City of Barre, Vermont
2017 Local Hazard Mitigation Plan

Prepared by the City of Barre
With assistance from the Central Vermont Regional Planning Commission

Date of City Adoption: November 28, 2017

December 7, 2017
Date of Final Approval by FEMA
(Plan Expires 5 years from FEMA approval – December 7, 2022)

Funded in part by a Hazard Mitigation Grant Program grant from Vermont Emergency Management
(formerly known as the Division of Emergency Management and Homeland Security)

U.S. Department of Homeland Security
FEMA Region I
99 High Street, Sixth Floor
Boston, MA 02110-2132

FEMA

DEC 21 2017

Lauren Oates
State Hazard Mitigation Officer
Vermont Department of Public Safety
45 State Drive
Waterbury, Vermont 05671-1300

Dear Ms. Oates:

We would like to acknowledge the City of Barre and the State of Vermont for their dedication and commitment to mitigation planning. The Department of Homeland Security (DHS), Federal Emergency Management Agency (FEMA) Region I Mitigation Planning Team has completed its review of the City of Barre, Vermont 2017 Local Hazard Mitigation Plan and determined it meets the requirements of 44 C.F.R. Pt. 201.

With this plan approval, the City of Barre is eligible to apply to the Vermont Division of Emergency Management & Homeland Security for mitigation grants administered by FEMA. Requests for mitigation funding will be evaluated individually according to the specific eligibility requirements identified for each of these programs. A specific mitigation activity or project identified in your community's plan may not meet the eligibility requirements for FEMA funding; even eligible mitigation activities or projects are not automatically approved.

Approved mitigation plans are eligible for points under the National Flood Insurance Program's Community Rating System (CRS). Complete information regarding the CRS can be found at http://www.fema.gov/national-flood-insurance-program-community-rating-system, or through your local floodplain administrator.

The City of Barre, Vermont 2017 Local Hazard Mitigation Plan must be reviewed, revised as appropriate, and resubmitted to FEMA for approval within **five years of the plan approval date of December 7, 2017** in order to maintain eligibility for mitigation grant funding. We encourage the City to continually update the plan's assessment of vulnerability, adhere to its maintenance schedule, and implement, when possible, the mitigation actions proposed in the plan.

DEC 21 2017

Once again, thank you for your continued dedication to public service demonstrated by preparing and adopting a strategy for reducing future disaster losses. Should you have any questions, please do not hesitate to contact Josiah "Jay" Neiderbach at (617) 832-4926.

Sincerely,

Paul F. Ford
Acting Regional Administrator

PFF: jn

cc: Ben Rose, Recovery and Mitigation Section Chief, VT DEMHS
Stephanie Smith, Hazard Mitigation Planner, VT DEMHS

Enclosure

City of Barre, VT Local Hazard Mitigation Plan November 2017
Prepared by City of Barre and CVRPC

1. Introduction

The impact of expected, but unpredictable natural and human-caused events can be reduced through community planning. The impact of expected, but unpredictable natural and human-caused events can be reduced through community planning. According to 44 CFR Part 201, Hazard Mitigation Planning, this planning process establishes criteria for State and local hazard mitigation planning authorized by Section 322 of the Stafford Act as amended by Section 104 of the Disaster Mitigation Act of 2000. Accordingly, this Local Hazard Mitigation Plan (hereafter referred to as the Plan) seeks to provide an all-hazards local mitigation strategy that will make the community of Barre City more disaster resistant and reduce its risk from natural hazards.

Hazard mitigation is any sustained action that reduces or eliminates long-term risk to people and property from natural and human-caused hazards and their effects. Based on the results of previous Project Impact efforts, FEMA and State agencies have come to recognize that it is less expensive to prevent disasters than to repeatedly repair damage after a disaster has struck. This Plan recognizes that communities have opportunities to identify mitigation strategies and measures during all of the other phases of emergency management – preparedness, response, and recovery. Hazards cannot be eliminated, but it is possible to determine what the hazards are, where the hazards are most severe and identify local actions that can be taken to reduce the severity of the hazard.

Hazard mitigation strategies and measures alter the hazard by eliminating or reducing the frequency of occurrence, avert the hazard by redirecting the impact by means of a structure or land treatment, adapt to the hazard by modifying structures or standards, or avoid the hazard by preventing or limiting development.

The City of Barre recognizes the need to both prepare and to mitigate. Mitigation is those actions we take to minimize the amount of harm that will take place when an event occurs. This might include something like implementing land use zoning that prohibits building in known flood zones.

Preparedness is those things we do so that we can respond effectively when something does happen, such as having well-organized, trained and equipped fire, EMS and law enforcement personnel, regular training and drilling for disaster response skills and coordination.

Both mitigation and preparedness are designed to help individuals and communities have a better outcome in emergencies and disasters, but the difference between the two is important, because both the federal and state governments fund mitigation and preparedness differently. Preparedness funds are made available prior to a disaster occurring, and the mitigation funds from the federal government have traditionally been made available only after an event has happened in a given locality, with the mitigation project being intended to lessen the impact of a future event in the same place.

2. Purpose

The 2017 City of Barre Local Hazard Mitigation Plan is a single jurisdictional plan, and is an update of the City's FEMA approved 2012 Plan. The purpose of this Local Hazard Mitigation Plan is to assist the City of Barre in recognizing hazards facing the region and our community and identify strategies to begin reducing risks from acknowledged hazards.

Barre City strives to be in accordance the strategies, goals and objectives of the State Hazard Mitigation Plan, including an emphasis on proactive pre-disaster flood mitigation for public infrastructure, good floodplain and river management practices, and fluvial erosion risk assessment initiatives.

The City has reviewed, evaluated and revised the 2012 Plan to reflect changes in development, progress in local mitigation efforts and changes in priorities. New information has been incorporated into this Plan making it up to date, stronger and more useful for the City officials and residents who will implement the actions and measures going forward. Implementation of this Plan will help the City to be more resistant to harm, reduce damages in the future, as well as reduce public costs.

The updated 2017 Plan includes some of the following:

- Updated information since the last Plan was completed in 2011 and adopted in 2012;
- A status update of the previous Plan's strategies and actions;
- A new set of mitigation strategies and actions to reflect the current priorities and intended actions of the community over the next five years;
- An updated and healthier Hazard Ranking Methodology used here;
- Updates made to the Hazard Analysis Map;
- The addition of a Transportation Vulnerability Analysis Map;
- An updated version of the Dam Inundation Area for the East Barre Dam and the Thurman Dix Reservoir;
- Updated the hazards to reflect changes in the City's priorities;
- Few changes to the update to incorporate greater public participation and reflect scheduling changes of the City Council since the last adoption.

3. Community Profile

Geography

The City of Barre is the eleventh largest community in Vermont and is located on the eastern edge of Washington County. It is bounded by Barre Town to the north, east and south and shares its western boundary with the Town of Berlin. Located within the Winooski Watershed, Barre City covers 4.02 squares miles. Residential neighborhoods surround the downtown core, which is nestled at the confluence of two river valleys; the Steven Branch and the Jail Branch Rivers. Like many New England Towns the downtown core, located within the floodplain, is already built-out and a majority of new development is occurring

outside of the floodplain in the residential neighborhoods. Residential development since the last plan has been limited and is relatively the same year over year.

The Municipal Plan includes a description and proposed implementation strategies in regards to riverbank management, solid waste planning and access management. The City of Barre Zoning Regulations, last amended in 2010, contains Flood Hazard Area Bylaws.

Population

In addition to municipal buildings and other community facilities, the City of Barre hosts the Washington County Court House, the McFarland State Office Building, and many regional social service organizations. The City of Barre has a unique and diverse population. According to the 2010 Census, the City has a total population of 9,052 people living in 4,504 housing units. The population in Barre City has declined by 2.6% since the 2000 Census. The Municipal Plan indicates that the City has a higher percentage of elderly population than the region and state. According to the Barre City Police Chief, the community has the highest rate of furloughed inmates.

Redevelopment

The Main Street and Merchants Row areas of Barre City underwent extensive revitalization projects since 2012, including the rehabilitation of the Blanchard Block, and the $17.5M reconstruction of North Main Street, that replaced the public infrastructure below and above ground in our downtown business district; the removal of old buildings for the construction of the new Barre City Place; and most recently the removal of two concrete blocked apartment buildings for a new 4-story energy efficient building containing 27 multi-family apartments and 7,000 square feet of commercial office space to house the Downstreet Housing & Community Development offices, as well as an updated city parking lot in front. The Merchant's Row Redevelopment was for the Enterprise Aly, a 1.2 acre parking lot located in the central area of the downtown, to clean up former dry cleaner contamination and to decrease the likelihood of downtown flooding by up-sizing the capacity of the storm drainage system and altering elevations to direct storm water away from buildings.

The City is currently working on the redevelopment of the City parking lot in front of Downstreet Housing. Coupled with the construction of Downstreet Housing's building, the parking lot design will also take into consideration the increased efficiency of the storm drainage system.

According to the City of Barre Municipal Plan, the valley floor is at approximately 600 feet above sea level and ranges from one-half to one mile in width. Rising above the valley floor are flat-topped, gently rolling to steep hills approximately 400 feet above the valley floor. The City is bisected by Route 302 running east to west and by Route 14 running north to south.

Utilities, Water and Sewer

The Thurman W. Dix (herein after referred to simply as the Reservoir) Reservoir and the Lower Orange Reservoir serve as drinking water sources for the City. The City owns these dams and the approximately 1,200-acre tract of adjacent lands surrounding the reservoirs.

The Dix Reservoir Dam was built in 1950, drains 9.1 square miles and is classified by the State of Vermont as a High Hazard dam. This means that the potential for loss of life, more than a few, and potential economic loss is excessive.

Green Mountain Power (GMP) provides electricity for the entire City. The Barre Waste Water Treatment Facility services the City as well as a portion of Barre Town, as does the Water Treatment Facility located on the edge of the downtown.

Transportation

Barre City is a 10-minute drive from Exit 7 on Interstate 89, and 15 minutes from Montpelier. US Route 302, a major east-west route through New England, brings travelers through downtown Barre City where the highway serves as our main street. Vermont Rail runs through Barre City to Montpelier were it connects to New England Central Railroad. Many of our industrial properties abut the rail line and have the potential for rail services. The E. F. Knapp State Airport is located four miles outside the City. There is public transit service linking Barre City to neighboring communities. We have ample public parking in our downtown.

Emergency Services

The City's fire coverage and ambulance service is provided by the Barre City Fire and Ambulance Department. According to the City's 2016 Annual Report, the Department responded to 527 fire related calls and 2,188 calls for emergency assistance, and the Police Department provides for its law enforcement services. The City of Barre has an approved Emergency Operations Plan dated 2012, and an updated Local Emergency Operations Plan readopted in June of 2017.

National Flood Insurance Program

The City entered the NFIP (National Flood Insurance Program) by FEMA (Federal Emergency Management Agency) via Resolution of the City Council and adopted on January 22, 1974, and became effective on April 15, 1974, and we are currently in compliance. The City's FHBM (Flood Hazard Boundary Map) was identified with the NFIP on July 26, 1974. This was the initial flood hazard identification used for emergency program communities. Then, the City received its first FIRM (Flood Hazard Rate Map) identified on January 17, 1985. This showed the flood hazard boundaries within the City, delineating the 100-year floodplain and the 500-year flood plain. Recently, FEMA updated the City's FIRM with a newer delineation dated March 19, 2013 that is the effective date of the current map used for flood hazard purposes. The Community Panels are 50023C0434E and 50023C0453E, both effective March 19, 2013. These FIRMs are adopted by reference and declared to be a part of the Flood Hazard Area Regulations. The FIRM is in digital format as well, and is an overlay found on the City's digital tax map.

Barre City is not enrolled in the NFIP Community Rating System. It is the intention of the Department of Planning to pass the Certified Floodplain Manager's exam and then begin work with the Department of Public Works to begin seeing what is already being done in the City, and how to take the next steps. The City of Barre is ERAF Eligible, at 12.5%, and can be found at http://floodready.vermont.gov/sites/floodway.

The City of Barre Zoning Regulations, last amended in 2010, and is currently undergoing a total re-write, contains Flood Hazard Area Bylaws as a set of regulations governing flood hazard areas in the City. The City's first Flood Hazard Area Regulations were adopted on February 25, 1985, with minor updates, most recently being amended and effective on August 27, 2010. The Flood Hazard Area Administrator is the Director of Planning for the City. There are numerous structures in both the SFHA (Special Flood Hazard Area) and the Floodway, and according to data as presented on Vermont's FloodReady website, 44 repetitive loss properties in the City and 6 BCX Claims. B, C and X are zones from the previous FEMA maps and are areas outside of the SFHA Zone A. There are 215 policies for a total coverage of $39,370,300. There have been 22 Letters of Map Change to date, and 188 claims totaling $3,341,422 paid since 1978.

4. Planning Process and Maintenance

Barre City has experienced staffing changes since the adoption of the 2012 Barre City Hazard Mitigation Plan. During this time period, positions shifted in order to maintain mitigation efforts in the community. Staffing at the City of Barre, specifically key department head positions have been vacant over the last 3 years, with them slowly being filled again. The Planning Director's position, now filled by Janet Shatney, was empty for over a year and a half. The Public Works Director's position was vacant for over 2 years as well. Bill Ahearn, PE was hired in June of 2017 and now serves as the Public Works Director for the City, and is also a registered Professional Engineer. The previous 2012 plan stated that the Mitigation Plan would be maintained by the Fire Department. Now, with a full time Planning Director on staff, the plan maintenance will come under these duties.

4.1 Planning Process

The CVRPC (Central Vermont Regional Planning Commission) Executive Director, Bonnie Waninger sent a letter to the City Manager, Steven E. Mackenzie, P.E. on December 10, 2015 announcing the opportunity for the CVRPC to provide assistance in updating the Plan with funding provided by the Hazard Mitigation Grant Program. The letter noted the current plan expiration date of September 27, 2017, with copies distributed electronically to Planning Director Janet Shatney (also CVPRC Commissioner), Chief Timothy Bombardier, Director of Public Safety, and Mayor Thomas Lauzon.

Members of the City Planning Team who assisted with the revisions include:

Name/Title/Organization	Role
Janet Shatney, Planning Director, City of Barre	Lead Plan Editor
Steven E. Mackenzie, P.E., City of Barre Manager	Member

Jeffrey Bergeron, City of Barre Facilities Director	Member
Timothy J. Bombardier, Director of Public Safety	Member
Larry Eastman, City of Barre Police Dept. Deputy Chief	Member
Joseph Aldsworth, City of Barre Fire Dept. Deputy Chief	Member
William Ahearn, City of Barre Director of Public Works (Hired July 2017)	Member
Steve Micheli, City of Barre Superintendent of Water and Sewer	Member
Laura Ranker, CVRPC Emergency Management Planner	Coordinator

4.2 Plan Update Process

The Plan was originally adopted by the City as an Annex to the Central Vermont Regional Pre-Disaster Mitigation Plan in November 2007 and received FEMA final approval in December 2007. In 2012, the City updated the Plan creating a single jurisdiction local mitigation plan which received FEMA approval on September 27, 2012. This Plan is an update of the 2012 Plan and will guide the City into the next five years and maintain the City's eligibility as an applicant for mitigation grants.

Throughout many public process meetings that the City has had related to flood mitigation, the attendees are too numerous to list, and those include many members of the business and residential community, members of the City's various committees and commissions, the ANR (Agency of Natural Resources), ACCD (Agency of Commerce and Community Development), engineers and scientists.

The first meeting regarding the CVPRC's letter occurred on December 29, 2015 with Laura Ranker of CVPRC and Janet Shatney along with Joseph Aldsworth from the City. The purpose of this meeting was to initiate this update process, outline those requirements needed to update the plan, including but not limited to the coordination, public process and timeline.

The City of Barre began its public process before this letter was issued. The City of Barre was the recipient of being a pilot community for the VERI Report (Vermont Economic Resiliency Initiative), published in July of 2015. That report was a culmination of many local stakeholders, including river engineers, scientists, state agencies and community and business owners, along with City staff, who participated in meetings, community forums, morning coffee meetings, and City Council presentations. ACCD was the recipient of disaster recovery funding in May 2013, from the U.S. Economic Development Administration for VERI. The goals of VERI were to:

- Analyze threats to Vermont's areas of economic activity and their associated infrastructure;
- Develop plans to reduce impacts and avoid future losses and costs; and

- Identify projects that the communities and businesses can implement that avoid, minimize or reduce their flood risk and this ensure businesses stay open and communities minimize costs.

Barre City, along with Barre Town, was selected for the following reasons:

- The area has significant economic activity and it is state-designated downtown;
- Critical transportation infrastructure was identified to be at-risk that, if closed, would impact employees and customers trying to get to businesses and the flow of goods and services;
- Numerous buildings were identified to be at-risk near the Gunners Brook;
- Barre City has a history of repeated flooding and flood damages.

Meetings included the following:

- October 27, 2014 – VERI Community Forum #1
- April 16, 2015 – VERI Community Forum #2

The outcome of these meetings, along with the creation of the final VERI Report, were strategies and projects to further local area mitigation for a specific neighborhood, and these meetings spoke to input, strategy, information, process, participation and execution of mitigation efforts, many of which were the outcomes of the VERI Report.

Concurrently, the City of Barre experienced another major flood event on July 19, 2015. As much as 6" of rain fell on parts of Central Vermont causing serious flash flooding and damage to 80 homes and apartments along the Gunners Brook. It is known that Vermont businesses and homeowners have access to state flood assistance programs, but there was no program to help repair flood damaged rental properties. Because of this flood event, the Mayor, Thomas J. Lauzon, as a culmination of this and the 2011 event, worked closely with the then Governor Peter Shumlin and VEDA (Vermont Economic Development Authority) to create a new loan program to fill gaps in funding, help the neighborhood recover and provide our community the time we needed to develop a long-term solution.

The City of Barre then undertook the D&K Report (Phase I Flood Mitigation Study) published by DuBois & King, Inc. engineers on November 28, 2015 to identify and evaluate specific proactive and mitigative measures aimed at reducing the potential and frequency for flooding as a result of woody debris jamming in Gunners Brook in the vicinity of Brook Street and Harrington Avenue, and the reduction of associated frequency of flood damages. A large project in this neighborhood then evolved and is ongoing as of the writing of this revision.

Several public meetings for this large mitigation project then ensued. A list of neighbors, abutters, those directly impacted by flooding, city staff, reporters, city councilors and neighboring community members of Plainfield and Barre Town were invited. An email list that was kept apprised of the City's actions, where we were at with all of our mitigative actions ongoing, and those updates were emailed out beginning on October 18, 2015 and the last update, number 8, was issued on July 27, 2017. A copy of the October 18, 2015 public

outreach letter is included in the Attachments. This shows that the City Manager, along with other city officials, took major steps to keep people informed, that this flooding event was a serious exercise in improving communication, and getting great feedback from residents and business owners affected by this flooding.

A meeting of the City Team took place on March 17, 2017 to discuss the Risk Assessment and prioritize threats and hazards that pose a risk to the City. The next several months was utilized working independently reviewing the 2012 Plan and recommended updates along with the State Hazard Mitigation Plan November 2013, VERI Report, the D&K Report, and the FEMA Local Mitigation Plan Review Guide.

On September 6, 2017, CVRPC Emergency Management Planner Laura Ranker met with City representatives Janet Shatney, City Planner and Bill Ahearn, City Engineer to discuss the transportation vulnerability map created by CVRPC during the summer of 2016. This map creation came about from a grant received by the CVRPC to assist and complete culvert and drainage inventories in their Region's municipalities, Barre City being one of them. This map identified specific sites they felt were vulnerable. Discussion ensued regarding the City's thirteen (13) existing trash racks, many of which are contributing to stormwater damage, and not functioning as intended. These racks were put in place to simply protect major infrastructure, and maintenance measures such as bi-annual inspections will be ramped up.

On September 8, 2017, the City Team met and went over the tables regarding the status of the 2012 proposed mitigations, and created the proposed 2017 proposed mitigations. Many good ideas came about from this meeting, with more attention to detail over the ensuing 5 years being met.

Transportation Vulnerability Assessment

A Transportation Vulnerability Assessment was completed by the staff at CVPRC during the summer of 2016. Critical infrastructure and hazardous sites were reviewed and priority areas identified. Data included identification of adequate and undersized culverts and bridges; road modifications for areas with low or high spots; identification of areas with steep slopes; and road alterations required to improve drainage such as ditches, swales, and cross bars. CVRPC staff then drove all the roads in the City to field verify the vulnerable assessment data. Photos and notations were made and an updated map was sent to the City along with photos and the list of priority sites. This map was given to the City's Interim Public Works Director and was reviewed for its results. It has since been given to the recently hired Director of Public Works Bill Ahearn for use as noted above. The vulnerability assessment information was considered in updating this Plan, and the map can be found in the Attachments section of this plan.

Planning Team Findings

The Planning Team findings indicated that the City remains most vulnerable to flooding/fluvial erosion accompanied by dam failure, severe weather and ice jams.

Serious mitigation efforts have been taken already in areas of the City for things like flooding and storm damage. The City continues to invest in and improve our maintenance plans for its equipment and infrastructure. A new high tower fire truck was purchased during the summer of 2017; a new street vacuum truck was obtained utilizing two grants the City was awarded; to date 5 of 7 HMGP (Hazard Mitigation Grant Program) Buy-outs have occurred, with the remaining Phase 2 projects, that are two more properties mitigated slated to be completed by the end of 2017 or mid-2018.

Additionally, two more HMGP projects were applied for and awarded in 2015. The first is for the upgrade in storm sewer infrastructure on N. Main Street near the intersection of Fourth Street. The grant is for the update of a >100 year-old, 24" storm sewer/box culvert, approximately 350 feet long. This infrastructure has repeated damage from previous storms due to its inadequate capacity.

The other is for a grant in the Granite Street neighborhood. It is for the update of a >100 year-old, undersized 8" storm sewer approximately 710 feet long, to be replaced with and 18" storm sewer six additional catch basins and lateral connections, with a new outfall structure to be provided.

The City continues to focus mitigation efforts on flooding projects, as flooding has been the most common and damaging event.

Public Outreach

The draft Plan was distributed electronically to the area municipalities on September 14, 2017. These towns include Barre Town (Carl Rogers, Town Manager); Berlin (Rosemary Morse, Town Clerk), and Plainfield (Linda Wells, Town Clerk/Treasurer). It was also sent to Rob Evans, and Ned Swanberg of VTANR Floodplain Management, Josh Cox, VEM (Vermont Emergency Management, formerly known as DEMHS, or Vermont Department of Emergency Management and Homeland Security).

The draft Plan was posted on the City website (www.barrecity.org), links shared to the Barre City Facebook Fan Page Administrator and the Discover Barre Administrator, on the CVRPC website, and hard copies available within the City Offices. A notice was posted on FPF (Front Porch Forum), and in the Times Argus newspaper.

The public was directed to send comments to the Planning Director (jshatney@barrecity.org) or drop them off directly with the Director during regular business hours. Comments were asked to be received by September 25, 2017. All comments received were reviewed and incorporated as deemed appropriate, in keeping with the purpose of the goals of this Plan. Concurrently, the Plan was also submitted to VEM on the same date that started the review process with them and with FEMA.

Ongoing public participation in the Plan maintenance process will continue by providing opportunities for feedback at City Council meetings and any informational meetings particularly directed after hazard events. An electronic suggestion box is located on the City website as Citizen Feedback, which allows people to submit comments at any given time for

anything of question or importance in the City. An electronic copy of the final plan will be located both on the City's website and on the CVRPC's website under Barre City, along with several other plans that are already in place.

Governmental Participation and Involvement

The Planning Director worked with Stephanie Smith, VT Hazard Mitigation Planner with VEM and FEMA Planners during the Plan update review process prior to final adoption by the City Council.

Prior to formal adoption, a public meeting was warned for the City Council on November 10, 2017 to get public comment on the final Plan. Upon FEMA written notice of "***Approval Pending Adoption***", the City Council approved and adopted the 2017 Plan by resolution at a regularly warned meeting. A copy of this Resolution is in the Plan as an Attachment. FEMA approved this Plan on December 7, 2017 and a copy is found at the beginning of the Plan.

The City of Barre's Municipal Plan, adopted by City Council on June 17, 2014, will expire in 2019. During the 2018 year, the City Planning Commission will incorporate and address the hazard mitigation goals and objectives of this Plan into the updated 2019 Municipal Plan. Vermont Statute enables this incorporation to satisfy state municipal planning requirements for towns and cities to develop a flood resilience element in municipal plans.

Update of Mitigation Actions Identified in 2012

The Planning Team reviewed the 2012 Table for proposed hazard mitigation programs, projects and activities and has responded to all items, including those left over from the 2007 plan below.

