer around wetland area; 200 foot buffer around river front areas. Floodplains of Stillwater River area	Enforced by the Sterling Conservation Commission staffed by the municipal Conservation Agent.	No improvements or changes needed.
100 Year Flood Zone	Federal law requiring elevation above 100-year flood level of new and substantially improved residential structures in floodplain	100-year floodplain as shown on Flood Insurance Rate Map dated June 15, 1982.	Enforced by the Building Commissioner (municipal staff) and Sterling Conservation Commission staffed by the municipal Conservation Agent.	Update Insurance Flood Rate Maps
Town Zoning Bylaws. Flood Plain Districts	Local bylaw enhancing federal/state laws and regulating any development in the flood plain district	100-year floodplain as shown on Flood Insurance Rate Map dated June 15, 1982.	Enforced by the Building Commissioner (municipal staff) and Sterling Conservation Commission staffed by the municipal Conservation Agent.	Update Insurance Flood Rate Maps
Maintenance of municipal storm water drainage system	Regular cleaning of catch basins, storm drains, and culverts	Town-Wide	Undertaken by the Department of Public Works municipal staff.	Maintenance continues but additional personnel and equipment needed.
Maintenance of public water bodies (ponds, streams, brooks, wetlands)	Periodic cleaning of waterways needed, e.g., remove trash, debris	Town-Wide	Undertaken by the Department of Public Works municipal staff with guidance from Sterling Conservation Commission	Maintenance continues. No improvements or changes needed.

Inspection of major dams	Periodic inspections of the structural integrity of the dam	Major Dams	Directed by the DCR Office of Dam Safety	Update Dam failure studies for the dams rated as high hazard
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**Wind Related Hazards**

State Building Code	State Law related to design loads to include wind effects	Town-Wide	Enforced by Building Department municipal staff.	Continued enforcement remains in place. No improvements or changes needed.
Tree Maintenance	Regular inspection and tree maintenance to cut branches threatening power lines and overhead utilities	Town-Wide	Sterling Municipal Light Plant staff and Tree Warden.	Tree maintenance continues but additional staff needed.

**Fire Related Hazards**

Limited Brush Clearing	Provide access to Emergency Services	Town-Wide	Undertaken by the Department of Public Works municipal staff.	Limited brush clearing continues. Identify additional areas with potential for brushfires.
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**Winter Storms Related**

Residential Parking Bans	Parking bans to enable snow removal effectively from residential streets	Town-Wide	Department of Public Works municipal staff.	Parking bans remain in place but additional personnel and equipment needed for enforcement.
Clearing Snow from Major Arterial Routes	Ensure access to emergency service vehicles	Town-Wide	Department of Public Works municipal staff.	Snow clearing continues but additional personnel and equipment needed.

The table above represents the existing mitigation measures in the Town of Sterling. These priorities are consistent with the priorities listed in the 2015 Regional report due to mitigation goals from 2015 are still goals today, but with additional goals relevant to climate change being added in section 9. The following item below have been completed ongoing and/or annually reviewed; all other existing mitigation measure continue to make progress since the 2015 Regional Plan:

- Establishment of a Community Emergency Response Team (CERT).
- Completed analysis on floodplain and dam inundation areas. Existing shelters are the Butterick Municipal Building, Town Hall, Conant Public Library and all other municipal buildings.
- Established a CERT and are working with their Regional Emergency Planning Committee.
  - REPC - with towns of Holden, Boylston, West Boylston.
- Reduce of salt use on roadways for environmental protection.
- Place/relocate of Electrical utilities underground, some roadways completed.
- Tree maintenance in town with continued efforts for more staff to continue upkeep.
- Continued research into opportunities for higher quality internet service.
- Continue with annual emergency planning.
- Upkeep for Code Red system and radio system
- Continue funding for facilities maintenance on designated shelters.
- Purchase of more backup batteries for emergency use.
- Planning updates for emergency evacuation routes.

## 9. HAZARD MITIGATION GOALS AND OBJECTIVES

The last portion of the CRB workshop engaged all stakeholders in a discussion of the actions and priorities identified by each of the five break out groups. Each of the groups identified three actions as their highest-priority actions to increase community resilience in Sterling. As part of the overall discussion, the actions listed by each group were sorted into four categories and color coded to aid in the identification of themes. The actions presented by each group varied in breadth and scope but seemed to fall within four major categories: Water Supply System and Groundwater Quality, Roadway Improvements and Stormwater Management, Emergency Services, and Development Planning. The original goals and objectives that were endorsed by the original planning team in the 2015 regional plan are still relevant to mitigation efforts today however, many have been incorporated into the objectives listed below along with new priorities. Top recommendations to increase resilience were identified by workshop participants and are presented in the following categories:

### *Water Supply System and Groundwater Quality:*

Wrap-up discussions among all five workshop breakout groups identified the following actions as top priorities under this category:

- Inventory and assess the existing infrastructure components and identify and prioritize improvements.

- Increase redundancy of the water system by investigating and establishing additional wells and exploring opportunities to work with MWRA.
- Engage in cross agency planning and implementation of Low Impact Development and Green Infrastructure as a way to use stormwater to recharge groundwater and protect groundwater quality.
- Identify and implement ways to reduce town wide water use over time such as required water efficient design, removal of irrigation systems from town water, and encouraging greywater and stormwater reuse.

#### *Roadway Improvements and Stormwater Management:*

Concerns surrounding roadway conditions and stormwater management also ranked as a top priority, and included several actions to help improve resilience:

- Implement local regulation changes requiring updated rainfall standards to be used for the hydraulic design of stream crossings and other stormwater related infrastructure, so that climate change is adequately captured in the design conditions.
- Work with MassDOT and DCR to address water quality from I-190.
- Study and implement resizing of culverts and stormwater system.
- Consider a wholistic approach for design, implementing, and maintaining Green Infrastructure Stormwater systems throughout Town. By creating a Low Impact Development Bylaw this will help for future development. Particularly funding and programs for maintenance will need to be identified to maintain this goal.
- Consider the use of impact/betterment fees for new development to support public infrastructure funding.
- Develop an Asset Management Plan for Roadways, Culverts, and Stormwater Infrastructure.
- Execute projects to address roadway drainage issues and downstream washout at critical areas including Swett Hill Road and the Town Beach.

#### *Development Planning:*

Protecting Agricultural Land and forested open space through development planning emerged as the third highest priority category for potential actions. Actions in this category relate to supporting the farming community, protecting the natural resources of the Town, while also encouraging responsible development. In this category, the following actions emerged as priorities:

- Establish an Environmental Advisory Committee in Town to consider environmental impacts of land use and development decisions in Town.
- Review opportunities for "smart growth." Consider updating land use planning and zoning to plan for future development including growth of uses including residential, industrial, etc. This would include updating the Open Space Residential Design Bylaw. This will work to address sprawl control to help densify, encourage affordable housing, preserve open space.
- Work to disincentivize the loss of farms. Encourage water saving farming techniques, work to alleviate the pressure of development, and foster continuity of farming across generations.

### *Emergency Services:*

Concerns surrounding emergency response and providing security in the event of acute events within Sterling also ranked as a top priority and included several actions to help bolster the existing Emergency Response efforts for the future. Specific discussion and consideration were given to the fact that Sterling has an aging population that needs to be considered and accommodated in cases of emergency and otherwise:

- Increase upkeep and awareness around the existing evacuation routes, shelters, and emergency plans that are already in place.
- Consider developing a central repository for Town information and a marketing plan for Municipal and Town-wide dissemination.
- Address financial burden of extreme weather events by mitigating impacts and funding recovery.
- Establish animal friendly shelters and communicate this to the public, educate public about "go kits" necessary for domestic animals.
- Identify and engage vulnerable populations (e.g. Sholan Terrace population and HMEA Adult Daycare Facility) to improve access to essential emergency services during a major hazard event.
- Conduct a facilities inventory and assessment to assess sheltering capacity and identify potential improvements to expand capacity.

## **10. POTENTIAL HAZARD MITIGATION MEASURES**

### **What is hazard mitigation?**

Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries and property resulting from natural and human-made hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects and other activities. FEMA currently has three mitigation grant programs: the Hazards Mitigation Grant Program (HGMP), the Pre-Disaster Mitigation program (PDM), and the Flood Mitigation Assistance (FMA) program. The three links below provide additional information on these programs.

<http://www.fema.gov/government/grant/hmgp/index.shtm>

<http://www.fema.gov/government/grant/pdm/index.shtm>

<http://www.fema.gov/government/grant/fma/index.shtm>

### ***10.1 Process for Setting Priorities for Mitigation Measures***

The decision on priorities for the 2021 update was determined during the MVP workshop. The method used was to reach consensus through discussion, using the CRB framework recommended by the MVP program, rather than taking a vote. Priority setting was based on local knowledge of the hazard areas, cost information, climate change projections, and an assessment of benefits.

Potential Mitigation and Climate Adaptation Measures are outlined in the following section. This section is an update of the potential mitigation measures included in the previous version of this plan, with the priority actions outlined in the MVP Summary of Findings incorporated.

## 10.2 *Introduction to Potential Mitigation Measures (Table 21)*

Description of the Mitigation Measure – The description of each mitigation measure is brief and cost information is given only if cost data were already available from the community. The cost data represent a point in time and would need to be adjusted for inflation and for any changes or refinements in the design of a mitigation measure.

Priority – The designation of high, medium, or low priority was done at the meeting of the Local Multiple Hazard Community Planning Team meeting. The designations reflect discussion and a consensus developed at the meeting but could change as conditions in the community change.

Implementation Responsibility – The designation of implementation responsibility was done by Sterling based on a general knowledge of what each municipal department is responsible for. It is likely that most mitigation measures will require that several departments work together and assigning staff is the sole responsibility of the governing body of each community.

Time Frame – The time frame was based on a combination of the priority for that measure, the complexity of the measure and whether the measure is conceptual, in design, or already designed and awaiting funding. Because the time frame for this plan is five years, the timing for all mitigation measures has been kept within this framework. The identification of a likely time frame is not meant to constrain a community from taking advantage of funding opportunities as they arise. Strategies are grouped by 1-2 year timeframe, 3-5 year timeframe, and ongoing items.

Estimated Cost - The column represents the estimated cost that the mitigation measure would have to implement into the Town of Sterling. Estimated cost for the mitigation measure includes the following classifications: Low – less than \$50,000, Medium – between \$50,000 – \$100,000, High – over \$100,000. The column also analyzes the cost compared to the benefits. This includes quantitative benefits along with qualitative benefits which helped distinguish the differences between each mitigation measure.

Potential Funding Sources – This column attempts to identify the most likely sources of funding for a specific measure. The information on potential funding sources in this table is preliminary and varies depending on several factors. These factors include whether a mitigation measure has been studied, evaluated or designed or is still in the conceptual stages. MEMA and DCR assisted MRPC in reviewing the potential eligibility for hazard mitigation funding. Each grant program and agency have specific eligibility requirements that would need to be taken into consideration. In most instances, the measure will require several different funding sources. Identification of a potential funding source in this table does not guarantee that a project will be eligible for or selected for funding. Upon adoption of this plan, the local committee responsible for its implementation should begin to explore the funding sources in more detail.

**TABLE 20: MITIGATION MEASURES FOR THE TOWN OF STERLING**

Hazard Area	Mitigation Measure(s)	Implementation Responsibility	Time Frame	Estimated Cost	Potential Funding Sources
<b>Higher Priority - Water infrastructure</b>					
Drought	Implement an integrated water management plan to address vulnerabilities. Create new well fields, update aged infrastructure, increase footprint.	DPW/Water Department	3-5 years	Cost: High Benefit: Essential for public safety and quality of life.	Town of Sterling, MVP Action Grants, MEMA
Drought	Explore incentives for individual properties reusing grey water and stormwater	DPW	3-5 years	Cost: High Benefit: By exploring options and proposing modified Town bylaws to implement this change, the adjustments will increase resiliency for infrastructure.	Town of Sterling, MVP Action Grants, MEMA
Drought	Build redundancy in water systems	DPW/Water Department	3-5 years	Cost: High Benefit: By exploring options and proposing modified Town bylaws to implement this change, the adjustments will increase resiliency for infrastructure	Town of Sterling, MVP Action Grants, MEMA
Winter Storms, Drought, Heavy Rain	Continue ongoing work to reduce salt use	DPW	Ongoing	Cost: Low Benefit: Environmental Protection	Town of Sterling

Drought	Drill new municipal wells to bring them online (add to system for emergency and dry times)	DPW/Water Department	3-5 years	Cost: High Benefit: Essential for public safety and quality of life.	Town of Sterling, MVP Action Grants, MEMA
Drought	Consider incentives or requirements for the use of private irrigation wells instead of connection to potable water supply	DPW	1-2 years	Cost: Low Benefit: Water protection	Town of Sterling
Drought	Encourage water conservation	DPW	1-2 years	Cost: Low Benefit: Water resource Protection	Town of Sterling
Drought, Heavy rain	Partner with Department of Conservation and Recreation (DCR) on stormwater Best Management Practices (BMPs), identify how to take advantage of rain to recharge aquifer	DCR, DPW	1-2 years	Cost: Medium Benefit: Environmental Protection	Town of Sterling, MVP action Grants, MEMA
Drought	Start discussions with Massachusetts Water Resources Authority (MWRA) about buying in.	DPW, Selectman Board	3-5 years	Cost: Medium Benefit: Essential for public safety and quality of life.	Town of Sterling, MWRA
<b>Higher Priority - Transportation infrastructure</b>					
Heavy Rain, Winter Storms	Asset Management Plan on roadways	DPW	1-2 years	Cost: Low Benefit: Essential for public safety, and emergency management.	Town of Sterling
All Hazards	Integrate local evacuation routes into regional plan (evaluate additional signage)	DPW, FD	1-2 Years	Cost: Low Essential for public safety, and emergency management.	Town of Sterling
All Hazards	Additional mobile variable message signs	DPW, FD	1-2 years	Cost: Low Benefit: Public service announcements	Town of Sterling, MEMA
All Hazards	Implementing impact fees for roadways and drainage	DPW, Town Administrator, Selectman	3-5 years	Cost: Low Benefit: Quality Infrastructure	Town of Sterling

All Hazards	Dedicate town funding to maintenance & projects (match Ch90)	DPW, Town Administrator, Selectman	3-5 years	Cost: Low Benefit: Quality Infrastructure	Town of Sterling
Heavy Rain, Thunderstorms	Plan for stormwater management strategically	DPW, Planning Department	1-2 years	Cost: Low Benefit: Quality Infrastructure	Town of Sterling, MVP action grants
Heavy Rain, Thunderstorm, Winter Storms	Research forward-looking precipitation amounts for planning and design	DPW, Planning Department	1-2 years	Cost: Low Benefit: Quality Infrastructure	Town of Sterling
Heavy Rain, Thunderstorms	Resize culverts and stormwater system along with green infrastructure	DPW, Planning Department	3-5 years	Cost: Medium Benefit: Quality Infrastructure	Town of Sterling, MVP grants, MEMA
Heavy Rain, Thunderstorms	Inventory of size and condition/compare to current design requirements and storms (Hydrology & Hydraulics), determine impact from dams	DPW	1-2 years	Cost: Low Benefit: Data for future Planning	Town of Sterling, DCR, MVP Action Grants
Heavy Rain, Thunderstorms	Asset Management Plan on culverts	DPW	1-2 Years	Cost: Low Benefit: Quality Infrastructure	Town of Sterling, MVP Action Grants
Heavy Rain, Thunderstorms	Improve conditions at the existing drainage outfall(s) at the center of town	DPW	1-2 years	Cost: Low Benefit: Quality Infrastructure	Town of Sterling
<b>Higher Priority - Power and Communication Systems Infrastructure</b>					
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Place/relocate utilities underground (already underway in some locations)	DPW, SMLD	Ongoing	Cost: High Benefit: Infrastructure Protection	Town of Sterling, MEMA, MVP Action Grants
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Tree maintenance - continue and improve and find funding	DPW, SMLD	Ongoing	Cost: Low Benefit: Infrastructure Protection	Town of Sterling
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Explore opportunities for higher quality internet service	DPW, Town Administrator, SMLD	Ongoing	Cost: Low Benefit: Quality of life	Town of Sterling
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Evaluate plan for local broadband, communication system.	SMLD	1-2 years	Cost: Low Benefit: Quality of life	Town of Sterling

<b>Higher Priority – Community Shelters</b>					
All Hazards	Continue with annual emergency planning	FD, Town Administrator	Ongoing	Cost: Low Benefit: Public Safety	Town of Sterling
All Hazards	Upkeep for Code Red system and radio system	FD, Town Administrator	Ongoing	Cost: Low Benefit: Public Safety	Town of Sterling
All Hazards	Continue funding for facilities Maintenance for designated shelters	FD, Town Administrator	Ongoing	Cost: Low Benefit: Public Safety	Town of Sterling
All Hazards	Evaluate alternative shelter facilities	FD, Town Administrator	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling
All Hazards	Generator maintenance, establish approach for supplies	FD, Town Administrator	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling
All Hazards	Senior Center/Community education from EMD regarding emergency responses	FD, Police Department, Town Administrator	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling
All Hazards	Develop Transportation plans to the shelters	FD, Police Department, Town Administrator	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling
All Hazards	Update/educate/mark route/publicize/ alternate route	FD, Police Department, Town Administrator	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling
All Hazards	Assess capacity to assist the Town with special/higher need individuals - develop partnerships	FD, Nursing homes, Town Administrator	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling
All Hazards	Establish animal friendly shelters and communicate this to the public. Public education on animal to go kits for emergencies.	FD, Animal Shelters	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling
<b>Higher Priority – Environmental Protection for Agriculture</b>					
Drought, Extreme Temperatures, Heavy Rain, Winter storms	Generate methods to help keep farms in a position of future success (for example, matching future farmers with farms that may be in need, or funding creation of exit/succession strategy)	Agricultural Commission, Board of Selectmen	3- 5 years	Cost: Low Benefit: Public Support	Town of Sterling, USDA, MEMA

Drought, Extreme Temperatures, Heavy Rain, Winter storms	Share resources and collaborate with other local Towns for Agricultural preservation and long term planning	Agricultural Commission, Town Administrator, MRPC	1-2 years	Cost: Low Benefit: Public Support	Town of Sterling
<b>Higher Priority – Environmental Protection for Land Development</b>					
All Hazards	Review opportunities for "smart growth"	Town Administrator, Board of Selectman, Planning Department	3-5 years	Cost: Low Benefit: Preservation of Town character and environmental protection	Town of Sterling
All Hazards	Develop OSRD/cluster zoning bylaws	Planning Department	3-5 years	Cost: Low Benefit: Preservation of Town character and environmental protection	Town of Sterling
All Hazards	Forward looking planning (20+ years) & re-think zoning; promote certain kinds of development in certain locations (more attention to the northern edge of Rt. 12 and other areas)	Town Administrator, Board of Selectman, Planning Department	3-5 years	Cost: Low Benefit: Preservation of Town character and environmental protection	Town of Sterling
<b>Higher Priority – Environmental Protection for Water Quality</b>					
All Hazards	Assess water quality, which is leading to turbidity, algae, and other problems	Conservation Commission	1-2 years	Cost: Low Benefit: Environmental protection	Town of Sterling, MVP Action Grant
All Hazards	Bolster development permitting requirements with a focus on Low Impact Development and Green Infrastructure best management practices	Conservation Commission, Planning Department	3-5 years	Cost: Low Benefit: Environmental protection	Town of Sterling
All Hazards	Work with DCR to address watershed wide pollution concerns	Conservation Commission, DCR, MRPC	3-5 years	Cost: Low Benefit: Environmental protection	Town of Sterling, DCR, MVP action grants
All Hazards	Reduce salt use. Work to advance regional efforts in collaboration with DCR to	DPW, DCR	Ongoing	Cost: Low	Town of Sterling

	address reduction of salt use			Benefit: Environmental protection	
Extreme Weather	Pursue outfall drainage improvements	DPW	3-5 years	Cost: Medium Benefit: Environmental protection	Town of Sterling, MVP Action Grants, MEMA
Extreme Weather	Increase homeowner education about stormwater runoff	Conservation Commission, MRCP	1-2 years	Cost: Low Benefit: Environmental protection	Town of Sterling
<b><u>Moderate Priority- Electric Utility Infrastructure</u></b>					
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Revisit several streets with several old trees (forest management plan)	DPW	1-2 years	Cost: Low Benefit: Infrastructure and property protection	Town of Sterling
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Review of substation locations to ensure they are not susceptible to flooding	DPW/Water Department	3-5 years	Cost: Low Benefit: Infrastructure protection	Town of Sterling, MVP Action Grants, MEMA
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Consider more battery backup	DPW	Ongoing	Cost: Low Benefit: Emergency preparedness	Town of Sterling, MEMA
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Assess/inventory/prioritize of current system	DPW/SMLP	3-5 years	Cost: Low Benefit: Emergency preparedness	Town of Sterling,
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Encourage alternative power sources/preventive actions/demonstration projects	DPW	1-2 years	Cost: Low Benefit: Emergency preparedness	Town of Sterling
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Conservation guidance from Town (education/promotion)	DPW	1-2 years	Cost: Low Benefit: Emergency preparedness	Town of Sterling
<b><u>Moderate Priority- Dam Infrastructure</u></b>					
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Dams not in Town ownership - Develop agreements to review	DPW, DCR	1-2 years	Cost: Low Benefit: Emergency preparedness	Town of Sterling

	reports as a major stakeholder				
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Work to fix the dams that are considered in serious condition	DPW, DCR	3-5 years	Cost: High Benefit: Hazard Prevention	Town of Sterling, MEMA, DCR
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Carefully study impacts of dams and dam removal on water table elevations as it relates to water supply	DPW, DCR	3-5 years	Cost: Medium Benefit: Data collection hazard prevention	Town of Sterling, MEMA, MVP Actions
<b>Moderate Priority- Highway Infrastructure</b>					
All Hazards	Partner with DCR and other Wachusett watershed towns on getting state DPW and others to consider alternative salting and other road maintenance systems	DPW, MRPC	1-2 years	Cost: Low Benefit: Environmental Protection	Town of Sterling
<b>Moderate Priority- Bridge Infrastructure</b>					
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Inventory: How many State owned/how old/when inspected/impact from dams	DPW, MASSDOT	1-2 Years	Cost: Low Benefit: Data collection	Town of Sterling
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Develop prioritization/Sterling communicate with MassDOT regarding state bridge concerns	DPW, MASSDOT	1-2 Years	Cost: Low Benefit: Hazard prevention	Town of Sterling
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Secure financial assistance and engage in design	DPW, MassDOT	3-5 Years	Cost: High Benefit: Hazard prevention	Town of Sterling, MassDOT
<b>Moderate Priority- Town Beach Infrastructure</b>					
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Study drainage improvement	DPW	1-2 years	Cost: Low Benefit: Data collection	Town of Sterling, MVP Action Grants, MEMA
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Utilize \$1M bond for improvements (fix drainage & improve on strengths); Improvements to building at the beach	DPW	3-5 Years	Cost: High Benefit: Quality of life and infrastructure improvements	Town of Sterling, MEMA

	(old buildings can be updated)				
<b>Moderate Priority- Wastewater Disposal Infrastructure</b>					
Heavy Rain	The town is reliant entirely on aging septic systems. The Town has previously completed a Feasibility Study that recommends installing sewers to serve Route 12 and possibly the industrial park. Consider advancing work towards implementing new sewer system	DPW	3-5 Years	Cost: High Benefit: Quality of life and infrastructure improvements	Town of Sterling, MVP Action Grants, MRCP
<b>Moderate Priority- Community Organizations</b>					
All Hazards	Provide a bigger seat at the table as a stakeholder in town-wide issues	Planning Department, Board of Selectmen	1-2 years	Cost: Low Benefit: Public Support	Town of Sterling
All Hazards	Formalize/identify partnerships to assess capacity, services, and accessibility	Board of Selectmen	1-2 years	Cost: Low Benefit: Public Support	Town of Sterling
All Hazards	Assess partnerships to establish financial assistance	Board of Selectmen	1-2 years	Cost: Low Benefit: Public Support	Town of Sterling, MVP Action Grants
All Hazards	Assess partnerships to establish continued food distribution during storm events	Board of Selectmen,	1-2 years	Cost: Low Benefit: Public Support	Town of Sterling, MEMA
<b>Moderate Priority - Recreation Facilities</b>					
All Hazards	Help the Recreation Department match the infrastructure to the projected program	Recreation Department, DPW	1-2 years	Cost: Medium Benefit: Public use improvements	Town of Sterling
All Hazards	Match the recreation plan with the open space plan	Recreation Department, Planning Department	1-2 years	Cost: Low Benefit: Public use improvements	Town of Sterling
<b>Moderate Priority – Volunteer participation in Local Governance</b>					
All Hazards	Work more with natural volunteer organizations in town (e.g. Friends of the Library)	Board of Selectmen, Town Administrator	1-2 years	Cost: Low Benefit: Public Support	Town of Sterling

All Hazards	Refresh the culture of volunteerism in town	Board of Selectmen, Town Administrator	1-2 years	Cost: Low Benefit: Town and public relations	Town of Sterling
<b><u>Moderate Priority – MART District Transportation Services</u></b>					
All Hazards	Enhance services with public/private partnership	MRCP	1-2 years	Cost: Low Benefit: Public Support	Town of Sterling
All Hazards	Expand public transportation options, negotiate with Montachusett RTA	MRCP, MASSDOT	1-2 years	Cost: Low Benefit: Public Support	Town of Sterling
<b><u>Moderate Priority - Elderly Population</u></b>					
All Hazards	Plan for evacuation developed and implemented	Police Department, Fire Department	ongoing	Cost: Low Benefit: Public Safety	Town of Sterling
<b><u>Moderate Priority - HMEA (adult daycare facility)</u></b>					
All Hazards	Education - make town residents aware of this facility (50+/- clients daily)	Town Administrator, Local Paper	1-2 years	Cost: Low Benefit: Public Support	Town of Sterling
All Hazards	Plan for evacuation to be developed and implemented	Police Department, Fire Department	1-2 years	Cost: Low Benefit: Public safety	Town of Sterling
All Hazards	Increase cooperation of the Town with the Facility owners	Town Administrator	1-2 years	Cost: Low Benefit: Public Support	Town of Sterling
<b><u>Moderate Priority – Farming Community</u></b>					
All Hazards	Consider revisions to zoning, policy, or bylaws to reduce the pressure of development (e.g. change parcel size requirements)	Board of Selectmen, Town Administrator, Planning Department	1-2 years	Cost: Low Benefit: Public support and Town preservation	Town of Sterling
All Hazards	Support farmers market and farm stands - continue to promote use of local products	Town Administrator, Local Paper	1-2 years	Cost: Low Benefit: Public support and Town preservation	Town of Sterling
<b><u>Moderate Priority – Environmental Protection for Conservation Land</u></b>					
All Hazards	Generate accurate inventory of existing properties (prepare acquisition/protection plan for future green spaces)	Conservation Commission, MRPC	1-2 years	Cost: Low Benefit: Data collection	Town of Sterling

All Hazards	Explore opportunities for Community Preservation Act	Conservation Commission, MRCP, Board of Selectmen, Town Administrator, Planning Department	1-2 years	Cost: Low Benefit: Land Preservation	Town of Sterling
All Hazards	Provide tools for access to quicker funding in case properties become available	Conservation Commission, MRCP	1-2 years	Cost: Low Benefit: Land Preservation	Town of Sterling
<b>Moderate Priority – Contamination Prevention</b>					
All Hazards	Updated contingency plan to account for potentials of contamination	Conservation Commission	1-2 years	Cost: Low Benefit: Environmental Protection	Town of Sterling
All Hazards	Explore salt reduction techniques on roads	DPW, Conservation Commission	1-2 years	Cost: Low Benefit: Environmental Protection	Town of Sterling
All Hazards	Explore chemical use reduction in orchards	Conservation Commission	1-2 years	Cost: Low Benefit: Environmental Protection	Town of Sterling
All Hazards	Training/education materials outlining contamination impacts on the community	Conservation Commission, Town Administrator	1-2 years	Cost: Low Benefit: Environmental Protection	Town of Sterling
<b>Moderate Priority – Flood Prevention</b>					
All Hazards	Join mosquito control efforts at the State level	DPW, Conservation Commission	1-2 years	Cost: Low Benefit: Quality of life	Town of Sterling
All Hazards	Work across agencies to identify and implement solutions	DPW, Conservation Commission, MRPC, DCR	1-2 years	Cost: Low Benefit: Environmental Protection	Town of Sterling
All Hazards	Consider forming an Environmental Advisory Committee (with potential purview in conjunction with Conservation Commission and Department of Public Works Board)	Board of Selectmen, Town Administrator, Conservation Commission, DPW	1-2 years	Cost: Low Benefit: Environmental Protection	Town of Sterling
<b>Moderate Priority – Environmental Protection Plan to Reduce Chemicals/Fertilizer</b>					

All Hazards	Educate community on proper practices for fertilizers and gardening practices	Conservation Commission	1-2 years	Cost: Low Benefit: Environmental Protection	Town of Sterling
All Hazards	Restrict pesticides	Board of Selectmen, Town Administrator, Conservation Commission, DPW	1-2 years	Cost: Low Benefit: Environmental Protection	Town of Sterling
<b><u>Moderate Priority – Environmental Protection Wildfire Prevention</u></b>					
All Hazards	Development management & restrictions on development considering wildlife corridors	DPW, Fire Department, Board of Selectmen, Planning Department, Town Administrator, Conservation Commission,	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling
<b><u>Lower Priority- Emergency Management Infrastructure</u></b>					
All Hazards	Explore backup generators at sheltering locations	DPW, Police Department, Fire Department	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling, MEMA
All Hazards	Assess local food capacity within Town, create Emergency Food Distribution Plan for wide spread power outages	Fire Department, Police Department	1-2 years	Cost: Medium Benefit: Data collection and public safety	Town of Sterling, MEMA
<b><u>Lower Priority- Sterling Airport Infrastructure</u></b>					
All Hazards	Determine how to protect the wide-open field	Fire Department, Conservation Commission	1-2 years	Cost: Low Benefit: Land protection and operations planning	Town of Sterling
Winter Storms	Improve snow removal	DPW,	1-2 years	Cost: Low Benefit: Operations planning	Town of Sterling
<b><u>Lower Priority- Code Red System</u></b>					
Heavy Rain, Thunderstorms, Winter Storms, Hurricanes	Explore backup system in case of power outages/phone outages	DPW, Fire Department, SMLP	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling, MEMA

All Hazards	Advertise/marketing for people to sign up and to receive information	Town Administrator, Fire Department	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling
All Hazards	Define an emergency contact protocol for town-wide communications	Town Administrator, Fire Department	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling
All Hazards	Town website updates potentially needed	Town Administrator, Fire Department	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling
<b>Lower Priority- Vulnerable Populations</b>					
All Hazards	Explore consolidated mental health/public health plan for the community	Board of Health,	1-2 years	Cost: Low Benefit: Public Support	Town of Sterling
<b>Lower Priority- "Isolated Neighborhoods" (outside of hydrant district)</b>					
All Hazards	Explore ways to reduce response times to these areas for first responders	Fire Department, Police Department	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling
<b>Lower Priority- Environmental Protection for Soil Erosion/Crop Damage</b>					
Drought, Heavy Rain, Extreme Temperatures	Collaborate with Farmers to develop educational resources about farming techniques inclusive of plowing and irrigation	Agricultural Commission, Conservation Commission, MRPC	1-2 years	Cost: Low Benefit: Public support and environmental protection	Town of Sterling
<b>Lower Priority- Environmental Protection for Trees/Biodiversity/Habitat</b>					
All Hazards	Maintenance of both open space and woodland space to provide diverse habitats	Conservation Commission, MRPC	1-2 years	Cost: Low Benefit: Environmental protection	Town of Sterling
All Hazards	Develop open space, residential, cluster bylaw	Conservation Commission, Planning Board, Town Administration	1-2 years	Cost: Low Benefit: Environmental protection	Town of Sterling
All Hazards	Uphold cooperation with Land Trusts and DCR who currently manage and plan forest land to prevent biodiversity loss	Conservation Commission, DCR, MRPC	1-2 years	Cost: Low Benefit: Environmental protection	Town of Sterling
All Hazards	Consider managed replanting	Conservation Commission, DCR, MRPC	1-2 years	Cost: Low Benefit: Environmental protection	Town of Sterling
All Hazards	Consider a forest management plan	DPW, Conservation	1-2 years	Cost: Low	Town of Sterling

		Commission, MRPC		Benefit: Environmental protection	
<b>Lower Priority- Environmental Protection for Orchards/Farms</b>					
All Hazards	Collaborate with Farmers to develop educational resources about farming techniques inclusive of crop selection, pesticides etc	Agricultural Commission, Conservation Commission, MRPC	1-2 years	Cost: Low Benefit: Public Support	Town of Sterling
<b>Lower Priority- Environmental Protection for Fire access to forested areas</b>					
All Hazards	Establish right-of-ways (ROW)/agreements for fire access (discontinued or abandoned roads)	Fire Department, Police Department, Board of Selectmen	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling
All Hazards	Currently have 4 fire vehicles for woods - maintain this fleet	Fire Department, Police Department,	1-2 years	Cost: Low Benefit: Public Safety	Town of Sterling
All Hazards	Continue to monitor fire towers	Fire Department, Police Department	On going	Cost: Low Benefit: Public Safety	Town of Sterling
All Hazards	Increase public education for forest protection	Fire Department, Police Department	On going	Cost: Low Benefit: Public Safety	Town of Sterling
<b>Lower Priority- Environmental Protection for Surface Water</b>					
Drought, Extreme Temperature, Extreme Weather	Work with managers of Wachusett Reservoir as needed	Conservation Commission, MRPC	1-2 years	Cost: Low Benefit: Water resource protection	Town of Sterling

## 11. REGIONAL AND INTER-COMMUNITY CONSIDERATIONS

Some hazard mitigation issues are strictly local. The problem originates primarily within the municipality and can be solved at the municipal level. [The Town of Sterling has taken steps to implement the findings of the 2016 Montachusett Regional Hazard Mitigation Plan into the following policy, programmatic areas and plans: The Open Space and Recreation Plan 2019 Update, Housing Production Plan 2019 update, the 2021 Vegetation Management Plan, Protective \(Zoning\) Bylaws or other planning documents the Town has created through their various committees and department. Many of the potential mitigation measures mentioned](#)

above for future goals will require the Town of Sterling to integrate the updated HMP mitigation measures into their Town legislature such as updating the Town's Master Plan, Protective (Zoning) Bylaws or other planning documents the Town has created through their Planning Board department. However, other issues are intercommunity issues that involve cooperation between two or more municipalities. This intercommunity collaboration is crucial for resource management and emergency assistance. There is a third level of mitigation which is regional; involving a state, regional or federal agency or an issue that involves three or more municipalities.

### 11.1 *Regional Partners*

In many communities, mitigating natural hazards, particularly flooding, is more than a local issue. The drainage systems that serve these communities are a complex system of storm drains, roadway drainage structures, pump stations and other facilities owned and operated by a wide array of agencies including but not limited to the Town of Sterling, the Department of Conservation and Recreation (DCR), the Massachusetts Water Resources Authority (MWRA), Massachusetts Highway Department (MHD) and the Massachusetts Bay Transportation Authority (MBTA) and the Montachusett Regional Planning Commission. The planning, construction, operations and maintenance of these structures are integral to the flood hazard mitigation efforts of communities. These agencies must be considered the communities regional partners in hazard mitigation. These agencies also operate under the same constraints as communities do including budgetary and staffing constraints and numerous competing priorities.

### 11.2 *Inter-Community Considerations*

The Town of Sterling's Core Team did not identify specific inter-community during the planning process. However, the following general regional issues continue to be an important part of the town's ability to draft and implement effective multiple hazard mitigation plans.

### 11.3 *Regional Issues*

- Maintenance and drainage from state highways
- Inspection and maintenance of dams
- Coordinated response to water resources protection

## **12. PLAN ADOPTION AND MAINTENANCE**

### ***12.1 Plan Adoption***

The Local Hazard Mitigation & Climate Adaptation Plan was adopted by the Select Board on [REDACTED]. See Appendix B for documentation.

### ***12.2 Plan Implementation***

Implementation of this plan will be the responsibility of Chief David Hurlbut with the assistance of the Core Team. Additional community members will be included in the implementation plans from businesses, non-profits, community groups, and institutions, as required. Chief David Hurlbut shall be responsible for tracking the implementation of the plan over the 5 year period until the next HMP update. The plan will be monitored by Chief David Hurlbut annually at the beginning of the year with the Core Team to create a plan for which mitigation measures will be accomplished that year by identifying which grants application will be completed for which mitigation measures. The monitor will also review the progress quarterly to provide town officials updates.

