Town of Grafton, Vermont:

Local Hazard Mitigation Plan

2019-2023

Adopted by the Town: October 7, 2019

Prepared by the Town of Grafton

and

New England Digital Resources

Town of Grafton 2019-2023 All Hazard Mitigation Plan
October 7, 2019

CERTIFICATE OF ADOPTION

Town of Grafton, VT
Selectboard
A Resolution Adopting the
Town of Grafton 2018-2023 All Hazard Mitigation Plan

WHEREAS, the Town of Grafton has worked with New England Digital Resources to prepare an updated hazard mitigation plan for the town to identify natural hazards, analyze past and potential future damages due to natural and man-made caused disasters, and identify strategies for mitigating future damages; and

WHEREAS, duly-noticed public meetings were held by the Grafton Selectboard on July 1, 2019 to present and receive public comment on the draft Plan; and

WHEREAS, the updated Town of Grafton 2019-2023 Local Hazard Mitigation Plan demonstrates the community's commitment to implementing the mitigation strategies and authorizes responsible agencies to execute their actions; and

WHEREAS, the updated Town of Grafton 2019-2023 Local Hazard Mitigation Plan was submitted to Vermont Emergency Management and the Federal Emergency Management Agency for review on August 5. 2019; and

NOW, THEREFORE BE IT RESOLVED that the Town of Grafton Selectboard hereby adopts the 2019-2023 Grafton Local Hazard Mitigation Plan for municipal use and implementation.

Duly adopted this 7 day of October, 2019

Selectboard

Chair, Grafton Selectboard

Member

Member

Member

Member

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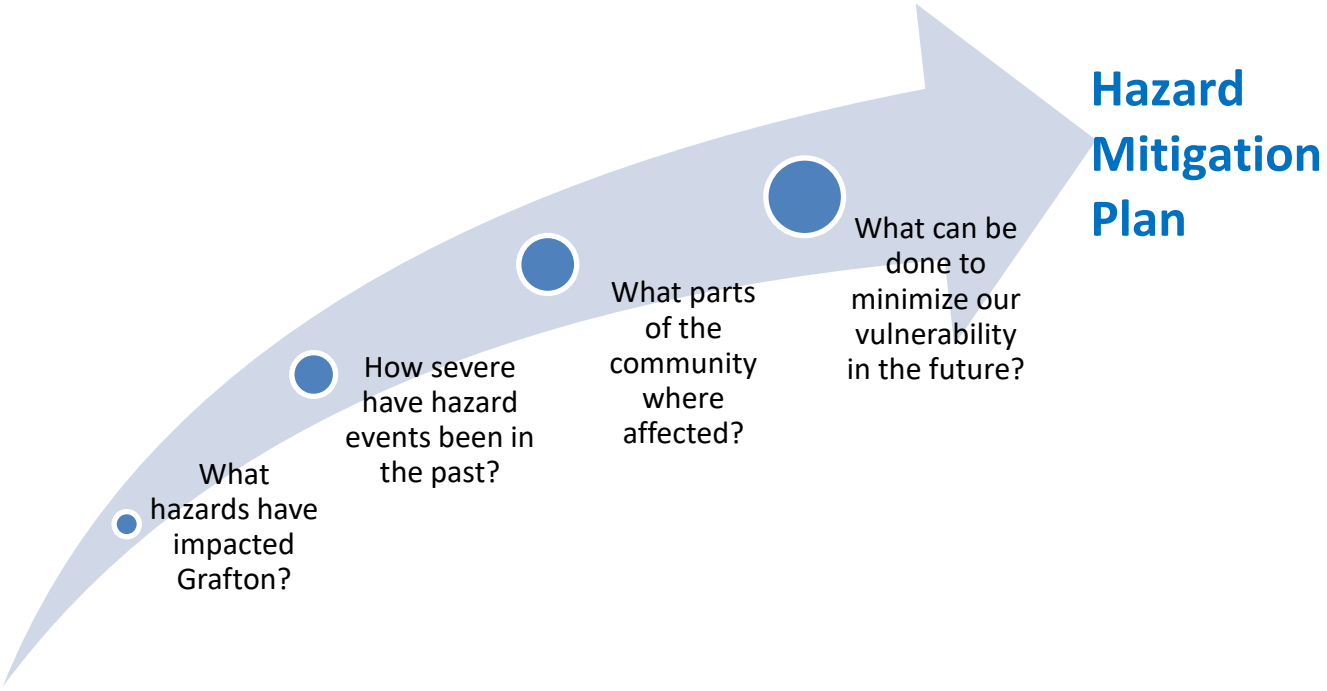
1. INTRODUCTION

Local Hazard Mitigation Planning is the process of identifying strategies and policies to develop a long-term plan of action that will reduce risk and future losses in a community caused by natural or man-made disasters. According the Windham Regional Commission,

> *"A disaster resilient town is designed, or retrofitted, to be in harmony with the natural environment as much as possible, in a way that takes into account vulnerabilities and works to reduce or eliminate them. The goal of mitigation is to lessen or remove risk to human life, animal life, and the built environment, thus causing less disruption to social and economic facets of the community when disasters occur."*

This plan will focus on assessing natural hazards and mitigating actions to minimize the impact of these hazards on the community and increase the Town's resiliency to disaster. The Grafton community has provided input to this plan in the form of local and historic knowledge. Their efforts have culminated in a comprehensive list of mitigating strategies and actions.



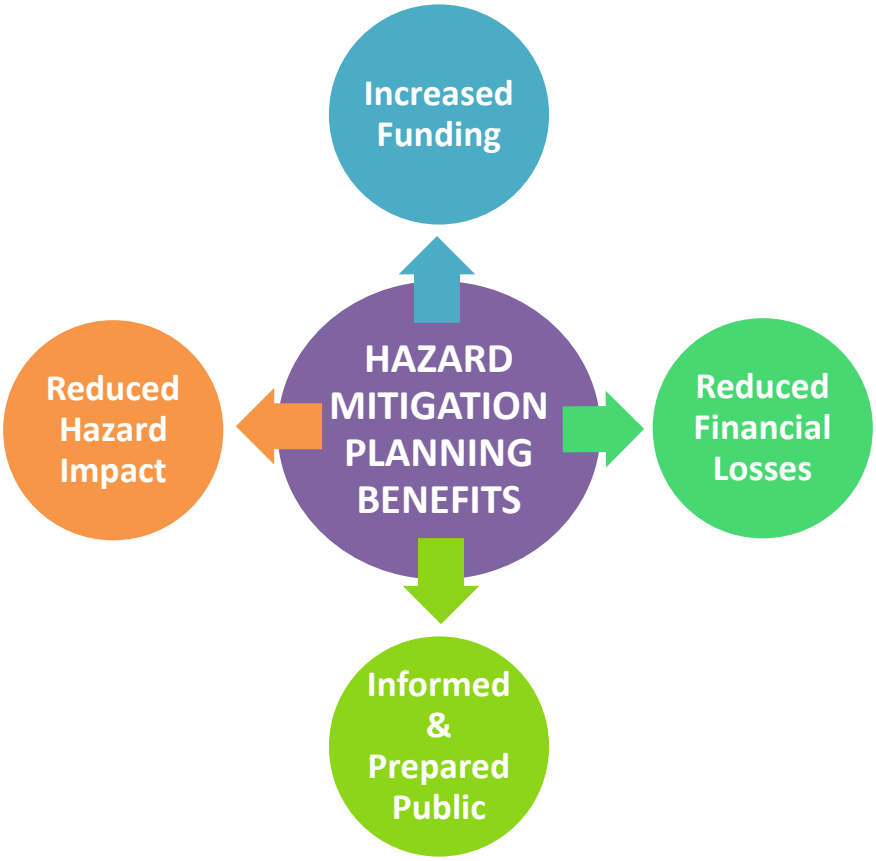
2. PURPOSE

The Federal Emergency Management Agency (FEMA), Vermont Emergency Management (VEM), and local towns have come to recognize that it is less costly to take action to minimize the impact of natural hazards

than to repeatedly repair damage after a disaster has struck. Hazards cannot be eliminated, but it is possible to determine what the hazards are and which are more likely to occur and tend to have the greatest impact on a community. With some research and outreach, a local community can also determine the extent and impact of these hazards and which assets and areas are most at risk. A culmination of these efforts is a working dynamic list of local strategies and actions that can be taken to reduce the impact of these hazards, both financial and physical, on the community.

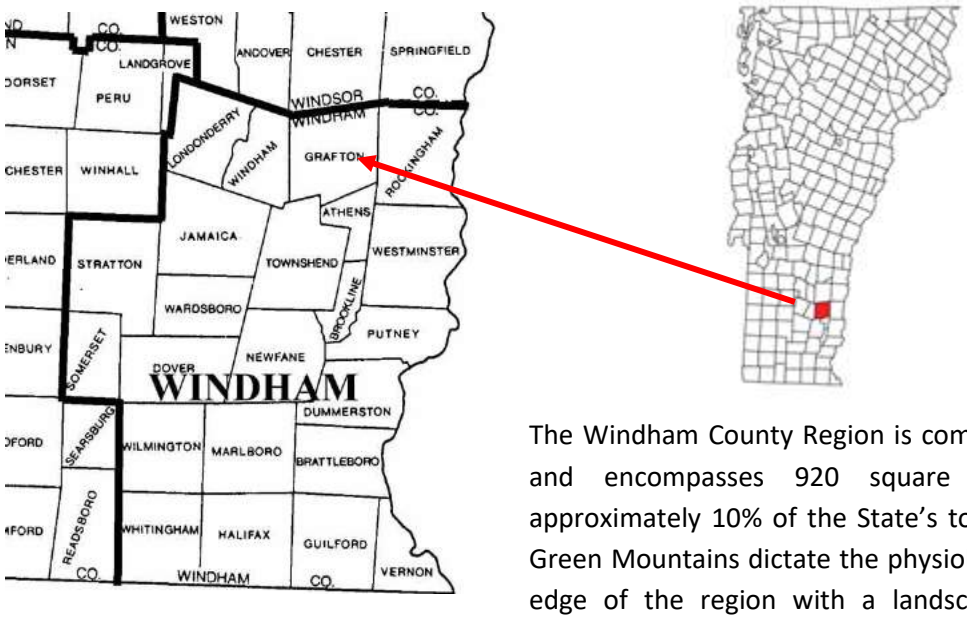
It is less costly to prevent disasters than to repeatedly repair damage after a disaster has struck.

This plan recognizes that communities have opportunities to identify mitigation measures during all of the other phases of emergency management: preparedness, response, and recovery.



3. TOWN PROFILE[1]

Grafton is a small rural historic New England town located in the northcentral part of Windham County, in southern Vermont. It is bounded on the north by Chester in Windsor County, on the east by Rockingham, on the south by Townshend and Athens, and on the west by Windham.



The Windham County Region is comprised of 23 towns and encompasses 920 square miles, which is approximately 10% of the State's total land area. The Green Mountains dictate the physiology of the western edge of the region with a landscape of ridges and mountain peaks, steep rugged slopes and narrow stream valleys.

The eastern side of the region is bordered by the Connecticut River. From the eastern slopes of the Green Mountains, the terrain is generally hilly with areas of relatively flat rolling land as it transitions to the Connecticut River with steep slopes on the river valley.

Stratton Mountain is the highest point in the region at 3,936 feet. The lowest point is along the Connecticut River in Vernon at 200 feet. In addition to the Connecticut, other major rivers of the region are the Deerfield, Green, North, Saxtons, West, and Williams, all tributaries of the Connecticut.

The Town of Grafton has a total area of 36 square miles and is still relatively undeveloped, with most of its land in resource-related or low-intensity uses. Rugged topography and distance from commercial and resort areas have influenced the Town's quiet rural character and New England charm. It has a centrally located historic village surrounded by predominantly rural single-family residential development, both permanent and vacation. Residential dwellings lie along winding secondary roads, most of them narrow and unpaved.

[1] Adapted from the Grafton 2019 Draft Town Plan, Grafton 2013 Single Jurisdiction Hazard Mitigation Plan, and the Windham 2014 Regional Plan.

In addition to Grafton Village, there are two hamlets: Cambridgeport in the Southeast, and Houghtonville in the Northwest. These are less densely populated than the Village, but more densely populated than the rest of the town. With a few exceptions, the off-road backlands have remained undeveloped since the middle of the nineteenth century.

Much of the Town's terrain is rugged and forested with 25% slopes draining the headwaters of the Saxton's River. The vast majority of the town lies within the Saxtons River watershed with its major tributaries converging with the mainstem in the village center on its way to the Connecticut to the east. The northeast corner of the town lies within the Williams River watershed.

There are four access corridors into Grafton Village: Route 121 heading west from Bellows Falls or heading east from Windham, Townshend Road from the south, and Chester Road from the north. All four of these corridors are extremely rural with acres of open land and no public services or private business.

A distinctive topographical feature of Grafton is the short steep hillsides giving rise to a large number of streams draining into the Saxtons River, which accounts for the numerous bridge-crossings over gravel roadways.

The Village looks today much like it did 150 years ago with most circa. 1850 structures restored to their natural beauty. There are 90 structures throughout the town that are listed on the Vermont State Register of Historical Sites. Some notable structures include the Grafton Inn, the White Church, the Brick Meeting House, the Kidder Hill Covered Bridge, the library, Town Hall, and many of the residential homes. The Grafton Village Cheese Company has earned a name beyond town borders.

In addition to its historic structures, Grafton values its critical resource areas. Forest-related land use is a significant part of Grafton life; this includes commercial and non-commercial logging, hunting, fishing, hiking, horseback riding, bicycling, and winter sports, or just general recreation and for scenic pleasure. Identified Critical Resource Areas include the Turner Wildlife Management Area for its historic, ecological and cultural significance and three state forests (Mollie Beattie, Putnam and Dorand), the Grafton Town Forest and the Village Park. (See **Appendix A: Map 1 – Existing Land Use**)

Windham County's population of 46,720 (2010 U.S. Census Bureau) experienced uninterrupted growth since 1950 averaging 7.9%. However, according to the Census, the most recent decade has seen a substantial decrease in the rate of population growth at 0.6% from 2000 to 2010, compared to Vermont State at 2.8%. This was primarily the result of substantial drops in the two highly populated towns of Rockingham and Brattleboro, offset by modest increases in smaller towns.

The population of Grafton has grown slowly over the past forty years. The 2010 U.S. Census Bureau indicated a population of 679 in Grafton, a rate increase of 4.2% from the 2000 census. As is true for the state, the overall population for the region is aging. The fastest growing age group is 55 to 64 years of age. Median age of residents in Grafton has also risen over that period from 46 to 51 years, while Windham County median age is younger at 45 years.[2]

As in the rest of Vermont, the climate in Grafton is generally temperate with moderately cool summers and cold winters. Average annual precipitation is around 40 inches and annual snowfall, averaging 80 inches, can be as much as 200 inches in a single winter. However, as is true throughout the state, the town is experiencing more extreme climate conditions. The weather is unpredictable, and large variations in temperature, precipitation, and other conditions may occur both within and between seasons.

Improvement in Resiliency to Flood and Erosion

Development over the previous plan period has not negatively impacted the community's vulnerability to the hazards addressed in this plan. During this period, the only development in a floodplain has been a pedestrian bridge installed by the Windham Regional Foundation as approved by the Flood Regulation Board.

It can be surmised that, over the past 5 years, the Town has substantially reduced their risk to flood and erosion hazards as a result of damage caused by Tropical Storm Irene.

The projects that have reduced this risk include the relocation of the Town Garage out of the flood hazard area on Rt 121 and four FEMA property buyouts which are identified in **Appendix A: Map 5 – Structure damage from Tropical Storm Irene.** These include:

[2] Windham Regional Commission webpage, http://www.windhamregional.org/towns/grafton

- The "Pump House" on Kidder Hill Rd.
- Two (2) single family homes on Rt. 121 east of the Village
- A property in Cambridgeport at the intersection of Rt. 121 and Parker Hill Rd. with two (2) mobile homes and a shed

In addition, the Town is making steady progress on implementing the 2017 Road Erosion Inventory Report recommendations to improve the resiliency of town roads and road infrastructure. The only development within the floodplain since the prior plan has been the construction of a footbridge funded by the Windham Foundation and approved by the Grafton Development Review Board based on FEMA regulations.

4. PLANNING PROCESS

The local planning process used to develop this hazard mitigation plan follows guidance by the Federal Emergency Management Agency (FEMA) and Vermont Emergency Management (VEM). The planning process began in December 2018 with the Grafton Town Administrator reaching out to municipal staff and local volunteers to participate as members of a Hazard Mitigation Committee. A ten-member committee was formed to direct the activities of the process with guidance from New England Digital Resources (NEDR) consulting services.

Cindy Ingersoll, NEDR Consultant, met initially with the Town Administrator of Grafton to review the overall planning process. The discussion included the need for town input, the importance of the public participation and notice procedure, VEM and FEMA review and approval process and the timeline to complete the update. This information was also provided to committee members via email in December.

The Hazard Mitigation Committee was tasked with updating the plan and overseeing the public process.

Committee members (listed below) include representation from a cross-section of town departments, boards, and commissions.

- William Kearns, Grafton Town Administrator and Emergency Management Director
- Elizabeth Harty, Grafton Elementary Principal
- Keith Hermiz, Grafton Rescue Squad
- Stanley Mack, Grafton Selectboard member, retired Fire Chief
- Kim Record, Grafton Town Clerk, Town Treasurer
- Allan Sands, Grafton Emergency Management and Selectboard member
- Robert Sprague, Grafton Fire Department
- Eric Stevens, Grafton Emergency Management Coordinator, Planning Commission, Windham Regional Commission Board member, retired Fire Chief
- Daniel Taylor, Grafton Highway Department
- Richard Thompson, Grafton Fire Department-Fire Chief
- Cindy Ingersoll, NEDR consultant

The Hazard Mitigation Committee members participated throughout the planning process either by scheduled group meetings or via committee email correspondence and conference calls as outlined in **Appendix C** and detailed in **Section 4.1**.

4.1. Plan Update Process

The Hazard Mitigation Committee, together with the NEDR consultant, discussed the required FEMA plan elements and established a process and timeline for completion of this Local Hazard Mitigation Plan update. The update process, activities and timeline, as depicted in the **2019-2023 Grafton Hazard Mitigation Plan Process Flow Chart** in **Appendix C,** incorporates all FEMA required plan elements as outlined in FEMA's Local Mitigation Plan Review Tool**.** The meeting dates and tasks performed are identified in the flow chart.

This update was a complete re-write to reflect input from meeting discussions, new data and hazard profile information, and new reference reports and documents. Throughout the process and with the discussion of each hazard, members and the public were encouraged to recollect previous hazard events, identify vulnerable areas and community assets, and suggest potential mitigating actions that will reduce the community's risk to each hazard. Areas in towns most vulnerable to natural hazards were mapped to assess correlation of strategies with areas of concern (**See Appendix E**).

A number of plans, studies, reports, and technical information and web data sources were consulted during the preparation of this plan.

These sources provided data on hazard extent and historical trends, new hazard mitigation ideas, and potential improvements to current resources. A partial listing of these sources includes the following:

- Single Jurisdiction Hazard Mitigation Plan, Town of Grafton, Adopted July 7, 2014
- State of Vermont 2018 Hazard Mitigation Plan
- Grafton Flood Damage and Prevention Regulations, Adopted May 8, 2007
- Grafton 2008 Town Plan, readopted in 2014
- Grafton 2019-2026 DRAFT Town Plan update
- Grafton Annual Town Reports
- River Corridor Plan for Saxtons River Watershed, Windham County, September 30, 2010
- Grafton Local Emergency Operations Plan (LEOP). Updated in 2017.
- 2017 Town Grafton Road Erosion Inventory and Report
- Windham Regional Commission website and resources
- Tactical Basin Plan for the West, Williams, and Saxtons Rivers and Adjacent Connecticut River Tributaries, December 2015
- Vermont Annual Fire Marshall Reports
- Town of Grafton River Corridor Mapping Report, May 24, 2016 by Fitzgerald Environmental Associates, LLC

- NOAA Storms Event Database
- Vermont Division of Fire Safety
- U.S. Climate Data
- USGS WaterWatch
- FEMA Disaster Declarations
- Vermont Agency Of Natural Resources-Flood Ready

This plan is an extensive update to the previous single-jurisdictional plan and includes a number of revisions and improvements. The following is a partial list of revisions:

- General updates to Town profile and town maps.
- Inclusion of an easy-to-read Process Flow Chart to depict the planning process.
- Reorganization/restructuring of the plan contents to better reflect required FEMA elements.
- Reevaluation of hazards with a new methodology for scoring to more accurately determine priority of hazards for the planning period.
- Update of hazard data using new data sources and more local data.
- Use of sub-sections under each hazard profiled for discussion of 'Extent and Historical Trend' and 'Vulnerable Community Assets'.
- Organization and prioritization of mitigation strategies and correlation to plan goals.
- Further specification in identifying mitigation strategies and actions.
- Review and integration of new relevant reports and documents.
- Formalization of the Plan Monitoring Process to maintain focus on plan goals and to encourage progress, annual reporting, recording of local hazard events, identification of new vulnerable assets, and public outreach over the plan period.

4.2. Public Process

The kick-off meeting with the Hazard Mitigation Committee began with an overview of the process with a discussion on the purpose of hazard mitigation planning, the planning process and timeline, and the importance of community outreach and public involvement. Hazard Mitigation Committee members and meeting schedules were determined at that time and a procedure was discussed on how to engage the local community to participate. Grafton is a small town where residents often participate as members on more than one local board, commission, committee, or planning effort. The Committee roster had representation from the Selectboard, Planning Commission, Emergency Management, Public Schools and the Highway and Fire Departments.

The process proceeded with the tasks as depicted in Appendix C: 2019-2023 Grafton Local Hazard Mitigation Plan Process Flow Chart.

Planning meeting dates, including discussion topics assigned to each session, were scheduled, and circulated through committee members to their respective noticed board meetings where participation

was encouraged with other board members and attending public. Committee members would discuss hazard mitigation planning progress at their board meetings and would relay any comments to be incorporated into the planning process. In addition, a public notice was published in the Grafton News and on the Town website for the June 20th and July 1st meetings. Discussion of hazard mitigation planning, also took place during the publicly noticed meetings of the Planning Commission during the drafting of the new Town Plan.

The July 1st meeting was held as part of a Selectboard meeting and was well attended. The initial draft format allowed for further discussion on hazard assessment, community vulnerabilities, and potential strategies. The discussion at this meeting resulted in modifications in **Table 2: Existing Grafton Resources for Mitigating Hazards** and **Table 10: 2019-2023 Town of Grafton Mitigation/Preparedness Strategies and Actions** requiring revisions and/or additions to strategies, changes in priorities, responsible parties, and timeline for implementation. Additional vulnerable areas to flooding and erosion were also identified and incorporated into **Appendix E**.

Public Release of First Draft

A first draft was released for public review, comment and input on June 20, 2018. The Public Review Process included:

- An electronic copy posted on the Town website that circulated to individual members of the Board of Selectmen and Planning Commission, requesting comments from the local boards and community.
- A hard copy made available at the Grafton Town Hall Office.
- An electronic distribution made to adjacent towns (Athens, Chester, Rockingham, Townshend, Windham) via email to respective Town Clerks with a request to post the draft on their websites and provide a copy to their Planning Commission and Selectboard members.
- All distributions included the following:

"The Town of Grafton is seeking comment on its 2019-2023 Local Hazard Mitigation Plan final draft. The purpose of this planning effort is to improve Grafton's resiliency to natural hazards through hazard assessment, recognition of vulnerable assets, and identification of mitigating actions and strategies to reduce the impact of these hazards on the community. The neighboring town communities are also invited to attend the Grafton Selectboard meeting of July 1st, 2019 at 5:30 PM for a review of the draft plan. The meeting will be at the Town Garage on Bell Road, Grafton, VT. Please feel free to forward any questions or comments to Bill Kearns, Town Administrator at townadmin@graftonvt.org by July 5th, 2019. We welcome all input."

- A number of comments were received during the public release process and incorporated into the draft including modification of **Table 10** for
  - addition of an action item for Kidder Hill Dam Removal,
  - description of some action items,
  - changes in timelines, and
  - the addition of the Saxtons River Watershed Collaborative (SRWC) as a responsible party.

- No comments were received from neighboring communities.

Subsequently, the plan will complete the Vermont State Hazard Mitigation Officer review for referral to FEMA for Approval Pending Adoption (APA). Following APA, the Town may then adopt the Local Hazard Mitigation Plan and forward a copy of the adoption resolution for FEMA to complete the plan approval and adoption process. The final adopted Local Hazard Mitigation Plan will also be posted on the Town and Windham Regional Commission websites and made available at the Grafton Town Offices.

4.3. Previous Hazard Mitigation Plan Review

Table 1 below lists the mitigation and preparedness projects and actions from the previous *2014 Single-Jurisdictional Hazard Mitigation Plan for Grafton*. Mitigation actions, listed in order of priority set at that time, are shown here with an additional column to indicate the status of each as determined by the Hazard Mitigation Committee. It can be seen that most of these actions have been completed. Other actions have been reevaluated and/or incorporated into this plan update and included in **Table 10: 2019-2023 Mitigation/ Preparedness Strategies and Actions** at the end of this document. Others were deemed to be ineffective or not necessary and have been dropped.

TABLE 1: Status of Previous Plan Mitigation Actions

MITIGATION ACTION	TYPE*	HAZARD ADDRESSED	STATUS
Develop Town Emergency Shelter Implementation Plan	P	All Hazards	Not feasible due to liability cost and change in Red Cross priorities. Evaluate a Local Limited Shelter Plan.
Maintain Town agreement with the Windham Foundation concerning shared use of the Foundation's generator.	P	All Hazards	Continue/On-going
Review Town/School agreements on the shelter generator at the school, and develop a plan for maintenance and periodic testing.	P	All Hazards	Continue/On-going
Develop an emergency response plan which coordinates the School Crisis Plan with LEOP and Shelter plans.	P	All Hazards	Done through incorporation into Local Emergency Plan but needs improvement.
Conduct Public Outreach on Personal Responsibility for Emergency Preparedness.	M	All Hazards	Completed

Support financial costs for training of Emergency Services personnel and maintain level of competency.	M, P	All Hazards	Continue/On-going
Offer ICS/NIMS training to all town and emergency services personnel and Town Officials.	P	All Hazards	Continue/On-going
Complete Fluvial Erosion Hazard mapping in Grafton watersheds.	M	Flood, Erosion	An interactive on-line mapper was created by Fitzgerald Environmental Associates for public input on Grafton's 2016 Saxtons River Corridor and Fluvial Erosion Plan.
Develop a Fluvial Erosion Hazards Plan	M	Flood, Erosion	Completed by Fitzgerald Environmental in *Town of Grafton River Corridor Mapping Review*, May 24, 2016
Continue dry-hydrant installation.	P	Structure Fire	Completed
Upgrade culvert from Ball Field to Saxtons River.	M	Flood, Erosion	Repaired with upgrade included in this plan update**
Upgrade culvert on Eastman Rd.	M	Flood, Erosion	Not Done. Included in this plan update**
Upgrade two (2) culverts near Fisher Hill Rd./Bell Road intersection.	M	Flood, Erosion	Not Done. Included in this plan update**
Upgrade bridge near Fisher Hill Rd./Bell Road intersection.	M	Flood, Erosion	Not Done. Included in this plan update**
Upgrade seven culverts on Hinkley Brook Rd.	M	Flood, Erosion	Not Done. Included in this plan update**
Maintain an up-to-date town-wide culvert and bridge inventory.	M	Flood, Erosion	Continue/On-going
Conduct annual tree inventory and trimming near power lines.	M	High Wind	Continue/On-going
Bury wires in Grafton Village for critical facilities.	M	High Wind	Completed.
Conduct a community education program for elementary schools and residents by providing literature and presentations on reducing fire and ice hazards.	M	Structure Fire, Wildland Fire, Severe Winter Weather	Established and conducted every fall.

Have an annual program for the sale of fire/smoke alarms and other fire protection devices.	M	Structure Fire	Had been done but was stopped. Consider re-starting the program for this plan up-date.

*M- Mitigation, P- Preparedness
** See **Table 10**

4.4. Town Plan Review

The Grafton Town Plan is currently being updated and, compared to earlier plans, the community is making strides in its efforts to address sustainable development, natural resource conservation, flood resiliency, and hazard mitigation. The Town's prior 2014 Town Plan was a re-adopted version of the 2008 town plan which had referenced its 2008 annex to the Windham Regional All Hazards Mitigation Plan of that time and was, therefore, outdated. The current draft of the fully updated 2019-2026 Town Plan, if adopted, contains a more comprehensive integration of the local hazard mitigation plan and a commitment to implementing its strategies and actions.

Town planning can always benefit from better integration and coordination of hazard mitigation planning goals and strategies in the planning process.

To help achieve this, integration of hazard mitigation in town planning has been identified as a high priority action item in **Table 10: 2019-2023 Mitigation/Preparedness Strategies and Actions.** This is expected to be accomplished this year as the plans are both in the process of being updated by many of the same town officials.