Proposed 2012 Mitigation Action	2017 Status
Expansion and upgrade of culverts on Beckley St, Farwell St, Onward St (outlet), East St (rebuild box), Montpelier Rd, Packard St, City Place/Depot Sq. (box culvert),	*Beckley St culvert was repaired in place during the N. Main St. reconstruction, Farwell St. the City stabilized the bank behind the auto business; Onward St, the City has replaced the outlet headwall; East Street has not been done yet; Rte. 302 (Montpelier Rd) is cleaned out repeatedly; and Packard St the City continues routine maintenance with stream work*
Buyout 2 private properties on Hilltop Ave	*15 and 21 Hilltop Avenue - 2 single family residential homes recognized as "cliffhanger" properties as a result from landslides associated with Tropical Storm Irene: they were bought out by the City using VEM HMGP funds, with 25% match coming from TRORC (Two Rivers-Ottauquechee Regional Commission); completed in 2014*
Mapping study of underground streams through City center	*This task has not been done yet; the City will reconsider this task at a later date, and is a low priority*

Create local flood hazard maps which indicate flooding potential beyond FEMA's 100-year flood plan	*This task has not been done yet, and the new FIRM maps were issued March 2013, so we have new models for interpretation of our local areas; the City will reconsider this task at a later date, and is a low priority*
Improve drainage in proximity to and within City, including improvement of on- site stormwater management and the establishment of riparian buffers	*The City of Barre is currently engaged in a Tri-Town Stormwater Master Planning process with the CVRPC taking lead for the City, Barre Town and with Plainfield. The planning process incudes the Pouliot and Winter Meadow neighborhoods as designated by the Friends of the Winooski. The City also has 2 HMGP storm sewer grants to improve drainage on N. Main Street in the "North End" and another on Granite Street.*
Improve City stormwater drainage system to eliminate backfilling and flooding potential during storm events	*This task has a very broad meaning to the current members of the team, and feels that with the Friends of the Winooski plans for the City, we are slowing working our way through this task*
Adopt and enforce Vermont Agency of Transportation "Codes & Standards for Roads" or other standards more appropriate for Barre City	*The City has been thinking of this for several years now, and identifies that having standards would be beneficial for construction and for funding; we are currently looking to whether or not we could adopt portions of the standard as many City streets would become impassable as many currently are narrow and have a steep grade*
Ensure Main Street reconstruction project includes flood-proofing components as mentioned in Section 7 Existing Hazard Mitigation Programs, Projects & Activities	*The North Main Street project was an Agency of Transportation project. The City took advantage of the ability to put in sprinkler stubs to every building that did not already have one for any future requirements the business may need*
Establish alternate egress from Public Safety Building	*The City attempted this endeavor with all the abutting landowners around the Public Safety Building. No landowner would grant the City any right-of-way or easement for us to add this. The City received 2 high water vehicles to add to the fleet of fire trucks, as we have learned in past experiences without that alternate egress not all the trucks can exit onto Main Street if there is high water*

Enroll in NFIP's Community Rating System	*With staffing changes over the past several years, this has not been done yet, but the current Planning Director desires to acquire Certified Floodplain Manager's certificate and begin this endeavor. The Permit Administrator will also eventually be tasked with passing the CFM as well*
Implement and enforce a fuel tank anchoring ordinance.	*We have not done this yet; and with the regulations that have changed in the past several years, anchoring of certain sizes for certain products is now already required. The City endeavors to consider an ordinance that would require anything larger than a 25 lb. cylinder be anchored*
Reengineer RR trestle on Vanetti Place	*The City approached VTrans to complete this task as it falls to their jurisdiction. The railroad now uses this trestle with the reactivation of the train, and we have contingency plans in place where the DPW inspects quarterly to keep an eye on the debris that may build up and remove any of it*
Stormwater mapping/closed pipe system study	*This task was completed by the CVRPC from a grant they received for the summer of 2016 to inventory municipal systems, including the City; and the VYCC (Vermont Youth Conservation Corp) also was tasked with completing certain city's inventories of culverts, headwalls and inlets and outfalls*
Develop alternate egress to Elementary School	*This task was completed insofar as Dubois & King engineers designed the alternate road, but was not implemented by the school due to cost.*
Work with the VTDEC River Management Division to remove obstructions in the floodway and develop strategies to decrease sedimentation in river	*The VTDEC played a large role in authoring the City's VERI report, which examined various locations where obstructions occur. This task is ongoing and will become a part of the City's inspections once we enroll in the CRS (Community Rating System)*
Improve access to Wastewater Treatment Facility during flood events to ensure fuel oil delivery to generator	*This task is complete; we examined the access to the treatment plant and is simply not feasible given the topography, and would cost the City upwards of $500,000. We are considering utilizing an auxiliary tank*

Install “trash racks” on Gunner Brook	*This task is complete; two sets of trash racks were installed. The Gunners Brook Upper Trash Rack, over the City line near the LePage Gravel pit was installed in the fall of 2016, and the Lower Trash Rack was installed as part of the Phase 1 Flood Mitigation project behind Brook Street and Harrington Avenue.*
Implement selected projects from Stevens/Jail Branch Corridor plan (see attachments)	*This task is ongoing, as the Tri-Town Stormwater Master Planning continues to firm up; there have been new items and a new list is being generated for planning purposes*
Provide training to residents and sensitive populations on how to insulate homes (pipes, attics) for extreme cold spells	*This task was not a priority anymore, as Efficiency Vermont has really taken on the task of providing so much information to the general public for various energy saving tips*
Provide looped distribution service or other redundancies in the electrical service to critical facilities	*This task is complete, as there are generators in place for most City structures now*
Installation of guard rails around reservoir	*This task was not done and is considered a low priority at this point*
Work with Barre Town to keep debris around dam spillway clear	*The Planning Team believes that this item pertains to the East Barre Dam, and work would be coordinated with the Town of Orange, not Barre Town. This task is ongoing as part of the DPW maintenance process*
Work with Barre Town to improve communications regarding Curtis Pond Dam and Adamant Dam issues	*This task is ongoing and part of the DPW maintenance process*
Review and adapt building code so that new structures are earthquake resistant	*The City decided not to complete this task. With design standards in place by the State Dept. of Public Safety, and the building height in Barre City is capped at 72 feet, we are not going to pursue this*
Develop an all hazards public outreach campaign including evacuation maps and an explanation of warning systems. Ensure campaign is accessible to all residences including elderly, blind and to people of which English is a second language (carried forward from 2007 plan)	*Public outreach, evacuation maps, and using the media and the alert system are still being considered and still proves to be something we are interested in*
Develop a School Evacuation and School Crisis Plan and distribute to all Emergency Service Departments (carried forward from 2007 plan)	*This task was done once for all the schools due to the rise in school shootings nationwide. The schools were required to develop these plans and adopt them as they are now mandated*

Develop a Capitol Equipment Plan and include snow removal equipment, flood rescue boat, portable lighting and 6x6 ATV with EMS and fire suppression skids for Public Safety Building (carried forward from 2007 plan)	*This task never was done. The City could not support any of these desires due to costs, and justify the real need. The City is not interested in boats or swift water rescue due to equipment needs and required training. The City Tower Truck, as well as others in the fleet all have lighting on them that sufficiently light up large areas when and where needed*

Review of Plans, Studies and Reports

Preparation for the update of this Plan included a review of the following documents and resources, as well as conversations with Laura Ranker, CVRPC Emergency Management Planner.

- Barre City Local Hazard Mitigation Plan Update August 2012; FEMA approved September 2012;
- Barre City Municipal Plan adopted June 17, 2014;
- Barre City Flood Hazard Area Regulations effective August 27, 2010;
- Barre City Zoning Regulations, effective August 27, 2010;
- Barre City Emergency Operations Plan, updated March of 2015;
- Barre City Local Emergency Operations Plan, adopted June 2017;
- Jail Branch and Stevens Branch Corridor Plan, adopted 2009;
- Barre City Annual Reports, years covering 2012-2016;
- Barre City Hazard Analysis Map dated 2017;
- 2012 Final FEMA Review Tool – City of Barre;
- State of Vermont Hazard Mitigation Plan dated November 2013;
- FEMA Flood Insurance Study for Washington County, effective March 19, 2013;
- Barre City's NFIP FEMA FIRM's March 19, 2013;
- FloodReady Vermont website for Repetitive Losses/BCX Claims, and non-mitigated repetitive loss properties data;
- FEMA Disaster Declarations in Vermont;
- National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental Information and Historical Weather Data;
- FEMA Mitigation Planning Handbook, March 2013;
- FEMA Local Mitigation Plan Review Guide, October 2011;
- Vermont Economic Resiliency Initiative Barre, VT Community Report July 2015;
- Gunners Brook Phase I Flood Mitigation Study, November 2015.

During the process of updating this Plan, the following is a list of revisions to the 2012 Plan. Hazards are clarified and reprioritized based on current conditions and vulnerability. New hazards were identified, due to the extensive efforts of the VERI Report, and are contained here.

General Updates

- Updates to the Community Profile;

- Updates to the Planning Process;
- General reorganization of the Plan;
- Reevaluation, identification and analysis of all significant hazards;
- Acknowledgement of implemented mitigation strategies since 2012;
- Identification of on-going and new mitigation projects and strategies;
- New Hazard Risk Assessment that expands on the City's vulnerability ranking and is similar to what is used by VEM;
- Incorporation of new data throughout the Plan from the current Plan (2012);
- Includes references to City regulations, Ordinances, and Hazard data (events, declarations, non-declared disasters);
- Acknowledgement of implemented mitigation strategies since 2012 and update status of 2012 proposed actions and strategies;
- Identification of on-going, new and proposed mitigation projects and strategies for the next 5 years;
- Use of a mitigation action evaluation table;
- Recommended use of the Mitigation Tracking Tool.

Hazard Analysis Updates

- Review of the Vermont Hazard Mitigation Plan dated November 2013;
- Review of Federally Declared Disasters, weather data, ANR resources, and VT FloodReady Site; and NOAA site;
- Update of location/vulnerability/extent/impact/likelihood table for each hazard so summarize hazard description.

Maps

- Updated Hazard Analysis Map 2017 showing Tier II sites, current E-911 locations, structures in the Special Flood Hazard Areas;
- Included Transportation Vulnerability Map 2017;
- Included Dam inundation areas map for the Thurman W. Dix Dam taken from EAP prepared by Dubois & King, Inc. Engineers on January 28, 2009.

This Plan reflects changes and updates from the 2012 Plan, related to the City's vulnerabilities to hazards and how the City addresses them based on changes in our priorities, and the effects of the implementation of past mitigation actions and strategies. The implementation of several mitigation actions over the past five years, some not listed because the City considers them to be regular maintenance and program implementation measures have reduced the City's vulnerability to specific hazards.

The City has benefitted from the collaborative approach to achieving mitigation on the local level, by partnering with ACCD, ANR, VEM, FEMA, CVRPC, Friends of the Winooski, and may other agencies, all working together to provide assistance and resources to pursuing mitigation projects and planning initiatives in the City.

Implementation Mitigation Strategy

Services provided by the City of Barre are overseen by the City Manager, who is overseen by

a 7-member City Council. The City has a volunteer 7-member Planning Commission who is charged with developing and updating the Municipal Plan, the Zoning Regulations, the Flood Hazard Area Regulations, and any other land use regulations that may arise.

The City employs many staff to carry out services to its residents on a daily basis. The following are the paid positions involved in hazard mitigation. Many staff who works under the list of people below assists as well, and are too numerous to list:

- Director of Planning, Zoning and Assessing Services: Janet Shatney
- Floodplain Administrator: Janet Shatney
- Director of Public Works: Bill Ahearn
- City Manager: Steven Mackenzie
- Superintendent of Water/Sewer: Steve Micheli
- Director of Facilities, Buildings & Services: Jeffrey Bergeron
- Director of Public Safety: Timothy Bombardier
- City Clerk and Treasurer: Carolyn Dawes

The City's fiscal year begins on July 1 and ends on June 30, annually. The budget year is wrapped up for the former year within approximately 5 months into the start of a new year, at which time the budgeting process for the ensuing year begins. The budget is prepared by the City Manager working with Department Heads, and is developed, with a draft ready for City Council shortly after the first of the year. The City Council then reviews and approves the draft budget before it is put to vote by the voters of the City of Barre on the first Tuesday in March at the Annual City Meeting. The Director of Public Works has undertaken the Capital Equipment Budget this year. It will be presented to the City Council in the Fall of 2017 for initial approval, and will become a part of the annual budget process moving forward. Throughout the fiscal year, each Department Head is charged with maintaining and abiding by the budget that gets approved for their respective department(s). When issues arise, the City Manager is the first person to go to. And, the City Council has the authority to adjust the budget for instances of extraordinary circumstances, such as equipment or infrastructure failures, and natural disasters.

Municipal revenues are generated primarily through levy of taxes on property values. Other major sources of revenue are state and federal payments to support the schools, and grants from many different sources, both state and federal. The City also has the authority to incur debt through bonding.

Existing Programs, Projects & Activities

The City is currently engaged in, working on or has completed the following hazard mitigation programs, projects and activities:

	Type of Existing Authority/Policy/Program/Action	Resource: Staffing	Ability to Expand/Improve on:
Community Preparedness Activities	Program: Annual update of the City of Barre's LEOP (Local Emergency Operations Plan). Last updated and adopted June 22, 2017.	City staff time is set aside each spring by the Planning Director, who assists the Director of Public Safety in this endeavor	This document is reviewed and updated each year to ensure that the contact information of emergency response personnel is up to date. This information is then sent to VT Emergency Management for their records, as well as the CVRPC. There is no need to expand on this program at this time.
	Program: Update of the main EOP (Emergency Operations Plan). Last updated and adopted in March 2015	City staff time is set aside annually to review and update any relevant sections	This Plan for the City was created and adopted to meet certain Public Safety requirements, and will be updated as needed.
	Program: Attendance/participation at Local Emergency Planning Commission (LEPC) #5 meetings	Volunteer time from the Deputy Fire Chief	Improve on this only if attendance becomes unsatisfactory where the City is not represented.
	Policy: Evacuation plans for the BHA (Barre Housing Authority) Buildings	BHA staff time	A one-time action in the creation, then annually if anything changes due to construction of structures.
	Completed Action: Barre City Schools' Evacuation plans.	BCEM (Barre City Elementary and Middle School), and SHS (Spaulding High School)	A one-time action in the creation, then annually if anything changes due to construction of structures.
	Program: Capital Equipment Replacement Plan	City staff is working to create the plan summer 2017 then annual maintenance of plan	A one-time creation of a comprehensive equipment replacement plan, then annual monitoring and maintenance thereof.
	Completed Action: ARC (American Red Cross) Shelter designation. Shelters designated are the Barre City Civic Center and the Barre City Elementary & Middle School	ARC will manage the shelters upon request by a duly authorized City official to the ARC office.	This is a one-time action, and no need to expand the program.
	Policy: Mutual Aid agreements with surrounding communities Creation of a Regional Public Safety Authority	City Council, associated surrounding communities	The City is currently working through the ability to create a regional authority. This would be a one-time action.

Insurance Programs	Authority/program: participation in the NFIP (National Flood Insurance Program) The City participates in and is compliant with the NFIP by enforcing its current Flood Hazard Area Regulations (last amended August 27, 2010), based on the 3/19/13 FIRMs	City Planning Director serves as the initial Flood Hazard Administrator, with delegation with the City Permit Administrator.	The City entered the NFIP via resolution by City Council on 1/22/74; the FHBM (Flood Hazard Boundary Map) was identified on 7/26/74, and received its first FIRM (Flood Hazard Rate Map) on 1/17/85. The FIRM has since been updated by FEMA and is effective 3/19/13.
Land Use Planning/Management	Policy/Program: City of Barre Municipal Plan (adopted June 17, 2014)	Staff time and volunteer time from the City Planning Commission and citizen planners. Funding from Planning grants or budgetary items	This 5-year plan will be worked on beginning in 2018 with an intent to adopt with revisions before the 2019 expiration date. Once adopted , it will become an 8-year plan.
	Authority: City Zoning Regulations Last updated August 27, 2010	Staff time and volunteer time from the City Planning Commission and citizen planners. Funding from Planning grants or budgetary items	It was noted through the 2014 Municipal Plan revision that the zoning ordinance needed to be revised to reflect those goals and changes. The zoning ordinance is currently being rewritten (2017-2018) and will be adding the subdivision regulations to become the City's Unified Development Bylaws.
	Authority: City Special Flood Hazard Area Regulations Last updated August 27, 2010	Staff time and volunteer time from the City Planning Commission and citizen planners. Funding from Planning grants or budgetary items	City is currently working under the auspices of these regulations – no action needed at this time.
	Authority: City LHMP (Local Hazard Mitigation Plan) Last updated and approved by FEMA on 9/27/12.	Planning Director is the key responsible party, as well as other City staff participation, along with public input	The 2017 Plan will replace the 2012 Plan, and has evolved, expanded and improved greatly. Future iterations of this LHMP will be updated by the City at least every 5 years.
	Authority: Jail Branch and Stevens Branch Corridor Management Plan, March 13, 2009	Volunteer time that created the plan, staff time to implement and execute	This plan was created from work done to identify stressors and constraints in this watershed and create a strategy to help alleviate them
	Completed Action: North Main Street Reconstruction Project Final plan for paving being executed Summer 2017	VTrans along with City Public Works Dept.	This was a one-time construction plan

	The plan called for flood-proofing the utilities, new utilities and improved surface drainage; and install back flow prevention valves in sewers and drains		
Hazard Control & Protection of Infrastructure and Critical Facilities	Action: Barre City Public Safety Building (built outside of the floodplain in 2005). A designated secondary means of egress has been identified as a low priority for the City.	City staff with potential civil engineering firm	This is a one-time action that would serve the building and its vehicles, especially during any flooding situations
	Action: culvert inventory	Completed in summer of 2014 by the CVRPC	One-time action; verifications to be made then map will be updated as needed.
	Policy: City Road and Bridge Standards adoption; the City's version of VTrans Roads and Bridges Standards	Creation by City staff and approved and adopted by the City Council	This would be a one-time action; it would specify minimum construction standards for roadway, ditches, culverts and bridges and guardrails. VTrans updates the Town Road and Bridge Standards on a fairly regular basis, and the City has the authority to require above-and-beyond what is written in the policy.
	Action: purchase and installation of a backup generator and both the Water Filtration Plant and the Wastewater Treatment Plant	Initiation, purchase and installation all by City staff	These would both be a one-time action for the protection of the plants.
Education/Public Outreach	Action: All City Department Heads take and maintain ICS 100 and 402 training and certification. Copies of certifications sent to Human Resources.	City Staff and City Council members	This is a one-time action until FEMA creates or changes any ICS standards.
	Action: Education and Communication to community regarding structure fires prevention, and any other citizen important topics	City Fire Department Staff time	This is an on-going action, and there is no need to expand or improve on this.
	Ongoing Action: The City of Barre website, where important information is posted. There are various community City of Barre Facebook pages, as well as Councilor-run fan pages, that are not endorsed by the City of Barre, although hold important information.	City staff time as needed	This is an on-going action and there is no need to expand or improve on this.

4.3 Plan Maintenance Process

The Barre City Local Hazard Mitigation Plan will be updated and evaluated annually at a regular City Council meeting during the months of March through May, along with the review and annual adoption of the LEOP. Updates and evaluation by the department heads will also occur within three months after every federal disaster declaration and as updates to City plan/zoning come into effect. The plan will be reviewed by the department heads, City

Council, and public at the abovementioned City Council meeting. CVRPC may help with updates or if no funding is available, the Planning Director will maintain plan maintenance.

The process of evaluating and updating the plan will include continued public participation through public notices posted on the municipal website, notice in the municipal building, Times Argus, Washington World, Front Porch Forum, newspaper and CVRPC newsletter inviting the public to the scheduled City Council (or specially scheduled) meeting. Additional stakeholders invited to the meeting will be the Barre Housing Authority, Capstone Community Action, Washington County Mental Health, and Superintendent and Principals of Schools. Also invited in the future will be the VT Agency of Natural Resources (VT ANR), as they are able to provide assistance with NFIP outreach activities, models for stricter floodplain zoning regulations, delineation of fluvial erosion hazard areas, and other applicable initiatives. These efforts will be coordinated by the Planning Director.

Monitoring of plan progress, implementation, and the 5 year update process will be undertaken by the Planning Director. Monitoring updates may include changes in community mitigation strategies; new city bylaws, zoning and planning strategies; progress of implementation of initiatives and projects; effectiveness of implemented projects or initiatives; and evaluation of challenges and opportunities. The plan is to be a "living document" to allow for new actions to be identified in the five year interim period and amended without formal re-adoption during regularly scheduled City Council meetings. Prior to the end of the five year period, the plan will be undergo a formal update and submitted to FEMA for re-adoption following the process outlined the schematic found in the Attachments section. The City may use the Mitigation Action Tracking Sheet found in the Attachments section, or a similar method to assist with progress reporting on the mitigation actions and strategies taken over the next five years.

Barre City shall also consider incorporation of mitigation planning into their long term land use and development planning documents. It is recommended the City review and incorporate elements of the Local Hazard Mitigation Plan when updating the municipal plan, zoning regulations, and flood hazard/FEH bylaws. The incorporation of the Local Hazard Mitigation Plan into the municipal plan, zoning regulations and flood hazard/FEH bylaws will also be considered after declared or local disasters. The City shall also consider reviewing future Stevens and Jail Branch River Corridor planning documents for ideas on future mitigation projects and hazard areas.

In order to maintain a current up-to-date unexpired Plan, within one year of this Plan's expiration date, the plan update process with FEMA should begin. For the next update, should funding be available for CVRPC staff to assist the City of Barre, the updates shall commence. Should funding not be available, or CVRPC be unable to assist in the update, the City's Planning Director shall take the lead to update the Plan. The City is responsible for the update and maintenance of this Plan. The City will consider sending updates and requests to our local businesses and adjacent municipalities. Barre City has a downtown development corporation known as Barre Area Development Corp., which could, in the future be drawn upon for comment and suggestion. The City also has a downtown merchant's organization called the Barre Partnership, that City merchants can become

members of, and can utilize their membership list as well.

In 2013, the Vermont Legislature passed a law requiring all municipalities to incorporate a flood resiliency element into their Municipal Plan, effective July 2014. When the City updates their Municipal Plan in 2018, the requirements will be met by identifying flood hazard and fluvial erosion hazards, strategies, and recommendations to mitigate risks to public safety, critical infrastructure, historic structures, and public investments. The Municipal Plan will help the City comply with the new community flood resilience requirements for Municipal Plans adopted after July 2014, and will assist the Barre City Planning Commission in their work as they update the existing Municipal Plan.

5. Risk Assessment

5.1 Hazard Identification and Analysis

The planning team performed an evaluation of the known hazards to the area and the risks the hazards pose looking at three main questions, 1) what damage can happen given the City's vulnerabilities, 2) how likely are they to occur, and 3) how damaging can they be. Using a table to show this process, the City was able to then prioritize actions designed to mitigate the effects of each of the disaster types. The City looked at past occurrences within the City, county and state level for guidance. Although the City cannot predict the future, recent changes in the climate have made old weather patterns less predictable and Vermont has seen an increase in the number and severity of storms, especially high intensity rainfall events. In response to the changes in the weather patterns, the City continues to keep flooding and severe weather as a top priority.

The following table reflects the hazards the City feels can be expected, or at least are possible, to occur. In this 2017 Plan, the City expanded on the risk analysis by considering factors shown on the Vermont Hazards Ranking sheet, such as frequency of occurrence, warning time, and potential community impact modeling the methodology used in the 2013 Vermont Statewide Hazard Mitigation Plan. The hazards were ranked based on these factors to determine which hazards posed the greatest risk to the City and found to be the most significant. The top or worst threats are highlighted and bolded in the table. Further discussion, associated mitigation actions and follow-up is provided in this Plan.

The process used to rank the hazards and score them is found as an Attachment of this Plan. The process is very similar to the one the State of Vermont used in their 2013 statewide hazard mitigation plan. Unlike the state process, the geographic extent focused on the City, not the entire State of Vermont and therefore did not use the state-wide or region wide extent.

Those hazards not found to pose the greatest threat to the City such as drought, avalanches, extreme heat, tornados, hazardous materials spills, wildfires, earthquakes, sinkholes, civil disturbances and invasive species are not addressed in this Plan due to

low probability of impact and scarce community resources (time and money). A review of the Vermont State Hazard Mitigation Plan of November 2013 provides a greater explanation of these hazards and possible mitigation strategies to address them.

Like the State of Vermont Hazard Mitigation Plan, the City did not include the following hazards in the risk and vulnerability assessment due to the low occurrence, low vulnerability, and or geographic proximity: coastal erosion, nuclear power plant failure, expansive soils, Karst Topography, tsunami's and volcanos.

