Adopted by the Town of Charleston Selectboard on:
April 8, 2021

TOWN of CHARLESTON, Vermont
All-Hazards Mitigation Plan Update

FEMA ID#: 019-13150-00

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Prepared by:

The Town of Charleston, Vermont

CERTIFICATE OF LOCAL ADOPTION

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Town of Charleston, Vermont

A Resolution Adopting the All-Hazards Mitigation Plan Update

WHEREAS, the Town of Charleston has worked with its residents and stakeholders to identify its hazards and vulnerabilities, analyze past and potential future losses due to natural and human-caused hazards, and identify strategies for mitigating future losses; and
WHEREAS, the Town of Charleston All-Hazards Mitigation Plan contains recommendations, potential actions and future projects to mitigate damage from disasters in the Town of Charleston; and
WHEREAS, the Town of Charleston and the respective officials will pursue implementation of the strategy and follow the maintenance process described in this plan to assure that the plan stays up to date and compliant; and…
WHEREAS, a meeting was held by the Town of Charleston to formally approve and adopt the Multijurisdictional All Hazards Mitigation Plan.

NOW, THEREFORE BE IT RESOLVED that the Town of Charleston adopts this Hazard Mitigation Plan Update.

APRIL 8, 2021
Date

Selectman

Selectman

Selectman

Selectman

Teri L. Gray
Attested to by Town Clerk

Executive Summary

In late 2020, the Town of Charleston began to develop this All-Hazard Mitigation Plan update from the last approved plan in 2016. This update reflects recent changes in the Vermont State Hazard Mitigation Plan and works to identify the updated profiled hazards and associated mitigation actions for the next planning cycle. The results of this work represent the collaborative efforts of the Hazard Mitigation Planning Team and associated residents, towns and agencies that contributed to the development of this plan. As hazard mitigation is a sustained effort to permanently reduce or eliminate long-term risks to people and property from the effects of reasonably predictable hazards, the town has communicated its efforts related to developing this plan to its residents and surrounding municipalities, providing a formal opportunity to provide input and review relevant sections of the plan. Along these lines, the town has documented the planning process so that future updates can follow an efficient pattern in addition to capturing this important component as means of establishing institutional memory. In realization that eligibility to receive federal hazard mitigation grants and optimize state-level reimbursement or "match" dollars during a federally declared disaster is dependent on a federally approved plan, the town remains committed to sustaining its mitigation efforts and by developing this plan, will have a guide for action that will foster enhanced emphasis on mitigation in the years to come. The town realizes the importance of mitigation inherent to its own resilience as well as means to establishing strong partnerships with regional support agencies and associations, state government and FEMA. The pandemic-related events of 2020 have resulted in new considerations in the financial, health and safety arenas and the town feels it must formally engage in pandemic planning to mitigate risk. As the town moves towards formally adopting this All-Hazards Mitigation Plan update, the purpose of this plan is to:

- Identify specific hazards that impact the town
- Prioritize hazards for mitigation planning
- Recommend town-level goals and strategies to reduce losses from those hazards
- Establish a coordinated process to implement goals and their associated strategies by taking advantage of available resources and creating achievable action steps

This plan is organized into 5 Sections:

Section 1: Introduction and Purpose explains the purpose, benefits, implications and goals of this plan. This section also describes demographics and characteristics specific to the town and describes the planning process used to develop this plan.

Section 2: Hazard Identification expands on the hazard identification in the Town Plan with specific municipal-level details on selected hazards.

Section 3: Risk Assessment discusses identified hazard areas in the town and reviews previous federally declared disasters to identify what risks are likely in the future. This section presents a hazard risk assessment for the municipality, identifying the most significant and most likely hazards which merit mitigation activity. Building upon the identified hazards from 2005, the updated profiled hazards are introduced in the grid below:

Severe winter/Ice storm	Extreme Cold	Flooding/Erosion
Pandemic		

Section 4: Vulnerability Assessment discusses buildings, critical facilities and infrastructure in designated hazard areas and estimates potential losses.

Section 5: Mitigation Strategies begins with an overview of goals and policies in the most recent Town Plan that support hazard mitigation and then formulates a work plan around major infrastructure projects, community awareness and documentation. An analysis of existing municipal actions that support hazard mitigation, such as planning, emergency services and actions of the highway department are also included. The following all-hazards mitigation goals are summarized below:

1) Reduce at a minimum, and prevent to the maximum extent possible, the loss of life and injury resulting from all hazards.
2) Mitigate financial losses and environmental degradation incurred by municipal, educational, residential, commercial, industrial and agricultural establishments due to various hazards.
3) Maintain and increase awareness amongst the town's residents and businesses of the damages caused by previous and potential future hazard events as identified specifically in this Local All-Hazards Mitigation Plan.
4) Recognize the linkages between the relative frequency and severity of disaster events and the design, development, use and maintenance of infrastructure such as roads, utilities and storm water management and the planning and development of various land uses.
5) Maintain existing municipal plans, programs and ordinances that directly or indirectly support hazard mitigation.
6) Develop a mechanism for formal incorporation of this Local All-Hazards Mitigation Plan into the municipal comprehensive plan as described in 24 VSA, Section 4403(5). This mechanism will be developed by the Planning Commission, Selectboard and NVDA and integrate the strategies into the existing town plan as annexes until the next formal update occurs, where a section devoted to mitigation planning will be integrated into the plan.
7) Develop a mechanism for formal incorporation of this Local All-Hazards Mitigation Plan, particularly the recommended mitigation actions, into the municipal/town operating and capital plans & programs as they relate to public facilities and infrastructure within political and budgetary feasibility. The Planning Commission will review the updated LHMP and use language/actions from it to inform the integration and future update processes. Town Meeting Day will serve as the formal time that mitigation strategy budgetary considerations will be approved and incorporated into the town budget.

Section 5 also identifies and provides a detailed discussion on the following mitigation actions:

Action #1: Improve road infrastructure and municipal systems protection programs

Action #2: Improve resilience to severe winter storms

Action #3: Reduce impact of extreme cold durations

Action #4: Raise public awareness of hazards and hazard mitigation actions

Action #5: Continue fluvial geomorphology assessments in collaboration with DEC and develop strategies and regulatory actions in response to identified risk

Action 6: Reduce risk and impact of pandemic

In conclusion, Section 5 provides an Implementation Matrix to aid the municipality in implementing the outlined mitigation actions with an annual evaluation process to be coordinated and administered by the Planning Commission.

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SECTION 1: INTRODUCTION AND PURPOSE

1.1 Purpose and Scope of this Plan

The purpose of this Local All-Hazards Mitigation Plan Update is to assist this municipality in identifying all hazards facing their community and in identifying strategies to begin to reduce the impacts of those hazards. The plan also seeks to better integrate and consolidate efforts of this municipality with those outlined in the Town Plan as well as efforts of NVDA, the Local Emergency Planning Committee and the State Hazard Mitigation Plan.

This document constitutes an All-Hazards Mitigation Plan Update for the Town of Charleston. Community planning can aid significantly in reducing the impact of expected, but unpredictable natural and human-caused events. The goal of this plan is provide hazard mitigation strategies to aid in creating disaster resistant communities throughout Orleans County.

1.2 Hazard Mitigation

The 2018 Vermont State All-Hazards Mitigation Plan (SHMP) states:

> *"The impact of anticipated yet unpredictable natural events can be reduced through community planning and implementation of cost effective, preventive mitigation efforts.*
>
> *The State of Vermont understands that it is not only less costly to reduce vulnerability to disasters than to repeatedly repair damage, but that we can also take proactive steps to protect our economy, environment and most vulnerable citizens from inevitable natural hazard events. This Plan recognizes that communities have the opportunity to identify mitigation strategies during all phases of emergency management (preparedness, mitigation, response, and recovery) to more comprehensively address their vulnerability. Though hazards themselves cannot be eliminated, Vermonters can reduce our vulnerability to hazards by improving our understanding of both the natural hazards we face and their potential impacts.*
>
> *The 2018 Vermont State Hazard Mitigation Plan (SHMP) presents the hazard impacts most likely to affect Vermont and a mitigation strategy to reduce or eliminate our most significant vulnerabilities."*

Hazard mitigation strategies and measures can reduce or eliminate the frequency of a specific hazard, lessen the impact of a hazard, modify standards and structures to adapt to a hazard, or limit development in identified hazardous areas. This plan aligns and/or benefits from the State's 2018 Hazard Mitigation Plan and as part of the Emergency Relief Assistance Funding (ERAF) requirements. With enhanced emphasis on community resiliency, many state agencies and local organizations have an increased awareness of the importance of mitigation planning and have produced plans and resources that towns can use to support their planning efforts. This plan will reference, when relevant, pertinent tools and resources that can be used to enhance mitigation strategies.

1.3 Hazard Mitigation Planning Required by the Disaster Mitigation Act of 2000

Hazard mitigation planning is the process that analyzes a community's risk from natural hazards, coordinates available resources, and implements actions to reduce risks. According to 44 CFR Part 201, Hazard Mitigation Planning, this planning process establishes criteria for State and local hazard mitigation planning authorized by Section 322 of the Stafford Act as amended by Section 104 of the *Disaster Mitigation Act of 2000*. Effective November 1, 2003, local

governments now must have an approved local mitigation plan prior to the approval of a local mitigation project funded through federal Pre-Disaster Mitigation funds. Furthermore, the State of Vermont is required to adopt a State Pre-Disaster Mitigation Plan in order for Pre-Disaster Mitigation funds or grants to be released for either a state or local mitigation project after November 1, 2004.

There are several implications if the plan is not adopted:

- After November 1, 2004, Flood Mitigation Assistance Grant Program (FMAGP) funds will be available only to communities that have adopted a local Plan
- For disasters declared after November 1, 2004, a community without a plan is not eligible for HMGP project grants but may apply for planning grants under the 7% of HMGP available for planning.
- For the Pre-Disaster Mitigation (PDM) program, a community may apply for PDM funding but must have an approved plan in order to receive a PDM project grant.
- For disasters declared after October 14th, 2014, a community without a plan will be required to meet a greater state match when public assistance is awarded under the ERAF requirements (Emergency Relief Assistance Funding).

1.4 Benefits

Adoption and maintenance of this Hazard Mitigation Plan will:

1. Make certain funding sources available to complete the identified mitigation initiatives that would not otherwise be available if the plan was not in place.
2. Ease the receipt of post-disaster state and federal funding because the list of mitigation initiatives is already identified.
3. Support effective pre- and post-disaster decision making efforts.
4. Lessen each local government's vulnerability to disasters by focusing limited financial resources to specifically identified initiatives whose importance has been ranked.
5. Connect hazard mitigation planning to community planning where possible.

1.5 All-Hazards Mitigation Plan Goals

This All-Hazards Mitigation Plan establishes the following general goals for the town as a whole and its residents:

1. Reduce at a minimum, and prevent to the maximum extent possible, the loss of life and injury resulting from all hazards.
2. Mitigate financial losses and environmental degradation incurred by municipal, educational, residential, commercial, industrial and agricultural establishments due to various hazards.
3. Maintain and increase awareness amongst residents and businesses of the damages caused by previous and potential future hazard events as identified specifically in this Local All-Hazards Mitigation Plan.

4. Recognize the linkages between the relative frequency and severity of disaster events and the design, development, use and maintenance of infrastructure such as roads, utilities and storm water management and the planning and development of various land uses.
5. Maintain existing municipal plans, programs and ordinances that directly or indirectly support hazard mitigation.
6. Develop a mechanism for formal incorporation of this Local All-Hazards Mitigation Plan into the multi-jurisdictional municipal comprehensive plan as described in 24 VSA, Section 4403(5). This mechanism will be developed by the Joint Planning Commission, Selectboard and NVDA and integrate the strategies into the existing town plan as annexes until the next formal update occurs, where a section devoted to mitigation planning will be integrated into the plan.
7. Develop a mechanism for formal incorporation of this Local All-Hazards Mitigation Plan, particularly the recommended mitigation actions, into municipal operating and capital plans & programs as they relate to public facilities and infrastructure within political and budgetary feasibility. The Joint Planning Commission will review the plan and use language/actions from it to inform the integration and update process. Town Meeting Day will serve as the formal time that mitigation strategy budgetary considerations will be approved and incorporated into the town budgets

1.6 Town of Charleston: Population and Characteristics

Population:
The Town of Charleston covers 24,662 contiguous acres. The 2010 U.S. Census reports a total population of 1023 residents, 51% male and 49% female, indicating a population density of about 1 person per 26 acres. The Town's population has shown slow to moderate growth over the past 50 years—a rate that has increased somewhat over the past decade. About 22% of the population is younger than 20 years, about 20% is between 20 and 40 years of age, about 31% is between 40 and 60 years, and 27% is aged 60 or older. The median age is 49 years.

Table 1-1 Town of Charleston, selected population characteristics, 2010 Census

Category	Number	%
Total Population	1023	100
Median Age	49	--
Population age 60 years and over	276	27
Population under 20 years old	225	22
Population between 20 and 40	205	20
Population between 40 and 60	317	31

Housing:
The entire population of Charleston is housed, with more than half living in traditional nuclear families, a third living in non-family households, and about one-quarter living alone. The average family size is 2.7 and the average household size is 2.2. In 2017, the average annual household income was $39,500 with per capita income at 24,032, both lower than state averages. About one-third of the Town's housing stock was built before 1950. Almost half was built

between 1960 and 1990. About 12% has been built since 2000. Median house value in 2017 was $160,771. More than 80% of the housing is owner-occupied, with about 20% rented. Rental costs range from $500 to $1500 per month.