The current 2019 Draft of the Grafton Town Plan has outlined goals, policies and recommendations related to hazard mitigation which can be found in **Appendix D.** Note that, although the Town Plan is currently in draft form, some of these recommendations have been selected as action items for this plan update and can be found in **Table 10: 2019-2023 Mitigation/Preparedness Strategies and Actions.**

4.5. Review of Existing Town Resources

Grafton currently participates in the NFIP program and will continue to regulate floodplain use through the Grafton Flood Damage and Prevention Regulations (adopted in May 2007 and to be updated during this 5-year Hazard Mitigation planning period). The town has adopted the FEMA floodplain maps (last amended by FEMA in 2007).

Continued enforcement of these regulations by the Grafton Administrative Officer will maintain Grafton's compliance with the NFIP. The Administrative Officer is charged with implementing these regulations and, in concert with the Development Review Board, advising residents on floodplain development.

The following town authorities, policies, programs, and resources which help to reduce the impact of hazards on the community were evaluated for opportunities for improving effectiveness.

These resources help to reduce damage to existing buildings and new development, town infrastructure, and critical facilities by encouraging or regulating development location, building design, environmental conservation, and best management practices to reduce flooding and erosion.

TABLE 2: Existing Grafton Resources for Mitigating Hazards

Resource*	Description	Effectiveness in Implementing HM Goals	Opportunities for Improving Effectiveness
Town Municipal Plan (Draft 2019)	Coordinated town-wide planning for land use, natural resources, energy, transportation, housing etc. (Currently being updated)	Outlines goals, policies and recommendations for each planning sector with some references to hazard mitigation. (Appendix D)	The Town Plan is currently being updated and intends to expand references to Hazard Mitigation Planning for erosion, flood, and energy.
Local Emergency Municipal Plan (LEMP) (previously LEOP)	Outlines local procedures for emergency response. State revised and formalized format May 2018.	LEMP outlines procedures for call-outs, evacuations, etc. and is effective for Hazard Event Preparedness.	Effective with annual updates.
Continuity of Government Plan	Plan for continuity of government in the event of a catastrophic incident or pandemic.	Effective for preserving municipal functions to support emergency response.	Plan requires review and update
Continuity of Operations Plan	Plan for continuity of municipal operations in the event of a catastrophic incident or pandemic.	Effective for emergency response preparedness.	Plan requires review and update
School Emergency Response Protocol	School procedures for emergency response	Provides a checklist for school administrators and first responders for use in an emergency situation; is effective for Hazard Event Preparedness.	Response procedures are well coordinated with hazard response planning; resource is effective with continued annual updates for new identified hazards.
LEPC 6 Hazardous Materials Plan	Outlines resources available to Grafton in emergency situations.	Effective in providing data and resources to town first responders.	Review and continued involvement are needed to improve effectiveness.

Mutual Aid – Emergency Services	Currently under Southwest New Hampshire System out of Keene for regional coordinated emergency services including fire and rescue, ambulance.	Effective in providing additional emergency support during atypical events requiring emergency services.	Review cost effectiveness of Keene program relative to a more local mutual aid program.
Mutual Aid – Public Works	Informal agreement for regional coordinated emergency highway maintenance services	Effective in providing additional highway support and resources during atypical events.	Consider formalizing an agreement if it would improve effectiveness and if feasible.
Road Erosion and Bridge & Culvert Inventories	Town Infrastructure surveys assess condition of town roads, culverts and bridges and identifies vulnerabilities. Updated per State Requirement. Road Inventories last updated in 2018. Bridge & Culvert Inventories last updated in 2012.	Effective in identifying and helping to prioritize road erosion issues and road infrastructure status. Road erosion reports include recommended actions which are being implemented.	These reports are most effective when considered for capital budgeting, infrastructure upgrades and planning. Additional funding is needed to implement recommendations.
State Road Standards & Municipal Roads General Permit (MRGP)	Town complies with State design and construction standards for roads and drainage systems. Standards have been updated to include the MRGP to control runoff and drainage on hyrdo-logically connected road segments.	Effective in controlling road erosion and stormwater run-off from roads with implementation of Best Management Practices. Current update requires prioritization and planned implementation schedule of identified road segments.	Continued implementation of state road standards and prioritization of road segments will maintain effectiveness. Work with regional planners to actively pursue available funding opportunities to increase effectiveness.
Subdivision Regulations	Regulates the division of land, standards for site access and utilities.	Effective when implemented, enforced and updated.	Continued updates and enforcement are important for continued effectiveness. Possible update this planning period.
Flood Damage Prevention Regulations	Regulates development in FEMA flood hazard areas. Last updated in 2007.	Effective through limiting development in known hazard locations.	Will be reviewed and updated this planning period for improved effectiveness.
Building Notification Process	Site development form is reviewed by the Development Review	Effective in limiting development in hazard	Continued use of this tool will help reduce

	Board to ensure State Development Standards are maintained.	areas. Need to rely on State updates for continued effectiveness	Impact of hazards. Provides a base upon which the Town could build and expand.
State Building Code	Regulates building construction standards	Effective in meeting fire and safety standards for residential and commercial buildings	Can be made more effective by improving outreach and notification of these State safety rules.
National Flood Insurance Program (NFIP)	Provides ability for residents to acquire flood insurance.	Effective if Grafton remains compliant with the NFIP program.	Flood maps should be updated by ANR (last update 2007), town can pursue CRS rating or educate vulnerable properties.
Windham County Natural Resource Conservation District	Provides technical assistance in planning and funding applications	Effective in planning to meet state requirements	Currently effective
Saxtons River Watershed Collaborative	Provides community outreach and education on watershed related issues	Effective in Informing Community	Currently effective
Windham Regional Commission (WRC)	Regional organization working to further emergency management and hazard mitigation goals	Effective in assisting towns in the adoption of new/updated regulations and the revision of planning tools.	The RPC should focus on improving the planning process and investigate additional sources for historical hazard data. Annual overview of funding opportunities would increase effectiveness.

5. HAZARD ASSESSMENT

The following assessment addresses Grafton's vulnerability to all of the hazards identified by the Hazard Mitigation Committee during the hazard analysis. The probability of occurrence and impact to the town were used to assess the town's vulnerability to each hazard.

5.1. Hazard Identification and Impact Assessment

A hazard vulnerability assessment for Grafton began with identifying all possible natural hazards.

The assessment considers the probability of occurrence, the community's vulnerability and potential impact of each hazard to determine the relative risk each poses.

To this overall hazard score was added an additional score to assess the 'Probability of Occurrence Over the Plan Cycle' in order to give more relative weight (and therefore priority) to those hazards that are more likely to occur. The total sum of the scores in these four categories reflects the Final Hazard Score. The results of this analysis are shown in **Table 3: Grafton Hazard Identification and Analysis.** The ranking methodology used is detailed below.

A discussion of each of the hazards is given in the proceeding subsections under 5.2a through 5.2f. The Hazard Profile and Assessment in **Section 5** provided a basis for the selected implementation strategies and actions listed in **Table 10: 2018-2023 Mitigation/Preparedness Strategies and Actions.**

Methodology Used for Hazard Analysis

Probability of Occurrence: Probability of local occurrence expected over time period below

0 = Not Likely	less than 1 occurrence in 10-year period (has not occurred nor expected to occur)
1 = Possible	1 to 2 occurrences in a 10-year period (or expected to occur at least once every 10 years)
2 = Likely	2 to 5 occurrences in 10-year period (or expected to occur at least once every 5 years)
3 = Highly Likely	5 to 9 occurrences in a 10-year period (or expected to occur at least once every 2 years)
4 = Annual Occurrence	10 or more occurrences in a 10-year period (or expect to occur annually)

Probability of Occurrence over Plan Cycle: Probability of local occurrence over next 5 years.

0 = Not Likely
1 = Possible
2 = Likely
3 = Highly Likely

Potential Impact: Severity and extent of property damage, facilities disruption, impact on residents

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, few people in town are impacted
3 = Moderate	Severe property damage on a neighborhood scale, temporary shutdown of critical facilities, and/or injuries or fatalities, many people in town are impacted
4 = Major	Severe property damage on a town-wide or regional scale, shutdown of critical facilities, and/or multiple injuries or fatalities, most of the people in town are impacted

Overall Community Vulnerability: Relative and trending vulnerability of community assets

0 = Negligible	Low vulnerability and trending lower
1 = Minor	Low vulnerability and trending higher
2 = Moderate	Moderate vulnerability
3 = High	High vulnerability or moderate vulnerability and trending higher
4 = Major	Very vulnerable and trending higher

TABLE 3: Grafton Hazard Identification and Analysis

Hazard	Likelihood of Occurrence	Likelihood of Occurrence over Plan Cycle	Potential Impact	Overall Community Vulnerability	Hazard Score
Score Range	**0 - 4**	**0 - 3**	**1 - 4**	**0 - 4**	**1 - 15**
Hurricanes/Tropical Storms[1]	1	1	4	3	**9**
Flood (Flash Flooding, Inundation)	3	2	2	2	**9**
Erosion (Gully, Riverbank)	4	3	2	1	**10**
Landslide/Slope Failure	3	1	1	1	**6**
High Winds	4	3	3	2	**12**
Severe Weather[2]	2	1	1	1	**5**
Severe Winter Weather[3]	4	3	2	2	**11**
Ice Jams	4	3	1	0	**8**
Extreme Cold	1	1	1	0	**3**
Extreme Heat	1	1	1	0	**3**
Structure Fire	4	4	2	1	**11**
Brush Fire	4	4	2	1	**11**
Wildfire	4	4	2	1	**11**
Drought	1	1	1	0	**3**
Earthquake[4]	0	0	3	1	**4**
Tornado[4]	0	0	3	1	**4**

[1] *The Hurricanes/Tropical Storms Hazard Score is higher than in previous plans with the projection of more frequent occurrences due to climate change and general increase in the frequency of extreme weather conditions in the region.*

[2] 'Severe Weather' is defined to include two or more of the following hazards: Thunderstorm, Lightning, High Wind, Micro/Macro Bursts.

[3] 'Severe Winter Weather' includes snow, blizzards, Nor'easters and ice storms.

[4] *'Earthquake' and "Tornado" scores assume that, were an event to occur during the plan period, it would be minor (less than a 6 magnitude on the Richter Scale, or F0-F1 on the Fujita Scale). Although these can be significant hazards, the likelihood of occurring in Grafton over the plan period would be negligible for New England per the Vermont State Hazard Mitigation Plan.*

5.2. Hazard Profile and Vulnerability Assessment

This section includes a profile of each of the hazards determined to be most relevant to the Town of Grafton. Each hazard is profiled under subsections 5.2a through 5.2f and includes:

1. a description of the hazard and its general impact on a community,
2. a discussion of historical local occurrences including trends and extent of the hazard based on available data, and
3. an assessment of the vulnerability of Grafton's residents and community assets to that hazard.

Grafton is a small rural town, and much of the town-specific data for these localized hazards does not exist. Previous occurrence hazard data specific to Grafton has been provided where available. However, where no town-specific data exists, the most relevant available data or information has been provided, such as county, regional or state data, or data from a neighboring town. Grafton will strive to improve the recording and maintenance of local hazard data and has included this as part of the monitoring process for this plan.

The Hazard Mitigation Committee had decided that only those hazards which scored an '8' or greater were considered for inclusion and are profiled in this plan. For other hazards which scored a '7' or less, the HMC decided that these be excluded given that the likelihood of occurrence is very low with no account of recent local occurrence. For these hazards, the reader is directed to the **State of Vermont Hazard Mitigation Plan** for additional information.

Note that HMC determined the community's vulnerability score to each hazard based on the historical extent of impact on the community and its residents with regard to their safety and the availability of town services, as well as property and infrastructure damage. The safety of residents is considered in terms of both the potential level of risk (such as death due to local home fires) as well as the number of residents affected, as with damage to town infrastructure or loss of town services from a flood event. It should also be noted that the town considers secondary hazards in its assessment of the primary hazard.

Although the town and its residents are well prepared to handle Severe Winter Weather, as are many rural towns in Vermont, it is the secondary hazards that could have a significant impact and are

reflected in the Severe Winter Weather score. These secondary hazards include structural fires from indoor heating methods and power outages from downed power lines.

The following hazards scored an '8' or higher total for impact score and are detailed in **Section 5.2**:

Profiled Hazards:

SCORE	*HAZARD*
12	*High Winds*
11	*Brush Fire*
11	*Wildland Fire*
11	*Structure Fire*
11	*Severe Winter Weather*
10	*Erosion*
9	*Hurricane/Tropical Storm*
9	*Flood*
8	*Ice Jams*

The types of hazards having the greatest impact on a regional basis can be gleaned from **Table 4**, a listing of **FEMA Disaster Declarations for Windham County** since 1990. It can be seen from this table that these are typically severe storms with heavy rains that cause flooding. Severe Winter Storms also occur; however, harsh winters are a 'way-of-life' in Vermont and the Grafton Town Highway Department is accustomed to operating in heavy snows and low temperatures. Other hazards such as flooding, wildfires, ice jams and landslides are more localized and characteristic of a town's topography, roadways, infrastructure, location of critical facilities, and land use.

TABLE 4: Federal Disaster Declarations for Windham County VT[3]

Federal Disaster Declarations: Windham County 1970 – 2018(current)		
FEMA Disaster Number	**Date of Declaration**	**Description**
4356	January 2, 2018	Severe Storms and Flooding
4343	November 8, 2011	Severe Storms and Flooding
4022	September 1, 2011	Tropical Storm Irene
3338	August 29, 2011	Hurricane Irene

[3] FEMA Disasters Declaration Website

1816	January 14, 2009	Severe Winter Storm
1698	May 4, 2007	Severe Storms and Flooding
1559	September 23, 2004	Severe Storms and Flooding
1488	September 12, 2003	Severe Storms and Flooding
EM-3167	April 10, 2001	Snow
1336	July 27, 2000	Severe Storms and Flooding
1307	November 10, 1999	Tropical Storm Floyd
1124	June 27, 1996	Extreme Rainfall and Flooding
1101	February 13,1996	Ice Jams and Flooding
518	August 5, 1976	Severe Storms, High Winds and Flooding
397	July 6, 1973	Severe Storms, Flooding and Landslides
277	August 30, 1969	Severe Storms and Flooding

5.2a. Wildland Fire/Structure Fire

Wildland fires, brush fires, and structure fires were identified during the hazard analysis and vulnerability assessment as relatively high hazards to the Town of Grafton with all scoring 11 out of a 15 maximum. Since data that addresses brush and forest fire separately is unavailable, the two will be addressed together here under "Wildland Fires."

Wildland Fires, which for discussion here include forest, brush, crop or grassland fires, are defined as *'An uncontrolled burning of woodlands, brush or grasslands."* [4] Wildland fires have the potential to damage structures and utilities as well as forest and croplands.

The State Hazard Mitigation Plan's analysis of wildfire threat states that *"Wildfire conditions in Vermont are typically at their worst either in spring when dead grass and fallen leaves from the previous year are dry and new leaves and grass have not come out yet, or in late summer and early fall when that year's growth is dry".* [5]

In addition to lack of precipitation, a particular town's vulnerability to large wildfires is directly related to the proportion and continuity of acreage that is forested, pasture and cropland.

Large wildland fires are always a threat for rural communities with large tracts of forested and vegetative land, such as Grafton. However, the Town's vulnerability is mostly dependent upon weather conditions, climate change, and continued outreach efforts to provide information on fire prevention. Continued enforcement of 'red flag' warnings is used to restrict controlled burning during dry season.

[4] 2018 Vermont State Hazard Mitigation Plan
[5] 2018 Vermont State Hazard Mitigation Plan

Structural Fires were identified as having a high possible risk to the town due to their high probability of occurrence, short warning time, and potential for catastrophic loss. With little or no warning, these fires can affect a single residential structure or spread to other homes, businesses or apartment complexes and can result in loss of property and life.

According to FEMA's Nation Fire Incident Reporting System (NFIRS), ***Fire*** accounts for 6.9% of incident types reported in Vermont compared to 4.5%, nationally[6]. The National Fire Protection Association reports that 25% of all structure fires nationwide are in residential construction. In Vermont, residential-related fires accounted for 72% of total structure fires in 2018.[7]

Structure fires are common throughout Vermont during the winter months as residents heat their homes with wood or wood pellet burning stoves and other open flame methods. For this reason, structure fire can be considered a secondary hazard to severe winter weather and extreme cold temperatures together with other state risk factors noted below. Most recently, in 2018, reports of cooking fires, chimney fires and unauthorized burning increased substantially. [8] While these reported incidents were contained, this does indicate the potential risk of a more serious structure fire incident.

Over the past 10 years, the top cause for residential fires has consistently been related to home heating.

Historically, Vermont has had a disproportionately high per capita fire fatality rate due to risk factors contributing to home heating fire related incidents, as compared to other states are[9]

- Age of Housing Structures - 33% of all homes, owned or rented, were built before 1950, 2nd oldest in the nation behind Maine.
- Extreme Winter Temperatures – Vermont is the 7th coldest state.
- Higher Risk Population -2nd oldest median age where the elderly are at higher risk. Over the past 5 years, 51% of Vermont's fire deaths have been seniors over the age of 65.
- Home Heating Methods - 1st for per capita use of wood for heating.

The Vermont Fire Marshal Reports identify the leading causes of structure fires to be the result of heating and cooking incidents. Fires can be caused by improperly disposing of ashes with live coals from wood stoves, misuse of space heaters, failure to clean creosote from solid-fuel heating equipment chimneys, as well as faulty electrical wiring and lit smoking materials. The high proportion of seasonal occupations and rentals increases the likelihood of structure fires from improper operation and maintenance of solid-fuel heating systems due to lack of knowledge on the part of residents.

[6] 2017 Vermont Fire Marshall Annual Report
[7] 2018 Vermont Fire Marshal Annual Report
[8] 2018 Vermont Report of the State Fire Marshal
[9] 2018 Vermont Fire Marshal Annual Report, p. 10

The most significant common factor in fire fatalities in Vermont continues to be the absence of a functioning smoke detector in the sleeping area of residential structures.

Higher death rates from fire statistically correlate to other population factors including the following for Vermont:

- Incomes below the poverty line (12%);
- Current adult smokers (17%)
- Adults without a high school diploma or equivalent (8%); and
- Living in rural areas (61%).

"*While the fire problem varies across the country, there are several common contributing factors such as poverty, climate, education, code enforcement, demographics and other factors that impact the statistics. Like the rest of the country, heating appliance and cooking fires in Vermont continue to be the leading causes of structure fires. The leading factor contributing to home heating fires was failure to clean creosote from solid-fueled heating equipment chimneys. The long cold Vermont winters put added stress on heating systems. Further-more, fluctuating fuel prices can force people to use alternative heating sources that may not be safe. An improperly installed and maintained heating appliance is dangerous and can result in carbon monoxide poisoning or be the source of a fire.*" [10]

Extent and Historical Trend - Structural Fire/Wildland Fire

Both structural and wildland fires have historically been reported in the annual *Vermont State Fire Marshal Report,* which provides yearly fire statistics from FEMA's Nation Fire Incident Reporting System (NFIRS). In the 2018 State Report, there were over 45,000 emergency incidents statewide, 2,500 of which were related to fire.

Statewide, a total of 10 civilian fatalities were reported as a result of a fire incident with 70% over the age of 50.[11]

Table 5, on the following page, shows historical fire reporting data (where available) for structure and wildland fires for Vermont, Windham County and the Town of Grafton as reported to NFIRS. Although fire statistics no longer breakout data for wildland and structure fire separately, it can be estimated that

[10] 2015 Vermont Report of the State Fire Marshal
[11] 2018 Vermont Report of the State Fire Marshal

the average annual fire incidents reported for Grafton is 1-3 wildland fires and 5-8 structure fires. Total number of fire incidents reported in Grafton has trended up over the past 5 years.

According to the 2018 data on Estimated Dollar Loss compiled for **structure fires** in Vermont shown below[12], local fire departments reported a total of 1,708 with an estimated dollar loss of $22,628,798, or $13,248 per incident. While the number of reported fires has dropped from the previous year, the cost per incident has risen significantly from $8,555 in 2017. Applying the $13,248 cost per incident, the potential annual loss due to structure fire for the Town is estimated to be on the order of $50,000 to $100,000.

Year	Fire Departments Reporting	Fires Reported	Estimated Dollar Loss by Fire Departments	Insurance Companies Reporting/ Total	Fire Claims Reported	Reported Dollar Loss by Insurance Companies
2012	194	2,233	$ 17,840,192	860	839	44,510,095
2013	194	2,116	$ 26,485,951	615	878	50,911,724
2014	228	2,114	$ 30,412,139	615	1,130	50,589,356
2015	230	2,198	$ 25,112,224	606	939	45,574,673
2016	228	3,138	$16,919,906	644	706	57,098,292
2017	172	2,458	$ 21,029,493		**1,104**	**54,359,205**
2018	**170**	**1,708**	**$ 22,628,798.00**	Data not currently available		

[12] *NFIRS and Insurance Company Data, 2017 Vermont Report of the State Fire Marshal*

TABLE 5: Fire Statistics for Vermont, Windham County and Town of Grafton[13]

	Vermont State				Windham County			Grafton			
YEAR	Fire-NFIRS Series 100[3]	Structure Fire Responses	Wildland Fire Responses	Total	Structure Fire Responses	Wildland Fire Responses	Total	Fire-NFIRS Series 100[1]	Structure Fire Responses	Wildland Fire Responses	Total
2008	-	1994	581	2575	-	-	-	-	6	1	7
2009	-	1885	585	2470	247	50	297	-	6	2	8
2010	-	1956	475	2431	227	61	288	-	12	2	14
2011	-	2366	1144	3369	220	61	288	-	4	0	4
2012	-	2225	667	2892	189	30	319	-	0	0	0
2013	-	2114	625	2739	157	25	182	-	DNR[4]	DNR	DNR
2014	-	2232	470	2702	144	28	171	-	3	0	3
2015	3575	-	-	3575	193	62	255	18	-	-	18
2016[3]	3269	-	-	3269	-	-	-	8	-	-	8
2017	2458	-	-	2458[1]	-	-	-	6	-	-	6
2018	2660	-	-	2660[2]	-	-	-	10	-	-	10
Annual Average									5-8	1- 3	8

[1] 74.4% of Active Fire Departments Reporting
[2] 71.7% of Active Fire Departments Reporting
[3] As of 2016, the Vermont Fire Marshall Report no longer reports fire statistics by county nor by fire type (structure and wildland)
[4] Did Not Report

[13] Vermont Annual Report of the State Fire Marshal, for years 2008 through 2018

Vermont's prime seasonal conditions for **wildland fires** are in the spring and fall. 'Despite the drought in 2016-2017, Vermont's 2017 Wildland Fire Program Annual Report notes that the 2017 fire season was well below normal at 49 acres burned from 51 fires. The average between 2012 and 2016 was 109 fires and 317 acres per year. These numbers were below normal and the lowest since 2011.' [14] This was, in part, due to heavy winter snow melt and wetter and cooler spring months.

A special report on fire statistics from the *2015 Spring Fire Season Summary* published by the *Vermont Department of Forests, Parks, and Recreation* is shown below. [15] The report indicates that the average number of acres burned per wildfire incident over a 10-year period (2005-2014) was 2.2 acres. Using this average to estimate the extent of potential wildland fire hazard for Grafton gives an annual loss of about 2-7 acres. This can be compared with large fire activity in the spring of 2015 during a moderately dry spring for southern Vermont when red flag warnings were issued by the National Weather Service:

- 26-acre forest fire in Andover, nearby Windsor County, caused by a re-kindled brush fire,
- 47-acre forest fire in Brattleboro, sparked by a downed powerline, and
- 137-acre forest fired in Norwich, also caused by a downed powerline.

Fire Statistics

	2015 Fire Statistics		10-Year Average 2005-2014	
Official reports – reports have been verified by warden or FPR				
	#Fires	#Acres	#Fires	#Acres
March	2	1	9	29
April	38	50	62	142
May	51	284	19	30
Year to date	91	335	90	201

According to the State of Vermont Hazard Mitigation Plan, 'there has not been a major wildfire in Vermont in the last 50 years. Vermont has a reliable system of local fire suppression infrastructure coordinated at the state level. Vermont's climate, vegetation type, and landscape discourage major wildfire.'[16] Wildfires can be ignited by lightening during a thunderstorm; however, this is rare in Vermont. More typically, brush fires or burning debris are the major causes for wildland fires, according to the Vermont Department of Forests, Parks and Recreation.

[14] 2018 Vermont State Hazard Mitigation Plan
[15] 2015 Spring Fire Season Summary/Vermont Dept. of Forests, Parks and Recreation
[16] 2018 Vermont State Hazard Mitigation Plan

Vulnerable Assets - Structural Fire/Wildland Fire/Brush Fire

Wildland and Brush Fires pose a unique danger to local rural communities and controlling them can be challenging given a small town's limited capacity to respond to a major wildfire. If heavy rains follow a major forest fire, other natural disasters can occur, including landslides, mudflows, and floods. A major wildfire can leave a large amount of scorched and barren land susceptible to erosion for many years, particularly on steep slopes and ridgelines. Given the right conditions, the potential for widespread forest fires is great.

Wildland fires can threaten people who are living in remote forested areas. Protecting these structures from fire poses special problems, given the longer response time and limited resources. Grafton's town and state forests are particularly vulnerable to wildland fire as these tracks are maintained to be contiguous for the preservation of wildlife crossings and recreational purposes. The use of fire breaks would not be a plausible option for reducing risk (See **Appendix A: Map 1-Existing Land Use**). The Town encourages new development in or near village areas in order to preserve these natural resources and conserve municipal infrastructure resources. This policy also helps to reduce the risk of structure damage losses to wildfire.

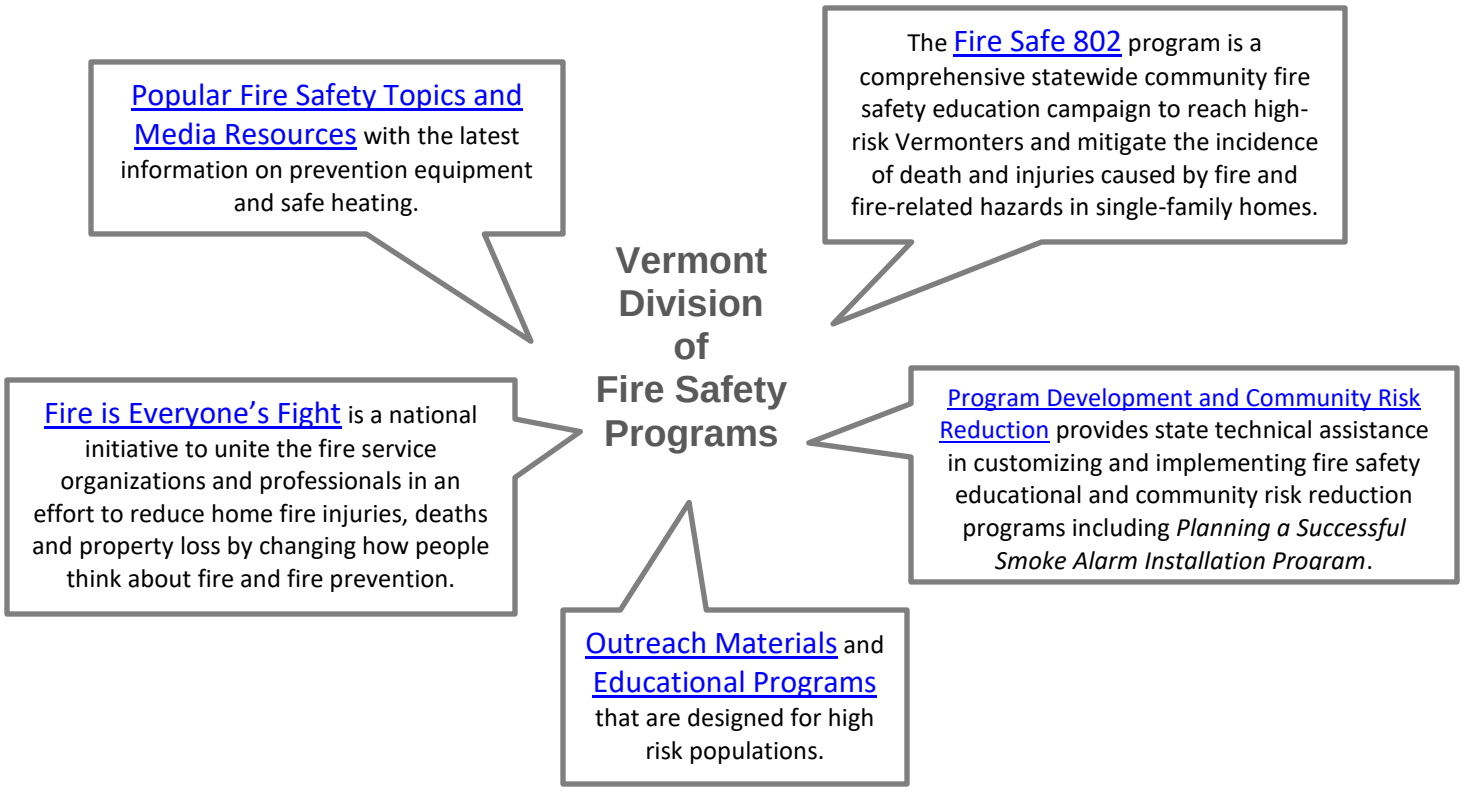
Community structures are not particularly vulnerable to wildfires because they are typically located in town centers and away from large tracts of forested and vegetative land, though their close proximity to each other increases vulnerability if a structure fire is triggered by accident. With expectations of more frequent drought conditions and increased wildfire risk, the town will plan to use available resources and outreach programs, to educate the community on how to minimize the risk of brush and wildfires and to issue and enforce dry weather alerts when the risk wildfire is high.

