Town of Shirley

Community Resilience Building Workshop

Summary of Findings

October, 2019

FUSS & O'NEILL

Project No. 20170390.H50

Town of Shirley

Community Resilience Building Workshop

Summary of Findings

Overview

Extreme weather and natural and climate-related hazards are an increasing concern for the communities of Massachusetts, and there is a clear need to involve municipalities, corporations, organizations, and the State in increasing resilience at all levels. Recent storm events affecting the region have highlighted many of the vulnerabilities that towns and cities face. Hurricane Irene and Superstorm Sandy brought intense flooding to many municipalities and threatened (or destroyed) infrastructure across the state. Extreme temperatures at both ends of the spectrum have pushed the limits of communities' preparedness to protect both infrastructure and people. In coastal communities, the impacts of sea level rise are felt daily and further exacerbate the impacts of other extreme events. Current climate modeling indicates that all of these hazards are expected to increase in frequency and scale over the coming decades. The Municipal Vulnerability Preparedness (MVP) program provides support and a prescribed process for cities and towns in Massachusetts to plan proactively for resiliency and implement key climate change adaptation actions.

In 2019, the Town of Shirley was awarded a $20,000 MVP grant to fund the planning stage of this process. The Town partnered with Fuss & O'Neill, a state certified MVP Provider, to complete a comprehensive, baseline climate change and natural hazard vulnerability assessment and develop a list of priority actions for the Town. This process involved the development of an MVP Core Team, which met on September 3, 2019 to determine initial concerns and worked to identify stakeholders within the municipality and set goals for the process. Those stakeholders were then invited to participate in a Community Resilience Building (CRB) workshop on September 26, 2019, engaging in a day-long, tried and tested process developed by The Nature Conservancy. The CRB methodology is an "anywhere at any scale" format that draws on stakeholders' wealth of information and experience to foster dialogue about the strengths and vulnerabilities within the Town. Workshop participants interacted at both large and small group levels, using an iterative process to gather input, synthesize ideas across groups, and ultimately develop a set of priority resilience and adaptation actions.

The CRB workshop's central objectives were to:

- Define top local natural and climate-related hazards of concern;
- Identify existing and future strengths and vulnerabilities;
- Develop prioritized actions for Shirley;
- Identify immediate opportunities to collaboratively advance actions to increase resilience.

Top Hazards and Vulnerable Areas

During the Community Resilience Building workshop, participants were asked to identify the top four natural hazards of concern for the Town of Shirley. Discussion of the top hazards built on earlier conversations that took place at the MVP Core Team Meeting. Flooding was identified as a top hazard. Extreme precipitation, including ice and snow, was a second hazard, while drought was considered a third hazard. The impacts of heat, especially the increase in days over 90 degrees Fahrenheit, was seen as a fourth hazard. These four hazards have already had demonstrated impacts on the Town, and as climate change progresses, these hazards are expected to have ever greater consequences for infrastructure and environment, as well as for various societal elements. Specific areas of concern are identified below.

Top Hazards

- Flooding
- Extreme Precipitation/Snow and Ice
- Drought
- Heat

Areas of Concern

While many impacts are expected to be felt Town-wide, certain elements, locations, or community groups present particular concerns.

Neighborhoods/Communities
Walker Street, senior population, student population, environmental justice communities

Facilities
Senior Center, Lura A. White Elementary, Ayer Shirley Regional Middle School, Ayer Shirley Regional High School, MBTA station

Ecosystems
Mulpus Brook area, Squannacook River area

Dams
Mulpus Brook Dam, Lake Shirley Dam, and Hickory Hills Dam

Infrastructure
Electrical lines, water infrastructure, pump station, culverts

Current Concerns and Challenges Presented by Hazards

Major storm events have been a recurring threat to Shirley throughout its history, from hurricanes bringing wind, intense precipitation, and localized flooding, to winter storms delivering ice and snow. Notable historic events include impacts from the Great Hurricane of 1938, which caused considerable tree damage in Shirley. More recently, the Town has been experiencing an increasing regularity of storms, with the so-called 100 year storm now happening several times a year—as workshop participant Roy Herzig noted, "the 100 year storm isn't the 100 year storm anymore."

More intense storms delivering higher volumes of precipitation in a single event are expected to put significant pressure on dams, culverts, and other drainage infrastructure that were designed to handle smaller storms with more consistent distributions of precipitation. This problem manifests at points across the Town and is acute where the local drainage systems concentrate and discharge, especially in areas such as Benjamin Road.

The Town is also noticing a shift in the type and timing of storms. Many storm events now encompass a mixture of rain, ice, and snow, making it more difficult to maintain safe, accessible roadways. The 2008 flood was fresh in residents' minds. Sam Santiago, Police Chief, recalled evacuating residents of Walker Street by boat after the flood isolated their homes. In addition to forcing residents out of their houses, it also required additional personnel from both the Fire and Police Departments, placing further burden on the staffing limits and the budget of the Town.

In 2018, the schools were impacted by extreme temperatures, both heat and cold. As Bill Plunkett from the School Department recounted, "it was 98 degrees on the first day of school last year." Concerns were voiced over the impact of heat on students and staff, especially with the forecasted increase of days over 90 degrees. In the past few years, Shirley has also been on the verge calling off school for excessive heat as well as extreme cold.

Extreme temperatures are also leading the Town to make greater use of cooling shelters. The Senior Center and the Middle School are both used as designated cooling shelters and were first opened during the heat wave of summer 2019. Municipal leaders are eager to get the word out and increase transportation options so that more people, especially the elderly, are able to access these vital resources more often.

Specific Categories of Concerns and Challenges

Infrastructural

Culverts and Bridges

Culverts and bridges are a concern Town-wide, particularly as Shirley's developed areas are in such close proximity to the numerous rivers, streams, and wetlands. Existing culverts and bridges were designed to accommodate historic patterns of precipitation and runoff, but are rapidly becoming inadequate as a result of climate change. While design standards have changed, the Town's infrastructure largely predates such changes, and thus has not kept up with new standards. As precipitation events become more intense and less predictable, undersized culverts are expected to pose a greater threat of failure and flooding. A majority of the culverts in Town were built from the 1950s to 1970s—as DPW Director Brandon Kelly noted, many of these corrugated metal culverts have reached their life expectancy and are "completely falling apart." Brandon discussed how structural issues, like separating and crumbling headwalls, are not uncommon. In addition to Town-wide concerns, several culverts were specifically discussed during the workshop. Participants were concerned about the condition of the culvert at Mulpus Road, as its collapse would cause widespread impacts—the Town has been in discussions with MassDOT to replace it. Additionally, the double box culvert on Townsend Road was recently replaced, although DPW staff have to clear out accumulated beaver debris from the 7-foot culvert annually. Workshop participants also discussed the 42-inch culvert on Benjamin Road, which is "rotted out completely." There are concerns over its structural integrity, as it would "shut down the road permanently if it failed catastrophically." The area is also prone to flooding during heavy rains—participants said that it is not uncommon for police to divert traffic in the area for 30 minutes to an hour when it floods. The problem has improved in recent years, although it still a concern for emergency vehicles. Workshop participants also discussed ongoing issues with the culvert on Lancaster Road, which is hydraulically undersized.

Fourteen culverts in Town have been assessed – four by the Massachusetts Department of Transportation (DOT) and ten by the Nashua River Watershed Association (NRWA). Brandon Kelly noted that limited funding is a major source of concern and the DPW is facing increased financial pressure to repair and replace aging infrastructure. He also noted the difficulty in obtaining funding for projects that are not visible, like culverts and drainage, as residents "want to see something for their money." The Town has considered applying for the Municipal Small Bridge Program in the past, although the competitive nature and limited scope for sizing make it an unreliable funding source.

Stormwater Infrastructure

Detention basins and other stormwater infrastructure are recognized as a potential concern Town-wide. Similarly to culverts conveying natural streams, there is a general recognition that much of the stormwater drainage system was designed to accommodate historic patterns of precipitation and runoff, and may be undersized as climate and weather patterns continue to shift. The Town's aging stormwater infrastructure and lack of maintenance funds exacerbates flooding potential during heavy rains. Catch basin maintenance was voiced as a concern Town-wide, and workshop participants were specifically concerned about the catch basins near the MBTA station on Ayer Road/Front Street at the bottom of Benjamin Hill, which they noted are routinely clogged.

Roads

Roads in Shirley are vulnerable to flooding, as well as the impacts of snow and ice. In general, shifting weather patterns due to climate change are increasing the difficulty of maintaining those roadways. Potholes and sinkholes are becoming more problematic due to new patterns of freezing and thawing that

occur repeatedly throughout the winter season. Participants also voiced concern about the amount of sand and salt needed to keep streets clear during the winter, the financial burden of purchasing increasing quantities of these materials, and the impact that these materials have on wetlands and protected areas (as well as impacts on the landscapes where they are being mined or extracted). Roadway impacts due to hazard events in turn compromise the Town's ability to provide emergency services. Roads vulnerable to flooding were identified in multiple locations across the Town and were especially of concern where they limit access for emergency vehicles, such as Benjamin Road and Front Street/Ayer Road. DPW Director Brandon Kelly also voiced concern over the high water table and poor soils leading to pavement failure Town-wide.

Water Infrastructure

The Shirley Water District is the oldest water district in the Commonwealth and serves 1,500 customers Town-wide. The water main on Front Street near Benjamin Road has broken multiple times, causing mud to clog the six-inch pipe. Workshop participants noted that water lines in this area are prone to blowing out, with the most recent incident in October/November 2018. Aging water infrastructure is also a concern Town-wide. The Water District expressed interest in partnering with the Town regarding Front Street—if the Town repaves the street, the Water Department would like to simultaneously replace the 4,000 feet of main line, valves, and the hydrant in the area, which are over 100 years old. The Water Department also expressed concerns over the cost of repainting the water tanks every 15 years, which costs $1.5 million per tank. The pump station near Morris Brook is also in a low-lying area that is prone to flooding.

Electrical Infrastructure

Communications and power lines can be knocked out by snow and ice, in addition to wind events, causing extensive impacts to the Town. Extreme heat also stresses the electrical system, as increasing use of air conditioning leads to a risk of brown outs and outages, particularly if heat impacts are region-wide. Scott Farrar, the National Grid Community Manager, discussed the increasing pressure for repairing downed lines from residents expecting uninterrupted power. He also discussed the difficult, ongoing process of converting the system from a 1-way flow to 2-way flow to accommodate the increase of renewable energy tying into the grid, such as solar and wind. Scott also discussed the impact of increasing solar on the community, as it requires additional infrastructure (larger poles, higher voltage lines) that necessitates considerable tree clearing and landscape changes—as Scott said, "Please realize what you're getting into when you approve solar." Workshop participants noted that the Route 2 corridor and Route 117 near Townsend Road are two areas that have already been impacted by the solar development.

Buildings and Facilities

Extreme temperatures are impacting the ability to effectively heat or cool buildings. For example, buildings with brick and masonry facades absorb excessive heat from the urban environment and retain it during extremely hot days. Cooling capacity is an issue at locations Town-wide, but was specifically noted at the schools in the area. More generally, the need to buffer and protect structures in flood zones and establish backup power for critical infrastructure and facilities across the Town was recognized as a major concern affecting large portions of the community.

Title V and Septic Systems

The majority of the Town is on septic systems. Septic systems in Shirley are a concern due to increasing flooding and the potential for high groundwater to lead to septic failures and discharges of sanitary waste to the environment, posing a threat to both human health and the environment. Beaver-related flooding in the Townsend Road area has also led to problems with septic systems in the area. Additionally, participants voiced concern over the burden that replacing septic systems places on residents.