The following shows the types of housing within Charleston, also based on the 2010 U.S. Census data:

Table 1-2 Town of Charleston, selected housing unit data, 2010 Census Block Group 2

Category	Number	%
Total Housing Units	672	--
Occupied housing units	447	66.5
Vacant housing units	225	33.5
Owner-Occupied	363	54
Renter Occupied	84	12.5
Population in Renter-occupied	201	19.6
Households with individuals under 18	110	10.8

Town Districts

West Charleston Village is described by the area on both sides of Vermont Route 105 from the junction of Routes 105 and 5A on the east to the Derby-Charleston border on the west. The Clyde River forms the northern boundary. The southern boundary is 1,000 feet in distance on a line perpendicular to the center line of Vermont Route 105. The eastern boundary is the Clyde River, north of Vermont 105 and Vermont 5A, south to a point 1,000 feet from the centerline of Vermont 105.

East Charleston Village is described by an area on both sides of Vermont Route 105 from Route 105/Ten Mile Square Road to a point approximately .9 of a mile west of the centerline of Church Hill Road. The northern boundary is 1,000 feet in distance measured on a line perpendicular to the center line of Vermont Route 105. The southern boundary is the Clyde 2 River.

Pensioner Pond is described by the area lying within Route 105 to the north, Route 5A to the 5 south, and to the south and east along Stumpf Brook to where its meets the Clyde River, and from that point to the intersection of Parlin Meadow Road and Vermont Route 5A.

Echo Lake is described by the area circumscribed by East and West Echo Lake Roads.

Rural: All other land within the Town is part of a Town-wide Rural District, which contains approximately 22,050 acres. 12 13 Commercial 14 Small scale enterprises flourish in Charleston, employing many Town residents (see below). Many of these are directly tied to the Town's land and natural resources and depend on the preservation and stewardship of these features to thrive.

1.7 Summary of Planning Process

The work to update this plan was led by the planning team made up of municipal officials, school officials, local businesses, service agencies, and the regional planning organization (NVDA). The update project followed a work plan which provided the public and other stakeholders the opportunity for two-way communication. Existing documents were also researched and incorporated into the plan update. Planning team members, for the most part, fulfill multiple roles in the community and represent a broad array of stakeholders. The following table presents the Planning Team members and their title:

- Peter Moskovites, Charleston Selectboard Chair
- Patrick Austin, Charleston Selectboard
- Mark Hinton, Great Bay Hydro
- Patrick McLaughlin, HAZMAT Chief, State of Vermont
- Kristen Watson, School Board Chair, Charleston Elementary School District
- Christopher Lawson, Charleston Elementary School Principal
- Laurie Gee, President, Echo Lake Protective Association
- Tom Wagner, Echo Lake Protective Association
- Maria Young, Director, NorthWoods Stewardship Center
- Phil Marquette, LEPC 10 Chair
- Duane Moulton, Charleston Fire Chief & Charleston EMD
- John Kellogg, Charleston Planning Commission Chair
- Teri Gray, Town Clerk
- Colleen Kellogg, Asst. Town Clerk
- Bruce Melendy, Emergency Planner, NVDA
- Bernie Pepin, Road Foreman
- Larry Young, Selectboard

There is a current understanding of the need to integrate the content of this update and its goals, actions and reporting into the daily operational structure and awareness of all town officials so that mitigation planning establishes itself as a consistent topic of concern and discussion. The community survey was mailed with tax bills in August, 2020 with a tax deadline of October 23rd. Charleston has about 740 parcels. Five responses were received and focused on flooding, emergency notification and pandemic issues. All neighboring towns were sent notification via the town clerk of the plan's development and the subsequent draft and were given an opportunity to provide input through email and/or phone call to the town clerk. No responses were obtained from this solicitation. Following FEMA guidance in Local Mitigation Plan Review Tool Regulation Checklist, the plan was written using data sources that included:

- Surveys and warned, public meetings collecting public comment (issues raised were addressed in plan and the public meeting)
- 2019 Town Plan (provided current goals and regulations supporting mitigation, recent capital expenditures and infrastructure value helped to drive vulnerability assessment)
- 2018 Vermont State Hazard Mitigation Plan (provided key guidance language and definitions throughout the plan).

- Vermont Agency of Natural Resources (ANR) and Transportation (VTrans) (Provided key policy recommendations on environmental conservation, high accident locations, climate change and fluvial erosion data).
- Vermont Departments of Health (VDH) and Environmental Conservation (DEC) (provided information related with public health services that could be impacted during a disaster and state support functions designated to both VDH and DEC. DEC also provided river corridor data for mapping purposes.
- FEMA Open Source (data.gov) Data for Disaster History and PA funding (provided comprehensive declared disaster by year and type as well as project descriptions and cost per event).
- FEMA NFIP "Bureau.Net" database (provided detailed information on repetitive loss properties and associated flood insurance claims).
- EPA's Incident Action Checklist for cold weather resilience of water systems (provides a guidance tool for public works to cross-reference actions on the system).
- 2013 ACCD Mobile Home Resilience Plan (served as resource for future mitigation actions)

Based on the information obtained, input from town and state officials, the planning team, state and federal databases, local associations and NVDA, the plan was created. While many small communities in Vermont face similar circumstances (e.g. flooding, winter storms and remote residents), each one has unique considerations and opportunities. There was a point made to capture the subtle characteristics of the town and its distinct villages. From this, the specific risks, vulnerabilities and mitigation strategies were developed and applicable, broken down to the specific entity impacted. NVDA's role in assisting the entire region with all facets of planning provided crucial information and NVDA's Emergency Management Planning representative attended planning team meetings and provided guidance. While the LEPC provides the best platform to engage representatives from various towns and agencies, all bordering towns were contacted with planning objectives and asked to provide input through a formal email invitation. Vermont Emergency Management (VEM) also provided information during the development of the plan. VEM also has representation at the LEPC meetings and will continue to provide input and guidance as the town moves forward with their mitigation strategies. The following summary represents the timeline for the planning process:

- 8/10/20: Community Input Surveys mailed with tax bills to residents of Town
- 10/9/20: Workplan meeting with Charleston Planning Commission Chair and Town Clerk
- 10/13/20: Meeting with Town Road Foreman to discuss mitigation projects and progress on 2016 mitigation action items related to infrastructure.
- 10/15/20: All returned Community Input Surveys collected and reviewed by planning team lead
- 11/12/20: Planning Team Kick-off meeting. Planning team was approved by selectboard and updated hazards to be profiled were discussed. The public was notified and in attendance at this meeting, however, no comments were received.

- 12/10/20: Warmed Community Meeting to review updated profiled hazards and draft sections I and II of the update. The public was notified and in attendance at this meeting, however, no comments were received.
- 01/09/21: Mitigation Action Status Report sent to Town for required updates. Results captured and included as Appendix B.
- 01/26/21: Updated Mitigation Actions for next planning cycle sent to planning team for review. Minor corrections were made based on feedback.
- 01/28/21: Proposed mitigation actions were discussed at warned community meeting. The public was notified and in attendance at this meeting, however, no comments were received.
- 02/01/21: Draft Sections III and IV sent to planning team for review and comment. Inclusion of Climate Change was brought up and addressed.
- 02/05/21: All neighboring towns received notice of availability of draft plan for review and comment via the town clerk. No comments were received.
- 02/09/21: Draft plan submitted to VEM for review and approval.
- 03/19/21: VEM review and request for edits obtained
- 3/24/21: Plan revision made and resubmitted to VEM

The draft plan was then revised based on input from planning team (e.g. minor corrections to names and titles of planning team members with an additional infrastructure project added). The revised draft was made available for review at the town office and residents were informed via meeting minutes and the town bulletin board of the ability to review the draft and additional opportunity for formal comment and suggestions. No additional public comment was received. Minor edits were made to the plan following State recommendations and the final draft was resubmitted to VEM for formal review and approval pending municipal adoption. A resolution of adoption will occur following VEM review and "approval pending adoption" status.

SECTION 2: HAZARD IDENTIFICATION

For this update, the planning team considered the continued inclusion or deletion of the 2016 hazards profiled by developing and researching the natural hazard categories outlined in the state mitigation plan and for each, considered prior history, current trends and available data to estimate risk. Some profiled hazards remain a risk for the town. However, other hazards, due to lack of occurrence frequency, risk and/or vulnerability have been removed in this update. The definitions of each hazard, along with historical occurrence and impact, are described below.

Types of Natural Hazards: weather /climate hazards (drought, hurricane/tornado, high winds, severe winter storm, extreme temperatures, climate change, lightning, hail), flooding, geological hazards (landslide / erosion, earthquake, naturally-occurring radiation), and fire hazards.

2020 Updated Profiled Natural Hazards: Severe Winter Storm/Ice, Flooding/fluvial erosion, Extreme Cold Temperature, Pandemic (listed as "Epidemic" in 2016 plan).

2.1 Natural Hazards Overview

There have been 22 disasters and 4 emergencies declared in Orleans County from 1964 through 2020 (it is noted that "Hurricane Irene" was listed as an Emergency, and then "Tropical Storm Irene" was listed as a Disaster a few days later). The following discussion on natural hazards is based upon information from several sources. Often, extent data specific to Charleston is not available but when appropriate and available, nearby Newport City data can be used to capture the extent of natural hazard events for the town and villages. General descriptions are based upon the *2018 Vermont State Hazard Mitigation Plan (SHMP).* According to NOAA Storm data, there were over 460 severe weather events from 1995-2020 in Orleans County.

The highest risk hazards (severe winter/ice storm, flooding, extreme cold and pandemic) have been profiled to provide the basis of future mitigation strategies. However, lower risk natural hazards (drought, tornado, tornado, high winds, extreme heat, hail, landslide, earthquake, naturally-occurring radiation, hurricanes and fire hazards) are omitted from full profiling because they do not pose enough risk to substantiate mitigation efforts at this time. And while the risk of a hazardous materials incident as outlined remain moderate due to border crossings and the associated vulnerabilities that result, the town will focus on natural hazards and pandemic response for this update. Additionally, impacts from hurricanes are addressed under flooding hazard.

Table 2-1: Summary of Vermont Emergency Declarations

Number	Year	Type
3437	2020	Pandemic (COVID-19) national 3/13/20
3338	2011	Hurricane Irene
3167	2001	Snowstorm
3053	1977	Drought

Source: FEMA

Table 2-2: Summary of Orleans County Disasters (Green rows indicate town PA received)

DN	Date	Disaster Type	Incident Type	Title
397	1973	DR	Flood	SEVERE STORMS, FLOODING, & LANDSLIDES
518	1976	DR	Flood	SEVERE STORMS, HIGH WINDS & FLOODING
1063	1995	DR	Severe Storm(s)	EXCESSIVE RAINFALL, FLOODING
1307	2000	DR	Severe Storm(s)	TROPICAL STORM FLOYD
1559	2004	DR	Severe Storm(s)	SEVERE STORMS AND FLOODING
1428	2002	DR	Severe	SEVERE STORMS AND FLOODING

			Storm(s)	
1184	1997	DR	Flood	EXCESSIVE RAINFALL, HIGH WINDS, AND FLOODING
1101	1996	DR	Flood	ICE JAMS AND FLOODING
1228	1998	DR	Severe Storm(s)	SEVERE STORMS AND FLOODING
1715	2007	DR	Severe Storm(s)	SEVERE STORMS AND FLOODING
3167	2001	EM	Snow	SNOW
1995	2011	DR	Severe Storm(s)	SEVERE STORMS AND FLOODING
3338	2011	EM	Hurricane	HURRICANE IRENE
4178	2014	DR	Flood	SEVERE STORMS AND FLOODING
4207	2015	DR	Severe Storm(s)	SEVERE WINTER STORM
4163	2014	DR	Severe Ice Storm	SEVERE WINTER STORMS
4380	2018	DR	Severe Storm(s)	SEVERE STORM AND FLOODING
4022	2011	DR	Hurricane	TROPICAL STORM IRENE
4066	2012	DR	Severe Storm(s)	SEVERE STORM, TORNADO, AND FLOODING
4356	2018	DR	Severe Storm(s)	SEVERE STORM AND FLOODING
4140	2013	DR	Flood	SEVERE STORMS AND FLOODING
4474	2020	DR	Severe Storm(s)	SEVERE STORM AND FLOODING
160	1964	DR	Drought	DROUGHT & IMPENDING FREEZE
164	1964	DR	Flood	FLOODING
4474	2020	DR	Severe Storm(s)	SEVERE STORM AND FLOODING
4532	2020	ED	Pandemic	COVID-19

2.1.1. Profiled Hazards

An Introduction to Climate Change:

"Over the past several decades, there has been a marked increase in the frequency and severity of weather-related disasters, both globally and nationally. Most notably, the Earth has experienced a 1°F rise in temperature, which has far-reaching impacts on weather patterns and ecosystems. This statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer), is known as climate change. The Intergovernmental Panel on Climate Change (IPCC) forecasts a temperature rise of 2.5°F to 10°F over the next century, which will affect different regions in various ways over time. Impacts will also directly relate to the ability of different societal and environmental systems to

mitigate or adapt to change6. Increasing temperatures are forecasted to have significant impacts on weather-related disasters, which will also increase risk to life, economy and quality of life, critical infrastructure and natural ecosystems. The IPCC notes that the range of published evidence indicates that the costs associated with net damages of climate change are likely to be significant and will increase over time. It is therefore imperative that recognition of a changing climate be incorporated into all planning processes when preparing for and responding to weather-related emergencies and disasters. Most of the natural hazards identified in this plan are likely to be exacerbated by changes in climate, either directly or indirectly. The National Aeronautics & Space Administration (NASA) reports that global climate change has already had observable effects on the environment: glaciers are shrinking, sea ice is disappearing, sea level rise is accelerating, heat waves are occurring more frequently and intensely, river and lake ice is breaking up earlier, plant and animal ranges have shifted, and trees are flowering sooner. Though climate change is expected to have global reach, the impacts differ by region. While the southwestern United States is expected to experience increased heat, wildfire, drought and insect outbreaks, the northeastern region is predicted to experience increases in heat waves, downpours and flooding. Accordingly, consideration of climate change was identified as a key guiding principle of the 2018 SHMP, addressed in each of the pertinent hazard profiles and incorporated into all relevant mitigation actions." 2018 SHMP