Hazard	Frequency of Occurrence	Warning Time	Potential Impact	Hazard Score
Drought (*while a drought may occur occasionally, the planning team decided to remove this hazard from further analysis due to the relatively large volume of precipitation the City receives each year*)	2	1	2	5
Avalanche	1	4	1	6
Extreme Heat (*while extreme heat does occur occasionally, the planning team discussed past occurrences of extreme heat and determined that a reprieve from the heat often comes before serious issues result, and therefore decide to remove from further analysis*)	4	1	2	7
Tornados (*due to the City's topography, tornados are not likely to form here*)	1	4	1	6
Hazardous Materials Spills	2	4	1	7
Wildfire/Forest Fire	1	4	1	6
Ice Jams	**4**	**2**	**3**	**9**
Land/Rock/Mudslides	2	4	2	8
Earthquakes (*while an earthquake may occur occasionally, the planning team decided to remove this hazard from further analysis due to the*	2	4	1	7

very low magnitude earthquakes that have occurred in the City in the past)				
Flooding/Flash Flood/Fluvial Erosion	**4**	**2**	**3.5**	**9.5**
Extreme Cold/Winter Storm/Ice Storm	4	1	3	8
Severe Weather (*thunderstorm, lightning, high winds, hail storm*) **Note: we have defined severe weather to include two or more of the above hazards**	**4**	**3**	**3.5**	**10.5**
Hurricanes/Tropical Storms	3	2	3	8
Dam Failure	**1**	**4**	**4**	**9**
Water Supply Contamination	3	2	3	8
Structure Fires	3	4	1	8
Sinkholes	1	4	2	7
Civil Disturbance	1	4	2	7
Infectious Diseases	2	1	2	5
Invasive Species	4	1	1	6

Just because the City has not identified a hazard as a top priority or significant threat, does not mean the hazard will not occur in the future; they are simply not the focus of this Plan.

The City of Barre has identified the following hazards to be the most significant (bolded and shaded in rose color):

- Flash Flood/Flood/Fluvial Erosion;
- Dam Failure;
- Severe Weather (thunderstorms, lightning, high winds, hail storm);
- Ice Jams.

Moderate threat hazards include:

- Extreme Cold/Winter Storm/Ice Storm/Power Failure;
- Hurricanes/Tropical Storms;
- Water Supply Contamination;
- Structure Fires.

A discussion of each significant hazard is included in the proceeding subsections. An updated Hazard Analysis Map is included as an attachment. Each subsection includes a list of past occurrences based upon County-wide and State-wide FEMA Disaster Declarations

(DR-#) where applicable. Information was also gathered from local records, the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (formally known as the National Climate Data Center, NCDC), reports from the National Weather Service in Burlington, Vermont, the Vermont Forest, Park and Recreation Department, and VT State Hazard Mitigation Plan. This section includes a narrative description of the hazard and a hazard matrix containing the following overview information:

Hazard	Location	Vulnerability	Extent	Observed Impact	Probability
Type of hazard	General areas within municipality that may be vulnerable to the Identified hazard.	Community structures, systems, populations, or other assets as defined by the community that are susceptible to damage and loss from hazard event	Strength or magnitude and general details of the most notable event(s): Minimal, Moderate; or Severe	Dollar value or percentage of damages	Likelihood of hazard occurring based upon past events: Occasionally: 1-10% probability of occurrence pre year, or at least one chance in next 100 years Likely: >10% but <100% probability per year, at least 1 chance in next 10 years Highly Likely: 100% probable in a year

5.2 Worst Threat Hazards

5.2.1 Flash Flood/Flood/Fluvial Erosion

Flooding/flash flooding/fluvial erosion is Barre City's most commonly recurring hazard. Flooding is the overflowing of rivers, streams, drains and lakes due to excessive rain, rapid snow melt or ice. Flash flooding is a rapidly occurring flood event usually from excessive rain. Fluvial erosion is the process of natural stream channel adjustments. Fluvial erosion causes erosion of sediment in some areas, while causing aggradation of sediment in others. Fluvial erosion processes occur more quickly and severely during flood events.

Flooding of land adjoining the normal course of a stream or river has been a natural occurrence since the beginning of time. If these floodplain areas were left in their natural state, floods would not cause significant damage. Development has increased the potential for flooding because rainfall that used to soak into the ground or take several days to reach a body of water now quickly runs off streets, parking lots and rooftops and through human-made channels and pipes.

From the Vermont Emergency Management website:

Know your Terminology	
Flood Watch	Flooding is possible. Watches are issued by the National Weather Service, 12 to 36 hours in advance of a possible event
Flash Flood Watch	Flash flooding is possible. Be prepared to move to higher ground. A flash flood could occur without warning.
Flood Warning	Flooding is occurring, or will soon. If advised to evacuate, do so immediately.
Flash Flood Warning	A flash flood is occurring. Seek higher ground immediately and stay away from streams and creeks.

The following chart indicates the history of occurrence with regard to this hazard in City of Barre. Data is both county-wide and state-wide. Federal declared disaster numbers are noted where applicable. Data on the fluvial erosion damage in number of acres lost was not found for the events. Information to complete the history of occurrences was taken from the National Oceanic and Atmospheric Administration (NOAA), National Center for Environmental Information (NCEI), formally the National Climate Data Center, the FEMA Declared Disasters in Vermont data base, the State of Vermont Hazard Mitigation Plan dated November 2013, and City records.

Date	Event	Location	Extent
7/19/2015 (**DR-4207 VT**)	Flash Flooding	County Wide, Barre City	Repetitive flooding and systems/structural damage to homes in the lower Gunners Brook area of the City rendering at least 3 homes uninhabitable.
4/15/2014-4/18/2014 (**DR-4178 VT**)	Severe Storms and Flooding	Stateside, County Wide	Heavy rains and melting snow pack created widespread flooding and release of 4"-6" of water from snowpack causing many waterways to reach near bank-full conditions across Central Vermont. Damage to roads and bridges occurred.
8/27/2011 – 9/02/2011 **(DR-4022 VT)**	Flood/Tropical Storm Irene	Statewide, Barre City	Montpelier Flood gauge at 19.05 feet (flood stage is at 15 feet)

5/26/2011 – 5/27/2011 **(DR-4001 VT)**	Severe Storms and Flooding	Barre City, County Wide	Montpelier flood gauge at 17.59 feet, 3-5" of rain. Flooding and/or significant systems damage to homes and businesses in the downtown and "north end" areas including Gunners Brook neighborhood, Stevens Branch area, portions of N. Main Street as well as areas of the City where flood damage created washouts in the high elevations.
8/02/2008	Flash Flood	Barre Town, Barre City	No data – route 302 flooded
7/11/2007 **(DR-1715 VT)**	Severe Storms and Flooding	Barre City, County wide	Tropical like showers and thunderstorms struck east-central Vermont, with localized rainfall 3-6" of rain in 2 hrs.
4/14/2002	Flood	County wide	1-3" of rain across the county
12/17/2000	Flood	County Wide	3" of rain, $1M in damages
9/16/1999 – 9/21/1999 **(DR-1307 VT)**	Tropical Storm Floyd	County Wide	Montpelier flood gauge at 9.30 feet, 5-7" rain county wide
6/27/1998 **(Part of DR-1228 VT)**	Severe Storms	Barre City, County Wide	$2M in damages, 3-6" rain across county. Several homes and businesses without power and flooded; National Guard called in for relief efforts.
7/15/1997	Flash Flood	County Wide	$500K in damages
1/19/1996 – 1/20/1996	Flood; ice jam	County Wide	Montpelier flood gauge at 14.64/ A deadly storm caused strong winds and flooding throughout the state. Many roads washed out, numerous power outages were reported. More detailed rainfall data was unavailable for the City. Power outage time data for this event are not known. feet.
03/1992 (**DR 938 VT**)	Ice jams and Flooding	County Wide	Heavy rain and ice jams during the winter season prompted flooding throughout the state, including Washington County. More detailed rainfall data was unavailable for the City. Power outage time data for this event are not known.
8/10/1976	Flood	County Wide	Montpelier flood gauge at 12.31 feet

6/28/1973 – 6/30/1973 **(DR-397 VT)**	Flash Flood	Barre Town (adjacent town); County-wide	Montpelier flood gauge at 17.55 feet; Rainfall as much as 6 inches in 24 hours in some locations. State declared disaster area. 3 deaths occurred and resulted in $64 million in damage. Power outage time data for this event are not known.
9/22/1938	Flood, Hurricane	County Wide	Montpelier flood gauge at 14.11 feet
11/02/1927 – 11-04-1927 **("Flood of 1927")**	Flood	County Wide	Montpelier flood gauge at 27.10 feet; Considered to one of VT's most devastating events, the flood took out 1285 bridges, miles of roads and railways, and countless homes and buildings. 84 people were killed, including Lt. Gov. S. Hollister Jackson. Rainfall totaled 4-9" statewide, following a month with 150% the normal amount of rain. Power outage time data for this event are not known

Specific extent data for flood levels in Barre City is lacking as the closest flood gauge is located in Montpelier. During Tropical Storm Irene, flooding in Barre was minimal and the Montpelier flood gauge was 4 feet above flood stage. Flooding was more severe during the May 2011 event and areas in the 150 year floodplain were flooded up to 5 feet. A map of the extent of the May 2011 event is found in the Attachments. The worst flooding event in Barre City's history was the 1927 event; however, exact data from that event is not available. In 1927 event, the Montpelier flood gauge was at 27.10 feet; however, since the 1927 flood a number of flood control dams have been installed in the region to prevent the same flooding extent. Lesser but more regular flooding occurs in Barre City, with generally 1-2 feet of water in the Granite Street area and other low lying areas by the Stevens Branch. These areas are identified on the local areas of concern map. Barre City utilizes a painted wall within the Stevens Branch of the Winooski River, out behind City Hall. These painted lines represent incremental foot markings so that the level of the Stevens Branch can be monitored during flooding events. A map of the watercourses in the City of Barre is found as an Attachment.

The City of Barre is located within the Stevens Branch sub-watershed of the Winooski Watershed. The City is located predominantly within a river valley, surrounded almost entirely by the hills of Barre Town. The most prominent bodies of water in the City are the Stevens Branch River, which flows from southeast to west, followed by the Jail Branch and the Gunners Brook. The two major roads in Barre City, Route 302 and Route 14, parallel these waterways for much of their length within City limits.

A high concentration of Barre's development is located within the floodplain. Based on the results of overlaying the current Flood Insurance Rate Maps (FIRM) with the location of

E911 points, 602 properties are located within the National Flood Insurance Program's designated floodplain areas known as Zone A, and Zone AE, or AE-Floodway.

The Flood Hazard Areas (A & AE) is the land in the floodplain within a community subject to a 1% or greater chance of flooding in any given year. The term "flood hazard area" is synonymous with other terms like 'area of special flood hazard', and 'special flood hazard area.

The term Floodway means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one (1) foot at any point. This term is also referred to as the 'Regulatory Floodway'. A map of the Special Flood Hazard Areas in the City is found in the attachments.

The table below represents a summary of the types of properties and structures located within each of the flood zones:

Floodplain Zone	Type of Property	Number of Properties
Flood Hazard Area Zone A	Cemetery	1
	Commercial structures	5
	Industrial structures	1
	Multi-family dwellings	4
	Park	1
	Parking lot	1
	Railroad owned land	1
	school	1
	Single family dwelling	42
	Storage buildings	1
	Vacant land	4
	Total:	**62**
Zone AE	Care Home	1
	Civic Buildings	9
	Commercial structures	36
	Homeless Shelter	1
	Industrial structures	22
	Mixed Use buildings	30
	Motel	1
	Multi-family dwellings	98
	Office Buildings	3
	Park	2
	Parking lot	8

	Railroad owned land	1
	Restaurant	2
	Single family dwelling	93
	Storage buildings	4
	Power Sub-Station	1
	Utility Buildings	1
	Vacant land (no structures)	45
	Total:	**358**
Zone AE-Floodway	Care Home	1
	Civic Buildings	3
	Commercial structures	22
	Industrial structures	23
	Mixed Use buildings	11
	Motel	2
	Multi-family dwellings	20
	Office Buildings	1
	Park	4
	Railroad owned land	2
	Restaurant	1
	Retail Building	1
	Single family dwelling	41
	Storage buildings	5
	Power Sub-Station	1
	Utility Buildings	1
	Vacant land (no structures)	43
	Total:	**182**

The estimated loss for a severe flooding event for all properties located within the City's 100-year floodplain is well over $2M. That number comes from the general assessment of each of the properties located in the 100-year floodplain alone. There are 44 FEMA repetitive loss properties in Barre City. Barre City participates in the NFIP. Currently, the City has 215 active policies for a total coverage of $39,370,300. Flood hazard regulations limit development in the floodplain. The Planning Director and the Permit Administrator are responsible for enforcement of the flood hazard bylaws.

Documented events throughout history illustrate the devastating impact of flooding. One of the most significant flooding events was the Great Flood of 1927, where in November a total of 8.6 inches of rain fell over a 38-hour period, resulting in extensive damages including total destruction of homes, businesses, bridges, and roads. In response to these events, the United States Civilian Conservation Corps (CCC) constructed the East Barre Flood Control Dam in

1935, located within the neighboring Town of Orange. The Dam was redesigned and modified by the Corps of Engineers in the 1950's.

In more recent history, the flood event of December 17 and 18, 2000, where 1.5" to 3" of rain fell and warming temperatures caused snow pack melt resulting in the Stevens Branch and some of its smaller tributaries to overflow. According to the damage reports maintained by the Barre City Fire Chief, 24 private residences on North Main Street, Berlin Street, Vine Street, Smith Street, Granite Street, Third Street, Scampini Square, and River Street experienced furnace, electrical and heating oil problems as a result of the flooding. Other buildings which sustained flood damage included:

- Times Argus Newspaper, 540 North Main Street (regional media facility, now Dollar General)
- Ormsby's, 61 North Main Street (electronic and appliance retailer, now demolished and part of a parking lot)
- Studio Place Arts, 201 North Main Street (non-profit arts center)
- Socials Labor Party Hall, 46 Granite Street (historic community gathering hall)

The City of Barre sustained approximately $1,000,000+/- in direct damage costs to private property, private business property, and public property.

The flood of July 11 and 12, 2007 is one of most significant flooding events in recent history. Approximately 4-6 inches of rain fell in a 24 hour period between noon on July 11 and July 12, causing the Stevens and Jail Branches to overflow their banks resulting in the inundation of downtown businesses and surrounding neighborhoods with up to 5 feet of water. According to Patrick Ross, a stream alteration engineer for VTANR, upsized culverts, hillside roads and development in Barre Town contributed to an increased volume and rate of flow of stormwater draining into the receiving waters of the Stevens and Jail Branches. Debris within the river channel became lodged on obstructions, such as bridge abutments, abandoned railroad trusses and deteriorating floodwalls, further compounding the ensuing flood situation. Rising river waters flooded downtown businesses and homes on North Main Street, Granite Street, Scampini Square and Berlin Street. Flood waters on North Main Street inhibited the ability of emergency services vehicles to exit the Public Safety Building to respond to calls.

In addition, as river levels rose above stormwater outlet drains, flood waters backed flowed into Barre City neighborhoods. This additional pressure resulted in the collapse and failure of portions of the storm water drainage system. The City of Barre sustained severe damage, thousands of dollars of direct damage costs to private property, private business property, and public property.

In 2011, the May 27 event was much worse than Tropical Storm Irene. During the May 27 event the Granite Street and north were flooded. The attached flood map highlights the extent of the flooding beyond the 100 year floodplain. The flooding was a result of the river overtopping its banks and too much stormwater. 10 culverts were in the highlighted area were damaged. The hills of Barre City were also damaged. Barre City was interested in

buying two homes on Hilltop Ave which were damaged in the May floods. The City incurred over $1 million in damages from the May event.

There was minimal flooding during TS Irene. Flooding during TS Irene occurred in the usual flood prone areas as outlined on the Areas of Local Concerns map. It again hit the North-End and Harrington Avenue neighborhoods very hard. Flooding during TS Irene occurred in the usual flood prone areas such as outlined on the Areas of Local Concerns map. Subsequent to that, the City of Barre has since applied for and received 5 hazard mitigation grants for buy-outs of properties, to remove the structures and return the area to its natural floodplain state.

Again, repetitive flooding occurred on July 19, 2015, beginning as an evening rainstorm and escalating to a severe flash flooding that crippled the lower Gunners Brook neighborhood with multiple home damage. As stated earlier, City officials began working on flood resilient and mitigative measures, such as the grant application process once again for 5 homes in this neighborhood to be purchased and demolished. A large flood remediation project concurrently took place, adding a debris rack in the area, grading and shaping the land to accommodate flood surge waters and an area to "comb out" debris during and after future events. These measures will not prevent flooding in this neighborhood, but the intent is to limit future damage and loss.

As previous events have made clear, however, even areas beyond the NFIP designated 100-year floodplain may be vulnerable to flood related hazards. Channel adjustments with devastating consequences have frequently been documented wherein such adjustments are linked to historical channel management activities, floodplain encroachments, adjacent land use practices and/or changes in watershed hydrology associated with conversion of land cover and drainage activities, within and beyond the NFIP floodplain. The Hazard Analysis Map identifies areas that have experienced flooding in the past.

The following matrix provides an overview of the hazard:

Hazard	Location	Vulnerability	Extent	Observed Impact	Likelihood/Probability
Flooding/ Flash Flooding	Floodplain especially North Main Street, Brook Street, Maple Avenue, Fourth Street, Reid Street, Harrington Avenue, Berlin Street, Vine Street, Granite Street, Scampini Square, River Street. Plus Park and East Street Neighborhood.	Commercial and residential structures, historic buildings, Route 302/N. Main Street and City infrastructure and emergency services.	5 feet of flooding during 2007 and 2011, and 2015 events	2000 flood event = $1,000,000+/- in damages	HIGH

5.2.2 Dam Failure

Manmade and natural dams exist in the City, but two manmade dams of concern are the Thurman W. Dix Reservoir Dam - State of VT Dam # 147.01 (hereinafter known as the

Reservoir) and the East Barre Dam - State of VT Dam #14.02 (hereinafter known as the Dam). Barre City owns the Reservoir. The Reservoir serves as the municipal water supply for the City. The dam structure and water reservoirs are located in the Town of Orange. The State of Vermont owns the Dam with operation by the Department of Environmental Conservation (DEC). It serves as a flood control dam.

The Reservoir is located in the northwest quadrant of Town of Orange. The ANR Dam Safety Program identifies it as a "high hazard dam". The Reservoir has three dams located on it – top, middle and spillway. The spillway is a dam of concern, which received damage in the May 2011 rain event. The City has since repaired the spillway. The spillway is an earthen dam and has had several slow leaks repaired over the years to prevent leaks onto the road below the dam. It is important to note, when water levels in the reservoir are high, inlet culverts to the reservoir become flooded.

The Reservoir's Emergency Action Plan (EAP) provides information on the potential impacted area and the people and businesses at risk of flooding if the dam should fail and provides the estimated time for the flood wave to travel from the dam to the impacted locations. The EAP identifies one home, one business, and four roads (with the extent of overtopping that will occur), if dam failure should happen.

Information taken from the Reservoir's EAP dated 1/29/2009, summarizes the Thurman W. Dix Reservoir description:

Height: 48 ft. Built: 1950
Legal Description: Not Applicable
Latitude: 44.18082
Longitude: 72.42586
National Inventory of Dams No: VT00069

Drainage Area: 9.1 miles^2
Hazard Classification: High
Dam Operator: The City
Major Property Owner: N/A
Dam Designer: The City

The East Barre Dam is the dam of concern for the City. The Dam is located in the Town of Barre on the Jail Branch approximately 4.4 miles up from the confluence with the Stevens Branch at the City of Barre. Looking from VT Route 110 and US Route 302 the Dam and Reservoir are visible. The Dam was primarily constructed for flood control but also has a small conservation pool maintained for recreational use and hydropower. The State of Vermont owns the dam and the DEC operates it, and is responsible for performing dam inspections and maintenance. The dam was built in July of 1933 and is an earth fill dam with stone slope construction. It is 1,460 feet long and 65 feet high. The flood storage area of the dam totals 675 acres and extends 2.5 miles upstream through the towns of Orange and Washington. The dam can store up to 3.9 billion gallons of water. The extent of flooding that could occur would be the equivalent of 5.8 inches of water covering the drainage area of 38.7 square miles (USACE). The Dam was built in response to the 1927 flood event. A copy of the Dam Inundation Map is found in the Attachments section.

As noted in the EAP prepared by DuBois & King, Inc., the East Barre Dam "consists of a rolled earth embankment, having a maximum height of 65 feet and an embankment length of 1,460 feet, exclusive of the spillway. The spillway consists of a concrete overflow-section.

The concrete over-flow section has an effective crest length of 174 feet. The low-level outlet at the dam consists of a reinforced concrete rectangular conduit 4.0 feet wide by 7.0 feet high…" It too is ranked as a "high hazard" dam and is based on VEM classification, "according to the dam's potential for causing loss of life and property damage in the area downstream of the dam if it were to fail" and uses a Downstream Hazard Classification system like that used by the U.S. Army Corps of Engineers as found in Table 4-24 in the Vermont State Hazard Mitigation Plan, November 2013 on page 4-95 and as shown below. The ANR Dam Safety Program inventory has 1240 dams of which 61 are high hazard dams. Of the 61 high hazard dams, ANR has jurisdiction for 40 of them including the Reservoir and the Dam. According to the State Hazard Mitigation Plan, none of the ANR regulated dams are in imminent danger of failure.

Table 4-24
Downstream Hazard Classification of Dams

Class	Hazard Category	Potential Loss of Life	Potential Economic Loss
3	Low	None expected (No permanent structures for human habitation)	Minimal (Undeveloped to occasional structure or agriculture)
2	Significant	Few (No urban developments and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry, or structures)
1	High	More than few	Excessive (Extensive community, industry, agriculture)

The EAP for East Barre Dam was last updated in 2012. The Impact of Breach, detailed in Appendix B of the 2012 EAP, identifies the populations and major transportation corridors, as well as the level of water rise and inundation expected in the event of a dam failure.

The table below is taken from the East Barre Dam EAP of 2012, summarizes the dam description:

Description	Data	Comment
Drainage Area	38.7 square miles	At East Barre Dam
Dam Height	65 feet	Top of dam at maximum height
Surface Area at Conservation pool	20 acres	Water level at the conservation pool elevation is 1124.9
Storage at Conservation pool	40 acre-feet	Water level at the conservation pool elevation is 1124.9
Distance from fixed concrete spillway to top of dam	20.0 feet	Elevation of spillway 1165.0 Elevation at top of dam 1185.0

To date, there have been no occurrences of the dam breaching. CVRPC performed a dam inundation model and found that if the dam were to breach, 549.9 acres, including all of Barre City would be flooded. This equates to 1136 properties for a total damage amount of $149,531,680. The map of the inundation area is an attachment.

Hazard	Location	Vulnerability	Extent	Observed Impact	Likelihood/Probability
Dam Failure	Area along Stevens Branch – see map of dam inundation area	Commercial and residential structures, road and culvert infrastructure	5.8" of water over the 38.7 square mile drainage area	$149,531,680	Low
Dam Failure	East Barre Dam mapped Inundation Area: includes area populations in Barre City, Barre Town, Montpelier, Middlesex, and Moretown; public and private infrastructure, roads, residences, businesses, natural features, rivers; historic structures	Failure will impact communities downstream Appendix B Impact of Breach, found in the East Barre Dam EAP dated 2012 provides detail of the vulnerabilities as well as the extent	No known event severe if failure happened with loss of life and property probable	Dollar value or percentage unknown No known dam failure recorded occurrences	Unlikely

5.2.3 Severe Weather(Thunderstorms, lightning, high winds, hailstorms)

Severe weather consists of thunderstorms, lightning, hailstorms, tornados, and intense winds, but can also describe more widespread events such as tropical systems, blizzards, and nor'easters. Often it consists of multiple events that combine to create hazardous conditions that pose a threat to communities in the State of Vermont and the City of Barre. Therefore, the City has defined severe weather as the occurrence of two or more of that listed above. Severe weather can be incredibly unpredictable. More common than hurricanes or tropical storms are severe thunderstorms (usually in the summer), which can cause flooding, as noted above, and are associated with lightning, high winds, hail and tornadoes. Thunderstorms are further defined in the Vermont State Hazard Mitigation Plan as follows, "Thunderstorms range in size and type. An ordinary cell thunderstorm consists of one cell with an updraft and downdraft and produce strong winds, rain, lightning, and even hailstones. Multicell cluster thunderstorms consist of several ordinary cell thunderstorms in the vicinity of each other. Multicell cluster thunderstorms are extremely prone to causing flash flooding. Squall line thunderstorms move in a linear front that can exceed 100 miles in length, with the strongest rains and winds at the front of the storm. Supercell thunderstorms are the largest, longest lasting, and most devastating thunderstorms. Nearly all tornadoes are formed from supercell thunderstorms. Supercell thunderstorms can also form hailstones larger than golf balls. These Supercell storms have clockwise rotating winds that exacerbate the storm. Lightning, hail, flash flooding, and tornadoes are all associated with this type of thunderstorm." Thunderstorm activity in the City causes power outages, damaging winds, hail, and transportation and economic disruptions, particularly from blown down trees.