Beavers
Concerns about beavers were discussed as an environmental issue, but also, and more critically, as an infrastructure problem. Whereas the Town generally has some record of and control over man-made stream crossings or impoundments, beaver activity is often known only anecdotally, if at all, and can cause unpredictable problems during heavy precipitation, when flooding occurs in unexpected locations. The Town struggles with trying to keep beaver impoundments from inundating residential areas with water; for instance, beaver-driven flooding has impacted septic systems and causes road flooding near Thompson Road. Participants were uncertain if these septic systems are failing Title V as a result. Workshop participants also noted beaver issues near Holden Road. Conservation Agent Mike Fleming described how beavers are, with the exception of drought years, an annual problem in Town. Beavers are also known to clog the double culvert near the Townsend Road area (recently replaced by MassDOT) with debris—the DPW clears the structure out annually.

Dams
Dams in Shirley were identified as a priority for resiliency improvements. Understanding the Town's overall vulnerability to dam failure, where dam removal is possible, and where improvements can be made to public and privately-owned dams, especially high-hazard dams, was a major infrastructure concern. Three dams were specifically discussed during the workshop: the Mulpus Brook Dam, Lake Shirley Dam, and Hickory Hills Dam. Workshop participants noted that the failure of the Lake Shirley Dam would have "catastrophic" impacts. Paul Przybyla, Chair of the Historical Commission, stated that there have been at least three incidents of flooding related to the Lake Shirley Dam in the past, although there has been no recent flooding. The flow of the dam is controlled by Lunenburg. The Hickory Hills Dam was noted as a dam of concern because there are many houses downstream, although participants were unaware of any flooding issues in the past. Private dams could also pose failure risks, although these were not discussed in detail at the workshop.

Backup Power Supply
There is a lack of back-up power at facilities Town-wide, including the Lura A. White Elementary School and the Senior Center. Workshop participants noted that if a back-up power supply is needed at these facilities, they may have to borrow the Sewer Commission's trailer mounted generator. As an alternative to generators, workshop participants also discussed the possibility of a microgrid for the Town. A microgrid would allow buildings to continue receiving electricity even if the main power grid experienced an outage.

Environmental

PFAS
Workshop participant Roy Herzig, Environmental Engineer for Devens, expressed concerns over the possibility of PFAS contaminating water supplies in Town. PFAS, or per- and polyfluoroalkyl substances, are industrial surfactants that can be found in a variety of chemical products, notably in firefighting foam. PFAS does not break down and can accumulate in the human body, leading to adverse health effects. Firefighting training exercises conducted at Devens used foam containing PFAS, which leeched into groundwater. As a result, PFAS was detected in drinking water wells in Devens (at levels below the MassDEP advisory guidelines of the time but above the new proposed guidelines). MassDevelopment issued an advisory that certain residents only drink bottled water as a result. The Town of Ayer also recently received a filtration system to treat drinking water for PFAS after a well tested positive for the contamination. The Army is currently conducting additional tests for PFAS in drinking water wells in the area. Roy Herzig also voiced concerns over the impact that drought and flooding could have on the contamination. During drought, as wells pull in water from further out in the water table, additional areas

further from Devens could receive contaminated water. Conversely, during heavy precipitation, there water may push contaminants further out in the water table.

Water Quality

Workshop participants expressed concern over the water quality impact of runoff from the landfill and salvage yards. There is an automobile salvage yard in close proximity to Mulpus Brook—participants were concerned that unknown contaminants could enter into the waterbody, especially during heavy rains. Participants were also concerned that the landfill, on the border with Lunenburg, could contaminate drinking water supplies. The landfill is capped, although it contaminated wells in the past and forced some residents to tie into the public water supply.

Trees and Forests

Forests provide critical ecosystem services that help buffer the effects of climate change, from sequestering carbon, to increasing groundwater recharge, to modulating local temperature. Street trees are likewise critical for infiltration of rainwater and provision of shade. However, trees and forests are also threatened by climate change. Wind and storms cause blowdowns, drought can contribute to die-off, new invasive pests (e.g., Emerald Ash Borer and Hemlock Wooly Adelgid) are eliminating certain tree species, and others are in decline due to shifting temperature and precipitation regimes that favor more southerly species. The Town's emergency services also recognize that hazard events can convert trees from assets to threats. Workshop participant Mike Fleming, Conservation Agent, also expressed concern over the lack of snow cover (fluctuating winter temperatures causing premature snow melt) and how the subsequent lack of ground insulation affects root systems. Participants also noted concern over the increase in solar energy in Town and how this impacts tree coverage in Shirley, relating both to tree clearing for solar panels and the increased trimming required to keep trees away from two-way power flow electric lines.

Invasive Species

Invasive plants and animals are a source of concern in Shirley, as they are throughout the Commonwealth. Forest and upland ecosystems are threatened by a variety of invasive plants, including oriental bittersweet, multiflora rose, two types of swallowwort, and several non-native honeysuckles. Riparian and aquatic habitats are severely threatened by common reed, Japanese knotweed, invasive water chestnut, hydrilla, purple loosestrife, Eurasian milfoil, and zebra mussels. In addition to their habitat impacts, the latter can potentially cause flooding by clogging drain pipes. Critical invasive insect pests already in the area include the Gypsy Moth, Hemlock Wooly Adelgid, and Emerald Ash Borer, all of which have the potential to do serious damage (both environmental and economic) to Massachusetts' forests and trees. These and other species already pose a significant challenge and have serious consequences for ecosystem health and resilience, and these impacts are likely to increase in response to climate change. Warming temperatures will also bring new invasives to the area, and these will have an easier time gaining a foothold if the Town's natural ecosystems are simultaneously weakened due to changes in climatic conditions.

Local Agriculture

Unpredictable climate and weather conditions are taking a toll on agriculture locally and across the region. Climate change is expected to result in a longer growing season for New England, which can be beneficial for some crops but may lead to issues with others, for instance, by allowing additional time for blight or other crop diseases to develop. Early melt of snow pack, drought, excessive rain, and changing temperatures may all affect agriculture and livestock at varying scales. Pumpkin Brook Organic Gardening was one farm specifically discussed as an asset to the community. Another important agricultural resource for the Town is the Longley Acres Community Garden, which has 15 plots for residents to use.

Societal

Employee Safety
At the time of the workshop, EEE risk in Shirley was classified as "moderate" by the Massachusetts Department of Public Health. Employees have not received training on EEE exposure but have access to mosquito spray and have standard uniforms, typically boots and pants, which provide some level of protection from mosquitos. Participants discussed concern over a lack of training and personal protective equipment for Town staff that work outdoors and may be exposed to EEE.

Bemis Associates
Bemis Associates is the largest private enterprise in Town with over 250 employees. Bemis is a three shift plant that operates 24 hours a day manufacturing outdoor apparel and accessories. The operation requires uninterrupted electricity, and there are concerns over the impact of power outages on the manufacturing process. Alyssa Caddle, Director of Sustainability at Bemis Associates, also discussed the lack of HVAC at the facility and the company's concern over the impact of increasingly hot days on employees. Bemis has partnered with the Town on previous projects, and expressed interest in continuing and expanding on this partnership—as Alyssa stated, "we are only as resilient as the community we are in."

Devens
Devens is a regional enterprise zone abutting the Town. Jessica Strunkin, Senior Vice President of Devens, stated, "Issues don't stop at the border."Devens faces many of the same issues as the Town of Shirley. Jessica highlighted the Devens Enterprise Commission (DEC) as a strength of Devens, as it encourages environmentally friendly development. Devens is also part of a mosquito control district—Jessica discussed how Devens received many calls from organizations from neighboring towns asking to use their recreational fields because they were sprayed. Devens also has a redundant power supply, which was highlighted as a strength, although it is still connected to the grid and buys its power in bulk from National Grid.

Fishing
Shirley is a popular destination for fly-fishing, especially near the Squannacook River. Workshop participants expressed concerns over how climate change may impact this industry, ranging from shifting fish species to impacts on water quality. Workshop participants also discussed the role that fly-fishing could play in increasing tourism in the area.

Vulnerable Neighborhoods
Certain neighborhoods within Shirley are especially prone to flooding and have been experiencing problematic events for years. Walker Road was brought up frequently during the workshop. Sam Santiago, Chief of Police, recalled a 2008 incident that required boat rescue from the Police and Fire departments. Dennis Levesque, Fire Chief, added that six residences were evacuated during the incident and residents were without access to their homes for days. Some of these residences are mobile homes, and only a portion are on platforms, which increases their vulnerability to flooding. In some residences, basements were flooded up to the first floor and power had to be shut off completely. Participants noted the flow of the Nashua River is a good predictor of flooding; while there is usually an 8-10 foot drop at the dam, during heavy rains leading up to flooding there is "no drop-off—it's just straight across." Flooding of these homes is a recurring issue—access has been cut off 6 to 8 times in the past 20 years. Hill Street was also discussed up as an area prone to flooding. Additionally, there are a number of mobile home parks throughout Town, with one park designated for seniors only and one with low-income residents. Due to their very nature as semi-permanent structures, mobile homes can be particularly vulnerable to storm events and high winds. Participants noted that these parks are aging and in "rough shape," compounding vulnerability concerns.

Vulnerable Populations

Workshop participants acknowledged the challenges of identifying and reaching vulnerable individuals, especially those without internet access for viewing the Town's Facebook page or E-Alert System, which serve as primary outlets for emergency information, as well as those who may no longer have a land-line telephone, homeless individuals without an address, or those who may not self-identify as vulnerable. Certain populations, especially seniors, homeless citizens, citizens struggling with addiction, and environmental justice communities within the Town, are known to be at higher risk during hazard events and may require support beyond emergency notifications. The Town's Hazard Mitigation Plan (HMP) promotes coordination with vulnerable populations to ensure these residents receive adequate protection during hazard situations. There is a high senior population in Town—Marilyn Largey, Council on Aging Director, expressed concern over the impacts of power outages on seniors and the mobility of seniors during emergencies, such as transportation to shelters, as the Council only has a MART van that is available for senior transportation during weekdays. A new senior living center, the Meadows, is also under construction in Town, which will have 58 units for ages 60 and over. Additionally, on a day-to-day basis, the Police Department conducts well-being checks for seniors.

Shelters

The Ayer Shirley Regional Elementary School in Town serves as an emergency shelter. The shelter was last opened in 2008 for two weeks for the ice storm. The Middle School and the Senior Center also serve as cooling shelters for residents—these cooling shelters were opened for the first time in response to the summer 2019 heatwave.

Schools

Shirley's schools and student population are affected by a variety of hazard types. Schools are increasingly forced to cancel classes due to snow and ice events or extreme cold that make it impossible to safely get students to school. As days above 90 degrees increase, heat stroke is a concern for the student population in general, as the schools are not air conditioned, and for student athletes in particular. Bill Plunkett, Finance Director at the School Department, expressed concern over the impact of heat on the safety and comfort of students and staff. Bill described how in 2018 it was "98 degrees on the first day of school." There is no central air conditioning in any of the schools, although there is AC in the central office, nurse's office, and guidance office of the High School and the Middle School has air handling units on the roof and air conditioning in the central office and business office. Bill said there has been an increase in requests for air conditioners, although fans have been supplied instead. Conversely, there is an increase of ice in November and December, which is problematic because of temperature fluctuations and the thaw/refreeze cycle—Bill reported an increase of slip and fall concerns in the schools' parking lots. The schools have also considered closing due to extreme heat and cold in the past. Heating is also an issue at the Elementary School, where a boiler replacement is needed.