### ***12.3 Plan Maintenance***

The Local Implementation Group for Sterling will be Chief David Hurlbut and the Core Team, who were responsible for completing the MVP planning process for the town. Chief David Hurlbut and the Core Team will reconvene every five years to update this plan, in accordance with MEMA, FEMA, and MVP program requirements. At the first meeting Chief David Hurlbut and the Core Team will create set criteria for evaluating the plans progress. This will ensure the plan maintains visibility and that the next plan update commences in advance of the plan's expiration, which will occur in five-years. One year prior to that Chief David Hurlbut and the Core Team may decide to undertake the plan update themselves or hire another consultant to assist with the process.

However, Chief David Hurlbut and the Core Team decides to update the plan, the team will need to review the current disaster mitigation plan guidelines for any changes. The updates of the Local Hazard Mitigation and Climate Adaptation Plan are forwarded to MEMA, DCR, and MVP for review, and finally to FEMA for approval, with a focus for the next HMP update on expanding public engagement.

### ***12.4 Integration of the Plans with other Planning Initiatives***

Upon approval of the plan by MEMA, each local committee will provide all interested parties and implementing departments with a copy of the plan and will initiate a discussion regarding how the plan can be integrated into that department's on-going work. At a minimum, the plan will be reviewed and discussed with:

Department of Public Works  
Sterling Municipal Light Department  
Fire Department  
Recreation Department  
Planning Department  
Conservation Commission  
Board of Health

Other groups that will be coordinated with include large institutions, Chambers of Commerce, land conservation organizations and watershed groups. The plan will also be posted on the town's website. The posting of the plan on a web site will include a mechanism for citizen feedback such as an e-mail address to send comments.

In addition, the plan will be reviewed with state agencies such as MEMA, MVP, and DCR, and regional agencies.

## 13. LIST OF REFERENCES

Commonwealth of Massachusetts, MacConnell Land Use Statistics, 1999

Massachusetts State Hazard Mitigation and Climate Adaptation Plan, September 2018

Climate Change Clearinghouse for the Commonwealth, resilientMA.org

United States Environmental Protection Agency. (March 2018) Storm Smart Cities: Integrating Green Infrastructure into Local Hazard Mitigation Plans. Retrieved from [https://www.epa.gov/sites/production/files/2018-04/documents/storm\\_smart\\_cities\\_508\\_final\\_document\\_3\\_26\\_18.pdf](https://www.epa.gov/sites/production/files/2018-04/documents/storm_smart_cities_508_final_document_3_26_18.pdf)

Montachusett Regional Planning Commission. Montachusett Region Natural Hazard Mitigation Plan 2015 Update. <https://www.mrpc.org/>

United States Census. Employment Data retrieved from: <https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/>

United States Census. Population Data retrieved from: <https://www.census.gov/programs-surveys/decennial-census/data/datasets.2010.html>

Federal Emergency Management Agency. Emergency Declarations data retrieved from: [https://www.fema.gov/disasters/disaster-declarations?field\\_dv2\\_state\\_territory\\_tribal\\_value=MA&field\\_year\\_value=2020&field\\_dv2\\_declaration\\_type\\_value=All&field\\_dv2\\_incident\\_type\\_target\\_id\\_selective=All](https://www.fema.gov/disasters/disaster-declarations?field_dv2_state_territory_tribal_value=MA&field_year_value=2020&field_dv2_declaration_type_value=All&field_dv2_incident_type_target_id_selective=All)

National Oceanic and Atmospheric Administration Rainfall Data Retrieved from: [https://www.ncdc.noaa.gov/cag/county/time-series/MA-027/tavg/ann/12/1980-2020?base\\_prd=true&begbaseyear=1980&endbaseyear=2018](https://www.ncdc.noaa.gov/cag/county/time-series/MA-027/tavg/ann/12/1980-2020?base_prd=true&begbaseyear=1980&endbaseyear=2018)

Massachusetts Department of Transportation. Bridge Web Application data retrieved from: <https://www.arcgis.com/apps/webappviewer/index.html?id=d42ae2ac2cb640ac992f763570ce10ed>

National Oceanic and Atmospheric Administration Snowfall Data Retrieved from: <https://w2.weather.gov/climate/xmacis.php?wfo=box>

Massachusetts Department of Conservation and Recreation - Office of Dam Safety. Dams data Received December 2020

United States Army Corps of Engineers. Ice Jam Database by CRREL retrieved from: <https://geospatial-usace.opendata.arcgis.com/datasets/40dae38a18d44354bb977fb94b84a0c4?geometry=-71.899%2C42.417%2C-71.627%2C42.461>

National Oceanic and Atmospheric Administration. Hurricane Track data retrieved from:  
<https://coast.noaa.gov/hurricanes/#map=10.74/42.437/-71.7771&search=eyJzZWZlY2hTdHJpbmciOiJTdGVyY2VzdGVyIENvdW50eSwgTWZc2FjaHVzZXR0cywgVVNBliwic2VhcmNoVHlwZSI6Imdlb2NvZGVkIiwib3NtSUQiOiIxODQ0MTk2IiwiaWY2F0ZWdvcmlcyI6WyJINSIsIkg0IiwidmMiLCJIMiIsIkgxIiwiaWVFMiLCJURCIslkVUII0sInllyXJzIjpbXSwiZW5udGhziIjpbXSwiZW5zbyI6W10sInByZXNzdXJlIjpb7InJhbmdlljpbMCwxMTUwXSwiaW5jbHVkZVua25vd25QcmVzc3VyZSI6dHJ1ZX0sImJ1ZmZlclVuaXQiOiIsiTWIsZXMiXSwic29ydFNlbGVjdGlvbil6eyJ2YWx1ZSI6InllyXJzX25ld2VzdCIsImxhYmVsIjoiWWVhciAoTmV3ZXN0KSJ9LCJhcHBseVRvQU9JJjpb0cnVlLCJpc1N0b3JtTGFiZWxzVmlzaWJsZSI6dHJ1ZX0=>

National Oceanic and Atmospheric Administration. Thunder Storms Data Retrieved from:  
<https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=25%2CMASSACHUSETTS>

Federal Emergency Management Agency. Emergency Declarations Winter Storms Data Retrieved from: [https://www.fema.gov/disasters/disaster-declarations?field\\_dv2\\_state\\_territory\\_tribal\\_value=MA&field\\_year\\_value=2020&field\\_dv2\\_declaration\\_type\\_value=All&field\\_dv2\\_incident\\_type\\_target\\_id\\_selective=All](https://www.fema.gov/disasters/disaster-declarations?field_dv2_state_territory_tribal_value=MA&field_year_value=2020&field_dv2_declaration_type_value=All&field_dv2_incident_type_target_id_selective=All)

The National Drought Mitigation Center, University of Nebraska-Lincoln. Drought Data Retrieved from: [Droughtmonitor.unl.edu](http://Droughtmonitor.unl.edu)

National Oceanic and Atmospheric Administration. Temperature data retrieved from:  
[https://www.ncdc.noaa.gov/cag/county/time-series/MA-027/tavg/ann/12/1980-2020?base\\_prd=true&begbaseyear=1980&endbaseyear=2018](https://www.ncdc.noaa.gov/cag/county/time-series/MA-027/tavg/ann/12/1980-2020?base_prd=true&begbaseyear=1980&endbaseyear=2018)

United States Geological Survey. New England Seismic Network and USGS Earthquake GIS data retrieved from: <https://earthquake.usgs.gov/earthquakes/map/?extent=9.1021,-151.25977&extent=59.31077,-38.75977>

## **APPENDIX A**

### **HAZARD MAPPING**

A series of maps was developed using available GIS data to supplement discussions within the plan. Some of the data came from the MassGIS. Due to the various sources for the data and varying levels of accuracy, the identification of an area as being in one of the hazard categories must be considered as a general classification that should always be supplemented with more local knowledge. The documentation for some of the hazard maps was incomplete as well and the Local Hazard map was created in the 2015 Montachusett Regional Hazard Mitigation Plan.

Map 1: Facilities – This map shows critical facilities and landmarks located within the Town.

Map 2: Land Use – This map shows the 2016 data for land use. The map includes twenty different land use and development categories and the percent of Town land that occupies each.

Map 3: Transportation – This map shows major roadways along with Annual Average Daily Traffic data to display common areas of congestions.

Map 4: Open Space – This map shows protected open space by owner displaying State and Locally owned land.

Map 5: Hydrology – This map shows the location of dams, drainage subbasin, waterways and Mass DEP wetlands.

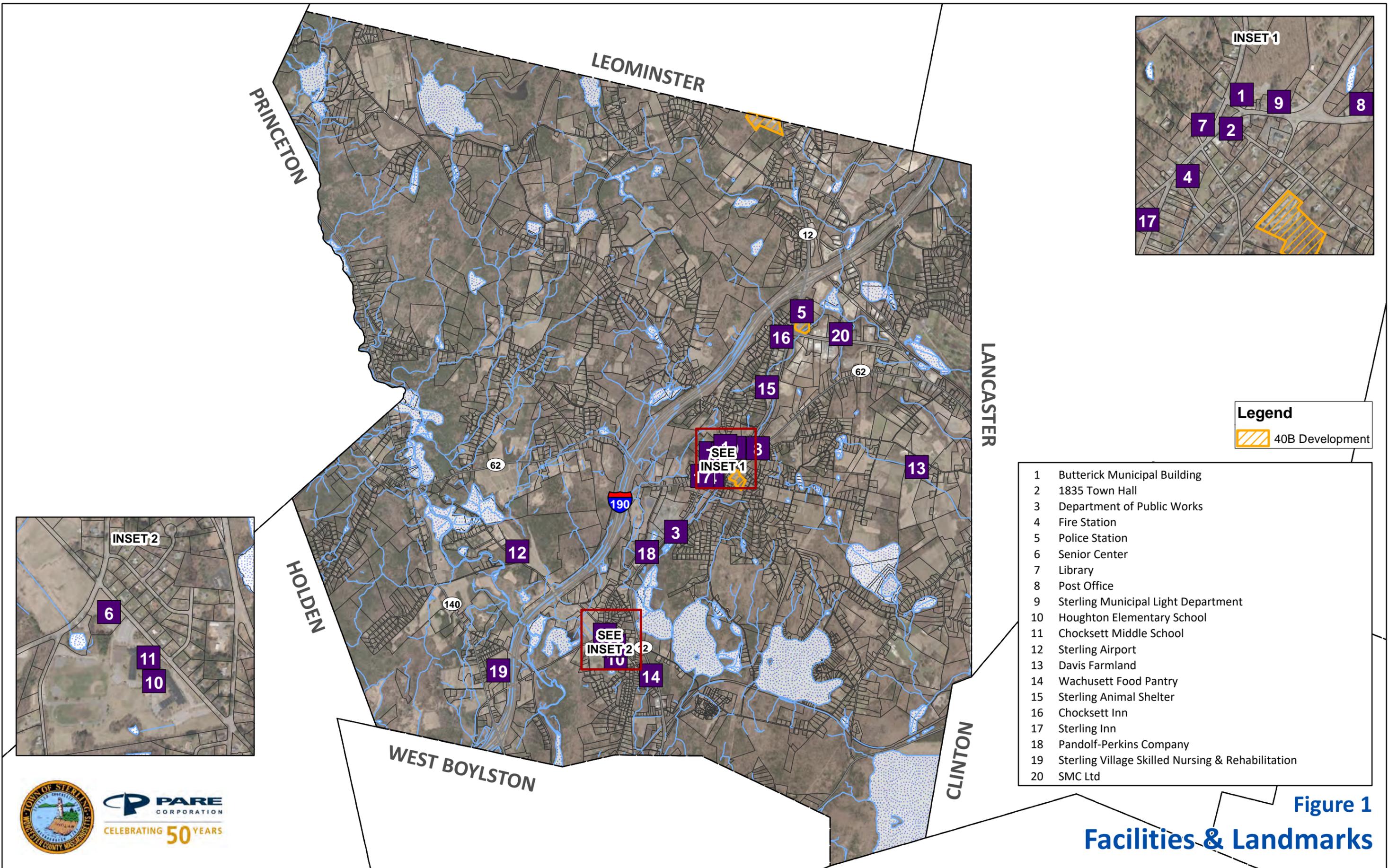
Map 6: Stormwater–The map of flood zones for more information, refer to <https://docs.digital.mass.gov/dataset/massgis-data-fema-q3-flood-zones-paper-firms>. The definitions of the flood zones are described in detail at <https://www.fema.gov/glossary/flood-zones>. The flood zone map also shows stormwater outfalls, drain pipes and culvert.

Map 7: Water System – This map shows the location of hydrants, Kendell Hill Water Tank, and water mains.

Map 8: Curve Numbers – This map shows surface covers throughout town. This shows the relationship between impervious surfaces and pervious surfaces.

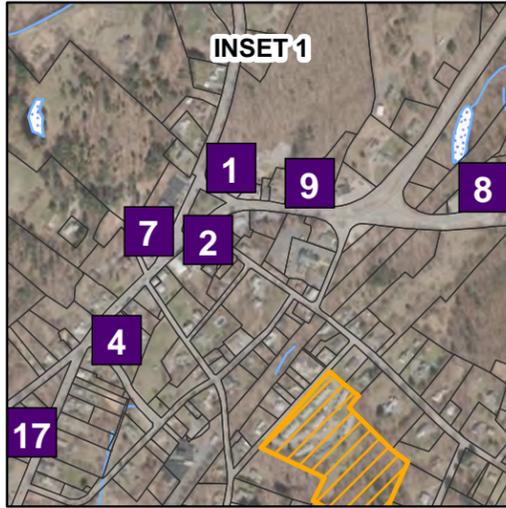
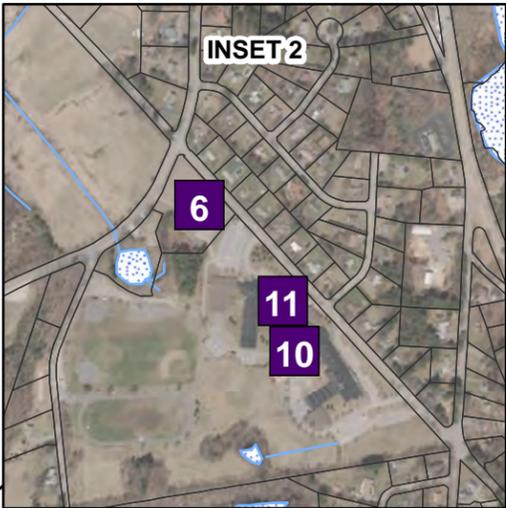
Map 9: Critical Facilities in Hazard Areas – This map shows the intersection of Critical facilities in Hazard areas which includes flood zones, the stormwater outfalls, drain pipes and culvert.

Map 10: Local Hazard Mitigation Map 2015 - This is a two-part map that was created after a meeting that discussed hazards that affect each community and the identification of specific problem areas in the community that need to be addressed. This included the identification of new hazards that were determined to pose a threat or community vulnerability which are detailed in Sterling's Local Hazards. The entire community is equally at risk to the following hazards: heavy rain, snow melt, ice jams, high winds, hurricanes, tornados, nor'easters, heavy snow, ice storms, blizzards, drought, extreme temperatures, earthquakes and landslides.

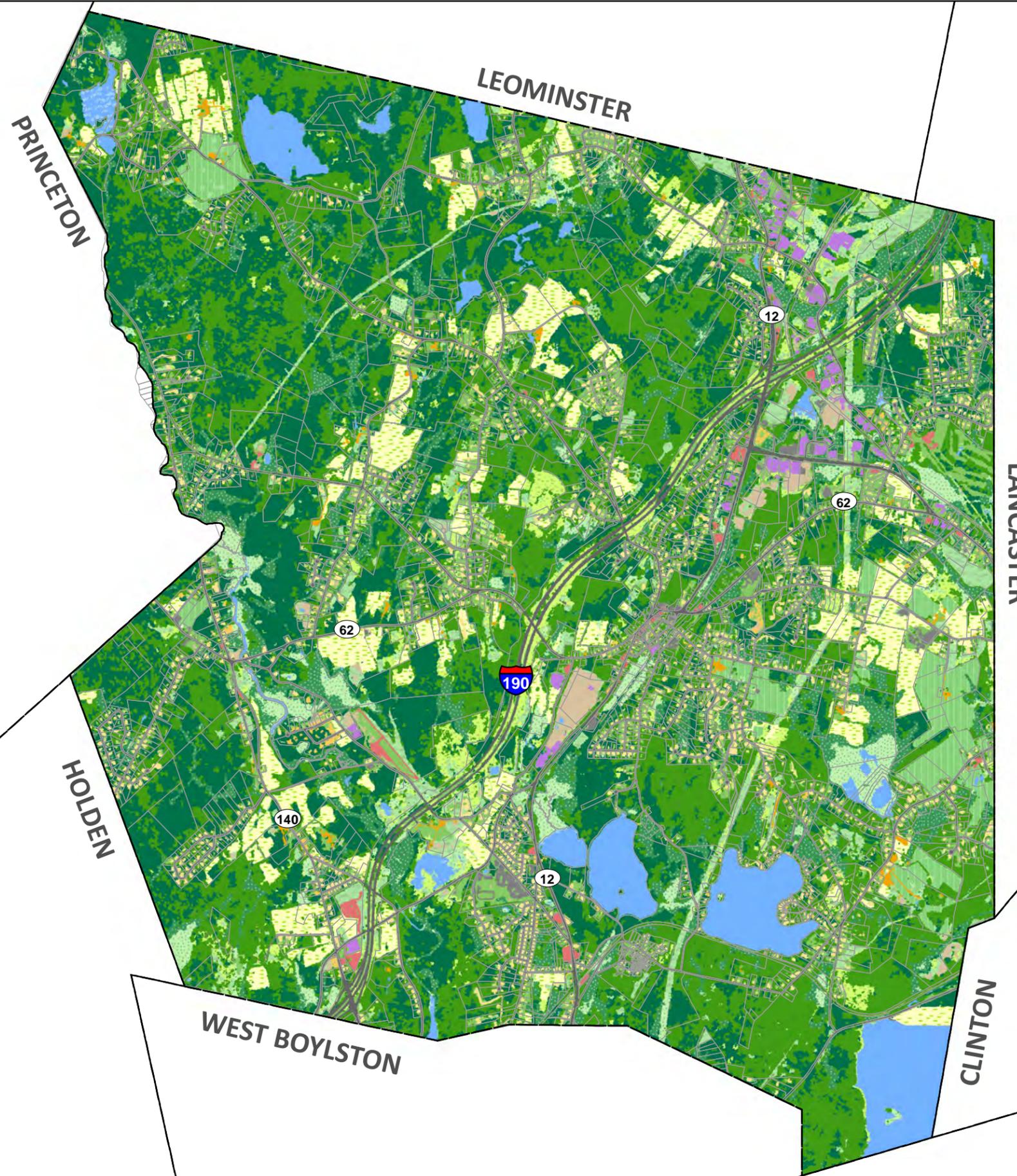


**Legend**  
 40B Development

- 1 Butterick Municipal Building
- 2 1835 Town Hall
- 3 Department of Public Works
- 4 Fire Station
- 5 Police Station
- 6 Senior Center
- 7 Library
- 8 Post Office
- 9 Sterling Municipal Light Department
- 10 Houghton Elementary School
- 11 Chocksett Middle School
- 12 Sterling Airport
- 13 Davis Farmland
- 14 Wachusett Food Pantry
- 15 Sterling Animal Shelter
- 16 Chocksett Inn
- 17 Sterling Inn
- 18 Pandolf-Perkins Company
- 19 Sterling Village Skilled Nursing & Rehabilitation
- 20 SMC Ltd



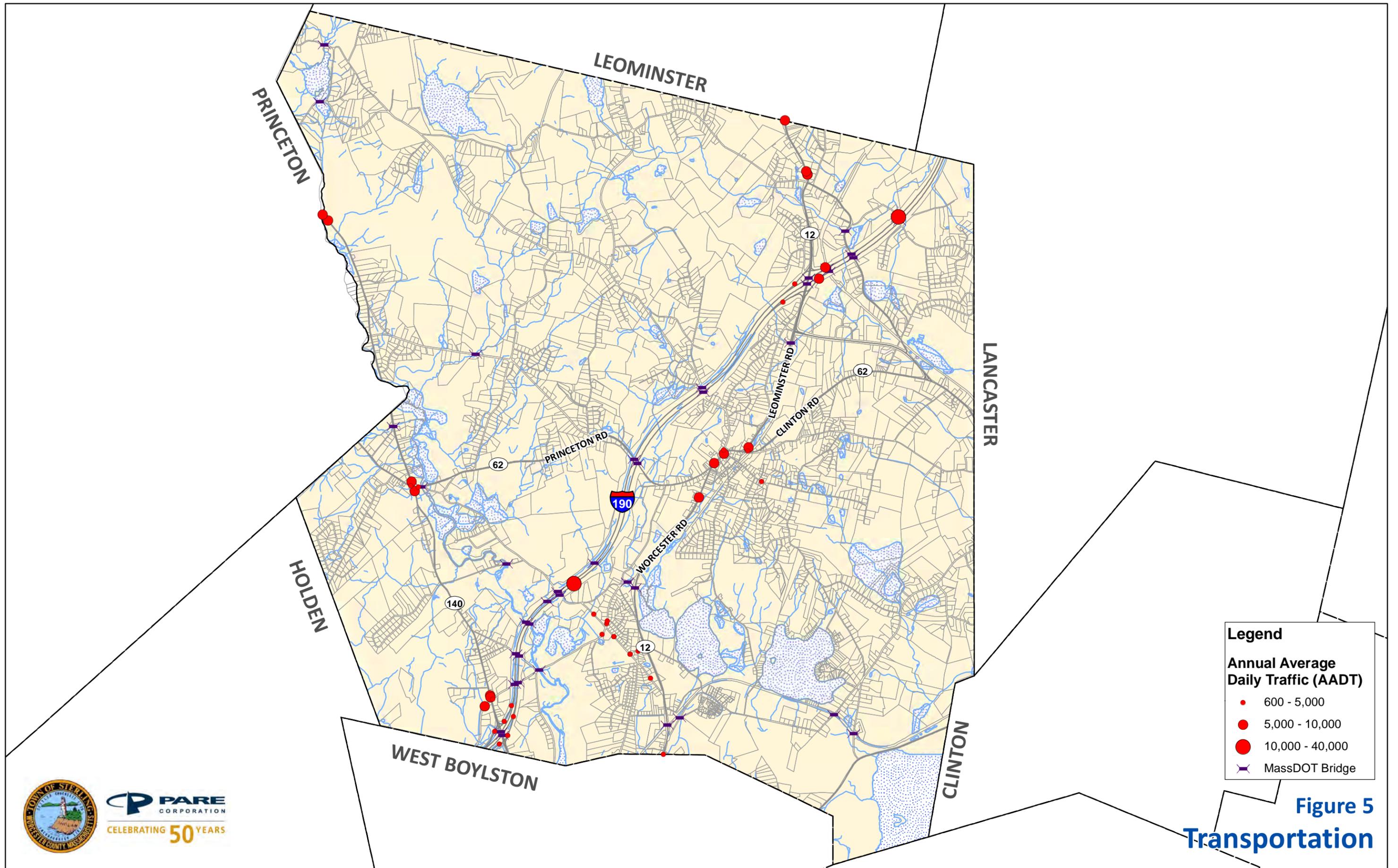
**Figure 1**  
**Facilities & Landmarks**



**Legend**

	Deciduous Forest - 31%
	Evergreen Forest - 22%
	Forested Wetland - 9%
	Developed Open Space - 8%
	Pasture/Hay - 6%
	Water - 4%
	Grassland - 4%
	Scrub/Shrub - 3%
	Non-forested Wetland - 3%
	Right-of-way - 2%
	Cultivated - 2%
	Residential - Single Family - 2%
	Bare Land - <1%
	Industrial - <1%
	Other Impervious - <1%
	Commercial - <1%
	Aquatic Bed - <1%
	Residential - Other - <1%
	Residential - Multi-Family - <1%
	Mixed Use - Other - <1%

**Figure 4**  
**Land Use & Development**  
**2016**



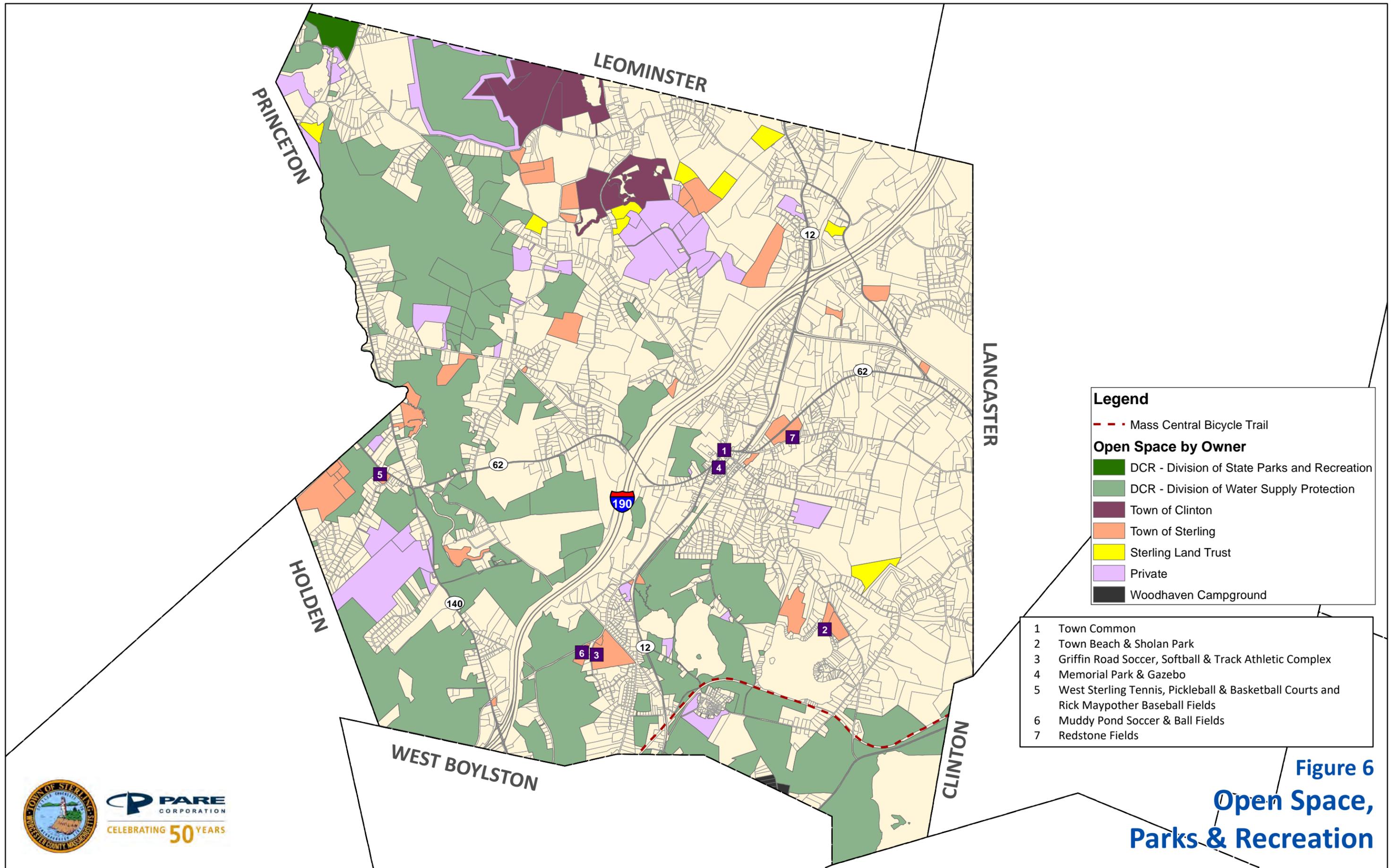
**Legend**

**Annual Average Daily Traffic (AADT)**

- 600 - 5,000
- 5,000 - 10,000
- 10,000 - 40,000
- ✕ MassDOT Bridge

**Figure 5**  
**Transportation**

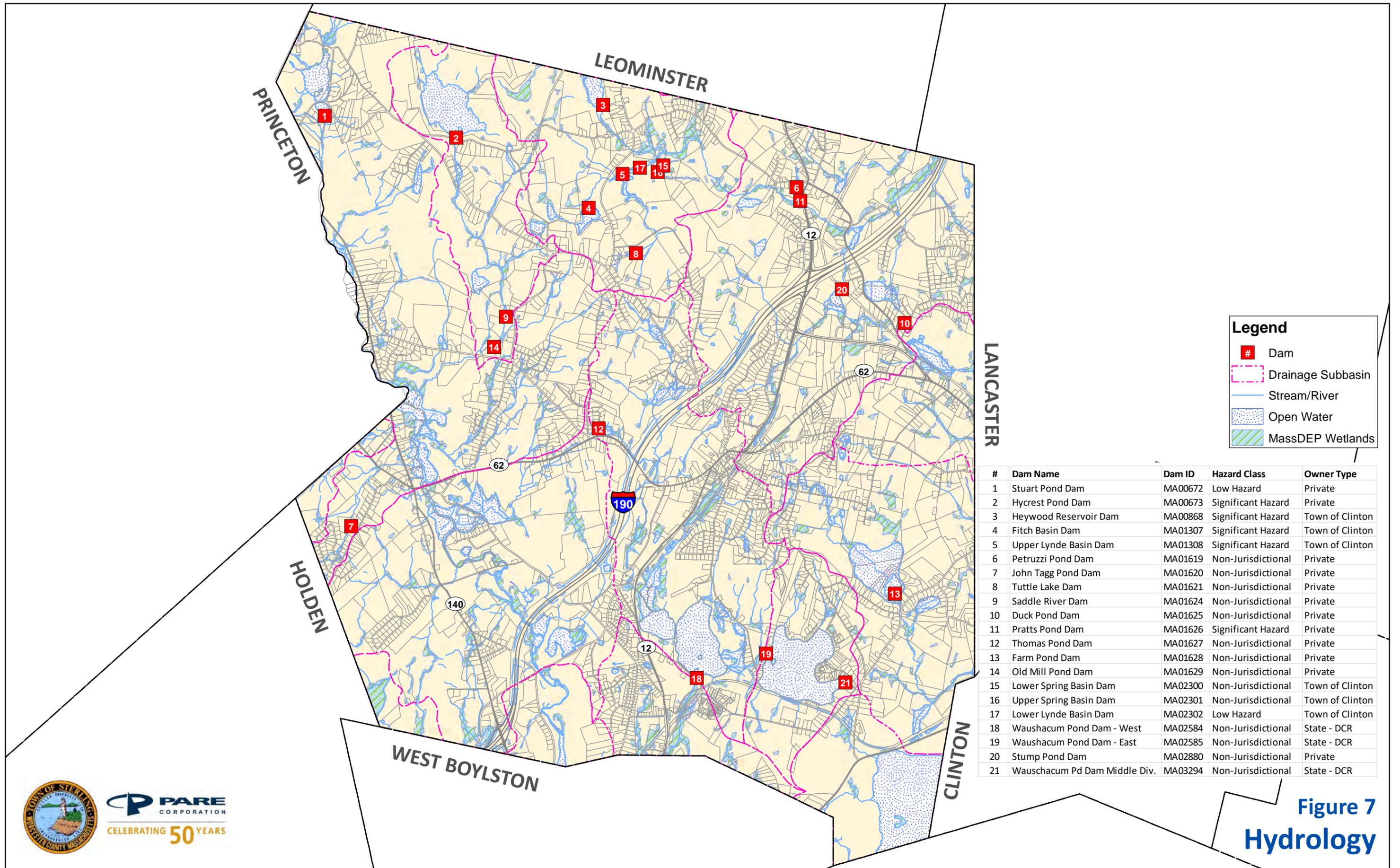




**Figure 6**  
**Open Space,**  
**Parks & Recreation**



**PARE**  
 CORPORATION  
 CELEBRATING 50 YEARS



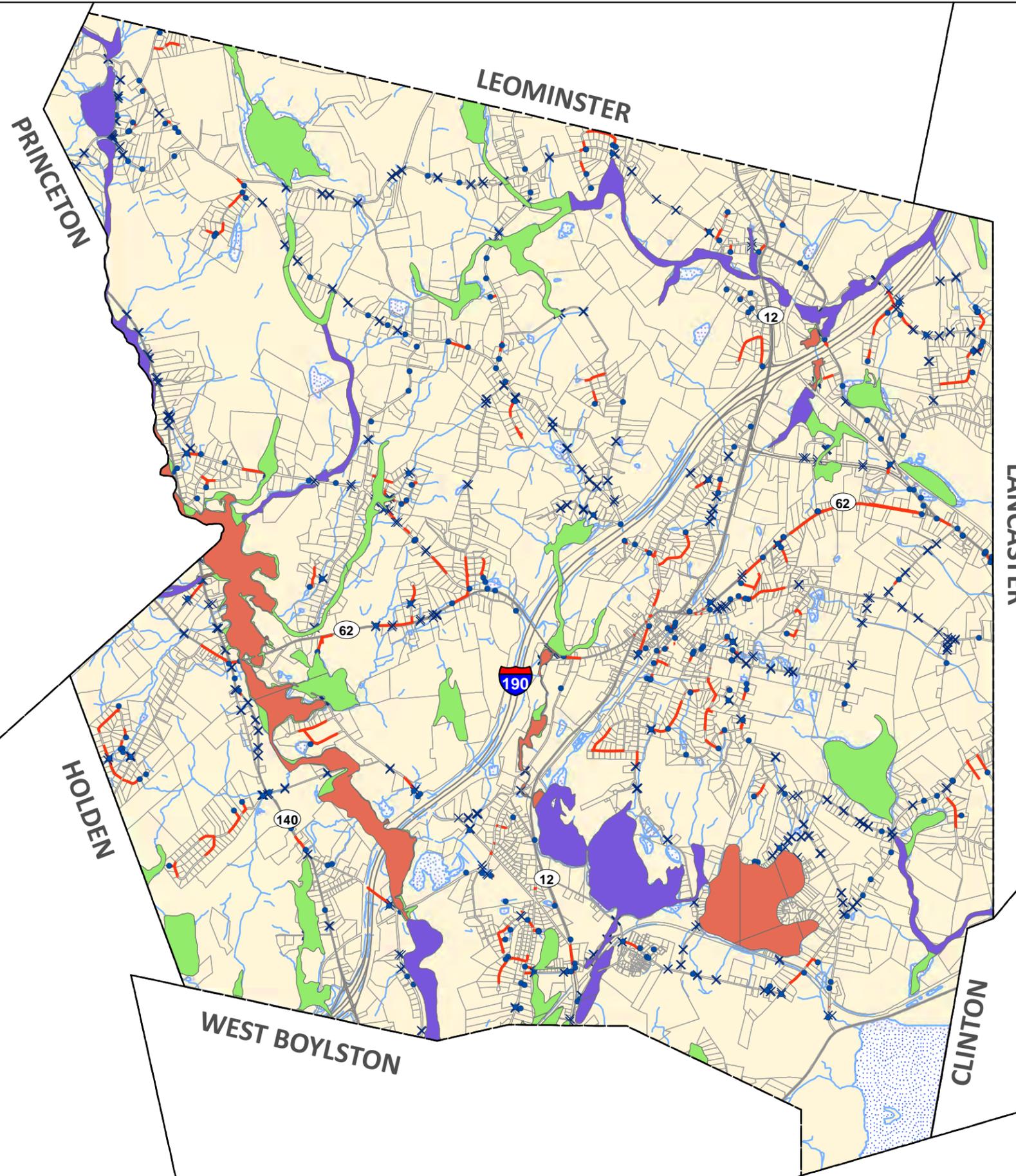
**Legend**

- # Dam
- Drainage Subbasin
- Stream/River
- Open Water
- MassDEP Wetlands

#	Dam Name	Dam ID	Hazard Class	Owner Type
1	Stuart Pond Dam	MA00672	Low Hazard	Private
2	Hycrest Pond Dam	MA00673	Significant Hazard	Private
3	Heywood Reservoir Dam	MA00868	Significant Hazard	Town of Clinton
4	Fitch Basin Dam	MA01307	Significant Hazard	Town of Clinton
5	Upper Lynde Basin Dam	MA01308	Significant Hazard	Town of Clinton
6	Petruzzi Pond Dam	MA01619	Non-Jurisdictional	Private
7	John Tagg Pond Dam	MA01620	Non-Jurisdictional	Private
8	Tuttle Lake Dam	MA01621	Non-Jurisdictional	Private
9	Saddle River Dam	MA01624	Non-Jurisdictional	Private
10	Duck Pond Dam	MA01625	Non-Jurisdictional	Private
11	Pratts Pond Dam	MA01626	Significant Hazard	Private
12	Thomas Pond Dam	MA01627	Non-Jurisdictional	Private
13	Farm Pond Dam	MA01628	Non-Jurisdictional	Private
14	Old Mill Pond Dam	MA01629	Non-Jurisdictional	Private
15	Lower Spring Basin Dam	MA02300	Non-Jurisdictional	Town of Clinton
16	Upper Spring Basin Dam	MA02301	Non-Jurisdictional	Town of Clinton
17	Lower Lynde Basin Dam	MA02302	Low Hazard	Town of Clinton
18	Wauschacum Pond Dam - West	MA02584	Non-Jurisdictional	State - DCR
19	Wauschacum Pond Dam - East	MA02585	Non-Jurisdictional	State - DCR
20	Stump Pond Dam	MA02880	Non-Jurisdictional	Private
21	Wauschacum Pd Dam Middle Div.	MA03294	Non-Jurisdictional	State - DCR