Lightning produces thunder. Lightning is the electrical charges in the atmosphere between clouds, the air, or the ground. In the early stages of development, air acts as an insulator

between the positive and negative charges in the cloud and between the cloud and the ground. When the opposite charges builds up enough, this insulating capacity of the air breaks down and there is a rapid discharge of electricity that we know as lightning (as defined by NOAA). The discharge of electricity produces light (lightning) and sound (thunder). Lightning can kill, cause forest fires, and damage property.

High winds are usually associated with severe thunderstorms in Vermont. When winds are sustained at 31 to 39 mph for at least an hour or any gusts at 46 to 57 mph, the National Weather Service will issue a wind advisory. If winds reach 58 mph or more, the National Weather Service will issue a High Wind Warning. The National Weather Service has classifications for hurricane and tropical storm winds which can be found in the Saffir-Simpson Scale graphic below, as well as the Beaufort Wind Chart used to estimate wind speeds. High winds cause damage to property and personal safety, and are a concern for the electrical and telecommunication utilities in Washington County and throughout the state due to customer power outages and damage to infrastructure.

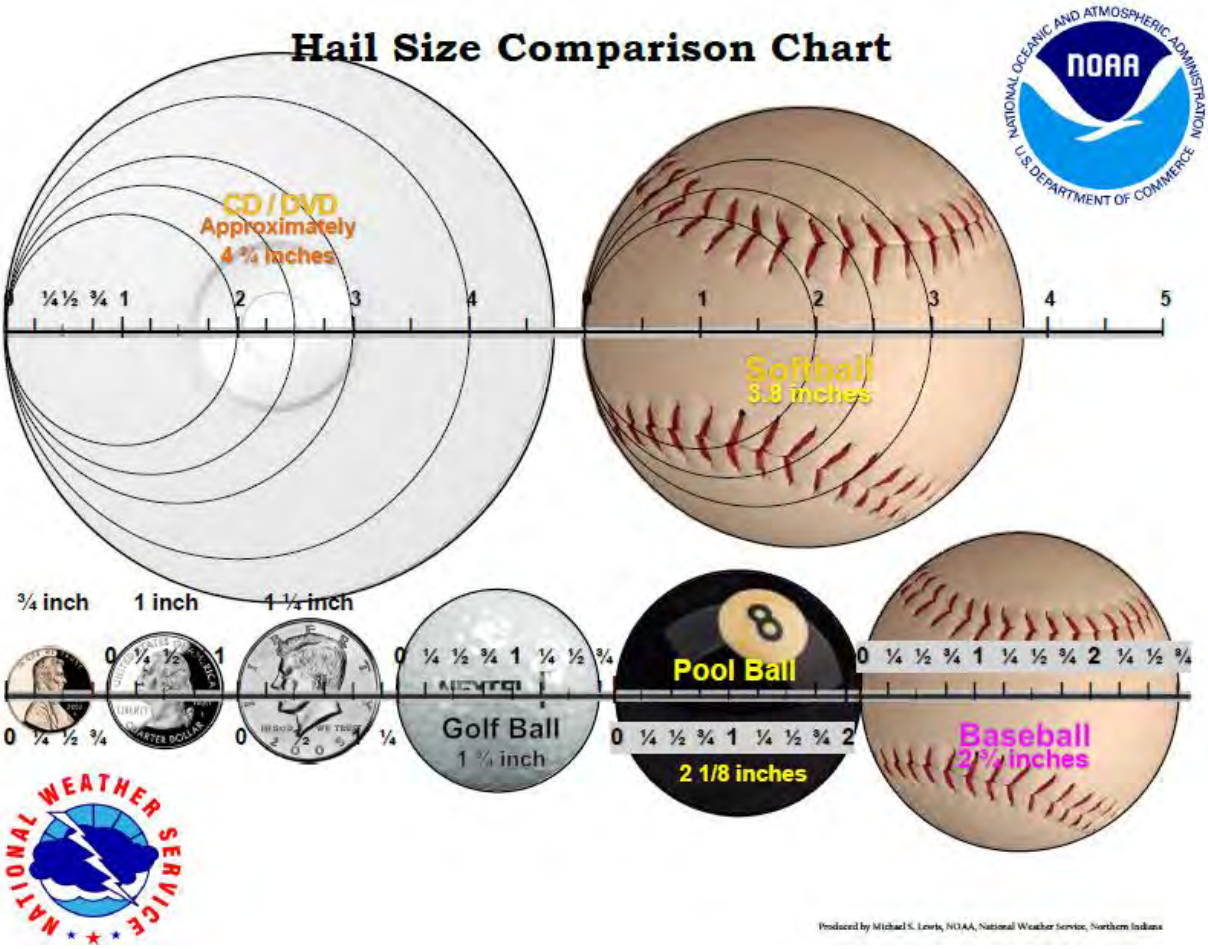
Saffir-Simpson Scale for Hurricane Classification				
Strength	**Wind Speed (Kts)**	**Wind Speed (MPH)**	**Pressure (Millibars)**	**Pressure**
Category 1	64- 82 kts	74- 95 mph	>980 mb	28.94 "Hg
Category 2	83- 95 kts	96-110 mph	965-979 mb	28.50-28.91 "Hg
Category 3	96-113 kts	111-130 mph	945-964 mb	27.91-28.47 "Hg
Category 4	114-135 kts	131-155 mph	920-944 mb	27.17-27.88 "Hg
Category 5	>135 kts	>155 mph	919 mb	27.16 "Hg
Tropical Cyclone Classification				
Tropical Depression	20-34kts			
Tropical Storm	35-63kts			
Hurricane	64+kts or 74+mph			

Beaufort Wind Chart – Estimating Winds Speeds

Beaufort Number	MPH Range	MPH Average	Terminology	Description
0	0	0	Calm	Calm. Smoke rises vertically.
1	1-3	2	Light air	Wind motion visible in smoke.
2	4-7	6	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	11	Gentle breeze	Leaves and smaller twigs in constant motion.
4	13-18	15	Moderate breeze	Dust and loose paper is raised. Small branches begin to move.
5	19-24	22	Fresh breeze	Smaller trees sway.
6	25-31	27	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult.
7	32-38	35	Near gale	Whole trees in motion. Some difficulty when walking into the wind.
8	39-46	42	Gale	Twigs broken from trees. Cars veer on road.
9	47-54	50	Severe gale	**Light structure damage.**
10	55-63	60	Storm	**Trees uprooted. Considerable structural damage.**
11	64-73	70	Violent storm	**Widespread structural damage.**
12	74-95	90	Hurricane	**Considerable and widespread damage to structures.**

Webpage: http://www.weather.gov/iwx
Twitter: @nwsiwx
Facebook: NWSNorthernIndiana

Hailstorms have occurred in Vermont, usually during the summer months. While local in nature, these storms are especially significant to area farmers, who can lose entire fields of crops in a single hailstorm. Large hail is also capable of property damage. Between 1950 and 2013, there were 698 hail events recorded in the state of Vermont, making hail an annual occurrence in some part of the state. Most of these events had hail measuring .75 inches, but many had hail at least 1.5 inches in size. The largest hail during the period was 3-inch hail that fell in Chittenden County in 1968 (NCDC). Tennis ball-sized hail was reported in the town of Chittenden during a storm in the summer of 2001. Thunderstorms can generate high winds, such as the event that hit Bethel in the summer of 2014 that produced straight-line winds which leveled trees in large swathes.


Hail Size Comparison Chart
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
CD / DVD
Approximately
4 ¾ inches
Softball
3.8 inches
¾ inch
1 inch
1 ¼ inch
Golf Ball
1 ⅝ inch
Pool Ball
2 1/8 inches
Baseball
2 ¾ inches
NATIONAL WEATHER SERVICE
Produced by Michael S. Lewis, NOAA, National Weather Service, Northern Indiana

Combined NOAA/TORRO Hailstorm Intensity Scales

Size Code	Intensity Category	Typical Hail Diameter (inches)	Approximate Size	Typical Damage Impacts
H0	Hard Hail	up to 0.33	Pea	No damage
H1	Potentially Damaging	0.33-0.60	Marble or Mothball	Slight damage to plants, crops
H2	Potentially Damaging	0.60-0.80	Dime or grape	Significant damage to fruit, crops, vegetation
H3	Severe	0.80-1.20	Nickel to Quarter	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	1.2-1.6	Half Dollar to Ping Pong Ball	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.6-2.0	Silver dollar to Golf Ball	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	2.0-2.4	Lime or Egg	Aircraft bodywork dented, brick walls pitted
H7	Very destructive	2.4-3.0	Tennis ball	Severe roof damage, risk of serious injuries
H8	Very destructive	3.0-3.5	Baseball to Orange	Severe damage to aircraft bodywork
H9	Super Hailstorms	3.5-4.0	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	4+	Softball and up	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Similar to flooding, the extent of severe storms is not well documented in Barre City. The impact of storms is usually flood related. See extent for flooding in the previous flood section. Wind impacts are city wide. Wind extent from storms is not well documented as there is no monitoring station in Barre City. Estimates for wind are gathered from county wide data off the NCDC website. An estimate of the worst anticipated wind extent in Barre City based on past occurrences would be Category 1 force hurricane winds and H8 hail according to the Hail/Torro scale. At a Beaufort number of 8-9 and hail sized H4 on the Torro/Hailstorm scale, Barre City may start to experience high wind impacts and damages. In the future, Barre City could consider installing a monitoring station to better gather data for wind events. Wind events can be recorded using the Beaufort, Saffir Simpson. Hail events can be recorded using the Torro/Hailstorm Scale.

Date	Event	Location	Extent
8/28/2011	TS Irene	Statewide	Montpelier flood gauge at 19.05', flood stage at 15'; 5" of rain – DR 4022
5/27/2011	Severe Storm, flash flooding	County Wide	1" hail, 50 knot winds, 25,000 customers lost power in VT, 3-5" of rain DR 4001, Montpelier gauge at 17.59 feet
7/21/2008	Severe storms, flooding	County Wide	1" Hail, 30 knot winds
8/25/2007	Severe Storms	Barre City, County Wide	55 knot wind gusts, 1" hail
7/9/2007	Severe Storms, hail, flooding	Barre City, County Wide	1"-2.75" hail
6/19/2006	Severe storms	Barre City, County Wide	50 knot winds, downed trees and power lines
8/1/2005	Severe Storm	Barre City, County Wide	1" hail, 55 knot winds
9/16/1999	Tropical Storm Floyd	Barre City, Statewide	Tropical storm winds and flooding – DR 1307, Montpelier flood gauge at 9.30 feet,
6/17/1998	Severe Storms	Barre City, County Wide	3-6" of rain, DR 1228, not a historical crest in Montpelier
5/29/1998	Severe Storms	Barre City, County Wide	50 knot winds, heavy rains, downed trees and power lines
7/15/1997	Severe Storms	Barre City, County Wide	3-5" of rain
6/7/1982	Severe Storms	New England	14" of rain, $276 M damages
8/1976	Hurricane Belle	Statewide	Gale force winds, 2 deaths
7/3/1964	Hail	Barre City, County Wide	1.5" hail
9/22/1938	Hurricane	Statewide	Category 1 force winds

5.2.4 Ice Jams

Ice jams are common during the winter and spring along rivers and streams. Many of the record flood events along major rivers are the result of ice jams. Debris jams can occur at any time of year and have the same implications as an ice jam. As ice or debris moves downstream, it may get caught on any sort of obstruction to the water flow. When this occurs, water can be held back, causing upstream flooding. When the jam finally breaks, flash flooding can occur downstream.

Typically, an ice jam is resolved when the ice melts. With debris jams, the options are to take measures to remove the jam or wait for the debris to break free. In addition to causing

flooding, these jams may also have economic and ecological implications. Jams can cause riverbank erosion, impede migration of aquatic creatures and adversely impact wildlife habitats. Loss of life has also been attributed to flooding caused by ice and debris jams.

Snowmelt and the breakup of river ice often occur at about the same time. Ice jams often form as a result of the sudden push exerted on the ice by a surge of runoff into the river associated with snowmelt. Ice jams can act as dams on the river that result in flooding behind the dam until the ice melts or the jam weakens to the point that the ice releases and moves downstream. A serious ice jam will threaten areas upstream and downstream of its location. Six inch thick ice can destroy large trees and knock houses off their foundations. Once an ice jam gives way, a location may experience a flash flood as all the water and debris that was trapped, rushes downstream.

The City is located in a narrow river valley with the Winooski River running from southeast to northwest, and has been greatly affected by flooding since its settlement over 200 years ago. The majority of the City's floodplain development is commercial, retail and industrial. Many previous events have made it clear that the City can be vulnerable to flood related hazards due to ice jam events, not only within the City itself, but upstream in the City of Montpelier as well. In the event of a major ice jam flood, the entire "north-end" along North Main Street, up Maple Avenue and a majority of the entire downtown area, including the historic business district may be inundated depending on the location of the ice jam.

Hazard	Location	Vulnerability	Extent	Observed Impact	Likelihood/ Probability
Ice Jam resulting in Flooding	Areas along the Winooski River, Stevens Branch, Gunners Brook	Commercial and residential structures, road and culvert infrastructure	1.5"-3" rainfall flood event on 12/17-18/2000: Severe results from snowpack melt from Stevens Branch, resulting in buildup of water, ice and woody debris at the Vanetti Place railroad trestle	In excess of $1M	Likely

5.3 Moderate Threat Hazards

5.3.1 Extreme Cold/Winter Storm/Ice Storm

Vermont is known for its cold snowy winters and Vermont towns and their residents are generally equipped to handle this weather. It is when the winter weather becomes extreme that a hazard is created. Severe winter storms bring heavy snow loads, ice, damaging winds, dangerous wind chills, below-zero temperatures, power outages, downed trees and power lines, collapsed roofs and buildings, stranded motorists and vehicles, and school closings.

People can be at risk of freezing in extended power outages if they lack wood heat or backup power, and individuals shoveling large accumulations of snow can also be at risk from frostbite, hypothermia, and heart attacks caused by cold and overexertion. While snow removal from the transportation system is standard fare in Vermont winters, extreme snow or ice can close rail and road systems, further jeopardizing any stranded persons that are in danger of freezing or needing medical assistance.

A winter storm is defined as a storm that generates sufficient quantities of snow, ice or sleet to result in hazardous conditions and/or property damage. Ice storms are sometimes incorrectly referred to as sleet storms. Sleet is similar to hail only smaller and can be easily identified as frozen rain drops (ice pellets) that bounce when hitting the ground or other objects. Sleet does not stick to wires or trees, but in sufficient depth, can cause hazardous driving conditions. Ice storms are the result of cold rain that freezes on contact with the surfaces coating the ground, tress, buildings, overhead wires and other exposed objects with ice, sometimes causing extensive damage. Periods of extreme cold tend to occur with these events.

One of the major problems associated with ice storms is the loss of electrical power. Major electric utility companies have active, ongoing programs to improve system reliability and protect facilities from damage by ice, severe winds and other hazards. Typically, these programs focus on trimming trees to prevent encroachment of overhead lines, strengthening vulnerable system components, protecting equipment from lightning strikes and placing new distribution lines underground.

Despite frequent occurrences of significant winter/ice storms, a majority of City residents are adequately prepared to face these types of events.

During the February 14, 2007 snow storm event, the Barre City Fire Department responded to 17 EMS calls and 9 Fire calls, some requesting assistance with shoveling. Major snow storms resulting in deep snow drifts can block heating vent pipes causing carbon monoxide poisoning. Hazardous materials pose a severe threat to a large percentage of Barre's population as elderly persons within the City are limited in their ability to shovel roofs and clear around vent pipes. During this snow storm the Fire Department experienced difficultly reaching customers as the roads had not been cleared due to the city road crews busy with snow removal in other areas of the City.

The physical impacts of winter storms are city wide due to the expansive nature of winter storms. Based on past occurrences, the worst anticipated winter weather the City could experience would be 2-3' in 24 hrs. of snow with more at higher elevations and several days of power outages. Using the wind chill scale and historical information, the estimate for extreme cold is – 60 degrees Fahrenheit. Scales to measure the extent of winter storms are found in the tables below, as published in the State Hazard Mitigation Plan.

Severe winter storms alerts are communicated using terminology listed in the table below.

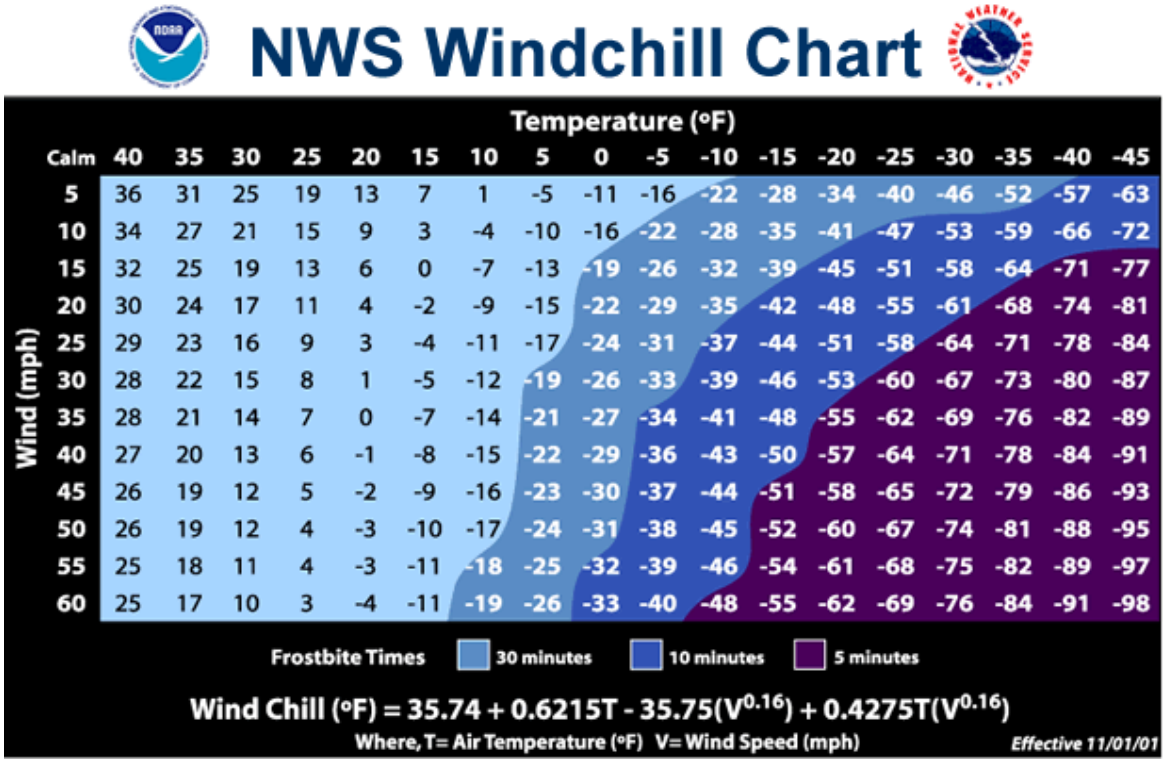
Table 4-8
Winter Storm and Blizzard Alert Terminology

Term	Definition
Winter Storm Watch	Snowstorm conditions are possible in the specified area, usually within 36 hours.
Winter Storm Warning	Snowstorm conditions are expected in the specified area, usually within 24 hours.
Blizzard Warning	Sustained winds or gusts of 35 mph occurring in combination with considerable falling/blowing snow for a period of at least three hours are expected.
Heavy Snow Warning	Snow accumulations are expected to approach or exceed 6 inches in 12 hours.

Terminology related to snowfall and other frozen precipitation is provided in the subsequent table below.

Table 4-9
Snowfall and Other Frozen Precipitation Terminology

Term	Definition
Snowstorm	A storm with heavy snow
Blizzard	A severe snowstorm with cold temperatures, winds at or above 35 mph, and low visibility (less than ¼ mile)
Heavy Snow	Seven inches or more of snow falling within a 24-hour period
Winter Storm	Heavy snow with sleet and/or freezing rain
Blowing Snow	Wind driven snow that reduces visibility to six miles or less causing significant drifting
Drifting Snow	Uneven distribution of snowfall caused by strong surface winds
Flurries	Light snow falling for short durations
Freeze	Occurs when the surface air temperature is expected to be 32°F or below over a widespread area for a significant period of time



Wind chills can be life threatening. The wind chill temperature is how cold a person or animal feels when outside. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As wind increases, it draws the heat from the body through exposed skin and reduces the body's skin temperature and eventually the body's core temperature. Often times exposed skin can freeze within minutes of exposure.

History of Occurrences (county wide) Snow and/or ice events occur on a regular basis. Recent significant events have included:

Date	Event	Location	Extent
3/14/2017 - 3/15/2017	Winter Storm	State-wide; Washington County	A major nor'easter with heavy intense snowfall. Total snowfall across Vermont was 12 to 36+ inches with northwest Vermont experiencing the heaviest snowfall. Blizzard to near blizzard conditions in areas. Numerous schools, businesses and local government offices closed for March 14th and 15th with numerous vehicle accidents and stranded vehicles
2112/2017-2113/2017	Winter Storm	State-wide; Washington County	6 to 12 inches of snow statewide with some localized higher amounts. Impacts were largely travel related with nearly all school districts closed on the 13th.

2/2/2015	Winter Storm/ Extreme Cold	State-wide; Washington County	Snowfall across the City was 6 to 12 inches. Cold temperatures only near zero degrees.
2/1/2015 - 2/28/2015	Winter Storm/ Extreme Cold	State-wide; Washington County	February 2015 record cold for much of VT. Recorded 15 to 20+ days below zero and on several days, dangerously cold wind chills of 30 below zero or colder occurred. Many communities witnessing the coldest month since December 1989 or January 1994. The average departure was 13 to 17 degrees below normal Damage to infrastructure, frozen water mains, etc. totaled at least $1 million.
1/7/2015 - 1/8/2015	Extreme Cold	State-wide; Washington County; City of Barre	Plummeting temperatures and brisk, strong winds (15 to 30+ mph) caused dangerously cold wind chills of 25 to 40 degrees below zero during the evening of January 7th into the morning hours of January 8th. Observed wind chills in the mountains ranged from 40 to 70 below zero. School closings and 2 hour delays. Actual morning low temperatures on January 8th were 15 below to 25 below zero in the City.
12/9/2014 - 12/12/2014 DR 4207 VT	Winter Storm	County-wide; Washington County	This storm was comprised of three phases. Phase 1 - (12/9/14) rain and wet snow changing to a heavy, wet snow; Phase 2 - (12/10/14) moderate snowfall in central and northern Vermont; and Phase 3 -(12/11 - 12/12/2014)- scattered snow showers .Snow to water ratios of 8:1 or less accounted for snow-loaded trees that resulted in more than 175,000 power outages and numerous vehicular accidents. This was the 2nd most power outages due to weather in the state of Vermont.
11/26/2014 - 11/27/2014	Winter Storm	County-wide; Washington County	Snowfall totals of 8 to 12 inches were common With holiday commuters, numerous vehicle accidents across the state.
3/12/2014 - 3/13/2014	Winter Storm	State-wide; Washington County	Heavy snow fall accumulation over two days with strong wind gusts up to 50 mph, considerable blowing and drifting of the snow. Snow mixed or changed to sleet and rain in southern Vermont. Numerous motor vehicle accidents, and school and business closures.

2/13/2014- 2/14/2014	Winter Storm	State-wide; Washington County	Two bands of heavy snowfall; snowfall rates of 1-2 plus inches an hour. Total snowfall ranged from 15 to 24 inches in central and eastern Vermont with the heaviest across the southern Green Mountains. Hazardous travel, school closings.
2/5/2014	Winter Storm	State-wide; Washington County	8- 12 inches of snow fell across the county. Snowfall was at its peak during both the morning and afternoon/evening commutes causing hazardous travel.
12/14/2013 - 12/14/2013	Winter Storm	State-wide; Washington County	A widespread 10 to 15 inches of snow fell across the county. Numerous vehicle accidents
2/8/2013 - 2/9/2013	Winter Storm	State-wide; Washington County	This snowfall event was a two-part system across Vermont. The second event was a large, powerful Nor'easter. 6- 15 inches of snow fell across the County with the higher totals across southern sections.
12/26/2012 - 12/28/2012	Winter Storm	State-wide; Washington County	This was the first widespread snowfall of more than 6 inches since March 2011. Snow fell heavily at times (snowfall rate of 1-2 inches per hour). Snowfall accumulations of 12 to 18 inches were common with 6 - 15 inches observed in the County.
3/6/2011	Winter storm	Barre City, County wide	12-18” of snow, 10,000 customers lost power statewide
2/23/2010	Winter Storm	Barre City, County wide	20” of snow and 50,000 customers lost power statewide
2/22/2009	Winter Storm	Barre City, County Wide	16” of snow, 30 mph wind gusts
2/1/2008	Winter storm	Barre City, County wide	3-7” of snow and ice ¼-1/2” thick, 50 mph wind gusts
2/14/2007	Winter storm	Barre City, County wide	22” of snow
2/14/2006	Winter storm	Barre City, County Wide	30” of snow
1/4/2003	Winter storm	Barre City, County wide	19” of snow
3/5/2001	Winter storm	Barre City, County wide	15-30” of snow
12/31/2000	Winter storm	County wide	10” of snow
1/15/1998	Winter storm	Barre City, County wide	10-12” snow (not a DR in Washington County)

12/29/1997	Winter storm	Barre City, County wide	21" of snow
12/7/1996	Winter Storm	Barre City, County wide	12" of snow
3/21/1994	Winter storm	Barre City, County Wide	5-11" of snow
11/1/1993	Winter storm	Barre City, County wide	15" of snow
1/3/1993	Freezing Rain	Barre City, Statewide	¼-1/2" freezing rain

By observing winter storm watches and warnings, adequate preparations can usually be made to lessen the impact of snow, ice and sleet, and below freezing temperature conditions on the City. Providing for the mass care and sheltering of residents left without heat or electricity for an extended time and mobilizing sufficient resources to clear broken tree limbs from roads, are the primary challenges facing community officials. Shelter locations include the Barre Auditorium and the Barre City Elementary School. The City encourages residents who are in remote locations to be equipped with generators and backup fuel supplies in the event of prolonged power outages and travel restrictions.