An assessment of town assets vulnerable to **structural fire** would be based on age and proximate location to other high-risk structures. Many of Grafton's historical structures have been renovated to proper building codes which has reduced their vulnerability to fire.

Grafton residents remain particularly vulnerable to **structure fires**, which are more likely to cause physical harm and damage to homes, as many of the residents heat their homes using open flame options, such as wood or pellet burning stoves. The elderly living alone are also more at risk, according to statistics, and the average age of Grafton's population is rising. The town also has a high vacation rental population during the winter months. Most renters stay for brief periods and can be unfamiliar with potential fire risks. Enhanced efforts to inform residents and renters of safe home heating and installation of smoke detectors is the most effective way to help mitigate this threat.

Although the incidence of structure and wildland fires in Grafton can fluctuate from year to year, the probability of occurrence remains high with the projection of more extreme temperatures and continued periods of draught due to climate change.

Local education and outreach programs continue to be the most effective way to reduce a community's risk to fire. Firewise, is a community outreach program through the National Fire Protection Association that provides guidance, resources, and training on protecting homes and property from wildland fire. The Vermont Annual Fire Marshal Report also offers informational resources for municipalities and property owners regarding fire safety. In addition, the Vermont Division of Fire Safety conducts a number of public educational events throughout the state and provides a toolbox of resources to educate communities which the town can take advantage of.



5.2b. Flood and Fluvial Erosion

Both Flood and Erosion are profiled here as these hazards are intrinsically linked.

Flooding, including **flash flooding** and overbank or **inundation flooding**, are significant natural hazard events for Windham County and Grafton.

The town is particularly susceptible to inundation flooding in lower lying areas of the Village and also to flash flooding in higher elevation areas.

"**Flash flooding** is characterized by intense, high velocity torrent of water that occurs in an existing river channel with little or no notice. Flash floods are very dangerous and destructive not only because of the

force of the water, but also the hurling debris that is often swept up in flow." [17] This type of flooding threatens high-elevation drainage areas and typically occurs during summer when a single or series of weather events result in excessive rainfall over a short period of time on already saturated soils from a spring melt. Flash floods can also be triggered by a dam breach causing further damage downstream.

The damage from spring flooding events can vary greatly depending upon the amount of precipitation, snow cover, spring melt, soil saturation, existing erosion and topography.

Road infrastructure within the narrow stream valleys receive drainage from the higher elevations and are often the most vulnerable to damage from flash flooding.

Although these are not frequent events, hazards posed can be significant as seen with the state-wide flooding from Tropical Storm Irene in the summer of 2011.

Inundation or overbank flooding occurs in lower lying areas when water levels rise overflowing the banks of a river or stream. In hilly or mountainous areas, drainage from higher elevations flows to the lower reaches or valleys of a watershed. These waters often carry with it debris which can block culverts or a bridge underpass. Instances of inundation type flooding can occur long after precipitation has ended or when no precipitation has occurred, such as an extreme winter warming event causing river ice to melt resulting in ice jams obstructing the flow of river waters.

Flood Zone Definitions	
Floodway	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 a designated height; also known as the regulatory floodway. As designated and determined by FEMA.
Special Flood Hazard Area (SFHA)	The land in the flood plain within a community subject to a 1 percent or greater chance of flooding in any given year; also known as **floodplain.** As designated by FEMA. Key part of the *National Flood Insurance Program* (NFIP). Includes Floodway Fringe (Zone A and Zone AE).
River Corridor	The land area adjacent to a river that is required to accommodate the dimensions, slope, planform, and buffer of the naturally stable channel and that is necessary for the natural maintenance or natural restoration of a dynamic equilibrium condition and for minimization of fluvial erosion hazards. Generated automatically as a 50-foot buffer on each side of the meander belt width. As delineated by the Agency of Natural Resources in accordance with river corridor protection procedures. (See figure below)
Fluvial Erosion	The erosion or scouring of riverbeds and banks during high flow conditions of a river. Fluvial erosion can be catastrophic when a flood event causes a rapid adjustment of the stream channel size and/or location. These areas are found within the River Corridor.

[17] INTERMAP http://www.intermap.com/risks-of-hazard-blog/three-common-types-of-flood-explained

Flood Zones Explained

The Federal Emergency Management Agency (FEMA) has designated flood zones, as defined above. The designated *Special Flood Hazard Areas* (SFHA) have the highest risk of flooding. These areas include the floodway and the river's floodplain. Both the Floodway and Floodplain typically lie within the River Corridor.

This is a depiction of a typical stream with its river corridor area highlighted and an example of the meandering pattern of the stream over time within that corridor. Areas within the River Corridor are considered areas of both flood and erosion risk as rivers and streams seek equilibrium in accommodating the high flows causing major flood and erosion damage even outside of SFHAs.

River corridors *and* ***floodplains*** *are different, but related. The* River corridor *is the area that provides the physical space that the* river *needs to express its energy and meander without causing it to dig down. A floodplain is the area where water flowing out over the* river *bank spreads out.* [18]

Vermont Agency of Natural Resources has mapped River Corridors for the Saxtons River stream segments along with SFHA which are shown **in Appendix A: Map 2- Flood Hazards** and can be found on-line.[19] River Corridors are currently being modified to more closely reflect the valley topography and will allow for improved identification of elevated fluvial erosion hazard areas.

Fluvial Erosion, which often accompanies flood events, is the predominant form of flood damage in Vermont and in mountain valley towns like Grafton. Rivers are dynamic and move both water and sediment. As a result, river channels may move vertically or horizontally. High flows can cause sediment to become detached from a riverbed or riverbank, which can range from gradual bank erosion or massive slope failure to catastrophic changes in river channel location and dimension. The sediment and stone

[18] The ANR FLOOD READY link shows river corridors overlays and FEH zones, http://floodready.vermont.gov/assessment/vt_floodready_atlas.
[19] The ANR FLOOD READY link shows river corridors overlays and FEH zones, http://floodready.vermont.gov/assessment/vt_floodready_atlas.

that is dislodged can expose tree roots and wash away vegetative buffers which are carried downstream blocking culverts and bridges causing further flood damage.

Vermont is vulnerable to this hazard because of its topography, extreme climate, deep snows, destructive ice jams and intense rainstorms. Centers of commerce in villages and towns became concentrated along river banks, forests were cleared and, over time, many rivers moved or were channelized to accommodate this development rendering them unstable and prone to fluvial erosion. [20]

Fluvial erosion can severely threaten mountain communities like Grafton as most of rural town development lies in valley areas along rivers and streams.

Extreme channelization, berming and armoring of the Saxtons River in the past, has reduced the rivers access to its natural floodplain. As much as 70% of Vermont's rivers have lost access to their floodplains due to these common practices.

The photo on the left is an example of the extent of fluvial erosion which occurred during Tropical Storm Irene resulting in extensive loss of property and home damage in Windsor County

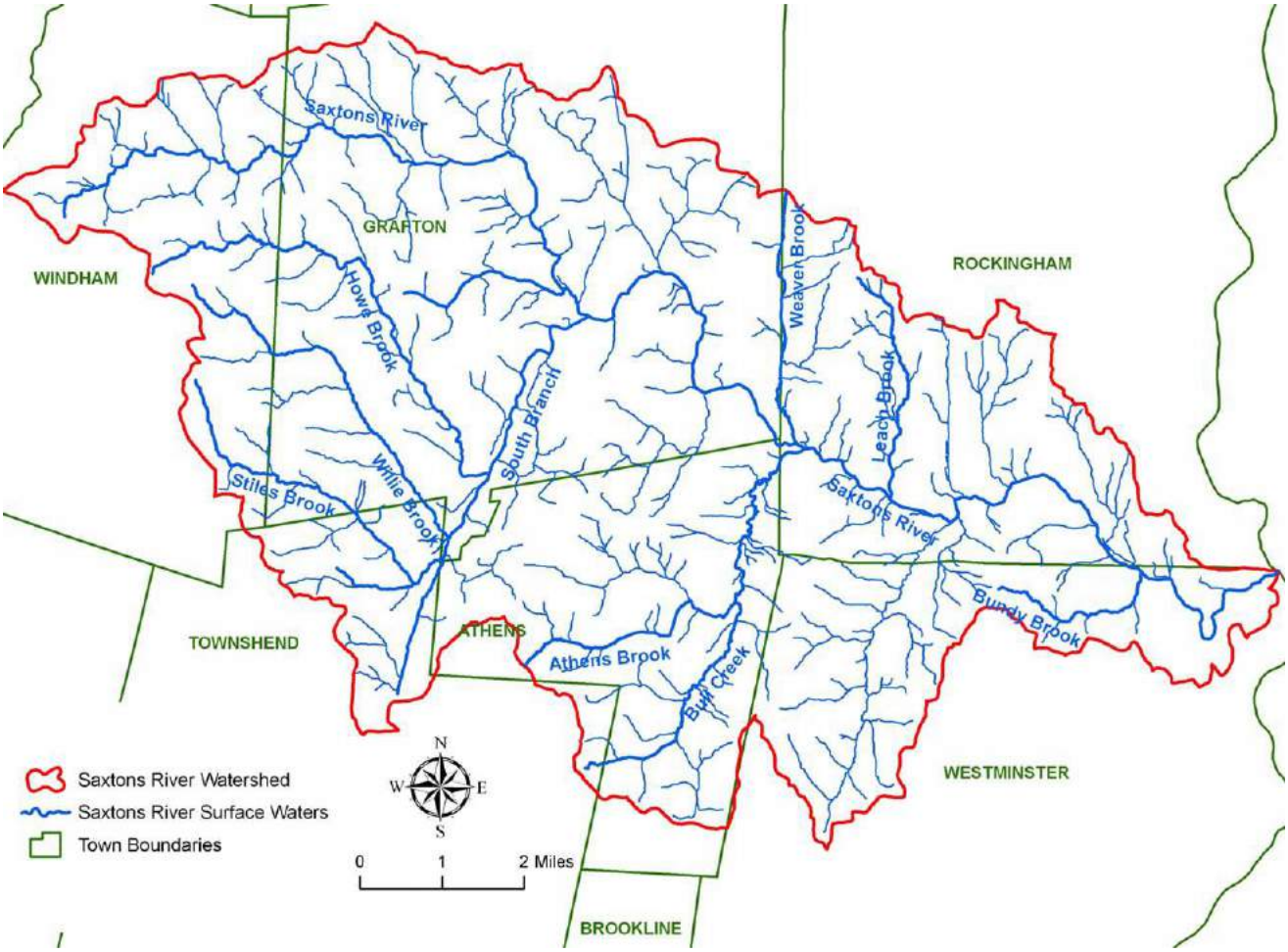
Saxtons River Watershed Background

The vast majority of the Town of Grafton lies within the Saxtons River watershed. A smaller portion of the northeast corner of the town lies within the lower Williams River watershed**. (See Figure 1)**

The Saxtons River watershed is one of three main watersheds considered part of Vermont Basin 11 along with the Williams and the West Rivers. It has two main branches, the Upper and Lower Saxtons River, and four significant tributaries. The watershed spans 5 towns and drains 78 square miles to the main stem which runs for twenty miles from its headwaters in the eastern slopes of the southern Green Mountains in the Town of Windham, through the Town of Grafton, and continues eastward where it empties into the Connecticut River.

[20] Municipal Guide to Fluvial Erosion Hazard Mitigation, Vermont Agency of Natural Resources

FIGURE 1: Saxtons River Watershed



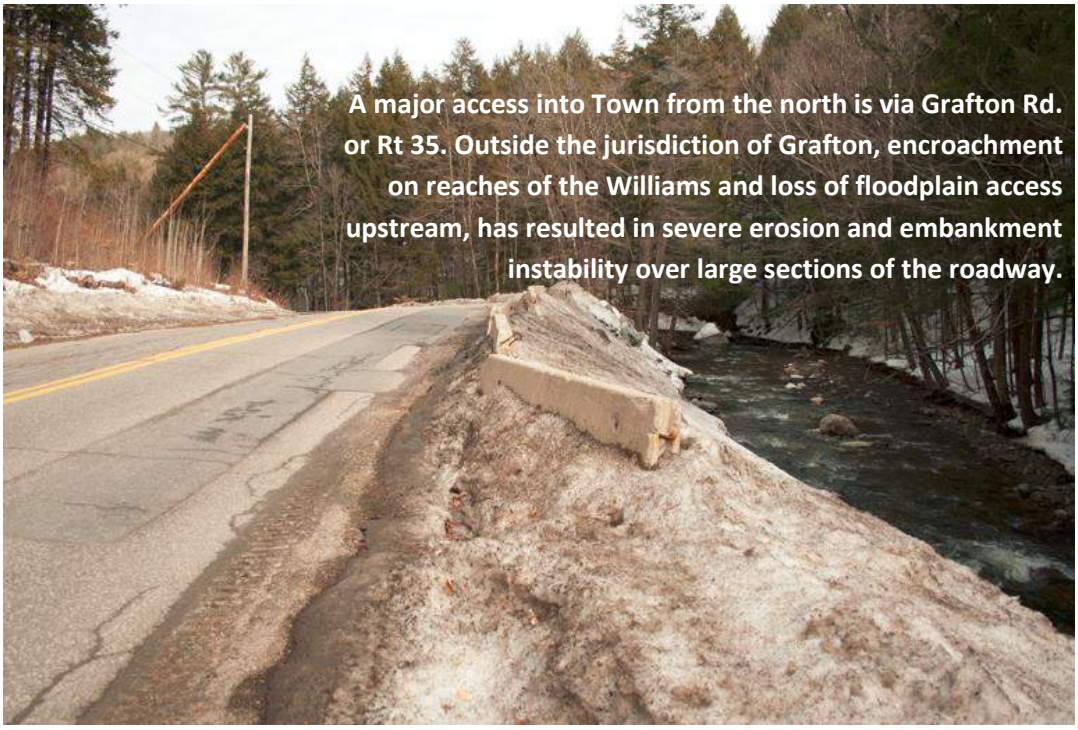
From its headwaters, an extensive wetland complex, it drops from its highest elevation of 2,870 feet through narrow steep gorges of bedrock to forested valleys and then to a wider valley floor in Grafton Village. The South Branch picks up Styles Brook, Willie Brook and Howe Brook in the southwestern portion of town and then flows into the Upper Saxtons River mainstem in the village. Other major tributaries join the mainstem east and downstream of the town.

Saxtons River Watershed Planning Efforts include several studies completed over the past 20 years. More recently, Phase 1 and Phase 2 Stream Geomorphic Assessments were completed in 2008 and the *River Corridor Plan for the Saxtons River Watershed* was completed in 2010. These watershed assessments and management plans focus primarily on hazard mitigation, local water quality and resource conservation. The overarching strategy is to protect the river corridor and floodplain access which will minimize, in the long run, hazards related to flooding, flash flooding, fluvial erosion and ice jams.

In the wake of major flooding during Tropical Storm Irene in late summer of 2011, the Town of Grafton was awarded a Municipal Planning Grant from the Vermont State Department of Housing and Community

Development to improve long term flood resiliency along the Saxtons River in Grafton through the evaluation of fluvial erosion hazards and improvement of river corridor mapping.[21] The objective of this study effort was to evaluate existing River Corridor mapping and areas of fluvial erosion hazards to identify improvements and provide recommendations for integrating findings in the Town's Flood Damage Prevention Regulations.

A relatively smaller portion of the town lies within the Williams River Watershed. This most northeastern part of town contains Hall Brook, a tributary of the Williams. Corridor planning has not identified projects or recommendations for this sub-watershed of the Williams. The photo below is from the *Chester Telegraph*, February 2019.



A major access into Town from the north is via Grafton Rd. or Rt 35. Outside the jurisdiction of Grafton, encroachment on reaches of the Williams and loss of floodplain access upstream, has resulted in severe erosion and embankment instability over large sections of the roadway.

[21] *Town of Grafton River Corridor Mapping Review*, May 2016, Fitzgerald Environmental Associates, LLC.

Extent and Historical Trend – Flood & Fluvial Erosion

Flooding is the most common recurring hazard event in Vermont. In recent years, flood intensity and severity appear to be increasing.[22] **Table 4**: **FEMA Disaster Declarations for Windham County from 1970-2018** shows that of the 16 disaster declarations for Windham County, 14 were related to flooding. The most significant state-wide flooding events and their impact on the region are detailed in **Table 6: Historical Regional Flood Events.** Other more recent flooding events are recalled and described below by the local community.

April, 2007 - A flooding event occurred which was associated with flash floods and inundation flooding over a period of several days in the spring (April 15-21). Rain and snow caused damage to roads and utility lines across Windham County and Grafton. FEMA assistance statewide was nearly 3.6 million dollars.

August 2004 - A severe prolonged period of flooding and thunderstorms lasted from the period of August 12- September 12.

August, 2003 - Nearly constant rain and thunderstorms affected Grafton from the period of July 21 through August 18.

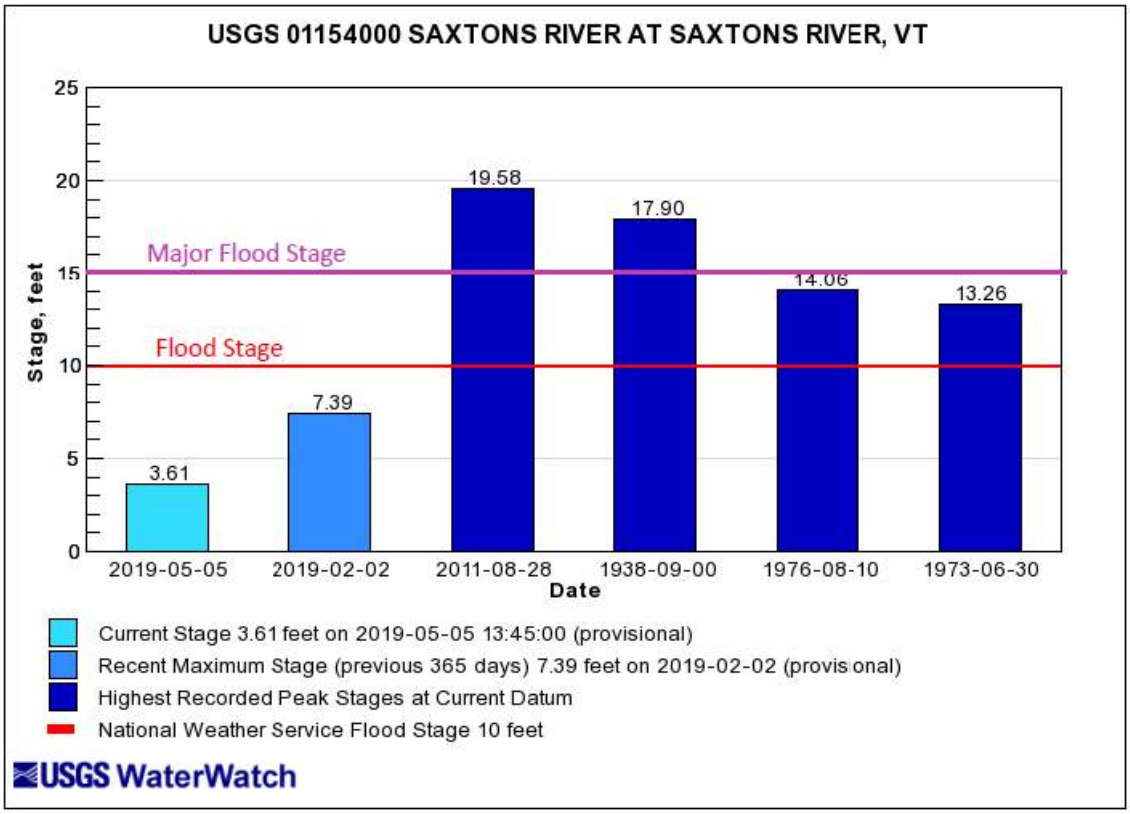
June 1996 - Flash flooding occurred from heavy rainfall. The fluvial erosion from this event released debris resulting in destruction of a house in the Village.

[22] 2013 State of Vermont Hazard Mitigation Plan, p 55.

TABLE 6: Historical Regional Flood Events.			
Event	**Date**	**Description**	**Impact or Extent of Damage**
Great Flood of 1927	November 3, 1927	After a wet October, rivers were swollen and the ground was saturated. Nine inches of rain fell in a 36-hour period triggering disastrous flooding. The month of October saw 150% greater rainfall than normal and lack of vegetation due to de-forestation may have reduced the ground's ability to absorb water. Though all of New England was affected, Vermont was devastated. The state flooded from Newport to Bennington, with the Winooski River Valley the hardest hit. Deadliest disaster in Vermont history.	○ 84 people perished ○ 9,000 left homeless ○ Many roads, countless homes and over 1,200 bridges washed away ○ Over $28 MM in damages ($404 million in current $s)
The Great New England Hurricane of 1938	September 21, 1938	One of the most powerful and destructive hurricanes to hit southern New England and the region of Southeast Vermont with winds over 100 mph. Authorities were unaware of the magnitude so no evacuation procedures were instituted and very few precautions were taken. The only tropical cyclone to make a direct hit on Vermont in recorded history. Hurricane-force winds caused extensive damage to trees, buildings, and power lines.	○ 600 people perished in southern New England, only 5 in Vermont ○ Over 2,000 miles of roads were blocked taking months to reopen ○ Vermont maple and sugar groves were damaged ○ Over $300 MM in damages ($5 Billion in current $'s)
Tropical Storm Irene	September 1, 2011	Tropical Storm Irene tracked north northeast across eastern New York and western New England producing widespread flooding, and damaging winds across the region. The greatest impact across southern Vermont was due to heavy to extreme rainfall, which resulted in catastrophic flooding. Catastrophic flooding was reported in Windham County with widespread damage and road closures. Route 9, the main route across southern Vermont was closed, with the city of Wilmington inaccessible for a period of time. Numerous evacuations were reported. In addition, record flooding occurred on the Saxtons River at Saxtons and the Williams River at Rockingham.	○ Frequent wind gusts of 55-60 mph ○ 18,000 customers in Windham County lost power. ○ Greatest single-day rainfall in Vermont's recorded history. ○ Rainfall averaged 4 to 8 inches, and up to 11 inches in some areas over a 12-hour period. ○ Over $5MM in damages in Grafton ○ All connecting roads into Grafton were cut off.

The extent of flood events can also be derived from the recorded relative height of the river waters during a flood event. For example, the United States Geological Survey (USGS) maintains a streamgage on the Saxtons River in Rockingham, east of the Town of Grafton which regularly monitors the river height and streamflow in the Saxtons River. The figure below displays historic peak data on gage height relative to National Weather Service Flood Stage levels. It shows the gage height exceeding Major Flood Stage during Tropical Storm Irene and the next maximum prior to that, during the Flood of 1938. (See **Section 5.2c "Tropical Storms/Hurricanes")**

FIGURE 2: Historical Gage Heights for Saxtons River in Rockingham, VT[23]



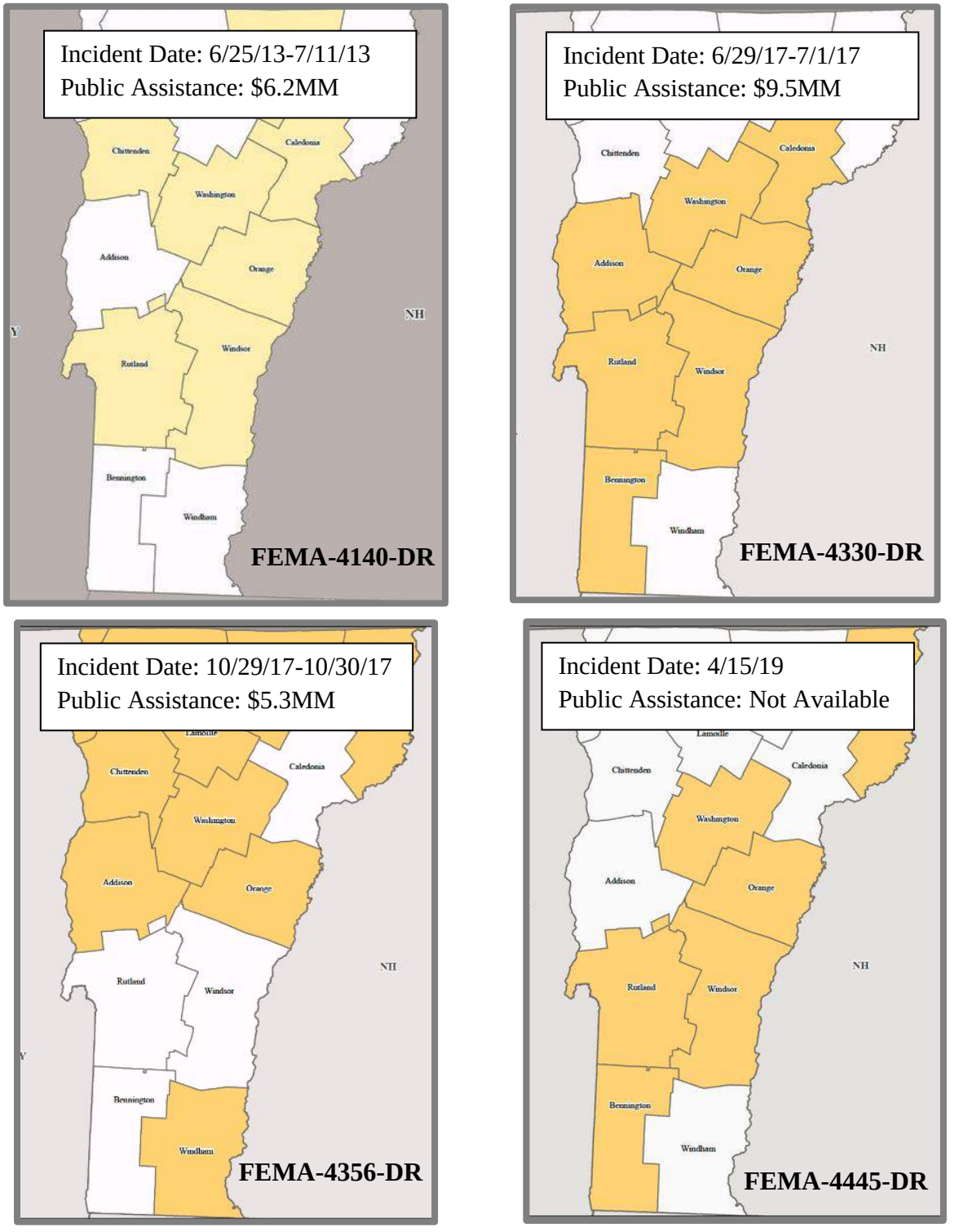
***Note** the gage height exceeded 'Major Flood Stage' of 15 feet during Tropical Storm Irene at 19.58 feet, the highest recorded since 1938 during the 1938 Hurricane. More recent events causing historic flooding in Windham County were federally declared disasters of 1976 and 1973*

Over the past several years, flooding has occurred in limited areas of the State from intense, scattered storm events and ground saturation from persistent and excessive rainfall. Since Irene, Vermont has experienced 9 FEMA declared disasters from severe storms and flooding. Four of these had impacted neighboring counties and one in Windham County. Grafton has not experienced severe flooding since Irene. According to the *2013 State of Vermont Hazard Mitigation Plan*, studies show that areas of the State can expect a greater frequency of flooding with an increase in extreme rainfall amounts.[24]

[23] http://waterwatch.usgs.gov accessed in May 2019, Toolkit, Flood-Tracking Chart
[24] 2013 State of Vermont Hazard Mitigation Plan, p 4-9

FEMA Declared Disasters

Severe Storms and Flooding
Since Tropical Storm Irene in 2011



Flood damages are associated with inundation flooding and **fluvial erosion**. Data indicate that greater than 75% of flood damages in Vermont, measured in dollars, are associated with fluvial erosion, not inundation. Grafton's Hazard Mitigation Committee also assessed the impact of fluvial erosion greater than that of flooding.

While specific data on the extent of this hazard is not readily available, a visual is helpful. Below are photos of the extensive damage to major access roads to Grafton Village due to erosion during Tropical Storm Irene. on Rt. 121 and Townsend Rd., major access roads to Grafton Village, due to erosion during Tropical Storm Irene.

Route 121 East of Grafton Village looking West

Townsend Rd. at intersection with Howe Brook

Vulnerable Assets – Flood & Fluvial Erosion

Grafton is vulnerable to both **Inundation Flooding** and **Flash Flooding** described above. Both flood hazard types rely on natural floodplains to disburse flood waters and reduce their potentially disastrous impact. Floodplains provide important social, economic and ecological functions. They are areas where human structures and critical transportation infrastructure are at risk. River Corridors are dynamic areas where a great deal of damage can also occur during flooding disasters.

Fluvial Erosion along rivers and streams is the predominant form of flood damage in Vermont. The areas most vulnerable to fluvial erosion are those that were triggered by Tropical Storm Irene and exacerbated by subsequent storms.