Pests and Disease Control

Climate change is affecting pests and disease vectors both through changing precipitation conditions and changing temperature conditions. Warmer, wetter conditions lead to increased mosquito populations, while the absence of sufficient periods of cold means that pest populations that would historically have been killed off or reduced are able to survive the winter and emerge in greater numbers the following season. Further, as the Massachusetts climate begins to look more like the climate of the mid-Atlantic and southern states, we are seeing new types of diseases show up in existing pests (e.g. mosquitoes carrying West Nile Virus, Eastern Equine Encephalitis, or Zika and ticks carrying Rocky Mountain Spotted Fever). 2018 marked the Commonwealth's highest ever incidence of West Nile Virus diagnosis while 2019 was had the highest EEE prevalence in decades in the Commonwealth. These changes present a major public and animal health challenge in terms of education, prevention, and treatment. The increased threat of EEE

was deemed "scary" by multiple workshop participants. Mike Gibbons, Assistant Town Accountant, discussed "people calling in every day with questions" about EEE. Bill Plunkett from the School Department also described increasing concerns over the safety of students and school-related outdoor activities during mosquito season. The Town opted out of a mosquito district in 1993, but in 2019 took immediate action to address the EEE threat and sprayed. In fall 2019, the Town plans to propose rejoining a mosquito control district and including these plans for spring 2020. The Town also wants to increase resident awareness and outreach and what residents can do to protect themselves from EEE and vector-borne diseases.

Provisions, Medicine, and Fuel

Maintaining access to essential supplies like groceries, medicines, and fuel (for vehicles, heating, and generators), as well as critical medical care and drug treatment during emergencies, was a concern for workshop participants. It was acknowledged that power outages or road closures which affect access to these services could have extensive impacts on residents throughout the Town. These issues are exacerbated for vulnerable populations, and for particular neighborhoods where there is limited access to grocery stores. There are no grocery stores, gas stations, or pharmacies in Town, and participants were concerned over how this would impact residents in a prolonged power outage. Although there is no hospital in Shirley, the Town has its own ambulance service.

Stress on Emergency Services

Shirley's Fire, Police, and Public Works departments bear much of the burden of responding to the increased human threats that result from climate-induced hazards. An ever larger percentage of the departments' time and resources are being devoted to handling things like traffic accidents and injuries that result from ice or other dangerous conditions and activities to protect property and maintain traffic flows during storm events, and Public Works is relied upon to clear roads and maintain access throughout the Town. Shirley has a formal mutual aid agreement for police and fire services, but many climate hazards are expected to have regional effects, in which case resources from neighboring communities may not be available. Flooding leading to road closure, specifically near Front Street/Benjamin Road, has been an issue in the past that has placed an additional burden on Fire, Police, and Public Works departments in Town. Not only does this require additional efforts from these departments to divert traffic, it also increases the distance that emergency vehicles need to cover.

Transportation

Shirley is serviced by the Fitchburg line on the Massachusetts Bay Transportation Authority Commuter Rail. The MBTA station on Ayer Road/Phoenix Avenue is considered a major resource for the community. It also provides transportation options for employees of Bemis Associates, which is located down the road. Workshop participants voiced concern over the possibility of the MBTA closing the station, as it would further reduce already limited public transportation options in Town. Participants also discussed the option of installing electric vehicle charging station at the MBTA parking lot for commuters visitors, and residents to charge their vehicles.

Parks and Open Space

Open space provides ecosystem services that help buffer the effects of climate change, from sequestering carbon, to increasing groundwater recharge, to modulating local temperature. Open space is also critical in floodplains for providing a buffer and increased flood storage, near public water supplies to maintain high water quality and promote recharge, and to maintain overall habitat connectivity that will be vital to allowing ecosystems and individual species to adapt to a changing climate. From a social perspective, open space and parks also provide opportunities for recreation and stress-relief. The Town currently owns a number of conservation and recreational properties, totaling 3,400 acres. The Town is also looking

to acquire additional open space, including the Little Turnpike Road property; Shirley received an EEA grant for acquisition and is looking to receive approval in October 2019 to finance the project.

Current Strengths and Assets

While the Town recognized a number of vulnerabilities, workshop participants identified key strengths as well. Shirley has a number of systems in place to facilitate emergency communications and information transfer, and the Town has obtained specialized equipment to help ensure that emergency services can be provided in a wide range of conditions. The Town has also established memorandums of understanding and mutual aid agreements that will support resiliency during hazards.

- The Town has an up-to-date **Hazard Mitigation Plan** for the Montachusett Region.
- The Meadows, a **new senior living center**, is under construction.
- The Town has an up-to-date **Master Plan**.
- A Town-wide **Open Space and Recreation Plan** is in development.
- Shirley is taking steps to **reduce greenhouse gas emissions at schools**.
- The Police Department conducts **senior check-ins**.
- Shirley has **3,400 acres of conservation land**.
- The **DPW's new work order system** will prioritize resident calls and concerns in Town.
- The local Boy Scouts built **bat boxes** for mosquito control amid EEE concerns.
- The **USFWS assessed four culverts** in Town.
- The **NRWA assessed ten culverts** in Town.
- There are several **shelters** in place for emergency situations and hazard events.
- The Town has short-term **cooling centers**.
- There is a **Bemis Association 2025 carbon reduction plan** in place.
- The Army is conducting ongoing water **testing for PFAS**.
- The Town is taking actions to join a **Mosquito Control District.**
- The Town has its **own ambulance system**.
- Shirley operates an **E-alert system for emergencies** that can be used to share information relevant to short-term hazards or expected long-term hazards.
- The Town has **mutual aid agreements** for police and fire services.

- Shirley has an existing Town **Facebook page** that serves as an information hub for residents.
- The Town benefits from the efforts of **National Grid,** which invests time and money into clearing hazard trees and improving the robustness of the electrical system through grid modernization.
- There is a **redundant power supply at Devens.**

Top Recommendations to Improve Resilience in Shirley

Participants at the CRB workshop identified a number of recommendations to address vulnerabilities and increase resiliency in three main topic areas: infrastructure, environment, and society. Management of water, primarily dealing with excesses of water due to flooding, was a primary concern that emerged in both the small and large group discussions, encompassing a wide variety of infrastructural concerns. Providing sufficient protections and planning for vulnerable populations in the Town was a second major theme.

Highest Priority

Conduct a field inventory of culverts and bridges to rank and prioritize projects for increased flooding resiliency and storm-hardening, followed by design and implementation of priority re-sizing or replacement projects. Green infrastructure, Low-Impact Design, and other nature-based solutions will be integrated with hard-infrastructure improvements to establish approaches that will be robust in the face of natural hazards and climate-change scenarios.

- **Assess green infrastructure opportunities for stormwater management** to develop a list of specific priorities, assess feasibility and cost, rank priority projects in terms of climate resilience potential, and develop concept designs for key projects. Review Town regulations and update as necessary to support green infrastructure and low-impact development and encourage green infrastructure to be incorporated into all roadway projects. The Town was recently awarded a Complete Streets Grant from MassDOT for the Front Street in the downtown area. Discussions included making sure the Complete Streets improvements incorporated consideration for appropriate stormwater BMPs to address climate change flooding. The stormwater BMP assessments would need another funding source.

- **Consider options to address flooding at Benjamin Road**, such as green infrastructure or nature-based solutions to manage stormwater runoff. Explore funding for potential culvert repair or replacement.

- **Explore funding sources for Walker Road culvert replacement** to help mitigate flooding issues in the area**.**

- **Explore funding sources for Lancaster Road culvert replacement** to help mitigate flooding issues in the area**.**

- **Complete a Town-wide dam assessment** of all public, private, and beaver dams, focusing on reducing the risk of flooding from dam failures during intense storm events and protection of critical ecosystems that provide flood storage and other climate resilience benefits. Technical study should include town-wide survey to update information on ownership and condition, determine risks from each dam, and prioritize projects.

- **Conduct a microgrid feasibility study** for backup power supply for key facilities to alleviate the need to rely on fossil fuel burning generators during hazard events**.** Solar, anaerobic digesters**,**

storage, and more could be considered. Consider acquiring land to provide the necessary space for implementation.

- **Pursue public facilities upgrades that would increase resiliency**, including purchasing generators for the schools, Senior Center, and other key facilities.

- **Establish a comprehensive emergency awareness plan,** incorporating a robust education and outreach strategy to build awareness of town resources and make Town residents aware of the many planning efforts, agreements, shelters, etc. which are focused on making the Town more resilient to climate change impacts. Ensure that all residents know how to access these resources when they are needed. Focus special attention on outreach to new residents and others that includes contact numbers and emergency information, including shelter details, evacuation routes, emergency procedures, etc.

- **Perform a risk assessment of the pump station** and establish priority actions for reducing potential flooding impacts, including consideration of nature-based solutions or green infrastructure approaches. Establish plans to implement emergency back-up power for the pump station.

- **Provide employee training and personal protective equipment (PPE)** to help mitigate the risk of exposure to vector-borne illnesses like EEE for Town employees.

- **Develop transportation planning for vulnerable populations** during hazard events to ensure that vulnerable groups, notably seniors, will be able to get to shelters, obtain food and medications, or receive emergency services. The focus should be on identifying vulnerable populations and providing aid during all types of climate-induced risks, such as extreme temperatures, increasingly intense storms which may make travel difficult, or flooding and storm events that may leave residents unprepared, stranded, or cut off from supplies.

- **Increase communication with Devens and Ayer** on the ongoing PFAS testing and findings from the Army's study.

- **Coordinate with the MBTA** to develop a plan to address the flooding issue on Ayer Street/Front Street. Consider adopting green infrastructure in the area for stormwater control.

- **Evaluate options to increase resiliency of Front Street** to help protect vulnerable populations in the area.

- **Continue efforts for MS4 compliance.**

- **Develop a plan to address repetitive loss/flooding areas on Walker Road.** Explore options including infrastructure improvements, green infrastructure improvements, and buyouts/relocation in order to determine the best strategy for protecting people and property in this area of Town.

- **Increase the availability of electric vehicle charging stations** to encourage use of electric vehicles and decrease greenhouse gas emissions.

- **Develop communications and outreach strategy for vulnerable populations**, particularly seniors and the homeless, who may be more vulnerable to climate-induced risks, such as extreme temperatures, may lack appropriate shelter during increasingly intense storms, or that may be unprepared if stranded or cut off from supplies due to flooding or storm events.

Moderate Priority

- **Develop comprehensive plan for beaver management** to mitigate against unpredictable flooding/impoundment impacts.

- **Explore actions to preserve the Squannacook River area** and its water quality**,** such as restoring riparian buffers and acquiring nearby open space.

- **Increase resiliency of mobile home parks** to safeguard residents' homes against wind and other storm impacts. Ensure that all homes are adequately anchored, introduce retrofits to strengthen the park, and promote education and outreach among residents. Focuses should be on providing protection against wind, and ensuring continuity of power and heat.

- **Perform a risk assessment of the wastewater treatment plant and pump stations** and establish priority actions for reducing potential flooding impacts, including consideration of nature-based solutions or green infrastructure approaches. Establish emergency back-up plans for the plant and pump stations.

- **Evaluate the feasibility of flood plain restoration** to repair erosion, address downed trees, alleviate ice and flow issues.

- **Explore nature-based solutions for cooling** at schools and other municipal buildings. Consider actions such as tree plantings and pavement removal.

- **Acquire open space** consistent with Town planning priorities and focused on areas that will create flood resiliency through increasing storage capacity in floodplains and/or infiltration capacity in uplands. Focus on areas along the Mulpus River and Squannacook River in the flood plain.

- **Assess options to address excessively hot days in schools.** This may include implementing plans to install air conditioning in the schools, including necessary upgrades to the electrical infrastructure to allow for the additional capacity required to run air conditioning systems. An alternative solution is to keep children out of school on the hottest days of the year by reducing the school year. Options that will be considered include eliminating February vacation, lengthening the school day, and providing satellite education opportunities on snow days.