From 1962 to 2006, each five-year period resulted in 0-6 Major Disaster Declarations in Vermont. From 2007-2020, there were 23. It is commonly accepted that weather extremes are becoming more commonplace in Vermont. Since 2011, record setting snow, rain and cold have been experienced in the state. In recent years, it has become evident that human activities, mostly associated with the combustion of fuel, have added to the natural concentration of greenhouse gases in the atmosphere and are contributing to rapid climate change on a global scale. While projections of the effects of climate change vary, it is generally predicted that Vermont will have warmer temperatures year-round, with wetter winters and drier summers. An increase in the size and frequency of storms is also predicted. Thus, climate change in the next century will likely increase the chance of weather-related hazards occurring. An increase in precipitation may also result in increased flooding and fluvial erosion. Drier summers may increase the chance of drought and wildfire. A warmer climate may also result in the influx of diseases and pests that cold winters previously prevented. The severity of climate change is difficult to predict, though the effects may be mitigated somewhat if greenhouse gas emissions are reduced soon. In 2011, Governor Shumlin formed the *Vermont Climate Cabinet*. The Cabinet, chaired by the Secretary of Natural Resources, is a multidisciplinary approach to enhance collaboration between various state Agencies. Its primary objectives include providing the Governor with advisory information and facilitating climate change policy adoption and implementation. In 2013, the Vermont Agency of Natural Resources (ANR) released the Climate Change Adaptation Framework which addresses climate change exposures, vulnerability-specific elements within each of the natural resource sectors, and ongoing and proposed actions that can be or have been taken to prepare for the expected changes. In line and in conjunction with the ANR report, the primary goal of a VTrans climate change adaptation policy is to minimize long-term societal and economic costs stemming from climate change impacts on transportation infrastructure.

Severe Winter Storm

Winter storms impact the entire planning area and can include snowstorm, cold, blizzard and ice. According to the *2018 Vermont State All-Hazards Mitigation Plan*:

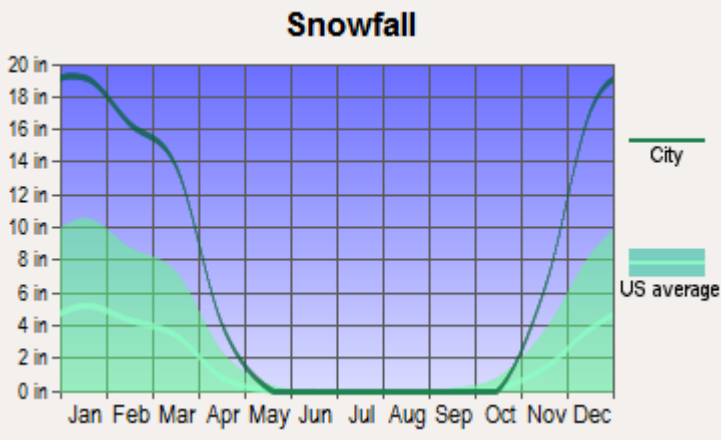
> *"Severe winter storms bring the threat of heavy accumulations of snow, cold/wind chills, strong winds, and power outages that result in high rates of damage and even higher rates of expenditures. A heavy accumulation of snow, especially when accompanied by high winds, causes drifting snow and very low visibility. Sidewalks, streets, and highways can become extremely hazardous to pedestrians and motorists. Severe winter storms develop through the combination of multiple meteorological factors. In Vermont and the northeastern United States, these factors include 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. Significant accumulations of ice can cause hazardous conditions for travel, weigh down trees and power lines, and cause power outages. Freezing rain can also be combined with snowfall, hiding ice accumulation and further hindering travel, or with mixed precipitation and potentially ice jams or flooding."*

Winter storm frequency and distribution varies from year to year depending on the climatological patterns but snowfall in the town is significantly higher than the national average. County-wide, the winter of 2010-2011 was the third snowiest on record with a total of 124.3 inches. The record of 145.4 inches was set in 1970-1971. The potential for a major snowstorm that exceeds the capabilities of town exists every year but with the recent increase in snowfall totals and cold temperature duration, the town realizes that further consideration is required. NOAA's National Centers for Environmental Information is now producing the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two thirds of the U.S. The RSI ranks snowstorm impacts on a scale from 1 to 5, similar to the Fujita scale for tornadoes or the Saffir-Simpson scale for hurricanes. NCEI has analyzed and assigned RSI values to over 500 storms going as far back as 1900. As such, RSI puts the regional impacts of snowstorms into a century-scale historical perspective. The index is useful for the media, emergency managers, the public and others who wish to compare regional impacts between different snowstorms. The RSI and Societal Impacts Section allows one to see the regional RSI values for storms as well as the area and population of snowfall for those storms. The area and population are cumulative values above regional specific thresholds. For example, the thresholds for the Southeast are 2", 5", 10", and 15" of snowfall while the thresholds for the Northeast are 4", 10", 20", and 30" of snowfall. 2010, 2012 and 2015 have some of the highest rankings for notable storms in Charleston. These rankings are based, in part on the severity of the storm using the following system. Since 2000, there has only been one event that reached a category 4 in the Northeast, five reached Category 3, eight were "significant" and all others were notable.

Table 2-3: NOAA's Regional Snowfall Index (RSI)

Category	RSI Value	Description
1	1–3	Notable
2	3–6	Significant
3	6–10	Major
4	10–18	Crippling
5	18.0+	Extreme

Table 2-4: Charleston Snowfall vs. U.S. Average



The Town has seen damage from declared snow disasters in the past, primarily dealing with debris removal from downed trees. In any Vermont community, this potential exists every winter. While there is no consistent record of snowfall for Charleston, nearby Newport City had the following events which serve to reflect the extent with which snow can impact the area. In January of 2015, the City received 28'' of snow compared to only 11.3'' in 2014.

Historic January snowfall totals fell in 1987 (47.5''), 1978 and 1979 (46.5'', 45.8''). Total average snowfall in December is 26.2'', January is 22.6'', February averages are slightly less at 16.9'' and March is 18.3''. February 14th-15th, 2007 saw the greatest 24-hour max snowfall total at 23.5''. The snowfall totals are annual averages based on weather data collected from 1981 to 2018 for the NOAA National Climatic Data Center. From 2011 to the first half of 2020, there were four recorded "extreme" weather events in Orleans County: February 4th and 15th: Heavy Snow. January 7th and February 1, 2015: Extreme Cold/Wind Chill.

On February 5, 2001, a winter storm event with accumulations of 10 to 14 inches across Orleans County had reported damage in several towns, including Charleston: "A storm system developed off the coast of Virginia early Monday, February 5, 2001 and moved northeast . It moved across extreme southeast coastal New England late Monday night and into the Gulf of Maine early

Tuesday, February 6th. Steady snow spread across the area by the afternoon of Monday, February 5th and continued overnight and was heavy at times. The snow tapered off to flurries Tuesday morning, February 6th. Some minor automobile accidents were reported. Barn roofs collapsed in the Towns of Craftsbury and Holland (Orleans County), apparently due to the weight of the snow after the storm ended. Across the counties, generally 10 to 14 inches of snow fell, with Sutton (Caledonia county) reporting 14.4 inches, Chelsea (Orange county) with 12 inches, and Greensboro (Orleans county) with 10." On March 5-7, 2001, there was a snow emergency event for which the Town of Charleston received Public assistance funds (EM 3167). The NOAA database reports that between 12 and 30 inches of snow fell, and $75,000 in regional property damage resulted. There are no standard loss estimation models or methodologies for the winter storm hazards. Potential losses from winter storms are, in most cases, indirect and therefore difficult to quantify. 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 snowfall (*2018 SHMP*).

Ice Storm

Major Ice Storms occurred in January 1998 and again in December 2014. While both Morgan and Brownington received heavy damage to forest stands, Charleston did not sustain any significant damage in the 1998 event. Known as the North American Ice Storm of 1998 a series of surface low pressure systems passed in this atmospheric circulation between January 5 and January 10, 1998. For more than 80 hours, steady freezing rain and drizzle fell over an area of several thousand square miles of the Northeast, causing ice accumulation upwards of 2'' in some areas. Charleston and the surrounding area received .5 to 1 inch of ice. The ice storm that hit Vermont on Thursday, January 8, 1998 was one of the worst weather calamities in Vermont history. It took Green Mountain Power seven days, one hour, and 29 minutes to restore power to all its customers. The power company supplying Charleston during the 1998 Storm is no longer operating and the Vermont Electric Cooperative has been supplying the town for about 10 years. With a recent generator grant application, the town has captured a recent history of outages with the greatest duration lasting four days but not due to an ice event. While there is evidence that supports an increase in weather and precipitation severity, the incidence of ice storms remains fairly spaced out. The town expects to have another ice storm but unlike rain and snow events, the occurrence of a major ice storm is not expected every year There has be no major ice event since the last approved plan. (www.wrh.noaa.gov/map/?wfo=sto).

Extreme Cold

"Extreme cold temperatures can have significant effects on human health and commercial and agricultural businesses, as well as primary and secondary effects on infrastructure (e.g. burst pipes from ice expansion and power failure). What constitutes "extreme cold" can vary across different areas of the country based on what the population is accustomed to in their respective climates. Exposure to cold temperatures can cause frostbite or hypothermia and even lead to heart attacks during physically demanding outdoor activities like snow shoveling or winter

hiking. When temperatures dip below freezing, incidents of icy conditions increase, which can lead to dangerous driving conditions and pedestrian-related slipping hazards. A large area of low pressure and cold air surrounding the poles, known as a polar vortex, is strengthened in the winter. When these polar vortex winds are distorted, due to cyclical strengthening and weakening or interaction with high-amplitude jet stream patterns, they have the potential to split into two or more patterns, allowing artic air to flow southward along a jet stream1. As this arctic air is able to access more southerly regions, extreme cold conditions can be observed in Vermont, which also have the potential to remain over the region for extended periods" (2018 SHMP).

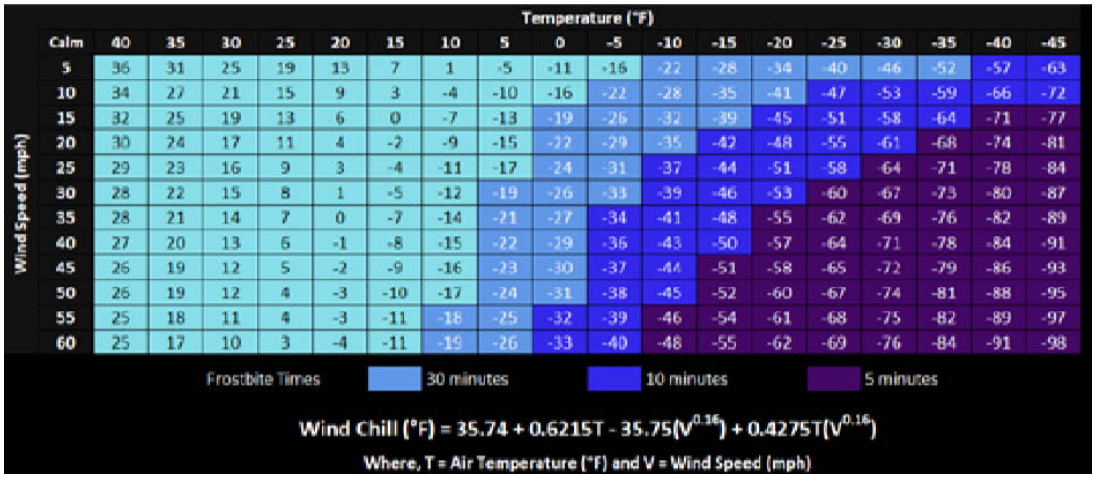
While there is no historical evidence to support a concern over the consequences of extremely hot temperatures on human health and safety, high temperatures can help to create severe storms as the one evidenced on September 11th, 2013, where record heat helped to produce damaging hail and winds in parts of the NEK and other areas of Vermont and New York. Recent extremes in cold temperatures is a concern and impact the entire planning area and region. 2015 tied the coldest winter (January to March) on record (1923) for Vermont according to the NOAA's National Climatic Data Center whose dataset dates to 1895. The National Weather Service has the following, recent, temperature records for nearby Newport City:

- Highest: 95 degrees, August 2001
- Lowest: -38 degrees, February 1933

Cold temperatures are expected in the Northeast, but they can pose a serious threat to health and safety, especially as the severity and duration increases in conjunction with other technological (e.g. power outage, fuel oil delivery disruption) and societal (ability to purchase heating fuel) factors. The winter of 2015 was the coldest anyone could remember with a mean temperature of 7.8 degrees Fahrenheit. However, the January of 1994 had a mean temperature of 2.7 degrees Fahrenheit which is the coldest mean temperature since 1930 and January is the statistically coldest month in all of Vermont. Since 1930, January produced temperatures in the negative 20's and 30's consistently for Orleans County with record cold temperatures occurring in 1957 and 1933 (-38). While the temperatures for the town remain within averages seen in the last 85 years, dangerously cold temperatures are expected every winter.