**Figure 7**  
**Hydrology**

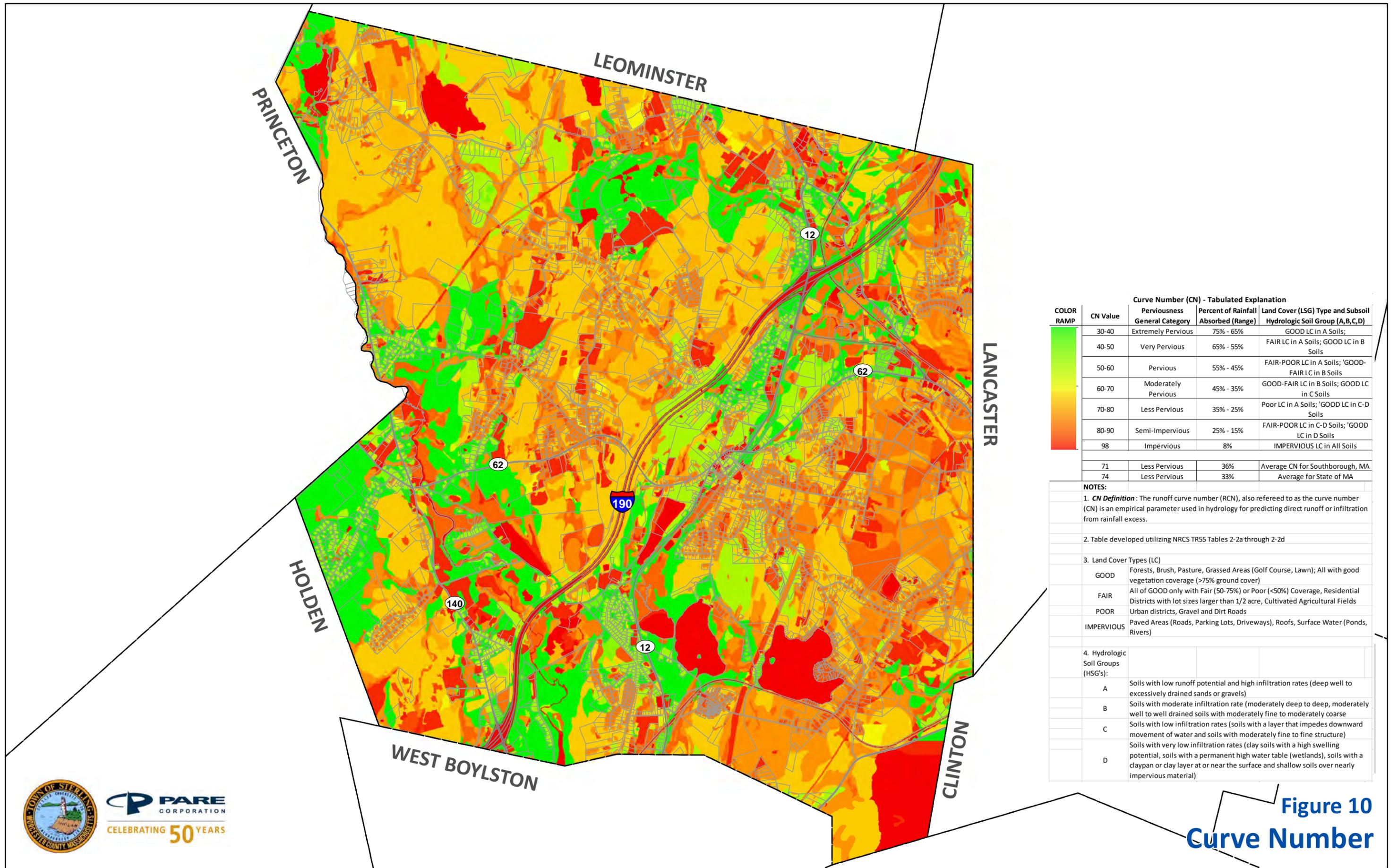


**Legend**

**FEMA Flood Zone**

- A
- AE
- X500
- Inlet/Outfall
- x Culvert
- Drain Pipe

**Figure 8**  
**Stormwater and Flooding**



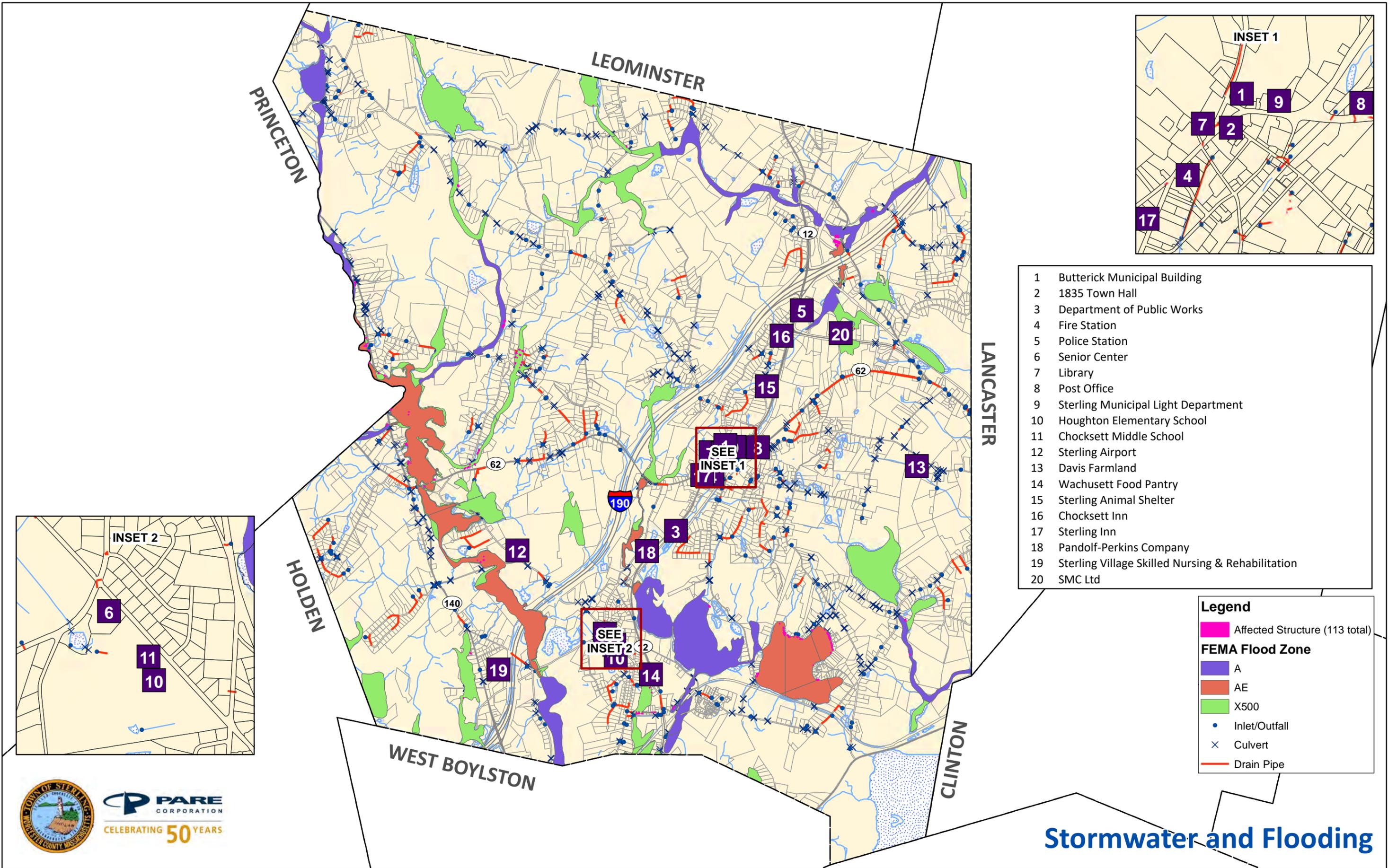
COLOR RAMP	Curve Number (CN) - Tabulated Explanation			
	CN Value	Perviousness General Category	Percent of Rainfall Absorbed (Range)	Land Cover (LSG) Type and Subsoil Hydrologic Soil Group (A,B,C,D)
[Color Ramp: Green to Red]	30-40	Extremely Pervious	75% - 65%	GOOD LC in A Soils;
	40-50	Very Pervious	65% - 55%	FAIR LC in A Soils; GOOD LC in B Soils
	50-60	Pervious	55% - 45%	FAIR-POOR LC in A Soils; 'GOOD-FAIR LC in B Soils
	60-70	Moderately Pervious	45% - 35%	GOOD-FAIR LC in B Soils; GOOD LC in C Soils
	70-80	Less Pervious	35% - 25%	Poor LC in A Soils; 'GOOD LC in C-D Soils
	80-90	Semi-impervious	25% - 15%	FAIR-POOR LC in C-D Soils; 'GOOD LC in D Soils
	98	Impervious	8%	IMPERVIOUS LC in All Soils
	71	Less Pervious	36%	Average CN for Southborough, MA
	74	Less Pervious	33%	Average for State of MA

**NOTES:**

- CN Definition:** The runoff curve number (RCN), also referred to as the curve number (CN) is an empirical parameter used in hydrology for predicting direct runoff or infiltration from rainfall excess.
- Table developed utilizing NRCS TR55 Tables 2-2a through 2-2d
- Land Cover Types (LC)**
  - GOOD** Forests, Brush, Pasture, Grassed Areas (Golf Course, Lawn); All with good vegetation coverage (>75% ground cover)
  - FAIR** All of GOOD only with Fair (50-75%) or Poor (<50%) Coverage, Residential Districts with lot sizes larger than 1/2 acre, Cultivated Agricultural Fields
  - POOR** Urban districts, Gravel and Dirt Roads
  - IMPERVIOUS** Paved Areas (Roads, Parking Lots, Driveways), Roofs, Surface Water (Ponds, Rivers)
- Hydrologic Soil Groups (HSG's):**
  - A** Soils with low runoff potential and high infiltration rates (deep well to excessively drained sands or gravels)
  - B** Soils with moderate infiltration rate (moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse)
  - C** Soils with low infiltration rates (soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure)
  - D** Soils with very low infiltration rates (clay soils with a high swelling potential, soils with a permanent high water table (wetlands), soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material)



**Figure 10**  
**Curve Number**



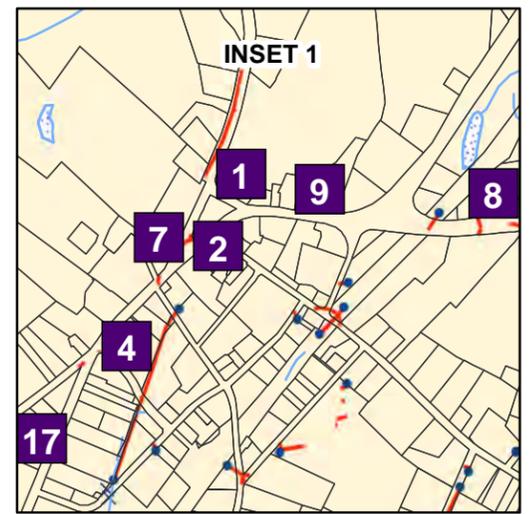
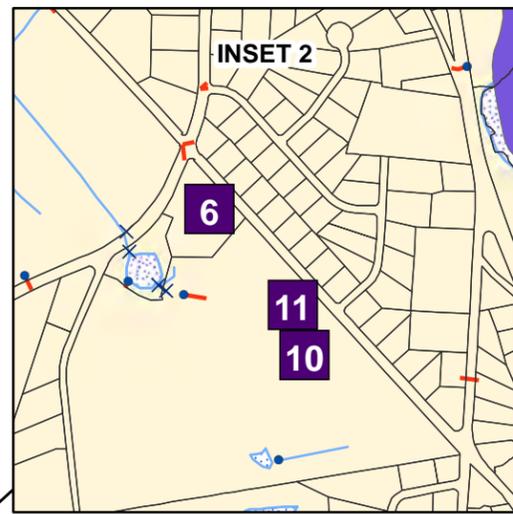
- 1 Butterick Municipal Building
- 2 1835 Town Hall
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- 15 Sterling Animal Shelter
- 16 Chocksett Inn
- 17 Sterling Inn
- 18 Pandolf-Perkins Company
- 19 Sterling Village Skilled Nursing & Rehabilitation
- 20 SMC Ltd

**Legend**

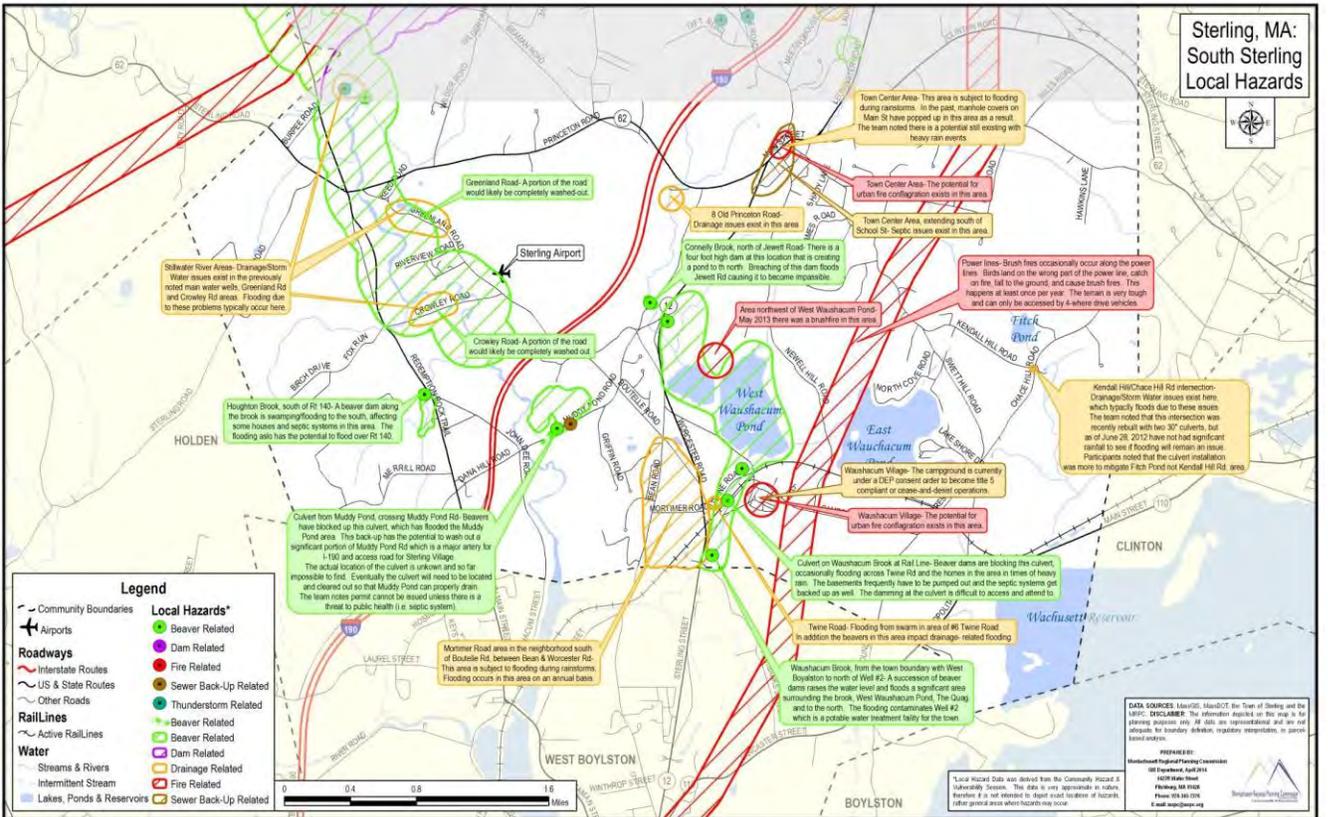
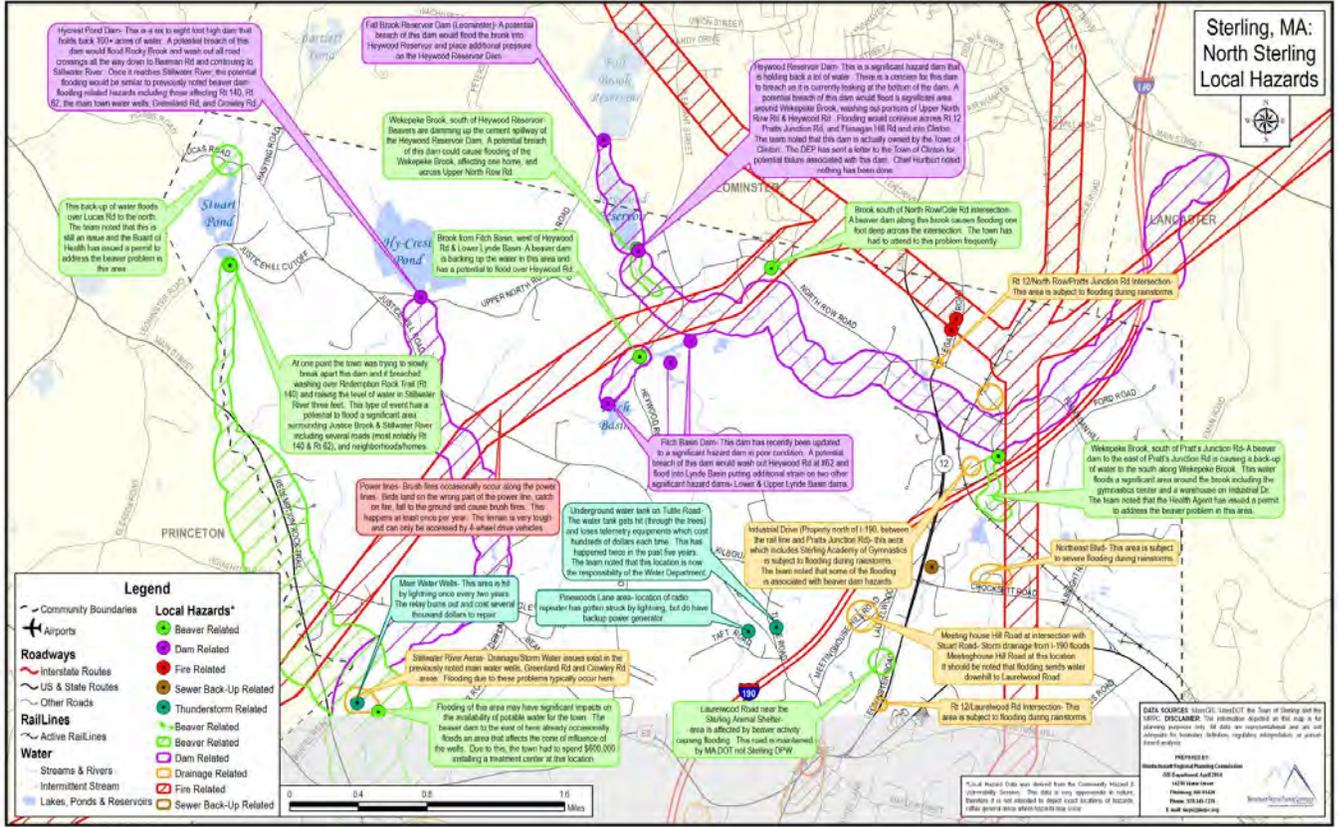
- Affected Structure (113 total)

**FEMA Flood Zone**

- A
- AE
- X500
- Inlet/Outfall
- Culvert
- Drain Pipe



# Stormwater and Flooding



**APPENDIX B**

**DOCUMENTATION OF PLAN ADOPTION**



# Town of Sterling

Butterick Building  
1 Park Street  
Sterling, MA 01564

WHEREAS, the Town of Sterling established a Committee to prepare the Town of Sterling Hazard Mitigation Plan 2021; and

WHEREAS, the Town of Sterling Hazard Mitigation Plan 2021 contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Sterling, and

WHEREAS, duly-noticed public meetings were held by the Town of Sterling on September 30th, 2020 and March 30, 2021 and

WHEREAS, the Town of Sterling authorizes responsible departments and/or agencies to execute their responsibilities demonstrated in the plan, and

NOW, THEREFORE BE IT RESOLVED that the Town of Sterling adopts the Town of Sterling's Hazard Mitigation Plan 2021 Update, in accordance with M.G.L. 40 §4 or the charter and bylaws of the Town of Sterling.

ADOPTED AND SIGNED this Date \_\_\_\_\_

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## **APPENDIX C**

MVP SUMMARY OF FINDINGS



**Municipal Vulnerability Preparedness:  
*Community Resilience Building  
Workshop Summary of Findings***

September 2020  
Town of Sterling, MA



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Appendix B: Workshop Agenda

Appendix C: Sterling Map Package

Appendix D: Group Matrices from Workshops

Appendix E: Top Priority Actions Discussion from Workshop



## OVERVIEW

The Town of Sterling has taken an important first step toward building societal, environmental, and infrastructure resilience within their community by participating in the Municipal Vulnerability Preparedness (MVP) program executed through the Executive Office of Energy and Environmental Affairs (EEA). An MVP Planning Grant was awarded to the Town from the EEA, allowing Sterling to complete the planning steps required to earn designation as an “MVP Community” and begin the process of updating their Local Hazard Mitigation Plan (LHMP). This approach to municipal resilience and climate adaptation planning will allow Sterling to undertake a comprehensive planning process that employs local knowledge to identify natural and weather-related hazards, recognize the community’s strengths and vulnerabilities, and prioritize actions to help mitigate damages and prepare them for the future. This successful MVP Planning effort results in a list of clear actions that Sterling can incorporate into the Town’s Master Plan, the LHMP and work toward implementing to improve community resilience, thus reducing disaster recovery time and cost for the Town, the region, and the Commonwealth.

Domenica Tatasciore, the MVP Project Manager and Town Planner for Sterling, initiated the MVP planning process by assembling a Core Team to help lead the effort within the community. The Core Team met in February 2020 and in July 2020 to outline the primary goals and objectives for the MVP process, discuss integration with the LHMP and Town planning efforts, and plan for the right workshop format. The original workshop format was planned to be a full-day in person workshop on April 2, 2020. The in-person workshop was postponed due to COVID-19 restrictions on in person gatherings. Throughout the spring of 2020 discussion among the Core Team and the Regional MVP coordinator led to the decision to host the workshop in a virtual format. With the assistance of Pare Corporation, a certified MVP Provider, the Town prepared for the workshop by developing a list of attendees, compiling community background resources and mapping data, and setting an agenda that meets the goals of the program.

### *STERLING CORE TEAM*

- Domenica Tatasciore, Town Planner
- Ross Perry, Town Administrator,
- Chief David Hurlbut, EMA Director and Fire Chief,
- Lieutenant Thomas Kokernak, Fire Prevention Officer
- Paul Lyons, DPW Superintendent
- Sean Hamilton, General Manager of the Sterling Municipal Light Dept
- Susan Aldrich, Sustainability Advocate and Community Member
- Veronica Buckley, Senior Center Director



A two-part virtual Community Resilience Building (CRB) Workshop was held on September 10, 2020 and September 17, 2020 from 9:00am-12:00pm via Zoom. A total of 26 community stakeholders in addition to the core team participated in the CRB Workshop (see full list of Attendees at the end of this document), divided into five breakout groups. Pare Corporation with assistance from Linnean Solutions provided one facilitator and one scribe for each group, which were also supplied with PDF reference map package (see Attachments). After an introductory presentation by the Lead Facilitator and the Town Administrator, the breakout groups dove into the main portion of the workshop.

The workshop followed the CRB framework, guiding each of the breakout groups through the following steps in the planning process:

- Identify past, current, and future impacts from natural hazards (*session #1*)
- Determine the highest-priority hazards (*session #1*)
- Identify the **infrastructural** vulnerabilities and strengths (*session #1*)
- Identify **societal** vulnerabilities and strengths (*session #1*)
- Identify **environmental** vulnerabilities and strengths (*session #1*)
- Identify and prioritize infrastructural actions (*session #2*)
- Identify and prioritize societal actions (*session #2*)
- Identify and prioritize environmental actions (*session #2*)
- Identify highest-priority actions for Sterling (*session #2*)

A Summary of Findings for the workshop is transcribed in the following pages, and outlines the thoughts, comments, and dialogue of the stakeholders that participated in the workshop. These findings were presented to the Town for public comment. A primary goal of the workshop was to identify the “Top Recommendations to Increase Resilience” in Sterling – a comprehensive list of these recommendations can be found in the following sections. At the conclusion of the CRB Workshop, the top four priorities for increasing community resilience were identified by workshop participants:

- I. Water Supply System and Groundwater Quality
- II. Roadway Improvements and Stormwater Management
- III. Development Planning
- IV. Emergency Services



The MVP process will allow the Town of Sterling to identify actions that can help address each of these priorities and incorporate them into the Town’s long-term planning. This document outlines the process by which these priorities were identified, and which actions can be taken by the Town. The findings of the MVP workshop are anticipated to be integrated into the LHMP, creating a comprehensive planning document to guide the hazard mitigation and climate adaptation planning efforts within the Town of Sterling.





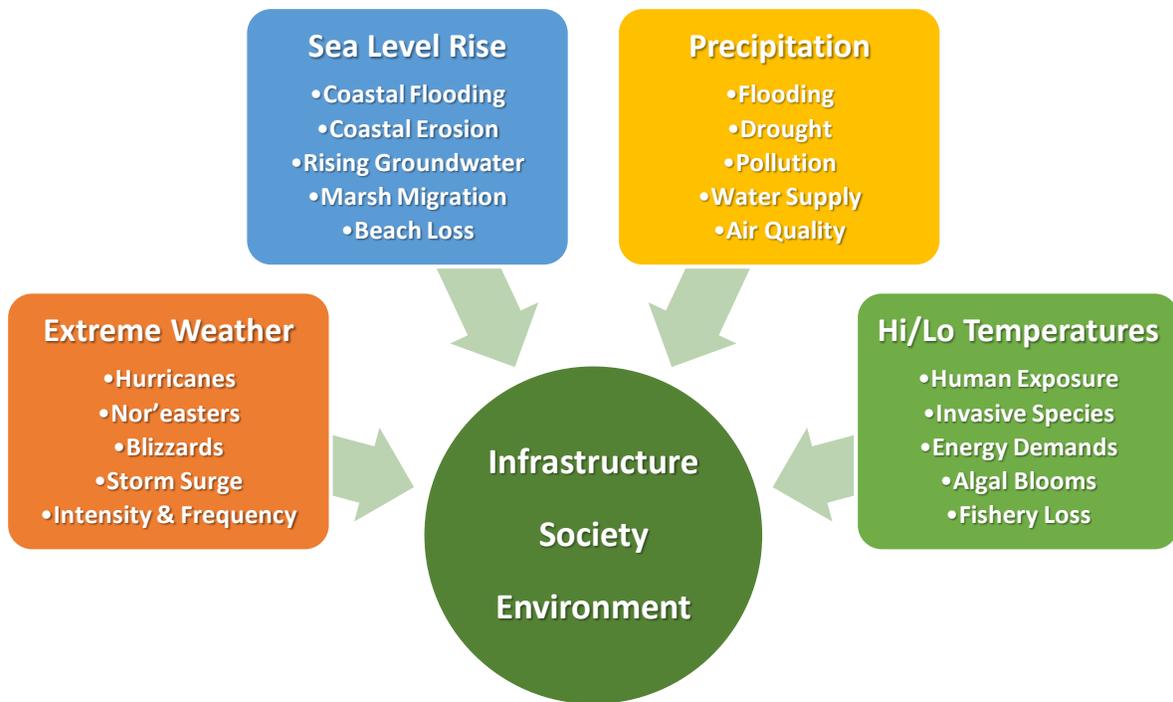


FIGURE 2 CLIMATE CHANGE HAZARDS IN MASSACHUSETTS

- **Extreme Weather Events:** Extreme weather events have the potential to interrupt the functioning of critical infrastructure including transportation networks, communication, and utilities. The frequency and intensity of extreme weather events is projected to keep increasing across New England.
- **Loss of Biodiversity and Agriculture:** Temperature increases projected over time have the potential to change the growing seasons and types of wildlife and crops that are able to persist in Massachusetts. The number of days with temperatures above 90°F is projected to increase by 6 to 22 days by 2050. Diseases within the flora and fauna can threaten biodiversity and disrupt agriculture and natural resources.
- **High Intensity Rainfall:** Increased precipitation has the potential to exacerbate Sterling’s issues with flooding as a result of infrastructure capacity. The number of days with over 1” of precipitation is projected to increase by 8-10 days by 2050.
- **Drought (Lowering of the Water Table):** Drought conditions present an increased risk of wildfires, threaten biodiversity, impact town wells (Water supply), impact the local agricultural economy, and put vulnerable populations at risk of exposure.

## TOP VULNERABILITIES AND AREAS OF CONCERN

During the CRB workshop, each group discussed vulnerabilities in each of the categories being addressed: infrastructure, society, and environment. Although there were vulnerabilities and strengths identified in each category by each group, there were three primary areas of concern that became evident during the discussion of the past impacts from natural hazards. These areas of concern, as identified by all workshop participants, are:

- **Wells and Water System:** The Town of Sterling's Water system consist of 4 wells, 2 water towers, and 68 miles of water main throughout Town. Approximately 80% of Town is serviced by the public water system and 20% of town is serviced through private wells. Every year, water capacity and quality in Town is a concern. Furthermore, as development in town expands, the permitted withdrawal rate through MassDEP is only projected to grow by 5% over time. The capacity, quality, and age of the infrastructure is a vulnerability for residents, especially for the fire protection system.
- **Roadways, Culverts and Stormwater Management:** The roadways throughout Town are in degraded condition primarily as a result of drainage concerns. Culverts and drainage network throughout Town are inadequate and lack the capacity to convey stormwater resulting in flooding during rain events and erosion leading to degradation of roadway quality. Particular areas of concern are Kendall Hill Road, Chace Hill Road, Swett Hill Road, and the Town Beach. Storm events can leave local roads impassable and not only washes out portions of the road itself, but the runoff contributes to washouts downstream at the Town Beach.
- **Land Use:** The various land uses currently existing in the Town of Sterling are an asset that is currently at risk. The Farming Land and farming community is vulnerable to economic and environmental pressure to convert land away from agricultural uses. The open space and forested land are currently owned primarily by DCR and provide ecological value and community character. Preservation of the agricultural land and open space is currently in conflict with the Town's interest in encouraging and enabling residential and industrial growth. Proper planning can set the Town of Sterling up for success to preserve land uses important to the town and efficiently enable growth.



15. In your opinion, which of the following categories are most susceptible to natural hazards in your community? (Please rank the community assets in order of vulnerability, 1 being most vulnerable and 6 being least vulnerable.)

[More Details](#)

1 2 3 4 5 6

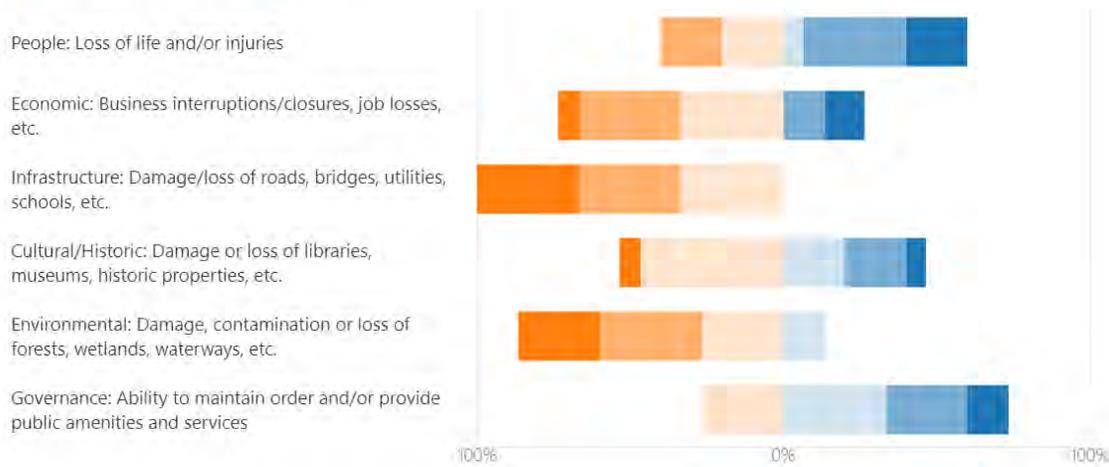


FIGURE 3: RESULTS OF THE COMMUNITY CHARACTERIZATION SURVEY QUESTION 15.