- **Develop a 25-year plan for replacement of gas infrastructure** to increase the resiliency of the system.

- **Determine status of forest management planning,** particularly on lands owned by the Town and Commonwealth, in order to reduce wildfire threats and encourage management of invasive species.

Lower Priority

- **Adopt the Community Preservation Act (CPA)** to become a member of the Community Preservation Coalition. Membership allows access to funding for projects that meet community needs

- **Explore options for 0% interest loans** for owners of septic systems to facilitate septic upgrades and alleviate burdens on residents.

- **Evaluate options for snow storage** that are environmentally friendly and compliant with regulations in the Commonwealth.

- **Conduct a feasibility study to expand the water district.**

- **Conduct a Town-wide hydrological study** to understand flows and where contaminants may spread.

- **Restore riparian cover** to increase resiliency in the flood-zone and to slow the flow and filter contaminants from establishments close to the river.

- **Conduct strategic planning to support agricultural community** in the face of climate change. All of the identified hazards (flooding, drought, extreme temperatures, storm events) have the potential to significantly impact agricultural production, with corresponding threats to livelihoods. Planning should address hazard resiliency.

- **Assess disease risk and economic impacts from pests** such as mosquito-borne diseases, tick-borne diseases, disease vectors (e.g., mice and deer), and invasive species such as the gypsy moth and emerald ash borer. Include determination of future risks due to increase in type and quantity of pests/disease vectors due to climate change, and develop an education and outreach program.

- **Educate owners of private septic systems** about the importance of having systems pumped out and keeping them in good working condition in order to prevent risks to public health and the environment from systems that become overwhelmed during periods of heavy precipitation.

- **Develop a neighbor-to-neighbor program** to facilitate identification of and support for vulnerable populations and promote assistance between neighbors.

- **Conduct a study to identify methods to increase tourism** and resiliency of the tourism industry based on Squannacook River.

- **Investigate potential contamination from the landfill** on the border with Lunenburg and assess vulnerability to flooding and other hazards.

- **Address car salvage lots through stronger enforcement of current regulations** in order to reduce the risk of spills and leaks that contribute to polluted stormwater runoff. Explore options for green infrastructure to reduce flow rates and contaminants from these sites.

- **Provide public education and outreach to private well owners**, focusing on conservation measures and means of limiting water use to prevent impacts to the water supply.

- **Assess levels and sources of stream contaminants** in tandem with the requirements of the MS4 Permit and develop and enforce measures to detect and eliminate illicit discharges where they are contributing to water quality problems. Utilize the MS4 requirements and TMDLs to promote stormwater management and green infrastructure improvements.

CRB Workshop Participants

All workshop invitees are listed below; attendees are indicated with an asterisk.

Name	Position/Organization
Michael Gibbons*	Assistant Town Accountant/Board of Selectmen, Town of Shirley
Scott Farrar*	National Grid Community Manager
Brandon Kelly*	DPW Director
Emma Lord*	Wild and Scenic Rivers Fellow, National Park Service
Ann M Towne*	Water District Commissioner
Bill Plunkett*	Finance Director, Ayer Shirley Regional School District
Roy Herzig*	Environmental Engineer, Devens
Josh Bedarian*	District Director, Office of Representative Jen Benson
Alyssa Caddle*	Director of Sustainability, Bemis Associates
Steve Kenneway*	Superintendent, Souza Baranowski Correctional Center
Paul Przybyla*	Personnel Board, Historical Commission
Jackie Esielionis*	Agent Partner, LAER Realty
Dennis Levesque*	Fire Chief, Shirley Fire Department
Mike Fleming*	Conservation Agent, Conservation Commission
Marilyn Largey*	Director, Council on Aging
Al Futterman*	Land Programs Director, Nashua River Watershed Association
Jessica Strunkin*	Senior Vice President, Devens
Danillo Sena*	District Director, Office of Senate Jamie Eldridge
Mike McGovern*	Town Administrator, Town of Shirley
Melissa Fetterhoff*	President and CEO, Nashoba Valley Chamber of Commerce
Samuel Santiago*	Police Chief, Shirley Police Department
Senator James Eldridge†	Massachusetts State Senator, Middlesex and Worcester District
Representative Jen Benson†	Massachusetts State Representative, 37th Middlesex District

*** indicates attendees**

† Indicate appearance but attendee did not stay for full workshop

Citation

Fuss & O'Neill (2019). Community Resilience Building Workshop Summary of Findings. Town of Shirley, Fuss & O'Neill, Inc. Springfield, Massachusetts.

CRB Workshop Project Team

Name	Organization	Role
Michael Gibbons	Town of Shirley	Project Coordinator/Core Team Member
Nick Gibbons	Planning and Zoning Board, Town of Shirley	Core Team Member
Marilyn Largey	Council on Aging, Town of Shirley	Core Team Member
Michael Fleming	Conservation Commission, Town of Shirley	Core Team Member
Samuel Santiago	Shirley Police Department	Core Team Member
Brandon Kelly	Department of Public Works, Town of Shirley	Core Team Member
Michael McGovern	Town Administrator, Town of Shirley	Core Team Member
Mary Monahan	Fuss & O'Neill	MVP Lead Facilitator
Nick Lapointe	Fuss & O'Neill	MVP Facilitator/Scribe
Sarah Hayden	Fuss & O'Neill	MVP Facilitator/Scribe

Acknowledgements

Many thanks to the MVP Core Team members, CRB workshop participants, and to Michael Gibbons who acted as the local Project Coordinator. Thanks to the Town of Shirley for providing a meeting space for the Core Team Meeting and CRB Workshop.

Funding for the CRB Workshop was provided through a Massachusetts MVP grant.

Appendix A

Final Risk Matrix

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.org

H-**M**-**L** priority for action over the **S**hort or **L**ong term (and **O**ngoing)
V = Vulnerability **S** = Strength

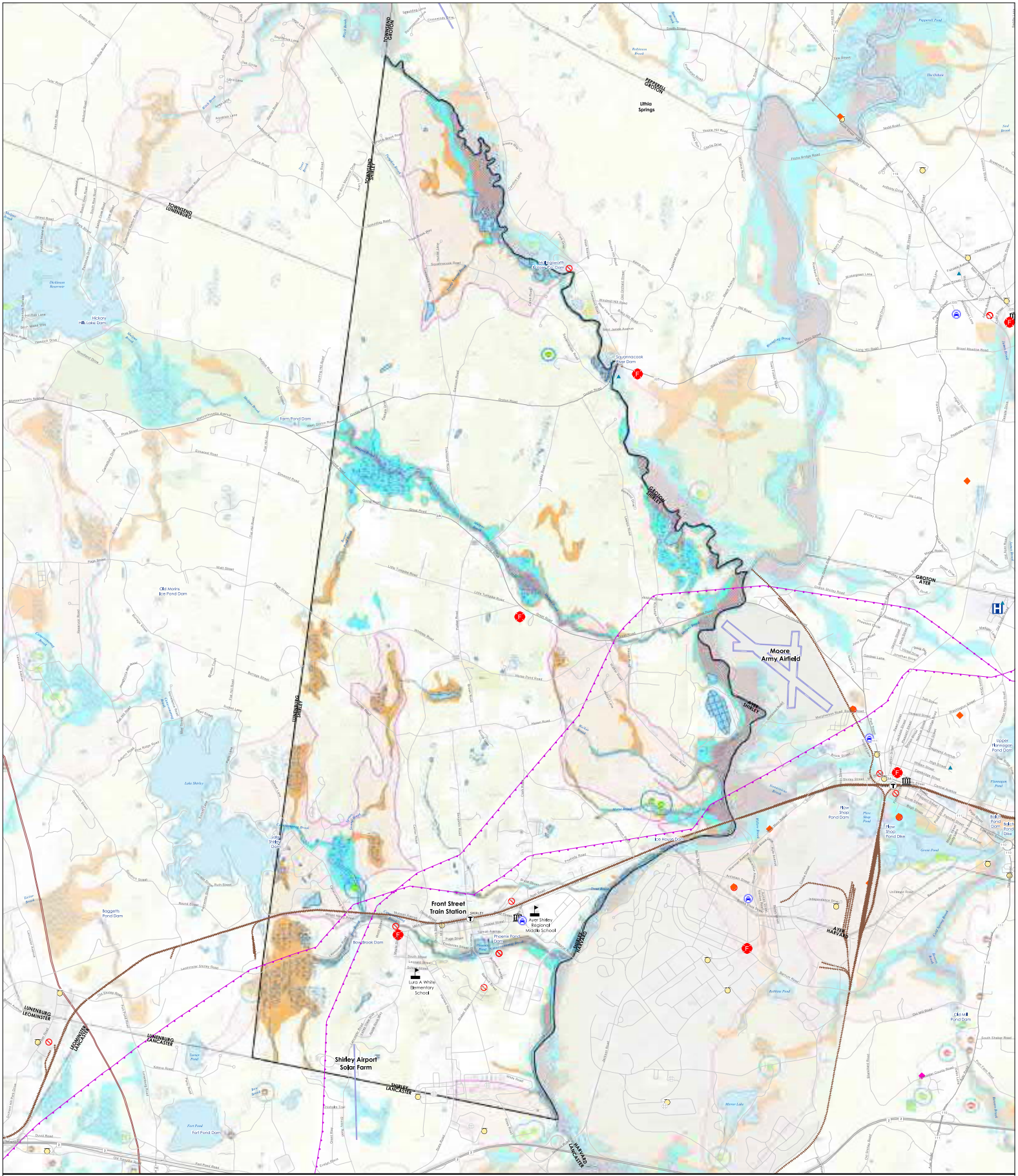
Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S	Flooding	Extreme Precipitation/ Snow and Ice	Drought	Heat	Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Culverts and Bridges	Town-Wide	Town, State	S	The DPW's new work order system will prioritize resident calls and concerns in Town. The US Fish and Wildlife Service assessed four culverts in Town, and the Nashua River Watershed Association assessed an additional ten.				N/A	O
			V	Conduct a field inventory of culverts and bridges to rank and prioritize projects for increased flooding resiliency and storm-hardening, followed by design and implementation of priority re-sizing or replacement projects.				H	S
			V	Explore funding sources for Walker Road culvert replacement to help mitigate flooding issues in the area.				H	S
			V	Explore funding sources for Lancaster Road culvert replacement to help mitigate flooding issues in the area.				H	S
Stormwater Infrastructure	Town-Wide	Town	V	Assess green infrastructure opportunities for stormwater management to develop a list of specific priorities, assess feasibility and cost, rank priority projects in terms of climate resilience potential, and develop concept designs for key projects. Review Town regulations and update as necessary to support green infrastructure and low-impact development.				H	S
			V	Continue efforts for MS4 compliance.				H	O
			V	Assess levels and sources of stream contaminants in tandem with the requirements of the MS4 Permit and develop and enforce measures to detect and eliminate illicit discharges where they are contributing to water quality problems. Utilize the MS4 requirements and TMDLs to promote stormwater management and green infrastructure improvements.				L	S
Roads	Town-Wide	Town	S	The DPW's new work order system will prioritize resident calls and concerns in Town.				N/A	O
					Evaluate options for snow storage that are environmentally friendly and compliant with regulations in the Commonwealth.			L	L
			V	Consider options to address flooding at Benjamin Road, such as green infrastructure or nature-based solutions to manage stormwater runoff. Explore funding for potential culvert repair or replacement.				H	S
Water Infrastructure	Town-Wide	Town	V	Perform a risk assessment of the pump station and establish priority actions for reducing potential flooding impacts, including consideration of nature-based solutions or green infrastructure approaches. Establish plans to implement emergency back-up power for the pump station.				H	S
			V	Conduct a feasibility study to expand the water district.				L	L
Electrical Infrastructure	Town-Wide	Town	S	The Town benefits from the efforts of National Grid, which invests time and money into clearing hazard trees and improving the robustness of the electrical system through grid modernization.				N/A	O
Buildings and Facilities	Town-Wide	Town	V	Pursue public facilities upgrades that would increase resiliency, including purchasing generators for the schools, Senior Center, and other key facilities.				H	L
			V	Perform a risk assessment of the wastewater treatment plant and pump stations and establish priority actions for reducing potential flooding impacts, including consideration of nature-based solutions or green infrastructure approaches. Establish emergency back-up plans for the plant and pump stations.				M	S
			V	Develop a 25-year plan for replacement of gas infrastructure to increase the resiliency of the system.				M	L
Title V and Septic Systems	Town-Wide	Private	V	Explore options for 0% interest loans for owners of septic systems to facilitate septic upgrades and alleviate burdens on residents.				L	L
			V	Educate owners of private septic systems about the importance of having systems pumped out and keeping them in good working condition in order to prevent risks to public health and the environment from systems that become overwhelmed during periods of heavy precipitation.				L	L
Beavers	Town-Wide	Town, Private	V	Develop comprehensive plan for beaver management to mitigate against unpredictable flooding/impoundment impacts.				M	S
Dams	Town-Wide	Town, Private	V	Complete a Town-wide dam assessment of all public, private, and beaver dams, focusing on reducing the risk of flooding from dam failures during intense storm events and protection of critical ecosystems that provide flood storage and other climate resilience benefits. Technical study should include town-wide survey to update information on ownership and condition, determine risks from each dam, and prioritize projects.				H	S
Backup Power Supply	Town-Wide	Town	V	Conduct a microgrid feasibility study for backup power supply for key facilities to alleviate the need to rely on fossil fuel burning generators during hazard events. Solar, anaerobic digesters, storage, and more could be considered. Consider acquiring land to provide the necessary space for implementation.				H	S
Societal									
Employee Safety	Town-Wide	Town	V	Provide employee training and personal protective equipment (PPE) to help mitigate the risk of exposure to vector-borne illnesses like EEE for Town employees.				H	S
Bemis Associates	Bemis Associates	Private	S	There is a Bemis Association 2025 carbon reduction plan in place.				N/A	O
Devens	Devens	Devens	S	There is a redundant power supply at Devens.				N/A	O
Fishing	Town-Wide	Town, Private	V	Explore actions to preserve the Squannacook River area and its water quality, such as restoring riparian buffers and acquiring nearby open space.				M	S
			V	Conduct a study to identify methods to increase tourism and resiliency of the tourism industry based on Squannacook River.				L	L
Vulnerable Neighborhoods	Town-Wide	N/A	V	Develop a plan to address repetitive loss/flooding areas on Walker Road. Explore options including infrastructure improvements, green infrastructure improvements, and buyouts/relocation in order to determine the best strategy for protecting people and property in this area of Town.				H	S
			V	Increase resiliency of mobile home parks to safeguard residents' homes against wind and other storm impacts. Ensure that all homes are adequately anchored, introduce retrofits to strengthen the park, and promote education and outreach among residents. Focuses should be on providing protection against wind, and ensuring continuity of power and heat.				M	S
Vulnerable Populations	Town-Wide	N/A	S	The Meadows, a new senior living center, is under construction. The Police Department also conducts senior check-ins.				N/A	O
			V	Develop transportation planning for vulnerable populations during hazard events to ensure that vulnerable groups, notably seniors, will be able to get to shelters, obtain food and medications, or receive emergency services. The focus should be on identifying vulnerable populations and providing aid during all types of climate-induced risks, such as extreme temperatures, increasingly intense storms which may make travel difficult, or flooding and storm events that may leave residents unprepared, stranded, or cut off from supplies.				H	S
			V	Evaluate options to increase resiliency of Front Street to help protect vulnerable populations in the area.				H	S
			V	Develop communications and outreach strategy for vulnerable populations, particularly seniors and the homeless, who may be more vulnerable to climate-induced risks, such as extreme temperatures, may lack appropriate shelter during increasingly intense storms, or that may be unprepared if stranded or cut off from supplies due to flooding or storm events.				H	S
Shelters	Town-Wide	Town	S	There are several shelters in place for emergency situations and hazard events. The Town also has short-term cooling centers.				N/A	O