Additionally, sensitive populations such as the elderly or handicapped may be susceptible to extreme cold when power is lost and life support systems run on electricity (versus gas or natural fuels). If power is lost, some populations may need to be relocated to areas with power so that medical equipment can function. Additionally limited mobility of some persons may make it difficult to relocate in general or in times of emergencies. The City encourages neighbors to check on those neighbors who they may believe to be at risk during times of emergency. The City has mapped the location of sensitive populations and trouble spots on roads that reach those populations in order to identify additional routes, found in the Local Emergency Operations Plan. A list of vulnerable sites and populations is found in the attachments. Also, the City can continue to provide outreach and education of the impacts of winter storms to these populations. Despite frequent occurrences of significant winter/ice storms, a majority of City residents are adequately prepared to face these types of events.

Major snowstorms resulting in deep snow drifts can block heating vent pipes causing carbon monoxide poisoning. Hazardous materials pose a severe threat to a large percentage of Barre's population as elderly person within the City are limited in their ability to shovel roofs and clear around vent pipes.

The following matrix provides an overview of the hazard:

Hazard	Location	Vulnerability	Extent	Impact	Probability
Winter Storm/Ice Storm	Entire municipality	Elderly & handicapped populations, remote structures, old/under insulated structures, utilities, trees	12+" of snow on March 2011 event; 22+" on Feb. 2006 event in 24 hrs.	Additional sheltering/ plowing/ emergency services costs for city - $15,000	Medium

5.3.2 Hurricanes/Tropical Storms/Severe Storms

Hurricanes and tropical storms are violent rain storms with strong winds that have large amounts of rainfall and can reach speeds up to 200 mph. Hurricane season is between the months of June and November. These types of storms originate in the warm waters of the Caribbean and move up the Eastern seaboard where they lose speed in the cooler waters of the North Atlantic. A severe thunderstorm is a thunderstorm that contains any one or more of the following three weather conditions: hail that is 3/4 of an inch or greater in diameter, winds 58 miles per hour or greater, and/or tornadoes. Severe storm events can occur late spring and early summer as temperatures increase in the summer season. The frequency and intensity of hurricanes, tropical storms, and severe storms is expected to increase with climate change.

The impacts associated with hurricanes and severe storms are mainly associated with flooding impacts. Damage locations from TS Irene and the May 28, 2011 storm events are outlined in the Flood/Flash Flood/Fluvial Erosion hazard section. There were no high wind impacts associated with the 2011 events.

In September 1999, Vermont was hit with Tropical Storm Floyd and a federally declared disaster resulted (DR 1307 VT). The primary impact from Floyd was downed trees and power lines due to high winds, and caused flooding state-wide. Approximately 3,000 people were without power in the Central Vermont Region. The Montpelier flood gauge was at 9.3 feet, and about 7" of rain fell over Barre City; however, flood impacts were offset by drought conditions from earlier in the year.

The most recent tropical storm to reach Vermont was Tropical Storm Irene in August of 2011. A federally declared disaster resulted (DR 4022 VT). The state saw up to 11 inches of rain with the heaviest rainfall occurring in the mountains of central and southern Vermont. The Orange reservoir was 15 feet above normal levels. The Montpelier flood gauge was at 19.05 feet; flood stage is at 15 feet. City-wide flooding, fluvial erosion, and flash floods resulted. Winds of 43 knots were reported in Washington County. This tropical storm caused major damage statewide with catastrophic flooding and fluvial erosion causing state and local roads to be devastated, washed out and closed with massive damage to the entire transportation network including bridges and railroads; major property damage to the public and private sector with the destruction and damage to homes and businesses, infrastructure, and crops. Three deaths resulted from the storm with many people injured.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Hurricane/Tropical Storms	City wide for wind impacts, roads; flooding/floodplain especially N. Main St., Berlin St., Vine St., Granite St., Scampini Sq., River St., plus Park and East St. neighborhoods	Large trees power lines, culverts/bridges. Fire station, village buildings, sensitive populations	5" rain from Irene in 24 hours; H8 hail; category 1 force winds	2011 damages over $1M	Medium

5.3.3 Water Supply Contamination

Barre City has concerns regarding water supply contamination. The concern comes from the fact that the supply is an open source. The reservoir is located in Orange. To date, there has not been any water supply contamination. However, the City worries that the supply is susceptible to contamination through hazardous materials and bioterrorism. A car once was found in the inlet of the supply, but did not cause contamination. Also, a plane once landed on the reservoir. There are no guard rails to protect the reservoir. The extent and capacity of the reservoir averages 1070 acre feet, with a maximum capacity of 2280 acre feet. The City supplies water to 4,140 accounts or 16,000 people.

The Barre City Sewer Treatment Plant is also susceptible to damage from car accidents as it is located on a busy road. If the treatment plant were damaged, downriver residents in Berlin and Montpelier would be affected by possible contamination.

Hazard	Location	Vulnerability	Extent	Impact	Likelihood
Water Supply Contamination	Reservoir, Sewer Treatment Facility	City residents, Downriver users	2280 acre feet of water; 16,000 people	$2 million	Medium

5.3.4 Structure Fire

Structure fire is when a building is partially damaged or destroyed by a fire. About 2% of the calls received in FY 2017 by Barre City's fire department were fire related incidents – building fires, fuel burner malfunction fires, and outside trash fires. Although many structures in Barre City are less than 100 years old, many residents heat their homes with wood or pellet burning stoves. The density and closeness of buildings and homes also increases the likelihood of a spreading from building to building.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Structure Fires	City Wide	Wood structures, especially older than 100 yrs., homes that use wood burning stoves for heat	Data gap	$150, 000 per home based on median grand list value	High

5.4 Hazards Posing A Threat Vulnerability from Previous Plans

While the City has learned a great deal over the past many years regarding certain threats and vulnerabilities, there are some potential threats that are not high on a ranking scale as others, but no less important than those listed as high or moderate hazards.

Tier II Facilities

Vermont's EPCRA (Emergency Planning & Right-to-Know Act) requires that any federal, state and local government facilities, businesses, Non-Profits, some Agriculture Based Companies, Rail Companies, Petroleum Based, or any facility that falls under VOSHA (Vermont Occupational Safety & Health Administration) regulations report known quantities of hazardous chemicals stored on site. Those types of chemicals that need to be reported include diesel fuel, gasoline, kerosene, #2 heating fuel oil, natural gas, oxygen, acetylene, motor oil, lubricating oils, solvents, road salt, sand, sawdust, battery acid, transformer oils, among the many.

In 2017, the City updated its LEOP to include those Tier II facilities that reported as required to VEM's Hazardous Materials EPCRA Compliance Tier II Program and the LEPC for the region. This list encompassed 34 reports, and it is known that there are some facilities and businesses that either didn't report, or didn't send a copy as required to the LEPC or the Barre City Fire Department. The LEPC keeps the municipality informed regarding what chemicals are known within the City limits, and what we need to be aware of for hazardous substances.

Tier II sites are locations where hazardous substances, pollutants, or contaminants are stored and their release has caused, or if released would cause, contamination of drinking water, surface water, air, or soils which are likely to cause exposure to nearby populations, or is likely to contaminate sensitive environments. Major Tier II sites of concern in the City are two fuel oil depots: one located on Smith Street and one located on Williams Lane. While these locations have not experienced a release and do have hazard control measures in place, the potential for a release does exists. The closest hazmat truck is located 42 miles away at the IBM Facility in Essex Junction. The Barre City Fire Department has a hazmat de-contamination trailer kept at the Barre City Auditorium staging area.

An additional Tier II site of concern is the storage and use of anhydrous ammonia at the Barre Civic Center. Ammonia continues to be used as a refrigerant in large industrial processes and is used at the Civic Center for maintenance and operation of the ice rink. On October 21, 2002 the Barre City Fire Department responded to a spill of 120 pounds of ammonia at the Barre Civic Center located at 20 Auditorium Hill. The incident cost the City of Barre approximately $60,000 in indirect damage costs and response and operational costs. Between 2012 and 2017 there were 76 other reported hazardous material spills or incidents within Barre City (see table in the Attachments section) as reported on the ANR Spills database. While damages costs are not explicitly recorded, these incidents no doubt affect the City of Barre financially and also pose a threat to public and environmental health and safety.

Flood events and winter storms can also increase the liability of hazardous materials within the City. During the floods of July 2015, 2007, and December 2000, the Barre City Fire Department witnessed propane and oil tanks that became buoyant and unhooked from supply lines due to rising flood waters. This repeating scenario poses a threat to public safety and environmental health.

Route 14 and Route 302 are major transportation routes in Central Vermont and pass through the City of Barre's downtown and adjacent neighborhoods. Varieties of hazardous materials are transported along these roads on a daily basis and pose a threat to business and public health and safety. The extent of hazardous materials spills pose a moderate threat to Barre City as past events have resulted in major property damage; some minor infrastructure damage; and essential services were briefly interrupted.

The following matrix provides an overview of the hazard:

Hazard	Location	Vulnerability	Extent	Impact	Probability
Hazardous Materials	Floodplain including facilities on Williams Land., plus facility on Smith Street and the BOR.	Commercial structures plus densely populated adjacent neighborhoods.	Moderate	2002 spill at the BOR = $60,000 in direct and indirect costs.	HIGH

The list from the 2017 LEOP is replicated in the Attachments section, at the end of the Major High Hazards and/or Vulnerable Sites List, and a map of the sites follows.

Power Shortage/Failure

The City of Barre is served by one energy utility, Green Mountain Power (GMP). GMP power generation is based upon substations, which are not set by jurisdictional lines. As a result, frequency and specific dates of power shortage/failure could not be attained. This level of detail could be provided in the future by working directly with the utilities in order to research this data. A variety of situations such as high winds, winter and ice storms plus rodent damage can cause power shortages/failures; the direct location of such events are difficult to predict.

Power shortage/failure can prove moderately hazardous if it occurs during the winter, particularly in conjunction with another hazard, such as a winter storm/ice storm or extreme cold. Vulnerable populations, such as the elderly and handicapped, are of greatest risk to this hazard. The City contains three nursing homes and assisted living facilities. Approximately 18% of the City's population is over 65 years of age and according to the Municipal Plan, Barre has a higher percentage of elderly population than the region and state. Elderly residents live in the above mentioned facilities or in private residences. These facilities, and much of the elderly population, depend on a reliable source of energy to power life support systems. While the nursing homes and assisted living facilities are equipped with generators many of the private residents do not have access to back up power.

The following matrix provides an overview of the hazard:

Hazard	Location	Vulnerability	Extent	Impact	Probability
Power Failure	Entire municipality	Sensitive populations - elderly	Moderate	18% of City population.	Unknown – data deficit

School Safety Issues

There are three schools in the City of Barre enrolling approximately 2,000 students. They are:

- The Barre City Elementary / Middle School – enrolling 900 students and located on the south side of the City on Parkside Terrace.
- Barre Technical Center / Spaulding High School – enrolling a total of 1,115 students and located in the south eastern quadrant of the City on Ayers Street.
- St. Monica Church School – a private elementary school with enrollment of 180 students located adjacent to downtown on Summer Street.

The Barre City Director of Public Safety states that areas of concern, such as students bringing fire arms on to school property, school safety issues are always a concern of the Barre City community. This is no data was available about specific occurrences or extent of occurrences, and the Director states the need for all city emergency response departments to plan for and be prepared for future events. As recent events across the country from the school shooting in Essex Junction, VT in August 2006, to the Virginia Tech school shooting in April 2007 have highlighted the need for increased effective communication between departments and emergency preparedness plans.

The following matrix provides an overview of the hazard:

Hazard	Location	Vulnerability	Extent	Impact	Probability
School Safety Issues	Barre City Elementary/Middle School on Parkside Terrace, Barre Technical Center / Spaulding High School on Ayers Street, St. Monica Church School, Summer Street, plus adjacent neighborhoods.	Sensitive populations – children/ students, plus faculty.	Moderate	Approximately 2000 +/- Students.	Unknown – data deficit

Earthquakes

An earthquake is a sudden and violent shaking of the ground, sometimes causing great destruction, as a result of movements within the earth's crust or volcanic action. Vermont is located in a moderate hazard earthquake region. Since 1843, there have been 63 earthquakes

which have had epicenters located in Vermont. The strongest of these earthquakes measured 4.1 on the Richter scale in Swanton (1943) and Middlebury (1962.) Stronger earthquakes originating in NY have also been felt in Vermont. In 1988 and 2002 quakes originating in Saguenay, Quebec (6.2) and Plattsburgh, NY (5.2) were felt in Vermont. The extent and impact of earthquakes in Barre is unknown due to limited past occurrences in the area.

A 1995 report titled "A Report on the Seismic Vulnerability of the State of Vermont" by John E. Ebel, Richard Bedell and Alfredo Urzua, states that it is very difficult to predict earthquakes in all of New England. No active faults have been identified in Barre City or New England. Hazus reports have been made for several counties in Vermont to determine the impacts of an earthquake. No such model has been made for Washington County; however, a model for Washington County could be a possible future study.

Barre City has had no history of earthquake damage. although the age and building materials of many structures in Barre City makes them susceptible to earthquake damage. Unreinforced masonry buildings and buildings with stone and concrete decorative cornices/lintels are the most susceptible. The large public housing apartments and blocks of buildings on Main Street are the most susceptible.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Earthquakes	Main Street, North Main Street	Public housing buildings, Older/taller unreinforced masonry structures	4.1 -6.2 on the Richter scale based on past history in VT and New England – data gap for Barre City	$75 million – public housing units & Main St buildings	Low

Beaufort Scale

Beaufort number	Wind Speed (mph)	Seaman's term		Effects on Land
0	Under 1	Calm		Calm; smoke rises vertically.
1	1-3	Light Air		Smoke drift indicates wind direction; vanes do not move.
2	4-7	Light Breeze		Wind felt on face; leaves rustle; vanes begin to move.
3	8-12	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended.
4	13-18	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move.
5	19-24	Fresh Breeze		Small trees begin to sway.
6	25-31	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
7	32-38	Moderate Gale		Whole trees in motion; resistance felt in walking against the wind.
8	39-46	Fresh Gale		Twigs and small branches broken off trees.
9	47-54	Strong Gale		Slight structural damage occurs; slate blown from roofs.
10	55-63	Whole Gale		Seldom experienced on land; trees broken; structural damage occurs.
11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	73 or higher	Hurricane Force		Violence and destruction.

6. Mitigation

6.1. Municipal Plan (2014) Goals that Support Hazard Mitigation

The goal of this Plan is to update the local mitigation strategy that makes the City more disaster resistant and reduces its risk from natural hazards. Further, it is the goal of this Plan to take actions to reduce or eliminate the long-term risk to human life and property from:

1. the natural hazard of flash flooding/flooding/fluvial erosion;
2. the natural hazard and man-made hazard of dam failure (Thurman W. Dix Reservoir Dam, East Barre Dam);
3. the natural hazard of severe weather (thunderstorms, lightning, high winds, and hail);
4. the natural hazard of ice jams;
5. the natural hazard of extreme cold/winter storm/ice storm;
6. the natural hazard of hurricanes and tropical storms;
7. the natural hazard and man-made hazard of structure fire.

The City of Barre Municipal Plan has a five-year life span. It was adopted by the City Council on June 17, 2014, with an expiration date of June 17, 2019. Barre City has an approved 2012 Hazard Mitigation Plan that is incorporated by reference into this plan (p.3-35, Emergency Management).

Transportation Goal 1: For Barre City to optimize and maintain its transportation infrastructure as needed to support economic vitality and quality of life in the City. (p. 2-15)

A. Invest in improvements to transportation infrastructure needed to attract and retain businesses in the City.

B. Improve the appearance and function of existing arterial roads in the City.

Public Utilities Goal 1: For Barre City's public utilities to provide business and residential customers with reliable and affordable services as needed to support economic vitality and quality of life in the City. (p. 2-21)

B. Continue efforts to improve stormwater drainage infrastructure within the City.

B-2. Implement the stormwater improvements identified in the City's Hazard Mitigation Plan.

Community Services and Amenities Goal 1: For Barre City's government and partner organization to provide community services and amenities, which are affordable to taxpayers, use tax dollars as efficiently as possible, enrich quality of life in the City and region, help attract new residents to the City and support economic revitalization and growth. (p. 2-30)

B. Take action to reduce or eliminate the long-term risk to life and property from, and be prepared to respond to, emergencies and disasters.

B-2. Increase public awareness of potential hazards in the City and educate residents about how to better prepare for emergencies and adequately insure their property.

B-4. Test and improve as needed, the ability of emergency response services and critical community facilities to function during emergencies or disasters.

Community Services and Amenities Goal 3: For Barre City residents to be well-informed, active citizens. (p.2-30)

A. Disseminate information about city government in a timely and convenient manner.

A-1. Develop and maintain a user-friendly city website that is kept up-to-date with information about all aspects of city government and civic affairs.

Natural Environment Goal 1: For Barre City to protect and enhance water quality in the Stevens and Jail Branches of the Winooski River and their tributaries, and improve riverbank stability, shoreline habitat, aesthetic quality of the river corridors and public access to the rivers. (p.2-34)

A. Implement the recommendations of the 2009 Stevens Branch River Corridor Management Plan to maintain or restore the natural condition and function of the river corridors including:

A-1. Adopting a fluvial erosion hazard (FEH) zone and riparian setbacks to protect both life and property, and the natural function of the floodplain;

A-3. Mitigating impacts of stormwater entering streams and rivers.

A-4. Replacing problematic culverts and bridges.

Natural Environment Goal 4: For Barre City to become more resilient to the effects of flooding. (p.2-35)

A. Maintain eligibility for flood insurance, hazard mitigation, and disaster assistance by continuing to meet federal requirements for participation in the National Flood Insurance Program.

C. Implement the recommendations of our 2012 Hazard Mitigation Plan.

D. Implement the recommendations of the 2009 Stevens Branch River Corridor Management Plan to maintain or restore the natural condition and function of the river corridors.

Land Use Goal 1: For Barre City to grow and flourish as a compact, walkable, mixed-use urban center that can attract and retain residents and businesses. (p.2-39)

A. Implement the City's land use strategies as set forth in this plan.

A-9. Revise the City's land use regulations related to stream setbacks and riparian buffers.

Some specific recommendations in the City's Municipal Plan 2014 that support local hazard mitigation are noted below.

- Re-engineer the railroad trestle on Vanetti Place to mitigate flood hazards. (p.2-17)
- Implement the stormwater improvements identified in the hazard mitigation plan. (p. 2-21)
- Expand and upgrade culverts on Beckley Street, Farwell Street, Onward Street, East Street, Packard Street, and Depot Square. (p. 2-22)
- Install guardrails around the City's reservoir. (p.2-22)
- Enroll in the National Flood Insurance Program's Community Rating System. (p.2-31)
- Develop a second route to the elementary school that could provide an alternative means of accessing the school during an emergency or disaster. (p. 2-31)
- Develop a second route to the Public Safety Building that could provide an alternative means of accessing the building during an emergency or disaster. (p. 2-31)

- Enroll in the National Flood Insurance Program's Community Rating System. (p. 2-35)
- Revise the City's land use regulations related to stream setbacks, riparian buffers, steep slopes, and other natural protection standards. (p. 2-35)
- Map and assess the underground streams. (p. 2-35)
- Develop and adopt a river management plan. (p. 2-35)

6.2 Proposed Hazard Mitigation Programs, Projects & Activities

The state emphasizes a collaborative approach to achieving mitigation on the local level, by partnering with ANR, VTrans, ACCD, Regional Planning Commission, FEMA Region 1 and other agencies, all working together to provide assistance and resources to municipalities interested in pursuing mitigation projects and planning initiatives.

The mitigation strategies identified by the City are listed in regard to local leadership, possible resources, implementation tools, and prioritization. Prioritization was based upon the economic impact of the action, the feasibility of the action, the Community's need to address the issue and its capacity to address the issue, the action's cost, and the availability of potential funding. The planning team used a mitigation action matrix worksheet to help evaluate and prioritize each mitigation action being considered. The template is found in the Attachments section of this plan. In evaluating potential benefit and or likelihood of successful implementation the team ranked each criteria as to being highly effective or feasible, neutral, or ineffective or not feasible. The Team considered each prioritization in the scope of the other projects, LHMP priorities and overall community priorities.

Strategies given a "High" prioritization indicate they are either critical or potential funding is readily available, and should have a timeframe of implementation of less than two years. A "Medium" prioritization indicates that a strategy is less critical or the potential funding is not readily available, and has a timeframe for implementation of more than two years but less than four. A "Low" prioritization indicates that the timeframe for implementation of the action, given the action's cost, availability of funding, and the community's need to address the issue, is more than four years.

The City understands that in order to apply for FEMA funding for mitigation projects, a project must meet more formal FEMA benefit cost criteria. A project seeking FEMA funds would undergo a full benefit-cost assessment in the FEMA-approved format. The City must have a FEMA- approved Local Hazard Mitigation Plan in effect.