## WORKSHOP RISK MATRICES

The risk matrices developed during the workshop have been transcribed and consolidated. The following tables include this compiled data, arranged by priority level:

### *Higher Priority*

Category	Action
Infrastructure	<p><b><u>Water Utilities</u></b></p> <ul style="list-style-type: none"> <li>• Implement an integrated water management plan to address vulnerabilities. (Create new well fields/update aged infrastructure/increase footprint)</li> <li>• Explore incentives for individual properties reusing grey water and stormwater</li> <li>• Build redundancy in water systems</li> <li>• Continue ongoing work to reduce salt use</li> <li>• Drill new municipal wells to bring them online (add to system for emergency and dry times)</li> <li>• Consider incentives or requirements for the use of private irrigation wells instead of connection to potable water supply</li> <li>• Encourage water conservation (water ban, conserving fixture, meeting requirements, efforts have been successful)</li> <li>• Partner with Department of Conservation and Recreation (DCR) on stormwater Best Management Practices (BMPs), identify how to take advantage of rain to recharge aquifer</li> <li>• Start discussions with Massachusetts Water Resources Authority (MWRA) about buying in.</li> </ul>
	<p><b><u>Roadway Network/ Traffic Signals/Traffic</u></b></p> <ul style="list-style-type: none"> <li>• Asset Management Plan on roadways</li> <li>• Integrate local evacuation routes into regional plan (evaluate additional signage)</li> <li>• Additional mobile variable message signs</li> <li>• Consider impact/betterment fees</li> <li>• Dedicate town funding to maintenance &amp; projects (match Ch90)</li> <li>• Plan for stormwater management strategically and identify funding for projects and maintenance</li> </ul>
	<p><b><u>Weather impact on routes in and out of town</u></b></p> <ul style="list-style-type: none"> <li>• Define forward-looking precipitation amounts for planning and design</li> </ul>



- Evaluate salt usage on winter roads
- Resize culverts and stormwater system along with green infrastructure

**Culverts – Capacity/structure concern**

- Inventory of size and condition/compare to current design requirements and storms (Hydrology & Hydraulics), determine impact from dams
- Culvert assessment/hydraulic analysis at specific locations
- Asset Management Plan on culverts
- Prioritize criteria (value provided by the culvert)
- Seek financial assistance/complete design
- Implementation
- Plan for stormwater management strategically and identify funding for projects and maintenance
- Consider impact/betterment fees
- Upkeep relationship with DCR (permissions, training, etc.)
- Improve conditions at the existing drainage outfall(s) at the center of town

**Power and Communication Systems**

- Place/relocate utilities underground (already underway in some locations)
- Tree maintenance - continue and improve and find funding (work with DPW & SMLD)
- Explore opportunities for higher quality internet service
- Evaluate plan for local broadband, communication system through SMLD (fiber optic to each town building already ongoing)

**Society**

**Shelters**

- Continue with annual emergency planning
- Upkeep for Code Red system and radio system
- Continue funding for upkeep of shelters
- Evaluate alternative shelter facilities
- Generator maintenance, establish approach for supplies (e.g., cots within the facility for various events)
- Senior Center/Community education from EMD regarding responses
- Develop Transportation plans to the shelters

**Evacuation Routes**

- Update/educate/mark route/publicize/ alternate route

**Sterling Village Nursing/Rehab**

- Assess capacity to assist the Town with special/higher need individuals - develop partnerships



	<p><b><u>Domestic Animal Sheltering</u></b></p> <ul style="list-style-type: none"> <li>• Establish animal friendly shelters and communicate this to the public</li> <li>• Educate public about "go kits" necessary for domestic animals</li> </ul>
<b>Environmental</b>	<p><b><u>Agriculture</u></b></p> <ul style="list-style-type: none"> <li>• Generate methods to help keep farms in a position of future success (for example, matching future farmers with farms that may be in need, or funding creation of exit/succession strategy)</li> <li>• Share resources and collaborate with other local Towns for Agricultural preservation and long term planning</li> </ul>
	<p><b><u>Residential &amp; Industrial Development &amp; addressing "Sprawl"</u></b></p> <ul style="list-style-type: none"> <li>• Review opportunities for "smart growth"</li> <li>• Develop OSRD and cluster zoning bylaws</li> <li>• Forward looking planning (20+ years) &amp; re-think zoning; promote certain kinds of development in certain locations (more attention to the northern edge of Rt. 12 and other areas)</li> </ul>
	<p><b><u>Stormwater Runoff</u></b></p> <ul style="list-style-type: none"> <li>• Address water quality, which is leading to turbidity, algae, and other problems</li> <li>• Bolster development permitting requirements with a focus on Low Impact Development and Green Infrastructure best management practices</li> <li>• Work with DCR to address watershed wide pollution concerns</li> <li>• Reduce salt use. Work to advance regional efforts in collaboration with DCR to address reduction of salt use</li> <li>• Pursue outfall drainage improvements</li> <li>• Increase homeowner education about stormwater runoff</li> </ul>

*Moderate Priority*

<b>Category</b>	<b>Action</b>
<b>Infrastructure</b>	<p><b><u>Electric Utilities (Town owned with vulnerable substations)</u></b></p> <ul style="list-style-type: none"> <li>• Revisit several streets with several old trees (forest management plan)</li> <li>• Review of substation locations to ensure they are not susceptible to flooding</li> <li>• Consider more battery backup</li> <li>• Assess/inventory/prioritize of current system</li> </ul>



	<ul style="list-style-type: none"> <li>• Encourage alternative power sources/preventive actions/demonstration projects</li> <li>• Conservation guidance from Town (education/promotion)</li> </ul> <p><b><u>Dams</u></b></p> <ul style="list-style-type: none"> <li>• Dams not in Town Ownership - Develop agreements to review reports as a major stakeholder</li> <li>• Work to fix the dams that are considered in serious condition</li> <li>• Carefully study impacts of dams and dam removal on water table elevations as it relates to water supply.</li> </ul> <p><b><u>I- 190</u></b></p> <ul style="list-style-type: none"> <li>• Partner with DCR and other Wachusett watershed towns on getting state DPW and others to consider alternative salting and other road maintenance systems</li> </ul> <p><b><u>Bridges maintenance and structures</u></b></p> <ul style="list-style-type: none"> <li>• Inventory: How many State owned/how old/when inspected/impact from dams</li> <li>• Develop prioritization/Sterling communicate with MassDOT regarding state bridge concerns</li> <li>• Secure financial assistance and engage in design</li> <li>• Implementation</li> </ul> <p><b><u>Town Beach</u></b></p> <ul style="list-style-type: none"> <li>• Study drainage improvement</li> <li>• Utilize \$1M bond for improvements (fix drainage &amp; improve on strengths); Improvements to building at the beach (old buildings can be updated)</li> </ul> <p><b><u>Wastewater Disposal</u></b></p> <ul style="list-style-type: none"> <li>• The town is reliant entirely on aging septic systems. The Town has previously completed a Feasibility Study that recommends installing sewers to serve Route 12 and possibly the industrial park. Consider advancing work towards implementing new sewer system.</li> </ul>
<p><b>Society</b></p>	<p><b><u>Faith based/community organizations/food bank</u></b></p> <ul style="list-style-type: none"> <li>• Provide a bigger seat at the table as a stakeholder in town-wide issues</li> <li>• Formalize/identify partnerships to assess capacity, services, and accessibility</li> <li>• Assess partnerships to establish financial assistance</li> <li>• Assess partnerships to establish continued food distribution during storm events</li> </ul>



**Recreation Facilities/Activities**

- Help the Recreation Department match the infrastructure to the projected program
- Match the recreation plan with the open space plan

**Volunteer participation in town governance**

- Work more with natural volunteer organizations in town (e.g. Friends of the Library)
- Be more clear about what a volunteer might do on a committee
- Refresh the culture of volunteerism in town

**MART District Transportation Services**

- Enhance services with public/private partnership
- Expand public transportation options, negotiate with Montachusett RTA

**Elderly Population (Sholan Terrace)**

- Plan for evacuation developed and implemented

**HMEA (adult daycare facility)**

- Education - make town residents aware of this facility (50+/- clients daily)
- Plan for evacuation to be developed and implemented
- Increase cooperation of the Town with the Facility owners

**Farming Community**

- Consider revisions to zoning, policy, or bylaws to reduce the pressure of development (e.g. change parcel size requirements)
- Support farmers market and farm stands - continue to promote use of local products

**Environmental**

**Conservation Land – Open Space**

- Generate accurate inventory of existing properties (prepare acquisition/protection plan for future green spaces)
- Explore opportunities for Community Preservation Act
- Provide tools for access to quicker funding in case properties become available

**Contamination**

- Updated contingency plan to account for potentials of contamination
- Explore salt reduction techniques on roads
- Explore chemical use reduction in orchards
- Training/education materials outlining contamination impacts on the community

**Flooding**

- Join mosquito control efforts at the State level
- Work across agencies to identify and implement solutions



<ul style="list-style-type: none"> <li>Consider forming an Environmental Advisory Committee (with potential purview in conjunction with Conservation Commission and Department of Public Works Board)</li> </ul>
<p><b><u>Chemical/Fertilizer runoff from residential land and agriculture</u></b></p> <ul style="list-style-type: none"> <li>Educate community on proper practices for fertilizers and gardening practices</li> <li>Restrict pesticides</li> </ul>
<p><b><u>Wildlife</u></b></p> <ul style="list-style-type: none"> <li>Development management &amp; restrictions on development considering wildlife corridors</li> </ul>

*Lower Priority*

Category	Action
<b>Infrastructure</b>	<p><b><u>Medical Facilities/Emergency Management/Shelters</u></b></p> <ul style="list-style-type: none"> <li>Explore backup generators at sheltering locations</li> </ul>
	<p><b><u>Airport/Sterling Fair/Town Mtg Location</u></b></p> <ul style="list-style-type: none"> <li>Determine how protect the wide open field</li> <li>Improve snow removal</li> </ul>
<b>Society</b>	<p><b><u>Code Red System/Alert System</u></b></p> <ul style="list-style-type: none"> <li>Explore backup system in case of power outages/phone outages</li> <li>Advertise/marketing for people to sign up and to receive information</li> <li>Define an emergency contact protocol for town-wide communications</li> <li>Town website updates potentially needed</li> </ul>
	<p><b><u>Vulnerable Populations</u></b></p> <ul style="list-style-type: none"> <li>Explore consolidated mental health/public health plan for the community</li> </ul>
	<p><b><u>“Isolated Neighborhoods” (outside of hydrant district)</u></b></p> <ul style="list-style-type: none"> <li>Explore ways to reduce response times to these areas for first responders</li> </ul>
<b>Environmental</b>	<p><b><u>Soil Erosion/Crop Damage</u></b></p> <ul style="list-style-type: none"> <li>Collaborate with Farmers to develop educational resources about farming techniques inclusive of plowing and irrigation</li> </ul>
	<p><b><u>Trees/Biodiversity/Habitat</u></b></p> <ul style="list-style-type: none"> <li>Maintenance of both open space and woodland space to provide diverse habitats</li> <li>Develop open space, residential, cluster bylaw</li> </ul>



- Uphold cooperation with Land Trusts and DCR who currently manage and plan forest land to prevent biodiversity loss
- Consider managed replanting
- Consider a forest management plan

**Orchards/Farms**

- Collaborate with Farmers to develop educational resources about farming techniques inclusive of crop selection, pesticides etc.

**Fire access to forested areas**

- Establish right-of-ways/agreements for fire access (discontinued or abandoned roads)
- Currently have 4 fire vehicles for woods - maintain this fleet
- Continue to monitor fire towers
- Increase public education

**Surface Water (Wachusett Reservoir)**

- Work with managers of Wachusett Reservoir as needed



## TOP RECOMMENDATIONS TO INCREASE RESILIENCE:

The last portion of the CRB workshop engaged all stakeholders in a discussion of the actions and priorities identified by each of the five break out groups. Each of the groups identified three actions as their highest-priority actions to increase community resilience in Sterling. The actions as they were being reported by each group representative were recorded on a virtual note board. As part of the overall discussion, the actions listed by each group were sorted into four categories and color coded to aid in the identification of themes. The actions presented by each group varied in breadth and scope but seemed to fall within four major categories: Water Supply System and Groundwater Quality, Roadway Improvements and Stormwater Management, Emergency Services, and Development Planning. Top recommendations to increase resilience have been identified by workshop participants and are presented in the following categories:

### *I. Water Supply System and Groundwater Quality:*

Wrap-up discussions among all five workshop breakout groups identified the following actions as top priorities under this category:

- Inventory and assess the existing infrastructure components and identify and prioritize improvements.
- Increase redundancy of the water system by investigating and establishing additional wells and exploring opportunities to work with MWRA.
- Engage in cross agency planning and implementation of Low Impact Development and Green Infrastructure as a way to use stormwater to recharge groundwater and protect groundwater quality.
- Identify and implement ways to reduce town wide water use over time such as required water efficient design, removal of irrigation systems from town water, and encouraging greywater and stormwater reuse.

### *II. Roadway Improvements and Stormwater Management:*

Concerns surrounding roadway conditions and stormwater management also ranked as a top priority, and included several actions to help improve resilience:



- Implement local regulation changes requiring updated rainfall standards to be used for the hydraulic design of stream crossings and other stormwater related infrastructure, so that climate change is adequately captured in the design conditions.
- Work with MassDOT and DCR to address water quality from I-190.
- Study and implement resizing of culverts and stormwater system.
- Consider a wholistic approach for design, implementing, and maintaining Green Infrastructure Stormwater systems throughout Town. Particularly funding and programs for maintenance will need to be identified.
- Consider the use of impact/betterment fees for new development to support public infrastructure funding.
- Develop an Asset Management Plan for Roadways, Culverts, and Stormwater Infrastructure.
- Execute projects to address roadway drainage issues and downstream washout at critical areas including Swett Hill Road and the Town Beach.

### *III. Development Planning:*

Protecting Agricultural Land and forested open space through development planning emerged as the third highest priority category for potential actions. Actions in this category relate to supporting the farming community, protecting the natural resources of the Town, while also encouraging responsible development. In this category, the following actions emerged as priorities:

- Establish an Environmental Advisory Committee in Town to consider environmental impacts of land use and development decisions in Town.
- Review opportunities for "smart growth." Consider updating land use planning and zoning to plan for future development including growth of uses including residential, industrial, etc. Work to address sprawl control to help densify, encourage affordable housing, preserve open space.
- Work to disincentivize the loss of farms. Encourage water saving farming techniques, work to alleviate the pressure of development, and foster continuity of farming across generations.

### *IV. Emergency Services:*

Concerns surrounding emergency response and providing security in the event of acute events within Sterling also ranked as a top priority, and included several actions to help bolster the existing Emergency



Response efforts for the future. Specific discussion and consideration was given to the fact that Sterling has an aging population that needs to be considered and accommodated in cases of emergency and otherwise:

- Increase upkeep and awareness around the existing evacuation routes, shelters, and emergency plans that are already in place.
  - Consider developing a central repository for Town information and a marketing plan for Municipal and Townwide dissemination.
- Address financial burden of extreme weather events by mitigating impacts and funding recovery.
- Establish animal friendly shelters and communicate this to the public, educate public about "go kits" necessary for domestic animals.
- Identify and engage vulnerable populations (e.g. Sholan Terrace population and HMEA Adult Daycare Facility) to improve access to essential emergency services during a major hazard event.
- Conduct a facilities inventory and assessment to assess sheltering capacity and identify potential improvements to expand capacity.



### *Core Team:*

- Domenica Tatasciore, Town Planner (and project manager)
- Ross Perry, Town Administrator
- Chief David Hurlbut, EMA Director and Fire Chief
- Lieutenant Thomas Kokernak, Fire Prevention Officer
- Paul Lyons, DPW Superintendent
- Sean Hamilton, Gen Manager – Sterling Municipal Light Department
- Susan Aldrich, Sustainability Advocate and Community Member
- Veronica Buckley, Senior Center Director

### *Facilitation Team:*



- Lindsey Machamer, PE – Lead Facilitator, Pare Corporation
- Matthew Bellisle, PE – Pare Corporation
- Lance Hill, PE – Pare Corporation
- Andrew Cummings – Pare Corporation
- Jim Newman – Linnean Solutions
- Amy Gerhard – Pare Corporation
- Nicole Capistran – Pare Corporation
- Brandon Barry – Pare Corporation
- Patricia Teeter – Pare Corporation
- Lydia Neitlich – Pare Corporation

### *Workshop Participants:*

- Sarah Culgin – Building Commissioner
- Arden Sonnenberg – Select Board
- Kimberly Archambault – Sterling Skilled Nursing
- Cathie Ryan – Resident
- Neal Davidson – Hope Chapel
- Peder Pedersen – OSIC
- Bob Kimball – Resident
- Janet Segur – Sterling Grange
- Gerson Cintron - North Central Mass Housing Authority - Director of Facilities
- Jim Emerton – Fire/EMT
- Linda Woodland – School Committee
- Lou Massa – Animal Control
- Phil Holman – First Church
- Pat Campebell – Library Director
- Matt Marro – Conservation Agent
- Kelley Freda – DCR
- Pete Monchamp – Resident
- John Kilcoyne – Resident
- Weymouth Whitney – SHA & Resident
- Dick Maki – Resident
- Joyce Hinkley – Resident
- Erik Ares – Fire/EMT
- Kristen Dietel – Recreation Director
- Everett Heller – Finance Committee
- Lacy Gillotti – NEADS, Inc.
- Bob Dumont – MPC



## *Acknowledgements:*

The Sterling MVP Workshop has been funded in part by the Massachusetts Executive Office of Energy and Environmental Affairs through an MVP Planning Grant, awarded to the Town of Sterling during the fiscal year of July 2019 through June 2020 with an extension through June 2021.

The Town of Sterling contracted with Pare Corporation to assist in planning and conducting the CRB workshop in Originally planned for April 2020 and rescheduled to be September 2020. Pare Corporation and Linnean Solutions partnered to provide MVP-certified staff to facilitate the workshop and prepare this Summary of Findings.

## *Integration with the Local Hazard Mitigation Plan:*

A Local Hazard Mitigation Plan was approved for the Town of Sterling in 2016 and requires an update. This Community Resilience Building process will be utilized as a first step in updating the Local Hazard Mitigation Plan. The hazard assessment and mitigation goals of the 2016 plan will be updated to reflect mitigation actions taken to date. In addition, the findings outlined in this report will be incorporated into the Updated Local Hazard Mitigation Plan, so that resilience and climate adaptation are reflected in the Town's mitigation goals and implementation plan.

## *Suggested Citation:*

Town of Sterling. 2020. Sterling Municipal Vulnerability Preparedness Workshop Summary of Findings. Prepared by Pare Corporation, Foxborough, MA.

## *Appendices*

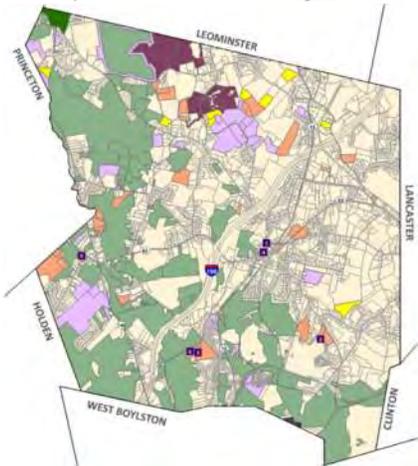
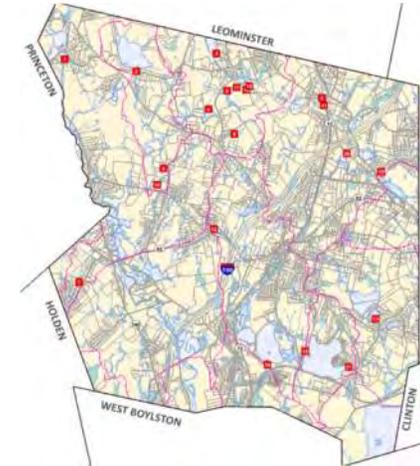
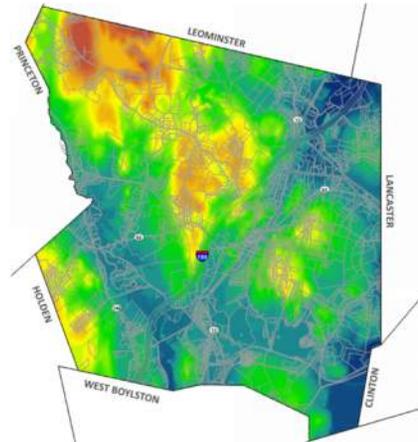
- Workshop Introductory Slide Show
- Workshop Agenda
- Reference Maps
- Base Maps
- Workshop Group Matrices
- Survey Results
- Prioritized Actions



## Appendix A: Workshop Presentation

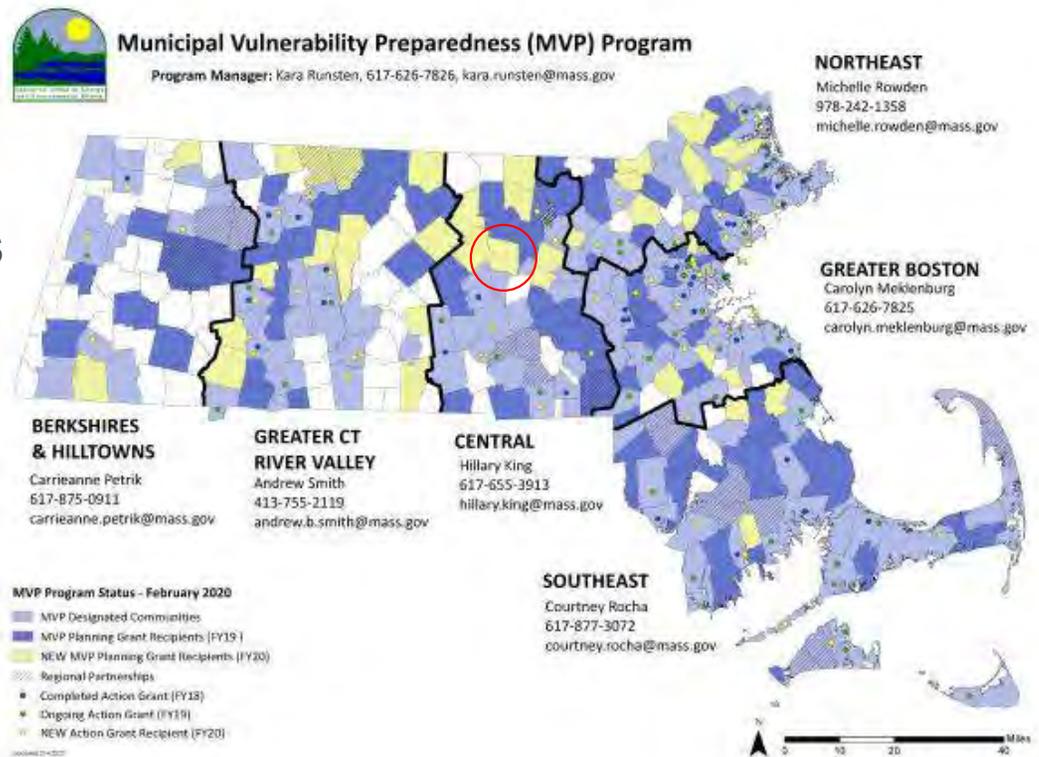
# TOWN OF STERLING, MA

## *Municipal Vulnerability Preparedness*



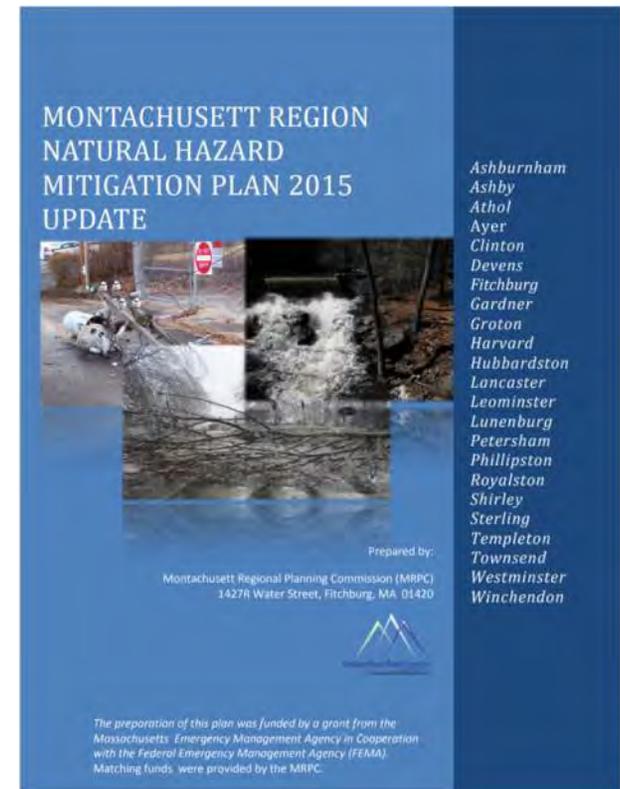
# What is the MVP Program?

- › **Community** led process
- › Reinforces **Town partnerships**
- › Informs **statewide** efforts
- › Additional **funding** opportunities
- › Designated “**MVP Community**”
- › **Leverages existing efforts**
- › Integrates MVP with **Hazard Mitigation Plan**



# MVP Planning Outcomes

- › MVP Summary of Findings / **Resilience Plan**
- › Public **Listening Sessions**
- › Prioritized **implementation plan**
- › **MVP Action Grant candidate projects**
- › Updates every five years
- › Community **accountability**
- › **Updated HMP Plan**, incorporating resilience and climate adaptation



## The MVP Planning Format

- › The Core Team & Background Materials
- › Characterization Survey

### › **Characterize Hazards**

#### › **Small Group Workshop**

- Identify Community Vulnerabilities & Strengths
- Identify Community Actions
- Prioritize Community Actions

### › **Discuss & Identify Top Three Actions**

- › Combine Information, Prepare Draft Reports
- › Public Engagement Period

### › **IMPLEMENTATION**

# Today's Agenda

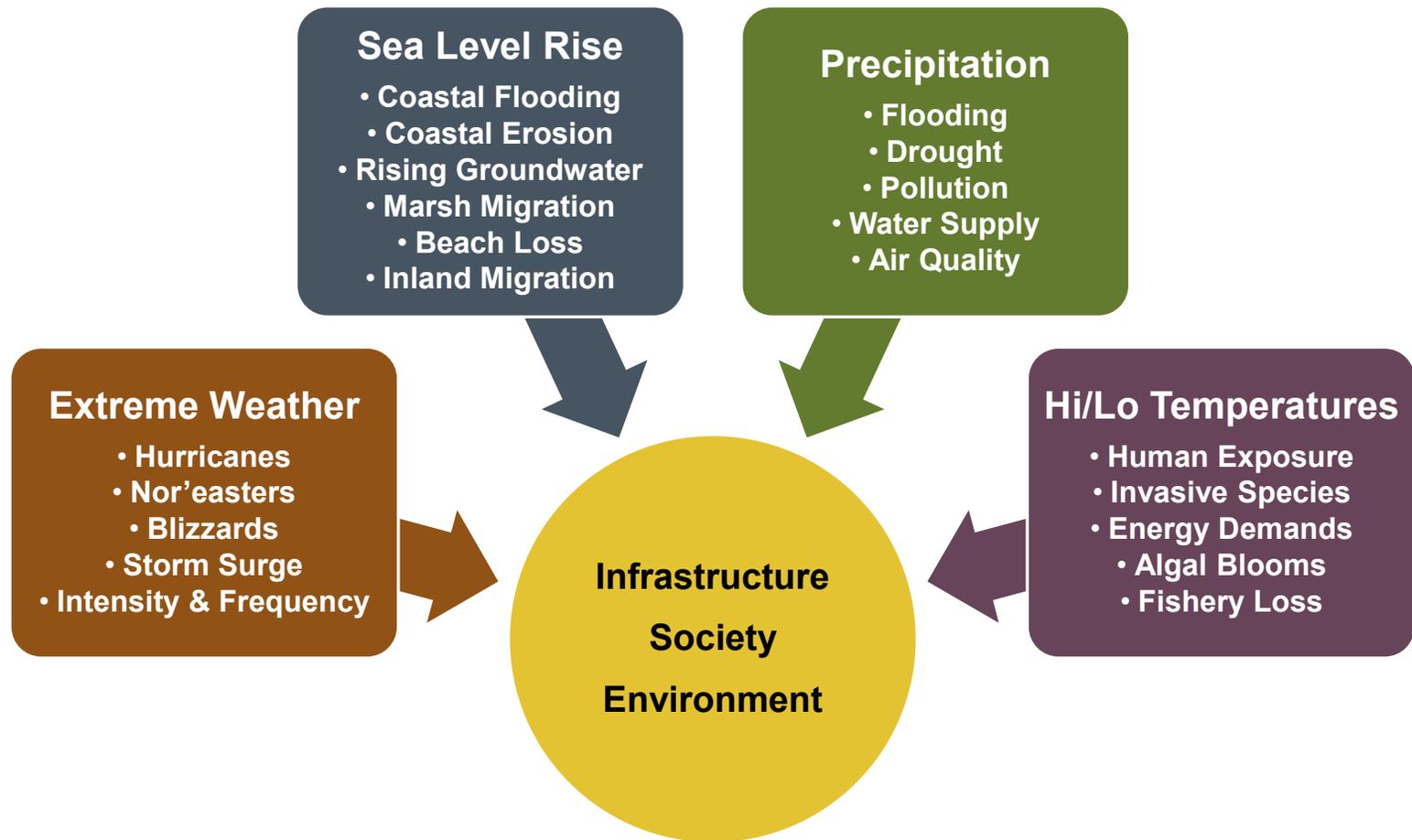
September 10<sup>th</sup>, 2020

- |             |  |
|-------------|--|
| 8:50-9:00   | <i>Logon &amp; Zoom Familiarity</i>  |
| 9:00-9:30   | Welcome & Introduction <ul style="list-style-type: none"><li>• Workshop Overview</li><li>• Climate Change introduction</li></ul>   |
| 9:30-9:45   | Characterize Community Hazards & Select Priority Hazards (Full Group)  |
| 9:45-10:00  | Review community resources <ul style="list-style-type: none"><li>• Overview of Maps &amp; Matrix</li><li>• Group Facilitator Introductions, Group Instructions</li></ul>   |
| 10:00-11:30 | Breakout Groups: <ul style="list-style-type: none"><li>• Identify Community Vulnerability &amp; Strengths<ul style="list-style-type: none"><li>- ~30 minutes per category (Environment, Infrastructure, and Society)</li></ul></li><li>• <u>**15 minute break at 10:30</u></li></ul> |
| 11:30-11:55 | Reconvene in Full Group <ul style="list-style-type: none"><li>• Report from each Breakout Group</li></ul>  |
| 11:55-12:00 | Closing Remarks & Wrap Up & Best Participation Prize!  |

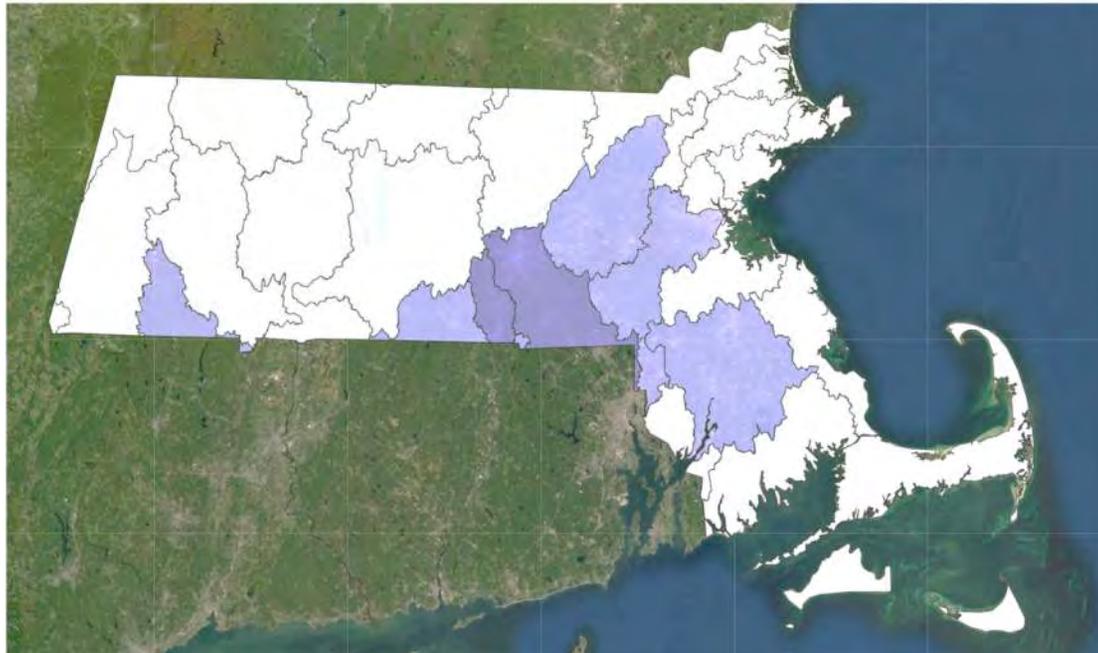
# WHY WORRY ABOUT CLIMATE CHANGE IF WINTERS ARE STILL COLD??



# Perceived Natural Hazards



# Climate Change in Massachusetts



- › **Extreme Weather**
- › **Sea-level Rise**
- › **Changes in Precipitation**
- › **Rising Temperatures**

## Massachusetts Observed Climate Changes

Temperature:  **2.9°F**  
Since 1895 (Statewide)

Growing Season:  **15 Days**  
Since 1950

Sea Level Rise:  **11 inches**  
Since 1922 (Boston)

Heavy Precipitation:  **55%**  
Since 1958

Source: Climate Science Special Report, 2017. NOAA NCEP/Climate Div., NOAA Ocean Service

# Extreme Weather

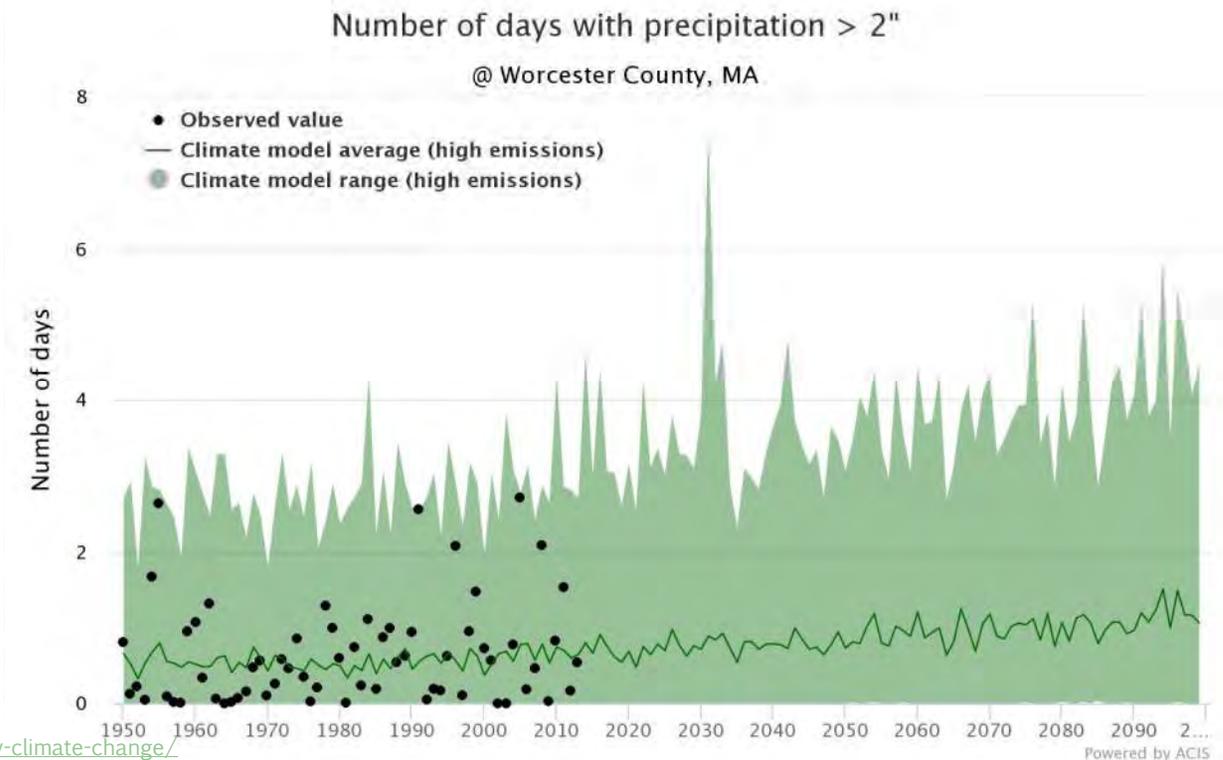
- > **Mar – Apr 2010:** A series of severe storms and flooding events throughout Massachusetts
  - Widespread rainfall, causing small streams to rise above their flood stages
  - Over \$145 million received in individual and public assistance
- > **Aug 2011, Tropical Storm Irene:** tropical storm producing heavy rain in Western Massachusetts
  - Average of 10 inches of rain in Western Mass
  - Power outages peaked at more than 500,000
- > **Feb 2013, Winter Storm Nemo:** Blizzard producing widespread heavy snowfall throughout the state
  - Widespread snowfall greater than two feet, with snowfall rates of one to two inches per hour at time
  - Nearly 400,000 customers lost power
  - Over \$43 million received in public assistance
- > **Jan 2015, Winter Storm Juno:** Winter storm breaking daily snowfall records throughout MA



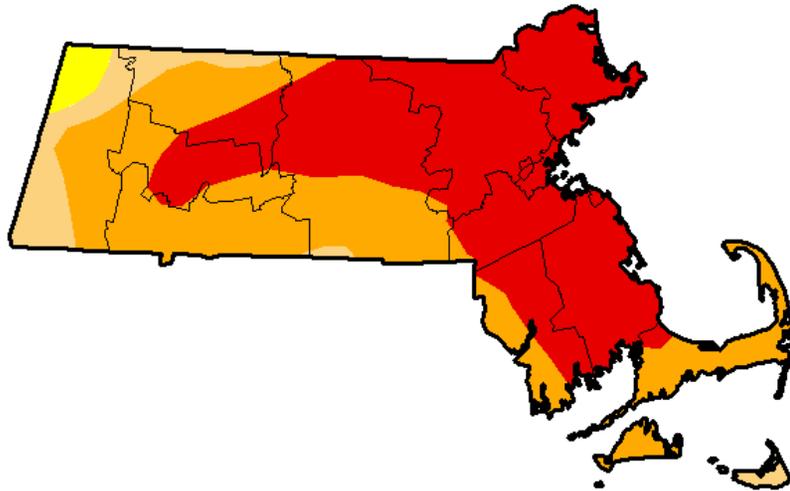
# Changes in Precipitation

- › Projections show increasing days of higher precipitation totals per year

Climate Indicator	Observed Value		Mid-Century	End of Century
	1971-2000	Average	Projected Change in 2050s	Projected Change in 2090s
Days with Precipitation > 1"	Annual	7 days	Increase by 10-42% 8-10 more days per year	Increase by 15-55% 8-11 more days per year



# U.S. Drought Monitor Massachusetts



**October 4, 2016**  
(Released Thursday, Oct. 6, 2016)  
Valid 8 a.m. EDT

*Drought Conditions (Percent Area)*

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
<b>Current</b>	0.00	100.00	98.15	89.95	52.13	0.00
<b>Last Week</b> <i>9/27/2016</i>	0.00	100.00	98.15	89.95	52.13	0.00
<b>3 Months Ago</b> <i>7/5/2016</i>	0.70	99.30	54.99	29.65	0.00	0.00
<b>Start of Calendar Year</b> <i>12/29/2015</i>	22.85	77.15	26.34	0.00	0.00	0.00
<b>Start of Water Year</b> <i>9/27/2016</i>	0.00	100.00	98.15	89.95	52.13	0.00
<b>One Year Ago</b> <i>10/6/2015</i>	22.34	77.66	13.81	0.00	0.00	0.00