Schools	Town-Wide/Regional	Town/Regional	S	Shirley is taking steps to reduce greenhouse gas emissions at schools.				N/A	O
			V				Explore nature-based solutions for cooling at schools and other municipal buildings. Consider actions such as tree plantings and pavement removal.	M	S
			V				Assess options to address excessively hot days in schools. This may include implementing plans to install air conditioning in the schools, or keep children out of school on the hottest days of the year by reducing the school year.	M	S
Pests and Disease Control	Town-Wide	N/A	S	The Town is taking actions to join a Mosquito Control District. The local Boy Scouts also built bat boxes for mosquito control amid EEE concerns.				N/A	O
			V	Assess disease risk and economic impacts from pests such as mosquito-borne diseases, tick-borne diseases, disease vectors (e.g., mice and deer), and invasive species such as the gypsy moth and emerald ash borer. Include determination of future risks due to increase in type and quantity of pests/disease vectors due to climate change, and develop an education and outreach program.				L	S
Provisions, Medicine and Fuel	Town-Wide	Town, Private	S	The Town has its own ambulance system.				N/A	O
Stress on Emergency Services	Town-Wide	Town	S	The Town has an up-to-date Hazard Mitigation Plan for the Montachusett Region and an up-to-date Master Plan.				N/A	O
			S	Shirley operates an E-alert system for emergencies that can be used to share information relevant to short-term hazards or expected long-term hazards. The Town's Facebook page also serves as an information hub for residents. Additionally, the Town also has mutual aid agreements for police and fire services.				N/A	O
			V	Establish a comprehensive emergency awareness plan, incorporating a robust education and outreach strategy to build awareness of town resources and make Town residents aware of the many planning efforts, agreements, shelters, etc. which are focused on making the Town more resilient to climate change impacts. Ensure that all residents know how to access these resources when they are needed. Focus special attention on outreach to new residents and others that includes contact numbers and emergency information, including shelter details, evacuation routes, emergency procedures, etc.				H	S
			V	Develop a neighbor-to-neighbor program to facilitate identification of and support for vulnerable populations and promote assistance between neighbors.				L	L
Transportation	Town-Wide	Town, State	V	Coordinate with the MBTA to develop a plan to address the flooding issue on Ayer Street/Front Street. Consider adopting green infrastructure in the area for stormwater control.				H	S
			V	Increase the availability of electric vehicle charging stations to encourage use of electric vehicles and decrease greenhouse gas emissions.				H	S
Parks and Open Space	Town-Wide	Town, Private	S	Shirley has 3,400 acres of conservation land. A Town-wide Open Space and Recreation Plan is also in development.				N/A	O
			V	Evaluate the feasibility of flood plain restoration to repair erosion, address downed trees, alleviate ice and flow issues.				M	L
			V	Acquire open space consistent with Town planning priorities and focused on areas that will create flood resiliency through increasing storage capacity in floodplains and/or infiltration capacity in uplands. Focus on areas along the Mulpus River and Squannacook River in the flood plain.				M	L
			V	Adopt the Community Preservation Act (CPA) to become a member of the Community Preservation Coalition. Membership allows access to funding for projects that meet community needs				L	L
Environmental									
PFAS	Town-Wide	N/A	S	The Army is conducting ongoing water testing for PFAS.				N/A	O
			V	Increase communication with Devens and Ayer on the ongoing PFAS testing and findings from the Army's study.				H	S
Water Quality	Town-Wide	Town, Private	V	Restore riparian cover to increase resiliency in the flood-zone and to slow the flow and filter contaminants from establishments close to the river.				L	L
			V	Conduct a Town-wide hydrological study to understand flows and where contaminants may spread.				L	L
			V	Investigate potential contamination from the landfill on the border with Lunenburg and assess vulnerability to flooding and other hazards.				L	S
			V	Address car salvage lots through stronger enforcement of current regulations in order to reduce the risk of spills and leaks that contribute to polluted stormwater runoff. Explore options for green infrastructure to reduce flow rates and contaminants from these sites.				L	S
			V	Provide public education and outreach to private well owners, focusing on conservation measures and means of limiting water use to prevent impacts to the water supply.				L	S
			V	Assess levels and sources of stream contaminants in tandem with the requirements of the MS4 Permit and develop and enforce measures to detect and eliminate illicit discharges where they are contributing to water quality problems. Utilize the MS4 requirements and TMDLs to promote stormwater management and green infrastructure improvements.				L	S
Trees and Forests	Town-Wide	Town, Private	S	The Town benefits from the efforts of National Grid, which invests time and money into clearing hazard trees and improving the robustness of the electrical system through grid modernization.				N/A	O
			V	Determine status of forest management planning, particularly on lands owned by the Town and Commonwealth, in order to reduce wildfire threats and encourage management of invasive species.				M	S
Invasive Species	Town-Wide	Town, Private	V	Assess disease risk and economic impacts from pests such as mosquito-borne diseases, tick-borne diseases, disease vectors (e.g., mice and deer), and invasive species such as the gypsy moth and emerald ash borer. Include determination of future risks due to increase in type and quantity of pests/disease vectors due to climate change, and develop an education and outreach program.				L	S
			V	Determine status of forest management planning, particularly on lands owned by the Town and Commonwealth, in order to reduce wildfire threats and encourage management of invasive species.				M	S
Local Agriculture	Town-Wide	Private	V	Conduct strategic planning to support agricultural community in the face of climate change. All of the identified hazards (flooding, drought, extreme temperatures, storm events) have the potential to significantly impact agricultural production, with corresponding threats to livelihoods. Planning should address hazard resiliency.				L	S

Appendix B

CRB Workshop Base Map



SHIRLEY, MA

MUNICIPAL VULNERABILITY PREPAREDNESS PROGRAM

FUSS & O'NEILL

- Town Hall
- Police Station
- Fire Station
- Hospital
- School
- Long Term Care Residences
- Prisons
- Dams
- Community Groundwater Source
- Non-Community Groundwater Source
- Underground Storage Tanks

Oil and/or Hazardous Material Sites

Chapter 21E Tier Classification

- TIER I
- TIER II
- Activity and Use Limitation Sites
- Railroads - Active Service
- MBTA Commuter Rail Station
- Pipeline
- Powerline
- Landing Strip/Airport
- Perennial or Intermittent Stream
- Shoreline
- Pond, Lake, Ocean
- Wetland
- Wellhead Protection Zone I
- Wellhead Protection Zone II

Flood Zone Designations

- 1% Annual Chance of Flooding
- Regulatory Floodway
- 0.2% Annual Chance of Flooding