In Grafton, the Saxtons River mainstem riverbanks have been armored to protect against erosion over the years. However, these practices have destabilized these river reaches making them more prone to the development of temporary flood chutes or a dramatic avulsion which is the rapid abandonment of an established river channel and the formation of a new permanent river course in the adjacent floodplain. A severe channel migration outside of the river corridor and valley wall occurred at the intersection Houghtonville Rd. and Cabell Rd. during Tropical Storm Irene.

Areas impacted by Tropical Storm Irene, detailed below, continue to be problem areas vulnerable to reoccurring minor flooding during a hard rain. Floodwaters overwhelmed road infrastructure at these sites, within and outside of the SFHA, and washed away a house located upstream of the Howland Mill bridge, and a garage upstream of the Fire House. Several Grafton homes were damaged or destroyed; three of which received FEMA funding for property buyouts. The Town Garage was also damaged and was relocated out of the flood zone. Tropical Storm Irene is also covered under **Section 5.2c, Tropical Storms/Hurricanes.**

Areas of Grafton Impacted by TS Irene

- Houses and structures on Main St. upstream from the Main St. Bridge
- Kidder Hill St. downstream from the Main St. Bridge for 100 yards
- Townshend Rd. at the culverts for Howe Brook, Willie Brook and Stiles Brook
- Foot of Turner Hill Rd.
- Hinkley Brook Road at and below 300 Hinkley Brook Road
- Middletown Road from Hinkley Brook Road northerly for 50 yards
- Parker Hill Road for 150 yards upstream of the Cambridgeport Bridge
- Fisher Hill Road from Bell Road to VT Route 121 East
- Eastman Road from ¼ mile easterly of VT Route 35 for the next ½ mile
- VT Route 121 easterly 50 yards upstream of the Howland Mill bridge
- First culvert easterly of the Grafton Fire Station
- VT Route 121 West in the Village of Houghtonville for 100 yards on either side of the Cabell Road Bridge.

Given the historic social and economic function of river valleys it is no surprise that the majority of town community assets would be located in or near these flood prone areas.

The flood map below of Grafton Village in **Figure 3**, shows structural assets (white squares) located in flood hazard areas (highlighted in red) and river corridor areas (highlighted in yellow). It can be seen that most of the structures, residential, public, and commerce, are concentrated along the Saxtons River which runs through the center of the village. Development in these areas is vulnerable to flood and erosion with the risk of re-channelization during high flow events.

FIGURE 3: Flood Ready Map of Grafton Village

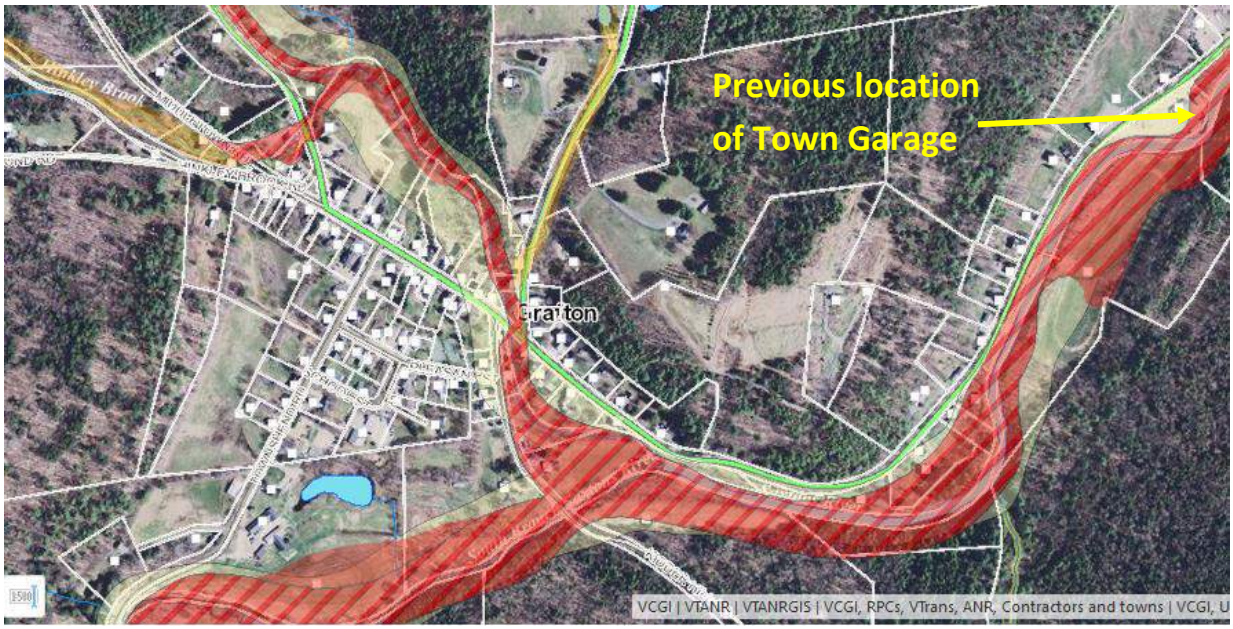


Table 7 below lists the number and types of vulnerable structures in Grafton that lie within these Special Flood Hazard Zones and the River Corridor. Most of the town's most critical town structures listed on the right, do not lie in Flood Hazard zones and are not at risk for flood and erosion. The Town Garage was relocated out of the flood zone since the previous Hazard Mitigation Plan. However, portions of main access or evacuation routes and other roadway segments lie within flood zones including sections of Rt. 121 and Townsend Rd. See Appendix E: Flood Ready Maps for identification of vulnerable structures and areas. The Town Garage was relocated out of the flood zone since the previous Hazard Mitigation Plan.

Critical Town Structures

- White Church
- Brick Church
- Town Hall
- Grafton Public Library
- Grafton Fire Department
- Grafton Town Garage
- Chapel
- Old Grafton Tavern/Inn
- Village Store
- Elementary School
- Telephone Building
- Grafton Cheese Company
- Grafton Village Garage

TABLE 7: Summary of Structures within Flood Hazard Zones and River Corridor [25]

Flood Zone	Building Type	# Units	%
Floodway	Accessory	0	0.0%
	Single-Family	18	66.7%
	Multi-Family	0	0.0%
	Mobile Homes	4	14.8%
	Camps	1	3.7%
	Commercial	1	3.7%
	Lodgings	0	0.0%
	Civic	1	3.7%
	Other	2	7.4%
	SUBTOTAL	*27*	100.0%
Floodway Fringe	Accessory	0	0.0%
	Single-Family	21	55.3%
	Multi-Family	0	0.0%
	Mobile Homes	3	7.9%
	Camps	7	18.4%
	Commercial	5	13.2%
	Lodgings	0	0.0%
	Civic	0	0.0%
	Other	2	5.3%
	SUBTOTAL	*38*	100.0%
SFHA TOTAL		**65**	

Flood Zone	Building Type	# Units	%
River Corridor	Accessory	0	0.0%
	Single-Family	53	66.3%
	Multi-Family	0	0.0%
	Mobile Homes	7	8.8%
	Camps	7	8.8%
	Commercial	6	7.5%
	Lodgings	0	0.0%
	Civic	2	2.5%
	Other	5	6.3%
	TOTAL RC	**80**	**100.0%**

In 2016, the Town of Grafton completed a River Corridor Mapping Study to refine the designated state river corridor boundaries and inventory flood and erosion hazard areas to aid development planning[26].

River Corridor data can be used along with Floodplain data to direct new structures to safer locations.

Roads, bridges and culverts are also vulnerable to flood and fluvial erosion damage as much of this infrastructure is located in mountain valleys and along rivers and streams. Vermont State has begun to focus its efforts on "hydrologically-connected" road segments as part of the new *Municipal Roads General Permit (MRGP) Standards*. These standards will help to increase flood resiliency and reduce the risk of road erosion.

[25]GIS analysis using E911 building points (2018), FEMA-mapped floodplains (2015), and ANR-mapped River Corridors (2015). Some structures may have been removed from SFHA or RC since this data was compiled.
[26] *Town of Grafton River Corridor Mapping Review*, May 2016, Fitzgerald Environmental Associates, LLC.

The failure of bridges and culverts throughout southern Vermont during Tropical Storm Irene, was primarily due to their being undersized and constricting flow.

This resulted in debris jams, streambed scour, bank erosion both up and downstream of the crossing and slope failure at some locations. Blocked culverts compromised the structural integrity and safety of the road crossing resulting in damage to adjacent properties. Factors contributing to debris jams include materials stored in the floodplain and unsecured structures (i.e. hay bales, propane tanks; small sheds; wood piles). **Appendix A, Map 7: Bridge and Culvert Inventory** shows the assessed condition of Grafton's bridges and culverts. Throughout Vermont, undersized and poorly aligned river crossings critically interrupt flood flows, sediment and woody debris movement downstream. These conditions result in channel instability, damage to infrastructure and personal property, as well as increased flooding.

Areas of road embankment and other bank armoring where the channel is narrowed and floodplain access is restricted are most vulnerable and can increase fluvial erosion, according the *River Corridor Mapping Review Report.* [27] The Report identified 22 bridges and 16 areas of embankment armoring constriction that are potential areas of increased fluvial erosion hazard. In addition, the study recommended 6 priority projects from the River Corridor Plan for reducing erosion hazards. These recommended actions can be found in **Appendix F.**

Townsend Road bridge over the South Branch Saxtons River is a major constriction for the measured bankfull channel width. The bridge is also poorly aligned and the opening is partially filled with sediment, increasing the fluvial erosion hazard risk at the site.[28]

[27] *Town of Grafton River Corridor Mapping Review*, May 2016, Fitzgerald Environmental Associates, LLC.
[28] *Town of Grafton River Corridor Mapping Review*, May 2016, Fitzgerald Environmental Associates, LLC.

National Flood Insurance Program (NFIP)

Grafton is a participatory, non-sanctioned member of the National Flood Insurance Program and regulates development in the floodplain through the enforcement of by-laws in the Town's Flood Damage Prevention Regulations. NFIP policies and claims are summarized in **Table 8**[29]

TABLE 8: Grafton National Flood Insurance Program Statistics (Report Date 6/26/2018)

# of Policies	Total Premium	Total Coverage	# LOMCS	# of Policies in A Zone	# of Claims Since 1978	Claims Paid Since 1978	# of Repetitive Losses
22	$28,503	$5,332,500	13	10	16	$193,985	0

5.2c. Hurricanes/Tropical Storms

As a hurricane moves toward the coast, it loses wind speed and may be downgraded to a tropical storm. This is the case for the tropical storms that have reached Vermont as Category 1 storms or below. The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 rating based on a hurricane's sustained wind speed. The scale estimates potential property damage. Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and damage. Category 1 and 2 storms are still dangerous, however, and require mitigation.

Extent and Historical Trend – Hurricanes/Tropical Storms

Prior to Tropical Storm Irene in August, 2011, Vermont was impacted by Tropical Storm Floyd in November, 1999, causing major flooding and power outages. However, the Hurricane of 1938 may have been the most powerful tropical storm to hit Vermont in modern times,

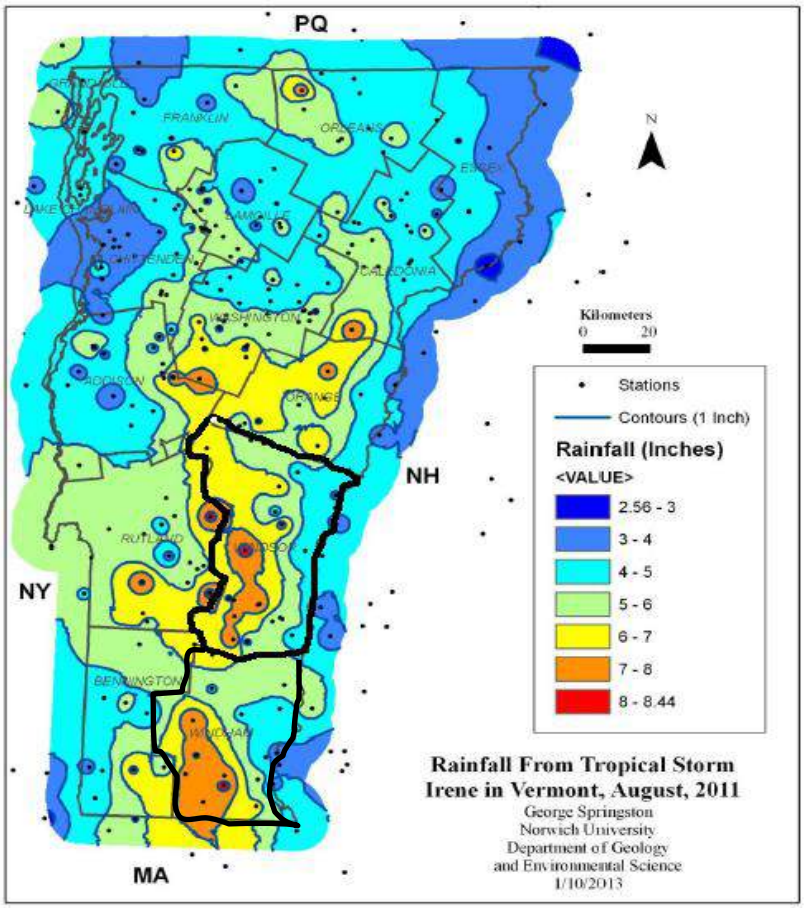
[29] Vermont Flood Ready FEMA Policy & Claim Statistics for Flood Insurance -Claim Information by Town, https://floodready.vermont.gov/assessment/community_reports#Flood

with sustained winds of 74mph which was claimed to have changed the landscape of the state with the extensive tree damage. The Flood of 1927 termed 'the greatest natural disaster' was caused by a tropical system in Vermont which produced over 9 inches of rain. The deluge caused the most extensive flooding and structural damage and the greatest loss of life in recorded history for the state.

Saffir-Simpson Hurricane Scale		
Category	Wind Speed	
	mph	knots
5	≥156	≥135
4	131-155	114-134
3	111-130	96-113
2	96-110	84-95
1	74-95	65-83
Non-Hurricane Classifications		
Tropical Storm	39-73	34-64
Tropical Depression	0-38	0-33

On August 28 and 29 in 2011, ***Tropical Storm Irene*** dropped 3 to 7 inches of rainfall on much of Vermont. The heavier rainfall totals tended to fall in higher elevation areas which made the impacts much worse in and around steep headwater areas. The greatest impact from Irene across southern Vermont was due to heavy to extreme rainfall over which occurred within a 12-hour period resulting in widespread and catastrophic flash flooding and inundation from river flooding.

The counties that fared the worst were located in sub-watersheds with the heaviest rainfall. The map below shows the great variation in rainfall amounts in Vermont.



Windsor and Windham Counties endured some of highest rainfall amounts as shown in the outlined area of the map.[30] In Windham County, catastrophic flooding was reported along with widespread damage and road closures. Route 9, the main route across southern Vermont was closed, making the Town of Wilmington inaccessible for a period of time. Numerous evacuations were reported. In addition, record flooding occurred on the Saxtons River and the Williams River at Rockingham.

Strong winds also caused major tree damage across southern Vermont, with frequent wind gusts of 35 to 55 mph, along with locally stronger wind gusts exceeding 60 mph. The combination of strong winds and extremely saturated soil led to

[30] 2013 State of Vermont Hazard Mitigation Plan, p 4-61

numerous downed power lines across the region and widespread, long duration power outages. In Windham County, 18,000 customers were estimated to have lost power, some for more than a week. This FEMA Disaster Declaration provided assistance to 12 of 14 counties in the state of Vermont including Windham County. The Tropical Storm Irene event in August 2011 was an example of the most damaging flood event that has happened in Grafton in decades with a total estimated cost of $ 5.1 million.

Vulnerable Assets – Hurricanes/Tropical Storms

The Town's vulnerability to Hurricanes and Tropical Storms is a culmination of the identified vulnerabilities to flood, erosion and high winds **(See Sections 5.2b and 5.2f** under Vulnerable Assets**).** The town's exposure to this hazard risk would include all connecting roads into Grafton which were cut off for a period of time after the storm. Route 121 both east and west were impassable with sections that were completely washed away. Several culverts in Grafton, south toward Townshend, and toward the north to Chester, were washed out. In all, 45 out of 55 miles of road were out of service with sections either damaged or destroyed. Three homes were damaged beyond repair and eligible for FEMA buyouts and 24 homes had minor flood damage. These high-risk areas are mapped in **Appendix E.**

5.2d. Severe Winter Weather

Winter storms and **blizzards**, with **snow**, **ice**, wind and extreme cold in varying combinations, are fairly commonplace in Grafton and occur statewide. Heavy accumulation of snow accompanied by high winds causes drifting of snow and low visibility making it difficult to keep roads cleared. Sidewalks, streets, and highways can become extremely hazardous to pedestrians and motorists.

Heavy wet snows of early fall and late spring, as well as ice storms, can result in property damage and in loss of electric power, leaving people without adequate heating capability. Power loss is often the result of downed trees and power lines from the weight of wet snow, ice, or gusty winds. This type of

infrastructure damage can also disrupt traffic and emergency response by making roads and driveways impassable.

Severe winter storms in the northeastern United States develop through the combination of weather and atmospheric conditions including the moisture content of the air, direction of airflow, collision of warm air masses coming up from the Gulf Coast, and cold air moving southward from the Arctic.[31]

A winter storm is considered severe when there is a possibility of:

- Six or more inches of snow fall at a given location within 48 hours,
- Property damage, injuries or deaths, or
- An ice/glaze storm which causes property damage, injuries or death.

Severe Winter Storm Alerts	
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.

A Nor'easter is a large weather system traveling from South to North, passing along, or near, the Atlantic seacoast. As the storm approaches New England and its intensity becomes increasingly apparent, the resulting counterclockwise cyclonic winds impact the coast and inland areas from a northeasterly direction. The sustained winds may meet or exceed hurricane force. There are no standard models or methodologies for estimating loss from winter storm hazards, however, extreme winter weather is considered a way of life in Vermont and many rural Towns are accustomed to and prepared for these events.

Blizzards are defined by the National Weather Service as "sustained winds or frequent gusts of 35 mph or greater (and) considerable falling and/or blowing snow reducing visibility frequently to 1/4 mile or less for a period of three hours or more." [32] These storms become a challenge in keeping roads plowed due to the snow drifts that occur.

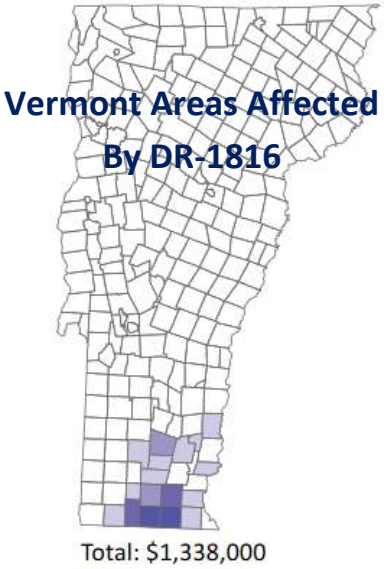
Ice Storms are defined by the National Weather Service as "occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication. These accumulations of ice make walking and driving

[31] 2018 State of Vermont Hazard Mitigation Plan
[32] National Weather Service Glossary

extremely dangerous. Significant ice accumulations are usually accumulations of ¼" or greater."[33] Multiple sources state that a ¼ inch of ice accumulation from an ice storm can add 500 pounds of weight on the lines between two power lines.

Extent and Historical Trend – Severe Winter Weather

Severe winter storms bring the threat of heavy accumulations of snow, cold/wind chills, strong winds, and power outages that can result in high rates of damage. Although FEMA Disaster Declarations with greater damages have occurred in Central and Northern Vermont, Windham County in Southern Vermont experienced two FEMA Declarations qualifying for Public Assistance funding.

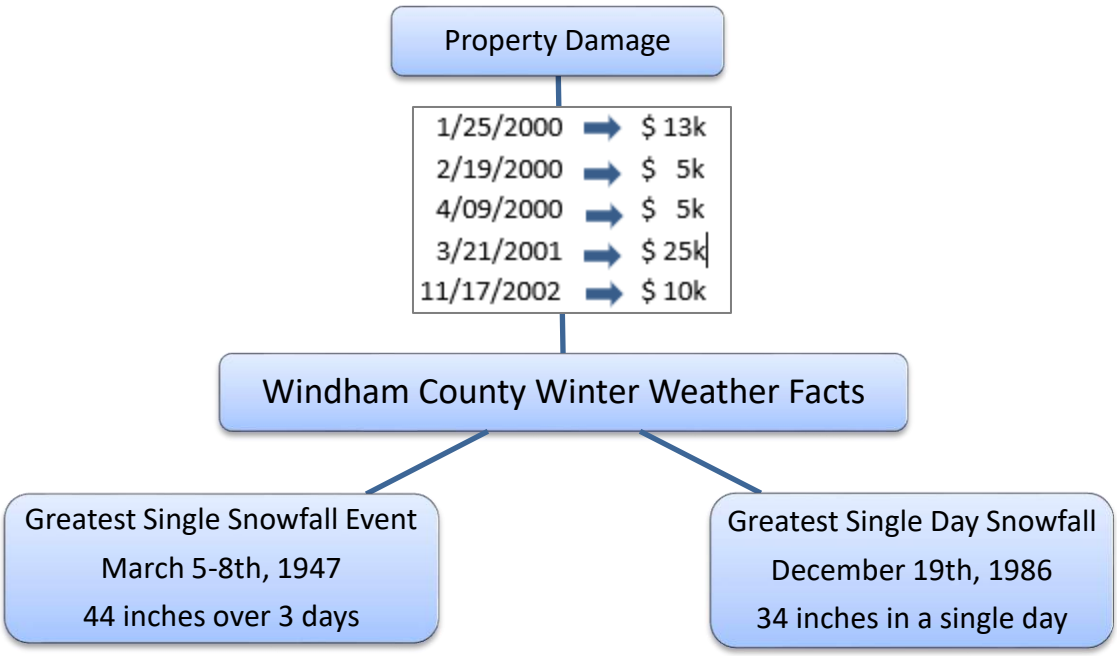


DR-1816, a Major Disaster Declaration was the result of an ice storm on December 11, 2011, which impacted primarily Windham County and a portion of Bennington County to the west. Upward of 40,000 homes were without power for several days during this period. Although Grafton was spared extensive damages, the majority of Windham County was impacted. Total Public Assistance from this ice storm event was $1,338,000.

EM-3167, an Emergency Declaration from a heavy snowstorm on March 5, 2001, with upwards of 26 inches of heavy snow throughout Bennington and Windham Counties resulting in collapsed structures and damaged infrastructure. Total Public Assistance from this snow storm event was $1,302,000.

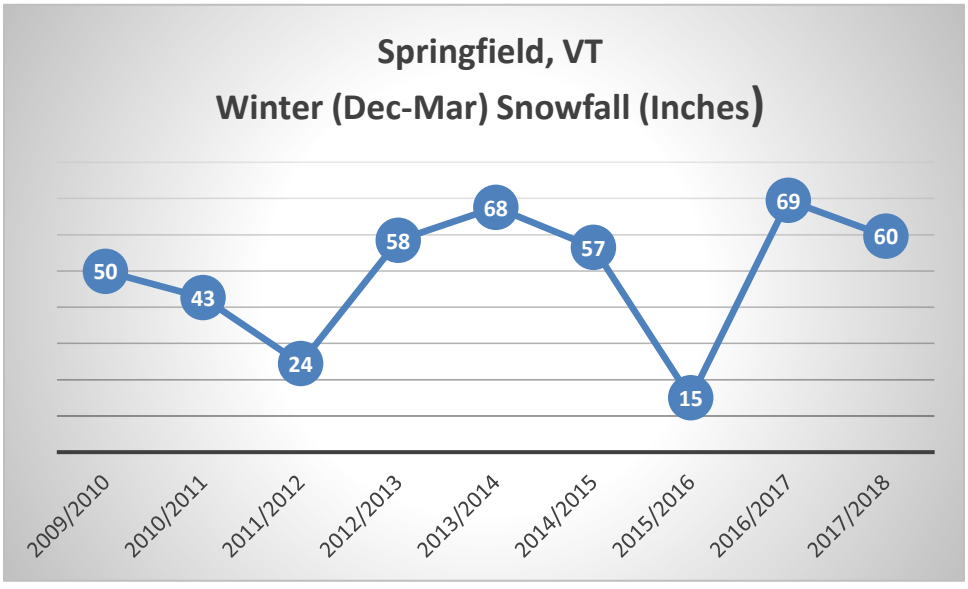
There have been over 50 recorded winter storm/weather events in Windham County since 2010 as recorded by NOAA National Centers for Environmental Information (NCEI) which are listed and described in **Appendix G.**[34] The descriptions of the winter events include type of precipitation, snow totals, ice accumulations, exceptional cold and wind speed data, and the extent of impact on the community where available. Unlike neighboring Windsor County to the north, which incurred close to $800,000 in property damages due to winter storm events over the same period, there were little or no damages recorded in Windham County as a result of any of these noted winter events.

[33] National Weather Service Glossary
[34] NOAA, National Centers for Environmental Information, Winter weather events for Windham County



Historical data for snowfall trends for Grafton is not available. However, the closest town for which historical data exists is the Town of Springfield in Windsor County and can be found online at U.S. Climate Data.[35] Selected winter snowfall seasonal totals for this town are charted below.

FIGURE 4: Total Seasonal Snowfall for Springfield, VT (closest town for which complete data is available)



[35] https://www.usclimatedata.com/climate/springfield/vermont/united-states/usvt0505/2018/1

"According to the 2014 National Climate Assessment, there is an observable increase in severity of winter storm frequency and intensity since 1950. While the frequency of heavy snowstorms has increased over the past century, there has been an observed decline since 2000 and an overall decline in total seasonal snow fall."[36] Snow cover on the ground is also trending downward due to rising minimum temperatures and a shortening winter season, according to the 2018 Vermont State Hazard Mitigation Plan. Still this past winter season of 2018-2019 saw higher than average snow totals and a mid-May snowfall.

Snow totals climbed to over 80 inches in northern parts of the state, more than 2 feet above average[37] and, on May 13, 2019, parts of southern Vermont received from a dusting to as much as 4 inches of heavy wet snow with up to 10 inches in the Green Mountains.[38]

Vulnerable Assets –Severe Winter Weather

Potential losses from winter storms are mostly indirect and can be difficult to quantify or predict. Damage from **snow** and **ice storms** can vary depending upon snow or ice accumulation, wind speeds, storm duration, tree cover, and structural conditions.

For example, large, flat roofed structures or aged structures in deteriorating condition are most vulnerable to collapse under heavy snow and/or ice accumulation.

Most roofs can withstand 20 pd/sf of snow which equates to approximately 3 to 4 feet of fresh snow or a foot of heavy wet snow. A season's worth of snowfall, however, can be well above what a typical roof will support, particularly if there have been layers of old snow and ice.

In addition to accumulating snow, drifting snow and low visibility during high intensity storms can become extremely hazardous for pedestrians and motorists. Also, warming trends have led to a greater frequency of freezing rain followed by flash freezing causing black ice to form on paved roadways which are typically the major thoroughfares in the region.

Vermont communities and municipal roadcrew are generally well prepared to handle heavy snowfall. However, it is typically the secondary hazards that are most concerning to the town. Depending on the event, particularly with heavy, wet snow or ice, electricity may be knocked out for a few hours or days due to downed powerlines from falling trees. This is a time when residents are most vulnerable to structure fire hazard. Many residents heat their homes with open flame heating sources including fireplaces and wood or pellet stoves, and will supplement with electric or kerosene space heaters.

[36] 2018 Vermont State Hazard Mitigation Plan,
[37] https://www.vnews.com/Total-snow-far-surpasses-average-in-parts-of-Maine-Vermont-23542704
[38] National Weather Service in Burlington

Extended periods of extreme cold or loss of power during the winter months require continued vigilance on the safety of heating to reduce the risk of a structure fire as a secondary hazard.

5.2e. Ice Jams

Ice jams are common in New England and occur during winter and spring months when river ice begins to break up and flow downstream or when a warm spell occurs midwinter season.

Though not identified as a high hazard, ice jams can cause a secondary event of flooding and threaten many of the same properties located within the FEMA Special Flood Hazard Area. When broken river ice begins to flow downstream, ice can build up against bridge abutments and expanses, undersized structures, and other obstructions to create a temporary dam impounding large volumes of water that has the potential to damage infrastructure and flood surrounding areas. The loss of a bridge could disrupt transportation corridors and isolate residential areas.

The most devastating winter floods have been associated with a combination of heavy rainfall, warm temperatures, and rapid snowmelt. Winter weather with less than average snowfall can result in greater ice buildup on streams and rivers, potentially resulting in greater ice jam damage. [39]

Extreme changes in temperature during winter months is also a factor causing more frequent ice jams and can be expected to increase in frequency with climate change.