The NOAA Wind Chill Chart identifies those temperatures and associated wind speeds that may cause frostbite if skin is exposed to the air over a certain period of time:

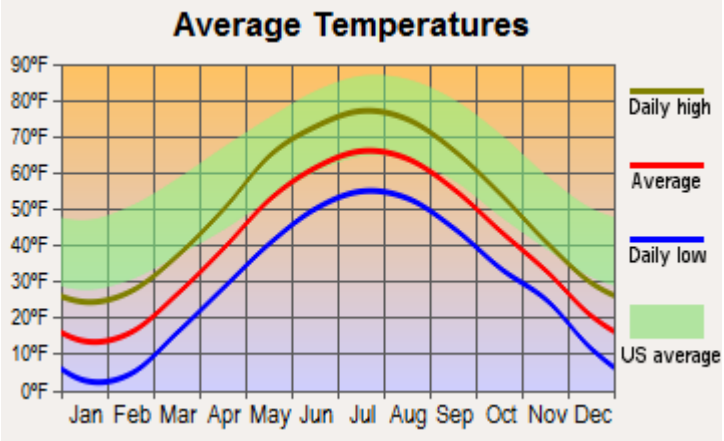
Table 2-5: NOAA Wind Chill Chart



In anticipation of extreme cold temperatures, the National Weather Service may issue the following watches, warnings or advisories, which are aimed at informing the general public as well as the agricultural industry:

• Wind Chill Warning: Dangerously cold wind chill values are expected or occurring
• Wind Chill Watch: Dangerously cold wind chill values are possible
• Wind Chill Advisory: Seasonably cold wind chill values but not extremely cold values are expected or occurring
• Hard Freeze Warning: Temperatures are expected to drop below 28°F for an extended period of time, killing most types of commercial crops and residential plants
• Freeze Warning: Temperatures are forecasted to go below 32°F for a long period of time, killing some types of commercial crops and residential plants
• Freeze Watch: Potential for significant, widespread freezing temperatures within the next 24-36 hours

Table 2-6: Charleston Temperature Ranges vs. National Average



Flooding

There are three main types of flooding that occur in Vermont: flooding from rain or snow melt, flash flooding and urban flooding. Flooding has also been known to occur as a result of ice jams in rivers adjoining developed towns and cities. These events may result in widespread damage in major river floodplains or localized flash flooding caused by unusually large rainstorms over a small area.

The effects of all types of events can be worsened by ice or debris dams and the failure of infrastructure (especially culverts), private and/or beaver dams. Rain storms are the cause of most flooding in town. Winter and spring thaws, occasionally exacerbated by ice jams, are another significant source of flooding, especially when coupled with high rain levels. Much of this flooding is flash flooding, occurring within hours of a rainstorm or other event. Flash flooding, as opposed to flooding with a gradual onset, causes the largest amount of damage to property and infrastructure. Floods cause two major types of damage: water damage from inundation and erosion damage to property and infrastructure. The 2018 Vermont State All-Hazards Mitigation Plan discusses flooding extensively:

"Flooding is the most common recurring hazard event in Vermont. In recent years, flood intensity and severity appear to be increasing. 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. These events may result in widespread damage in major rivers' floodplains or localized flash flooding caused by unusually large rainstorms over a small area. The effects of both inundation flooding and fluvial erosion can be exacerbated by ice or debris dams, the failure of infrastructure (often as a result of undersized culverts), the failure of dams, continued encroachments in floodplains and river corridors, and the stream channelization required to protect those encroachments." 2018 SHMP

Vermont experienced major floods long before Federal disaster assistance became available. But in November of 1927, Vermont experienced catastrophic flooding. In the month before the flood, rains more than 150% of normal precipitation fell after the ground had frozen. The flood itself was precipitated by 10 inches of rain falling over the course of a few days. The flood inundated parts of many towns and damaged or destroyed numerous bridges in the county. As the history of the flooding cited above bears out, the geography and topography are right for a significant localized storm with extreme damage at almost any location in Vermont. Numerous floods have resulted in Presidentially declared disasters and an influx of federal disaster assistance. Of these disasters, the 1973 flood inflicted the most widespread damage, and the residual rains of Hurricane Belle in 1976 resulted in the second highest amount of federal disaster assistance in Vermont.

Widespread, steady rainfall from frontal systems, tropical cyclones, or "northeasters" can result in flooding of large areas. Extensive and disastrous floods are rare but can result from intense spring rains combined with warm, humid winds that rapidly release water from the snowpack. Such was true for the devastating flood of March 11-12, 1936. During this flood, total rainfall and snowmelt ranged from 10 to 16 inches over the southeastern one-half of the State. Rainfall

alone can cause disastrous flooding similar to that in November 1927. During that flood, rainfall totals of 5-9 inches were common, and much more occurred at higher altitudes. Intense rainfall caused extensive flooding on September 21, 1938, when the "great hurricane" reached landfall in the southern area of the State. Severe thundershowers more commonly cause localized street and cellar flooding.

The Clyde River and associated brooks did rise during both the May, 2011 storms (which is the time for record high levels for Lake Champlain at 103.27 feet on May 6th, 2011) and due to the extent of these storms, the town is confident that Irene produced the greatest rise and discharge rates in the river in recent history. The discharge rate for the Clyde River during Irene was close to 1200 cubic feet per second compared to the average for that time of year at 100 cubic feet per second. While the data is for the portion of the Clyde River at Newport, it does indicate the magnitude of water resulting from the rains Irene produced. June 2015 broke records across the state for the wettest on record. Montpelier had the wettest June on record with 9.05 inches of precipitation, beating the old record of 8.36 inches set in 2013, according the National Weather Service. Mount Mansfield also had record rain with 15.54 inches, topping the 15.28 inches that fell in 1998. During May of 2011, Charleston saw 7'' of rain which is the most the town has seen in many years. Recent history, including the flooding events of 2011 and the records set in 2015 suggest that increases in total rain fall and severity in terms of rainfall per given unit of time are to be expected along the lines seen with the records seen across the state recently.

Tropical cyclones (storms) are officially ranked on one of five tropical cyclone scales, according to their maximum sustained winds and which tropical cyclone basin are located. Only a few scales of classifications are used officially by the meteorological agencies monitoring the tropical cyclones, but some alternative scales also exist, such as Accumulated cyclone energy, the Power Dissipation Index, the Integrated Kinetic Energy Index, and Hurricane Severity Index. Of most recent importance for Vermont was Tropical Storm Irene in 2011. Irene first struck the U.S. as a Category 1 hurricane in eastern North Carolina, then moved northward along the Mid-Atlantic Coast. Wind damage in coastal North Carolina, Virginia, and Maryland was moderate, with considerable damage resulting from falling trees and power lines. Irene made its final landfall as a tropical storm in the New York City area and dropped torrential rainfall in the Northeast that caused widespread flooding. Irene resulted in the worst Vermont flooding in 83 years but Charleston, along with much of the surrounding towns were not of the hardest hit. During Irene (August 20th-29th, 2011) Charleston received 3'' of rain (NOAA). By comparison, the following chart shows the three highest recorded rain and wind events for Vermont towns during Irene.

Tropical Storm Irene Rain and Wind Extremes	
Rainfall	Wind
Mendon, 11.23 inches	Burlington, 51 mph
Walden, 7.60 inches	Morrisville, 40 mph
Randolph Center, 7.15 inches	Springfield, 40 mph

Source: http://www.accuweather.com/en/weather-news/irenes-infamous-top-ten-1/54348

The state road to Island Pond from East Charleston (VT105) was closed due to damage from Tropical Storm Irene. While not classified as a Tropical Storm, the April 2011 rain totals for the NEK reached nearly 7'' compared to the normal precipitation for the month at 3''. The heaviest

rainfall event was associated with thunderstorms during the late afternoon of April 26th into the early morning hours of April 27th, 2011. These storms resulted in record and near record rainfall and flooding across portions of northern Vermont. Specific records for the town of Charleston regarding rainfall totals were not available but in using nearby Newport City (where the 7'' of rain was recorded), the town feels that this event can be used as a benchmark regarding extent.

Table 2-5: 2011 "Irene" Discharge Rates for Clyde River

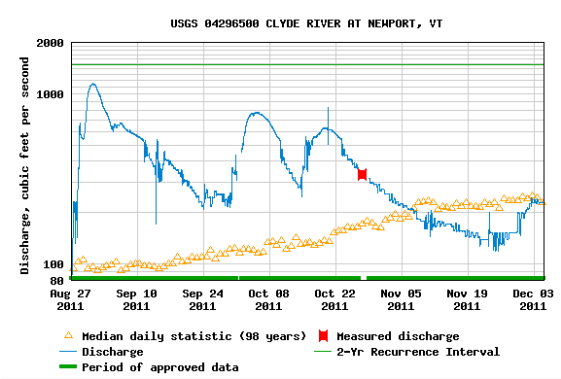
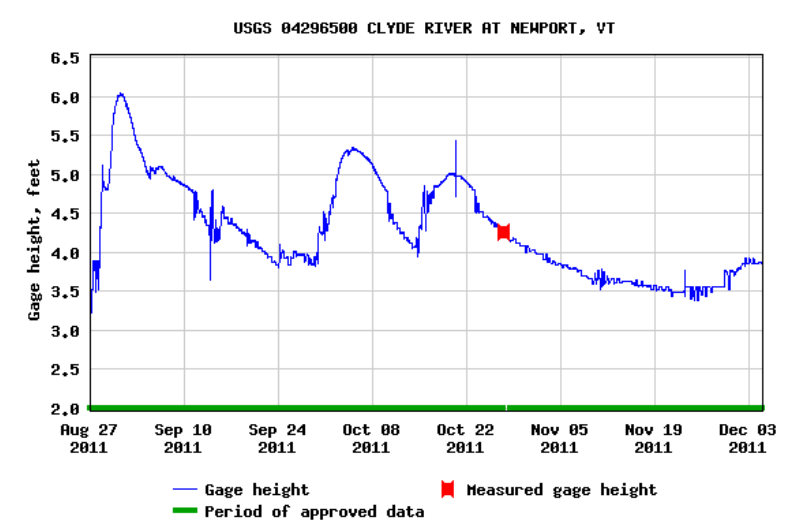


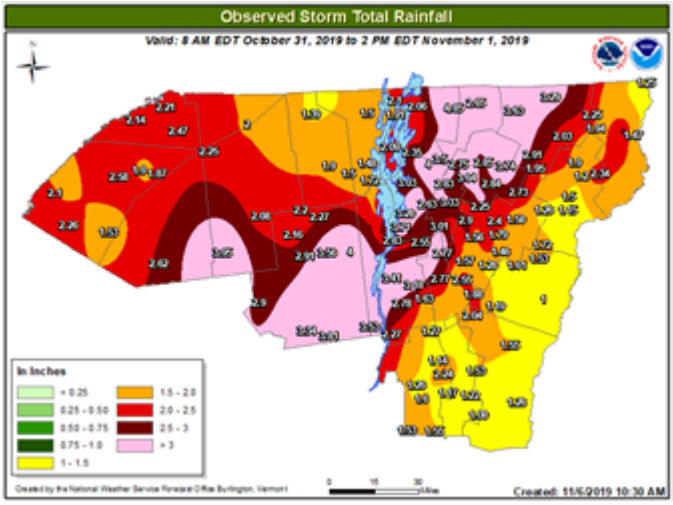
Table 2-6: 2011 "Irene" Gage Height for Clyde River



The "Halloween" storm of 2019 (DR4474) proved to be the most damaging flood event for many areas of the County in recent memory. This powerful storm system tracked across the eastern Great Lakes late on October 31st, 2019 and produced an axis of 3 to 5 inches of rain, which caused significant flooding across our region. Record rainfall occurred at Burlington, Vermont with 3.30 inches on October 31st, along with a record high temperature of 71 degrees. In addition, very gusty southwest winds developed behind this potent storm, which generated

scattered to widespread power outages. Surface wind gusts measured up to 65 mph across northern New York and parts of Vermont, with gusts over 100 mph at the summits. The heavy rainfall washed out numerous roads and culverts from Essex County, New York into parts of central and northern Vermont, while 10 rivers reached flood stage with 8 reaching moderate to major levels. A new record high level of 14.72 feet was attained at North Troy on the Missisquoi River. Extensive flooding was observed in the following river basins: Missisquoi, Lamoille, Winooski, and Ausable, while flash flooding with very sharp rises of smaller streams and rivers occurred across the higher terrain of the eastern Adirondacks into central and northern Green Mountains of Vermont, including the Champlain Valley. Observed total rainfall recordings were 5.26 inches in East Berkshire, 4.85 inches in Enosburg Falls, 4.80 in Fletcher, 4.32 Westford, and 4.0 inches in Elizabethtown, New York. Table 2-7 below shows the storm total precipitation from 31 October at 8 AM to 1 November 2019 at 2 PM.