Hazard Mitigated	Mitigation Action (Mitigation or Preparedness as identified)	Local Leadership	Prioritization	Possible Resources	Time-Frame
All Hazards	Ensure Local Emergency Operations Plan is maintained and up to date **PREPAREDNESS**	Fire Dept. with assistance from City Planner	High	Local resources with support and assistance from CVRPC	Annually, March 1 – May 1

All Hazards	Update City of Barre Municipal Plan before it expires in June of 2019 and include any missing elements **MITIGATION**	Planning Commission, City Planner	High	Local resources, VCDP municipal Planning Grant, CVRPC	Initiate January 2018 and complete by June 2019
All Hazards	Creation of a Continuity of Operations Plan for the City Hall building that includes the installation of fiber optics to the building **MITIGATION**	Director of Buildings and General Services; Director of Public Safety	High	Local Resources	To begin study of in January 2019 and complete by January 2020
Dam Failure	Dix Reservoir: develop a maintenance and operations plan that addresses routine assessment of conditions and actions to preserve or improve conditions **MITIGATION**	Director of Public Works	Medium	Local Resources	Begin assessment of the dam walls December 2018 and complete by June 2019
Dam Failure	Attend trainings and seminars on Dam Safety provided by the state, Army Corp of Engineers and CVRPC, as offered. **PREPAREDNESS**	Directors of Buildings and General Services; Public Safety, Public Works and Planning	High	ANR Dam Safety Program, VEM Critical Infrastructure Planner, local resources	September 2017, Waterbury VT and any other VEM trainings that are pertinent
Dam Failure	Develop a controlled emergency drawdown procedure for urgent response **PREPAREDNESS**	Director of Public Works	High	ANR Dam Safety Program, VEM Critical Infrastructure Planner, local Resources	Collaborate with VTDEC to define a maximum release rate for acceptable control by East Barre; begin March 2019 and complete by January 2019
Flash Flood/ Flood/Fluvial Erosion/ Severe Summer Weather/ Hurricanes/ Tropical Storms	Develop a schedule and program to replace the existing 13 trash racks around the City; appropriately sized culverts effectively handle the hydraulic capacity of our stormwater systems (culverts, racks, walls, inlets, outlets) **MITIGATION**	Director of Public Works	Medium	Local resources, CVRPC, Vermont Youth Conservation Corp.	Begin creating Fall 2019 with an estimated completion date of September 2021

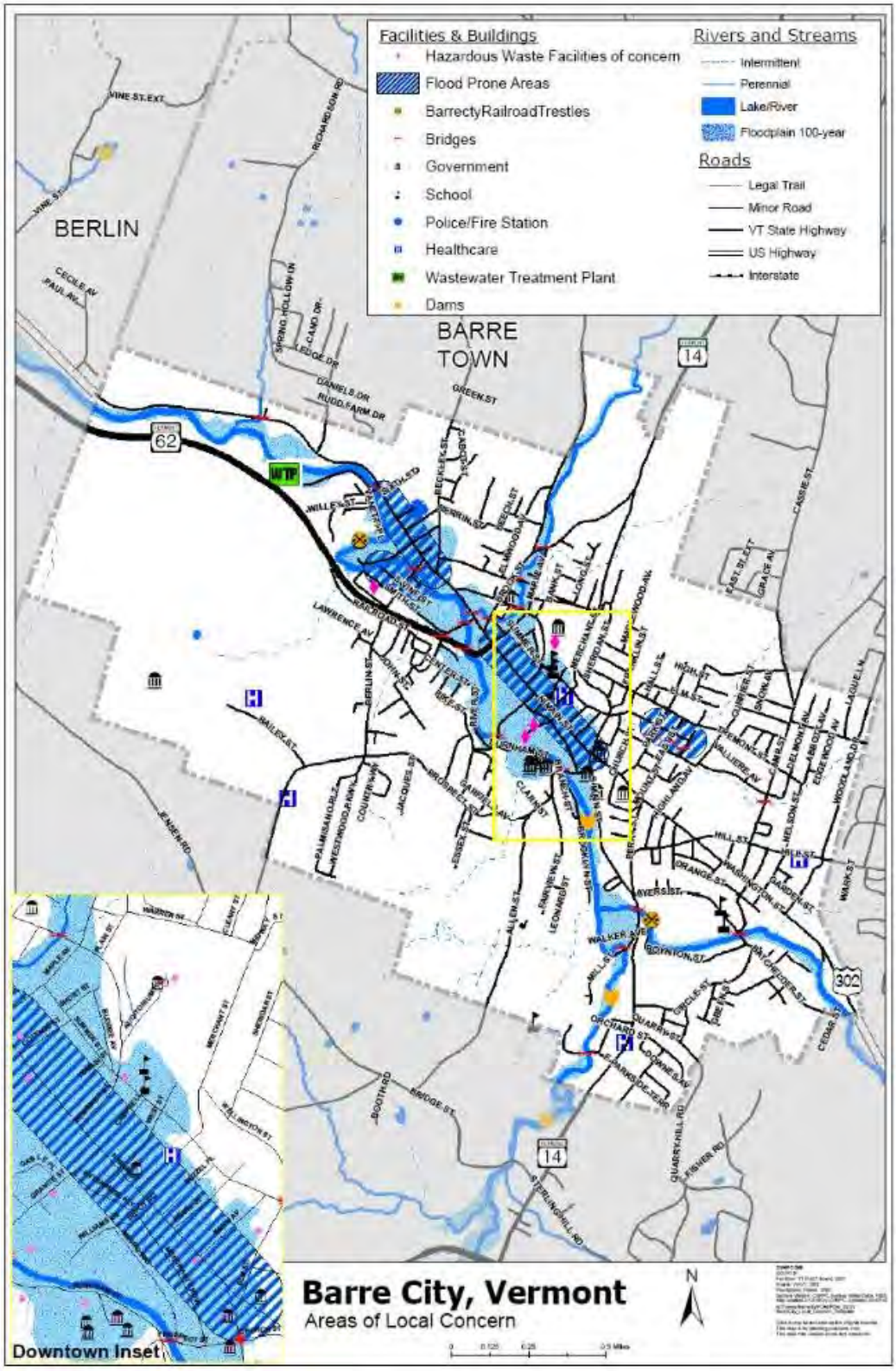
Flash Flood/ Flood/Fluvial Erosion/ Severe Summer Weather/ Hurricanes/ Tropical Storms	Adopt Flood Resiliency Element to City Plan, which will identify flood hazards to the City and will identify goals, policies, and recommendations to mitigate risks to public health and infrastructure **MITIGATION**	Director of Planning, Planning Commission	Medium	Local Resources, CVRPC, ACCD Grant	Begin revision to City plan January 2018 and complete by June 2019
Flash Flood/ Flood/Fluvial Erosion/ Severe Summer Weather/ Hurricanes/ Tropical Storms	Update City regulations (using alternate methods to protect buildings and allow flood waters to occupy the space beneath the structure) to limit or not allow any on-site filling within the flood hazard areas; part of the City's Flood Hazard Regulations **MITIGATION**	Planning Director, Permit Administrator	Low	Local Resources	Begin review of Flood Hazard Regulations for revisions if any, June 2020 and complete by June 2022
Flash Flood/ Flood/Fluvial Erosion/ Severe Summer Weather/ Hurricanes/ Tropical Storms	Monitor and Evaluate City structure stock to consider revising the City's Flood Hazard Elevation from 1 foot above, to 2 feet or 3 feet above base flood elevation to address the increased rainfall patterns and the actual flood heights from recent floods **MITIGATION**	Planning Director, Planning Commission	Low	Local Resources; CVRPC, VEM, ACCD grant	Begin review of Flood Hazard Regulations for revisions if any, June 2020 and complete by June 2022
Flash Flood/ Flood/Fluvial Erosion/ Severe Summer Weather/ Hurricanes/ Tropical Storms	Collaborative stormwater measures with all communities sharing the same watershed to develop a dialog on ways to limit stormwater runoff **PREPAREDNESS**	Public Works Director, City Manager, Planning Director, Buildings and General Services Director	High	Local Resources; CVRPC; VEM	Tri-Town Stormwater Master Planning is currently being worked on with implementation of a plan estimated for June 2019
Flash Flood/ Flood/Fluvial Erosion/ Severe Summer Weather/ Hurricanes/ Tropical Storms	Adopt AOT Bridge and Road Standards **MITIGATION**	Director of Public Works, Planning Director	High	Local Resources; VTDEC, Agency Of Transportation	Begin review to see if only portions of the standard can be adopted and the City can create specific standards where the template will not work for certain City streets July 2018 with a completion summary of June 2019

Flash Flood/ Flood/Fluvial Erosion/ Severe Summer Weather/ Hurricanes/ Tropical Storms Dam Failure	Develop a protocol for Debris Rack construction and operation within the City and Flood Resilient Channel Wall Design Standard **MITIGATION**	Director of Public Works; Planning Director	Low	Local resources, hired engineers, ANR, CVRPC	Beginning June 2020 an investigation of whether wall and stream section would be feasible, with a completion date of June 2021
All Hazards	Develop and Implement a Hazardous Debris Management Plan **PREPAREDNESS**	Directors of Public Works, Public Safety, Planning; City Manager	Medium	Local Resources, waste hauling company, hazardous handing firm, VEM, CVRPC	Begin September 2021 and complete by October 2022
All Hazards	Develop and Implement a Post Disaster Debris Management Plan **PREPAREDNESS**	Directors of Public Works, Public Safety, Planning; City Manager	Medium	Local Resources, waste hauling company, hazardous handing firm, VEM, CVRPC	Begin September 2021 and complete by October 2022
Flash Flood/ Flood/Fluvial Erosion/ Severe Summer Weather/ Hurricanes/ Tropical Storms	Replace the Upper Brook Street bridge from being undersized **MITIGATION**	City Manager, various City Directors, City Council	Low – Undetermined	HMGP grants, VEM, CVPRC, ANR, AOT	Begin review of structure July 2022; the City does not want to lose sight of this potential action, the bridge and Gunners Brook are functioning well with the newest Trash Rack installed upstream, so we will monitor over time; with a completion summary report by October 2023
Flash Flood/ Flood/Fluvial Erosion/ Severe Summer Weather/ Hurricanes/ Tropical Storms	Purchase buildings to help restore floodplain: relocate those most at-risk buildings between the upper Brook St bridge and N. Main Street **MITIGATION**	City Manager, various City Directors, City Council	Low – Undetermined	HMGP grants, VEM, CVPRC, ANR	Begin review of more structures in May 2022 (the City does not want to lose sight of this potential action; the City has already completed Phase 1 of our mitigation project, and Phase 2 should be done by the summer of 2018) complete review for summary report by October 2023

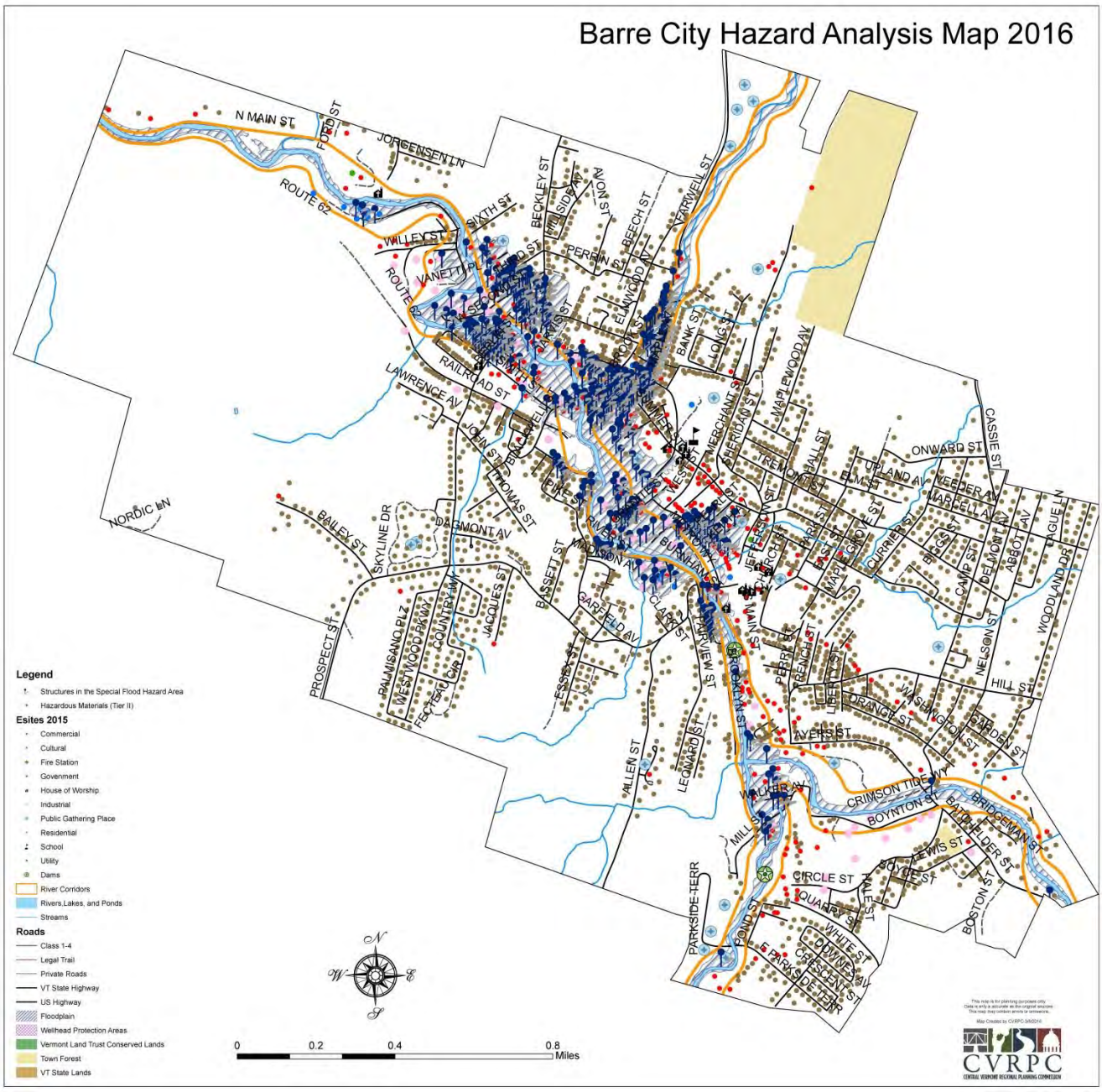
All Hazards	Support staff training and certification in floodplain management **PREPAREDNESS**	Planning Director; Permit Administrator	High	Local Resources	By December 2018 for Planning Director; December 2019 for Permit Administrator
All Hazards	Make information readily available for residents and businesses regarding flooding, flood insurance and how to protect themselves **PREPAREDNESS**	City Council; Barre Landlords Association	Medium	Local Resources	Annually: Begin implementation with Local Leadership before Town Meeting Day in February; table during voting in March (Town meeting is the 1st Tuesday in March in Vermont)
All Hazards	Explore the need for St. Monica Elementary School and Spaulding High School generator need – if the City needs a 3rd alternate Emergency Shelter, a generator would be needed **MITIGATION**	Director of Public Safety	Low	Local Resources; VEM, CVRPC, School District	Begin review July 2022, with a completion determination summary report by October 2023
	Geologic slides occurring on Orange St. W. Patterson St., Berlin St. near Dagmont Ave., Foster Street due to channel degradation (It has been identified that in the next 15 years or so, some of the channels will give way and cause severe erosion and possible structural damage) **MITIGATION**	Director of Public Works	Low	Local Resources, Engineering firms, CVRPC, VEM, HMGP grants, ANR	Begin creating a strategy to deal with some of these identified potential problems October 2021 with a completion summary report by October 2023

Attachments of this Plan

Areas of Local Concern Map

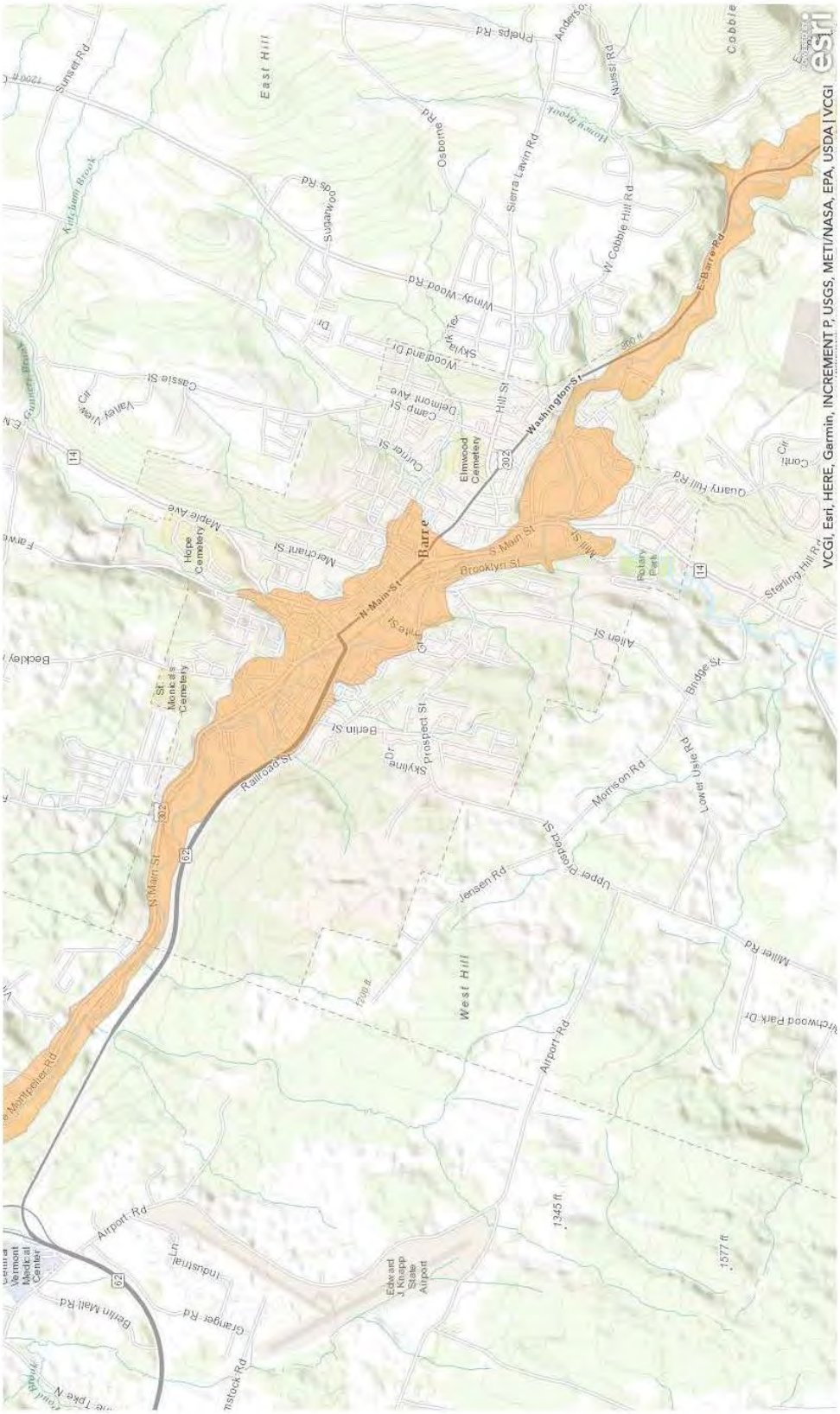


Barre City Hazard Analysis Map



Map of Extent of 2011 Flooding Event

East Barre Dam Inundation Area Map



Copy of Gunner Brook Flood Initiative Update #1 issued October 18, 2015

City of Barre, Vermont

"Granite Center of the World"

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City Manager

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Gunners Brook Flood Mitigation Initiative
Update #1
(10-18-15)

As promised by the Mayor, City Manager, and City Council, I am forwarding this first of periodic updates advising interested property owners and residents of the Harrington Avenue /Brook & Maple Streets neighborhood, and well as the general public, of initiatives and progress-to-date related to flood mitigation efforts in the Gunners Brook Flood Zone.

Since the July 19, 2015 Gunners Brook flood event, the following flood mitigation activities have occurred to date:

1. City staff created a Flood Information & Update link on the City web-site (www.barrecity.org)

2. The Agency of Commerce and Community Development (VACCD) prepared and released the Final version of the **VERI Report** (Vermont Economic Resiliency Imitative) addressing short and long term Gunners Brook flood mitigation planning and action steps. This report is available on-line at the City web-site (barrecity.org)

3. On July 29, 2015, the Mayor, City Manager and Chief of Emergency Services met with, and at the request of, a core group (8+/-) of neighborhood property owners, to discuss the causative factors and response actions during the flooding event, as well as a general discussion of action steps going forward.

4. Following the meeting, the Manager prepared this **Gunners Brook Flood Recovery Group** distribution list to affected neighborhood individuals, in addition to the City Council, City Department Heads, VACCD, and the Times-Argus. The purpose of this list is to provide a mechanism for periodic notice to those flood zone individuals with a vested interest in mitigation planning of post-flood mitigation planning and action steps. Notice via US mail of this distribution list was sent to approximately 120 flood zone property Owners on August 24, 2015. To date, approximately 25 individuals have requested to be on this update list.

5. On July 28, 2015 the Mayor presented a proposal to the City Council for creation of a **$1M Stormwater Management Fund (Bond)** to be used for the purpose of

1

funding/supporting annual maintenance and meaningful flood mitigation projects over a ten (10) year period, inclusive of a funding mechanism that would raise and/or allocate approximately $150,000 annually for flood mitigation efforts. This proposal will be the subject of a March, 2016 Town Meeting ballot item seeking voter approval to authorize this funding source.

6. On August 21, 2015, the City Manager contacted, as a courtesy, the three (3) prospective buy-out property owners to advise that their properties are under consideration as components of a Phase 1 Buy-out Program should it be determined feasible. No buy-out commitment will be made until and unless funding for such a program can be identified and secured.

7. At the request of the Mayor, the Vermont Economic Development Authority (VEDA) and VACCD established a **Non-Owner-Occupied Multi-Family Loan Program**, to make available expedited, low-interest loans to owners of damaged rental properties in the flood zone, who would otherwise not be eligible for any flood related facial assistance.

8. The Mayor organized a **Flood Recovery Public Information Meeting** held at Alumni Hall on August 5, 2015.

9. On August 25, 20915, the City Council designated donations totaling $7,325 to Capstone Community Action for use through the Flood Relief Center.

10. On July 31, 2015, the City of Barre, in partnership with Capstone Community Action, the Vermont Disaster Relief Fund and others, established a **Flood Recovery Center** at the Capstone Community Action Campus at 20 Gable Place.

11. The City Manager has identified a **Harrington Avenue Short-term Targeted Buyout and Debris Control Management Concept** (see attached sketch) involving the buy-out of three damaged/destroyed structures and associated properties for the purpose of constructing future flood event/high-water debris physical containment and control improvements.

12. On August 6, 2015, a team comprised of the City Manager, the Interim Director of Public Work's, representatives of the Agency of Natural Resources, the VERI project team, and DuBois & King. Inc., conducted a post-flood inspection and (base-line) stream inventory of Gunners Brook from the vicinity of the LePage Gravel Pit to the lower Brook Street Bridge. A detailed photo documentation of key stream post-flood characteristics was prepared (woody and stone debris accumulation and entrapment locations, scoured and (severely) eroded stream banks and siltation sources, and failed, damaged or deteriorated retaining walls, etc.)

13. On August 25, 2015, pursuant to Item 11 above, the City Council authrozied $25,000 to engage the engineering firm of DuBois & King, Inc., to conduct a **Gunners Brook Phase 1 Flood Mitigation Study.** (See below)

14. On August 21, 20915 the City Manager has prepared and submitted to the Agency of Transportation (VTrans) a **Town Highway Grant Application** in the amount of $200,000 to reimburse the City for **municipal** (not private) expenses associated with the emergency response, recovery (clean-up) and infrastructure repairs necessitated by the flood.

15. On August 27th, 2015, the City Manager, with the Interim Director of Public Works and representatives of Dubois & King, Inc., conducted a second inspection of the lower reach of Gunners (Buzzi's Garage to North Main Street) to flag woody debris for removal.

16. With the assistance of a work crew(s) from the Department of Corrections working with City DPW staff, the City Manager organized a "woody debris" removal operation for the lower reach of Gunners Brook. This occurred during the weeks of September 7th and 16th, with the intent to remove loose woody debris (branches, trees, vegetation) that is susceptible to re-floatation and downstream clogging in a future high-water event.

17. On September 29th, the City Coil authorized the City Manager to prepare a state/federal HMGP (Hazard Mitigation Grant Program) Grant Application for submission to the Vermont Depigment of Emergency Management and Homeland Security (DEMHS) and FEMA.

Flood Mitigation Activities anticipated in the (near) future:

1. Complete the **Gunners Brook Phase 1 Flood Mitigation Study** (anticipated during the week of October 19, 2015). Hi-lites of the study will include, but not be limited to, the following items:

    a. Feasibility, effectiveness and cost of implementing the Manager's flood mitigation concept.

    b. Feasibility of primary (LePage pit area) and secondary (Harrington Avenue area) engineered debris "trash racks" to control the locations and amount of debris accumulation., with the goal of safely passing high water with minimal, if any, flood damage in the upper Brook Street Bridge to the Harrington Avenue area.

    c. Contingent upon Items (a) and (b), evaluate and plan for the removal of the Harrington Avenue Bridge.

    d. A **Public Information Meeting** is anticipated to be scheduled on/about **October 29, 2015** for public presentation of the study and to obtain public feedback on the recommended course of action.

2. During the week of October 19th, conduct a final "sweep" of the lower brook to remove any remaining woody debris that was not removed during the September work sessions.

3. Review with the Agency of Natural Resources (ANR) as to the more difficult challenge of removal of some of the larger stone debris deposited in the lower reach of the Gunners

Brook stream bed. While some large stones may be obvious candidates for removal, the logistics (equipment, equipment access, and removal mechanics) are not necessarily straightforward. In addition, all in-stream operations must be pre-approved by ANR. Lastly, removal of embedded stones and/or stones adjacent to the base of existing retaining walls must be examined closely, as removal or disturbance of some of these embedded stones may, in fact, cause further stream bed erosion/damage and/or associated undermining of the exiting retaining walls.

4. Confer with ANR staff and consulting professionals regarding the feasibility, regulatory acceptability, logistics, cost and funding targeted and limited sediment removal primarily from the lower Gunners Brook (between the upper and lower Brook Street bridges).

5. The City Manager, with the assistance of the City Permits Administrator (Janet Shatney) have been coordinating with the appropriate State and Regional Agencies (Department of Emergency Management and Homeland Security [DEMHS], Agency of Commerce and Community Development [ACCD], Central Vermont Regional Planning Commission, [CVRPC]) and the cooperation of the affected property owners, have initiated preparation of an HMGP (Hazard Mitigation Grant Program) application for financial assistance in future flood mitigation steps. The Application submission deadline is November 6, 2015.

I anticipate preparing future Flood Mitigation Updates on an approximately quarterly basis, and more frequently if substantive developments have occurred in the interim.

Please feel free to contact me at **manager@barrecity.org** if you have questions/comments/input reading this Update or flood mitigation activities in general. Also, please feel free to encourage any of your neighbors to contact me to add their name to this distribution list. I will also add names to a smaller US mail list for those who do not have computer access as long as I am supplied (476-0241) with names and mailing addresses.