It is difficult to predict changes in ice conditions due to climate change. "Although there is limited research on how climate change may influence the frequency and magnitude of ice jams . . . more frequent rainfall events during the winter months could lead to more frequent ice jamming occurrences." [40]

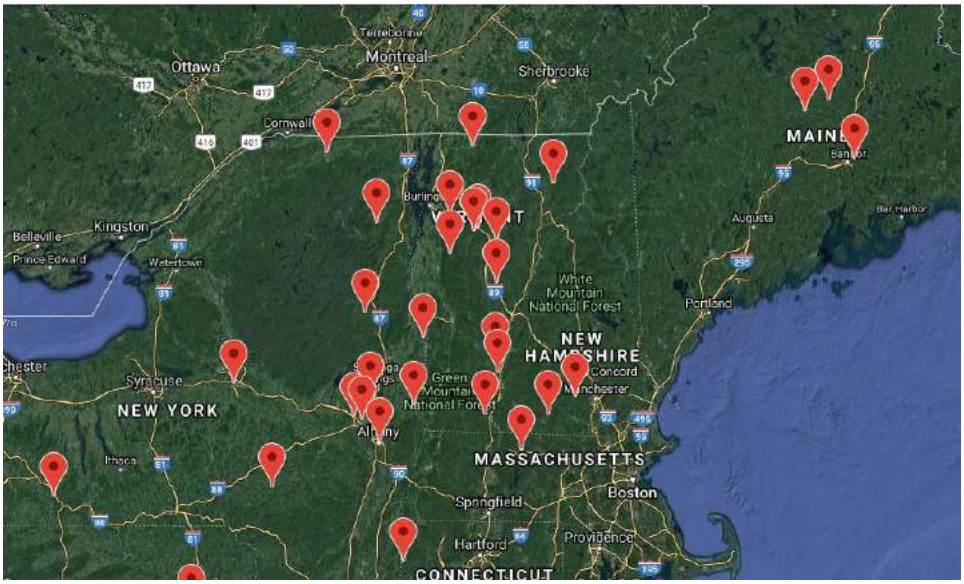
Extent and Historical Trend - Ice Jams

Vermont ranks tenth with a total of 987 ice jam events in 310 locations between 1/1/1785 and 2/26/2017, according to the US Army Corps of Engineers, Ice Jam Database CRREL State Summary Report. **Figure 5** below identifies the location of ice jam events in the region during 2019.[41] It can be seen that Vermont had experienced more ice jams in 2019 than other New England states.

Courtesy Brattleboro Reformer: Kristopher Radder

[39] CRREL Ice Jam Database
[40] 2013 State of Vermont Hazard Mitigation Plan
[41] CRREL Ice Jam Database

FIGURE 5: 2019 Ice Jam Locations, CRREL Database



The Spring Floods of 1936 (**Section 5.2b)** were, in part, the result of river channels blocked by ice causing flooding that damaged mills, dams, factories and highway bridges.

Most recently, on January 24, 2019, flooding caused by ice jams on the Whetstone Brook in Brattleboro in Windham County damaged 20 homes and 75 people had to be evacuated. [42]

On March 15, 2007, warm weather and heavy rain caused the breakup of many rivers in the northeast. This was followed by cold which froze the breakup jams at the historic Kidder Hill Covered Bridge on the South Branch of the Saxtons River. According to Eric Stevens, then Emergency Management Coordinator for Grafton, the toe of the jam was about 200 yards downstream of the confluence of the north and south branches extending upstream on the south branch. The ice reached the lower members of the bridge which was 5-6 feet higher than normal. [43]

Vulnerable Assets - Ice Jams

Ice jams can cause a secondary event of flooding and threaten many of the same properties located within the FEMA Special Flood Hazard Area as are impacted by inundation river flooding and the damage can be expected to be similar. Discussion on vulnerability of community assets with regards to flooding would apply to ice jams as well and strategies identified for flood mitigation may also apply to mitigating ice jams. Bridge underpasses are most vulnerable, particularly at the historic Kidder Hill Covered Bridge and

[42] CRREL Ice Jam Database , Event Index #20190130122919
[43] CRREL Ice Jam Database , Event Index #20070319141916

Cambridgeport Bridge, however, any instream infrastructure and streamside areas are at risk of flood and erosion damage from ice jams.

5.2f. High Winds

High Winds can be generated from a thunderstorm, hurricane or tropical depression, a localized microburst, or simply just a wind storm. Any of these events can produce wind gusts up to 50 mph or greater causing property damage and disruption in electric and telecommunication utilities, transportation, and commercial businesses. Although difficult to predict, these events also pose a high risk of injuries and loss of life. The Hazard Mitigation Committee assessed tornadoes as unlikely to occur.

Severe thunderstorms are a relatively common hazard in Vermont, particularly in the spring and summer months. Although typically short in duration, they are capable of producing damaging winds, heavy rain and flooding, dangerous lightning and large hail. Multicell cluster thunderstorms are likely to cause local flash flooding. It is the winds from these storms have most impacted the town.

The downward draft from these storms can produce ***microbursts*** which are not uncommon in Vermont. These events can come with wind speeds in excess of 80 mph, and pose an additional threat to low flying aircraft, making it difficult for them to maintain altitude. Although less common in Vermont, super cell thunderstorms are the largest, longest lasting, and most devastating thunderstorms, which can produce tornadoes and widespread destruction of crops and property. Tropical storms, hurricanes, nor'easters, and winter storms can also cause high wind damage throughout the state.

The ***Beaufort Wind Scale*** shown below can be used to predict damage based upon wind speeds. The National Weather Service will issue Wind Advisories when sustained winds of 31-39 mph are reached for at least one hour or gust between 46-57 mph and High Wind Warnings for winds of 58 mph or higher. Thunderstorm winds tend to affect areas of Vermont with significant tree stands as well as areas with exposed property and infrastructure and aboveground utilities. [44]

Beaufort Wind Scale		
Classification #	**Wind Speed**	**Land Conditions**
6	25 to 31 mph	Large branches in motion; whistling in telephone wires
7	32 to 38 mph	Whole trees in motion; inconvenience felt walking against wind
8 to 9	39 to 54 mph	Branches can break off trees; wind generally impedes progress
10 to 11	55 to 73 mph	Damage to chimneys and TV antennas; pushes over shallow rooted trees
12 to 13	74 to 112 mph	Peels surfaces off roofs; windows broken; mobile homes overturned; moving cars pushed off road
14 to 15	113 to 157 mph	Roofs torn off homes; cars lifted off ground

[44] 2018 State of Vermont Hazard Mitigation Plan

Power Failure is a common secondary hazard caused by high winds and occurs frequently within Windham County. Power outages can occur on a town-wide scale and are typically the result of power lines damaged by high winds or heavy snow or ice storms, but may also result from disruptions in the New England or national power grid as indicated by the widespread outages in 2003.

Dead or dying trees in proximity to power lines pose a particular threat for power failure, as these trees are often brought down by triggering events such as high winds during a thunderstorm or a Nor'easter.

Potential loss estimates are difficult to predict for power failures as they are typically isolated in geographic area and short in duration. Therefore, power failures often have only minimal impact to people and property, however, longer duration events may result in major disruptions and business losses. Power outages in winter months may result in the loss of home heating, ruptured water pipes, and the resulting structural damage. The loss of home heating may be a contributing factor to the increase in structure fires during the winter months. Local data on historical occurrences, extent of outage and associated costs are not available.

Extent and Historical Trend – High Winds

One example of a **high wind** event in Vermont was the Nor'easter of April 2007 that resulted in a Federal Disaster Declaration, DR-1698. "High winds during this April storm resulted in many trees down and damage to some private homes and public infrastructure, primarily in Southern Vermont." [45] Total Public Assistance for this event was $3,398,000 with the costliest damages in Windham County.

While the vast majority of the impact from Tropical Storm Irene was due to flooding, the Chittenden County area sustained damage from winds of 35 to 45 mph with gusts in excess of 60 mph. Estimated wave heights of 4-6' damaged boats, moorings and knocked down or uprooted numerous trees leaving thousands without power in northern Vermont. An estimated $1.25 million in property damages is attributed to wind.

Since 2010**, NOAA National Centers for Environmental Information's Storm Events Database** recorded over 50 incidents of damaging winds from 30 individual ***Thunderstorm*** events in Windham County. Damage from thunderstorm wind is typically localized in the form of downed trees and powerlines and isolated structural damage to buildings and vehicles. Thunderstorms and associated

[45] 2018 State of Vermont Hazard Mitigation Plan

hazards can occur anywhere in Vermont at any time of the year; however, spring and summer are the most common times for severe thunderstorms. [46]

TABLE 9: High Wind Event Damages in Eastern Windham County, 1/1/2010 – 2/28/2019[47]

EVENT ID	DATE	GUSTS (mph)	EVENT DESCRIPTION
Various*	5/26/2010	50	Severe thunderstorm. Numerous trees and wires were reported down in five town and two homes were damaged from falling trees.
260385	9/30/2010	40-60	Strong gusty winds accompanied a heavy rain event of 3 to 6" across southern Vermont. Widespread power outages, 312 countywide.
	6/8/2011	50	Severe thunderstorm. Trees reported down in two towns, including Grafton.
339926	8/28/2011	Over 60	During Tropical Storm Irene the combination of strong winds, and extremely saturated soil led to numerous downed trees and power lines across the region. This also resulted in widespread long duration power outages and road closures.
416481	10/29/2012	40-60	Remnants of Hurricane Sandy closed Rt 9 due to downed powerlines. Trees down on Interstate 91.
615275	3/1/2016	Over 40	Large tree damage. Trees fell damaging a home.
660716	10/22/2016	Over 50	Downed trees and powerlines, isolated power outages.
679407	3/1/2017	30-45	Multiple trees and power lines were down across the region as a result of the high winds. A few hundred people were without power for a period of time.
Various*	5/18/2017	50	Severe thunderstorm. Trees and wires were reported down along Route 5 and Interstate 91. 4,000 lost power countywide with three towns reporting damage.
Various*	9/5/2017	60	Severe thunderstorm. Extensive wind damage and large hail reported by 5 towns in the county. Numerous trees and powerlines reported down.
726301	10/30/2017	50	Multiple reports of downed trees and powerlines. Thousands of power outages accompanied by heavy rainfall and flooding in the region.
727382	11/19/2017	40-50	1,700 customers lost power in Windham County with a few reports of downed trees and wires.
751995	4/4/2018	40-50	There were multiple reports of trees and wires down.
Various*	5/4/2018	50	Severe thunderstorm. Extensive wind damage and large hail reported by 5 towns in the county, including Grafton. Numerous trees and powerlines reported down and 2,500 customers lost power.
Various*	6/18/2018	50	Severe thunderstorm. Extensive wind damage reported by 5 towns in the county. Numerous trees and powerlines reported down with some structure damage. Over 80,000 lost power across southern Vermont.
Various*	7/28/2018	60	Severe thunderstorm. Extensive wind damage reported by 7 towns in the county. Numerous trees and powerlines reported down with some structure damage including 3 homes, a barn and 3 vehicles.
791613	11/3/2018	45	Over 1,400 people lost power in Windham County
796363	12/17/2018	50	Snow squall with strong winds
803291	1/1/2019	40-50	The winds brought down trees and wires and resulted in scattered power outages.
808829	2/24/2019	50	Numerous power outages and downed trees occurred from winter storm wind damaging one home.

***** Indicates numerous reports for the single event

** Only Severe Thunderstorms affecting 2 or more towns are shown here

[46] 2018 State of Vermont Hazard Mitigation Plan

[47] NOAA, National Centers for Environmental Information

Note that the frequency of high wind events has increased. It is anticipated that extreme weather conditions, due to climate change, will continue to impact the community in the form of high winds in Windham County during the 2019-2023 Plan cycle.

Vulnerable Assets – High Winds

For the Severe Weather hazard category, all Windham County residential areas are vulnerable to **high wind** and **power outages** from high wind events as those areas tend to be more **wooded (See Appendix 1: Map 1-Existing Land Use).**

Town assets are located in developed downtown areas with less trees and are not particularly vulnerable to this hazard. Based on the wind data from **Table 9**, the expected magnitude for future high wind events will fall between around 40 and 50 mph, or Beaufort scale number 8-9, and will likely result in downed trees, power lines, and small damage. However, the possibility does remain for larger high wind events such as the 1998 F3 tornado on the Enhanced Fujita Scale and localized microbursts. As of the writing of this plan, a localized microburst occurred in the Town of Windham near Magic Mountain leaving a swath of damaged trees, either downed or with the crowns sheared off, and substantial home damage which is currently being evaluated.

Heavily tree-lined roads, such as Otis Rd. in the northern part of town, experience frequent outages. Clearing overhanging, leaning, and dying trees near power lines is part of annual town-wide maintenance to minimize impact from high winds.

The Town is currently collaborating with Green Mountain Power and county Fire Departments and Emergency Management to improve communications with the town during recovery repairs.

6. MITIGATION PROGRAM

The following sections detail the mitigation goals and potential mitigation strategies identified by the Town and compiled and organized by the Hazard Mitigation Committee to reduce the impact of the hazards assessed in this plan. The implementation schedule that follows in **Table 10** is a comprehensive list of actions that the town has targeted for implementation during the five-year cycle of this plan.

6.1. Mitigation Goals and Objectives

Following the Hazard Analysis and Hazard Profile review, the Hazard Mitigation Committee then formulated the following overarching goals and associated objectives below. Note that the numbers do not indicate goal priority but are used to identify actions that support it.

Hazard Mitigation Goals and Objectives

1. **Provide protection to the community from impact of hazardous events.**
    a. Reduce the risk of potential loss of life, injuries, negative health impact, and property damage from hazard events, particularly flood, structure fire and erosion.
    b. Maintain and enhance Emergencies Operation Plan.

2. **Improve efforts to raise municipal awareness of the Local Hazard Mitigation Plan and likelihood of undertaking mitigating actions.**
    a. Incorporate hazard mitigation in the Grafton Town Plan, Flood Damage Prevention Regulations, Planning and Zoning, Road Standards and Maintenance Programs, and related projects.
    b. Review progress on hazard mitigation plan strategies and actions during publicly noticed meetings (Selectboard or Planning Commission).
    c. Be proactive in seeking funding opportunities for hazard mitigation projects and informing the public on progress made.
3. **Increase community awareness and resiliency to hazard events.**
    a. Increase efforts to inform residents and businesses of known hazards.
    b. Implement outreach programs to inform community members of pro-active measures they could take.
    c. Improve efforts to help minimize and address financial losses due to hazard events incurred by residents and business owners.
4. **Improve effectiveness of future Hazard Mitigation Planning efforts.**
    a. Improve efforts to identify and inventory vulnerable community assets to future hazards, including town infrastructure, and commercial and residential structures and properties.
    b. Improve efforts to identify and record local hazardous events.
    c. Develop and Implement a process for tracking plan implementation over the plan period.

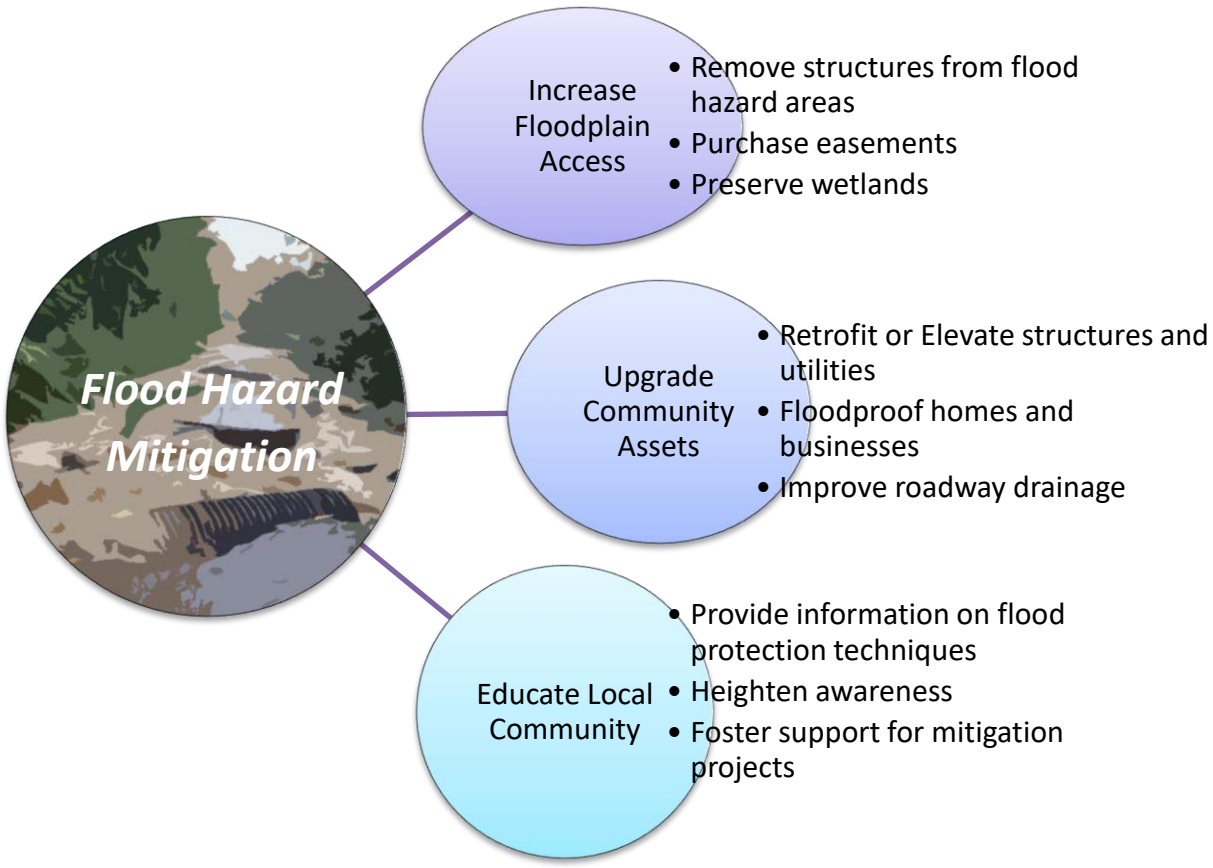
6.2. 2018-2023 Mitigation/Preparedness Strategies and Actions

Strategy Selection and Prioritization Process

The Committee reviewed the Previous Plan Strategies **(Table 1),** Existing Resources **(Table 2)**, the Town Plan and other relevant plans and reports and formulated the following Mitigation and Preparedness Strategies and Actions for the 2019-2023 planning period as listed in **Table 10** below. Efforts were made to identify actions that would address the town's vulnerabilities and achieve the goals and objectives outlined above.

These mitigation actions have been chosen by the committee as the most effective and feasible actions to be taken during this plan period to lessen the impacts of the hazards identified in **Section 5**. A new column has been added to identify the related goal and objective for each action. It was determined that some of the actions from the previous plan have been carried-over with some modifications either because they have been expanded or because of their on-going cyclical nature. Compared to the previous Hazard Mitigation Plan, below are changes in the priority of hazards addressed and changes in the approach on formulating goals and actions:

- The Town's method of hazard assessment was modified to use a number scale.
- The general assessment of natural hazards compared to the previous plan period has not changed except for a higher vulnerability assessment to **Severe Winter Weather** and **High Winds**.
- More local hazard data has been obtained.
- Efforts were made to better identify goals and more specific actions to improve plan effectiveness and clarity in tracking progress. The association of actions to specific goals is also new this plan.



Prioritization of Strategies and Actions

The Committee determined that the method of prioritizing mitigation strategies and actions in **Table 10** be simplified to a more general 'categorizing' of priorities based on three categories – High, Moderate, and Low (see color coded legend below). It was decided that a more general prioritization methodology would improve overall progress on implementation for the follow reasons:

- *Offers the needed flexibility as priorities can change over time.*
- *Allows the Town to take advantage of all funding opportunities as they arise.*
- *Implies that several actions can progress simultaneously.*
- *Encourages the Town to keep all proposed actions in mind.*

To assign action priority, a number of criteria were taken together, in addition to the Hazard Analysis Score in Section 5.1, but weighted subjectively. These are listed below in no particular order. For example, a "High" priority action would typically score higher in the Hazard Analysis and have greater weight for the first two criteria listed below than those with a "Moderate" priority.

- Severity or immediacy of need. This subjective assessment would consider the potential extent of risk in terms of structural damage repair costs, level of safety risk to residents, and probability of occurrence.
- Number of residents impacted that would benefit from mitigation.
- Availability of funding and personnel resources to implement the project. Availability of town, state or federal funds, and availability of town personnel and Windham Regional Commission staff.
- Project feasibility and cost-benefit. Grafton is a small town and does not currently have the capacity to assess the potential damage and cost of repairs for each of the proposed actions. However, prior to pursuing any mitigation project, the Town would consider the costs and benefits of the project using FEMA methodology.

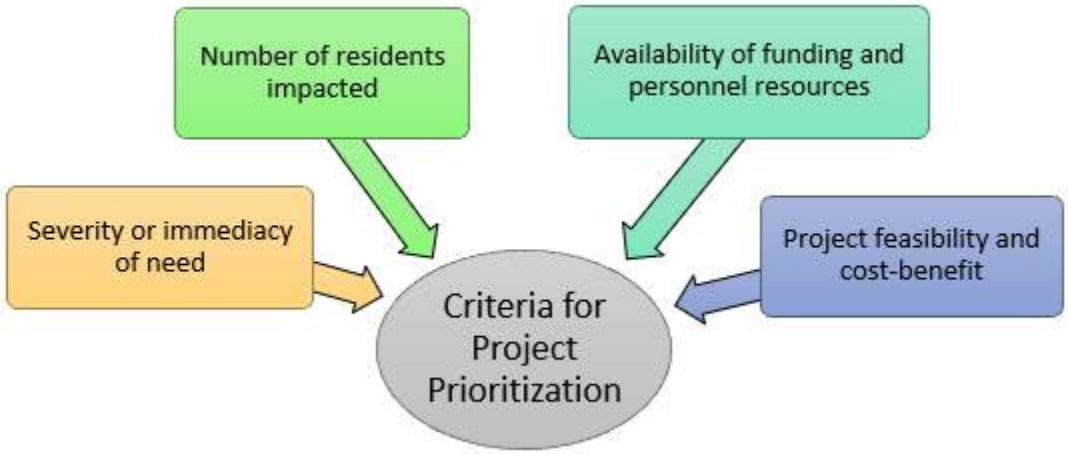


TABLE 10: 2019-2023 Town of Grafton Mitigation/Preparedness Strategies and Actions

High Priority
Moderate Priority
Low Priority

MITIGATION ACTION OR STRATEGY	TYPE[1]	HAZARD ADDRESSED	RELATED GOAL/ OBJECTIVE[2]	RESPONSIBLE PARTY[3]	TIME FRAME	FUNDING SOURCE/ COST TO TOWN[4]
INFRASTRUCTURE PROJECTS[6]						
Upgrade deteriorated culvert #1 on Chester Rd.	M	Flood, Erosion	1a, 2c, 3c	SB, HD	3Q/2019 – 3Q/2020	BRGP, MRGIA, ERGP, CWBG HMGP, FMA, VTrans, TAP, THC2RP, THSGP, Town Match, Town Capital
Assess and repair or upgrade culvert #10 on Fisher Hill Rd.	M	Flood, Erosion	1a, 2c, 3c	SB, HD	3Q/2020 - 3Q/2021	BRGP, MRGIA, ERGP, CWBG, HMGP, FMA, VTrans, TAP, THC2RP, THSGP, Town Match, Town Capital
Re-assess priority and determine cost to design & upgrade culvert #13 on Fisher Hill Rd. should opportunity arise given historic restrictions.	M	Flood, Erosion	1a, 2c, 3c, 4a	SB, HD	Beyond Plan Period – unless washed out	Moderate Town Personnel, BRGP, MRGIA, ERGP, CWBG, HMGP, FMA, VTrans, TAP, THC2RP, THSGP, Town Match, Town Capital to Implement
Conduct hydrology study and engineering for replacement/upgrade of culvert/bridge at intersection of Fisher Hill Rd. and Bell Rd.	M	Flood, Erosion	1a, 2c, 3c	SB, HD	Beyond Plan Period – unless washed out	BRGP, MRGIA, ERGP, CWBG, HMGP, FMA, VTrans, TAP, THC2RP, THSGP, Town Match, Town Capital
Upgrade culvert #1 on Bell Rd.	M	Flood, Erosion	1a, 2c, 3c	SB, HD	2Q/2022 - 2023/3Q	BRGP, MRGIA, ERGP, CWBG, HMGP, FMA, VTrans, TAP, THC2RP, THSGP, Town Match, Town Capital
Upgrade culvert from the Ball Field to Saxtons River on Townshend Road.	M	Flood, Erosion	1a, 2c, 3c	SB, HD	Next Plan Period	Town Capital, Moderate Town Personnel

Upgrade culvert #13 on Eastman Rd.	M	Flood, Erosion	1a, 2c, 3c	SB, HD	2Q/2022 - 2023/3Q	BRGP, MRGIA, ERGP, CWBG, HMGP, FMA, VTrans, TAP, THC2RP, THSGP, Town Match, Town Capital
Assess cost, prioritize and establish a capital plan to upgrade of 7 culverts on Hinkley Brook Rd.	M	Flood, Erosion	1a, 2c, 3c, 4a	SB, HD, PC, DRB, WRC, HMC	4Q/2020 – 4Q/2021	BRGP, MRGIA, ERGP, CWBG, HMGP, FMA, VTrans, TAP, THC2RP, THSGP, Town Match, Town Capital
Pursue funding for a hydrology study and preliminary design to upgrade/retrofit bridge #18 on Cabell Rd. Bridge is undersized causing downstream erosion with debris catchment this can be a severe flooding risk to upstream properties. (See **Appendix F**: Project #18 in RCP, and a priority in RCMR) [2]	M	Flood, Erosion	1a, 2c, 3c	SB, HD, PC, DRB, WRC	1Q/2023 – 4Q/2023	BRGP, MRGIA, ERGP, CWBG, HMGP, FMA, VTrans, TAP, THC2RP, THSGP, Town Match, Town Capital
Pursue funding for a hydrology study and preliminary design to upgrade/retrofit bridge beneath Townshend Rd. on Howe Brook. Bridge is undersized causing upstream bank erosion and is threatening erosion and flooding of adjacent home and roads. (See **Appendix F**: Project #29 in RCP, and a priority in RCMR) [2]	M	Flood, Erosion	1a, 2c, 3c	SB, HD, PC, DRB, WRC	1Q/2023 – 4Q/2023	BRGP, MRGIA, ERGP, CWBG, HMGP, FMA, VTrans, TAP, THC2RP, THSGP, Town Match, Town Capital
Include a review of the Hazard Mitigation Plan in annual capital budgeting process and incorporate projects from this plan.	M	All Hazards	2a, 2c, 3a, 3c	SB, PC, DRB, HMC, EM	Each Year-3Q	Town, Low Town personnel time, WRC
Develop a long-term plan to address new Municipal Roads General Permit (MRGP) standards for prioritizing hydrologically-connected road segments.	M	Erosion	2a, 2c, 3a, 3c, 4a	SB, HD, PC, DRB, HMC, WRC	2Q/2019-4Q/2020	Town, High Town personnel time, WRC
Implement MRGP Plan each year on prioritized	M	Erosion	1a, 2c, 3c, 4a, 4c	SB, HD, WRC	Each Year 2Q & 3Q	BRGP, MRGIA, ERGP, CWBG, HMGP, FMA, VTrans, TAP, THC2RP, THSGP,

road segments as funding becomes available.						Town Match, Town Capital, High Town Personnel time, WRC
Remove Kidder Hill Dam to reduce upstream erosion and flooding. (See **Appendix F**: Project #27 in RCP, and a priority in RCMR) [2]	M	Flood, Erosion	1a, 2c, 3c	SB, CRC	3Q/2019 – 4Q/2019	ERGP, CWBG, Town Match
PLANNING, PROGRAMS AND STRATEGIES						
Evaluate the feasibility of a local limited emergency shelter and plan for effective location of generator.	P	All Hazards	1a, 1b, 3a, 3b	EM, FD, TA, HMC	3Q/2021	HMGP, EMPG, PDM
Review and Update Continuity Plans for Government and Operations	M, P	All Hazards	1b, 2a, 3a, 3b	SB, TA	1Q/2021 - 4Q/2021	Moderate Town Personnel Time
Incorporate hazard mitigation planning into current municipal Town Plan update and other town planning, discussions, and activities to increase project visibility, municipal awareness, and support for funding.	M	All Hazards	2a, 3a	SB, HMC, PC, DRB, WRC	3Q/2019 – 1Q/2020	Moderate Town Personnel Time, WRC
Conduct formal monitoring of this HMP prior to the annual budgeting process and inform the public on progress made to increase community awareness.	M, P	All Hazards	2b, 4c	SB, HMC, TA	3Q-4Q Each Year	Moderate Town Personnel Time
Explore the development of a workable "At-Risk Resident Registry" program and/or outreach effort to identify vulnerable community members eligible for registration with C.A.R.E. to more effectively respond to those in need should a disaster occur.	P	All Hazards	1a, 1b, 3a, 3b, 4a	SB, FD, EM, TA, HMC, HA, SRWC	1Q/2021 – 4Q/2021	High Town Personnel Time, HMGP, C.A.R.E., Private Funders (Ames/Holt)
Review recommended activities from Vermont's	M	Wildland &	1a, 1b, 3a-c	SB, FD	1Q/2021 –	Moderate Town Personnel Time,