Intensity:



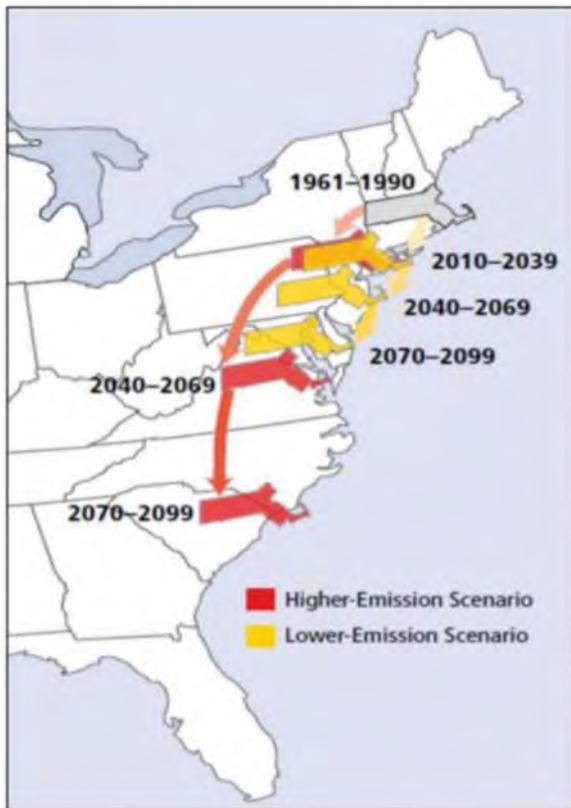
*The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.*

**Author:**  
Brian Fuchs  
National Drought Mitigation Center

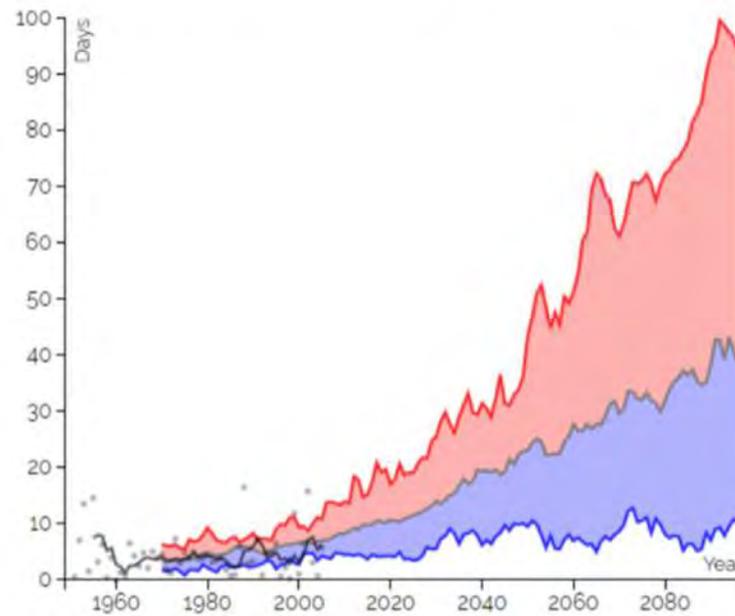


<http://droughtmonitor.unl.edu/>

# Rising Temperatures



Annual Days with Maximum Temperature Above 90°F



[Download Data](#)

Observed	
5-yr Mean	days
Modeled days	
Max	days
Median	days
Min	days
Changes from 1971-2000 for:	
2020 -	12.48 days
2049 -	20.15 days
2069 -	28.33 days
2089 -	33.82 days
2080 -	33.82 days
2097 -	33.82 days

# AGRICULTURE

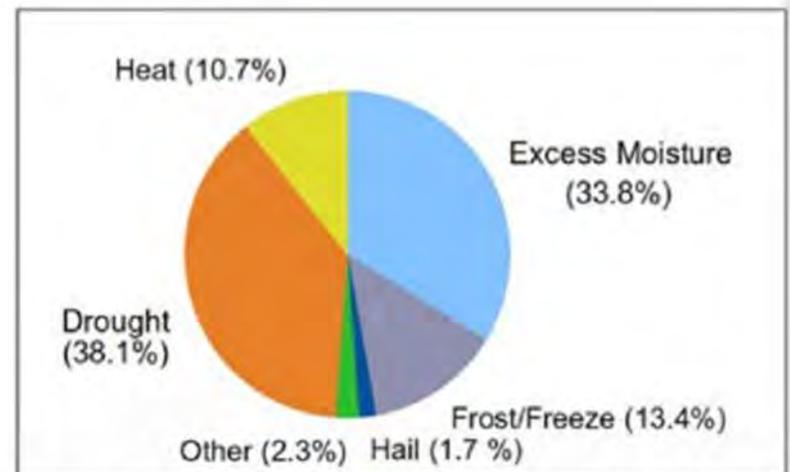
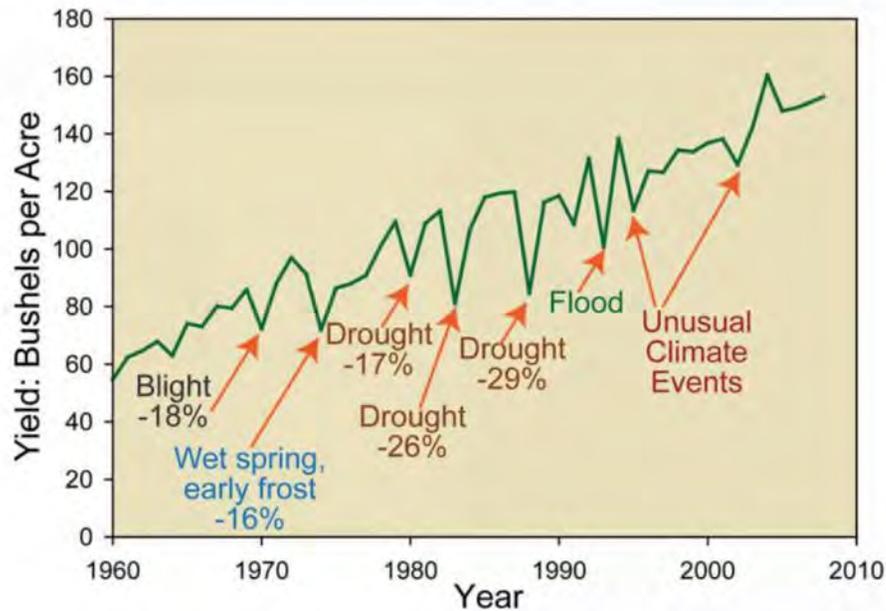
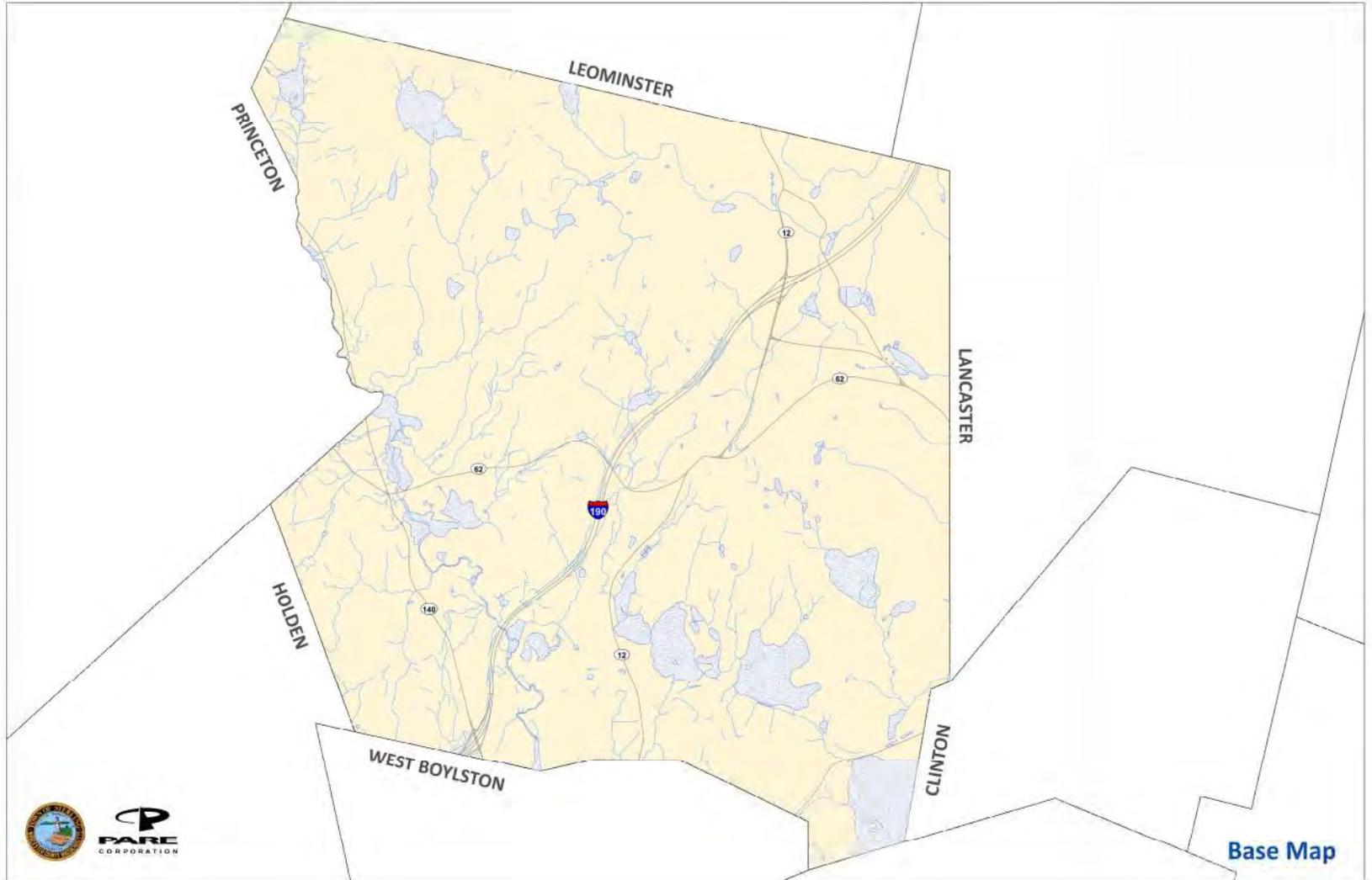


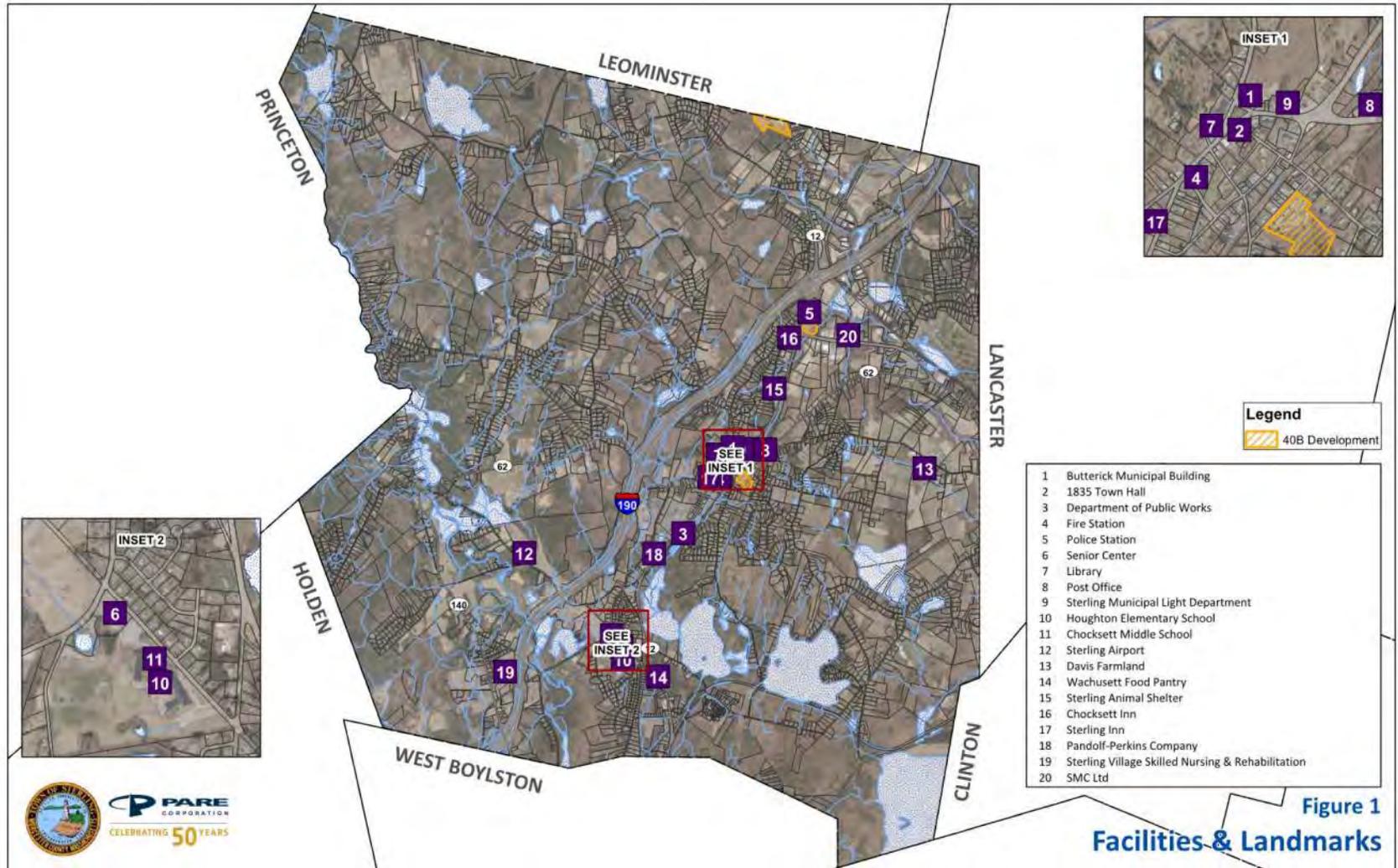
Figure 4. Categorization of weather-related crop losses in the northeastern U.S. from 2013 through 2016 (Wolfe et al., 2018)



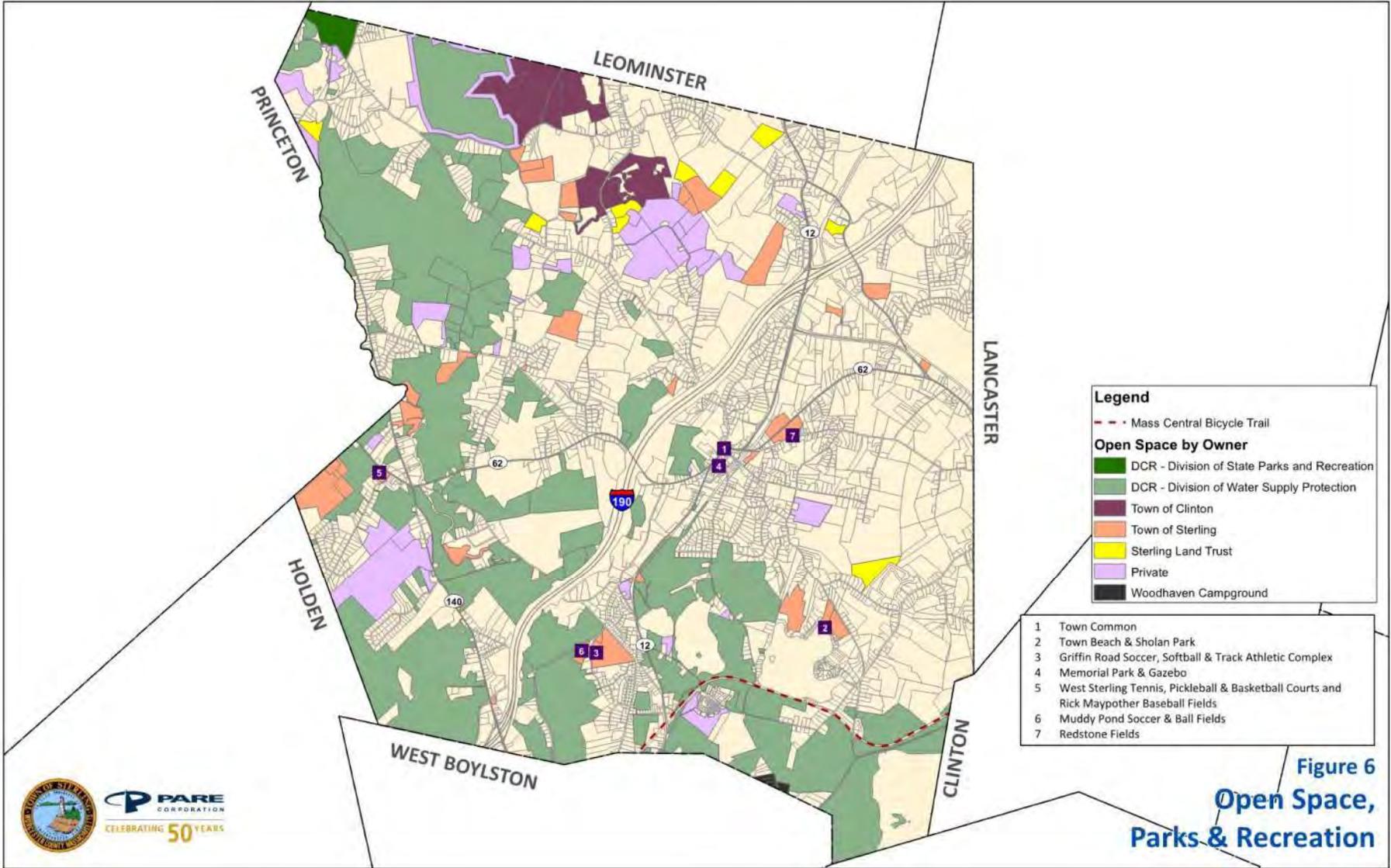
## Workshop Resources

- › Base Map
- › Map Booklet:
  - Facilities
  - Land Use
  - Hydrology & Flooding
  - Topography
  - Natural Resources
  - NE Landscape Futures
- › Nature Based Solutions

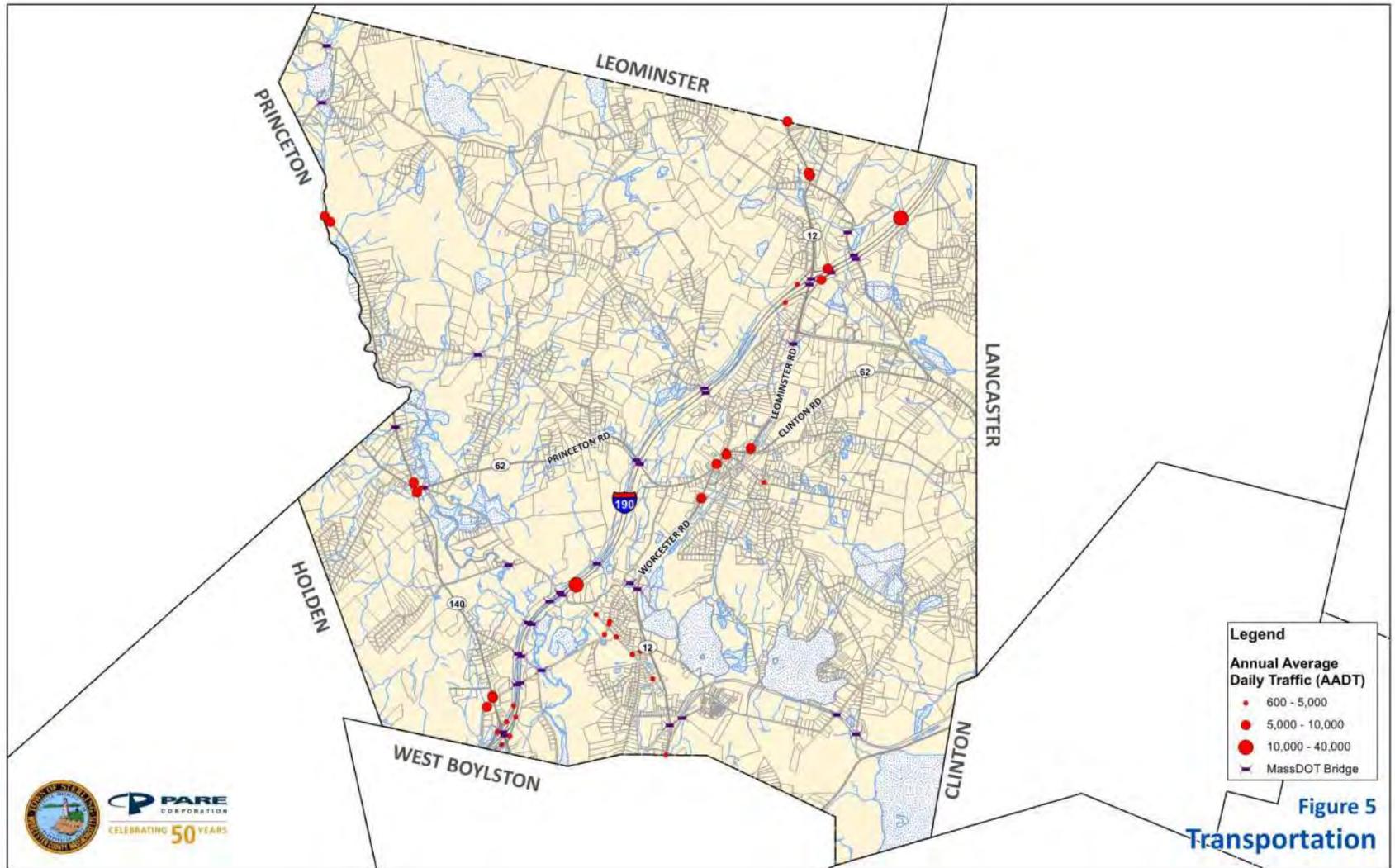


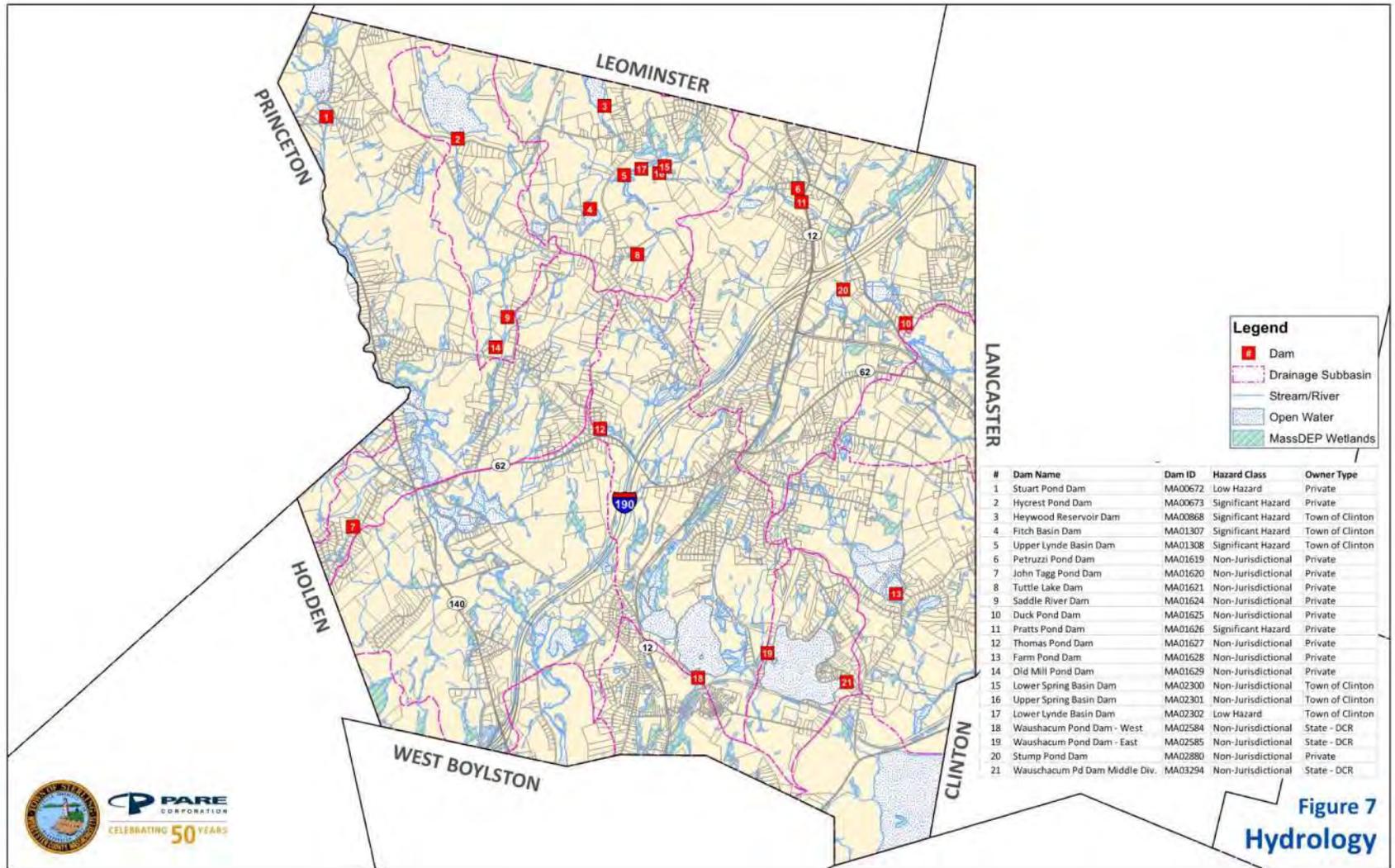


**Figure 1**  
**Facilities & Landmarks**



**Figure 6**  
**Open Space,**  
**Parks & Recreation**



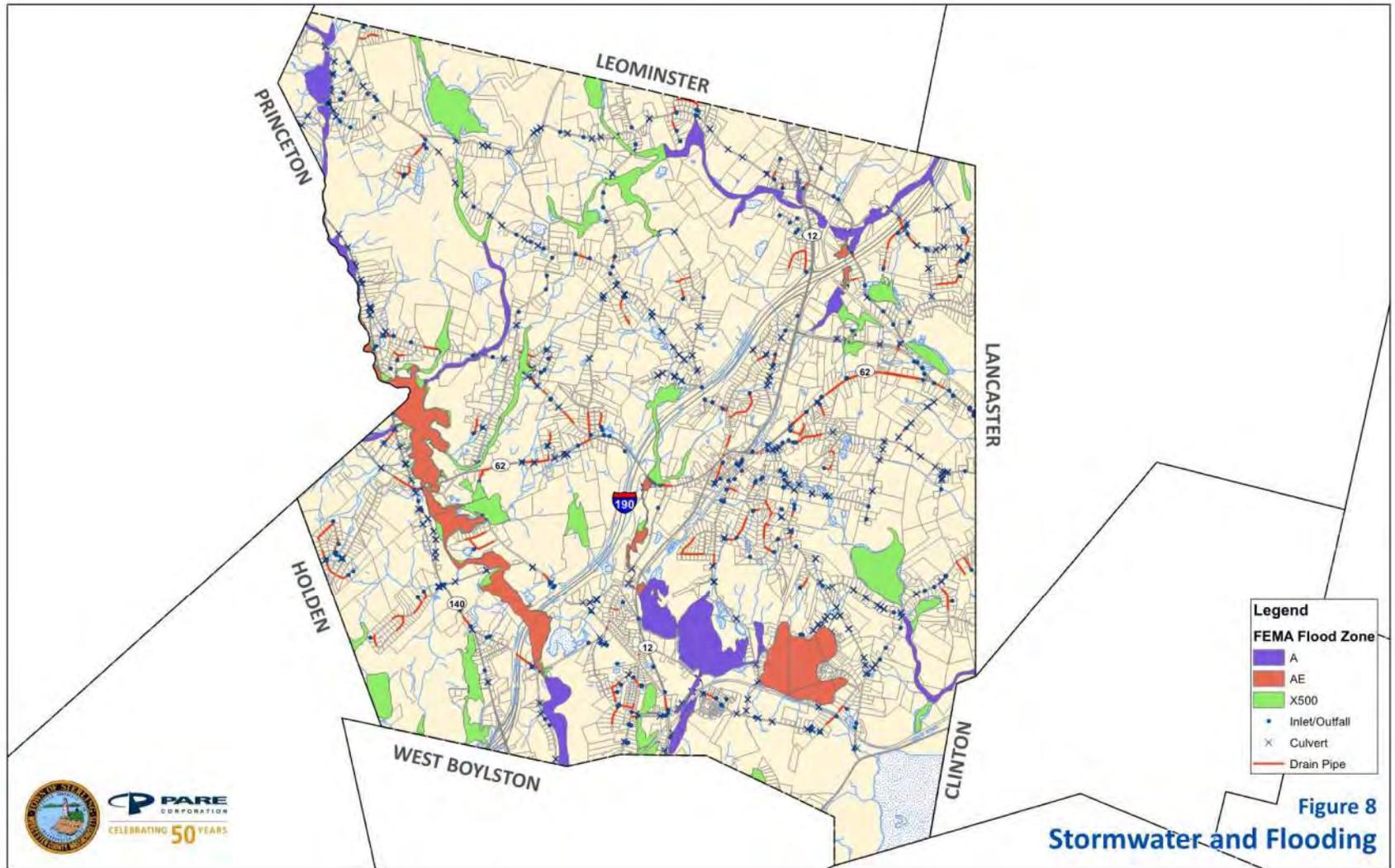


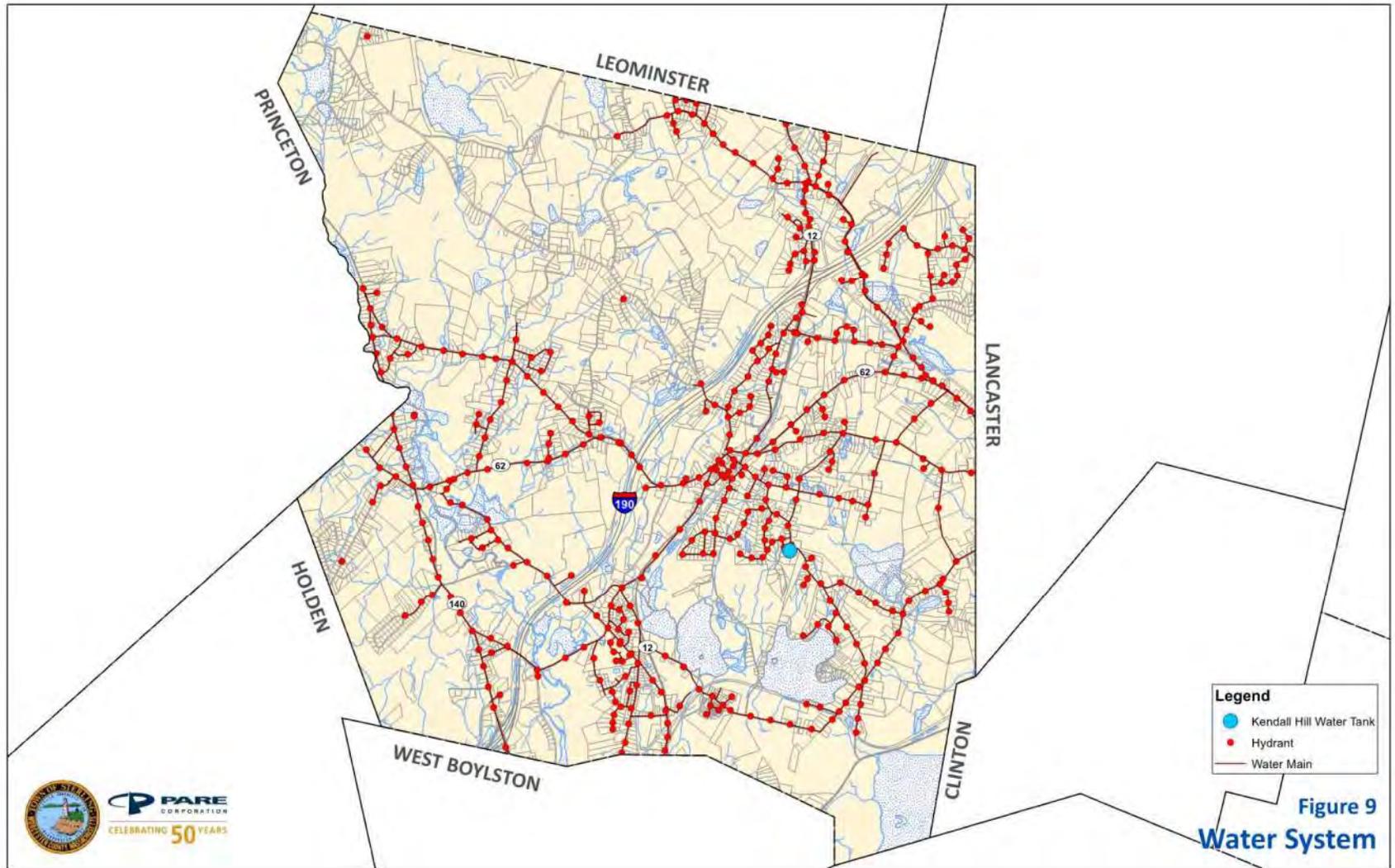
**Legend**

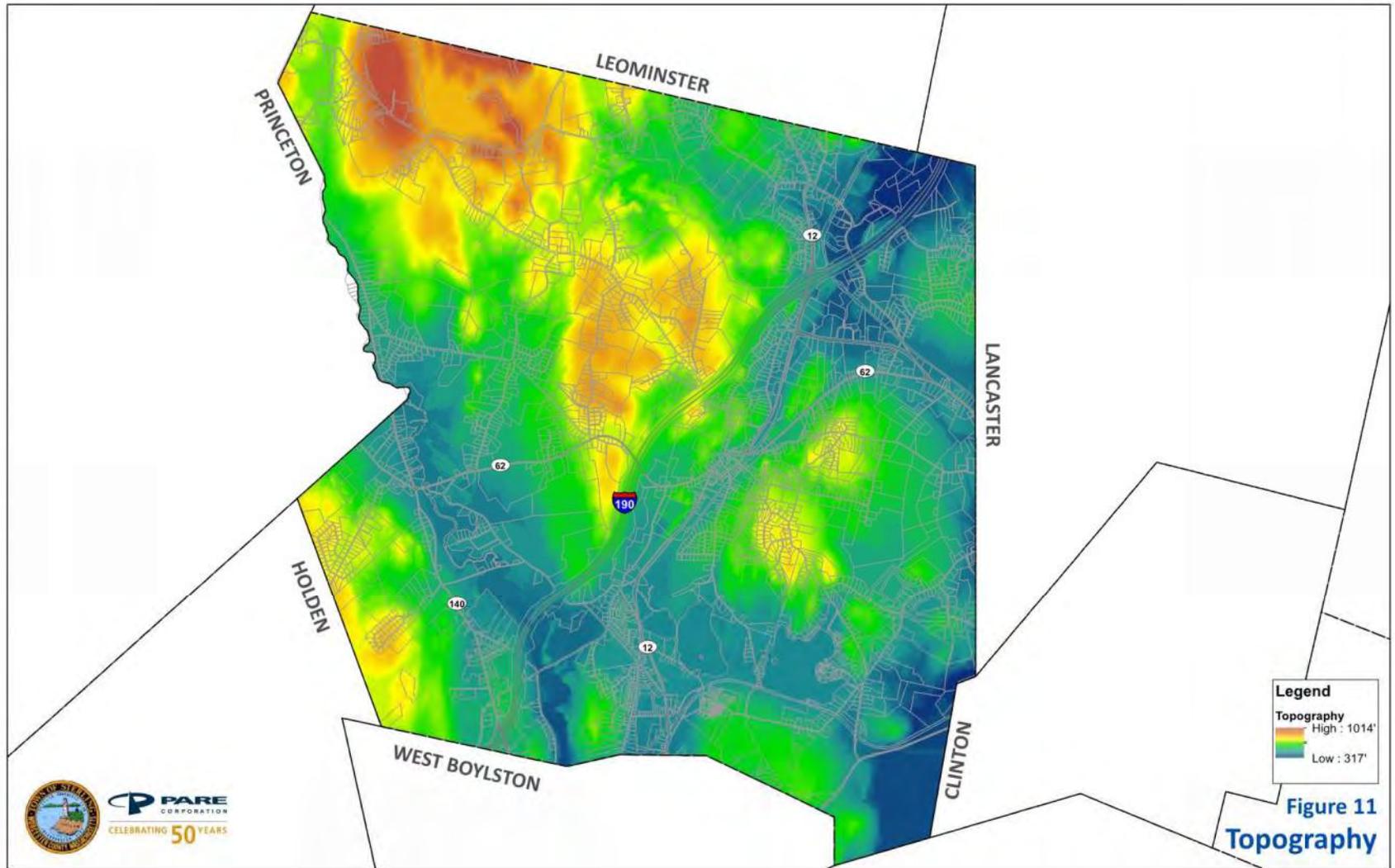
- Dam
- Drainage Subbasin
- Stream/River
- Open Water
- MassDEP Wetlands

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20	Stump Pond Dam	MA02880	Non-Jurisdictional	Private
21	Wausachum Pd Dam Middle Div.	MA03294	Non-Jurisdictional	State - DCR

**Figure 7**  
**Hydrology**







# Nature Based Solutions

- › “sustainable planning, design, environmental management, and engineering practices that weave **natural features or processes** into the built environment to build more resilient communities”
  - Watershed scale
  - Neighborhood scale
  - Coastal
- › “While gray infrastructure provides only the service for which it was designed, nature-based solutions yield additional community and ecosystem benefits.”