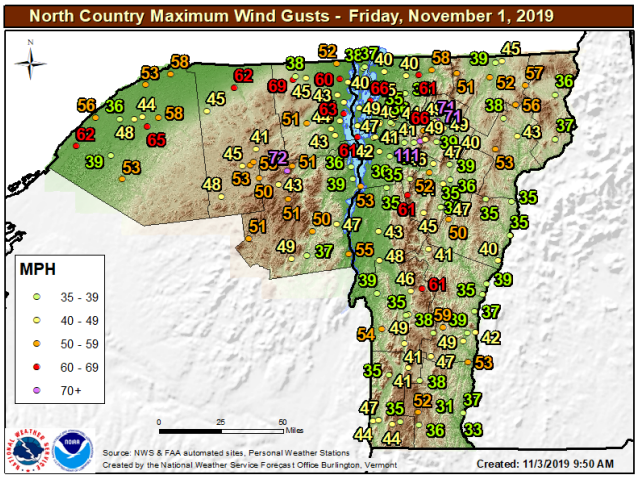
Table 2-7: Observed storm total rainfall from 8 AM EDT on 31 October to 2 PM EDT on 1 November 2019



The second significant impact from this powerful storm was the high winds, which caused scattered to widespread power outages across northern New York into Vermont. The core of the strongest winds occurred early morning on November 1st across New York and spread into Vermont during the daytime hours. At the peak, over 120,000 customers were without power across the region. Given how saturated the soils were from the recent heavy rainfall, shallow rooted trees were easily uprooted, exacerbating power outages. A few peak wind gusts included 69 mph at Ellenburg, 65 mph in Potsdam and 62 mph in Malone, New York, while a gust to 71 mph was measured in Johnson, 66 mph at Burton Island and 111 mph at Mount Mansfield in Vermont. Figure 2 below shows a map of observed peak wind gusts across the North County on

1 November 2019**.** Charlston did sustain wind damage that was addressed by electric and telephone service providers.

Table 2-8: Maximum Wind Gust Map for 11/1/2020



Inundation and Floodplains

The land area where inundation flooding occurs is known as the floodplain. During high water events, water flows out of the riverbank and spreads out across its floodplain. FEMA defines the portion of the floodplain inundated by the 1% annual chance flood as the Special Flood Hazard Area (SFHA); the area where the National Flood Insurance Program (NFIP) floodplain management regulations must be enforced and where the mandatory purchase of flood insurance applies for federally-secured loans.

Inundation flooding on larger rivers and streams typically occurs slowly, over an extended period of time but can spread out over a large area of land. Due to the slower onset of inundation flooding on larger rivers, there is time for emergency management planning (e.g. evacuations, electricity shut-off considerations, etc.) to take place. Though the inundation floodwaters are slower to hit, they often take time to recede as well, and exposure to water for an extended period of time can result in significant property damage. U.S. Geological Survey's (USGS) National Water Information System monitors real-time streamflow gaging stations in Vermont.

Inundation and fluvial erosion may both increase in rate and intensity as a result of human alterations to a river, floodplain, or watershed. For instance, when a dam fails there may be significant, rapid inundation which can occur without warning. Public and private structures and infrastructure become vulnerable when they are located on lands susceptible to inundation and fluvial erosion. The 2018 Vermont State All-Hazards Mitigation Plan contains the following on inundation:

"Recent studies have shown that most flooding in Vermont occurs in upland streams and road drainage systems that fail to handle the amount of water they receive. Due to steep gradients, flooding may inundate these areas severely, but only briefly. Flooding in these areas generally has enough force to cause erosion capable of destroying roads and collapsing buildings. These areas are often not mapped as being flood prone and property owners in these areas typically do not have flood insurance (DHCA, 1998). Furthermore, precipitation trend analysis suggests that intense local storms are occurring more frequently. Additionally, irresponsible land use and development will exacerbate the preexisting vulnerability. Urban flooding usually occurs when drainage systems are overwhelmed and damages homes and businesses. This flooding happens in all urban areas, but specifically in Burlington where the area is located at the bottom of a gradient, which adds to the intensity of this localized flooding…

…Over the past two decades, flood damage costs have risen dramatically in Vermont due to increasing occurrences of flooding and increases in vulnerability associated with unwise land use development in flood plains or within stream corridors. The geography and topography are right for a significant localized storm with extreme damage at almost any location in Vermont. Heavy rains with previous ground saturation, which causes runoff, are a significant part of the flooding formula in Vermont. Steep topography and narrow, inhabited, stream and river valleys further increase the dangerous nature of this hazard. Furthermore, precipitation trend analysis suggests that intense, localized storms that can cause flash flooding are occurring with greater frequency. While flooding will continue, planning and other mitigation measures can help minimize damages.

All of Vermont's major rivers have inhabited flood plains. While residents in mountain valleys are at risk, they may not be aware of the danger or may choose to ignore it. There are many reasons property owners are reluctant to relocate to less flood prone ground, not the least of which is the lack of personal experience of flooding. In addition, many communities originated beside rivers and streams, some of the most attractive property is located in vulnerable areas. Lakeshore property in Vermont is vulnerable to flooding from high water levels, either by surface water erosion or flooding. Occasionally, water-saturated ground and high-water tables cause flooding to basements and other low-lying areas. Lakeshore property is highly desirable and valuable, making the development of lakeshore areas very likely, even with the high potential for flooding. Restrictions on lakeshore property development have significant negative economic and tax revenue impacts that must be carefully weighed against the gains in personal safety and protection of property." 2018 SHMP

All of the planning area has the potential to be affected by flooding. Although, comparatively, the town has remained insulated from the catastrophic flood damage that the state has seen in the last ten years, the community continues to have concerns about impacts of future flooding. FEMA's current Flood Hazard Boundary Map of Charleston, published in 1974, delineates areas of concern along the Clyde River, Mad Brook, Pensioner Pond, Toad Pond, and Echo Lake. There is limited development in flood hazard areas of the Town, including a few residences and hay barns. There are no repetitive loss structures in the Town. Portions of the Mad Brook have some fluvial erosion potential, but Town has not seen any major increase in erosion since 2011 when repeated flooding inundated much of the state. With very little floodplain development in Charleston, the greatest danger during flood events is to Town highway infrastructure. All 41 culverts on Hudson Road and Twin Bridge Road are located within mapped floodplains. During

2017-2018, the Town completed two FEMA 404 Hazard Mitigation Program projects on 2 highways that saw repeated washout and closure during Tropical Storm Irene and other recent storms. The first was replacement of double culverts with a precast box culvert with natural stream bed over Mad Brook on Cole Road, a town-to-town connector. The second was to build the road surface and upgrade the ditch and culvert network on Hudson Rd, a Class 2 highway and major state highway connector adjacent to the Clyde River flood plain. Both projects will prevent or reduce damages caused by future disasters, reduce future highway repair costs, and mitigate the discharge of stormwater and pollutants into the watershed. Both projects were made possible because the Town adopted a Local Hazard Mitigation Plan in 2016. As well, the Better Roads Program provides grants and technical assistance to help the Town avoid erosion and flash floods resulting from road design and construction (*2019 Town Plan*).

Fluvial Erosion

Erosion occurs on a consistent, but small-scale, basis within the riparian corridor of the town's streams and rivers. This is a part of normal natural processes and as such is necessary for the proper functioning of the ecosystem of these waterways. However, fluvial erosion on a large scale can damage stream banks and undercut infrastructure such as roads, bridges and culverts as well as agricultural land and structures, causing severe damage. Most flood damage is associated with fluvial erosion rather than inundation. The 2018 Vermont State All-Hazards Mitigation Plan contains the following on fluvial erosion:

"In Vermont, most flood-related damage is due to fluvial erosion. Erosion occur when the power of the flood (i.e. the depth and slope of the flow) exceeds the natural resistance of the river's bed and banks. Rivers that have been overly straightened or deepened may become highly erosive during floods, especially when the banks lack woody vegetation, or when the coarser river bed sediments have been removed. In areas where rivers are confined due to human activity and development, they have become steeper, straighter, and disconnected from their floodplains. The more trapped the river is, the greater power it will gain, which eventually results in a greater degree of damage to critical public infrastructure such as roads and stream crossings, as well as homes, businesses, community buildings and other man-made structures built near rivers. Fluvial erosion is also increased downstream when all the eroded materials (i.e. sediment and debris) come to rest in a lower gradient reach, clog the channel, and cause the river to flow outside its banks. When severe enough, fluvial erosion can also be the cause of Landslides (see: Landslides). The land area that a river accesses to meander and overtop its banks to release flood energy without excessive erosion is known as the River Corridor. A river corridor includes the meander belt of a stream or river and a buffer of 50'. The River Corridor, as defined in Vermont statute, is: 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, as that term is defined in section 1422 of this title, and for minimization of fluvial erosion hazards, as delineated by the Agency of Natural Resources in accordance with river corridor protection procedures."

Vermont's River Corridor maps delineate river corridors for larger streams and rivers, and standard setbacks for smaller, upland streams. The setbacks were determined by factoring in the

same stable stream slope requirements used when delineating a river corridor using a meander centerline setback. These maps are located on the Vermont FloodReady and Vermont Natural Resources Atlas websites in addition to recent NVDA work for mapping river corridors for towns in the NEK.

The Vermont Agency of Transportation (VTrans) applies the term "scour critical" to stream crossing structures especially vulnerable to streambed scour—the undermining of bridge supports by water action and erosion. A spreadsheet database is maintained by VTrans and continually updated by the Bridge Inspection Program. Structures inspected are only those of 20 feet or longer owned by a municipality or the state. The scour critical rating is based on the structure itself, and does not consider debris jams, outflanking, channel change, or other issues commonly associated with fluvial erosion. Water supply source and distribution systems are also endangered by fluvial erosion. Many water distribution systems involve buried pipes that cross streams, which are vulnerable to fluvial erosion. In December 2014, the Vermont Department of Environmental Conservation (DEC) released the "Flood Hazard Area and River Corridor Protection Procedures" guide, outlining specific actions and considerations. Erosion of stream banks was a concern but is less-so now. A FEMA study has shown very little increase in velocities resulting from over-bank events which are infrequent and have subsequently not caused channel migration.

Charleston remains committed to enhancing awareness and incorporating recommendations in future planning and mitigation work. The Clyde River Stream Geomorphic Assessment is part of an on-going partnership between the Northwood's Stewardship Center and the State of Vermont to identify sources of nonpoint source pollution in the four main Vermont tributaries draining into Lake Memphremagog, a lake receiving high nutrient and sediment loads. Located in northeastern Vermont, the Clyde River Watershed encompasses 144 square miles of land noted for its remoteness and wildness. Although recognized for their natural beauty, relatively intact wetlands, and abundant recreational and fishing opportunities, the Clyde River, its tributaries, and associated lakes also face a number of water quality threats resulting from a variety of sources within the watershed. While it is important to address these threats, it is equally important to identify and prevent degradation of areas with excellent water quality. In streams, water quality is influenced by inputs from the watershed as well as the health of the stream itself.

Assessments on 83 miles of the Clyde River and its tributaries has been completed; from these, 17.5 miles were chosen for more detailed Phase 2 Stream Geomorphic Assessments. The results of these assessments indicate that many streams in the Clyde River Watershed are in good or reference condition. However, there are areas in the watershed which have lost their protective riparian buffers, are receiving inputs of sediment and nutrients from urban and agricultural development and are eroding and sending nutrients downstream. The Phase 2 reaches most profoundly affected by these stressors were rated in fair or poor condition and totaled 1.6 stream-miles. The Phase 2 assessments highlighted several potential stream restoration sites, including reaches in Newport (reach M01), West Charleston (reach M08), East Charleston (reaches M15, M16 and an unnamed tributary to M15), and the lower reach of Cold Brook in Brighton (reach T4.01). These reaches contain areas of actively eroding streambanks and significant areas without riparian buffers. These reaches would benefit from buffer enhancement projects such as tree or shrub plantings. Dropping only 40 feet in elevation from its beginning at Island Pond

(Reach M21) to Pensioner Pond (Reach M12), the Clyde River is a slow, low gradient river snaking its way through broad valleys, vast wetlands, and floodplain forests. The river receives inputs from numerous cold-water mountain tributaries during this 11.8 mile (16.5 river miles) stretch, most notably the Pherrins River (Reach T6), Oswegatchie Brook (T5), Cold Brook (T4), Webster Brook (not assessed), Mad Brook (T2), and outflows from Seymour and Echo Lakes (T1). Below Pensioner Pond and the Great Falls Dam above West Charleston, the river changes dramatically, cascading over several bedrock ledges before entering Charleston Pond. Below Charleston Dam, the Clyde becomes a whitewater river, encountering more small bedrock ledges, flowing over cobble and boulder stream beds, and finally leveling off downstream of West Charleston village. The river elevation drops 140 feet from Pensioner Pond (Reach M12) to West Charleston (Reach M09), a distance of only 0.68 river miles, excluding the pond lengths. After West Charleston village, the Clyde River transitions again to a low-gradient river, meandering through fields and forests before entering Little Salem Pond and Lake Salem (Reach M06). The river elevation drops 40 feet in these 1.7 miles (2.3 river miles). After exiting these lakes, the Clyde again changes to a fast-flowing and high-gradient river, traveling through a confined valley within the town of Derby and dropping 80 feet in 3.6 miles (3.9 river miles) between Lake Salem and Clyde Pond (Reach M03). Upon leaving Clyde Pond, the river passes over the Clyde Pond Hydroelectric Dam and becomes a fast and cascading stream, dropping 190 feet in only 1.1 miles before leveling off in Newport and entering Lake Memphremagog. The Clyde River flows through five lakes along its course. Its flows are affected by three man-made grade controls: Great Falls Dam below Pensioner Pond, Charleston Dam at Charleston Pond, and the Clyde Pond Dam in Newport. Salem Lake and Little Salem Pond are undammed, but all of these ponds and lakes capture sediment originating from upstream sources. Based on the intensity of channel and floodplain modifications, as well as the overall stream condition observed during the field assessments, reaches conditions were defined as reference, good, fair, and poor. Vermont ANR Stream Geomorphic Assessment Protocols describe these conditions below (State of Vermont 2007b):

In Regime: A stream reach in reference and good condition that is in dynamic equilibrium which may involve localized, insignificant to minimal change to its shape or location while maintaining the fluvial processes and functions of its watershed over time and within the range of natural variability.