"Fire Safe 802 Program" and National Fire Protection Association's "Firewise Program" for outreach ideas to educate community on how to reduce structure fire risk.		Structure Fire			4Q/2021	FPSG, VDFS
Annually review the Vermont Division of Fire Safety's Public Education webpage for new outreach ideas to maintain fire risk awareness. Implement if feasible.	M, P	Wildland & Structure Fire	1a, 1b, 3a-c	SB, FD, HMC	2Q Each Year	Moderate Town Personnel Time, FPSG, VDFS
Enhance current seasonal fire safety awareness program for residents, landowners, and rental properties on Fire Hazards to increase fire awareness during most vulnerable seasonal periods, winter and early spring.	M, P	Wildland & Structure Fire	1a, 1b, 3a-c	SB, FD, HMC	2Q/2022 – 4Q/2022	High Town Personnel Time, FPSG, VDFS
Develop a cost-effective inspection program for Air B&B rental properties for fire and building safety standards to mitigate potential fire hazards and implement, if plausible.	M, P	Structure Fire	1a, 1b, 3a-c	SB, FD, Town Listers, DRB, HA	3Q/2022	High Town Personnel Time, FPSG, VDFS
Pursue activities to attain criteria thresholds under FEMA's NFIP Community Rating System to raise community awareness and increasing available reimbursement funding.	M	Flood, Erosion	1a, 2a, 2c, 3a-c, 4a	SB, PC, TA, DRB, EM, SRWC	1Q/2020 - 3Q/2023	High Town Personnel Time, PDM, HMGP
Review and Update Flood Damage Prevention Regulations (FDPR) to consider extending provisions to upland development if stormwater runoff could impact flood/erosion hazard.	M	Flood, Erosion	1a, 2a, 3c, 4a	SB, PC, TA, DRB, WRC	Next Update of FDPR	Moderate Town Personnel Time, HMGP, PDM, WRC
Consider strengthening stormwater infiltration practices/recommendations for new development to improve flood resiliency and	M	Flood, Erosion	1a, 2a, 3c, 4a	SB, PC, DRB, WRC	To discuss during next Update of FDPR	Moderate Town Personnel Time, HMGP, PDM, WRC

minimize erosion.						
Identify property owners located within Special Flood Hazard Areas or River Corridor and develop an outreach plan to educate them on flood and erosion risks, mitigation ideas, local by-laws and NFIP.	M, P	Flood, Erosion	1a, 3a-c, 4a	HMC, PC, DRB, WRC, SRWC	1Q/2021 – 1Q/2023	High Town Personnel Time, HMGP, PDM, WRC, VWG
Expand outreach to residents and developers on the State Standard Building Codes and Safety Regulations for fire prevention.	M	Structure Fire	1a, 3a-c, 4a	FD, HA	1Q/2022-2Q/2022	Moderate Town Personnel Time
Further investigate and proactively seek viable options and funding for conservation easements and buffer restoration to improve floodplain access; particularly in the Willie and Styles Brook area west of Townshend Rd. Riprap and berming have reduced floodplain access west of Townshend Rd. putting homes and the road at risk. Passive restoration is recommended to restore floodplain access. (See **Appendix F**: Project #31 in RCP, and a priority in RCMR) [2]	M	Flood, Erosion	1a, 3a-c, 4a	SB, PC, DRB, WRC, SRWC	2Q/2020 – 2Q/2021	RCCEG, CRC, VLT, Private Funds, VRC, PDM, FMA, Moderate Town personnel cost to explore, Town Match
Further investigate and prioritize long-term stream corridor protection in areas identified in RCP through passive restoration, such as easements and buffer restorations to reduce property loss from erosion and potentially improve floodplain access to reduce risk of flooding downstream. (See **Appendix F**: Project #11, 12, 13, 15, 17, 28, and 30 in RCP, and a priority in RCMR) [2]	M	Flood, Erosion	1a, 3a-c, 4a	SB, PC, DRB, WRC, SRWC	2Q/2020 – 2Q/2023	RCCEG, CRC, VLT, Private Funds, VRC, PDM, FMA, Moderate Town personnel cost to explore, Town Match

[1] M – Mitigation, P – Preparedness
[2] As identified in the Saxtons River Corridor Mapping Report (RCMR) and/or the Saxtons River Corridor Plan (RCP)
[3] See Related Goal/Objective in **Section 6.1**
[4] Responsible Party:

HMC – Hazard Mitigation Committee
SB - Selectboard
DRB – Development Review Board
EM – Emergency Management
PC – Planning Commission
HD - Highway Department
HA – Health Administrator
TA – Town Administrator
FD - Fire Department/Rescue
WRC – Windham Regional Commission
SRWC – Saxtons River Watershed Collaborative

[5] Funding Source:

HMGP - Hazard Mitigation Grant Program (VT State Department of Emergency Management)
EMPG – Emergency Management Performance Grant (VT State Department of Emergency Management)
BRGP – Better Roads Grant Program
MRGIA – Municipal Roads Grants-In-Aid Program
ERGP - Ecosystem Restoration Grant Program
CWBG – Clean Water Block Grant Program
CDBG – VT ACCD Community Development Block Program
THSGP – Town Highway Structures Grant Program
THC2RP – Town Highway Class 2 Road Program
MHSMP – Municipal Highway Stormwater Mitigation Program
TAP – Transportation Alternatives Program
VMG – Vermont Watershed Grant
VLT – Vermont Land Trust
VTrans – Vermont Transportation Agency
RCCEG – River Corridor Conservation Easement Grant (ERPG)
CRC – Connecticut River Conservancy
VRC – Vermont River Conservancy

HBP – FEMA Home Buyout Program
FMA – FEMA Flood Mitigation Assistance Program
PDM – FEMA Pre-Disaster Mitigation Program
FPSG – FEMA Fire Prevention & Safety Grant
VDFS – Vermont Division of Fire & Safety

[6] Infrastructure projects from Grafton Road Erosion Inventory Report unless stated otherwise. These projects have been identified by the Windham Regional Commission to reduce road or streambank erosion and potentially reduce the risk of flooding.

6.3. Plan Monitoring and Maintenance Process

Plan Monitoring

The Hazard Mitigation Committee will be responsible for monitoring this plan as outlined below, to ensure that progress is made and identified mitigation actions are implemented as resources or opportunities become available. The Town will work with its regional partners, including Windham Regional Commission, to identify funding opportunities and for assistance with funding applications.

New this plan update is an effort to formalize a method for monitoring and evaluating the Town's progress on action items and to improve local hazard data collection. The monitoring process has been identified as an action item to be implemented annually (at a minimum) over the plan period and will include a noticed annual meeting of the Hazard Mitigation Committee, to review and track the following:

- progress on hazard mitigation strategies in **Table 10**;
- improvements in effectiveness of other resources in **Table 2**;
- updates to local, regional or State hazard data occurrences and extent;
- changes in prioritization of identified hazards;
- whether stated goals are being achieved; and
- consistency with other Town Plan goals, policies, and recommendations.

This formal review process will be conducted annually by the Hazard Mitigation Committee prior to the Town's annual budgeting process each fall with the completion of **Hazard Mitigation Plan Monitoring Form** in **Appendix H.** Completed forms will become part of this plan, distributed to the Town Selectboard and Planning Commission and, and made available for public viewing by posting on the Town website and making copies available at Town Hall.

An opportunity to provide public input will be scheduled for a Selectboard meeting once each year following the annual committee review above. These public meetings will have the Hazard Mitigation Committee provide updates on the progress made on plan strategies and actions outlined in **Table 10** and projected project implementation and funding for the next year. For these scheduled meetings, input will be requested, and involvement encouraged, from representatives of the Planning Commission, Emergency Management, Grafton Fire and Highway Departments, along with local volunteer boards and interested members of the public and other stakeholders.

Participants will be encouraged during these review periods to identify new hazards, additional vulnerable areas and assets and suggest new potential mitigating measures. All public input during the annual plan monitoring process will be recorded.

In addition, the Town will consider and incorporate appropriate hazard mitigation actions from **Table 10** as part of the planning process for updates to the Town Plan, Planning and Zoning Regulations, and Flood Damage Prevention Regulations, as well as for future community development projects. The Hazard Mitigation Committee will also be responsible for ensuring proposed mitigation actions remain in line with current town goals, strategies, and policies.

Plan Maintenance Process

Four years into the plan period, the Town will reconvene the Hazard Mitigation Committee in summer 2022 to kick-off the update process with an initial meeting to discuss contracting services for assistance in the planning process. The Town Administrator will again reach out to the community for additional volunteers to participate as members of the Hazard Mitigation Committee for the new plan period.

With the assistance of the Windham Regional Commission, or other consulting services, the Town will review the prior plan progress and monitoring forms. The Committee will conduct the planning activities as outlined in the Process Flow Chart **(Appendix C**) and incorporate the plan monitoring information, updated hazard data, town and regional plans, and new relevant reports and studies. All public meetings will be warned following town protocols.

A preliminary draft plan which will be made available for public comment. The plan will be available on the town and regional websites, and hard copies will be available at the town office. A second publicly warned meeting will be held no later than second quarter 2023, during which any substantial revisions gathered during the public input period will be discussed. All final edits and revisions will be made and a final draft will be provided to the Hazard Mitigation Committee for final review.

Subsequently, the plan will be sent to Vermont Emergency Management for review and referral to FEMA for Approval Pending Adoption (APA). Following the receipt of APA, the Grafton Town Selectboard may then adopt the updated Local Hazard Mitigation Plan and forward a copy of the adoption resolution to FEMA to complete the plan approval and adoption process.

Appendix A

CHESTER

WINDHAM

ROCKINGHAM

TOWNSHEND

ATHENS

Houghtonville

Houghtonville Rd

Houghtonville Rd

Saxtons River

121

Houghtonville Rd

Rd

Cabell Rd

Howe Brook

Hall Brook

Chester Rd

Burgess Cemetery

W.C. Putnam State Forest

Eastman Rd

Chester Rd

Eastman

Hall Brook

Rockingham Town Forest

Rd

Dorand State Forest

Hill Rd

Ada Ln

Grafton Town Forest

Fisher

Fisher Hill Rd

Middletown Rd

Saxtons River

121

35

Hinkley Brook Rd

Hinkley Brk

Main St

Grafton

Village Park

Rte 121 E

121

35

Cambridgeport Rd

Townshend Rd

Mollie Beattie State Forest

Howe Brook

Saxtons River

Rte 121 E

Ledge Road Brook

Cambridgeport

121

35

Athens Rd

Miller Brook

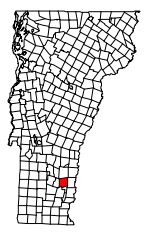
Turner Hill Wildlife Mgt. Area

Townshend Rd

South Branch

Stiles Brook

Existing Land Use
Town of Grafton, Vt.
November 2018



GIS Vermont Geographic Information System

WINDHAM REGIONAL COMMISSION

139 Main St • Suite 505 • Brattleboro, VT 05301

(802) 257-4547 www.windhamregional.org

0.5 0 0.5 1 1.5 Miles

1:42,000

Buildings (from E911):

- Commercial
- Public/Institutional
- Single-family
- Multi-family

- Village
- State forest, town forest, town park
- Parcel enrolled in Use Value Appraisal, 2013
- Conservation easement

- paved roads
- unpaved roads
- Stream
- Pond or river

Data sources:

- Village boundaries were determined by the Grafton Planning Commission. Boundary data were developed by WRC GIS staff using existing roads, surface waters, and parcel data.

- State and town forest lands were derived from 1:5000 parcel coverage.

- Building locations and type are from the Vermont Enhanced 9-1-1 program and are current to 2018.

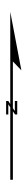
- Parcels enrolled in Use Value Appraisal were digitized by Windham Regional Commission using information provided by the Vermont Department of Taxes and the Windham County Forester.

November 2018; u:\GIS\Towns\Grafton\TP2019_ELU.mxd

Resource Areas - Land

Town of Grafton, Vt.

November 2018



GIS
Vermont Geographic Information System

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(802) 257-4547 www.windhamregional.org

0.5 0 0.5 1 1.5 2 Miles

1:48,000

- Gravel pit
- Scenic view
- Scenic road
- Sand and gravel resources
- 100-foot contour line
- Important farmland soil
- Stream
- Pond or river
- paved roads
- unpaved roads

Data sources:

- Important farmland soil delineations are derived using soils data available from VCGI. These soils qualify as Primary Agricultural Soils under Act 250. Soil boundary data were digitized from 1:20,000 orthophotos from the Windham County Soil Survey.

- Scenic roads and views were taken from the 1986 Resource Areas Town Plan map.

- Gravel pit locations were digitized from the 1982 Windham County Soil Survey.

- Sand and gravel resources are from the VGIS data layer AGGRES. This data layer was derived from "Geology for Environmental Planning" series, which in turn was derived from U.S. Geological Survey sources.

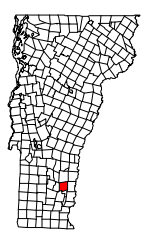
- Contour lines were generated from USGS 1:24000 Digital Elevation Models by WRC using ESRI's Spatial Analyst. They are intended to portray the general hypsography of the area and should not be used to determine actual elevations.

November 2018; u:\GIS\Towns\Grafton\Maps\TP2019_Res1.mxd

Community Facilities

Town of Grafton, Vt.

November 2018



GIS Vermont Geographic Information System

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(802) 257-4547 www.windhamregional.org

0.5 0 0.5 1 1.5 Miles

1:42,000

- Cemetery (town-wide map)
- Cemetery (village inset map)
- Community facility (town-wide map)
- Community facility (village inset map)
- School
- Church
- Electric transmission line
- State forest, town forest, town park

Data sources:

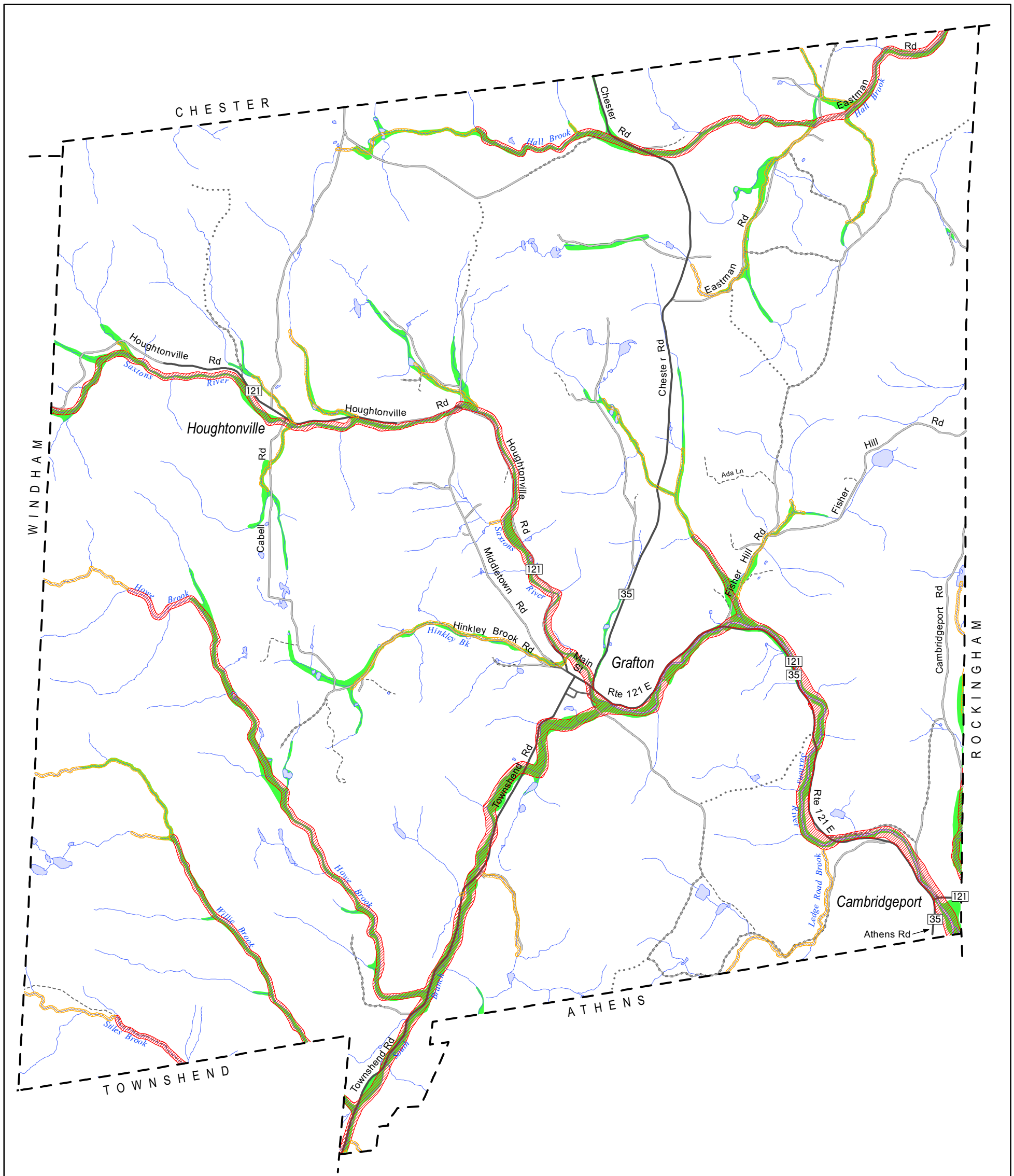
- Electric transmission lines were digitized from 1:5000 orthophotos by Greenhorne & O'Mara Inc. under contract with OGIS.

- Cemetery locations were determined by WRC using 1:5000 orthophotos and 1:5000 digital parcel data.

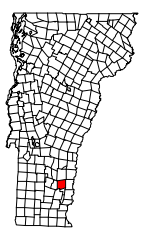
- Community facilities were identified by the Grafton Planning Commission. Locations were determined by WRC using 1:5000 orthophotos and building points located by GPS for Vermont's Enhanced 9-1-1 project.

- Public land boundaries were determined using Grafton's 1:5000 digital parcel data.

November 2018; u:\GIS\Towns\Grafton\TP2019_commfac.mxd



Flood Hazards
Town of Grafton, Vt.
November 2018



GIS
Vermont Geographic Information System

WINDHAM REGIONAL COMMISSION
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(802) 257-4547 www.windhamregional.org

0.5 0 0.5 1 1.5 Miles

1:42,000

- Special Flood Hazard Area
- Mapped River Corridor
- Streams with A River Corridor 50-foot setback

Official source of River Corridor data is tinyurl.com/floodreadyatlas. Where river corridors are not mapped (i.e., a stream with a drainage area of between 0.5 and 2 square miles), the corridor is measured 50 feet horizontally from the top of the stream bank.

Data sources:

- Special Flood Hazard Area boundaries (i.e. "the 100-year floodplain") are from FEMA (Federal Emergency Management Agency) D-FIRM (Digital Flood Insurance Rate Map) data effective September 28, 2007.

- Statewide River Corridors are from VT ANR Rivers Program 2015 data (VGIS data layer RIVERCORRIDORS).

November 2018; u:\GIS\Towns\Grafton\TP2019_FloodHazards.mxd

GIS
Vermont Geographic Information System

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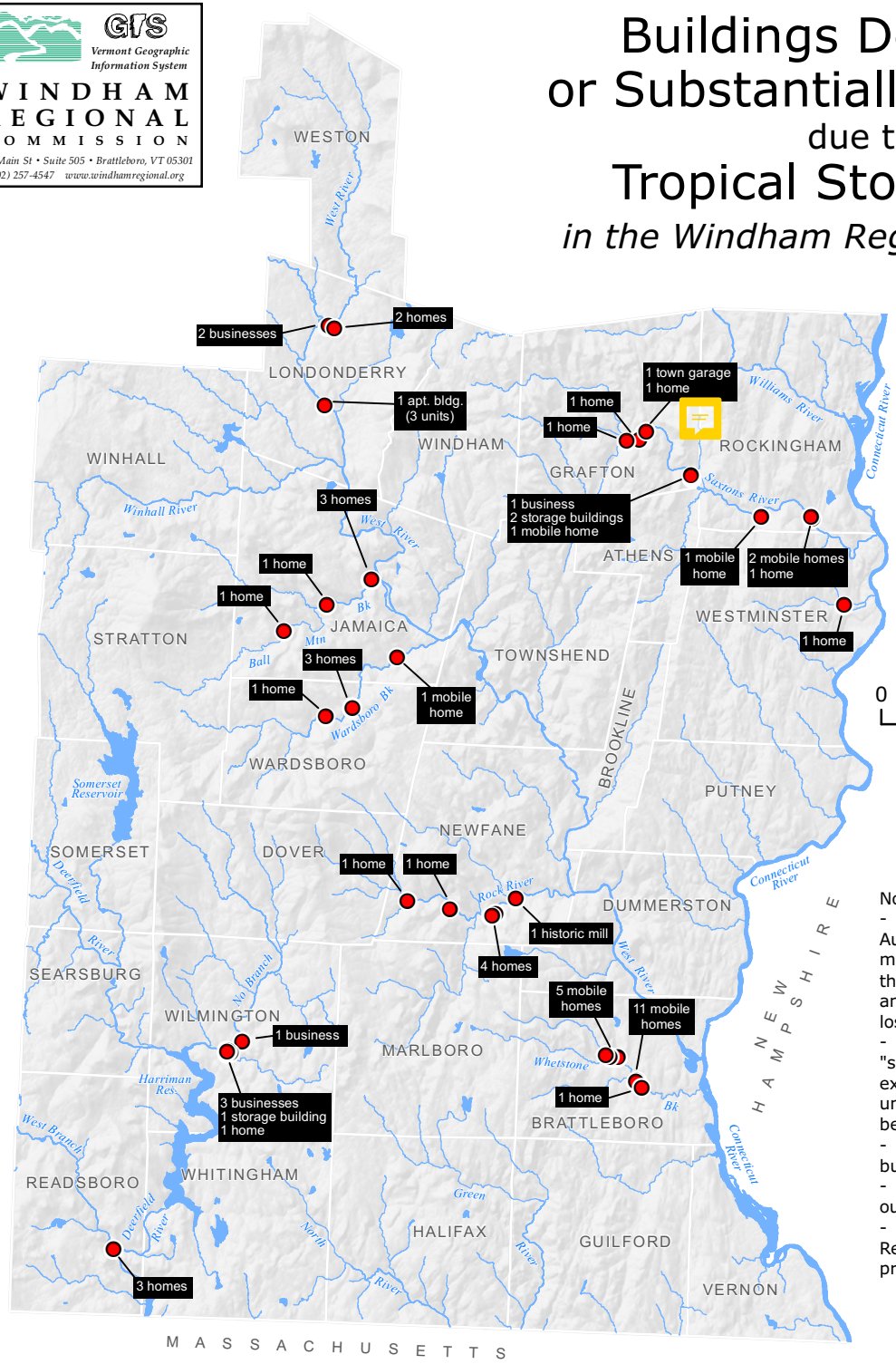
(802) 257-4547 www.windhamregional.org

Buildings Destroyed or Substantially Damaged due to Tropical Storm Irene

in the Windham Region of Vermont



Notes:
- As a result of Tropical Storm Irene, August 28, 2011, the buildings on this map were either: destroyed; damaged to the point that they were no longer usable and were not repaired; deemed a "total loss"; or deemed "substantially damaged."
- Some buildings deemed a "total loss" or "substantially damaged" did not suffer extensive damage, but the cost of repair under current regulations would have been prohibitive.
- A "business" means a commercial building.
- Only major buildings are shown; minor outbuildings have not been mapped.
- Data were collected by Windham Regional Commission from information provided by town officials.

town	address	bldg_type
Brattleboro	58 Glen St	mobile home
Brattleboro	62 Glen St	mobile home
Brattleboro	66 Glen St	mobile home
Brattleboro	59 Glen St	mobile home
Brattleboro	63 Glen St	mobile home
Brattleboro	67 Glen St	mobile home
Brattleboro	71 Glen St	mobile home
Brattleboro	75 Glen St	mobile home
Brattleboro	79 Glen St	mobile home
Brattleboro	81 Glen St	mobile home
Brattleboro	1 Village Dr	mobile home
Brattleboro	36 Brookwood Dr	mobile home
Brattleboro	46 Village Dr	mobile home
Brattleboro	30 Brookwood Dr	mobile home
Brattleboro	10 Winding Hill Rd	mobile home
Brattleboro	127 Glen St	mobile home
Brattleboro	805 Western Av	mobile home
Grafton	778 Route 121 E	town garage
Grafton	516 Route 121 E	house
Grafton	882 Rte 121 E	house
Grafton	55 Kidder Hill Rd	house
Grafton	121 Parker Hill Rd	storage building
Grafton	153 Parker Hill Rd	storage building
Grafton	175 Parker Hill Rd	mobile home
Grafton	201 Parker Hill Rd	business
Jamaica	275 Water St	house
Jamaica	289 Water St	house
Jamaica	317 Water St	house
Jamaica	309 Water St	house
Jamaica	1990 Pikes Falls Rd	house
Jamaica	2565 W Jamaica Rd	house
Jamaica	1881 Route 100 S	mobile home
Londonderry	2528 Route 11	house
Londonderry	2306 N Main St	business
Londonderry	2331 N Main St	business
Londonderry	2550 Route 11	house
Londonderry	434 Main St	apartment building
Newfane	28 Stratton Hill Rd	house
Newfane	279 Dover Rd	house
Newfane	236 Dover Rd	house
Newfane	5 Hickey Rd	house
Newfane	246 Dover Rd	house
Newfane	275 Dover Rd	house
Newfane	n/a, old mill	house
Readsboro	62 School St	house
Readsboro	40 School St	house
Readsboro	42 School St	house
Rockingham	409 Saxtons River Rd	house
Rockingham	429 Saxtons River Rd	mobile home
Rockingham	443 Saxtons River Rd	mobile home
Rockingham	37 Westminster West Rd, Lot 1	mobile home
Wardsboro	2085 Route 100	house
Wardsboro	244 S Wardsboro Rd	house
Wardsboro	108 S Wardsboro Rd	house
Wardsboro	222 S Wardsboro Rd	house
Westminster	36 Town Garage Rd	house
Wilmington	3 Shafter St	house
Wilmington	130 Route 100 N	business
Wilmington	5 W Main St	business
Wilmington	36 W Main St	business
Wilmington	23 W Main St	business
Wilmington	n/a, storage building	storage building

October 2013; c:\projects\604B_12\Buildings_8x11_landscape.mxd

Appendix B

VOLUNTEER FORM TO DOCUMENT IN-KIND SERVICES - MATCH INFORMATION

PROGRAM: Grafton Hazard Mitigation Plan Update
DATE OF MEETING: February 15, 2019
MEETING LOCATION: Town Highway Department
TOPIC: Hazard Mitigation Planning
MEETING TIME: 5:30 PM - 6:45 PM

VOLUNTEER ATTENDEES - CLAIMED

No.	NAME	AFFILIATION	MILEAGE ROUND TRIP	MEETING HOURS	TOTAL MILEAGE	TOTAL TIME
					0.58	$24.14
1	Wiiliam Kearns	Graftton Town Administrator	4	1.25	2.32	30.18
2	Allan Sands	Graftton Emergency Management, Selectb	16	1.25	9.28	30.18
3	Danny Taylor	Grafton Highway Department		1.25	-	30.18
4	Liz Harty	Grafton Elementary School Principal	18	1.25	10.44	30.18
5	Kim Record	Grafton Town Clerk	0.25	1.25	0.15	30.18
6	Keith Hermiz	Grafton Rescue Squad	5	1.25	2.90	30.18
7	Stan Mack	Selectboard	5	1.25	2.90	30.18
8	Richard Thompson	Grafton Fire Chief	1	1.25	0.58	30.18
9	Robert Sprague	Grafton Fire Department		1.25	-	30.18
10					-	-
11					-	-
12					-	-
13					-	-
14					-	-
15					-	-
16					-	-
17					-	-
18					-	-
34					-	-
35					-	-
		Sub Total	49.25	11.25	$28.57	$271.58

FEDERALLY SUPPORTED PERSONNEL - CAN NOT CLAIM

No.	NAME	AFFILIATION	MILEAGE ROUND TRIP	MEETING HOURS	TOTAL MILEAGE	TOTAL TIME
					0.565	$24.14
1	Cindy Ingersoll	New England Digital Resources			-	-
2					-	-
3					-	-
4					-	-
5					-	-
6					-	-
7					-	-
8					-	-
9					-	-
10					-	-
		Sub Total	49.25	11.25	$0.00	$0.00

TOTAL MATCH	$300.14
TOTAL Non-Volunteer Match	-
TOTAL VOLUNTEER MATCH	$300.14

VOLUNTEER FORM TO DOCUMENT IN-KIND SERVICES - MATCH INFORMATION

PROGRAM: Grafton Hazard Mitigation Plan Update
DATE OF MEETING: February 28, 2019
MEETING LOCATION: Town Highway Department
TOPIC: Hazard Mitigation Planning
MEETING TIME: 5:00 PM - 6:15 PM