N W E S

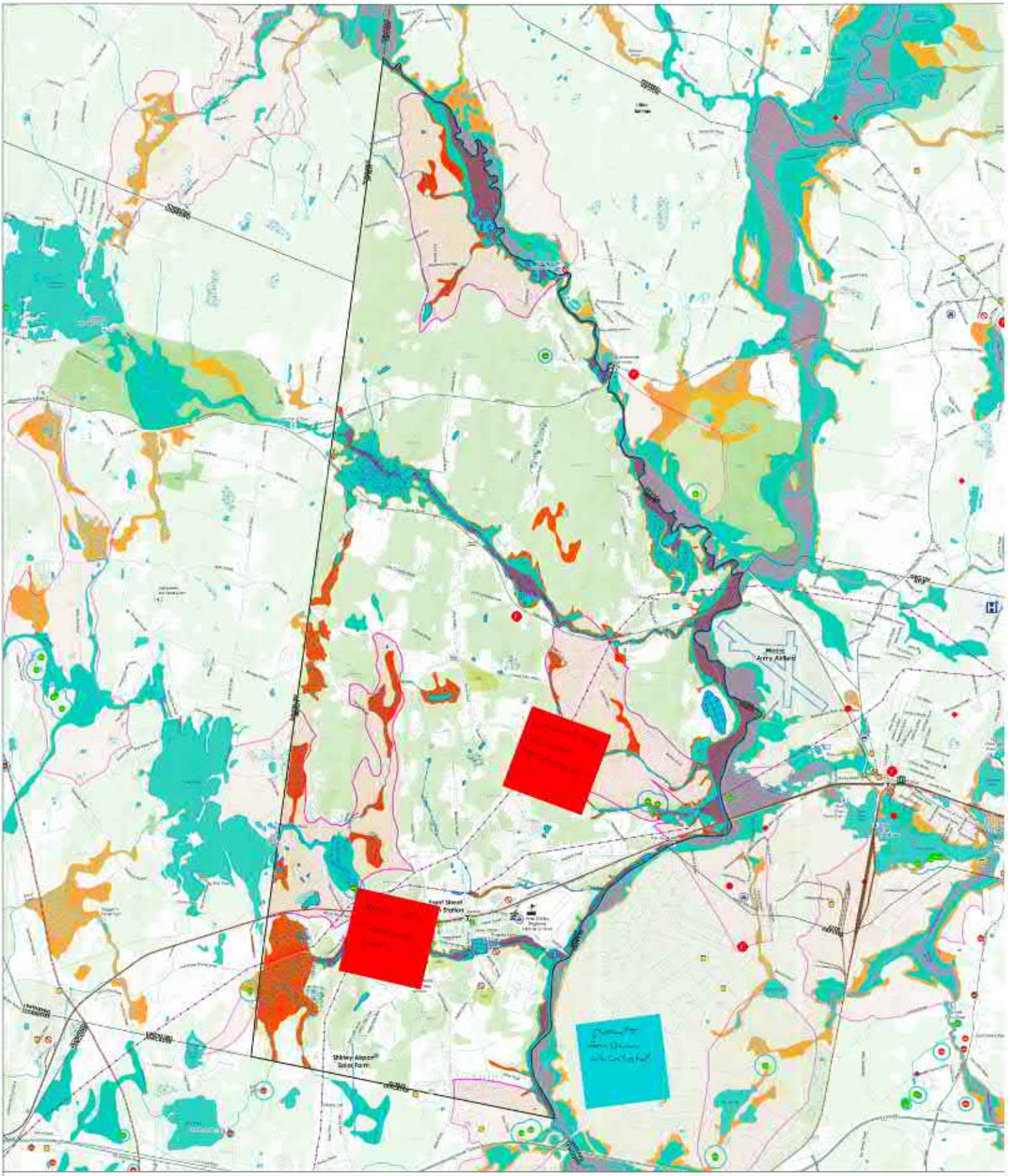
0 0.25 0.5 0.75

Miles

Data sources:
MassGIS - Infrastructure, Hydrology, and Administrative Data
ESRI - World Topographic Map - Base Map

Appendix C

CRB Workshop Outputs:
Participatory Mapping Exercise & Risk Matrices



SHIRLEY, MA

MUNICIPAL VULNERABILITY PREPAREDNESS PROGRAM

FUSS&O'NEILL

- Town Hall
- Police Station
- Fire Station
- Hospital
- School
- Long Term Care Residences
- Prisons
- Dams
- Community Groundwater Source
- Non-Community Groundwater Source
- Underground Storage Tanks

Oil and/or Hazardous Material Sites

Chapter 21E Tier Classification

- Tier I
- Tier II
- Activity and Use Limitation Sites

- Railroads - Active Service
- MBTA Commuter Rail Station
- Pipeline
- Powerline
- Landing Strip/Airport
- Perennial or Intermittent Stream
- Shoreline
- Pond, Lake, Ocean
- Wetland
- Wellhead Protection Zone I
- Wellhead Protection Zone II

Flood Zone Designations

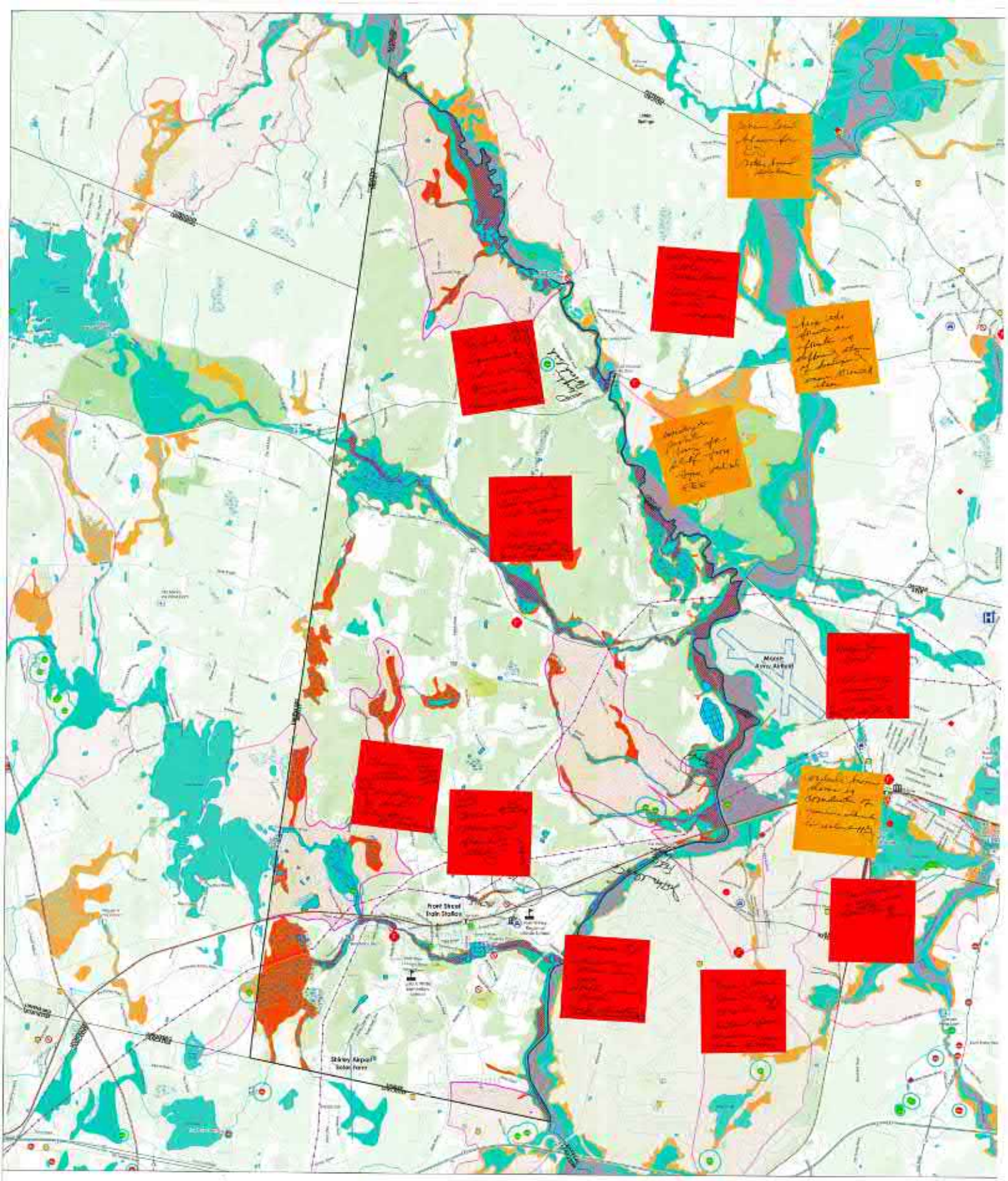
- 1% Annual Chance of Flooding
- Regulatory Floodway
- 0.2% Annual Chance of Flooding

N W E S

0 0.25 0.5 0.75

Miles

Data sources:
MassGIS - Infrastructure, Hydrology, and Administrative Data
ESRI - World Topographic Map - Basemap



SHIRLEY, MA

MUNICIPAL VULNERABILITY PREPAREDNESS PROGRAM

FUSS & O'NEILL

- Town Hall
- Police Station
- Fire Station
- Hospital
- School
- Long Term Care Residences
- Prisons
- Dams
- Community Groundwater Source
- Non-Community Groundwater Source
- Underground Storage Tanks

Oil and/or Hazardous Material Sites

Chapter 21E Tier Classification

- TIER I
- TIER II
- Activity and Use Limitation Sites

- Railroads - Active Service
- MBTA Commuter Rail Station
- Pipeline
- Powerline
- Landing Strip/Airport
- Perennial or Intermittent Stream
- Shoreline
- Pond, Lake, Ocean
- Wetland
- Wellhead Protection Zone I
- Wellhead Protection Zone II

Flood Zone Designations

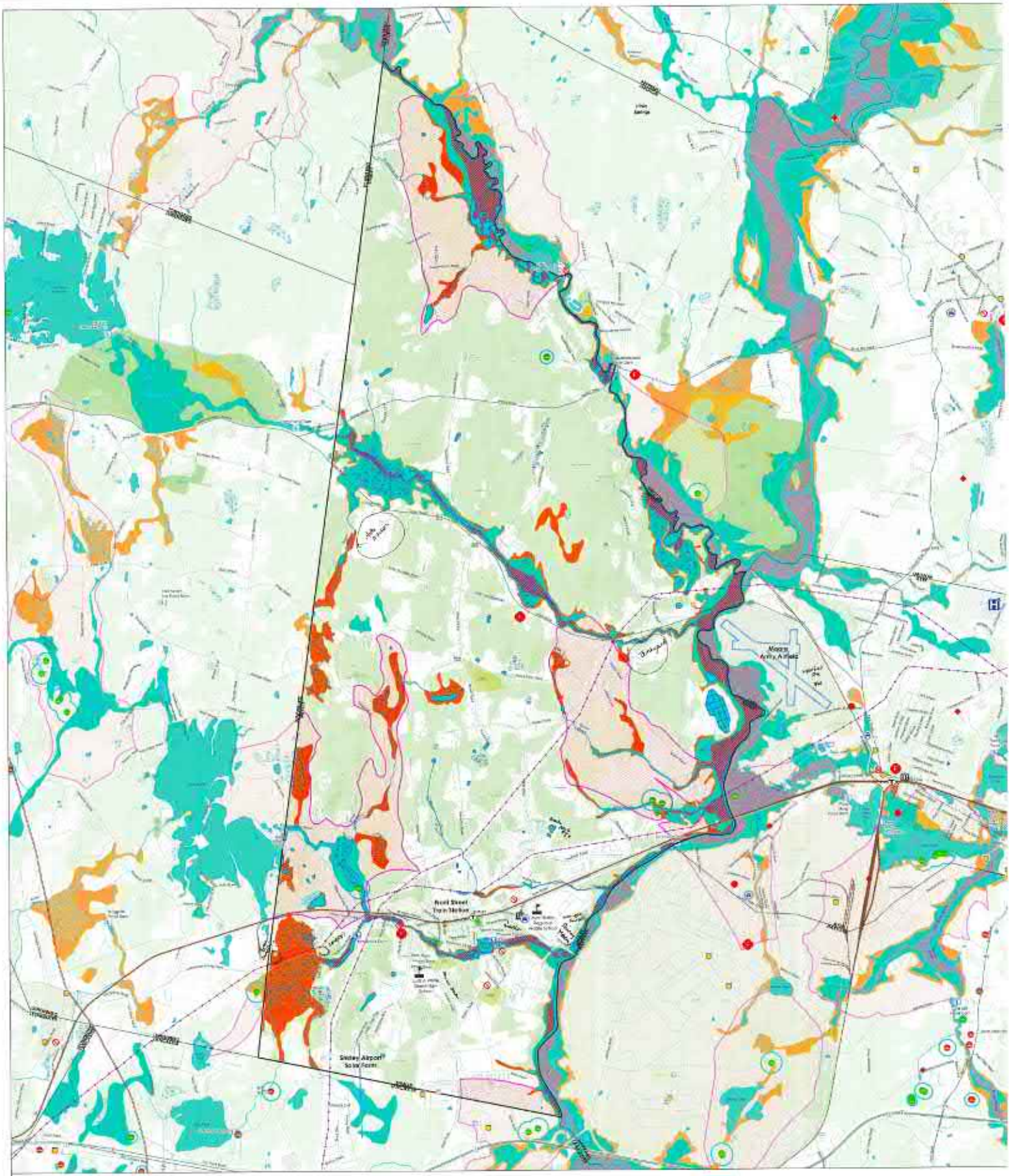
- 1% Annual Chance of Flooding
- Regulatory Floodway
- 0.2% Annual Chance of Flooding