In Adjustment: A stream reach in fair condition that has experienced major change in channel form and fluvial processes outside the expected range of natural variability; and may be poised for additional adjustment with future flooding or changes in watershed inputs that could change the stream type.

Active Adjustment and Stream Type Departure: A stream reach in poor condition that is experiencing extreme adjustment outside the expected range of natural variability for the reference stream type; likely exhibiting a new stream type; and is expected to continue to adjust, either evolving back to the historic reference stream type or to a new stream type consistent with watershed inputs and boundary conditions. There are five stages in channel evolution. Streams in stable condition that are not out of balance due to in-stream or upstream stressors are in Stage I. These streams are in good to reference condition and have the ability to regularly flood in order to disperse sediment and energy. Reaches in fair or poor condition are currently evolving to

regain balance; these streams will be in various stages of channel evolution. Streams in Stage II have eroded their beds and may have lost the ability to access their floodplains. These reaches have increased power, increased ability to erode, and decreased ability to store sediment within the reach. Instead, much of the sediment may be sent downstream to affect downstream reaches or lakes. In Stages III and IV, the stream is widening and migrating as it re-establishes meanders and a new floodplain at a lower elevation. Erosion may be severe at these stages as the stream attempts to establish its equilibrium. Finally, Stage V represents a new equilibrium and a reestablished floodplain at a lower elevation. Most assessed reaches in the Clyde River watershed were stable and in good to reference condition. Although some reaches rated in good condition contained areas of erosion and unstable banks, they lacked the widespread instability resulting from extensive modifications to the channel and watershed. Four reaches were in fair condition, and one reach was in poor condition. These reaches were unstable, have lost floodplain function, and may be responsible for sending large amounts of sediment and nutrients downstream. While this information provides a foundation for the town to understand erosion characteristics, continued analysis in conjunction with ANR and the Stewardship Center is needed. *(Source: Restoring Water Quality in the Lake Memphremagog Basin: Clyde River Phase I and II Stream Geomorphic Assessments, 2006).* The 2011 flooding events did result in enhanced erosion, further data was not available to determine the extent of this erosion nor is data available for any succeeding erosion since the last approved plan.

In summary, flooding is a significant hazard in Charleston, a fact that is unlikely to change. Protecting river systems as a preventative measure, protecting property and human health and safety from flooding and flood-related damage remains important facets of mitigation planning for most Vermont communities including Charleston.

Pandemic

Pandemic planning in Vermont appears to ebb and flow. Following the H1N1 Virus Outbreak in 2009-2010, increased emphasis on pandemic planning was seen across the state. From 2010 to 2019 however, without another major U.S. event, emphasis on pandemic planning diminished. While Vermont, due to its rural nature, has some level of protection from national infection rates during a pandemic, the financial implications experienced during the COVID-19 pandemic in 2020 hit the state extremely hard.

COVID-19 is a new disease, caused by a virus not previously seen in humans. COVID-19 is highly contagious and people with COVID-19 who do not have any symptoms can spread the virus to other people. On March 13, 2020, President Trump declared a nationwide emergency pursuant to Sec. 501(b) of Stafford Act to avoid governors needing to request individual emergency declarations. All 50 states, the District of Columbia, and 4 territories have been approved for major disaster declarations to assist with additional needs identified under the nationwide emergency declaration for COVID-19. Additionally, 32 tribes are working directly with FEMA under the emergency declaration. FEMA announced that federal emergency aid has been made available for the state of Vermont to supplement the state and local recovery efforts in the areas affected by the Coronavirus Disease 2019 (COVID-19) pandemic beginning on January 20, 2020 and continuing. Public Assistance federal funding was made available to the state and eligible local governments and certain private nonprofit organizations on a cost-sharing basis for

emergency protective measures (Category B), including direct federal assistance under Public Assistance, for all areas in the state of Vermont affected by COVID-19 at a federal cost share of 75 percent.

In early 2020, there was a quick return to the tenets of effective pandemic planning. Preparing for hospital surge, high death rates and the medical equipment necessary for both patients and health care workers are examples of the state's early focus. Public information and guidance on safety, isolation, travel and quarantine also became extremely important while mitigating the pervasive economic consequences of reducing work forces, sending students home and closing businesses. Additionally, Vermont had to consider the implication of, and work to control, the immigration of people from other states. Both infection risk and taxing of local resources were the main concerns associated with this real consequence of the pandemic.

While the Northeast Kingdom remained insulated from infection rates (and subsequent deaths) seen elsewhere in the state (e.g., Burlington), issues of border closure, implementing safety protocol and procedures and economic resilience were experienced in every community, including Charleston. The town has received public assistance for the COVID-19 disaster 4532. As of December 2nd, 2020, there have been 5015 cases, 79 deaths and 2951 recovered in the state. According to the current data, Charleston has had less than 10 cases. *(https://www.healthvermont.gov/response/coronavirus-covid-19/current-activity-vermont#town*

SECTION 3: RISK ASSESSMENT

3.1 Designated Hazard Areas

3.1.1 Flood Hazard Areas

FEMA's current Flood Hazard Boundary Map of Charleston, published in 1974, delineates areas of concern along the Clyde River, Mad Brook, Pensioner Pond, Toad Pond, and Echo Lake. There is very limited development in flood hazard areas of the Town, including a few residences and hay barns. There are no repetitive loss structures in the Town. Portions of the Mad Brook have some fluvial erosion potential, but Town has not seen any major increase in erosion since 2011 when repeated flooding inundated much of the state. With very little floodplain development in Charleston, the greatest danger during flood events is to Town highway infrastructure. All 41 culverts on Hudson Road and Twin Bridge Road are located within mapped floodplains. During 2017-2018, the Town completed two FEMA 404 Hazard Mitigation Program projects on highways that saw repeated washout and closure during Tropical Storm Irene and other recent storms. The first was replacement of double culverts with a precast box culvert with natural stream bed over Mad Brook on Cole Road, a town-to-town connector. The second was to build the road surface and upgrade the ditch and culvert network on Hudson Rd, a Class 2 highway and major state highway connector adjacent to the Clyde River flood plain. Both projects will prevent or reduce damages caused by future disasters, reduce future highway repair costs, and mitigate the discharge of stormwater and pollutants into the watershed. Both projects were made possible because the Town adopted a Local Hazard Mitigation Plan in 2016. As well, the Better Roads Program provides grants and technical assistance. According to the Charleston Town Plan, designated flood hazard areas exist in the town but most major infrastructure and roadways are out of harm's way. 12 residences are in the floodplain and no

commercial property other than hay fields and a few hay barns exist with the 100-year floodplain. The town has not seen any significant storm-related damage to infrastructure within the designated floodplain since the last approved plan.

3.1.2 Fluvial Erosion Hazard Areas

About two-thirds of Vermont's flood-related losses occur outside of mapped floodplains, and this reveals the fundamental limitations of the FEMA FIRMs. A mapped floodplain makes the dangerous assumption that the river channel is static, that the river bends will never shift up or down valley, that the river channel will never move laterally, or that riverbeds will never scour down or build up. River channels are constantly undergoing some physical adjustment process. This might be gradual, resulting in gradual stream bank erosion or sediment deposit – or it might be sudden and dramatic, resulting a stream bank collapse. The losses experienced during the May 2011 storms and Tropical Storm Irene were most often related to the latter. In fact, this type of flood-related damage occurs frequently in Vermont, due in part to the state's mountainous terrain. Land near stream banks are particularly vulnerable to erosion damage by flash flooding, bank collapse, and stream channel dynamics. The Vermont Department of Environmental Conservation, Agency of Natural Resources, has identified river corridors, which consist of the minimum 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. In other words, the river corridor provides "wiggle room" for a stream as its channel changes over time. Keeping development out of the river corridors therefore reduces vulnerability to erosion.

The town remains relatively free of concern related to stream bank scouring as there are no high-risk areas in terms of environmental or economic risk. While portions of the Mad Brook continue to have some fluvial erosion potential, the town has not seen any major increase in erosion since 2011, when repeated flooding inundated much of the state. However, the town remains cautious and realizes that severe weather can alter focus quickly. With the recent emphasis on climate change and subsequent weather-related disasters, the town remains committed to aligning with all applicable and logistically feasible recommendations and considerations resulting from the work of State agencies.

3.1.3 Repetitive Loss Properties

The town has no repetitive loss properties.

3.2 Non-designated Hazard Areas

3.2.1 1998 Ice Storm Damage

Impacts of the January 1998 ice storm in Charleston were minimal in comparison to other areas of the state.

3.2.2 High Winds and Lightning

Ridgeline and hilltop homes as well as homes located in the midst of mature forests are the most vulnerable to damage from falling trees and tree limbs. High tension line runs along VT RT 105 and the Vermont Agency of Transportation works to keep limbs trimmed.

3.3 Previous FEMA-Declared Natural Disasters, Non-declared Disasters and Snow Emergencies

Since 2007, the town has had $587,000 in road expenses resulting from washouts and flooding. Of this amount, $64,000 (10.9%) has been paid for by the town. The remainder has been paid for by FEMA and ERAF. In 2010, the town made a significant repair to Dane Hill Road. Beginning at Route 105, the first ¾ mile were completely rebuilt. The $78,000 project was paid for by the Vermont Department of Public Safety ($35,000), Better Back Roads ($12,000) and a Vermont Structures Grant ($27,000) with the remainder paid for by the town. This project was not caused by the result of a declared disaster but due to the volume of traffic and impact on the road resulting from being on such a steep slope. The resulting repair has substantially protected the town from future expenditures associated with minor repairs to this location. Charleston has received public assistance funding from FEMA for the following natural disasters:

Table 3-1 Town of Charleston, FEMA-declared disasters and snow emergencies

Date (FEMA ID#)	Type of Event	Total Repair Estimates	Project Worksheet #
DR-1715	Flooding	$61,719.00	30, 31
DR-1995	Flooding	$213,712.00	064, 116, 119, 134, 135, 141, 142, 156, 162, 173, 174, 223, 308, 378, 379, 384, 385, 390, 391, 394, 410, 411
DR-4022	Flooding	$187,394.00	016, 310, 784, 851, 852, 854, 855, 858, 866
DR-4140	Flooding	$76,598.00	0095, 0134, 0135
DR-4178	Flooding	$18,851.00	4163
DR-4532	Pandemic	$3849.00	00051

Sources: Town Records, Project Worksheets, financial report forms and award letters.

The Town of Charleston was reimbursed at a rate of 75 percent by FEMA for the estimated repair costs and 12.5% by the state. Funds provided in response to these natural disasters were used for gravel, ditching, road repair and additional secondary costs associated with these activities.

Non-declared disasters (e.g., snow and rainstorms) have not resulted in damage above and beyond normal maintenance. Extreme, long-lasting cold temperatures during winter months do pose a concern for the town as in many communities where the price of heating fuel often exceeds resident's ability to pay. Coupled with high unemployment, there is an increased risk for the town's residents to not meet the financial requirements for adequate heat, especially during long periods of extremely cold temperatures. Without adequate provisions, 48 hours of extremely cold temperatures could create a serious health hazard.

3.4 Hazard Assessment and Risk Analysis

Although estimating the risk of future events is far from an exact science, the Planning Team used best available data and best professional judgment to conduct an updated Hazards Risk Estimate analysis, which was subsequently reviewed and revised by town officials in 2014. This analysis assigns numerical values to a hazard's affected area, expected consequences, and probability. This quantification allows direct comparison of very different kinds of hazards and their effect on the town and serves as a method of identifying which hazards hold the greatest risk based on prior experience and best available data. The following scoring system was used in this assessment.

Area Impacted, scored from 0-4, rates how much of the municipality's developed area would be impacted.

Consequences consists of the sum of estimated damages or severity for four items, each of which are scored on a scale of 0-3:

- Health and Safety Consequences
- Property Damage
- Environmental Damage
- Economic Disruption

Probability of Occurrence (scored 1-5) estimates an anticipated frequency of occurrence.

To arrive at the overall risk value, the sum of the Area and Consequence ratings was multiplied by the Probability rating. The highest possible risk score is 80.

3.4.1 Natural Hazards

According to the updated Hazard and Risk Estimation for Charleston, the following natural hazards received the highest risk ratings out of a possible high score of 80:

- Severe Winter Storm (32)
- Flooding (36)
- Extreme Cold (32)
- Pandemic (18)

Flood-related disasters have had the greatest financial impact on the town. While no deaths or injuries have been recorded for declared or non-declared disasters, the potential for health and safety risk during a pandemic, severe winter storm or extreme cold event is considered higher than that posed by a flooding event. While flooding is likely to have a significant impact over a smaller area, severe winter storms tend to affect the entire town and are more common, hence the higher rating. Charleston has minimal fluvial erosion hazard areas along stream banks.