- › Business Case
  - Hazard Mitigation Benefits
  - Community Co-Benefits
  - Community Cost Savings



# Example Project

<b>Falmouth</b>	Falmouth is restoring the lower <u>Coonamessett</u> River.	Inland Flooding	Increased flood storage; Safer road	Improved fish and wildlife passage; Improved salt marsh migration
<b>FY19</b>	The project includes removal of an aging dam; restoration of floodplain wetlands;			
<b>\$760,000</b>	replacing failing culverts with a <u>storm-smart</u> culvert that provides passage for fish and wildlife.			
<b>Mattapoisett</b>	Mattapoisett partnered with the Mattapoisett Land Trust and the Buzzards Bay Coalition to purchase 120 acres of forest, streams, freshwater wetlands and coastal salt marsh in the Pine Island Pond area to limit future development in this vulnerable location.	Extreme Weather; Coastal Flooding	Storm protection; Reduced chance of future development in harm's way	Recreational opportunities; Natural resource conservation
<b>FY19</b>				
<b>\$960,000</b>				
<b>Spencer</b>	Spencer is implementing green stormwater infrastructure techniques as part of a parking lot redevelopment project. The design will incorporate rain gardens/bioretenion and belowground infiltration systems to reduce runoff and pollutant loads from the lot.	Inland Flooding	Increased flood storage	Improved water quality; Additional recreational areas
<b>FY19</b>				
<b>\$370,492</b>				

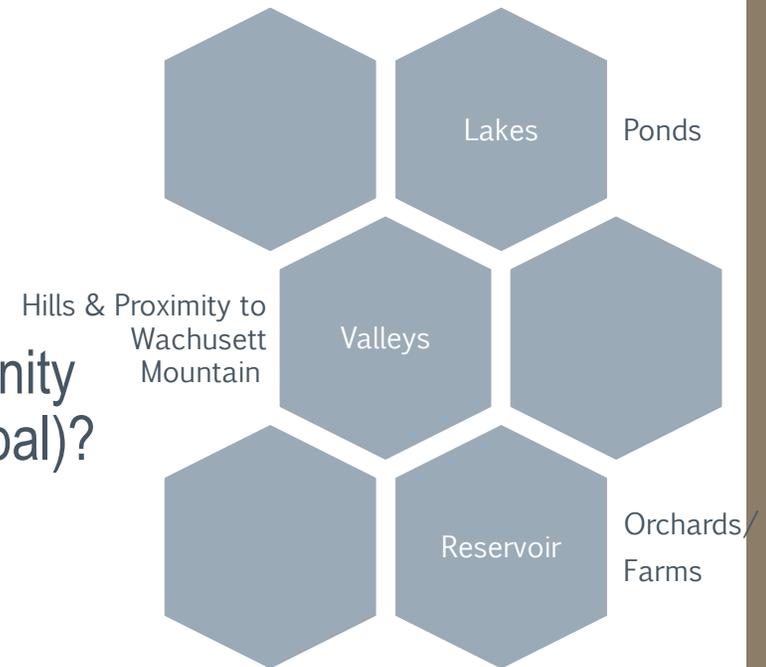


## Survey Results

- › Input from 14 different communities/companies/organizations/institutions/agencies throughout town
  - Small and large entities
  - Variable participation from town residents in each
  - ~8,000 residents

## Survey Results

- › How economically and demographically diverse is your community?
  - Rural community
  - Somewhat economically diverse
  - Aging community
  - Divide in older farming roots/young middle/upper-middle migration
- › What are prominent geographic features of your community?
  - Lakes
  - Ponds
  - Valleys
  - Hills & Proximity to Wachusett Mountain
  - Reservoir
  - Orchards/Farms
- › What is the land use profile in your community (%commercial/industrial/residential/municipal)?
  - Majority residential/farm
  - Industry in northeast
  - Small business/municipal services centralized downtown



## Survey Results



> What are the most important/influential institutions, organizations, or businesses in your community?

- UN Sustainable Development Group
- Town government
- Police
- Fire
- Schools
- Senior Center
- Library
- DPW
- Water Department
- Churches
- MassDOT
- Sterling Municipal Light Department
- LKQ
- Pandolf Perkins Quarry
- Gandalf
- Sterling National Country Club
- Davis Farmland
- Town Hall
- Altec
- Sterling Skilled Nursing
- Admore, Inc.
- Fiber Optic Components Inc.
- Horace Mann Educational Assoc.
- Ideal Industries Inc.
- Webster Veterinary Supply
- Laddawn Inc.
- Northeast Poly Bag Co.
- Meadowbrook Orchards
- Rota Springs Farm
- Clearview Farm
- The Brick

## Survey Results

- › What are the “hot-button” social/political/leadership issues? Have these changed substantially over the past 5-10 years?



## Survey Results

- › What local/regional/global management challenges are you currently dealing with?
  - Weather
  - Stormwater runoff/water quality
  - Infrastructure
  - Flooding
  - Transportation
  - Cesspools/lack of sewer
  - Ticks and mosquitoes
  - Water supply
  - Accidents on Rt. 190
  - Limited opportunity for development
- Pandemic responses
- Budget and taxes
- Municipal building maintenance
- Rural/development balance
- Aging population

15. In your opinion, which of the following categories are most susceptible to natural hazards in your community? (Please rank the community assets in order of vulnerability, 1 being most vulnerable and 6 being least vulnerable.)

[More Details](#)

■ 1 
 ■ 2 
 ■ 3 
 ■ 4 
 ■ 5 
 ■ 6

People: Loss of life and/or injuries

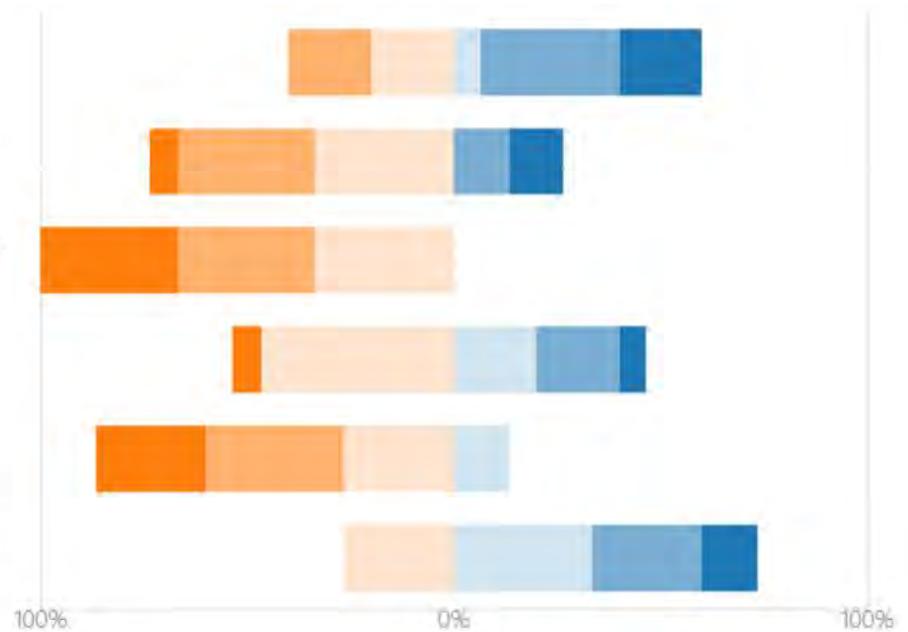
Economic: Business interruptions/closures, job losses, etc.

Infrastructure: Damage/loss of roads, bridges, utilities, schools, etc.

Cultural/Historic: Damage or loss of libraries, museums, historic properties, etc.

Environmental: Damage, contamination or loss of forests, wetlands, waterways, etc.

Governance: Ability to maintain order and/or provide public amenities and services



# Today's Agenda

- 10:00-11:30      Breakout Groups:
- Identify Community Vulnerability & Strengths
    - ~30 minutes per category (Environment, Infrastructure, and Society)
  - \*\*15 minute break at 10:30
- 11:30-11:55      Reconvene in Full Group
- Report from each Breakout Group
- 11:55-12:00      Closing Remarks & Wrap Up & Best Participation Prize!



# Questions?



## Appendix B: Workshop Agenda



## Municipal Vulnerability Preparedness Workshop Schedule

### September 10<sup>th</sup>, 2020

- 8:50-9:00 *Logon & Zoom Familiarity*
- 9:00-9:30 Welcome & Introduction
- Workshop Overview
  - Climate Change introduction
- 9:30-9:45 Characterize Community Hazards & Select Priority Hazards (Full Group)
- 9:45-10:00 Review community resources
- Overview of Maps & Matrix
  - Group Facilitator Introductions, Group Instructions
- 10:00-11:30 Breakout Groups:
- Identify Community Vulnerability & Strengths
    - ~30 minutes per category (Environment, Infrastructure, and Society)
  - *\*\*15 minute break at 10:30*
- 11:30-11:55 Reconvene in Full Group
- Report from each Breakout Group
- 11:55-12:00 Closing Remarks & Wrap Up & Best Participation Prize!

### September 17<sup>th</sup>, 2020

- 8:50-9:00 *Logon & Zoom Familiarity*
- 9:00-9:20 Welcome & Recap
- 9:20-11:10 Breakout Groups:
- Identify Community Actions
  - *\*\*15 minute break at 10:30*
  - Prioritize Community Actions
- 11:10-11:55 Reconvene in Full Group
- Report from each Breakout Group
  - Determine Overall Priority Actions
  - Final Thoughts & Discussion with Q&A
- 11:55-12:00 Closing Remarks & Wrap Up

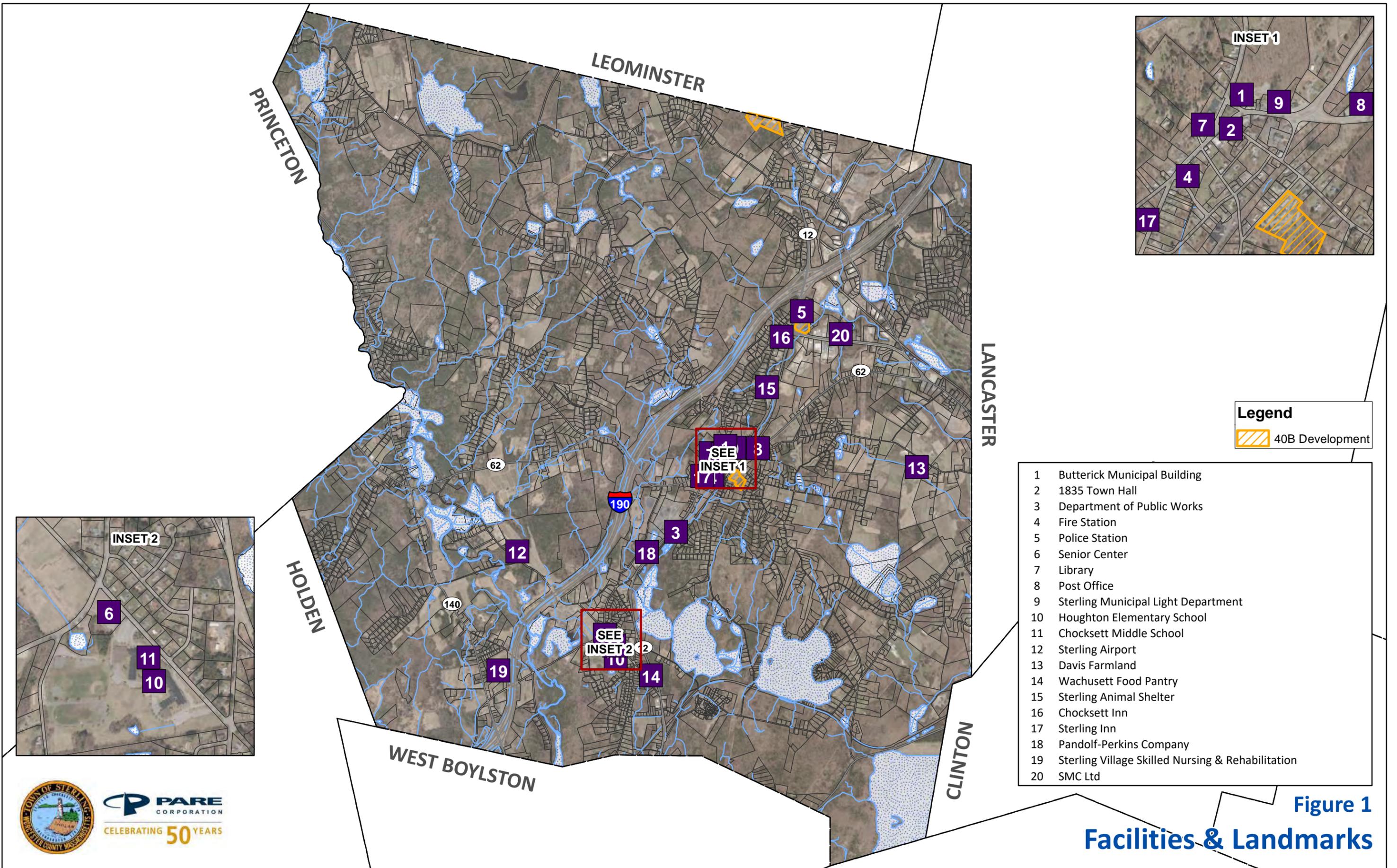
## Appendix C: Sterling Map Package

# Town of Sterling

## Municipal Vulnerability Preparedness

- Figure 1 - Facilities & Landmarks
- Figure 2 - Land Use & Development 1985
- Figure 3 - Land Use & Development 2005
- Figure 4 - Land Use & Development 2016
- Figure 5 - Transportation
- Figure 6 - Open Space, Parks & Recreation
- Figure 7 - Hydrology
- Figure 8 - Stormwater and Flooding
- Figure 9 - Water System
- Figure 10 - Curve Number
- Figure 11 - Topography
- Figure 12 - Prime Forest Land
- Figure 13 - Farmland Soils
- Figure 14 - New England Landscape Futures Current Use 2020
- Figure 15 - New England Landscape Futures Recent Trends 2060
- Figure 16 - New England Landscape Futures Connected Communities 2060
- Figure 17 - New England Landscape Futures Go It Alone 2060
- Figure 18 - New England Landscape Futures Growing Global 2060
- Figure 19 - New England Landscape Futures Yankee Cosmopolitan 2060



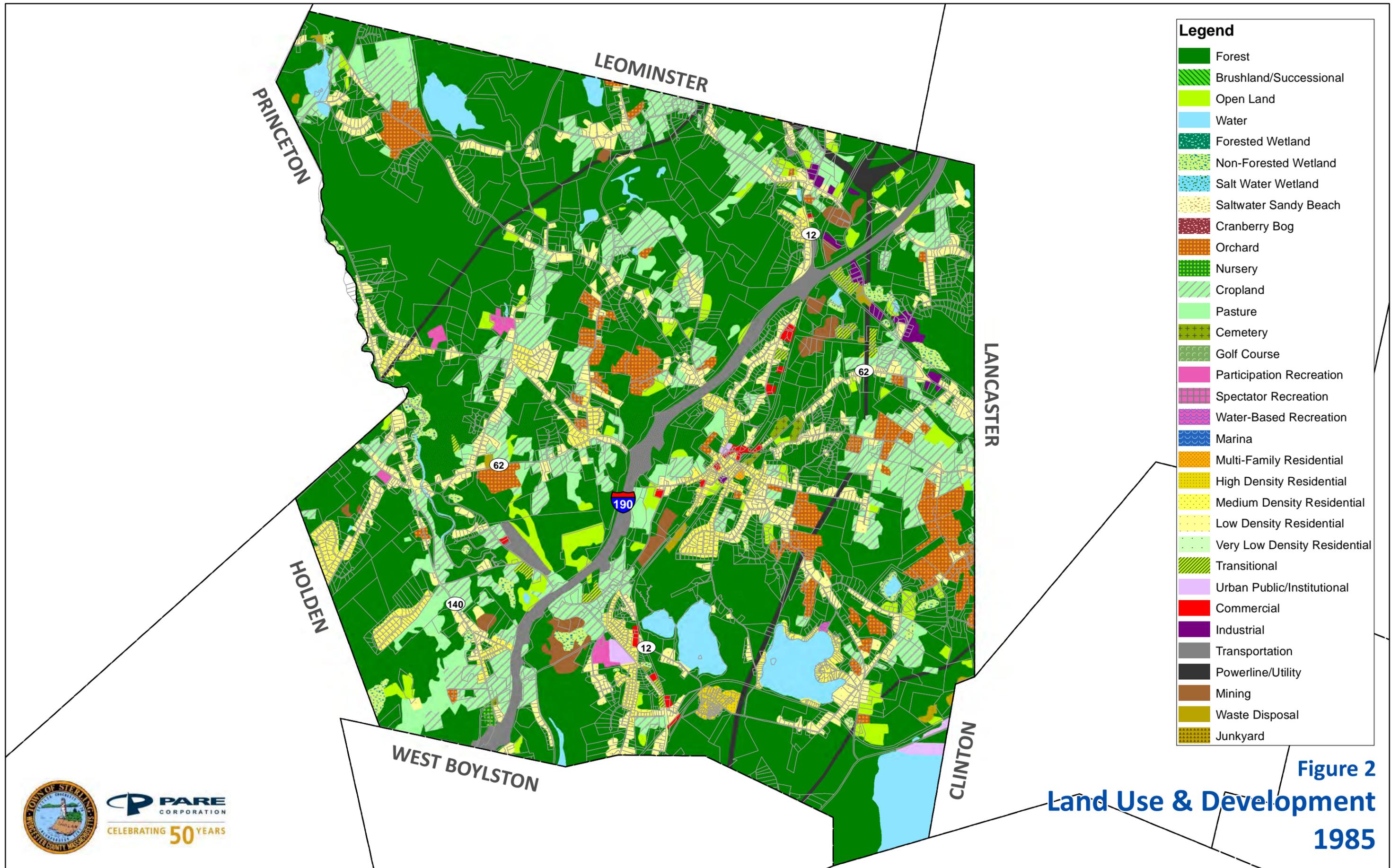


**Legend**  
 40B Development

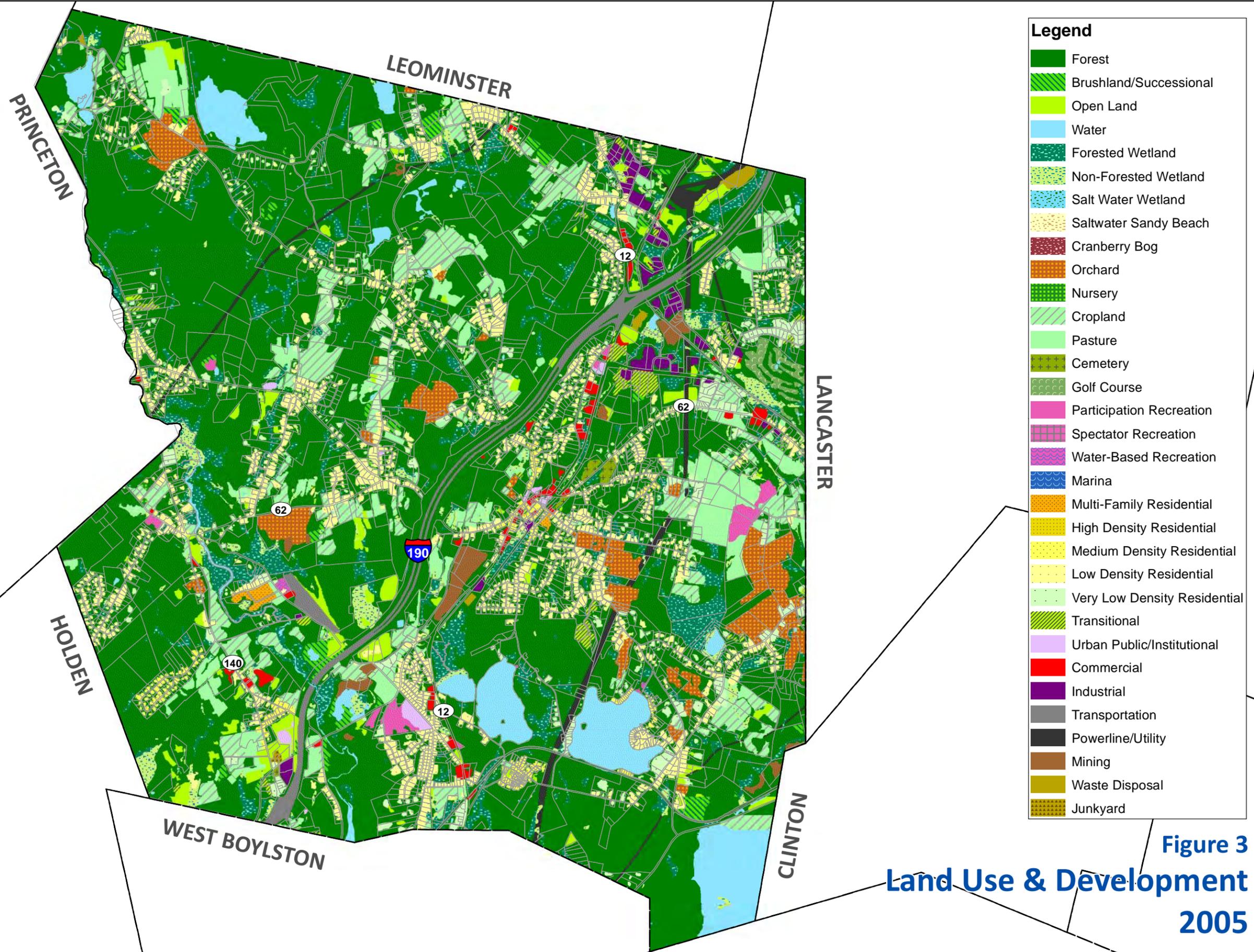
- 1 Butterick Municipal Building
- 2 1835 Town Hall
- 3 Department of Public Works
- 4 Fire Station
- 5 Police Station
- 6 Senior Center
- 7 Library
- 8 Post Office
- 9 Sterling Municipal Light Department
- 10 Houghton Elementary School
- 11 Chocksett Middle School
- 12 Sterling Airport
- 13 Davis Farmland
- 14 Wachusett Food Pantry
- 15 Sterling Animal Shelter
- 16 Chocksett Inn
- 17 Sterling Inn
- 18 Pandolf-Perkins Company
- 19 Sterling Village Skilled Nursing & Rehabilitation
- 20 SMC Ltd

**Figure 1**  
**Facilities & Landmarks**



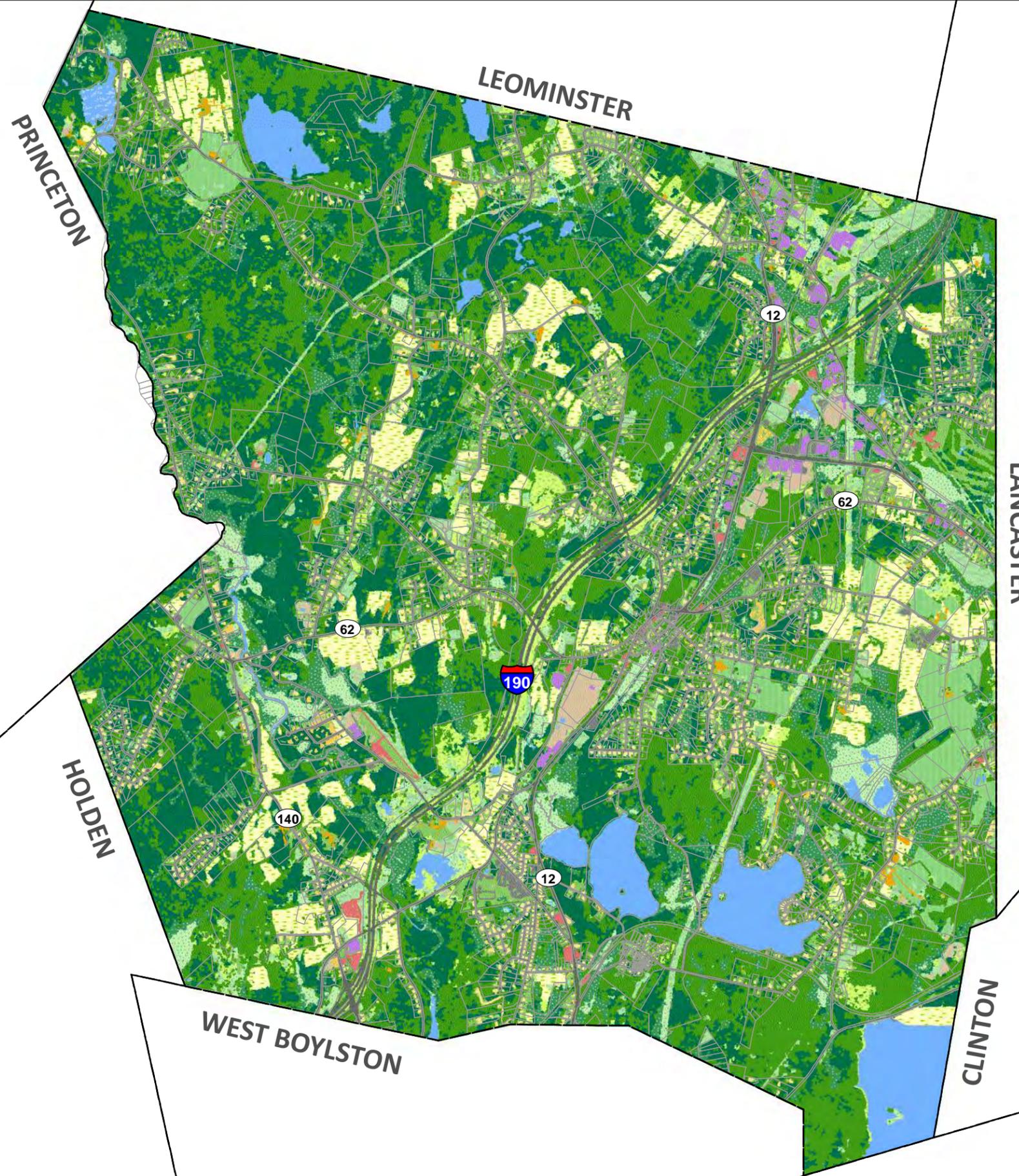


**PARE**  
CORPORATION  
CELEBRATING 50 YEARS



**Figure 3**  
**Land Use & Development**  
**2005**

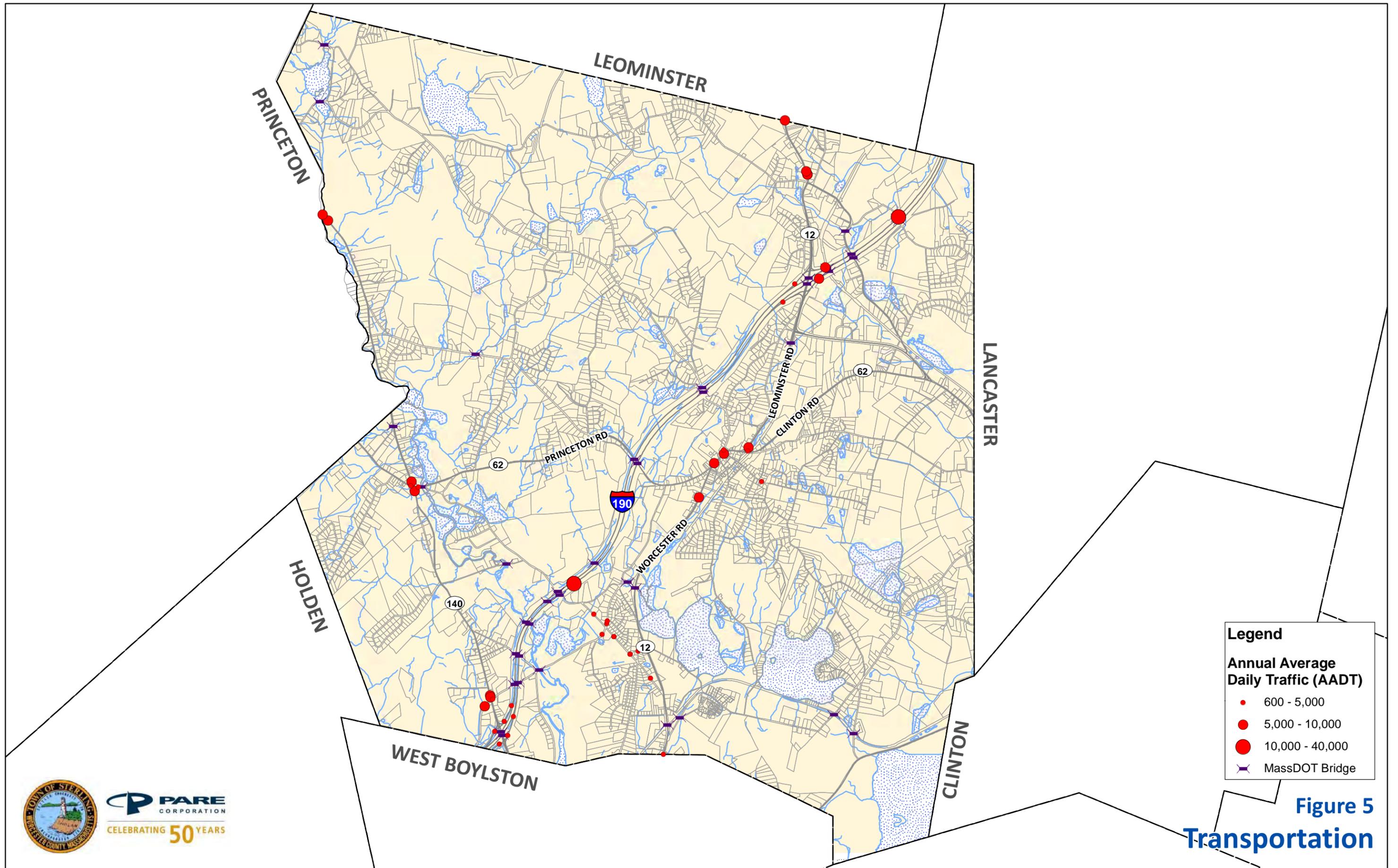




**Legend**

Deciduous Forest	- 31%
Evergreen Forest	- 22%
Forested Wetland	- 9%
Developed Open Space	- 8%
Pasture/Hay	- 6%
Water	- 4%
Grassland	- 4%
Scrub/Shrub	- 3%
Non-forested Wetland	- 3%
Right-of-way	- 2%
Cultivated	- 2%
Residential - Single Family	- 2%
Bare Land	- <1%
Industrial	- <1%
Other Impervious	- <1%
Commercial	- <1%
Aquatic Bed	- <1%
Residential - Other	- <1%
Residential - Multi-Family	- <1%
Mixed Use - Other	- <1%

**Figure 4**  
**Land Use & Development**  
**2016**



**Legend**

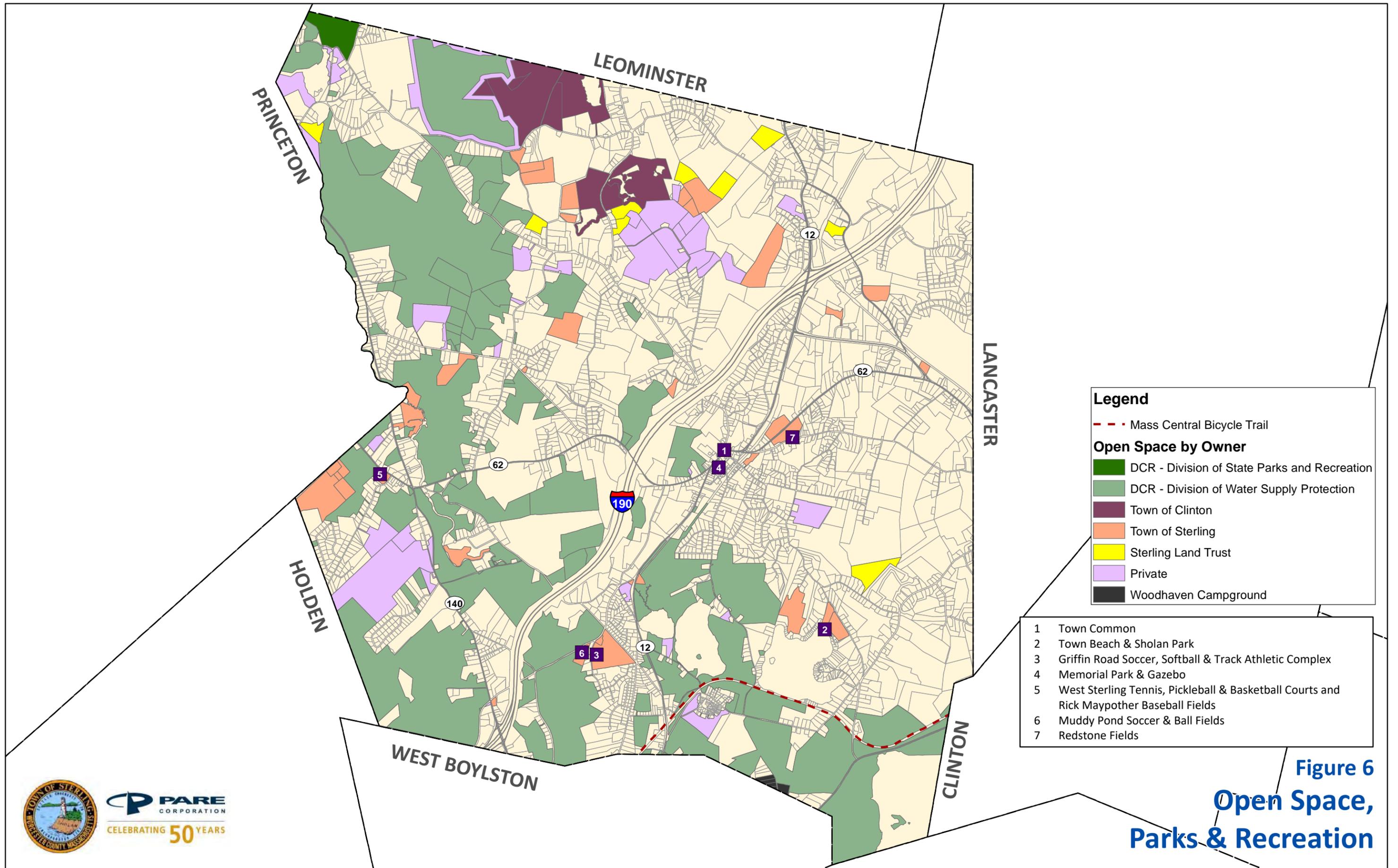
**Annual Average Daily Traffic (AADT)**

- 600 - 5,000
- 5,000 - 10,000
- 10,000 - 40,000
- ✕ MassDOT Bridge

**Figure 5**  
**Transportation**



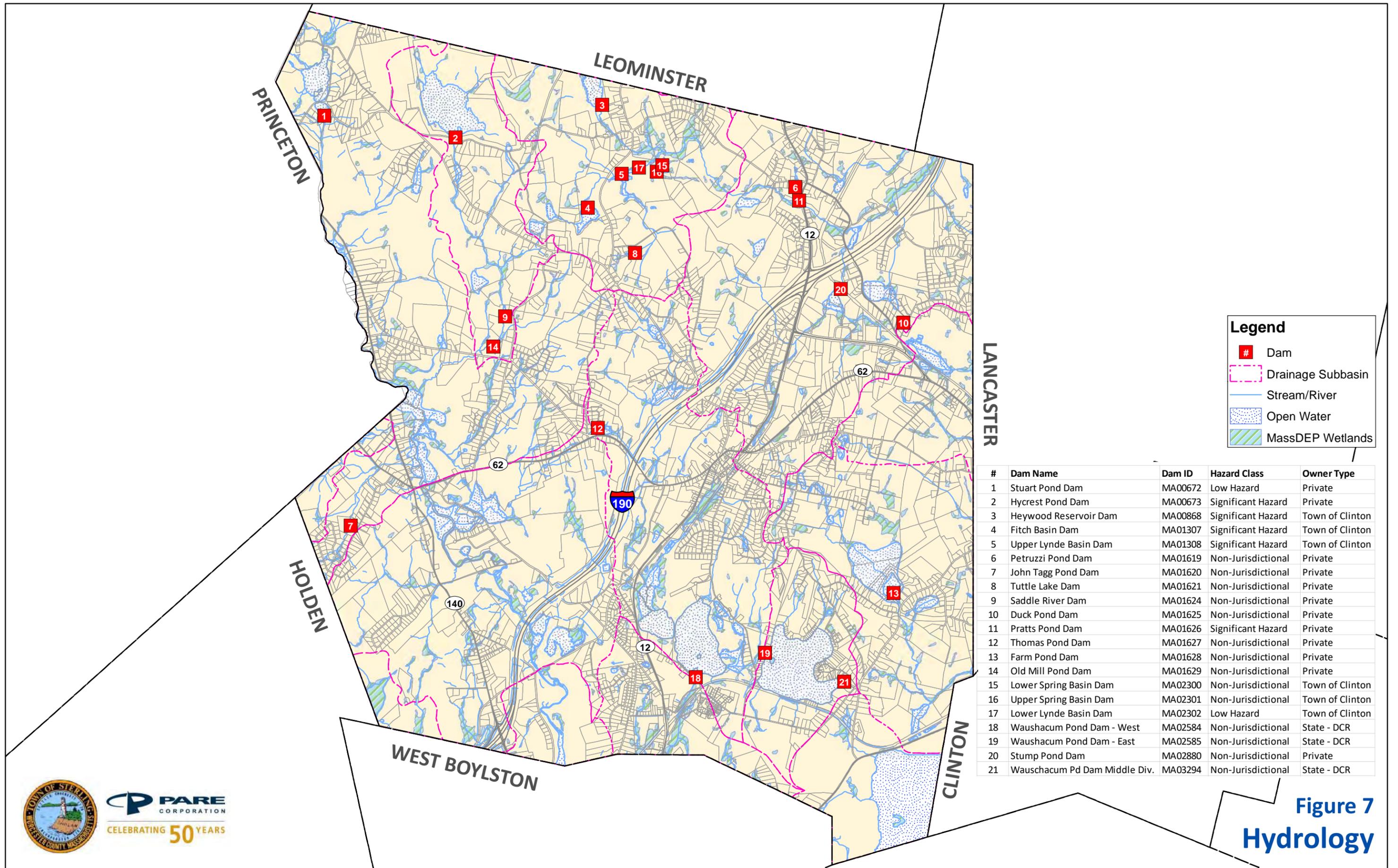
**PARE**  
CORPORATION  
CELEBRATING 50 YEARS