N W E S

0 0.25 0.5 0.75

Miles

Data sources:
MassGIS - Infrastructure, Hydrology, and Administrative Data
ESRI - World Topographic Map - Base Map



SHIRLEY, MA

MUNICIPAL VULNERABILITY PREPAREDNESS PROGRAM

FUSS & O'NEILL

- Town Hall
- Police Station
- Fire Station
- Hospital
- School
- Long Term Care Residences
- Prisons
- Dams
- Community Groundwater Source
- Non-Community Groundwater Source
- Underground Storage Tanks

Oil and/or Hazardous Material Sites

Chapter 21E Tier Classification

- TIER I
- TIER II
- Activity and Use Limitation Sites

- Railroads - Active Service
- MBTA Commuter Rail Station
- Pipeline
- Powerline
- Landing Strip/Airport
- Perennial or Intermittent Stream
- Shoreline

- Pond, Lake, Ocean
- Wetland
- Wellhead Protection Zone I
- Wellhead Protection Zone II

Flood Zone Designations

- 1% Annual Chance of Flooding
- Regulatory Floodway
- 0.2% Annual Chance of Flooding

N W E S

0 0.25 0.5 0.75

Miles

Data sources:
MassGIS - Infrastructure, Hydrology, and Administrative Data
ESRI - World Topographic Map - Base M

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.com

H-M-L priority for action over the **S**hort or **L**ong term (and **O**ngoing)
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	FLOODS	PRECIP / STORM	DROUGHT	HEAT	Priority H-M-L	Time Short Long Ongoing
Infrastructural									
Forester Road – intermittent stream double culvert – undersized and plugged		T	V	X Culvert repair and/or bridge replacement; street to [illegible] shelter – Anne White Elementary School					O
Trail – consider improvement important to shelter, Complete Street (multi-modal) MBTA		T	V	X	X				O
Culvert improvements DOER, reduce [illegible] Waterfall Acres, MA Fish & Wildlife			S	X assessment [illegible] for culvert/SW improvements; [illegible] storm [illegible]	X	X			O
Water pump station Nova Brook, protect flood impacts				X					
Societal									
Cooperative working relationships among town and private sector partners			S						
EJ – Consider in Trail Street development Clark St.			V						
Vector borne illnesses				Investigate education for town field staff & public from EEE, Lyme Disease, West Nile					
Environmental									
Third Brook at Forrest St & Clark Rd include MBTA input		T	V	X Consider historical [illegible] to reduce current/future flood; potential impact from new development X	X				O
Beaver Dams		P/T	V	X [illegible] flood / [illegible] source of [illegible]					O
P3 opportunity for microgrid feasibility study town, Boxer, MBTA			S						
Charging stations: Accessibility for charging stations; Boxer [illegible] employee [illegible] MBTA			S						
Little Tomapka Brook land acquisition			V/S	Supports land preservation; water supply development					
Recreation / [illegible] [illegible]			V/S	development / preservation; Squannacook cold water fisheries					

(Zoning & Planning "[illegible]") → Balance [illegible] (Natural Resources Zoning / Solutions) — V/S — LID / GI
Small [illegible] forest retention (… [illegible] of Forest Corr.) — [illegible] trade or [illegible]

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.com

H-M-L priority for action over the **S**hort or **L**ong term (and **O**ngoing)
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	Flooding	Extreme Precip/ Snow+ice	Drought	Heat	Priority H-M-L	Time Short Long Ongoing
Infrastructural									
STORM WATER INFRASTRUCTURE	TOWNWIDE	TOWN	V/S	FAILING CULVERTS, CATCHBASINS	PLUGGED DRAINS – PIPES – MS4 COMPLIANCE			H	O
WATER DISTRICT	DISTRICT	SHIRLEY WATER DISTRICT	V	MOVE CONTAMINENTS FILTERING SYSTEM	REPLACE FRONT ST PIPING	NEED MORE WELLS		M	L
SEWER SYSTEM / SEPTIC	2 LOCATIONS	TOWN + PRIVATE	✓	FAILURE				M	O
PRIVATE WATER WELLS	TOWNWIDE	PRIVATE	V	FILTERS, TESTING EXPANSION WATER DISTRICT	⟶			L H?	O
LOW IMPACT DEVELOPMENT	TOWNWIDE	TOWN	S	ZONING, NET ZERO ENERGY, RAIN GARDENS, CLUSTER ZONING				M/L	L
Societal									
SENIOR POPULATION	TOWNWIDE	PUBLIC + PRIVATE	V	SAFETY OUTREACH CODE RED	SAFETY OUTREACH CODE RED		ENERGY BACKUP, A/C, TREE PLANTING	H	O
SCHOOLS – STUDENTS + STAFF	SHIRLEY AYER	PUBLIC	✓			FEASIBILITY STUDY	NEED A/C AT SCHOOLS, TREE PLANTING	M	L
BUYOUT OF FLOOD PLAIN RISKS WALKER RD	WALKER RD	PRIVATE	✓	BUYOUT – FLOOD PRONE PROPERTY				H	S/L
SHELTERS – SCHOOLS, SENIOR CENTER	VILLAGE OR CENTER	TOWN + PRIVATE			BACKUP GENERATORS, TRANSPORTATION ISSUES OUTREACH	DO WE NEED MORE CODE RED	REVISIT EMERGENCY PLAN	M	O
Environmental									
AUTO JUNKYARDS	GREAT ROAD	PRIVATE	✓	CONTAMINENTS INTO MULPUS BROOK NASHUA RIVER				M	O
RIPARIAN BUFFERS	TOWNWIDE	PUBLIC		MITIGATE EFFECTS LOW COST	ENCOURAGE LANDOWNERS WITH LANDSCAPING INCENTIVES			M	O
OPEN SPACE ACQUISITION	FLOOD PLAINE TOWNWIDE	PUBLIC		MITIGATION C.P.A. PASSAGE	LARGEST UNDEVELOPED PARCELS		MITIGATE	H	O
SUPERFUND ABUTS TOWN	DEVENS (ARMY)	FEDERAL/ STATE		QUARTERLY MEETINGS HOSTED BY ARMY + TROY				H	O

C

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.com

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					Priority	Time
								H-M-L	Short Long Ongoing
Infrastructural									
Devens Stormwater	Nashua River	State	V						O
Ayer Rd Flooding (Benjamin Hill)	Town	Town	V					H	O
Walker Rd Culvert	Town	Town	V						
Benjamin Rd. Culvert Plant Brook Drainage		Town	V						
Lake Shirley Dam		Town	V						
Waterpark Dam		Town	V						
Societal									
LAW – Generator									
Senior Center Generator									
Environmental									
Devens Stormwater	Nashua River	State	V						O
Hydrological model (Water Flow)	Town wide	Town	S					M	O
Land Protection Along River Fronts									
Flood Plain Restoration									
Snow storage/Removal									

Land protection along River

Appendix D

CRB Workshop Presentation Materials

FUSS & O'NEILL

Boston Firefighters, January 4, 2018 (Reuters)

Shirley Station

Municipal Vulnerability Preparedness Program
Community Resilience Building Workshop
Town of Shirley

September 26, 2019

Community Resilience Building Workshop

Agenda

- **CRB Team and participant introductions**
- **Introduction to Massachusetts Municipal Vulnerability Preparedness Program (MVP)**
- **Introduction to Climate Change and the Town of Shirley**
- **Discussion by Shirley participants on status of current planning and risks**
- **Introduction to CRB Workshop process**

- **Large group**
  - Confirm top four hazards

- **Small work groups (Using Risk Matrix)**
  - Identify Shirley's vulnerabilities and strengths
  - Prioritize response actions

- **Lunch**

- **Large group**
  - Report out from small groups
  - Determine overall priority actions for the Town

- **Discussion on next steps**
- **Conclusion**

FUSS & O'NEILL

Fuss & O'Neill Overview

Fuss & O'Neill is a leading MVP consultant in assisting Massachusetts communities secure grant assistance, achieve designation as a Massachusetts Municipal Vulnerability Preparedness (MVP) community, and execute their MVP priority projects.

The MVP team is experienced in local government, environmental services, civil site engineering, stormwater management, and emergency management.

Fuss & O'Neill assisted MVP communities secure more than $3.15 million in MVP Action Grants in the program's first two rounds of funding.

MVP Project Team

Mary Monahan

Mary is a municipal public works specialist well-versed in issues related to climate change and resiliency; stormwater management; wastewater collection and treatment; drinking water supply, treatment, and distribution; solid waste management; and sustainable operations. Mary serves as a liaison between the public project owner and the design team.

Nick Lapointe

Nick is highly versed in MassDOT design procedures and has coordinated many projects through the state review process into construction. He has assisted numerous communities in acquiring TIP funding and MassWorks infrastructure grants.

FUSS & O'NEILL

MVP Project Team

Julie Busa, PhD

Julie is a senior environmental scientist in the Water Environment and Natural Resources group of Fuss & O'Neill. She is a Certified Senior Ecologist with over 10 years of experience in the areas of global biodiversity and forest conservation, sustainability, and ecological modelling. Julie works extensively with municipalities on MS4 compliance and the MVP program.

Sarah Hayden

Sarah is an environmental scientist in the Water Environment and Natural Resources group of Fuss & O'Neill. She has a background in environmental science as well as a strong foundation in business administration and environmental economics. Sarah works with municipalities on MS4 compliance and the MVP program.