VOLUNTEER ATTENDEES - CLAIMED

No.	NAME	AFFILIATION	MILEAGE ROUND TRIP	MEETING HOURS	TOTAL MILEAGE	TOTAL TIME
					0.58	$24.14
1	Wiiliam Kearns	Graftton Town Administrator		1.25	-	30.18
2	Allan Sands	Graftton Emergency Management, Selectb	16	1.25	9.28	30.18
3	Richard Thompson	Grafton Fire Chief		1.25	-	30.18
4	Liz Harty	Grafton Elementary School Principal		1.25	-	30.18
5	Kim Record	Grafton Town Clerk		1.25	-	30.18
6	Keith Hermiz	Grafton Rescue Squad		1.25	-	30.18
7	Stan Mack	Selectboard		1.25	-	30.18
8					-	-
9					-	-
10					-	-
11					-	-
12					-	-
13					-	-
14					-	-
15					-	-
16					-	-
17					-	-
18					-	-
34					-	-
35					-	-
		Sub Total	16.00	8.75	$9.28	$211.23

FEDERALLY SUPPORTED PERSONNEL - CAN NOT CLAIM

No.	NAME	AFFILIATION	MILEAGE ROUND TRIP	MEETING HOURS	TOTAL MILEAGE	TOTAL TIME
					0.565	$24.14
1	Cindy Ingersoll	New England Digital Resources			-	-
2					-	-
3					-	-
4					-	-
5					-	-
6					-	-
7					-	-
8					-	-
9					-	-
10					-	-
		Sub Total	16.00	8.75	$0.00	$0.00

TOTAL MATCH	$220.51
TOTAL Non-Volunteer Match	-
TOTAL VOLUNTEER MATCH	$220.51

VOLUNTEER FORM TO DOCUMENT IN-KIND SERVICES - MATCH INFORMATION

PROGRAM: Grafton Hazard Mitigation Plan Update
DATE OF MEETING: March 28, 2019
MEETING LOCATION: Town Highway Department
TOPIC: Hazard Mitigation Planning
MEETING TIME: 5:00 PM - 6:15 PM

VOLUNTEER ATTENDEES - CLAIMED

No.	NAME	AFFILIATION	MILEAGE ROUND TRIP	MEETING HOURS	TOTAL MILEAGE	TOTAL TIME
					0.58	$24.14
1	Wiiliam Kearns	Graftton Town Administrator	4	1.25	2.32	30.18
2	Allan Sands	Graftton Emergency Management, Selectb	16	1.25	9.28	30.18
3	Richard Thompson	Grafton Fire Chief	1	1.25	0.58	30.18
4	Robert Sprague	Grafton Fire Department		1.25	-	30.18
5	Kim Record	Grafton Town Clerk	0.25	1.25	0.15	30.18
6	Keith Hermiz	Grafton Rescue Squad	5	1.25	2.90	30.18
7	Stan Mack	Selectboard	5	1.25	2.90	30.18
8					-	-
9					-	-
10					-	-
11					-	-
12					-	-
13					-	-
14					-	-
15					-	-
16					-	-
17					-	-
18					-	-
34					-	-
35					-	-
		Sub Total	31.25	8.75	$18.13	$211.23

FEDERALLY SUPPORTED PERSONNEL - CAN NOT CLAIM

No.	NAME	AFFILIATION	MILEAGE ROUND TRIP	MEETING HOURS	TOTAL MILEAGE	TOTAL TIME
					0.58	$24.14
1	Cindy Ingersoll	New England Digital Resources			-	-
2					-	-
3					-	-
4					-	-
5					-	-
6					-	-
7					-	-
8					-	-
9					-	-
10					-	-
		Sub Total	31.25	8.75	$0.00	$0.00

TOTAL MATCH	$229.35
TOTAL Non-Volunteer Match	-
TOTAL VOLUNTEER MATCH	$229.35

VOLUNTEER FORM TO DOCUMENT IN-KIND SERVICES - MATCH INFORMATION

PROGRAM: Grafton Hazard Mitigation Plan Update
DATE OF MEETING: June 20, 2019
MEETING LOCATION: Town Highway Department
TOPIC: Hazard Mitigation Planning
MEETING TIME: 5:30 PM - 8:00 PM

VOLUNTEER ATTENDEES - CLAIMED

No.	NAME	AFFILIATION	MILEAGE ROUND TRIP	MEETING HOURS	TOTAL MILEAGE	TOTAL TIME
					0.58	$24.14
1	Wiiliam Kearns	Graftton Town Administrator	4	2.5	2.32	60.35
2	Kim Record	Grafton Town Clerk	0.25	2.5	0.15	60.35
3	Dave Culver	Resident	1	2.5	0.58	60.35
4					-	-
5					-	-
6					-	-
7					-	-
8					-	-
9					-	-
10					-	-
11					-	-
12					-	-
13					-	-
14					-	-
15					-	-
16					-	-
17					-	-
18					-	-
34					-	-
35					-	-
		Sub Total	5.25	7.50	$3.05	$181.05

FEDERALLY SUPPORTED PERSONNEL - CAN NOT CLAIM

No.	NAME	AFFILIATION	MILEAGE ROUND TRIP	MEETING HOURS	TOTAL MILEAGE	TOTAL TIME
					0.58	$24.14
1	Cindy Ingersoll	New England Digital Resources			-	-
2					-	-
3					-	-
4					-	-
5					-	-
6					-	-
7					-	-
8					-	-
9					-	-
10					-	-
		Sub Total	5.25	7.50	$0.00	$0.00

TOTAL MATCH	$184.10
TOTAL Non-Volunteer Match	-
TOTAL VOLUNTEER MATCH	$184.10

VOLUNTEER FORM TO DOCUMENT IN-KIND SERVICES - MATCH INFORMATION

PROGRAM: Grafton Hazard Mitigation Plan Update
DATE OF MEETING: July 1, 2019
MEETING LOCATION: Town Highway Department
TOPIC: Selectboard Meeting LHMP Draft Review
MEETING TIME: 5:30 PM - 7:00 PM

VOLUNTEER ATTENDEES - CLAIMED

No.	NAME	AFFILIATION	MILEAGE ROUND TRIP	MEETING HOURS	TOTAL MILEAGE	TOTAL TIME
					0.58	$24.14
1	Joe Pollo	Selectboard Chair		1.5	-	36.21
2	Stan Mack	Selectboard Vice Chair	5	1.5	2.90	36.21
3	Cathy Siano-Goodwin	Selectboard		1.5	-	36.21
4	Josh Hearne	Selectboard		1.5	-	36.21
5	Suzanne Welch	Resident		1.5	-	36.21
6	Dottie Cannen	Resident		1.5	-	36.21
7	Joan Lake	Resident		1.5	-	36.21
8	Jack Briar	Grafton School Board		1.5	-	36.21
9	Eric Stevens	Planning Commission		1.5	-	36.21
10	Danny Taylor	Road Foreman		1.5	-	36.21
11	Don Dougal	Resident		1.5	-	36.21
12	Peter Jezorski	Resident		1.5	-	36.21
13	Galen Pinkham	Resident		1.5	-	36.21
14	Jess Westclark	Resident		1.5	-	36.21
15	Sam B	Resident		1.5	-	36.21
16	Kim Record	Grafton Town Clerk	0.25	1.5	0.15	36.21
17					-	-
18					-	-
34					-	-
35					-	-
		Sub Total	**5.25**	**24.00**	**$3.05**	**$579.36**

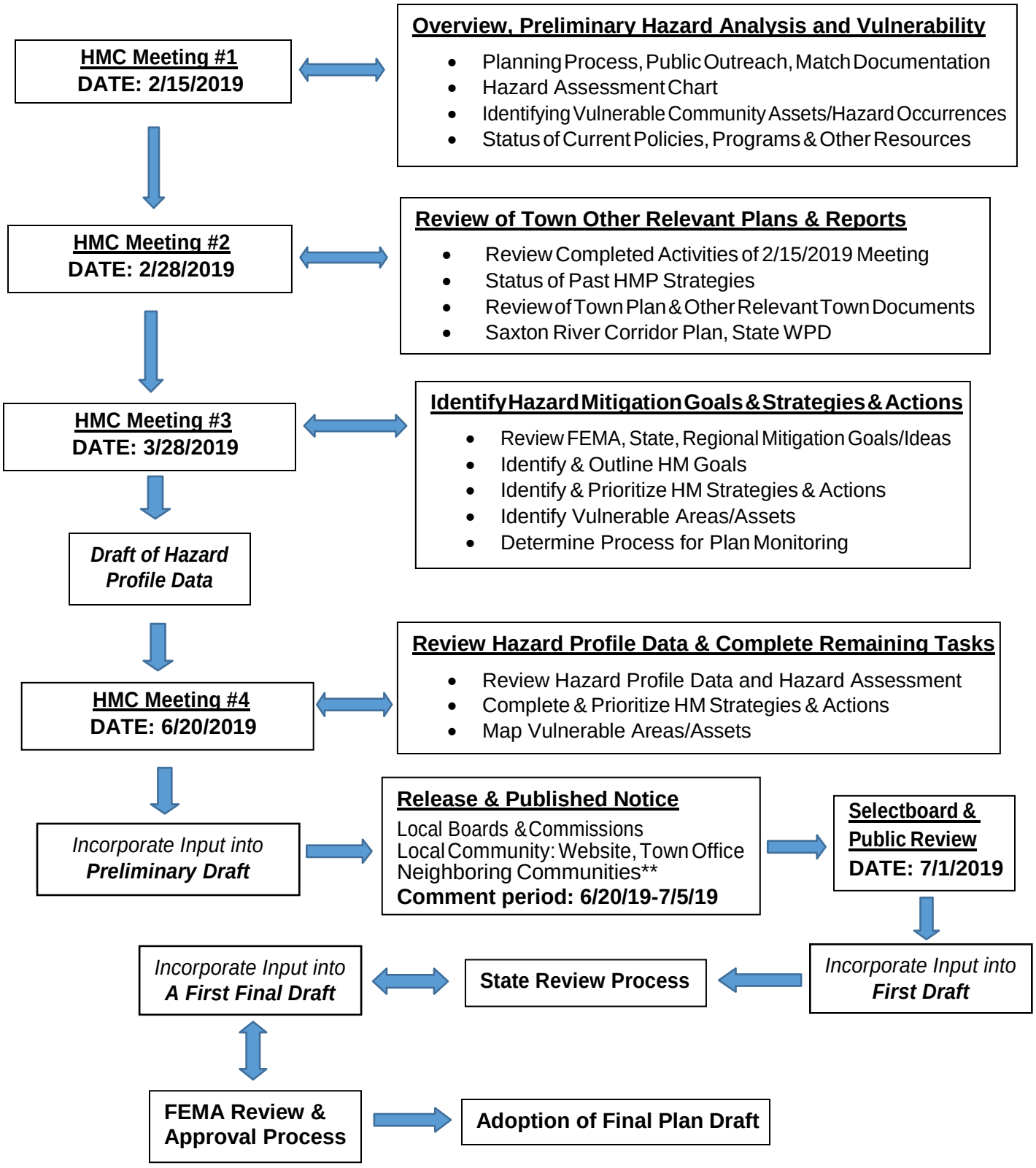
FEDERALLY SUPPORTED PERSONNEL - CAN NOT CLAIM

No.	NAME	AFFILIATION	MILEAGE ROUND TRIP	MEETING HOURS	TOTAL MILEAGE	TOTAL TIME
					0.58	$24.14
1	Cindy Ingersoll	New England Digital Resources			-	-
2					-	-
3					-	-
4					-	-
5					-	-
6					-	-
7					-	-
8					-	-
9					-	-
10					-	-
		Sub Total	**5.50**	**25.50**	**$0.00**	**$0.00**

TOTAL MATCH	**$582.41**
TOTAL Non-Volunteer Match	**-**
TOTAL VOLUNTEER MATCH	**$582.41**

Appendix C

APPENDIX C
Town of Grafton Hazard Mitigation Committee
2019-2023 Hazard Mitigation Plan Process Flow Chart



***Neighboring Community includes Andover, Athens, Chester, Rockingham, Springfield, Townshend, Windham*

Appendix D

APPENDIX D

2019(Draft) Grafton Town Plan Review

Below are goals, policies, and recommendations from the 2019-2026 Draft Grafton Town Plan subsections that were determined to be relevant to hazard mitigation planning.

Land Use

- Use conservation methods and river easements consistent with Act 171 guidance for the protection of habitat for wildlife and to promote flood resiliency.
- Examine lands adjacent to waterways and river corridors. Update the Town maps to include the most recent accurate data on flood zones. Identify priority areas to promote conservation of natural resources and use of conservation easements.

Historic, Cultural and Natural Resources

- Areas with routine flood hazard potential can be found along the Saxtons River, South Branch of the Saxtons River, Hinkley Brook, Kidder Hill Road, and Fisher Hill Road. It should be recognized that many smaller streams have potential for local flooding, flash flooding, and washouts.
- Identify, protect and preserve important historic sites and landscape features including structures, bridges, stonewalls, foundations, mill sites and ruins.
- Manage the floodplain by enforcing community Flood Damage Prevention Regulations which are compliant with the National Flood Insurance Program.
- Ensure that the scenic and recreational value and environmental quality of stream banks and shorelines are maintained.
- Discourage clear-cutting unless as part of a forest management plan. Minimize cutting of trees on stream banks. When appropriate, remove logging debris from watercourses.
- Encourage the use of conservation and river easements consistent with Act 171 guidance for the protection of habitat for wildlife and to promote flood resiliency.
- The Town of Grafton will continue to identify and catalog historic settlement patterns (i.e., the historical record on land use), historic sites & structures, archeological sites, ancient roads, old cellar holes, and stonewalls within the Town and assess the need for further protective measures.
- Encourage plantings of willows, dogwoods, sumac, and viburnum along the town's waterways to strengthen river banks, improve flood control, and combat the spread of invasive plant species.
- Pursue a planning project that examines lands adjacent to waterways and river corridors. Update the Town's maps to include the most recent data on flood zones.
- Promote conservation easements by identifying priority conservation of natural resource areas and informing land owners of opportunities in land stewardship and conservation easements.

Roads and Transportation

- Maintain road ditches, bridges and culverts for roadbed drainage, storm water capacity, and prevention of roadside erosion.
- Continue the timely maintenance of Grafton's roads and bridges through capital planning and budgeting.

Energy

- The rivers and streams that flow through Grafton have potential for hydroelectric energy generation. At this high elevation, Grafton lies in the headwaters of the Saxtons River watershed. These headwaters are delicate ecosystems and must not be disturbed. Flooding of the village, as well as surrounding areas is also a concern. Any development of hydroelectric power should utilize run- of-river diversion with no significant impoundment of water.
- Adhere to a high environmental standard that includes avoiding negative environmental impacts to the extent possible and adequately minimizing and mitigating those that cannot be avoided.
- Conduct thorough and proper studies and analyses of all anticipated socioeconomic and environmental impacts, both positive and negative.

Town and Government Services

- Promote emergency planning and build a disaster-resistant community.
- Keep all Town officials and first responders trained in emergency management.
- Require that all new public and private roads and driveways be properly constructed so that they do not contribute to the damage of Town or State roads from run-off.
- Encourage the improving of existing roads, and design culverts and bridges to carry a 25-year flood event without damage.
- Encourage the development of additional fire ponds.
- Require that fire ponds and dry hydrants be maintained by their owners.
- Ensure that year-round access to properties is maintained by the owner in case of emergencies.
- Continue the development and improvement of emergency evacuation plans**.**
- Require that the Town maintain its Local Emergency Operations Plan and update it annually.
- Require that the Town continue to participate in the National Flood Insurance Program.
- Continue to support the Grafton Firefighters' Association through annual appropriations and include its capital requirements in the Capital Budget.
- Develop an effective communication between the Firemen's Association and the Selectboard.
- Assist the Rescue Squad in meeting its capital costs and contribute to operating expenses.
- Ensure adequate ambulance services for the Town and ensure communication with neighboring communities regarding ambulance services.
- Work to identify at-risk populations.
- Work to protect the Town's historic assets from disasters.
- Evaluate flood hazard areas at least every two years.
- Adopt an all hazards mitigation plan.
- Work with State and local emergency preparedness organizations.

Flood Resiliency

(Refer to entire Section on Goals, Policies, Recommendations for Action)

Goals

be designed following hydraulic studies to avoid constrictions that would accelerate flow and to allow for passage by aquatic organisms.

6. Forested lands should be protected to assure that precipitation can be absorbed by forest soils and litter and the peak flow attenuated. Acquisition of land or easements or Current Use assessment should be used to protect these areas, especially along the tributaries.
7. Continually monitor and reevaluate capacities of culverts throughout the town. Make improvements and repairs as necessary.
8. Meet the requirements of Emergency Relief Assistance Fund for river corridor planning. Such compliance is limited by Goal 5 which requires a scientific basis for the areas defined as a river corridor.
9. Update the mapping and risk analysis of Fluvial Erosion flooding hazard zones as new data such as LIDAR become available.
10. Update Local Emergency Operations Plan annually.
11. Develop and review Local Hazard Mitigation Plan on a scheduled basis.
12. Get involved early and actively in any changes to National Flood Insurance Program (NFIP) flood maps.
13. Review the Town's Flood Damage Prevention Regulations and consider incorporating the Saxtons River river-corridor mapping into the regulations.
14. Consider legal options for removal of debris hazards within class B waters inclusive of natural river debris hazards as may occur in order to protect town listed dwellings and property.
15. Encourage plantings of willows, dogwoods, sumac, and viburnum along the town's waterways to strengthen river banks, improve flood control, and combat the spread of invasive plant species.
16. The Town will regulate any new development in identified flood hazard areas, fluvial erosion hazard areas, and/or River Corridors to ensure that development does not exacerbate flooding and fluvial erosion, and extend these provisions to development activities that might increase the amount and/or rate of runoff and soil erosion from upland areas.
17. The Town will further pursue a flood resilience management approach by implementing the Local Hazard Mitigation Plan and other strategies for restoring the stream geomorphic equilibrium conditions and enhancing the emergency preparedness that will mitigate the risks to public safety, critical infrastructure, historic structures, and municipal investments.
18. Continue working actively with the Saxtons River Watershed Collaborative in its efforts to increase flood resiliency in the watershed.

1. Avoid new development in identified flood hazard, fluvial erosion, and river corridor protection areas. If new development is to be built is such areas, it should not exacerbate flooding and fluvial erosion.

2. Encourage the protection and restoration of floodplains and upland forested areas that attenuate and moderate flooding and fluvial erosion.

3. Continually prepare for flood emergencies through the response planning process.

4. Adhere to goals and priorities of the Town's Local Hazard Mitigation Plan, particularly the flood hazard section.

5. Use scientific data to identify flood hazard and fluvial erosion hazard areas and designate those areas to be protected, including floodplains, river corridors, land adjacent to streams, wetlands, and upland forests, to reduce the risk of flood damage to infrastructure and improved property.

6. Protect the areas identified in Goal #5 and mitigate risks to public safety, critical infrastructure, historic structures, and municipal investments. Areas must also be protected to allow for continued recreational use and to provide valuable scenic resources.

Policies

1. Developments or activities that would adversely affect the quality of the Town's surface waters shall be discouraged.

2. Development with no net increase in volume occupying a floodway shall be considered to meet the NFIP requirement of no water rise within the floodway.

3. Encourage the use of conservation and river easements consistent with Act 171 guidance for the protection of habitat for wildlife and to promote flood resiliency.

4. Consider Green Infrastructure/Low Impact Development in site plans to manage storm water for infiltration rather than runoff.

Recommendations for Action

1. The Town has adopted a Flood Hazard Bylaw to regulate development in floodplain areas. These bylaws need to be reviewed and a review cycle schedule should be considered in the future.

2. Use maps provided by the National Flood Insurance Program, Vermont Agency of Natural Resources, and others to identify flood hazard areas and inform revisions to Grafton's Flood Damage Prevention Regulations. Such maps, to the extent possible, will be based upon scientific analysis of flooding risk and not based on arbitrary setbacks from land features, including public infrastructure. Refinement of maps, as new data becomes available, such as from LIDAR (Light Detection and Ranging), should continuously inform revision of flood hazard areas.

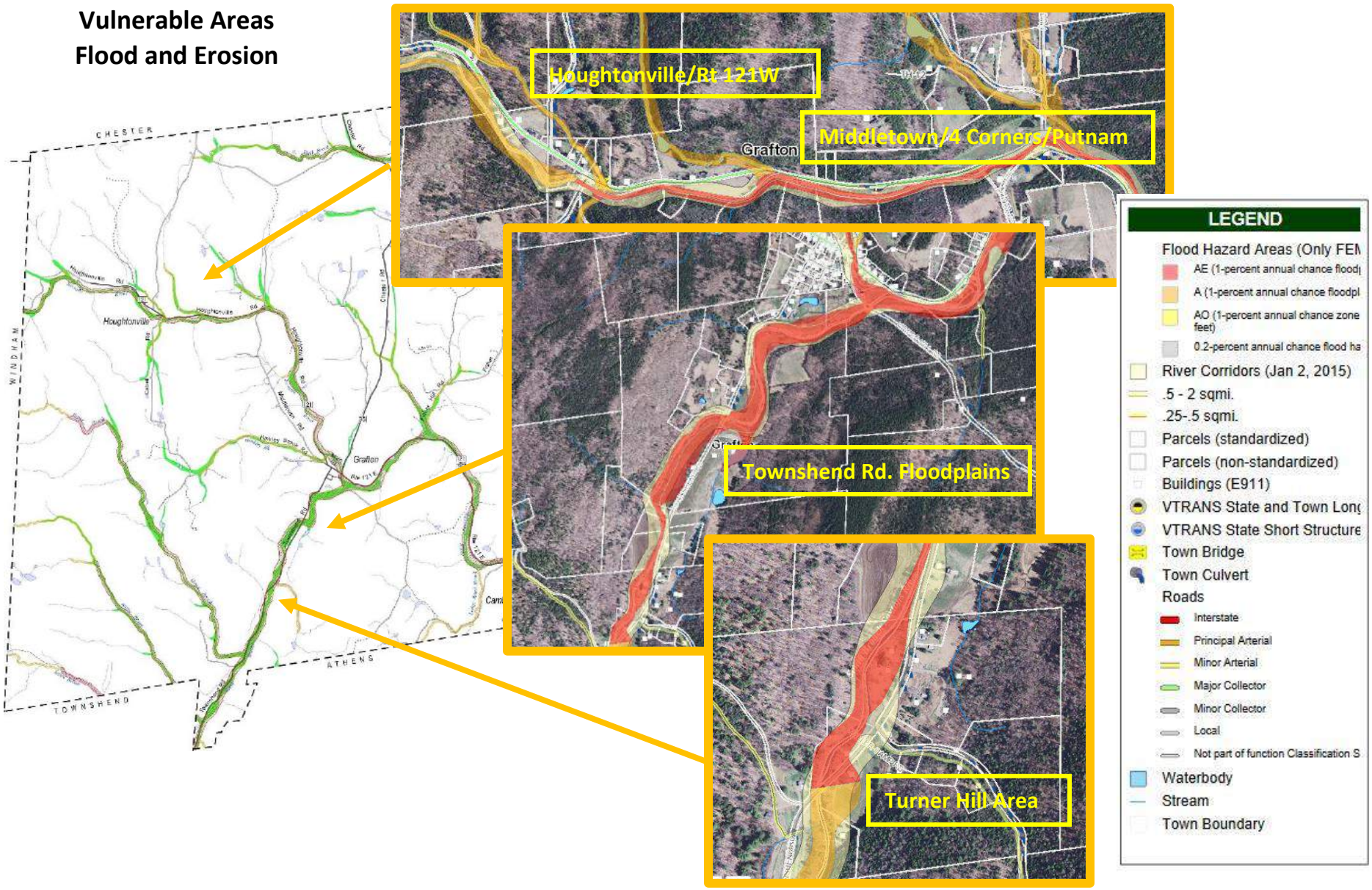
3. Develop Fluvial Erosion Hazard Area regulations to incorporate into the Flood Hazard Bylaw.

4. Where buffer planting is needed, protect the riparian areas through land acquisition or acquisition of easements to provide flood storage and to allow for the river to adjust laterally within the fluvial erosion hazard area.

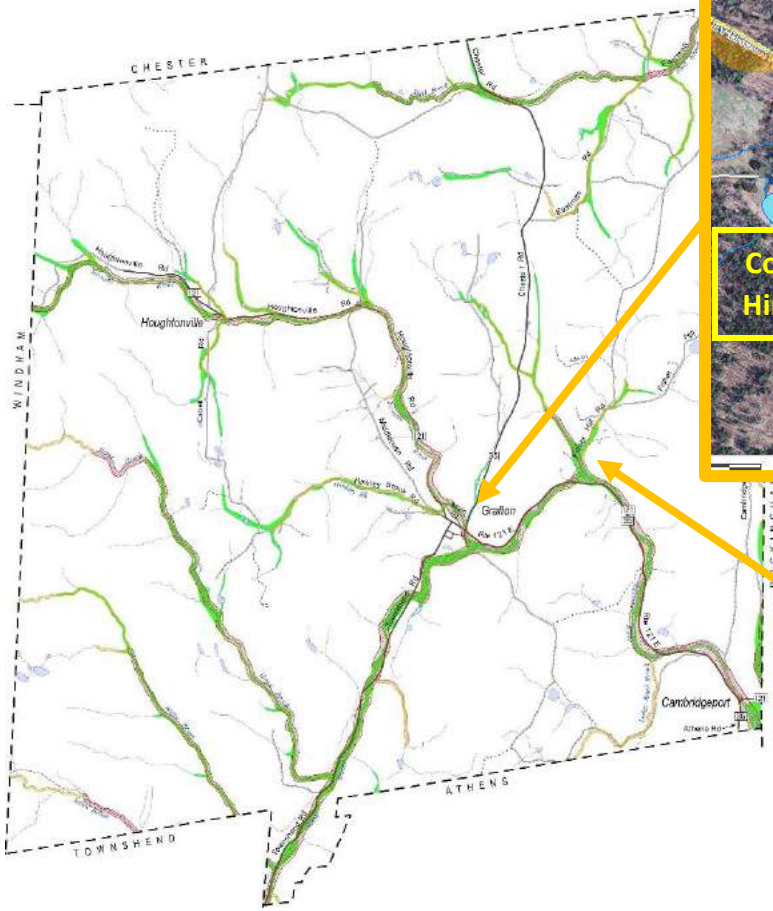
5. Grafton has adopted the 2013 Agency of Transportation Town Road and Bridge Standards and should adopt updates as they are developed. Bridge and culvert repairs and replacements should

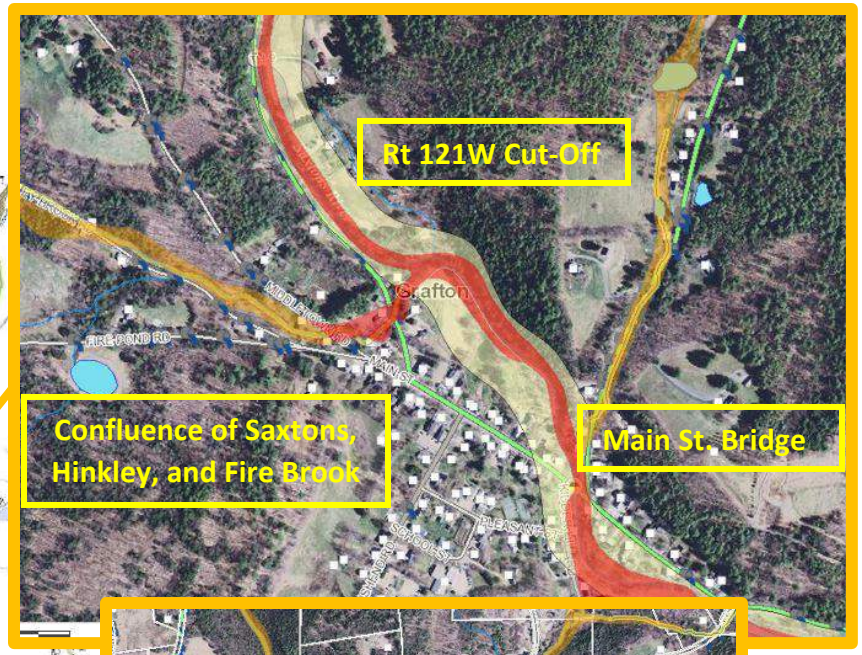
Appendix E

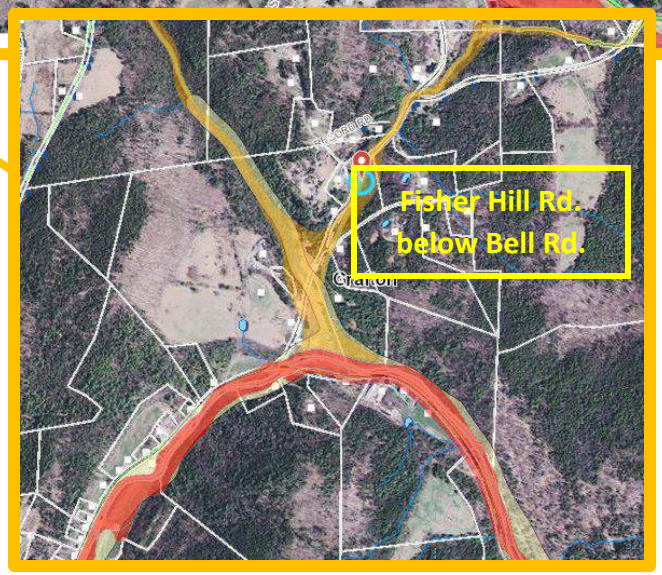
Town of Grafton
Vulnerable Areas
Flood and Erosion