**Figure 6**  
**Open Space,**  
**Parks & Recreation**



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 CORPORATION  
 CELEBRATING 50 YEARS



**Legend**

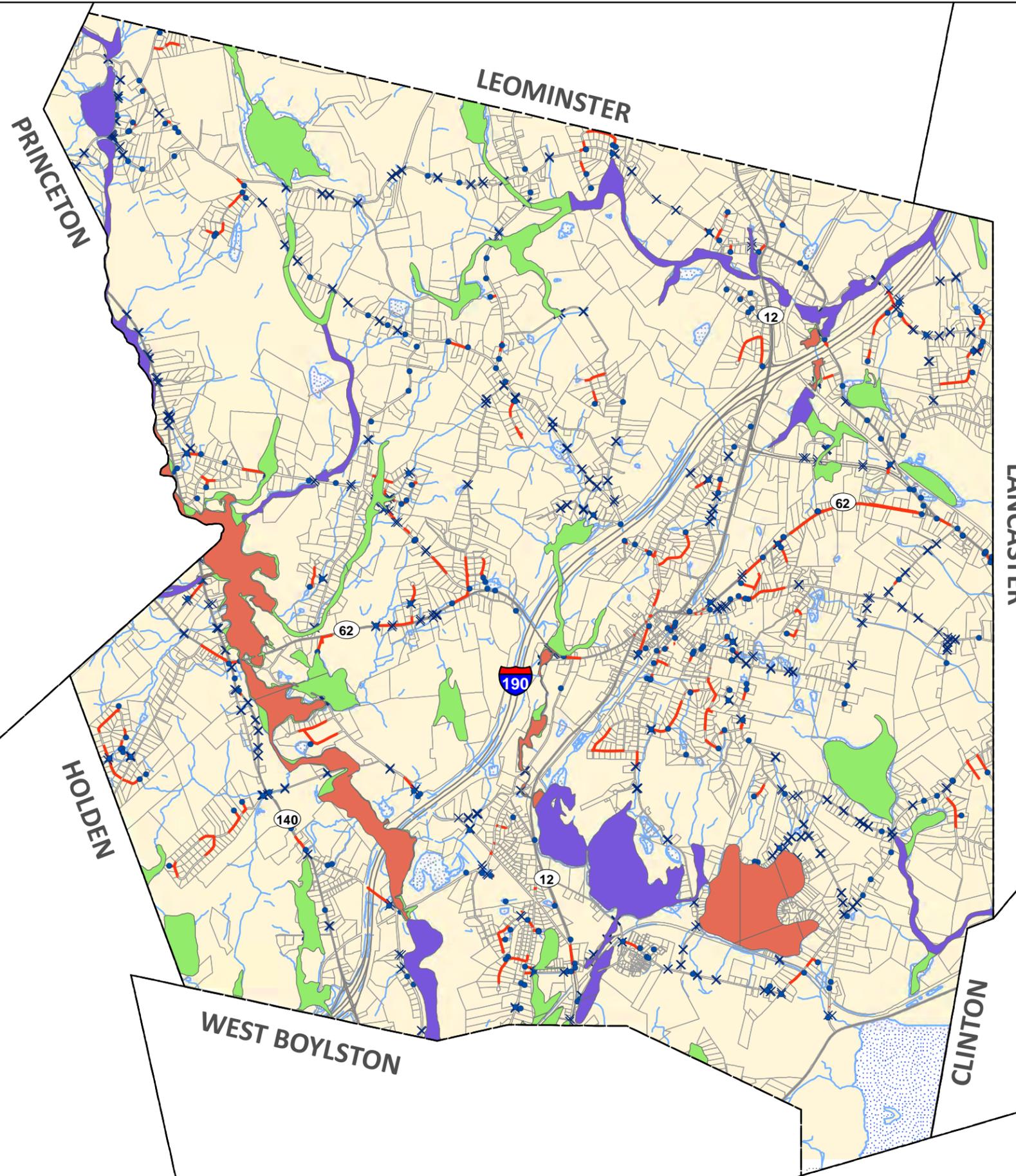
- # Dam
- Drainage Subbasin
- Stream/River
- Open Water
- MassDEP Wetlands

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**PARE CORPORATION**  
CELEBRATING 50 YEARS

**Figure 7**  
**Hydrology**



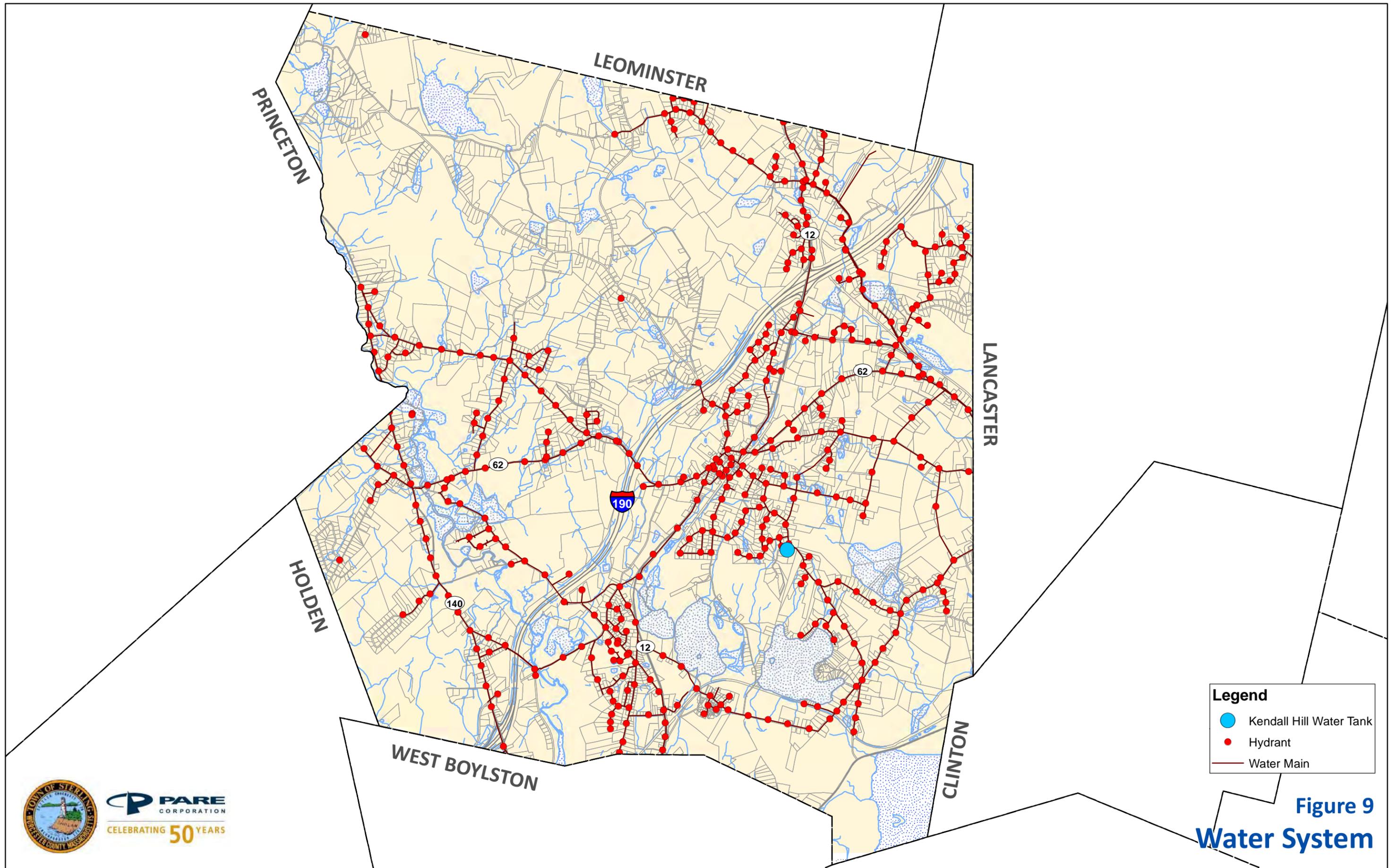
**Legend**

**FEMA Flood Zone**

- A
- AE
- X500
- Inlet/Outfall
- Culvert
- Drain Pipe

**Figure 8**  
**Stormwater and Flooding**





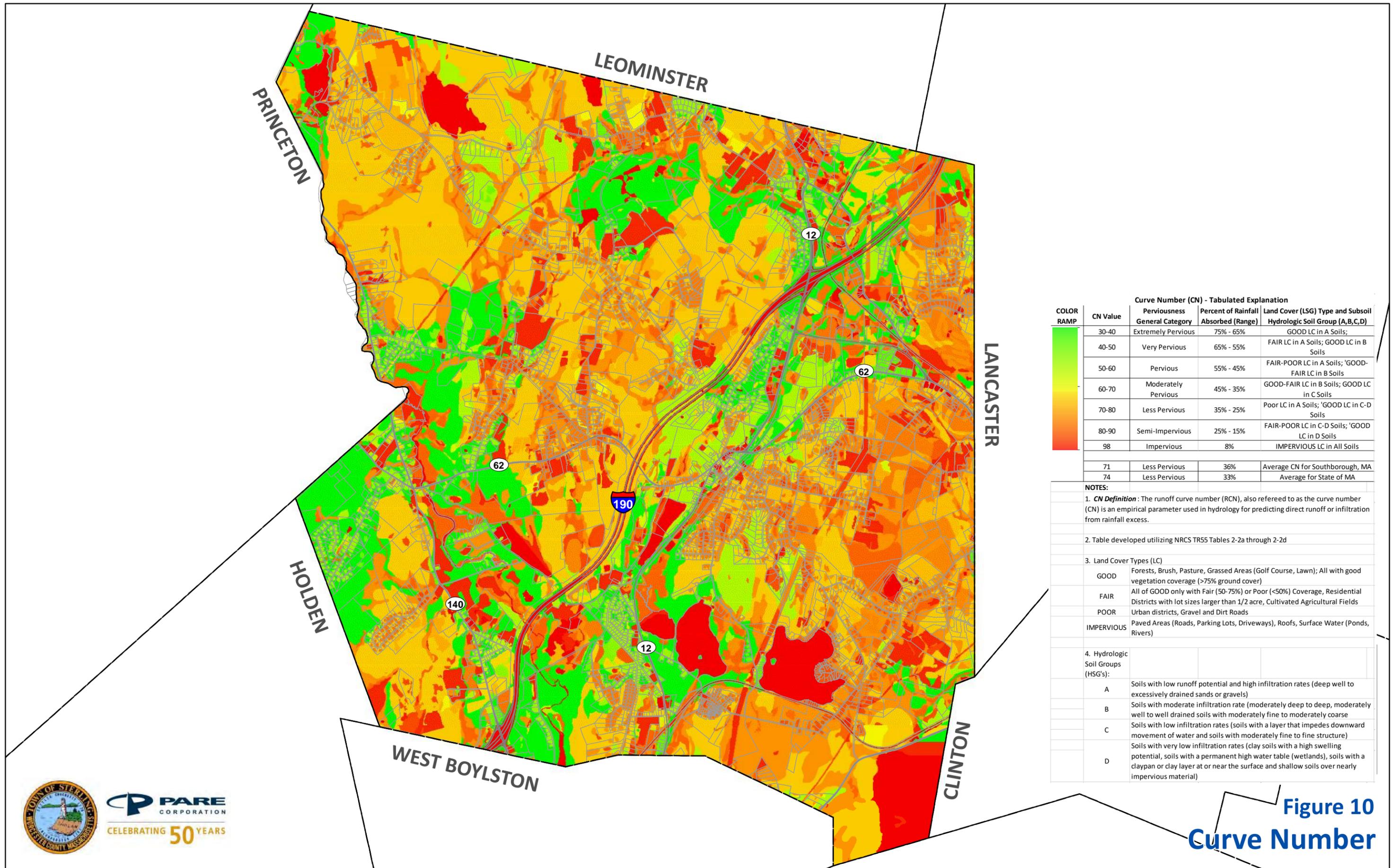
**Legend**

-  Kendall Hill Water Tank
-  Hydrant
-  Water Main

**Figure 9**  
**Water System**



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CORPORATION  
CELEBRATING 50 YEARS



Curve Number (CN) - Tabulated Explanation				
COLOR RAMP	CN Value	Perviousness General Category	Percent of Rainfall Absorbed (Range)	Land Cover (LSG) Type and Subsoil Hydrologic Soil Group (A,B,C,D)
	30-40	Extremely Pervious	75% - 65%	GOOD LC in A Soils;
	40-50	Very Pervious	65% - 55%	FAIR LC in A Soils; GOOD LC in B Soils
	50-60	Pervious	55% - 45%	FAIR-POOR LC in A Soils; 'GOOD-FAIR LC in B Soils
	60-70	Moderately Pervious	45% - 35%	GOOD-FAIR LC in B Soils; GOOD LC in C Soils
	70-80	Less Pervious	35% - 25%	Poor LC in A Soils; 'GOOD LC in C-D Soils
	80-90	Semi-impervious	25% - 15%	FAIR-POOR LC in C-D Soils; 'GOOD LC in D Soils
	98	Impervious	8%	IMPERVIOUS LC in All Soils
	71	Less Pervious	36%	Average CN for Southborough, MA
	74	Less Pervious	33%	Average for State of MA

**NOTES:**

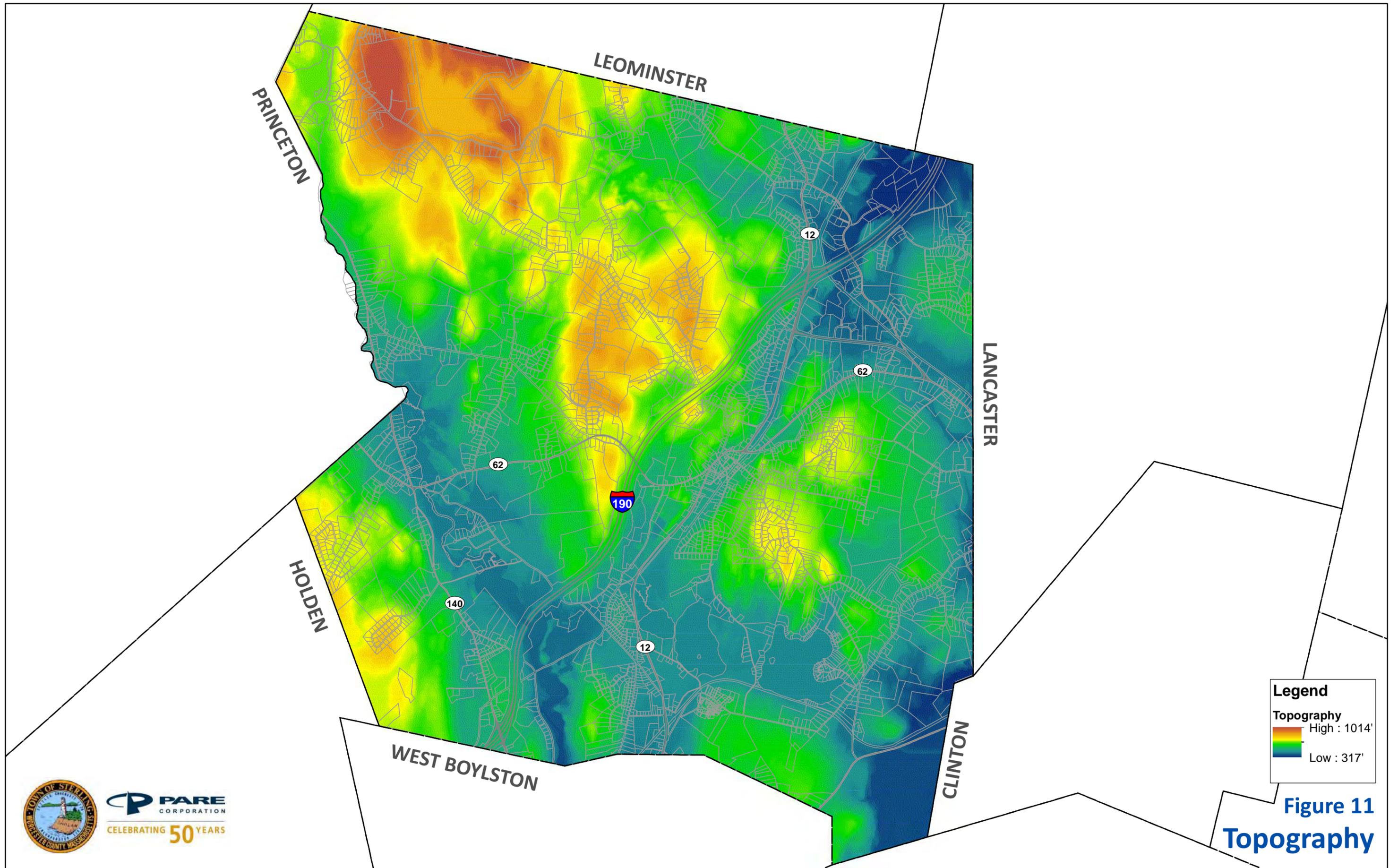
- CN Definition:** The runoff curve number (RCN), also referred to as the curve number (CN) is an empirical parameter used in hydrology for predicting direct runoff or infiltration from rainfall excess.
- Table developed utilizing NRCS TR55 Tables 2-2a through 2-2d
- Land Cover Types (LC)
 

GOOD	Forests, Brush, Pasture, Grassed Areas (Golf Course, Lawn); All with good vegetation coverage (>75% ground cover)
FAIR	All of GOOD only with Fair (50-75%) or Poor (<50%) Coverage, Residential Districts with lot sizes larger than 1/2 acre, Cultivated Agricultural Fields
POOR	Urban districts, Gravel and Dirt Roads
IMPERVIOUS	Paved Areas (Roads, Parking Lots, Driveways), Roofs, Surface Water (Ponds, Rivers)
- Hydrologic Soil Groups (HSG's):
 

A	Soils with low runoff potential and high infiltration rates (deep well to excessively drained sands or gravels)
B	Soils with moderate infiltration rate (moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse)
C	Soils with low infiltration rates (soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure)
D	Soils with very low infiltration rates (clay soils with a high swelling potential, soils with a permanent high water table (wetlands), soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material)



**Figure 10**  
**Curve Number**



**Legend**

Topography

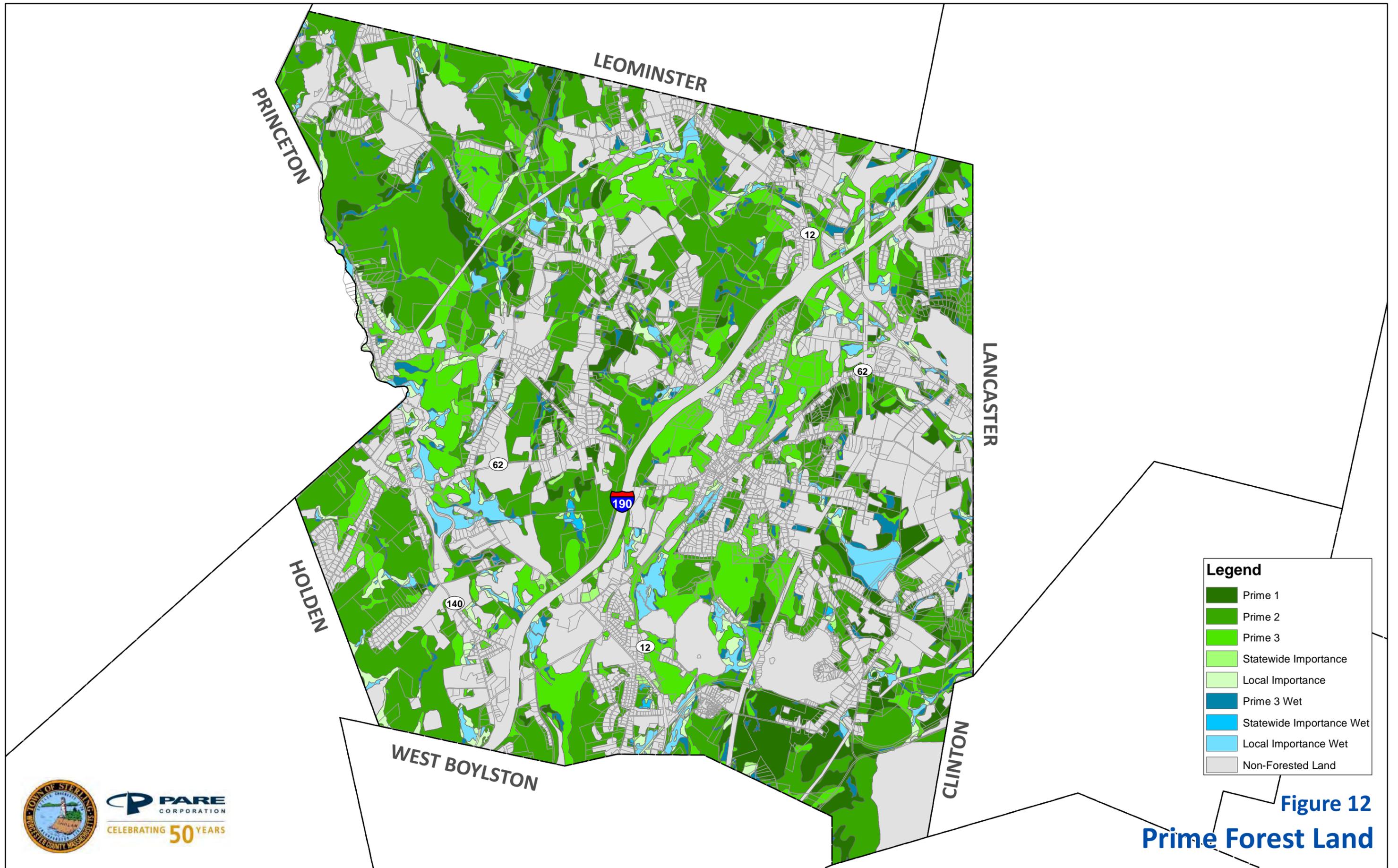
High : 1014'

Low : 317'

**Figure 11**  
**Topography**



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**Legend**

- Prime 1
- Prime 2
- Prime 3
- Statewide Importance
- Local Importance
- Prime 3 Wet
- Statewide Importance Wet
- Local Importance Wet
- Non-Forested Land

**Figure 12**  
**Prime Forest Land**



**PARE**  
CORPORATION  
CELEBRATING 50 YEARS



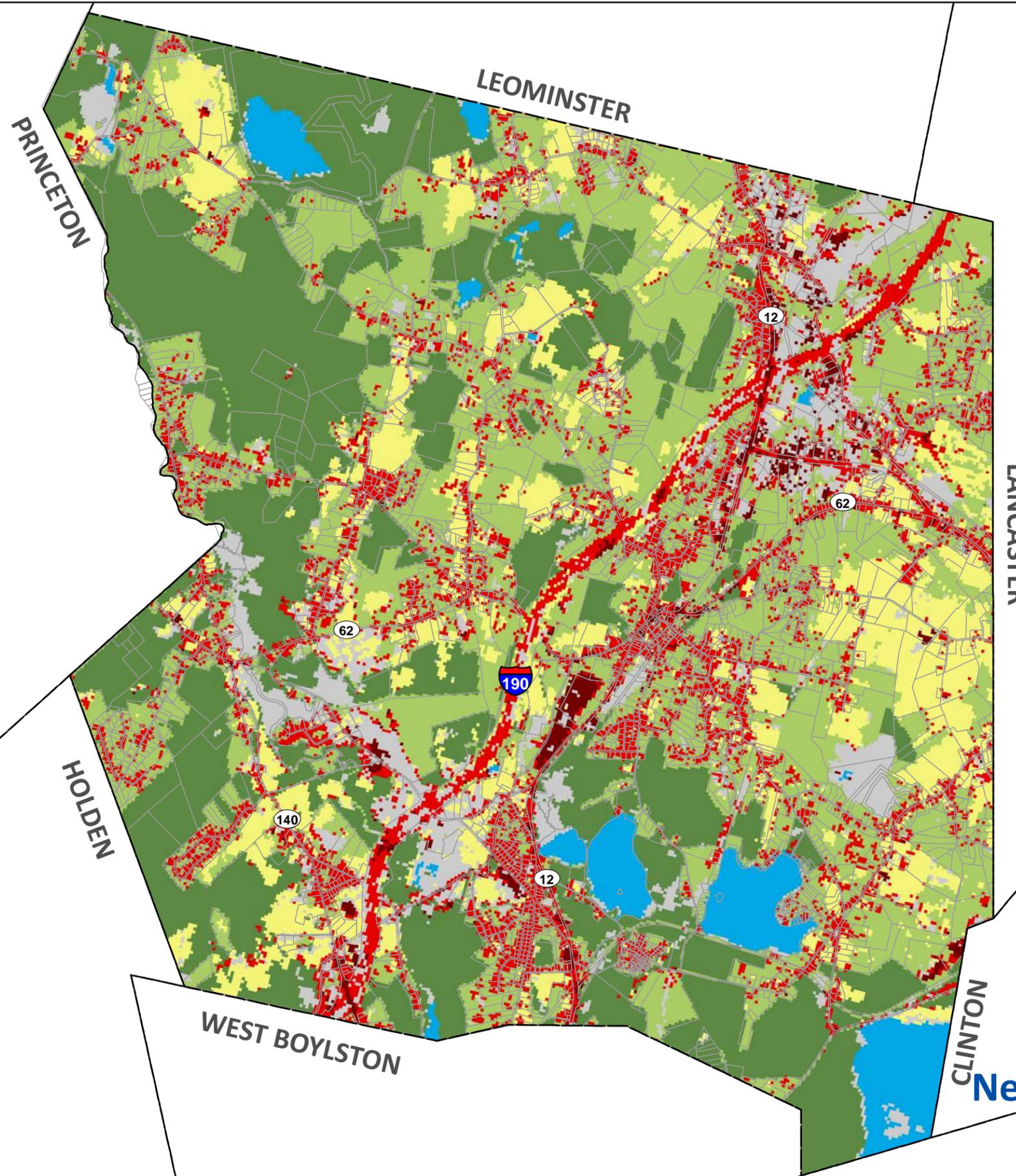
**Legend**

- All Areas are Prime Farmland
- Farmland of Statewide Importance
- Farmland of Unique Importance

**Figure 13**  
**Farmland Soils**



**PARE**  
CORPORATION  
CELEBRATING 50 YEARS



**Recent Trends**  
 This is a future of continuing along the current path where forest cover is declining in all New England states. Based on recent trends, New England will lose 1.2 million acres of forest by 2060, reducing forest cover by 4% from about 75% of the total land area today to 71% by 2060. Recent trends of land use indicate a future New England landscape with less forest overall and increasing fragmentation of our remaining forests with sprawling development.

**Legend**

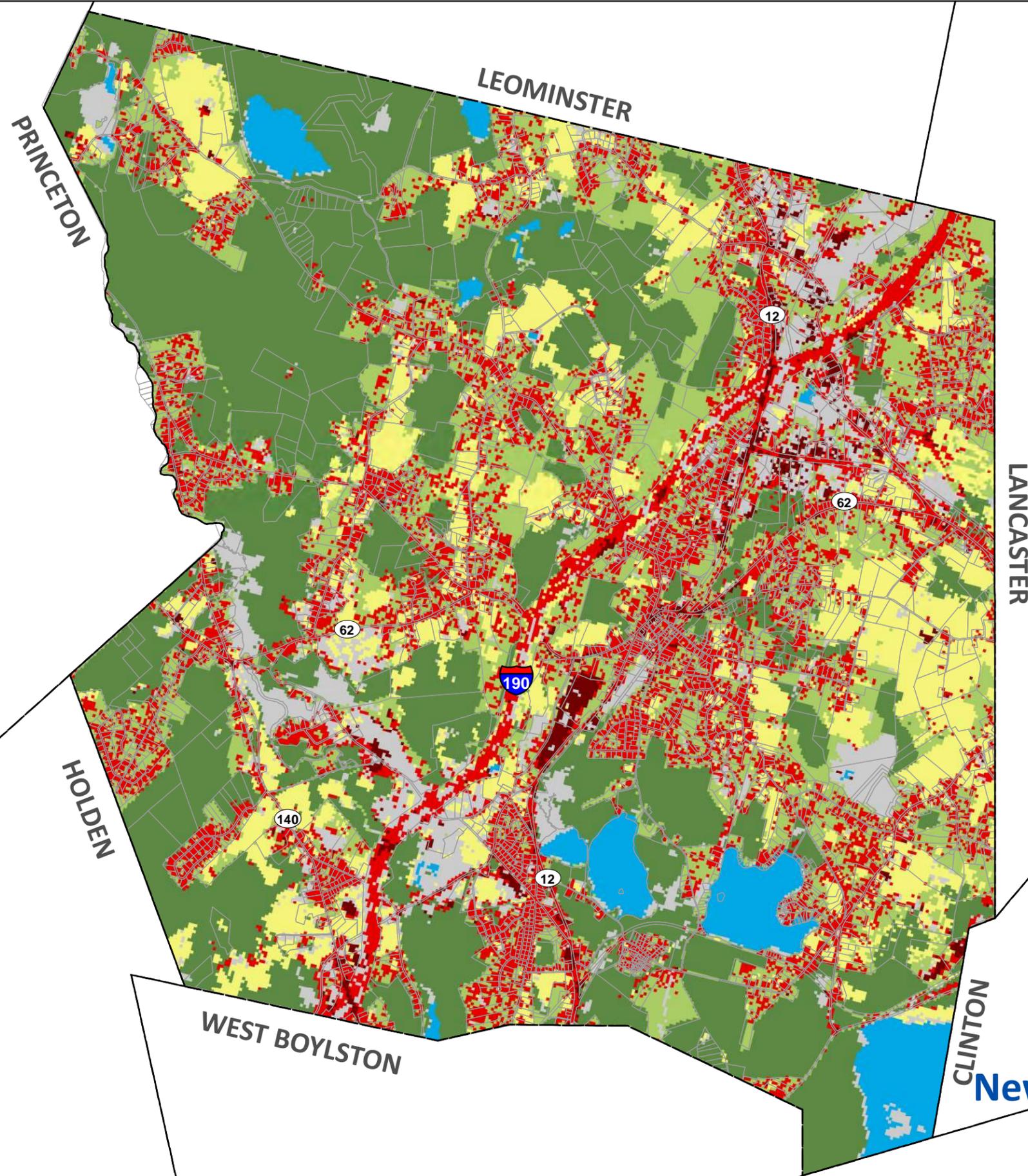
**Recent Trends 2020**

**Value**

- High Density Development
- Low Density Development
- Unprotected Forest
- Conserved Forest
- Agriculture
- Other
- Water

**Figure 14**  
**New England Landscape Futures**  
**Current Use 2020**





**Recent Trends**  
 This is a future of continuing along the current path where forest cover is declining in all New England states. Based on recent trends, New England will lose 1.2 million acres of forest by 2060, reducing forest cover by 4% from about 75% of the total land area today to 71% by 2060. Recent trends of land use indicate a future New England landscape with less forest overall and increasing fragmentation of our remaining forests with sprawling development.