FUSS & O'NEILL

Shirley's MVP Program- $20,000

- **Grant Supports Climate Change Vulnerability Assessments and Resiliency Planning**
- **MVP Comprehensive Approach**

  Infrastructure

  Society

  Environment

MVP designation may lead to enhanced standing in future funding opportunities

FUSS & O'NEILL

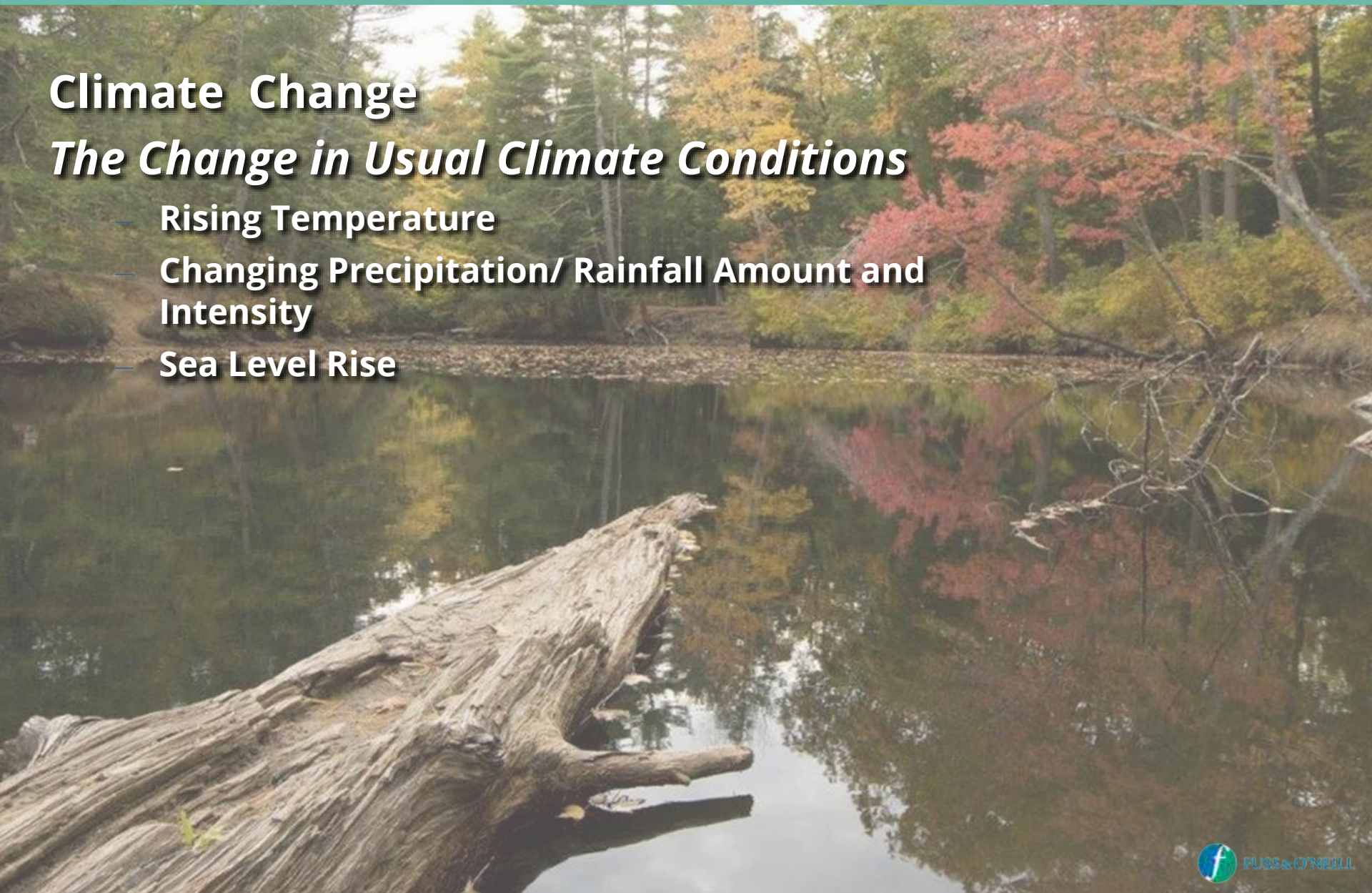
MVP Action Grant

- **Grant supports priority actions identified at Community Resilience Building Workshop**
- **$25,000 - $2M available (up to $5M for regional projects)**
- **Up to $7M available statewide**
- **Local match of 25% - can be in-kind**
- **Next funding round anticipated late September 2019**

Only those communities which have completed the CRB workshop are eligible to apply

FUSS & O'NEILL

Terminology



Climate Change

The Change in Usual Climate Conditions

- Rising Temperature
- Changing Precipitation/ Rainfall Amount and Intensity
- Sea Level Rise

FUSS & O'NEILL

Rising Temperature

Nashua	Observed Baseline 1971-2000	Projected Change in 2030s			Projected Change in 2050s			Projected Change in 2070s			Projected Change in 2090s		
Average Annual Temperature (°F)	46.78	2.20	to	4.44	2.99	to	6.39	3.54	to	9.02	3.90	to	10.95
Annual Days with Maximum Temperature over 90°F (Days)	4.37	5.83	to	17.04	8.93	to	29.98	10.40	to	49.93	12.50	to	69.88
Annual Days with Minimum Temperature below 32°F (Days)	156.4	-10.61	to	-28.20	-18.80	to	-38.26	-21.68	to	-53.63	-22.97	to	-63.67

Climate Change Impacts - Temperature

- **Economic**
  - **Winter Recreation**
  - **Snow and Ice**
- **Agricultural**
  - **Longer Growing Season**
- **Health**
  - **Increased Pests**
  - **Heat Stroke**
- **Infrastructure**
  - **Road Buckling**
  - **More Potholes**
  - **Power Outages**
- **Environment**
  - **Change in Habitat**

Boston & Maine Station, Shirley, Mass. 1

FUSS & O'NEILL

Changing Precipitation

Nashua	Observed Baseline 1971-2000	Projected Change in 2030s	Projected Change in 2050s	Projected Change in 2070s	Projected Change in 2090s
Total Annual Precipitation (Inches)	45.89	0.43 to 4.88	1.15 to 6.29	2.26 to 7.87	1.25 to 8.38
Annual Consecutive Dry Days (Days)	16.21	-0.41 to 1.65	-0.79 to 1.71	-0.75 to 2.139	-0.64 to 2.82

Climate Change Impacts - Precipitation

- **Economic**
  - Dangerous Floods
  - Lost work time

- **Agricultural**
  - Excessively Wet Spring
  - Drought

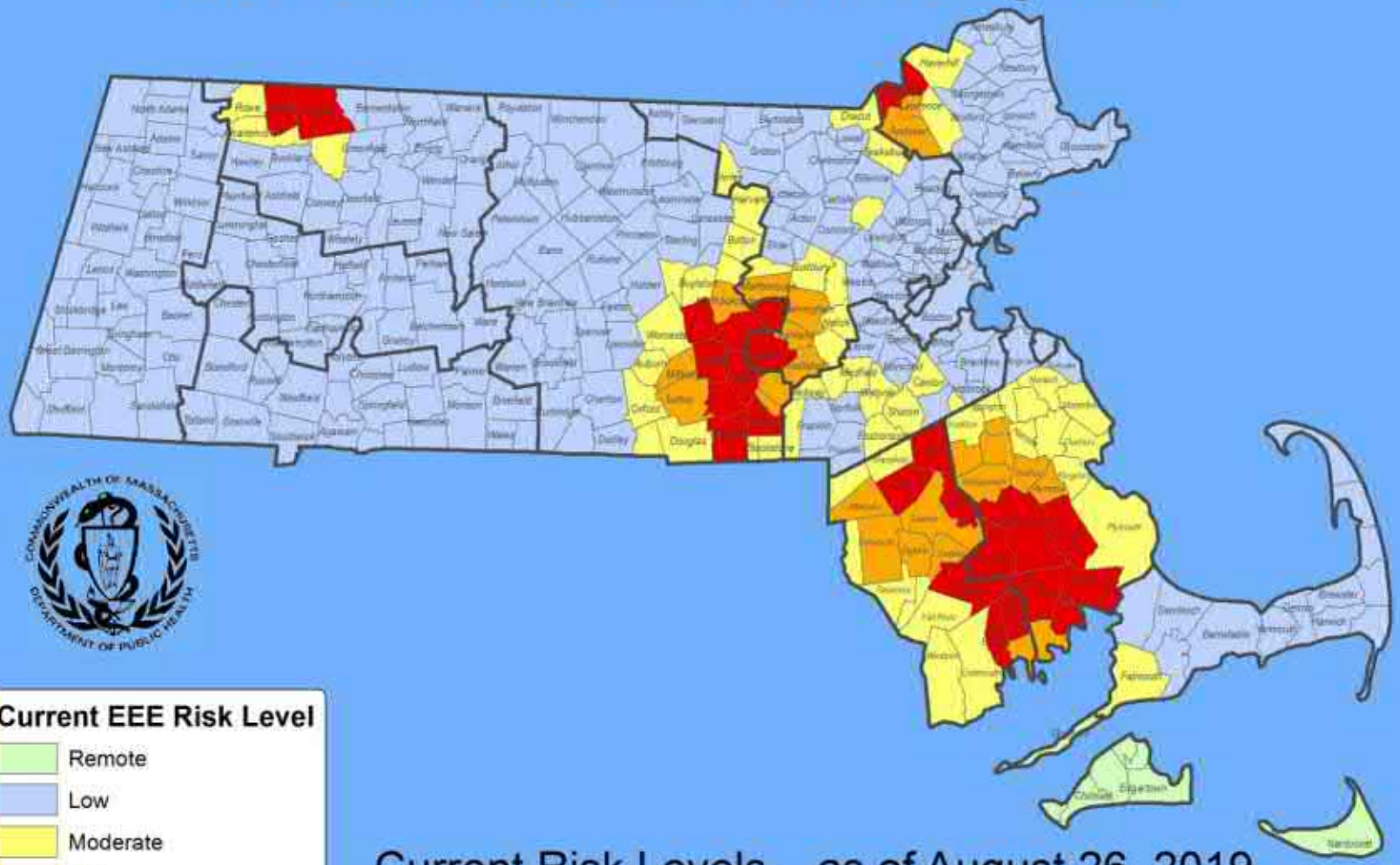
- **Health**
  - Flood/High Water-related Deaths
  - Emergency Response Delays

- **Infrastructure**
  - Road Washout
  - Environment
  - Sewer System Overflows
  - Compromised Bridges

- **Changes in Habitat**

FUSS & O'NEILL

Massachusetts EEE Risk Categories



Current Risk Levels – as of August 26, 2019

Massachusetts State Public Health Laboratory
Arbovirus Surveillance Program

Stakeholder Updates

Confirm Climate Change Hazards

- **Flooding ***
- **Extreme Precipitation Events***
- **Heat Waves**
- **Drought***
- **Snow/Ice***
- **Wildfire**
- **Tornadoes**
- **Hurricanes**
- **Nor’easters**
- **Other**

MVP Program

- Review MVP Sectors
- Maps as tool
- List infrastructure, societal, environmental feature
- Determine whether a vulnerability or strength
- Identify actions to reduce vulnerability or reinforce strength
- Prioritize actions
- Report Out

- **Finalize Prioritization Plan**

FUSS & O'NEILL

Risk Matrix – Determine Top Four Hazards

Community Resilience Building Risk Matrix www.CommunityResilienceBuilding.com

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					Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Societal									
Environmental									

FUSS & O'NEILL

MVP Sectors

- **Infrastructure**
  - **Evacuation routes**
  - **Schools**
  - **Roads, bridges, dams**
  - **Water and wastewater**
  - **Septic systems**
  - **Hospitals**
  - **Commercial Buildings, churches**
  - **Utilities: electric, gas**
  - **Factories**
  - **Emergency management facilities**

MVP Sectors

- **Societal**
  - **Emergency shelters**
  - **Senior housing**
  - **Schools and campuses**
  - **Economically challenged populations**
  - **Evacuation plans**
  - **Animal shelters**
  - **Hospitals, pharmacies**
  - **Grocery stores**
  - **Utilities: electric, gas**
  - **Homeless**
  - **Other**

MVP Sectors

- **Environmental**
  - **Drinking water supply**
  - **Rivers and streams**
  - **Parklands**
  - **Agriculture**
  - **Title V systems**
  - **Stormwater management**
  - **Open spaces**
  - **Flood plains**
  - **Forest**
  - **Other**

Next Steps:

- Public Review of Priorities
- Monitor and Update
- Annual Review

Questions?