Table 3-2 Natural hazards risk estimation matrix, Charleston

Charleston Natural Hazard Risk Analysis: NATURAL HAZARDS	Drought	Flooding	High Winds	Fluvial Erosion	Landslide	Lightning	Multi-Structure Urban Fire	Pandemic	Winter Storm	Extreme Cold
Area Impacted										
Key: 0 = No developed area impacted										
1 = Less than 25% of developed area impacted										
2 = Less than 50% of developed area impacted										
3 = Less than 75% of developed area impacted										
4 = Over 75% of developed area impacted	1	3	2	1	0	1	1	0	4	4
Consequences										
Health & Safety Consequences										
Key: 0 = No health and safety impact										
1 = Few injuries or illnesses										
2 = Few fatalities or illnesses										
3 = Numerous fatalities	0	1	0	0	0	1	1	3	1	1
Property Damage										
Key: 0 = No property damage										
1 = Few properties destroyed or damaged										
2 = Few destroyed but many damaged										
3 = Few damaged but many destroyed										
4 = Many properties destroyed and damaged	0	1	1	1	0	1	2	0	1	1
Environmental Damage										
Key: 0 = Little or no environmental damage										
1 = Resources damaged with short-term recovery										
2 = Resources damaged with long-term recovery										
3 = Resource damaged beyond recovery	2	2	1	1	2	0	1	0	0	0
Economic Disruption										
Key: 0 = No economic impact										
1 = Low direct and/or indirect costs										
2 = High direct and low indirect costs										
2 = Low direct and high indirect costs										
3 = High direct and high indirect costs	2	2	1	2	1	1	1	3	2	2
Sum of Area & Consequence Scores	5	9	5	5	3	4	6	6	8	8
Probability of Occurrence										
Key: 1 = Unknown but rare occurrence										
2 = Unknown but anticipate an occurrence										
3 = 100 years or less occurrence										
4 = 25 years or less occurrence										
5 = Once a year or more occurrence	1	4	3	3	1	2	2	3	4	4
TOTAL RISK RATING										
Total Risk Rating =	**5**	**36**	**15**	**15**	**3**	**8**	**12**	**18**	**32**	**32**
Sum of Area & Consequence Scores										
x Probability of Occurrence										

3.4.4 Hazard Summary

According to the risk estimation analysis, the highest rated hazards for Charleston are:

Severe Winter Storm

Flooding

Extreme Cold
Pandemic

Flooding is the highest rated hazard for Charleston due to previous damage events and subsequent costs to repair. Within each of the highest rated hazards, there exists the potential for the secondary, but no less important, consequence of increased financial demand on residents because of an event. While winters in Vermont are characterized by cold weather, recent increases in extreme weather events, including extremely cold temperatures increases the costs of heating energy and this is a challenge that the state and local communities are being forced to address. Along these lines, the cases of COVID-19 were minimal in the planning area but the financial impact of protective measures implemented on a state-level impacted the planning area as it did many of the surrounding communities. Recovery from the pandemic will be a long road for some and the consequences for residents and the town have the potential of being severe. The next planning cycle will give the planning team an opportunity to assess and work to mitigate these consequences.
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SECTION 4: VULNERABILITY ASSESSMENT

Vulnerability refers to the potential impact of a specific loss related to an identified risk. While the loss of any one facility would cause a disruption in town services and operations, the overall vulnerability is low. There are roads, bridges and culverts vulnerable to flooding and those are identified below. Loss of equipment function for the highway department is a vulnerability for the town but the risk is not due or predicted to be a result of a disaster, merely, the required maintenance expected of highway-related machinery. For this section of the plan, the planning team looked at prior history and worst-case scenarios. The primary vulnerability for the entire planning area remains transportation-related infrastructure damage due to flooding.

Of the profiled hazards, the following vulnerability rating (high, moderate, low) is given below. This vulnerability rating is based on the disaster case history for the town and when the greatest financial impact was seen due to the disaster. The specific vulnerability to the population as a whole or any specific sub-population (e.g., elderly) is subjective because there is no historical data to rank vulnerability to health and safety of residents, workers or travelers.

Severe winter/ice storm: Moderate
Summary: While all structures are vulnerable to major snow loads, there is little evidence to support concern over structure failure due to snow loads on roofs, ice on gutters, etc. Town snow removal equipment is vulnerable to damage with greater use, especially during emergency situations as well as road damage from plowing. Populations caught outdoors, commuting or working outside during a serve winter storm are more vulnerable to cold-related injury and/or snow related accidents but winter comes every year and residents and the town are accustomed to making intelligent decisions regarding safety and protection of infrastructure. Special populations (e.g. aging, disabled, etc.) are more vulnerable in terms of mitigating structure loads, hazardous travel and relocating to safety.

Extreme Cold: Moderate
Summary: Recent evidence shows that greater extremes in temperature and overall weather fluctuation are occurring with increased frequency. A long-duration cold snap can cause significant damage to structures due to bursting pipes and the residential health and safety considerations include factors related to financial resources, fuel supply, sheltering, provisions and employment.

Flooding: High
Summary: The town is flooding and this is specific to transportation routes and infrastructure more-so than buildings and people in Charleston. However slight in terms of probability, a dam failure would have catastrophic implications on homes, buildings, people and equipment. The magnitude of financial resources devoted to flood-related damage in the town equates to high vulnerability. Flooding impacts the planning area by inundation damage to structures, which are considered well-below the FEMA flood hazard elevation and roadway drainage structures. Most of the damage is to road surfaces, drainage structures (culverts, ditching) and driveways. Roadways are also an issue for municipal road crews in each jurisdiction when they become inundated and cut off traffic.

Pandemic: High
Summary: Not only is the COVID-19 current during the drafting of this plan but it will likely remain active, at very least, over the 2020-2021 flu season. While Vermont has remained relatively insulated from the worst-case scenarios already seen in other states in regard to infection rates, there have been significant financial impacts for the region and state. There are several important considerations for the town and villages to take on. Issues such as tax revenue reductions from failure to pay on a large scale to how a major storm event could compromise pandemic response (e.g., sheltering operations and resource allocation).

Table 4-1: Vulnerability Summary Table

Hazard	Vulnerability	Extent (Storm Data from most severe event)	Impact (economic/health and safety consequence)	Probability

Flood	Culverts, bridges, road infrastructure. 0 critical or public infrastructure in SFHA/.2% FHA	The greatest 24-hour rainfall record for immediate region occurred in late October 31st, 2019 at 3''. The greatest level of precipitation in any month occurred in August 2011 at 11'' No detailed data was available for fluvial erosion damage in town in terms of numbers of acres lost during each event.	The 2011 flood events (DR-1995 at $213,712 and DR-4022 at $187,394) were the most destructive and costly for the town. No extent data as available for this event	High
Extreme Cold/ Snow/Ice Storm	The entire planning area is vulnerable, including road infrastructure, town and privately-owned buildings, utility infrastructure	Snowfall has varied, from a few inches to over a foot or more. Heavy snow and wind may down trees and power lines. Snow/ice contributes to hazardous driving conditions.	For roof collapse: monetary damages will depend on each structure but, collapse of barn roof is often a total loss. This does not include the loss of livestock. Collapse of a house roof may be at a 50% loss. For car crashes due to poor driving conditions: minimal damage to vehicle to totaled vehicle and operator injury. Health impacts could vary significantly. Loss of energy or communication capabilities may occur and impede recovery.	High

Pandemic	The entire planning area is vulnerable in both health and financial stability	COVID-19 has far-exceeded severity of 2009-2010 HINI Pandemic	2020 COVID-19 has resulted in the greatest infectious disease-related financial consequence for the planning area in history	High

4.1 Critical Facilities

The Center for Disaster Management and Humanitarian Assistance defines critical facilities as: "Those structures critical to the operation of a community and the key installations of the economic sector." The Charleston Base Map shows the geographic distribution of some critical facilities and utilities. Table 4-1 identifies critical facilities in Charleston, excluding critical facilities designated as hazardous materials storage sites, which are listed in Tables 2-1 and 2-2.

Table 4-1 Critical facilities in the Town of Charleston

Facility Type	Number of Facilities
Education Facility	1
Fire Station	1
Emergency Shelters	2
Emergency Operations Center	1
Government and Military	1

4.2 Infrastructure

4.2.1 Town Highways

The following is a statistical overview of roads in the Town of Charleston. These tables show the range of road types within the town, from highways to unpaved roads. The different road types have different hazard vulnerabilities. Unpaved roads are more vulnerable to being washed out in a flood or heavy storm, while traffic incidents are more likely to occur on large, arterial roads.

Table 4-2 Town highway mileage by class, Town of Charleston

Class 1*	Class 2	Class 3	Class 4*	State Hwy	Legal Trail*	Interstate	Total 1, 2, 3, State Hwy
0	10.15	30.21	7.88	13.91	6.96	0	54.27

Source: data derived from VTrans TransRDS GIS data – Charleston Town Plan 2013
**Not included in Total*

4.2.2 Bridges, Culverts, and Dams

Bridges:

There are a variety of bridges, culverts and dams located in the municipality. The following bridges are contained in an inventory maintained by VCGI, VTrans and the NVDA and represent those of greatest concern for the town. This analysis does not take into account the fluvial geomorphology or the elevation of the bridge above the floodplain. For example, a slab bridge on Hudson Rd (Charleston BR#5) was identified as functionally deficient, with a rating of "3 – Scour Critical." This bridge was replaced in September of 2018 with a precast concrete box culvert with associated repair/shaping of the streambank and scour hole. A VTrans structures grant and preceding VTrans engineering grant supported the project, and all work was done incompliance with applicable standards and Vermont Stream Alteration requirements.

Table 4-4 Inventoried bridges in the Town of Charleston with identified need

Class	Bridge Type	Deficiency	Bridge Features	Scour Critical	Located in Floodplain
TOWN SHORT	SLAB	UNKNOWN	MAD BROOK	NO	NO
TOWN SHORT	SLAB	UNKNOWN	WESTMORE	NO	NO

The entire Bridge Inventory with maps for the town can be found on the state site: https://vtculverts.org/bridges#list

Culverts:

It is the responsibility of a property owner to buy, install, and maintain driveway culverts. For any driveway entering a town highway, property owners must consult with the Road Foreman, who will determine the required culvert specifications (never smaller than 15 inches in diameter per state standards). If a property owner fails to install the appropriately sized culvert, the town highway crew may cut a ditch across the driveway to maintain proper road drainage. (*adopted June 11, 2015*).

The Town maintains a culvert inventory that assesses over 800 culverts with data on length, overall condition, size and location. This data guides the town's culvert maintenance and replacement plan. All culverts removed from the Town roads become the Town's property. Usable culverts will be reused on Class 4 roads. Less useful culverts are sold on a first come first serve basis and others are sold as scrap metal. Guardrails are placed on an as-needed basis or as required by the state. A supply of beam rail and posts are stored at the Town Pit on Ten Mile Square Road. Culverts located in the 100-year floodplain are listed below.

Table 4-5: Charleston culverts located in 100-year floodplain

All (48) culverts on Hudson Road are in the 100-year Floodplain.
All (4) on Twin Bridges

Source: The entire Culvert Inventory with maps for the town can be found on the state site: https://vtculverts.org/map.

Dams:

The National Dam Inventory shows two structures in the town. The first is the West Charleston Hydroelectric Plant, federally licensed as the Clyde River Hydroelectric Project (FERC Project No. 2306). The facility ceased operation in 1998 due to poor condition but Great Bay Hydro, a private energy company based in Portsmouth, NH, acquired the facility from Citizens Utilities in 2004. The second and upstream from Great Bay Hydro's operation is the two-turbine Barton Village Hydropower Project (FERC No. 7725), operated by Barton Village Electric, which serves more than 2,000 customers in Barton, Westmore, West Charleston, Brownington, Evansville, and Sutton. The plant operates in "run-of-river" mode. Originally constructed in the 1890s, the current facility is between 60 and 70 years old.

4.2.3 Water, Wastewater and Natural Gas Service Areas
The Town currently has no water, wastewater or natural gas service areas. Water and sewer systems are the sole responsibility of the property owner and they are required to meet state and federal regulatory standards.

4.2.4 Electric Power Transmission Lines and Telecommunications Land Lines
High-tension electric transmission run through the Town of Charleston, running along VT RT 105.

4.3 Estimating Potential Losses in Designated Hazard Areas

12 residences and 0 commercial/industrial structures are located within the 100-year floodplain. Assuming most recent median grand list value, the estimated potential losses due to a major flood event inundating the floodplain are less than 1%. This estimate only takes structures into account, it does not account for personal property or business losses. The town has no repetitive loss properties and no new vulnerabilities arising since the last approved plan.

4.4 Land Use and Development Trends Related to Mitigation

Charleston's land use is primarily residential and commercial. The Town of Charleston covers 24,662 acres (38.5 square miles). Population density is 26.6 people per square mile. Residences are concentrated primarily within the East and West Charleston Village areas, around the larger lakes, and along the larger state and Town roads, leaving much of the Town's acreage in an undeveloped condition. Nearly all of the land in Charleston is privately owned with exception of a few small state-owned fishing access areas, Town-owned office and road maintenance facilities and a municipal Town Forest. The Town Forest is located along the Class 4 Town Farm Road on the Charleston-Westmore town line, and includes 184 acres within the Town of Charleston, as well as a contiguous 50 acres in Westmore. In Charleston, 9500 acres (41%) are currently enrolled in UVA (use value appraisal), including 51% of all parcels greater than 50 acres. This represents an increase of 2900 acres (15%) since 2003. Lands conserved by the Vermont Land Trust total 3221 acres (13%). One of the largest blocks of UVA and conserved acreage is found in the east corner of Town, made up of a dairy farm, the NorthWoods Stewardship Center, and multiple smaller private ownerships.