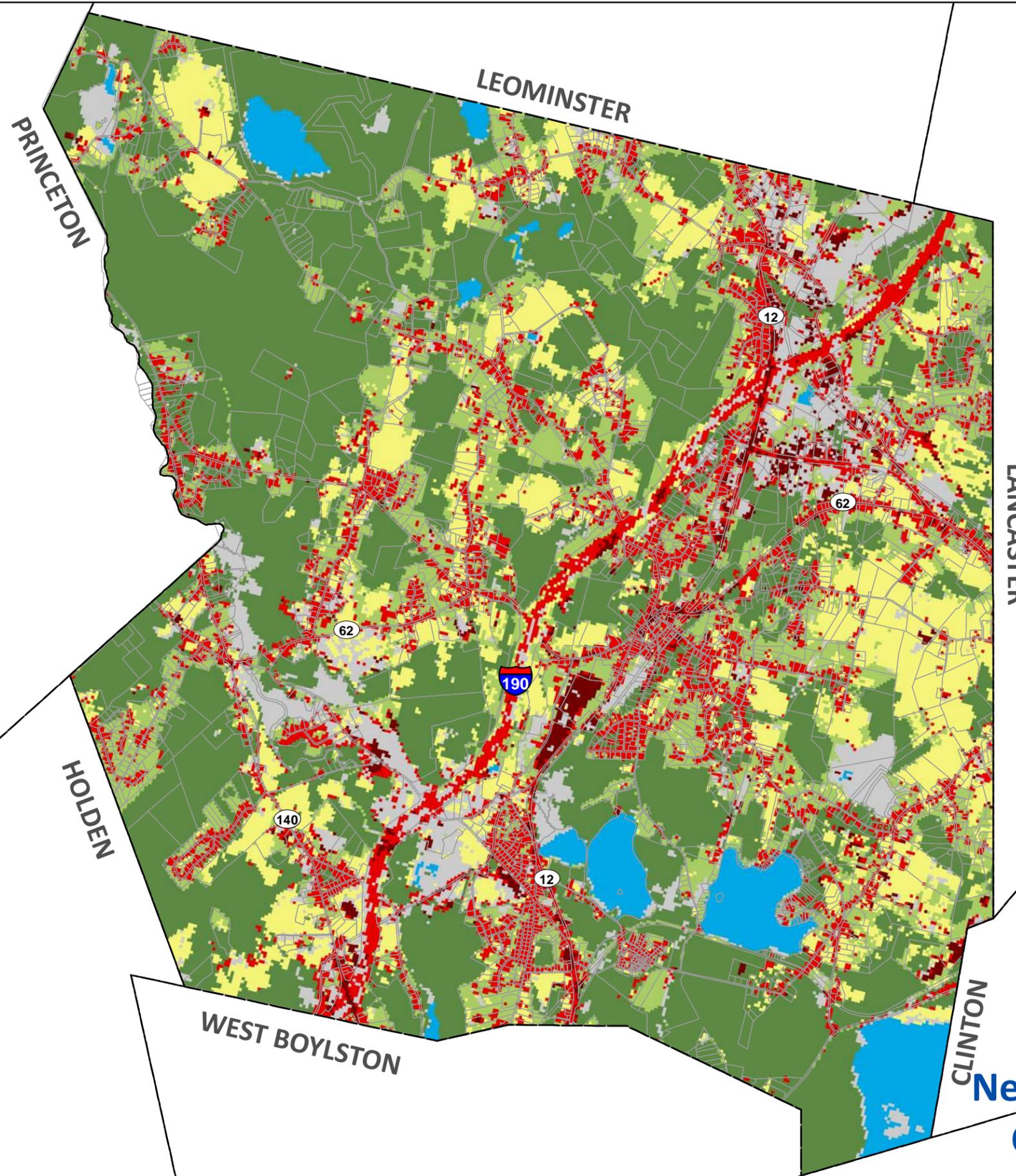
**Legend**

**Recent Trends 2060**

**Value**

- High Density Development
- Low Density Development
- Unprotected Forest
- Conserved Forest
- Agriculture
- Other
- Water

**Figure 15**  
**New England Landscape Futures**  
**Recent Trends 2060**

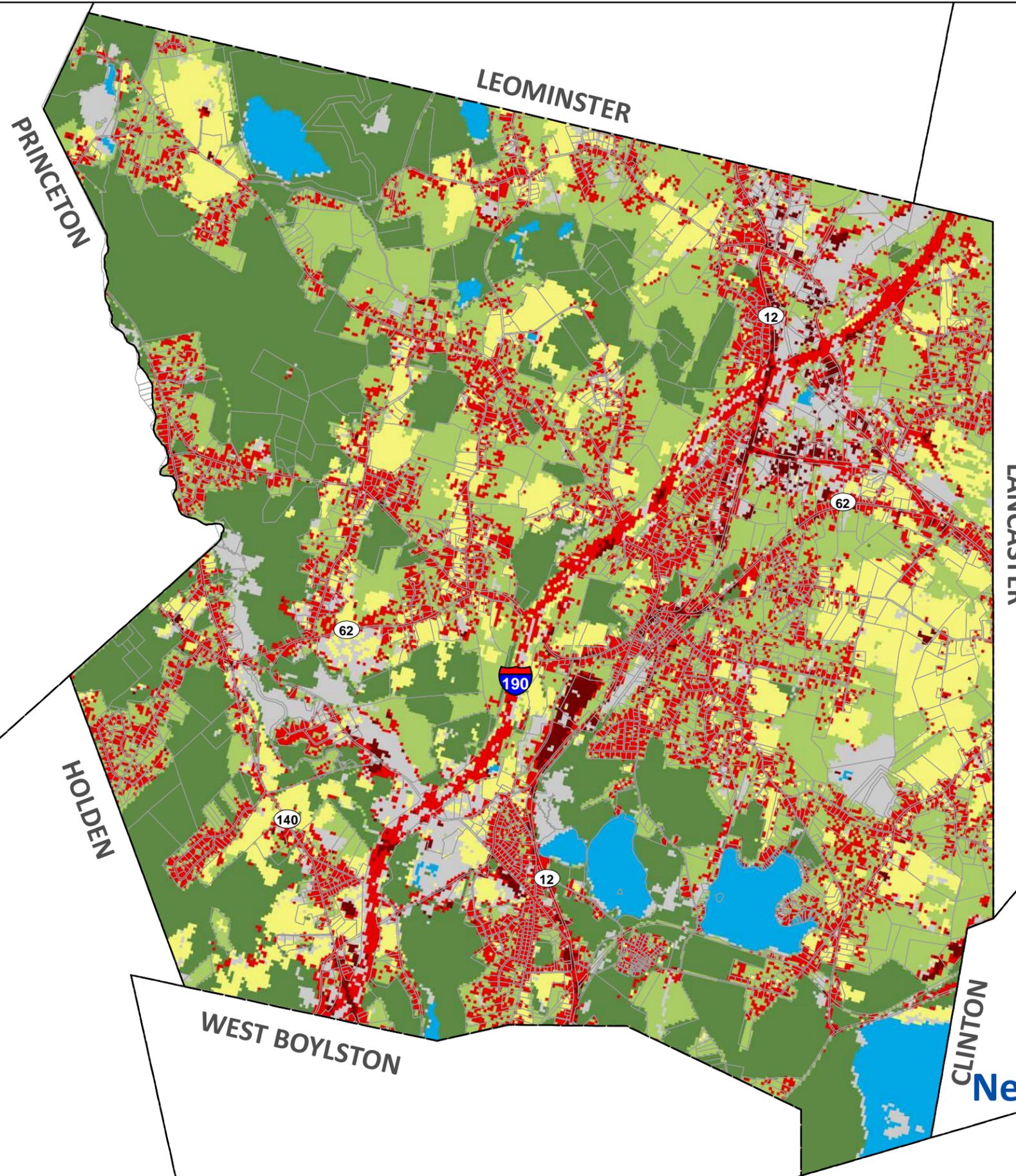


**Connected Communities**  
 -Localized world, economy  
 -High innovation  
 -Renewable energy  
 -Proactive government planning  
 -Ecosystem services highly valued  
 -Stable population  
 -Smart growth works  
 -Infrastructure investments serve local needs

**Legend**  
**Connected Communities 2060**  
**Value**  
 ■ High Density Development  
 ■ Low Density Development  
 ■ Unprotected Forest  
 ■ Conserved Forest  
 ■ Agriculture  
 ■ Other  
 ■ Water

**Figure 16**  
**New England Landscape Futures**  
**Connected Communities 2060**





**Go It Alone**

- Localized world, economy
- Low innovation
- Conventional, high-cost energy
- Low government planning
- Low value of ecosystem services
- De-population of the north
- Limited but sprawling development
- Decay in infrastructure
- Reduced mobility

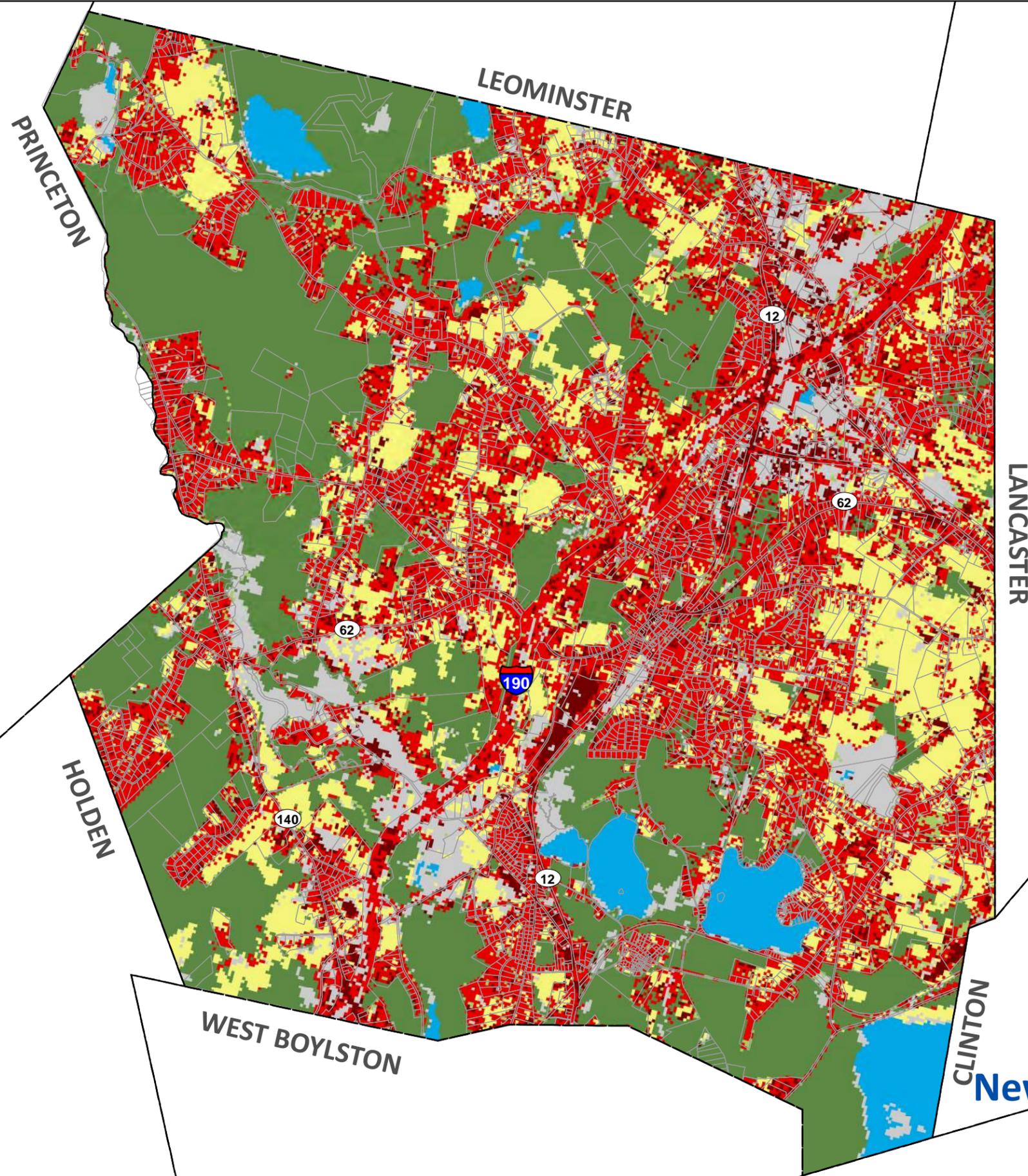
**Legend**

**Go It Alone 2060**

**Value**

- High Density Development
- Low Density Development
- Unprotected Forest
- Conserved Forest
- Agriculture
- Other
- Water

**Figure 17**  
**New England Landscape Futures**  
**Go It Alone 2060**



**Growing Global**  
 -Globalized world, economy  
 -Low innovation  
 -Conventional, cheap energy  
 -Low government planning  
 -Low valuing of ecosystem services  
 -High immigration  
 -Rapid, sprawling development  
 -Investment in conventional infrastructure

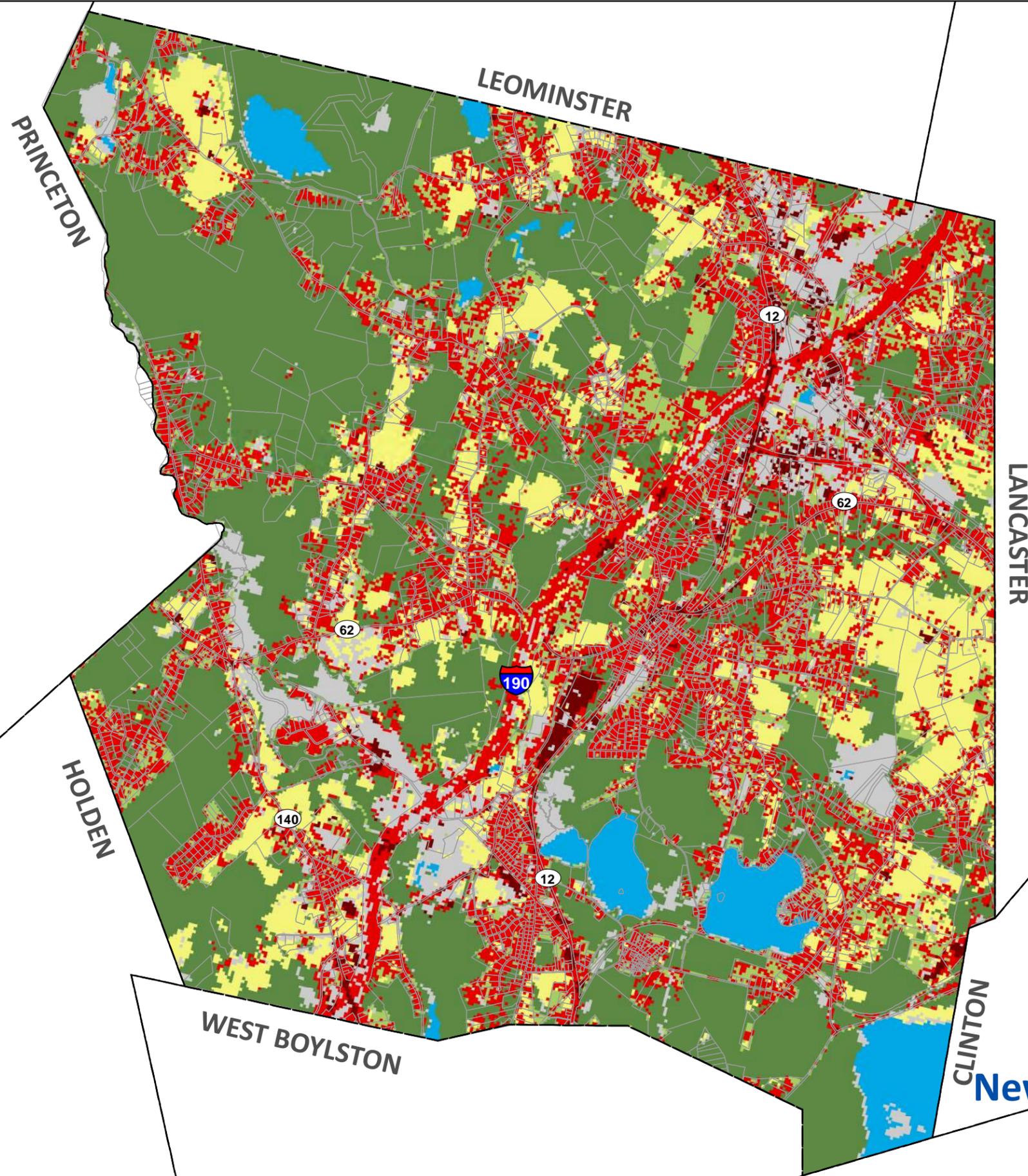
**Legend**

**Growing Global 2060**

**Value**

- High Density Development
- Low Density Development
- Unprotected Forest
- Conserved Forest
- Agriculture
- Other
- Water

**Figure 18**  
**New England Landscape Futures**  
**Growing Global 2060**



**Yankee Cosmopolitan**  
 -Globalized world, economy  
 -High innovation  
 -Renewable energy  
 -Proactive government planning  
 -Some ecosystem services highly valued  
 -High immigration  
 -Smart growth -> becomes sprawl, especially in South  
 -Infrastructure investments serve global needs

**Legend**

**Yankee Cosmopolitan 2060 Value**

- High Density Development
- Low Density Development
- Unprotected Forest
- Conserved Forest
- Agriculture
- Other
- Water

**Figure 19**  
**New England Landscape Futures**  
**Yankee Cosmopolitan 2060**

## Appendix D: Group Matrices from Workshops

**Top Priority Hazards** (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

**H-M-L** priority for action over the **Short** or **Long** term  
**V** = Vulnerability **S** = Strength

Features	Extreme Weather	Loss of Biodiversity Agriculture (temp change/pest/disease)	High Intensity Rainfall	Drought (lowering water table)	Priority	Time
					H - M - L	Short Long Ongoing

**Infrastructural**

Culverts - capacity/structure concern	1. inventory of size and condition/compare to current design requirements and storms (H&H), impact from dams. 2. prioritization criteria (value provided by the culvert) 3. seek financial assistance/complete design <b>[EW and HIR]</b> 4. implementation				H	ongoing
Bridges maintenance and structure	1. Answer the questions: How many state owned/how old/when inspected/impact from dams 2. Develop prioritization/Sterling communicate with MassDOT regarding state bridge concerns 3. financial assistance/design <b>[EW and HIR]</b> 4. implementation				M	s
Roads - wear and tear/sanding	1. inspect/volume of traffic 2. priortize maintenance/repairs/traffic managment, future storm events (drainage) 3. financial assistance to fund exisiting multi-year plan, state vs local <b>[EW and HIR]</b> 4. implementation /Pavement managmanet system				M	s
Electrical/Communication Infrastructure	<b>EW Risk:</b> 1. Assessment/inventory/prioritization 2. Encourage alternative power sources/preventive actions/demonstration projects 3. Conservation guidance from Town (education/promotion)				M	s
Drinking Water Infrastructure	<b>HIR and Drought:</b> identify new sources and tie ins; review/recommend conservation pactices				H	s
Airport/Sterling Fair/Town Mtg location	<b>EW Risk:</b> wide open paved field - how protect? Improve snow removal capabilities to mainatin use				L	l

**Societal**

evacuation routes (what is it, do we have one)	<b>EW, HIR:</b> update/educate/mark route/publicize/ alternate route				H	S
Shelters (schools)	<b>EW, HIR:</b> Senior Center shelter of choice - schools backup: Generator maintenance, establish approach for supplies, cots within the facility for various events Senior Center/Community education from EMD regarding responses transportation plans to the shelter				H	ongoing
Sterling Village Nursing/Rehab	assess capacity to assist the Town with special/higher need individuals - develop partnership - transportation					s
Domestic Animal Sheltering	establish animal friendly shelters and communicate this to the public, educate public about "go kits" necessary for domestic animals					ongoing
Churches	formalize/identify partnerships to assess cacpacity, services, and accessibility assess partnerships to establish financial assistance				M	ongoing
Food Pantries	assess partnerships to establish continued food distribution during storm events				M	ongoing

**Environmental**

chem/fert runoff from agri/res land	1. educate community on proper practices for fertilizers and farming practices 2. restrict pesticides				M	Short
Soil Erosion/crop damage	education about farming techniques inclusive of plowing and irrigation				L	Ongoing
trees/biodiversity/habitat	maintenace of both open space and woodland space to provide diverse habitats - develop openspace, residential, cluster by-law				L	Short
orchards/farms	education about farming techniques inclusive of crop selection, pesticides etc.				L	Long
Fire access to forested areas	establish right-of-ways/agreements for fire access (existing, discontinued, or new)				L	Short

**Community Resilience Building Risk Matrix**



www.CommunityResilienceBuilding.org

Jim Newman and Trish Teeter

H-M-L priority for action over the Short or Long term (and Ongoing)  
 V = Vulnerability S = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	Extreme Weather	Loss of Biodiversity and Agricultural Land	High Intensity Rainfall	Drought	Priority	Top	Time
								H - M - L		Short Long Ongoing
<b>Infrastructural</b>										
Rail lines through town			V							
Airport		Private owned	V/S							
I 190			V/S	Partner with DCR and other Wachusett watershed towns on getting state DPW and others to consider alternative salting and other road maint systems						
Dam in NW of town	North road area		V	Work to fix the dams that are considered in seious condition				M		O/L
Limited septic opportunity			V/S							
Electrical Infrastructure			V/S	enhanced tree maintenance	managing watertable (beavers and such)	Putting infrastructure underground		L		L
Town street infrastructure			V/S							
Ground water town water system (contamination)				<b>Build redundancy in water systems (Wachusett)</b>			program to reduce average water use	H		S
Ground water town water system			V	Partnering with DCR on BMPs	<b>Start discussion with MWRA about buying in</b>	How to take advantage of rain to recharge aquifer	Define forward-looking precipitation amounts for planning and design	H		S/O
Electromagnetic damage from weapons or space weather										
Weather impact on routes in and out of town				<b>Define forward-looking precipitation amounts for planning and design</b>	Lookat salt usage on winter roads	resizing of culverts and stormwater system along with green infrast.	<b>Evaluate precipitation data and effects</b>	H		S
<b>Societal</b>										
Limited space			V/S							
Volunteer participation in town governance			V/S	Work more with natural volunteer organizations in town (Friends of the Library, exampla)	Volunteering helps to keep tax rate down in an indirect way	be more clear about what a volunteer might do on a	Refresh the culture of volunteerism in town	M		O/L
MART District transportation services			V/S			Enhance services with public/private partnership		M		S/O
Senior center			S							
<b>Environmental</b>										
Watershed pollution			V							
DCR Conserved land in town			V/S							
Industrial development			V/S		<b>Re-look at zoning to look ahead 20 years (more attention to the northern edge of rt. 12 - might also be others)</b>		Want to facilitate responsible growth	H		S/O
residential development			V/S	<b>Forward looking planning</b>	Maybe also promote certain kinds of development in certain locations		Similar need for re-thinking zoning	H		S/O
Flooding					Join Mosquito Control		Work across agencies			
				<b>Might be time for an environmental advisory committee (DCR interested in as well as other natural partners - multiple agencies)</b>				M		S
Wetlands protection act			S							
Watershed protection Act (by DCR)			S							
Storm water runoff					DCR's concern about watershep			H		O

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

H-M-L priority for action over the Short or Long term  
 V = Vulnerability S = Strength

Features	Increased Storm Severity/Frequency	Extreme Percipitation (Drought & Flooding)	Extreme Temperatures	Population Growth/Population Vulnerability (pandemic)	Priority	Time
					H - M - L	Short Long Ongoing
<b>Infrastructural</b>						
Police/Fire Stations/Access to Clinton Hospital	Will increase calls for police & fire services; Increased response time;	Similar to previous hazard; increase wildfire risk	Similar to previous	Increase volume of requests for service; increased need for planning; (	M	O
Water Supply System/Water restrictions	Power outages could cause issues; contamination not really an issue	Could improve or exacerbate water supply and availability	Increased residential water line disruptions	Could impact availability and quality	H	O
DPW/Light/Power Department	Increased dependence on DPW; Increased budget	Increase dependence on DPW; Increase budget requirement; reduce access in flooding;	Higher demand	More demand for services and electricity		
Town Hall & School Buildings	Increased use as shelter; continuity of government operations	Minimally affected - increased use as shelter	Similar to extreme weather	Currently minimal impacts, but could be more severe in the future; may need		
Library/Senior Center	Increased use as shelter; Increase vulnerability to town historical items; Increase need for backup power	Minimally affected - increased use as shelter		Increases number of people to serve		
Recreational Facilities	Minimal impact - again, increasing dependence on DPW	Increase need for maintenance; susceptible to drought	Similar to previous	Increased demand		
<b>Societal</b>						
Aging population	Increased difficulty in meeting living needs of population at risk	Minimal impact	Could be detrimental to health/increased cost of	Could be affected by changes in tax base		
Urbanization (loss of farms)	Could increase financial risk;	Increases challenges of farm operation; decreases yield; can	Similar to previous	Likely to increase urabization/reduce farmland		
Interagency support	Increases demand/reliance	Increased demand/reliance	Similar to previous	Minimal impact		
Social groups, churches	Increases demand/reliance	Increased demand/reliance	Increased need for reliable HVAC systems; increased cost	May increase capabilities		
Reduction in volunteerism	People will volunteer more, but managing more volunteers can be	Similar to previous hazard	Could further reduce volunteerism	Depending on population demographics, could increase or decrease		
Recreation programs	Increased disruptions	Disrupt access	Could necessitate a change in programs; increased cost	Increase demand for programs		
<b>Environmental</b>						
DCR Land/Private Dams/DCR interaction	Dams may be vulnerable/Increased fire risk/Increased flooding potential	Increases stresses to DCR Infrastructure	Could increase fire risk in time of extreme heat	Increased demand		
Trail systems	Increased maintenance for trails following storm events; disruption of use	Detrimental, but low impact	Reduction in patronage	Increased demand/use		
Groundwater/surface water pollution	Minimal and short term	Could create major fluctuations in water table/water supply	Could be impacted is drought associated	Increased demand/use = reduction of groundwater availability		
Habitat loss/increased runoff	Increased runoff could pollute lake	Will stress natural habitats, flooding will increase runoff	Could be impacted is drought associated	Increases due to new construction		
Increased wildlife interaction	Could decrease wildlife populations; food availability	Will likely interact more often due to disruptions; could eventually	Could increase is drought associated	Increases with higher population		
Increased storm intensity/drought/incidents	Intersects with hazard description	Intersects with hazard description	Would likely increase severity of storm events	No effect		

H-M-L priority for action over the Short or Long term (and Ongoing)  
 V = Vulnerability S = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	Extreme Weather Events	Loss of Biodiversity /Agriculture	High Intensity Rainfall	Drought (lowering groundwater table)	Priority	Time
								H - M - L	Short Long Ongoing
<b>Infrastructural</b>									
Capacity of wells - water system	Townwide	Municipal &	V						
Road systems	Townwide	Municipal &	V						
Power and communication system (overhead)	Townwide	SMLC (power)	S (SMLC)						
Town Beach	Town Beach	Municipal	V (round)						
Culverts	Townwide	Municipal	V						
<b>Societal</b>									
Shelter (facilities & plan)	Senior center	Senior Center	S						
Elderly population (Sholan Terrace)	Bird St	Housing Authority	V - high						
Farming Community	Townwide	Private	S (V - at)						
HMEA (adult daycare facility)	Chocksett Rd	Private	S - as a						
Public transportation (limited, but does have)	Townwide (RTA)	Regional (RTA)	V						
<b>Environmental</b>									
Open Space / Forests	Townwide	Private, Municipal	S						
Surface Water (Wachusett Reservoir)	Southeast of	State	S						
Brush Fires	Townwide	State (DCR)	V						
Wildlife	Townwide	all	S & V						
Drinking water quality	Townwide	all (municipal)	S (risk)						
Stormwater runoff quality	Townwide &	all	V						

**Community Resilience Building Risk Matrix**



H-M-L priority for action over the Short or Long term (and Ongoing)  
 V = Vulnerability S = Strength

**Top Priority Hazards** (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	EXTREME WEATHER	LOSS OF BIODIVERSITY/AGRICULTURE	HIGH INTENSITY RAINFALL	DROUGHTS (LOWER WATER TABLE)	Priority	Time
								H - M - L	Short Long Ongoing
<b>Infrastructural</b>									
Water Utilities	-	Town	V	Implement an integrated water management plan to address vulnerabilities. (Create new well fields/update aged infrastructure/increase footprint). Explore incentives for individual properties reusing grey water and stormwater.				H	
Electric Utilities (Town Owned with vulnerable substations)	-	Town	S	Revisit several streets with several old trees (forest management plan); review of substation locations to ensure they are not susceptible to flooding; more batter backup.				M	
Roadway Network/Culverts/Traffic Signals/Traffic	-	Town/State	V/S	Culvert assessment/hydraulic analysis at specific locations; Asset Management Plan on roadways/culverts; Integrate local evacuation routes into regional plan (evaluate additional signage); Additional mobile variable message signs				H	
Town Meeting Spaces/Town Buildings	-	Town	S						
Dams	-	Mixed	V	Dams not in Town Ownership (also private owners) - Agreements needed to review reports as a major stakeholder				M	
Medical Facilities/Emergency Management/Shelters	-	Town/Private	S	Explore backup generators at sheltering locations				L	
<b>Societal</b>									
Code Red System/Alert Systems	-	Town	S	Explore backup system in case of power outages/phone outages; advertise/marketing for people to sign up and to receive information; define an emergency contact protocol for townwide communications; town website updates potentially needed				L	Town can implement a plan
Faith based/community organizations/food bank	-	Town/Private	S	Provide a bigger seat at the table as a stakeholder in town-wide issues.				L/M	
Vulnerable populations	-	N/A	V	Explore consolidated mental health/public health plan for the community				L	
"Isolated Neighborhoods" (outside of hydrant district)	-	Town/Private	V	Explore ways to reduce response times to these areas for first responders				L	
Recreation Facilities/Activities	-	Town/Private	V	Help the Rec department match the infrastructure to the projected program; help them meet their expected needs; match the rec plan with the open space plan				M	
<b>Environmental</b>									
Zoning - "Sprawl" eating up land	-	Private	V	Review opportunities for "smart growth"/revise zoning bylaws to allow for cluster developments/explore existing frontage requirements				H	
Conservation Land - Open Space	-	Town/State	S	Generate accurate inventory of existing properties (prepare acquisition/protection plan for future green spaces); explore opportunities for Community Preservation Act; provide tools for access to quicker funding in case properties become available				M	
Clean Drinking Water	-	Town/State	V						
Ponds/Lakes/Rivers	-	Town/State	S						
Contamination	-	N/A	V	updated contingency plan to account for potentials of contamination; explore salt reduction techniques on roads; explore chemical use reduction in orchards; training/education materials outlining contamination impacts on the community				M	
Agriculture	-	Town/Private	S	Generate methods to put farming to be in a position of future success (matching future farmers with farms that may be in need, or without a current exit strategy)				H/M	

## Appendix E: Top Priority Actions Discussion Summary from Workshop



# TOWN OF STERLING, MA

## Municipal Vulnerability Preparedness

### Top Priority Actions

Capacity of the Wells and Water System

Water availability and infrastructure - upgrade capacity and system

Water Supply and Water system

cross agency planning and implementation for LID and green infrastructure

Groundwater system - building redundancy into water supply system, reduce water use over time, green infrastructure to help with recharge, precipitation to use for high priority

Culverts & Drinking water infrastructure - inventory of what we have & prioritization for improvements

Power and Communication System - going below ground

roadway condition - drainage culverts

local roads - consider evacuation routes, high intensity precipitation impacts, salt alternatives

Road System - upgrading system and stormwater

Stormwater Runoff quality

Evacuation Route - increase awareness

Addressing financial burden of extreme weather events (providing security)

Shelters, sterling nursing rehab, animal sheltering - collaborate for proper emergency management

loss of farms - encourage water saving farming techniques, encourage shifting to high (pressure of development and continuity of generations)

zoning to plan for future development - residential, industrial, etc

zoning and sprawl control - help densify, encourage affordable housing, preserve open

establish environmental advisory committee

MUNICIPAL VULNERABILITY PLANNING WORKSHOP INVITATION LIST

MVP Invitation List						
Last Name	First Name	Organization	Not Attending	Attending	Note of Partial Attendance	Email
Abrams	Colleen	Wachusett Greenways	1			
Aldrich	Susan	Resident		1		<a href="mailto:sealdrich@gmail.com">sealdrich@gmail.com</a>
Archambault	Kimberly	Sterling Skilled Nursing		1		<a href="mailto:karchambault@sterling-village.com">karchambault@sterling-village.com</a>
Ares	Erik	Fire/EMT				
Ayala	Melissa	School Committee	1			
Bartlett	Robin	Pastor First Church	1			
Bershad	Blaine	MPC				
Borge	Darren	Light Dept.				
Bratko	Jassy	North County Land Trust				
Buckley	Veronica	Senior Center		1		<a href="mailto:ybucklev@sterling-ma.gov">ybucklev@sterling-ma.gov</a>
Campbell	Elizabeth	Nashua River Watershed				
Campbell	Pat	Library Director		1		<a href="mailto:pcampbell@cwmar.org">pcampbell@cwmar.org</a>
Carr	Jamie	DCR				
Carroll	Jeff	Sterling National C.C.				
Castagna	Nancy	Realtor				
Cathcart	Paul	EDC	1			
Chamberland	Gary	Police Chief				
Chandler	David	Meadowbrook Farm				
Chase	Meg	Resident	1			
Cintron	Gerson	North Central Mass Housing Authority - Director of Facilities		1		<a href="mailto:gerson@leominsterha.com">gerson@leominsterha.com</a>
Coonan	Samantha	Mike Radzicki's student				
Corrinne	Carl	CD Builders				
Cranson	Maureen	BOS				
Culgin	Sarah	Building Commissioner		1		<a href="mailto:sculgin@sterling-ma.gov">sculgin@sterling-ma.gov</a>
Curtin	Joe	Pandolf Perkins				

Davidson	Neal	Hope Chapel		1		<a href="mailto:neald@hopechapelsterling.org">neald@hopechapelsterling.org</a>
Davis	John	Davis Farmland				
Dietel	Kristen	Recreation Director		1		<a href="mailto:kdietel@sterling-ma.gov">kdietel@sterling-ma.gov</a>
Dumont	Bob	MPC				
Emerton	Jim	Fire/EMT		1		<a href="mailto:jemerton@sterling-ma.gov">jemerton@sterling-ma.gov</a>
Farrell	Kathy	Ass. Town Clerk				
Favreau	Blue					
Favreau	David	BOH Agent				
Fox	Pat	ZBA				
French	Jim	DCR				
Gaudette	Sean	Police Sergeant				
Gibson	Fran	Gibson Dairy				
Gillotti	Lacy	NEADS, Inc.		1		<a href="mailto:lgillotti@neads.org">lgillotti@neads.org</a>
Gold	Ben	Housing Authority	1			
Gould	Pam	Wachusett Food Pantry				
Grattaroti	Angela	MPC				
Guild	Pam	First Church				
Hamilton	Sean	Light Dept.				
Heller	Everett	Fin Com		1		<a href="mailto:everetheller@mac.com">everetheller@mac.com</a>
Hinkley	Joyce	Resident		1		<a href="mailto:bstrevenge@comcast.net">bstrevenge@comcast.net</a>
Hoffman	Allen	BOH				
Holman	Phil	First Church		1		<a href="mailto:philsterl@comcast.net">philsterl@comcast.net</a>
Hume	John	MRPC				
Hurlbut	David	Fire Chief		1		<a href="mailto:david.hurlbut@sterlingfd.net">david.hurlbut@sterlingfd.net</a>
Kelley	Freda	DCR				
Kilcoyne	John	BOS		1	X	<a href="mailto:jkilcoyne@sterling-ma.gov">jkilcoyne@sterling-ma.gov</a>
Kimball	Bob	Resident		1		<a href="mailto:bgregk@comcast.net">bgregk@comcast.net</a>
Kokernak	Tom	Fire Lieutenant		1		<a href="mailto:tkokernak@sterling-ma.gov">tkokernak@sterling-ma.gov</a>
Lamountain	Sarah	School Committee				
Larson	Marion	DCR				
Lyons	Paul	DPW Superintendant				
Mahoney	Sandy	Chamber of Commerce - Wachusett				
Maki	Dick	MPC		1		<a href="mailto:r.maki0491@comcast.net">r.maki0491@comcast.net</a>

Malone	Rick & Diane	Clearview Farms			
Marro	Matt	ConCom Agent		1	<a href="mailto:mmarro@sterling-ma.gov">mmarro@sterling-ma.gov</a>
Massa	Lou	Animal Control		1	<a href="mailto:animalcontrol@sterling-ma.gov">animalcontrol@sterling-ma.gov</a>
McDermott	Christopher	Chamber of Commerce - North Central			
Menin	Gary	BOH			
Michalak	Scott	Board of Engineers			
Miller	Hannah	Agricultural Commission			
Monchamp	Pete	Resident		1	<a href="mailto:pete.monchamp@outlook.com">pete.monchamp@outlook.com</a>
Nickerson	Bob	Agricultural Commission			
Nourse	Paul	8 Point SportsmenClub			
Page	Patty	PB & MPC	1		
Patacchiola	Jim	EDC			
Pedersen	Diane	OSIC			
Pedersen	Peder	OSIC		1	<a href="mailto:pedersen@wpi.edu">pedersen@wpi.edu</a>
Perry	Ross	Town Administrator		1	<a href="mailto:rperry@sterling-ma.gov">rperry@sterling-ma.gov</a>
Phinney	Susan	Agricultural Commission			
Pineo	Mike	Agricultural Commission			
Plaisted	Chuck	OSIC & MPC			
Protano	Rob	AHC & MPC	1		
Radzicki	Mike	WPI Professor & Resident			
Roberti	Barbara	East Lake Waushakum Assoc. & Conservation Commission			
Rota	David	Rota Spring Farm			
Rusch	Julie	Resident	1		
Ryan	Cathie	Resident		1	<a href="mailto:cathieryan@comcast.net">cathieryan@comcast.net</a>
Segur	Janet	Sterling Grange		1	<a href="mailto:sterlinggrange53@gmail.com">sterlinggrange53@gmail.com</a>
Simpson	Jim	Sterling Real Estate Dev.			
Sonnenberg	Arden	BOS		1	<a href="mailto:asonnenberg@sterling-ma.gov">asonnenberg@sterling-ma.gov</a>
Steuterma	Fr. James	St. Richard Catholic			
Tatasciore	Domenica	Town Planner		1	<a href="mailto:dtatasciore@sterling-ma.gov">dtatasciore@sterling-ma.gov</a>
Thomas	Lex	SBA/EDC			
Whitney	Weymouth	SHA & Resident		1	no email - Senior Center

Woodland	Linda	School Committee		1	X	<a href="mailto:linda_woodland@wrsd.net">linda_woodland@wrsd.net</a>
		Chocksett Inn				
		Sterling Shelter				
		Sterling Grange				
		Town of Holden				
		Town of Princeton	1			
		Town of West Boylston	1			
		Town of Boylston				