Respectfully,

COPY

Steven E. Mackenzie, P.E.
Barre City Manager

4

Gunner Brook at Harrington Ave
Barre City, VT
1 Inch = 75 Feet
July 30, 2015

Data shown on this map is provided for planning and informational purposes only. The municipality and CAI Technologies are not responsible for any use for other purposes or misuse or misrepresentation of this map.

www.cai-tech.com

Major High Hazards Table

Major High Hazard and/or Vulnerable Sites List (locations to check for damage)	
Site Type: (ex. Dam, culvert, bridges, railway crossing,, low-lying area, Tier II site)	**Site Location** (physical location)
Dam	East Barre Dam
Dam	Thurman W. Dix Reservoir
Large Culvert: Potash Brook	Under Currier Street and a house on Currier Street
Large Culvert: Potash Brook	Underground from Jefferson Street by old Mathewson School to river by Prospect Street bridge
Large Culvert: Potash Brook	Underground from Elm Street by old Mathewson School down Summer Street across the pearl Street parking lot to the river by the old Rouleau Granite Company on Metro Way
Railroad Crossing	Quarry Street
Railroad Crossing	Circle Street
Railroad Crossing	Boynton Street
Railroad Crossing	Ayers Street
Railroad Crossing	Hill Street
Railroad Crossing	S. Main Street
Railroad Crossing	Prospect Street
Railroad Crossing	Williams Lane
Railroad Crossing	Granite Street
Railroad Crossing	Route 62
Railroad Crossing	Blackwell Street
Railroad Crossing	at 460 N. Main Street
Railroad Crossing	Berlin Street
Railroad Crossing	W. Second Street
Railroad Crossing	Willey Street
Bridges over brooks and/or rivers	S. Main Street
Bridges over brooks and/or rivers	Mill Street
Bridges over brooks and/or rivers	Ayers Street
Bridges over brooks and/or rivers	Prospect Street
Bridges over brooks and/or rivers	Granite Street
Bridges over brooks and/or rivers	Blackwell Street
Bridges over brooks and/or rivers	N. Main Street by Blackwell Street
Bridges over brooks and/or rivers	Berlin Street
Bridges over brooks and/or rivers	Willey Street
Bridges over brooks and/or rivers	Route 62
Bridges over brooks and/or rivers	Nelson Street
Bridges over brooks and/or rivers	Camp Street
Bridges over brooks and/or rivers	Onward Street
Bridges over brooks and/or rivers	Cassie Street
Bridges over brooks and/or rivers	Tremont Street

Attachment A (1)

Major High Hazard and/or Vulnerable Sites List (locations to check for damage)	
Site Type: (ex. Dam, culvert, bridges, railway crossing,, low-lying area, Tier II site)	**Site Location** (physical location)
Bridges over brooks and/or rivers	Maple Grove Street
Bridges over brooks and/or rivers	East Street
Bridges over brooks and/or rivers	Park Street
Bridges over brooks and/or rivers	Brook Street by Laurel Street
Bridges over brooks and/or rivers	Brook Street by Maple Avenue
Bridges over brooks and/or rivers	N. Seminary Street
Low lying areas for flooding	N. Main Street
Low lying areas for flooding	Granite Street
Low lying areas for flooding	Scampini Square
Low lying areas for flooding	First Street
Low lying areas for flooding	Second Street
Low lying areas for flooding	Third Street
Low lying areas for flooding	Fourth Street
Low lying areas for flooding	Fifth Street
Low lying areas for flooding	W. Second Street
Low lying areas for flooding	Vine Street
Low lying areas for flooding	Keith Avenue
Low lying areas for flooding	Depot Square
Low lying areas for flooding	Pearl Street
Low lying areas for flooding	Eastern Avenue
Low lying areas for flooding	Park Street
Low lying areas for flooding	East Street
Low lying areas for flooding	North Street
Low lying areas for flooding	Cliff Street
Low lying areas for flooding	Maple Grove Street
Low lying areas for flooding	Delmont Avenue
Low lying areas for flooding	Currier Street
Places of Concern	GMP Substation #26 - 45 Burnham Street
Places of Concern	GMP South End Substation #37 - 121 S. Main Street
Places of Concern	GMP North End Substation #63 - 128 Railroad Street
Places of Concern	Irving Oil Propane Storage Tank - 7 Williams Lane
Places of Concern	Irving Oil Bulk Fuel Storage Terminal - 60 Smith Street
Places of Concern	Barre City Place Propane Storage Tank - 219 N. Main St
Places of Concern	Safety Kleen Systems, Inc. - 23 W. Second Street
Places of Concern	Fairpoint Telecommunications Bldg. - 46 Elm Street
Places of Concern	Vermont TRANSCO Substation (in the Town of Barre) just over the City limit, Upper Prospect St
Government Bldgs. - Vulnerable Population	VT District Court & Office Complex - 255 N. Main St.
Government Bldgs. - Vulnerable Population	McFarland State Office Bldg. - 5 Perry St.

Attachment A (2)

Major High Hazard and/or Vulnerable Sites List (locations to check for damage)	
Site Type: (ex. Dam, culvert, bridges, railway crossing, low-lying area, Tier II site)	**Site Location** (physical location)
Housing (>9 units) - Vulnerable Population	North Barre Manor - 455 N. Main St (120 units)
Housing (>9 units) - Vulnerable Population	Tilden House - 16 S. Main St (78 units)
Housing (>9 units) - Vulnerable Population	Washington St Apts - 14 Washington St (47 units)
Housing (>9 units) - Vulnerable Population	Jefferson St Apts - 25 Jefferson St (24 units)
Housing (>9 units) - Vulnerable Population	Green Acres - Bergeron & Chatot Sts (50 units)
Housing (>9 units) - Vulnerable Population	Summer St Housing - 22 Keith Ave (27 units)
Housing (>9 units) - Vulnerable Population	River St Associates - 96 Beckley St (12 units)
Housing (>9 units) - Vulnerable Population	Downstreet Housing - 1 Bromur St (12 units)
Housing (>9 units) - Vulnerable Population	Walbridge Apt. Bldg. - 44 Granite St (11 units)
Housing (>9 units) - Vulnerable Population	B.I.G. Apt. Bldg. - 121 Hill St (10 units)
Housing (>9 units) - Vulnerable Population	McCabe Apt. Bldg. - 35 Merchant St (11 units)
Housing (>9 units) - Vulnerable Population	Aja Apt. Bldg. - 54 Mill St (10 units)
Housing (>9 units) - Vulnerable Population	Bolster House - 114 N. Main St (12 units)
Housing (>9 units) - Vulnerable Population	Miles Block - 162 N. Main St (20 units)
Housing (>9 units) - Vulnerable Population	Housing Foundation - 260 N. Main St (20 units)
Housing (>9 units) - Vulnerable Population	Downtown Rentals - 14 & 28 Pearl St (32 units)
Housing (>9 units) - Vulnerable Population	Highgate Housing - 301 Prospect St (120 total units)
Housing (>9 units) - Vulnerable Population	Citi Properties Apt. Bldg. - 46 Washington St (11 units)
Housing (>9 units) - Vulnerable Population	Barre Realty Apt. Bldg. - 181 Washington St (14 units)
Tier II Hazard List	Airgas USA, LLC: 65 Granite Street
Tier II Hazard List	AJ's Sunoco Gas Station: 320 Washington Street
Tier II Hazard List	Bellavance Trucking Fuel Terminal: 5 S. Vine Street
Tier II Hazard List	Bellavance Repair Garage: 167 Boynton Street
Tier II Hazard List	Buttura and Sons, Inc.: 109 Boynton Street
Tier II Hazard List	City of Barre Public Works: 4 & 6 Burnham St (Bldg. 6)
Tier II Hazard List	City of Barre Barricade Building: 12 Burnham Street
Tier II Hazard List	City of Barre Sewer Dept.: 10 & 14 Burnham Street (Bldg. 14)
Tier II Hazard List	City of Barre Water Dept.: 4 & 6 N. Main St (Bldg. 4)
Tier II Hazard List	City Wastewater Treatment Plant: 69 Treatment Plant Dr.
Tier II Hazard List	Cumberland Farms Gas Station: 524 N. Main Street
Tier II Hazard List	Cumberland Farms Gas Station: 132 S. Main Street
Tier II Hazard List	Fairpoint Server Building: 46 Elm Street
Tier II Hazard List	GMP Substation #26 - 45 Burnham Street
Tier II Hazard List	GMP South End Substation #37 - 121 S. Main Street
Tier II Hazard List	GMP North End Substation #63 - 128 Railroad Street
Tier II Hazard List	Irving Oil Propane Storage Tank - 7 Williams Lane
Tier II Hazard List	Irving Oil Bulk Fuel Storage Terminal - 60 Smith Street
Tier II Hazard List	Barre City Place Propane Storage Tank - 219 N. Main St
Tier II Hazard List	Jiffy Mart (Champlain Oil) - 350 N. Main Street

Attachment A (3)

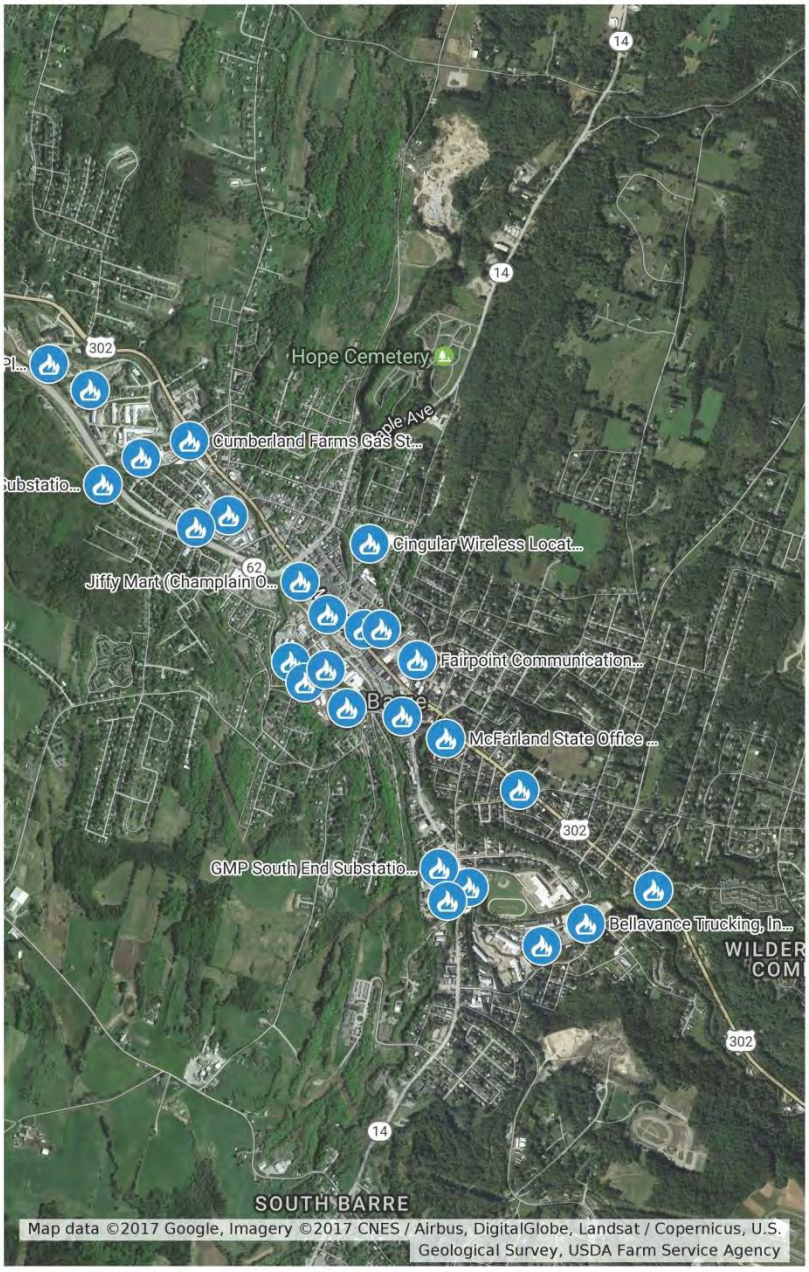
Major High Hazard and/or Vulnerable Sites List (locations to check for damage)	
Site Type: (ex. Dam, culvert, bridges, railway crossing, low-lying area, Tier II site)	**Site Location** (physical location)
Tier II Hazard List	Level 3 Communications - 316 N. Main Street
Tier II Hazard List	Cingular Wireless Hub - 20 Auditorium Hill
Tier II Hazard List	Safety Kleen Systems, Inc. - 23 W. Second Street
Tier II Hazard List	Sherwin-Williams Paint Company - 131 S. Main Street
Tier II Hazard List	Stone's Service Station (COCO) - 133 Washington Street
Tier II Hazard List	Fast Stop Gas Station: 377 N. Main Street
Tier II Hazard List	North End Deli Mart & Gas Station: 475 N. Main Street
Tier II Hazard List	Beverage Baron Gas Station: 411 N. Main Street
Tier II Hazard List	Westco Gas Station: 169 Washington Street
Tier II Hazard List	Swenson Granite (Anderson-Friberg Plant) - 54 Willey St
Tier II Hazard List	US Post Office - 3 S. Main Street
Tier II Hazard List	Verizon Wireless Cell Site Base Station - 5 Perry St
Tier II Hazard List	McFarland State Office Bldg. - 5 Perry St.
Tier II Hazard List	Washington District Court House - 255 N. Main Street

Attachment A (4)

Tier 2 Facilities Map Updated May 2017

Tier II Facilities

- Airgas USA, LLC
- AJ's Sunoco
- Bellavance Trucking, Inc. Repair Garage
- Bellavance Trucking, Inc. Fuel Terminal
- Buttura and Sons, Inc.
- Public Works Garages
- Wastewater Treatment Plan
- Cumberland Farms Gas Station
- Cumberland Farms Gas Station
- Fairpoint Communications
- GMP Barre Substation #26
- GMP South End Substation #37
- Irving Oil Propane Distribution Plant
- Irving Oil Fuel Plant
- Cingular Wireless Location
- Safety-Kleen Systems, Inc.
- Sherwin-Williams Co.
- Swenson Granite Co.
- United States Post Office
- McFarland State Office Building
- Washington District Court House
- GMP North End Substation #63
- Barre City Place
- Jiffy Mart (Champlain Oil)
- Level 3 Communications Location
- Stone's Sunoco



Reported Spills in Barre City from 2012 to September 2017

State of Vermont Spills Management Division
Reported Spills between January 1, 2012 and September 10, 2017

Facility Name	Street No.	Address	Date Reported	Nature of Incident	Quantity	Contaminants
Peppin Residence	255	Camp Street	02-24-2012	Blown hose	2-5 Gallons	Hydraulic Oil
Downtown Barre Development Property	355	N. Main Street	06-06-2012	Unknown source of petroleum (likely gasoline) contamination found during redevelopment	Unknown	Gasoline
GMP Substation	121	S. Main Street	06-09-2012	Transformer hit by lightning	20 Gallons	MODF (mineral oil dielectric fluid)
McDunnah Residence	42	Maple Avenue	07-31-2012	Spill during clean out of old AST	5 Gallons	#2 Fuel Oil
POV Accident	Keith Ave.; Washington St.	Keith Ave.; Washington St.	08-07-2012	Truck Accident	2 Gallons	Hydraulic Oil, Motor Oil
North End Deli 114 BE4	475	N. Main Street	12-11-2012	Dispenser piping leak	Unknown	Gasoline
Lyman Amstead apartment building	5	Averill Street	01-07-2013	Alleged AST release in basement	Unknown	Kerosene
North End Deli	475	N. Main Street	01-09-2013	Remedial system overflowed water/oil onto street	500 Gallons	Gasoline
Philip Residence	140	Berlin Street	02-28-2013	line to furnace failed 3-4 years ago - no clean-up performed	200+ Gallons	#2 Fuel Oil
VTrans Residential Property	11	Quarry Street	05-07-2013	Above Ground Tank leak or failure	Unknown	#2 Fuel Oil
Empty Residence	16	First Street	06-05-2013	Property in foreclosure - Someone removed copper tube from basement tank	50 Gallons	#2 Fuel Oil
Roadside	24	Waterman Street	06-23-2013	Hydraulic Equipment Failure	>2 Gallons	Hydraulic Oil
McFarland State Office Building	5	Perry Street	10-17-2013	Forest & Parks vehicle vandalized - gas tank punctured	20 Gallons	Gasoline
residence	12	Second Street	11-21-2013	Spill by delivery vehicle or personnel. Bulk tmslr	6 Gallons	#2 Fuel Oil
Residence	33	Berlin Street	01-09-2014	Heating oil fuel spill	5 Gallons	#2 Fuel Oil
Champlain Farms	15	S. Main Street	01-22-2014	customer overfill	3 Gallons	Gasoline
Roadside	Rte. 14 (South main St)	Rte. 14 (South main St)	03-27-2014	Automobile accident; car lost contents of its gas tank and approx 4 quarts motor oil	17 Gallons	Gasoline, Motor Oil
Barre City	14	Washington Street	04-26-2014	Unkown person disposed of waste oil in Barre City storm sewer	5 - 10 Gallons	Waste Oil
Cumberland Farms	524	N. Main Street	06-14-2014	customer wedged nozzle on with gas cap, didn't shut off when tank was full	35 Gallons	Gasoline
Howe Residence	7	Edgewood Avenue	07-02-2014	Above Ground Tank leak or failure	>1 Gallons	#2 Fuel Oil
Possible dumping into stream	114	S. Main Street	08-04-2014	Possible dumping of black top into river	Yards Cubic Yards	Solid Waste
Cumberland Farms	132	S. Main Street	08-05-2014	Fuel Station; failed shut off	3 Gallons	Gasoline
Cumberland Farms #4027	132	S. Main Street	08-18-2014	Fuel Station; failed shut off	2 Gallons	Gasoline
Anton Residence	174	S. Main Street	08-28-2014	Above Ground Tank leak or failure	Unknown	#2 Fuel Oil
Cumberland Farms	132	S. Main Street	10-08-2014	Fuel Station; failed shut off	2 Gallons	Gasoline
Behind Copy World	75	N. Main Street	10-14-2014	Old leaky UST discovered while excavating for a new drainage pipe	Unknown	#2 Fuel Oil
Cumberland Farms	132	S. Main Street	10-16-2014	fuel station spill	2 Gallons	Gasoline
Amsden Property	62	Brook Street	11-07-2014	Unconnected tank filled.	254 Gallons	#2 Fuel Oil
Cumberland Farms #4027	132	S. Main Street	11-17-2014	Leaking vehicle fuel tank at store	>1 Gallons	Gasoline
Sleeper residence	13	Beckley Street	12-17-2014	piping failure in slab	5 Gallons	#2 Fuel Oil
Cumberland Farms	132	S. Main Street	01-31-2015	customer jammed gas cap in nozzle handle and went inside store	15 Gallons	Gasoline
Pivetti Residence	23	Academy Street	02-10-2015	minor spill from hose	>1 Gallons	#2 Fuel Oil
Bates Residence	210	Hill Street	05-11-2015	Spray from hose while returning it to truck	>1 Gallons	#2 Fuel Oil
Former Acebo Residence	21	Hilltop Avenue	04-29-2015	Heating Oil UST leak	Unknown	#2 Fuel Oil
Granite Industries of VT	38-40	Vernett Place	06-04-2015	Cont. found during closure of 3 USTs	Unknown	#2 Fuel Oil, #6 Fuel Oil
Dailey Residence	19	Harrington Avenue	07-20-2015	Flooding caused basement AST to float/release contents	15 Gallons	#2 Fuel Oil
Hallock Residence	74	Maple Avenue	07-23-2015	AST tipped over due to flooding	Unknown	#2 Fuel Oil
Cumberland Farms	132	S. Main Street	09-25-2015	Fuel Station; failed shut off	2 Gallons	Gasoline
Cumberland Farms	132	S. Main Street	10-17-2015	Fuel Station; failed shut off	3-5 Gallons	Gasoline

State of Vermont Spills Management Division
Reported Spills between January 1, 2012 and September 10, 2017

Facility Name	Street No.	Address	Date Reported	Nature of Incident	Quantity	Contaminants
Cumberland Farms #4025	524	N. Main Street	11-05-2015	Not Accident - Car Fuel Tank Leak	2-3 Gallons	Gasoline
Cyr Apartments	116	Summer Street	11-23-2015	Above Ground Tank leak or failure	>400 Gallons	#2 Fuel Oil
Cumberland Farms	524	N. Main Street	11-27-2015	Fuel Station; failed shut off	3 Gallons	Gasoline
Al Burner Service LLC	31	Palmisano Plaza	12-02-2015	Not Accident - hauled material spilled in truck	>2 Gallons	#2 Fuel Oil
Cumberland Farms	132	S. Main Street	12-23-2015	customer wedged nozzle, shut-off failed, overfilled	3 Gallons	Gasoline
Cumberland Farms	132	S. Main Street	12-24-2015	failed nozzle shut-off	5 Gallons	Gasoline
Cumberland Farms	132	S. Main Street	12-24-2015	Second failed nozzle shut-off at pump in same day	3 Gallons	Gasoline
Safety-Kleen	23	W. Second Street	01-12-2016	disengaged hoses	3 Gallons	Hydraulic Oil
Austin residence	4	Shurtleff Place, Apt 3	03-31-2016	tank overfilled due to malfunctioning vent whistle	>1 Gallons	#2 Fuel Oil
Lynnette Claudon Residence	55	Wellington Avenue	04-11-2016	Hot water heater failed and flooded cellar causing AST filter to fail	10 Pounds	#2 Fuel Oil
Whalen Property	28	Tremont Street	04-26-2016	Tank removal PCS encounter under tank Owner is grant applicant	Unknown	#2 Fuel Oil
Cumberland Farms	132	S. Main Street	04-26-2016	Customer overfill when fueling vehicle	2 Gallons	Gasoline
Lunde Residence	199	Merchant Street	05-18-2016	excavator tipped over	1-2 Gallons	Diesel
Stevens Branch	near Granite Street bridge	near Granite Street bridge	06-28-2016	Petroleum sheen identified at culvert outfall	Unknown	Unknown/unspecified Petroleum
Cumberland farms store	132	S. Main Street	07-23-2016	not really an accident -- leaking oil pan on vehicle	3 Gallons	Motor Oil
Carpenter Property	12	Veeder Avenue	07-26-2016	Bsmt AST leaking over sump pit	Unknown	#2 Fuel Oil
Hollow Inn	278	S. Main Street	10-05-2016	spill when putting oil in AST from container	>1 Gallons	#2 Fuel Oil
LLEDNEW,Inc	441	N. Main Street	10-18-2016	Gasoline UST Release	Unknown	Gasoline
Cambell Residence	11	French Street	11-09-2016	Owner removed tank, did not contact oil company	28 Gallons	#2 Fuel Oil
Roadway	30	Beech Street	11-10-2016	Dropped delivery hose - contents of hose spilled	2-3 Gallons	#2 Fuel Oil
Dollar General	540	N. Main Street	11-11-2016	Non-accident. Spill from vehicle	10 Gallons	Diesel
Gingras Residence	20	Plain Street	12-02-2016	New customer inspection discovered release	Unknown	#2 Fuel Oil
Dan Smith Residence	66	Bailey Avenue	12-10-2016	Overfill of indoor AST	3 Gallons	#2 Fuel Oil,
Carpenter Residence	20	Hilltop Avenue	10-17-2016	apparent overfills of home heating oil underground storage tank	Unknown	#2 Fuel Oil
Barre Jiffy Mart	360	N. Main Street	01-10-2017	LUST Closure	Unknown	Gasoline
Pride, Inc., property	36	Summer Street	02-20-2017	Frost action cracked filter pack	75 - 125 Gallons	Kerosene
Wild Auto Electric	89	S. Main Street	03-28-2017	Tank discovered at property by excavation company Rogers Brothers	Unknown	#2 Fuel Oil
Barre City WWTP	69	Treatment Plant Drive	04-10-2017	Pad mounted transformer failure	2-3 Gallons	MODF (mineral oil dielectric fluid)
Substation	128	Railroad Street	04-15-2017	Hydraulic Equipment Failure	0.5 Gallons	Hydraulic Oil
Bach Residence	28	Knoll Drive	04-28-2017	Above Ground Tank leak or failure	7 Gallons	#2 Fuel Oil
US Post Office	3	S. Main Street	05-03-2017	PCS found during UST removal	Unknown	#2 Fuel Oil
Barre Fastop Gulf 110-BE3	377	N. Main Street	05-12-2017	Delivery overfill	2-3 Gallons	Gasoline
Roadside	near W. Second Street	near W. Second Street	06-27-2017	Transformer/Capacitor release	2 Gallons	MODF (mineral oil dielectric fluid)
Badeau Residence	100	Brook Street	07-05-2017	Fuel oil in flooded basement	20 Gallons	#2 Fuel Oil
Champlain Farms	169	Washington Street	07-17-2017	Failed Shut-off	8 Gallons	Diesel
Champlain Farms	169	Washington Street	07-17-2017	Presumed fuel dispenser malfunction	1-2 Gallons	Gasoline
Clean Harbors Warehouse	23	W. Second Street	09-05-2017	Forklift dropped pallet of used paint cans	2 Gallons	paint related liquids

Stevens/Jail Branch Map and Project List

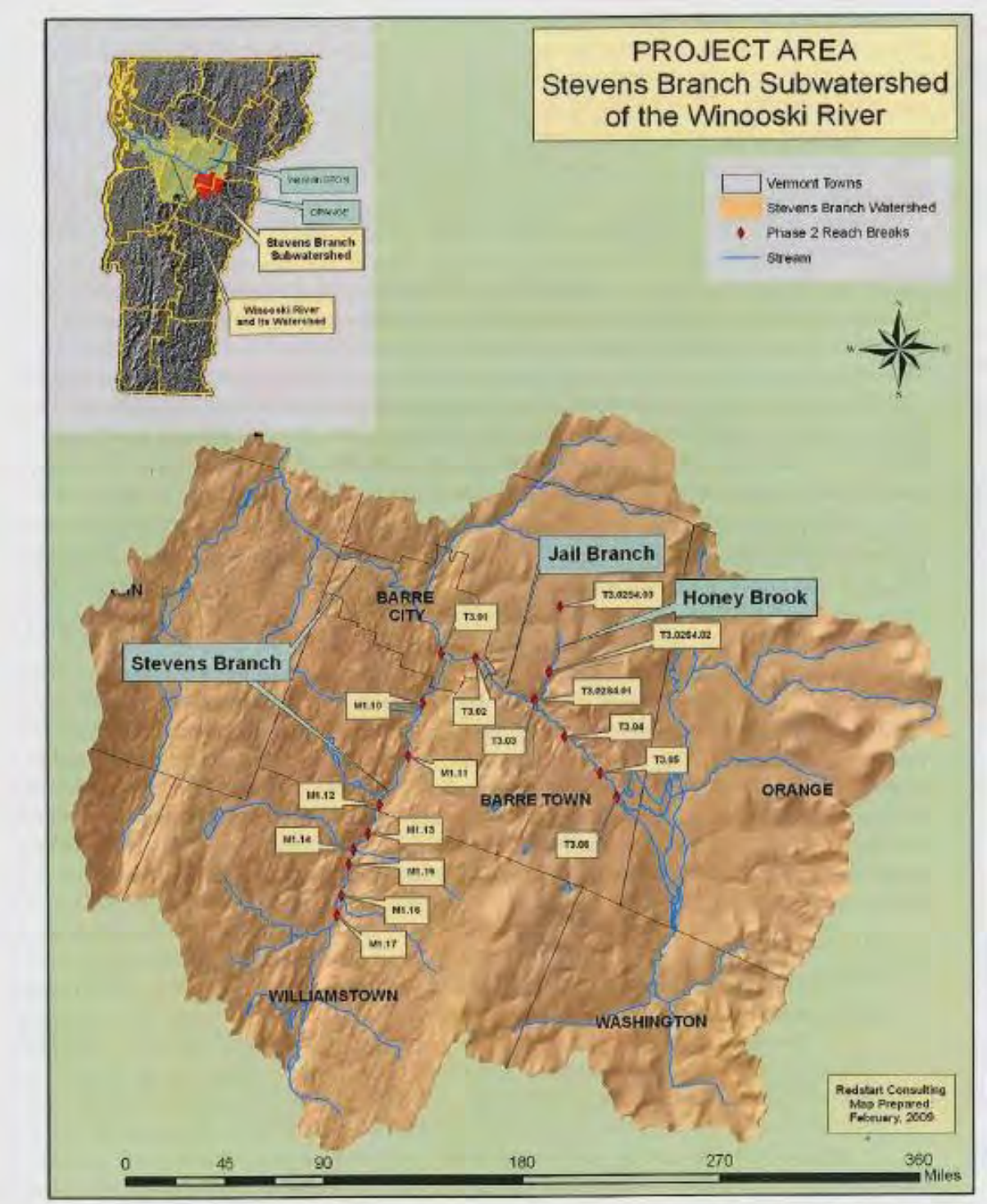


Figure 1. Six mainstem and seven tributary reaches included in the Stevens Branch Corridor Planning process. Inset shows the location of this area in terms of the entire State.