Town of Grafton
Vulnerable Areas
Flood and Erosion



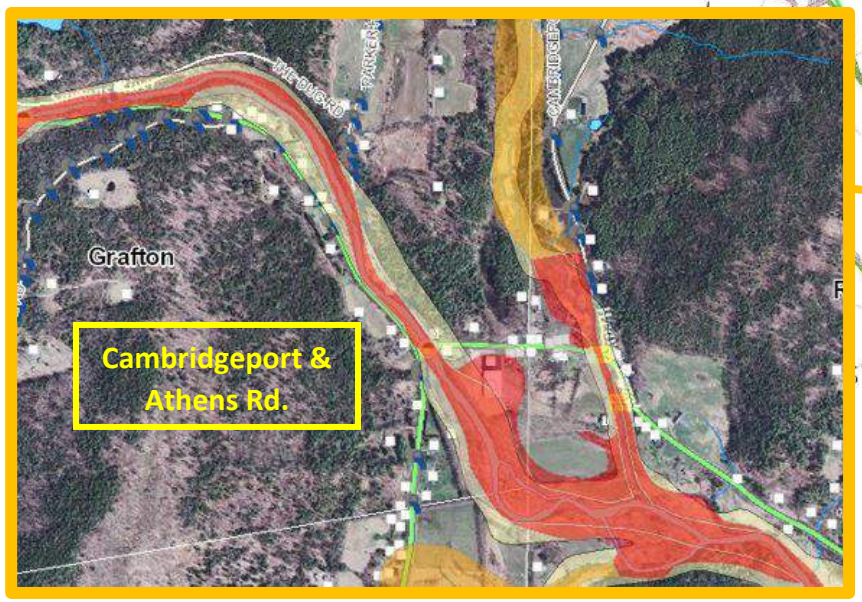


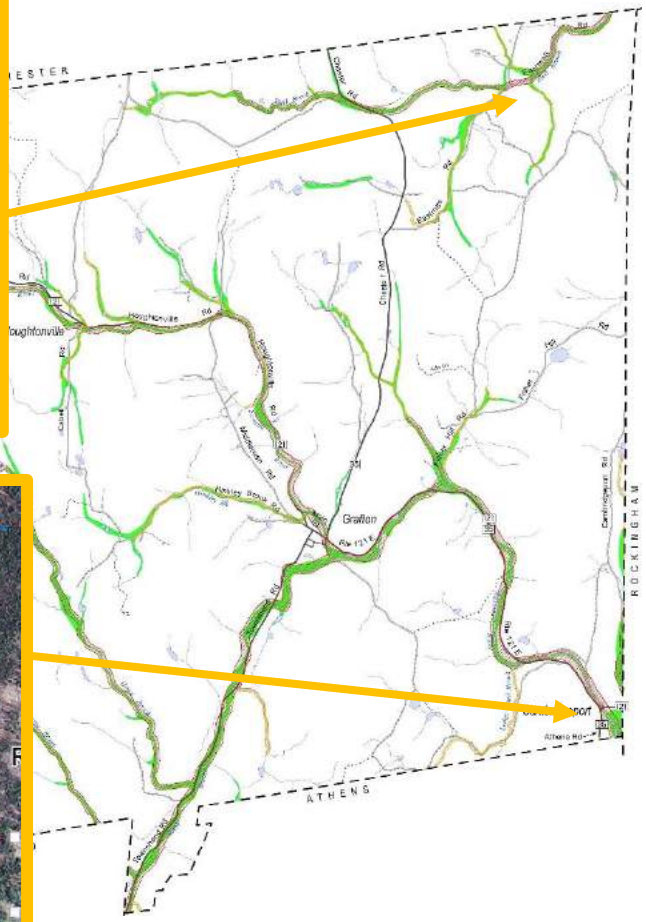


LEGEND

- Flood Hazard Areas (Only FEM
  - AE (1-percent annual chance flood
  - A (1-percent annual chance floodpl
  - AO (1-percent annual chance zone feet)
  - 0.2-percent annual chance flood ha
- River Corridors (Jan 2, 2015)
  - .5 - 2 sqmi.
  - .25-.5 sqmi.
- Parcels (standardized)
- Parcels (non-standardized)
- Buildings (E911)
- VTRANS State and Town Long
- VTRANS State Short Structure
- Town Bridge
- Town Culvert
- Roads
  - Interstate
  - Principal Arterial
  - Minor Arterial
  - Major Collector
  - Minor Collector
  - Local
  - Not part of function Classification S
- Waterbody
- Stream
- Town Boundary

Town of Grafton
Vulnerable Areas
Flood and Erosion



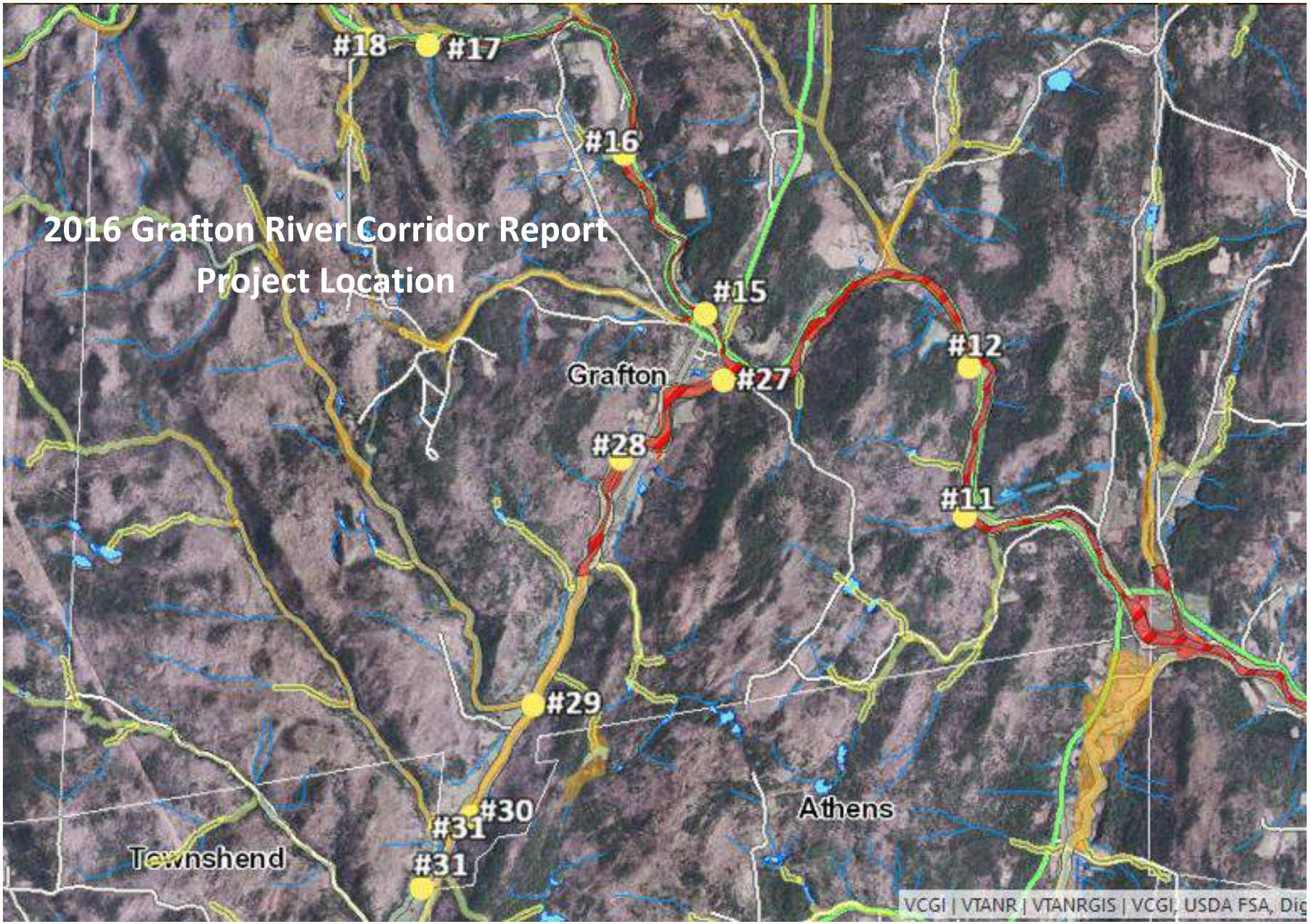


Appendix F

Taken from Table 5.8 of Saxtons River Corridor Plan: Site-Level Project Identification for Grafton								
Project #, Location, Reach, Lat/Long	**Type of Project**	**Site Description Including Stressors and Constraints**	**Project or Strategy Description**	**Hazard Mitigation Priority**	**Ecological Benefits Priority**	**Project Benefits**	**Costs**	**Potential Partners & Funding**
#11: West of Route 121 and The Dug Road in Grafton Saxtons River Reach M11 43.15747 N 72.57822 W	**Passive Restoration** *Corridor Protection*	Undeveloped corridor along inside of meander bend in between river and Route 121 upstream of the road crossing. Large flood chute noted in this area, and channel predicted to migrate laterally in future.	Long-term stream corridor protection to avoid conflict with river migration and development. FEH zone would cover this area.	Moderate	Low	Important sediment and floodwater attenuation section of reach downstream of channelized area.	Potentially moderate to high costs for easements due to private ownership; Needs further investigation	VTANR, VRC, VLT
#12: East of Route 121 in Grafton Saxtons River Reach M12 43.16977 N 72.57587 W	**Passive Restoration** *Corridor Protection*	Undeveloped corridor along inside of meander bend in between river and Route 121 upstream of the road crossing. Large depositional features suggest channel is active along only meander noted in reach.	Long-term stream corridor protection to avoid conflict with river migration and development. FEH zone would cover this area.	Moderate	Low	Important sediment and floodwater attenuation section of reach downstream of channelized area.	Moderate costs for easements due to private ownership; Needs further investigation	VTANR, VRC, VLT
#13: Grafton Town Garage Saxtons River Reach M13 43.17383 N 72.59488 W	**Passive & Active Restoration** *Buffer Plantings; Stormwater Management;*	Grafton Town Garage impacts stream buffer along north bank and discharges uncontrolled stormwater directly to channel. Mass failure along south bank across from site likely aggravated by bank/buffer impacts.	Develop stream buffer restoration plan for immediate near bank along north bank. Re-route stormwater runoff to a small BMP (e.g., bioretention basin or rain garden) to reduce fine sediment loading to channel.	Moderate	**High**	Reduced fine sediment loading to channel and downstream areas; Improved canopy cover in reach for habitat.	Low to moderate costs for planting materials and labor. Low costs for design and installation of stormwater BMP.	WCNRCD; WRC; VTDEC Watershed Grants; VTRANS Municipal Stormwater Mitigation Funds
#15: Upstream of Grafton Village Saxtons River Reach M14 43.17445 N 72.60865 W	**Passive Restoration** *Corridor Protection*	Section of right bank armored upstream of Village, but channel avulsion exists upstream and erosion found throughout. Limited floodplain access in downstream areas makes this a high priority area.	Protect stream corridor and plant buffer with native woody vegetation along right bank upstream of Grafton Village center at various locations.	**High**	Moderate	Potentially reduced property loss from erosion; Mitigation of floodplain loss downstream	Moderate costs for easements due to private ownership; Needs further investigation; Low costs for buffer planting	VTANR, VRC, VLT

#16: Farm North of Grafton Village Saxtons River Reach M15 43.18783 N 72.61782 W	**Active Restoration** *Stormwater Management*	Farm in the upper reach has dredged a deep farm ditch to divert water coming off the steep valley wall into the channel to avoid ponding in their fields. Ditch is delivering fine sediment to downstream channel.	Improve ditch by installing properly spaced check dams to encourage settling of fine sediment prior to reaching channel. Possible use of vegetation along check dams for nutrient uptake.	Low	**High**	Reduced fine sediment loading to channel and degradation of aquatic habitat.	Low costs to retrofit channel with check dams and vegetation.	VTANR
#17: Downstream of Cabell Road in Houghtonville Saxtons River Reach M19 43.19652 N 72.63982 W	**Passive Restoration** *Corridor Protection*	Historical channel straightening noted in the lower reach where a hay field is found in between Route 121 and the channel. Given the extensive bank armoring upstream and high bed load from naturally-steep reaches above, this area could be susceptible to lateral migration in the future.	Long-term stream corridor protection to avoid conflict with river migration and development. FEH zone would cover this area.	Moderate	Moderate	Important sediment and floodwater attenuation section of reach downstream of channelized area.	Moderate costs for easements due to private ownership; Needs further investigation	VTANR, VRC, VLT
#18: Cabell Road in Houghtonville Saxtons River Reach M19 43.19709 N 72.64703 W	**Active Restoration** *Bridge Retrofit/ Replacement*	Bridge beneath Cabell Road is undersized (78% of Wbkf) and causing sediment deposition upstream and minor bank erosion downstream.	As structure comes up for replacement, it should be replaced and resized according to the RMP recommendations as well as redesigned to eliminate current problems.	Moderate	Low	Reduced risk of debris catchment during large flood which could cause severe flooding and erosion.	High cost for structure redesign and replacement.	VTRANS; VTDEC
#27: Kidder Hill Dam South Branch Segment T6.01-A 43.16872 N 72.60636 W	**Active Restoration** *Dam Removal*	Old breached dam is a potential barrier to aquatic organism passage (esp. juvenile fish); Dam is not currently maintained; Aggradation, widening and bank erosion upstream.	Remove structure to restore aquatic organism passage; Channel restoration and/or sediment removal in upstream reaches would probably not be necessary.	Moderate	**High**	Increased AOP and potential for many miles of restored spawning habitat upstream	Moderate construction & permitting costs for structure removal	VTDEC; USFW; NOAA & American Rivers

#28: West of Townshend Rd in Grafton South Branch Segment T6.01-B 43.16235 N 72.61821 W	**Passive Restoration** *Corridor Protection*	70% of channel length historically straightened. Armoring in upper end of reach has increased stream power. Lower end of reach predicted to migrate laterally in future.	Long-term stream corridor protection to avoid conflict with river migration and development. FEH zone would cover the entire area most susceptible to erosion and flooding.	Moderate	Moderate	Important sediment and floodwater attenuation section of reach downstream of channelized area.	Moderate to high costs for easements due to private ownership and length of channel; Needs further investigation	VTANR, VRC, VLT
#29: Townshend Rd Howe Brook Segment T6.S1.01-A 43.14198N 72.62799 W	**Active Restoration** *Bridge Retrofit/ Replacement*	Bridge beneath Townshend Road on Howe Brook is undersized (74% of Wbkf). Bank erosion upstream. Deposition occurred upstream during 1996 flood and could worsen in future flood events.	Replace undersized bridge with an appropriately-sized structure to reduce risks of erosion and flooding of adjacent home and roads.	High	Low	Reduced localized erosion. Reduced risk of flooding and erosion.	High costs for design, permitting, and construction.	Town of Grafton; FEMA
#30: East of Townshend Road in Grafton South Branch Segment T6.03 43.13255 N 72.63500 W	**Passive Restoration** *Corridor Protection*	95% of channel length historically straightened. Upper reach has floodplain area that is partially disconnected, but the road is not an encroachment to the channel as it is downstream, making it ideal for corridor protection.	Long-term stream corridor protection to avoid conflict with river migration and development. FEH zone would encompass the entire area most susceptible to erosion and flooding.	Moderate	Low	Important sediment and floodwater attenuation section of reach upstream of channelized area.	Moderate costs for easements due to private ownership; Needs further investigation	VTANR, VRC, VLT
#31: West of Townshend Road in Grafton Willie Brook T6.S2.01-A 43.13172 N 72.63880 W Styles Brook T6.04-B 43.12670 N 72.64075 W	**Passive Restoration** *Corridor Protection*	Both areas were once alluvial fans that have been straightened and armored. Now, sediment can be delivered downstream with little resistance, putting homes and Townshend Road at risk.	Long-term stream corridor protection to avoid conflict with river migration and development. Reconnect some of the alluvial fan functions that have been lost because of channel straightening, rip-rap and berming.	High	Moderate	Important sediment and floodwater attenuation section of reach;	Moderate to high costs for easements due to private ownership; Needs further investigation	VTANR, VRC, VLT


2016 Grafton River Corridor Report
Project Location
#18
#17
#16
#15
#12
Grafton
#27
#28
#11
#29
#30
#31
#31
Townshend
Athens
VCGI | VTANR | VTANRGIS | VCGI, USDA FSA, Dig

Appendix G

APPENDIX G

WINTER WEATHER EVENTS

WINDHAM COUNTY 1/1/2010 TO 1/30/2019[1]

EVENT ID	DATE	EVENT TYPE	SUMMARY DESCRIPTION OF WINTER EVENT
801202	1/29/2019	Winter Weather	In excess of 8 inches in Northern Windham County
794742	1/19/2019	Winter Storm	Major Winter Storm beginning with up to 20" of snow in higher terrains before changing to sleet. Frigid weather followed with wind chills below -20F. Warming shelters were opened.
796360	12/17/2018	Winter Weather	Snow squall warnings were issued with winds gusting up to 50mph
791856	11/15/2018	Winter Storm	Snow changing to sleet and freezing rain with up to 8" in higher terrain.
746249	3/13/2018	Winter Storm	Heavy snowfall up to 3"per hour with 3-day totals of 1 to 2 ft. in most areas of Southern Vermont. Areas in neighboring Bennington County received up to 8 feet of snow.
745799	3/7/2018	Winter Storm	Strong Nor'easter with heavy snow bands stalling over the area resulting in 1 to 3 feet of accumulation. Second major winter storm in less than a week.
745746	3/2/2018	Winter Weather	Snowfall accumulations from 1" in the lowest valleys up to 18" in higher elevations. The combination of heavy, wet snow and winds gusting up to 45 mph resulted in scattered power outages.
741339	2/7/2018	Winter Storm	Mixed precipitation of snow, sleet and freezing rain with accumulations from 5 to 10".
734121	1/4/2018	Heavy Snow	Heavy snowfall up to 3" per hour with totals of 7 to 15". Gusty winds up to 45mph contributed to reduced visibility and drifting snow. Frigid temperatures followed opening many warming shelters across the state.
731946	12/24/2017	Winter Weather	Heavy snow early Christmas morning with totals up to 12" in southern Vermont
731928	12/22/2017	Winter Weather	Complex storm with mixed precipitation up to 8" of snow and ice accumulation.
731889	12/12/2017	Heavy Snow	Total snowfall was 7 to 12", with some high terrain areas within the southern Green Mountains up to 16".
731882	12/9/2017	Winter Weather	Snowfall resulted in slow and difficult travel across the region. Most areas saw 4 to 8" of snowfall with locally higher amounts.
686313	3/31/2017	Winter Weather	Wintry mixture of snow and sleet with accumulations from 6 to 12" over a 2-day period.
686336	3/14/2017	Winter Storm	2-day event of extremely heavy snowfall up to 4" per hour and blizzard conditions. Widespread extreme public impact. Many roads severely damaged, regional train service cancelled, near-zero visibility with considerable drifting snow.
677654	2/12/2017	Winter Storm	Wet snow accumulations up to 7 to 12" in most areas and up to 20" in higher elevations.
672861	2/9/2017	Heavy Snow	Classic Nor'easter with snow totals of 8 to 14" across the region.
672769	2/7/2017	Winter Weather	Mixed precipitation of snow and sleet from 3 to 6" in higher elevations.

[1] NOAA, National Centers for Environmental Information, Winter weather events for Windham County

672492	1/23/2017	Winter Weather	Combination of wet snow and sleet with ice glaze. Hazardous travel with many vehicle accidents and downed trees and power lines causing isolated power outages.
670085	1/17/2017	Winter Weather	Event produced 4 to 7" of snow in Windham County.
668190	12/29/2016	Winter Weather	Light to moderate snow fall of 4 to 10" with slow travel on area roadways and minor accidents.
665262	12/17/2016	Winter Weather	Wintry mix of snow, sleet and rain with accumulations of 4 to 9" resulting in slippery roads and difficult travel.
664615	12/12/2016	Winter Weather	Event produced 3 to 8" of snow in Windham County.
660815	10/27/2016	Winter Weather	Unseasonably cold air with steady precipitation up to 4" of snow locally and 9" in the mountains. Travel was disrupted with minor accidents.
606646	12/28/2015	Winter Weather	Snow changing to wintry mix producing icy conditions resulting in slippery travel and many car accidents throughout the region. Ice and gusty winds took down a 75-foot radio transmitter tower on the top of Mount Equinox near Manchester.
558115	2/21/2015	Winter Weather	Snowfall totals of 5 to 8" across the valleys of southern Vermont, with 7 to 11" across the higher peaks of the southern Green Mountains.
557700	2/14/2015	Winter Weather	Intense fast-moving storm made for hazardous travel conditions with 4 to 8" of snow accumulations.
559801	2/7/2015	Heavy Snow	A 3-day snow event with amounts between 1 and 2 feet.
554068	2/2/2015	Heavy Snow	A cold air mass and heavy precipitation produced 9 to 15" in most areas with up to 19" in higher terrain.
553846	1/27/2015	Winter Weather	Southern Vermont just barely avoided impact from a significant and powerful coastal storm impacting the Northeast states with just 3 to 7" of snow in Windham County.
549594	1/18/2015	Winter Weather	Rain falling on frozen ground producing 'black ice' conditions and up to 2/10" ice accumulations caused over 30 reported automobile accidents in the area, some with injuries.
549653	1/3/2015	Winter Storm	Mixed precipitation of snow and freezing rain produced 5" of snow and 1/10" ice accumulation causing hazardous travel.
549425	12/9/2014	Winter Weather	A slow moving 3-day event of mixed precipitation produced 4 to 9" of snow with up to 16" in higher terrain
544530	11/26/2014	Winter Storm	An early winter event resulted in 8 to 15" of snow.
500862	3/12/2014	Winter Weather	Event began as rain and sleet and ending as snow with accumulations of 6 to 12" and unseasonably cold temperatures.
490805	2/13/2014	Winter Storm	Severe winter storm accompanied by thunder and lightning with snowfall rates of 3" per hour changing over to sleet and freezing rain in some areas. Accumulations of 8 to 21" with gusty winds and drifting snow.
490472	2/5/2014	Heavy Snow	Event produced 6 to 12" of snow with rates of 2" per hour.
487192	1/2/2014	Heavy Snow	A long-lasting event producing 8 to 17" of snow and windchills of -20F.
481247	12/14/2013	Heavy Snow	Snowfall rates of up to 3" per hour with total accumulations which varied up to 18".
432871	3/18/2013	Heavy Snow	A late season snowfall with amounts from just 4 to 9" across valley areas and up to 17" in higher terrain.
432830	3/7/2013	Winter Weather	A strong storm system just south of the region produced up to 9" of snow in southern Vermont.
431059	2/27/2013	Winter Weather	Moderate to heavy snow event with accumulation of 8 to 19".
429036	2/8/2013	Winter Storm	Snowfall amounts ranged from 6 to 30" across the region.
420638	12/26/2012	Winter Weather	Heavy snow in southern Vermont varies greatly from a few inches to 27" in the Green Mountains with winds gusting to 45mph making for difficult holiday travel.
364118	2/29/2012	Winter Storm	A complex long-duration event lasting 36 hours with snowfall totals of 8 to16".

355739	1/23/2012	Winter Weather	Freezing rain produced icy conditions and numerous accidents.
357658	1/12/2012	Winter Weather	Snow sleet and freezing rain produced up to 6"of snow and 2/10" of ice accumulation.
350401	10/29/2011	Winter Storm	An early Nor'easter producing 10 to 16" of snowfall across the county with downed trees and powerlines causing numerous outages.
281780	2/25/2011	Winter Storm	Widespread heavy wet snowfall amounts of 12 to 17" causing hazardous travel.
284933	2/5/2011	Winter Weather	Mix of snow, sleet and rain accompanied by thunderstorms, frequent cloud to ground lightning and small hail. Ice accumulation of up to 2/10".
281511	2/1/2011	Winter Storm	Snowfall amounts ranged from 8 to 25" across the region.
277206	1/18/2011	Winter Storm	Sleet accumulations across southern Vermont varied from 3 to 9", with ice accumulations of up to 1/2" resulting in extremely hazardous conditions.
277303	1/12/2011	Winter Storm	Snowfall rates of 3 to 6" per hour with totals of 2 to 3 feet of snow.
271277	12/26/2010	Winter Storm	A major Nor'easter brought significant snows and near blizzard conditions with snowfall rates up to 3"per hour with snowfall accumulations of 1 to 2 feet. Strong, gusty winds of 35 to 45 mph caused significant blowing and drifting of the snow.
215849	2/26/2010	Winter Weather	Second powerful storm in 2 days with heavy rainfall, gusty winds up to 50mph and wet snow totals of 1 to 2 feet. Downed trees and powerlines caused widespread power outages across southern Vermont, treacherous travel and road closures.
212425	2/23/2010	Heavy Snow	Heavy wet snow accumulations of 1 to 2 feet that resulted in treacherous travel conditions and widespread power outages across southern Vermont.

Appendix H

2019-2023 Town of Grafton Hazard Mitigation Plan
Annual Monitoring Form
Progress on Mitigation Strategies & Actions

Period Covered: _____

Date: _____

High Priority
Moderate Priority
Low Priority

MITIGATION ACTION	PROGRESS MADE*	FUNDING SOUGHT	NEXT STEPS	RESPONSIBLE PARTY	TIME FRAME
Upgrade deteriorated culvert #1 on Chester Rd.					
Assess and repair or upgrade culvert #10 on Fisher Hill Rd.					
Re-assess priority and determine cost to design & upgrade culvert #13 on Fisher Hill Rd. should opportunity arise given historic restrictions.					
Conduct hydrology study and engineering for replacement/upgrade of culvert/bridge at intersection of Fisher Hill Rd. and Bell Rd.					
Upgrade culvert #1 on Bell Rd.					

Upgrade culvert from the Ball Field to Saxtons River on Townshend Road.					
Upgrade culvert #13 on Eastman Rd.					
Assess cost, prioritize and establish a capital plan to upgrade of 7 culverts on Hinkley Brook Rd.					
Pursue funding for a hydrology study and preliminary design to upgrade/retrofit bridge #18 on Cabell Rd. Bridge is undersized causing downstream erosion with debris catchment this can be a severe flooding risk to upstream properties.					
Pursue funding for a hydrology study and preliminary design to upgrade/retrofit bridge beneath Townshend Rd. on Howe Brook. Bridge is undersized causing upstream bank erosion and is threatening erosion and flooding of adjacent home and roads.					
Include a review of the Hazard Mitigation Plan in annual capital budgeting process and incorporate projects from this plan.					
Develop a long-term plan to address new Municipal Roads General Permit (MRGP) standards for prioritizing hydrologically-connected road segments.					

Implement MRGP Plan each year on prioritized road segments as funding becomes available.					
Remove Kidder Hill Dam to reduce upstream erosion and flooding. (See **Appendix F**: Project #27 in RCP, and a priority in RCMR) [2]					
Evaluate the feasibility of a local limited emergency shelter and plan for effective location of generator.					
Review and Update Continuity Plans for Government and Operations					
Incorporate hazard mitigation planning into current municipal Town Plan update and other town planning, discussions, and activities to increase project visibility, municipal awareness, and support for funding.					
Conduct formal monitoring of this HMP prior to the annual budgeting process and inform the public on progress made to increase community awareness.					
Explore the development of a workable "At-Risk Resident Registry" program and/or outreach effort to identify vulnerable community members eligible for registration with C.A.R.E. to more effectively respond to those in need should a disaster occur.					
Review recommended activities from Vermont's "Fire Safe 802 Program" and National Fire Protection Association's "Firewise Program" for outreach ideas to educate community on how to reduce structure fire risk.					

Annually review the Vermont Division of Fire Safety's Public Education webpage for new outreach ideas to maintain fire risk awareness. Implement if feasible.					
Enhance current seasonal fire safety awareness program for residents, landowners, and rental properties on Fire Hazards to increase fire awareness during most vulnerable seasonal periods, winter and early spring.					
Develop a cost-effective inspection program for Air B&B rental properties for fire and building safety standards to mitigate potential fire hazards and implement, if plausible.					
Pursue activities to attain criteria thresholds under FEMA's NFIP Community Rating System to raise community awareness and increasing available reimbursement funding.					
Review and Update Flood Damage Prevention Regulations (FDPR) to consider extending provisions to upland development if stormwater runoff could impact flood/erosion hazard.					
Consider strengthening stormwater infiltration practices/recommendations for new development to improve flood resiliency and minimize erosion.					
Identify property owners located within Special Flood Hazard Areas or River Corridor and develop an outreach plan to educate them on flood and erosion risks, mitigation ideas, local by-laws and NFIP.					
Expand outreach to residents and developers on the State Standard Building Codes and Safety Regulations for fire prevention.					

Further investigate and proactively seek viable options and funding for conservation easements and buffer restoration to improve floodplain access; particularly in the Willie and Styles Brook area west of Townshend Rd. Riprap and berming have reduced floodplain access west of Townshend Rd. putting homes and the road at risk. Passive restoration is recommended to restore floodplain access.					
Further investigate and prioritize long-term stream corridor protection in areas identified in RCP through passive restoration, such as easements and buffer restorations to reduce property loss from erosion and potentially improve floodplain access to reduce risk of flooding downstream.					