Stevens Branch Watershed 2008 Phase 2 Prioritized Project and Strategy Summary (from Stevens Branch Corridor Plan 3/13/2009)								
Project No.	**Reach/ Segment Condition Sensitivity**	**Site Description Including Stressors and Constraints**	**Project or Strategy Description**	**Technical Feasibility & Priority**	**Other Social Benefits**	**Costs**	**Land Use Conversion & Landowner Commitment**	**Potential Partner Commitments**
1	All of project area	Extensive straightening and frequent loss of floodplain access, escalating erosion conflicts due to increased stream velocity.	FEH and belt- width-based corridor planning, protection of attenuation assets.	Feasible, high priority; delineation process largely developed Development pressures in watershed likely to continue, upstream impacts affect success of projects	Flood hazard reduction, fisheries protection, prime farmland protection, viewshed preservation, water quality protection, oversight of management activities affecting stream function	Development of FEH corridor; outreach and educational materials; policy development and implementation	Depends on options chosen; see VT ANR Municipal Guide to Fluvial Erosion Hazard Mitigation (Literature Cited section of this report)	Towns of Barre, Barre City, and Williamstown FWR; CVRPC, VT ANR-RMP
2	Numerous reaches High Priority (In order of priority): M1.11-A, M1.11-B, M1.11-C, M1.15-A, M1.10-A, M1.18-B, M1.18-C, M1.19-A	Bank erosion, encroachment leading to bank destabilization and increased flows	Buffer protection and enhancement and corridor easement projects	Feasible, high priority; data available; cheap; easy to promote with landowners; funding available for easement projects	Water quality protection, fisheries protection, flood hazard reduction	Outreach; materials and planting costs; easement development costs	Landowner commitment critical. Potential land use conversion of buffer areas.	Private Landowners; FWR, CVRPC, VT ANR-RMP, CREP

3	Numerous reaches High Priority (In order of priority): M1.10- B, M1.11-B, T3.01-A, T3.01-B, T3.02B, T3.03-A, T3.04-D, T3.05-A, T7.01-A, M1.18-A	Increased flow, downstream reaches incised	Collect and assemble stormwater input data for reaches; develop plan for mitigating flow	Feasible, high priority; data available; towns may have model inventories and budgeting/resources?	Water quality protection, fisheries protection, flood hazard reduction	Data assembling; outreach and education; alteration costs where appropriate	Private landowners are key to success	Towns of Barre, Barre City, and Williamstown Private landowners; FWR; CVRPC VT ANR-RMP
4	Numerous reaches High Priority (In order of priority): T2S4.01-A, T3.01-A, T3.01-B, T2S4.01-B, T2S4.02-A, T2S4.02-B, M1.14-0, M1.15- B, T3.02S4.01S1.01-A, T3.02S4.01S1.01-B, T7.01-B	Downstream reaches incised, sediment discontinuities reducing movement of larger bedload sediments to help rebuild meanders and floodplain access	Collect and assemble geomorphic data for bridges and culverts; develop and disseminate sizing recommendations and/or requirements for private installations and help towns with inventory, prioritization, and capital budgeting	Feasible, high priority; data already available; some towns may have model inventories and budgeting	Flood hazard reduction; fisheries protection	Data collection and assembling; replacement costs where appropriate		Towns of Barre, Barre City, and Williamstown FWR; CVRPC VT ANR-RMP
5	M1.10B	RB mass failure exacerbated by stormwater outflow.	Re-location of stormwater input	Feasible, should fit in with City stormwater management priorities.	Protect fisheries and water quality from increased sediment	Landowner outreach and education; relocation of stormwater flow	Land use conversion minimal; landowner will need to commit to project	Landowners, Barre City Engineers, FWR, RMP

6	M1.10D	Extensive tributary erosion and head cut that has moved up to Route 14. Arrest headcutting [more?]	Arrest headcutting at Route 14	Feasible, should fit in with City stormwater management priorities.	Protection of State Highway, improved water quality, protection of fisheries	Replacement of culvert and other structures for arresting headcut	Land use conversion minimal; City road engineer must be on board	Barre City Engineers, VTrans, FWR, RMP
7	M1.15B	Floodplain not accessed on right bank due to berm presence; recent flooding over left bank into developed area	Remove berm	Feasible, should be further evaluated but is possibly simple solution to problematic flooding	Return area of non-floodplain habitat to floodplain habitat	Landowner outreach and education, equipment for berm removal and site restoration	Some land conversion of flood- protected land to non-flood- protected land; will need landowner commitment	FWR, RMP, CREP, EQIP
8	T3.01B	Mass failure RB; upstream of bridge is threatening house above	Stabilize stream bank; redirect stream flow with rock vein	Feasible; financial responsibility needs to be worked out	Water quality protection	Riprap and vein boulders, installation costs.	Landowner commitment needed, City commitment needed.	Barre City, Landowner at site, FWR, RMP
9	T3.03A	Gully formation on left valley wall is adding sediment to Jail Branch and is headcutting.	Arrest head cut in tributary gully	Potentially feasible; needs further evaluation to determine source, assess future erosion risk, and consider value of intervention	Landowner education, protection of water quality and fisheries.	Landowner outreach and education, materials and installation costs.	Minimal land use conversion; needs landowner commitment.	Site landowners, Barre Town, FWR, RMP CREP, EQIP

10	T3.01B	Lack of flood attenuation in city.	Remove berm	Potentially feasible; needs further evaluation to assess value and issues involved	Landowner education; reduced flood hazard downstream	Landowner outreach and education would be extensive considering potential flooding over school playing fields; cost of removing berm and stabilizing the site.	Land use conversion possibly; landowner and citizen commitment would have to be high	Barre City Government, Barre City citizens, landowners, FWR, RMP.
11	T7.01A	Possibly unnecessary barrier to attenuation.	Remove berms	Potentially feasible; needs further evaluation to assess value and issues involved	Landowner education; reduced flood and erosion hazard downstream	Landowner outreach and education, materials and installation costs.	Minimal land use conversion; needs landowner commitment.	Site landowners, Williamstown Town, FWR, RMP, CREP, EQIP

Floodplain Map for City

Barre City, VT

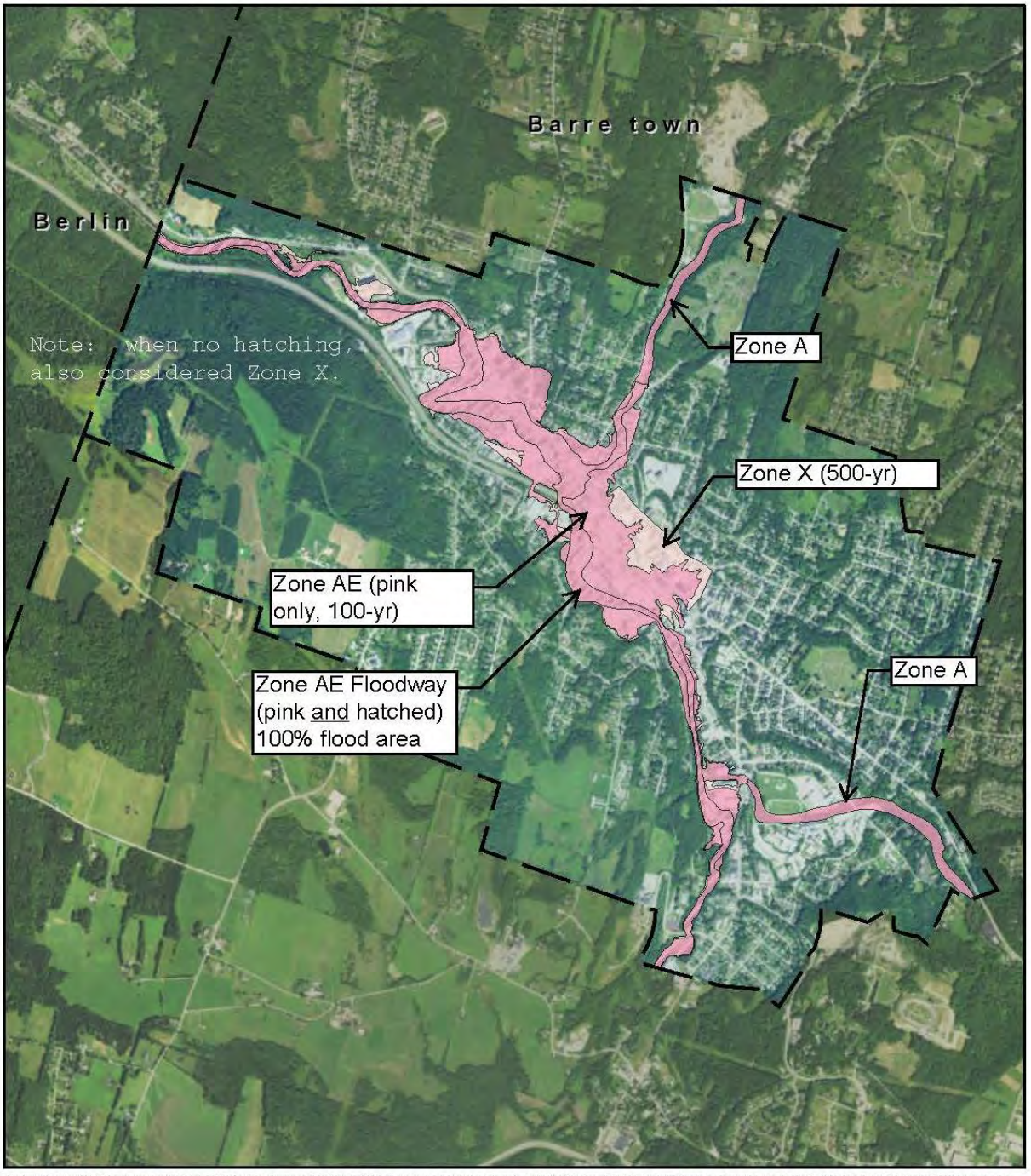
1 inch = 2151 Feet

June 5, 2017

0 2151 4302 6453

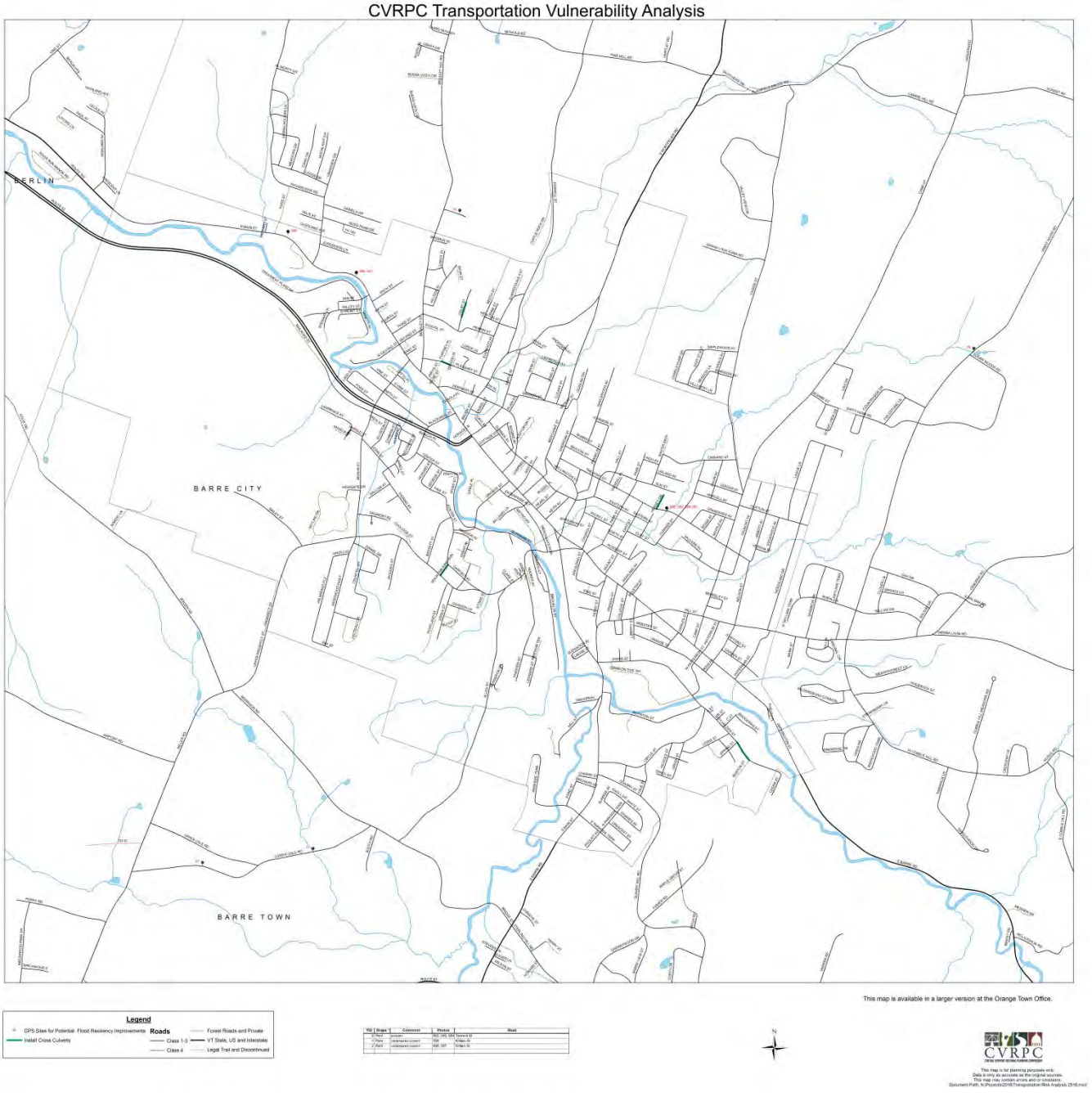
CAI Technologies

www.cai-tech.com

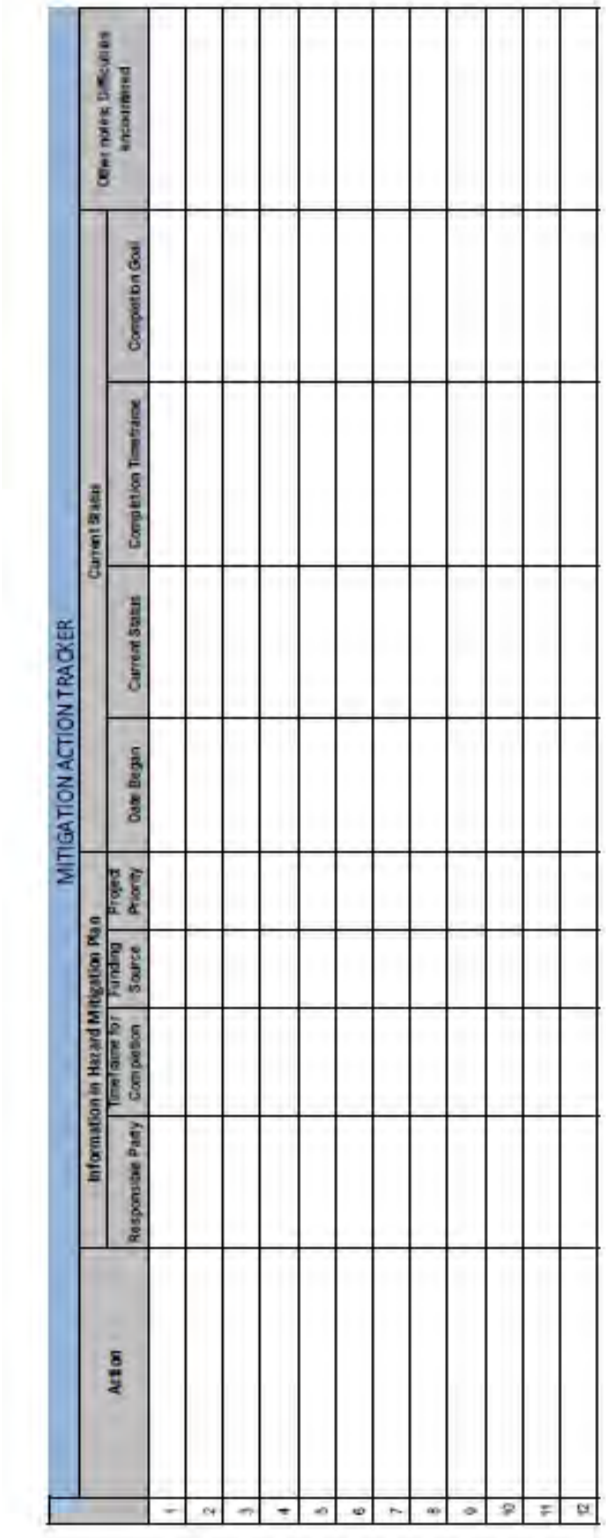


Data shown on this map is provided for planning and informational purposes only. The municipality and CAI Technologies are not responsible for any use for other purposes or misuse or misrepresentation of this map.

Transportation Vulnerability Map by CVRPC



Mitigation Action Tracking Sheet



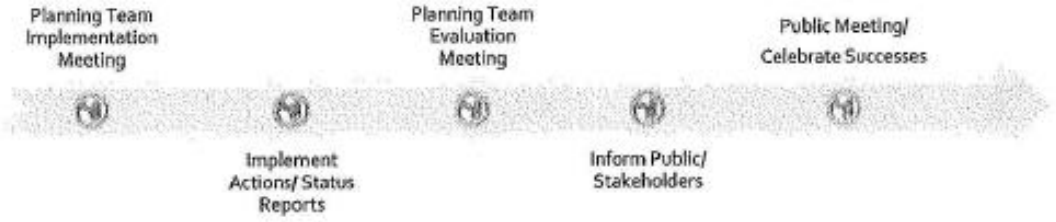
MITIGATION ACTION TRACKER													
	Action	Information in Hazard Mitigation Plan					Current Status						Other notes, Obstacles encountered
		Responsible Party	Timeframe for Completion	Funding Source	Project Priority	Date Begun	Current Status	Completion Timeframe	Completion Goal				
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													

Hazard Ranking Methodology

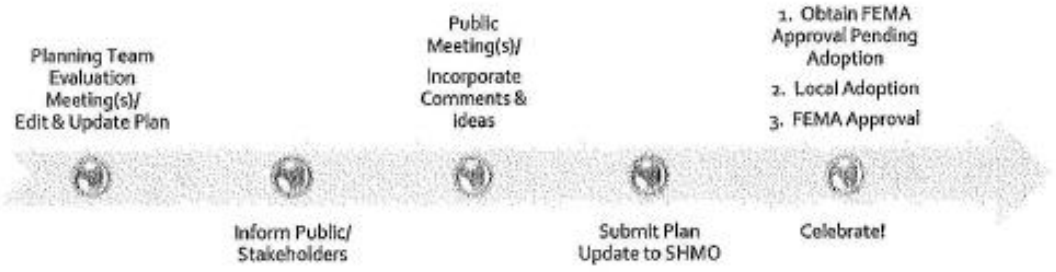
Frequency of Occurrence Probability	**Warning Time** Amount of time generally given to alert people to hazard	**Potential Impact** Severity and extend of damage and disruption Note: Severity of damage and disruption generally correlates with magnitude (extent) of an event
1 = Unlikely <1% probability of occurrence in the next 100 years **2 = Occasionally** 1-10% probability of occurrence per year, or at least one change in the next 100 years **3 = Likely** >10% but <100% probability per year, at least 1 change in next 10 years **4 = Highly Likely** 100% probable in a year	1 = more than 12 hours 2 = 6-12 hours 3 = 3-6 hours 4 = None – Minimal	**1 = Negligible** Isolated occurrences of minor property damage, minor disruption of critical facilities and infrastructure, and potential for minor injuries **2 = Minor** Isolated occurrences of moderate to severe property damage, brief disruption of critical facilities and infrastructure, and potential for injuries **3 = Moderate** Severe property damage on a neighborhood scale, shutdown of critical facilities, and/or injuries or fatalities **4 = Major** Severe property damage on a metropolitan or regional scale, shutdown of critical facilities, and/or multiple injuries or fatalities

5-year Plan Review Maintenance Matrix

After Plan Adoption-Annually
Implement and Evaluate



Fifth Year, and After Major Disaster
Evaluate and Revise



Certificate of Adoption

November 28, 2017

The City of Barre City Council

Resolution 2017-14 Adopting the 2017 Local Hazard Mitigation Plan

WHEREAS, the City of Barre has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of the hazards profiled in the 2017 Barre City Local Hazard Mitigation Plan, which result in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the City of Barre has developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for its 2017 Vermont Local Hazardous Mitigation Plan (Plan) under the requirements of 44 CFR 201.6; and

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

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

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

RESOLVED by the City of Barre City Council:

1. The 2017 Barre City Local Hazard Mitigation Plan is hereby adopted as an official plan of the City of Barre;

2. The respective officials identified in the mitigation action plan of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;

3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as part of this resolution for a period of five (5) years from the date of this resolution; and

4. An annual report on the process of the implementation elements of the Plan will be presented to the City Council by the Coordinator of this Plan.

IN WITNESS WHEREOF, the undersigned have affixed their signature and the corporate seal of the City of Barre, Vermont this 28th day of November, 2017.

Hon. Thomas J. Lauzon, Mayor

Councilor Lucas Herring

Councilor Sue Higby

Councilor John LePage

Councilor Jeffrey Tuper-Giles

Councilor Brandon Batham

Councilor Michael Boutin

ATTEST

Carolyn S. Dawes, City of Barre City Clerk/Treasurer