Table 4-6: Charleston Land Cover Types (Source VCGI)

Broad type Detail
Forested
Mixed forest 24.1%
Evergreen forest 23.3%
Deciduous forest 16.3%
Forested wetland 9.2%
Total forested 72.9%
Agricultural
Hay/pasture 7.8%
Row crop 6.8%
Total agricultural 14.6%
Other nonforested
Water 5.7%
Transportation/utilities 4.0%
Non-forested wetland 1.8%
Residential 0.6%
Brush/transitional 0.3%
Commercial/industrial 0.0%
Total other non-forested 12.4%

Parcel sizes in Charleston range widely, from a fraction of an acre to over 1100 acres, with 74% of parcels being at least 50 acres in size—slightly above the state average (VNRC 2012). Increasing land values and development have resulted in steady subdivision of large parcels, inhibited somewhat by the UVA program or conservation easements through various organizations—most notably the Vermont Land Trust (VLT).

4.4.2 Future Development and Housing

Charleston can benefit from attracting new business. An analysis of long-term development trends in the Northeast region has shown that market demand favors scattered and dispersed development. While Charleston does not have land use regulations to drive development back to its Village centers, it is possible that Village Center Designation may provide incentives for reinvestment in traditional areas of development. It is the Town's policy to encourage land development that attracts new enterprises while preserving the land in its undeveloped rural setting to the maximum degree possible because our scenic, natural environment is essential to our Town's economic development. As such, it is the Town's policy to prohibit large development for any purpose that is not in proper scale with our Town's rural setting, except as specifically mandated to keep this Plan in compliance with state law. Charleston is adjacent to five municipalities: Brighton to the east; Morgan to the east and north; Derby to the north and

west; Brownington to the west and south; and Westmore to the south. Interaction with these towns in terms of their land use and future development has been and continues to be a concern when actions conflict with the objectives and land conservation measures set forth in the Charleston Town Plan. Despite the advantages of attracting new businesses and housing, the town does not foresee major development occurring in the next five-year planning cycle. Other than individual real-estate transactions, there is little anticipated business development projected. With local shopping centers long-established and conveniently located in near-by Derby and Newport coupled with a stable population size and major business being farming, the town does not foresee substantial development occurring.

Housing

Mobile Homes occupied by full-time and part time residents continue to be a significant part of the housing mix (17% of overall housing units). According to the 2010 U.S. Census, about one-third of the Town's housing stock was built before 1950 (27% before 1940), and almost half was built between 1960 and 1990. About 12% has been built since 2000:

- About 45% of housing is valued between $50,000 and $150,000.
- 13% between $150,000 and $200,000.
- 28% between $200,000 and $300,000.
- 8% above $300,000.
- 43% of rental units cost between $500 and $750 per month.
- 50% cost between $750 and $1000 per month.
- 7% cost between $1000 and $1500 per month.

SECTION 5: MITIGATION STRATEGY

The greatest advancement in mitigation planning the town has achieved is from the direct experiences in responding to, and recovering from, the major disasters that have impacted the town and villages in the last decade. These disasters, have, to a large extent, redefined how the entire state views and approaches mitigation. The work of state agencies, including those devoted to transportation, planning and emergency management have also changed the way towns go about their day-to-day operations and planning, both in emergency situations and out. It is because of this that the town views this update as the new standard in their mitigation planning efforts. This plan update allows for a continuation of the systematic documentation of mitigation efforts in the next planning cycle. We feel that the implementation matrix captures specific progress in certain areas but more importantly, gives the town a guide from which all future action and updates can be based on.

5.1 Charleston Town Goals and Policies that support Hazard Mitigation

5.1.1 Purpose and Goals

5.1.1.1 Community Goals

a. Continue supporting state standards with local, POS water/sewer sources.

b. Increase capacity to maintain resources for residents impacted by pandemic

5.1.1.2 Capital Improvement Goals

a. Provide services and facilities deemed necessary for the orderly and rational development of the Town.

5.1.1.3 Public Participation Goals

a. Continue to solicit input regarding planning issues from town residents and from other entities which can help to offer solutions and insight into the problems the Town faces both now and in the future via formal meetings and advertised opportunities for input.

b. Utilize LEPC meetings to increase awareness, enhance planning and engage in exercises that address needs in the community.

5.1.1.4 Regulatory Devices Goals

a. The town is confident that state regulations will serve the town best and adopts to not have zoning at this time.

b. Maintain and continue a Capital Expense Budget and Program for the purpose of ensuring that Charleston's rate of growth does not outstrip the Town's ability to pay for the associated necessary services such as roads, schools, police and fire protection, solid waste, etc. The town's capital expense budget is for roads and maintaining town office and garage. School budget is administered separately by school board. There is not a local police force but a mutual aid agreement that includes 19 departments. Solid waste is handled by local haulers.

5.1.2 Land Use

5.1.2.1 Flood Hazard Overlay District

a. Work to develop a Flood Hazard Area Overlay District to include all designated flood hazard areas. The purpose of the Flood Hazard Area Overlay District is to (1) protect public health, safety, and welfare by preventing or minimizing hazards to life and property due to flooding, and (2) to ensure that private property owners within designated flood hazard areas are eligible for flood insurance under the National Flood Insurance Program (NFIP). The town has elected not to be part of the NFIP but is dedicated to not encouraging new development in the floodplain. The town has no mobile home parks and very few residences at risk of flooding with no repetitive loss properties.

5.1.3 Natural Resources

5.1.3.1 Natural Resources Goals

a. Ensure that the existing health ordinance is enforced to maintain protection of both surface and groundwater supplies.

b. Ensure that permits issued for development near sensitive areas, such as steep slopes, high elevations, wetlands, scenic vistas and wildlife habitats, contain conditions assuring conformance to the goals set forth in this plan.

c. The Selectboard can work with the NVDA to continue the process of identifying the Town's land conservation priorities, and to the degree possible, link them to broader regional conservation work.

d. The Selectboard can also be an active participant in the local management plans for Charleston's Natural Areas. In line with the VTrans mission statement regarding climate change, the town remains committed to:

- Ensure that there are viable alternative routes around vulnerable infrastructure such as bridges and roadways
- Make safety a critical component in the development, implementation, operation and maintenance of the transportation system
- Develop contingency plans for a wide-variety of climate impacts to be implemented as data/information becomes available
- Utilize information technology to inform stakeholders during times of emergency
- Educate the public and other stakeholders on the threats posed by climate change and fluvial erosion hazards
- Increase inspection of infrastructure if warranted by climate change indicators
- Apply a decision-making framework to incorporate cost-benefit analyses into adaptive plans and policy
- Work to protect essential ecosystem functions that mitigate the risks associated with climate change
- Educate individuals within the agency to use best-practices during recovery periods to avoid ecological damage that may further exacerbate risk
- Recognize the interconnected nature of our built environment with ecological processes
- Protect the state's investment in its transportation system and adapting transportation infrastructure to the future impacts of climate change

e. In line with DEC's best practices regarding fluvial erosion, the town will work to:

- Slowing, Spreading, and Infiltrating Runoff (The State Surface Water Management Strategy is found at http://www.watershedmanagement.vt.gov/swms.html and http://www.watershedmanagement.vt.gov/stormwater.htm)
- Avoiding and Removing Encroachments. http://www.watershedmanagement.vt.gov/rivers/htm/rv_floodhazard.htm

http://www.watershedmanagement.vt.gov/rivers/docs/rv_RiverCorridorEasementGuide.pdf

- River and Riparian Management: DEC has prepared a compendium of *Standard River Management Principles and Practices* to support more effective flood recovery implementation; improve the practice of river management; and codify best river management practices in Vermont. The document compiles the most current river management practices based on the best available science and engineering methods to create

consistent practice and language for risk reduction while maintaining river and floodplain function. Best practices are established to address common flood damages, including:

- Erosion of banks adjacent to houses and infrastructure
- Erosion of road embankments
- Channel movement across the river corridor
- River bed down-cutting that destabilizes banks, undermines structure foundations, exposes utility crossings, and vertically disconnects rivers from adjacent floodplains
- Bridge and culvert failure

Source: http://www.watershedmanagement.vt.gov/permits/htm/pm_streamcrossing.html

5.1.3.2 Policies

a. Through both town and state-level management, work to:

- Encourage and maintain naturally vegetated shorelines, buffers and setbacks for all rivers, ponds and streams.
- Allow higher density or cluster development in existing and designated settlement areas and low density development in the remaining areas.
- Reduce flood hazard and repetitive road and driveway washout through continued updates and adherence to the Town Capital Budget and Road Plan.
- Identify and manage pollution, flooding and fluvial erosion hazards along rivers and streams as they arise.

5.1.4 Transportation Plan

5.1.4.1 Transportation Goals

In adjunct to town-specific planning, the town is committed to continually subscribing to all current state standards related to:

a. Maintaining safe operating conditions on the present system of town roads through design to keep traffic at appropriate speeds and timely maintenance, including consideration of additional paving (though only on portions of roads prone to damage) should state funding become available.

b. Protection of existing town roads from flood damage and uncontrolled storm water runoff.

c. Preserving the capacity of town roads and maintain adequate traffic flows and safety.

d. Support the road maintenance crew through Town-provided training sessions.

e. Ensuring that owners and managers of recreational areas provide and maintain adequate and safe parking facilities.

f. Continuing long term access opportunities to gravel and sand deposits for future road maintenance use (the town has secured a 50 year supply of good sand and gravel).

5.1.5 Utilities and Facilities Plan

5.1.5.1 Utilities and Facilities Goals

a. Maintain current relationships with the Vermont State Police and Rescue for police and emergency medical services, respectively.

b. Lack of crime does not support necessity for additional actions or planning at this time.

c. Identify effective locations for tanker truck access to water in portions of town that currently do not have adequate supplies. The Charleston Fire Department and NVDA shall be responsible for this task.

d. Promote high-speed internet access throughout town to assist and encourage local businesses to reside in Charleston.

e. Ensure adequate provision of water sources for fire suppression by requiring dry hydrants, fire ponds or other measures as conditions on town land use permits where appropriate. The Planning Commission will work with developers and property owners on this task.

f. Work to develop a recruiting plan for fire department as a problem facing the town is an aging membership where no new (young) volunteers are coming in due to the perceived commitment of time the training required.

5.1.6 Educational Facilities

5.1.6.1 Educational Goals

a. The School Board should work with the Selectboard and the Charleston Volunteer Fire Department to ensure that the necessary equipment exists at the Elementary School for its use as an emergency shelter.

b. Increase emergency planning cohesion between school and town EOPs through mutual participation and presentation at scheduled LEPC meetings and town and/or school meetings.

5.2 Existing Town of Charleston Actions that Support Hazard Mitigation

The town has done an excellent job at monitoring and addressing transportation issues, engaging in a documented and systematic approach to mitigation actions. The Selectboard has successfully pursued funding to address needs. Using Better Back Roads, Structures Grants and HMGP funding streams, the town has been able to enhance its transportation resilience and overall preparedness. Road improvement projects remain the primary focus for the town and the areas identified were selected based on the condition of culverts and ditches and primarily focused on runoff issues particularly as the incidence of heavy storms has increased. In many cases, culverts properly sized for normal rain events are overwhelmed by the severe ones. The town will seek local, state and federal grants to address the sites.

Charleston will earmark the funds necessary to complete one major problem each year for the next 5 years and will keep its culvert inventory current to improve its institutional memory.

Table 5-1 Existing municipal actions that support hazard mitigation, Town of Charleston

Type of Existing Protection	Description /Details/Comments	Issues or Concerns
Emergency Response		
Police Services	Vermont State Police	None at this time
Fire Services	Charleston VFD	Water access for fire department is problematic; some roads are difficult to access.
Fire Department Personnel	20 active members	Need for new volunteers remains as current roster ages.
Fire Department Mutual Aid Agreements	Northeast International Mutual Aid (19 participants)	None at this time
EMS Services	Newport Ambulance	Newport Ambulance has established a Morgan substation that serves all areas quickly
Other Municipal Services		
Highway Services	Town Highway Department	The effective operation of the road system is dependent on the adequacy of road equipment and supporting facilities. The general condition of Road Department equipment and facilities is good
Highway personnel	3 FTE field personnel	MOU's completed with residents to avoid future conflict and liability over culvert and ditching work
Water / Sewer Department	None	None at this time
Planning and Zoning personnel		None at this time
Residential Building Code / Inspection	No	None at this time
Emergency Plans		
Local Emergency Operations Plan (LEOP)	2020	Assure sheltering plans and contact information is up to date and vulnerable populations addressed.
School Emergency/Evacuation Plan(s)	2020	Elementary School performed a safety audit in spring of 2020. Assessment of this audit will drive future actions as needed. School administration practices ALICE protocol and practices drills per state requirements. Supervisory Union is working on a common planning template for all schools to use and to replace current state emergency planning template. Annual meeting with rescue personal is also planned.
Dam Emergency Plans	Great Bay Hydro has shared its comprehensive Emergency Response Plan with the Town.	Invite representatives to LEPC and town to increase collaboration. Assure understanding of risk and associated protocol for residents and impacted town infrastructure (if any).
Shelter, Primary	Charleston Elementary School	Work with ARC with Sheltering Initiative to obtain training and supplies. Include volunteer staff in planning communication and schedule drills to test efficacy.
Replacement Power, backup generator	Pending	HMGP grant approved for generator installation and award awaiting Hazard Mitigation plan approval
Shelter, Secondary:	Plymouth Church Town Office	Town office is inventoried by ARC as a warming shelter
Replacement Power, backup generator	Plymouth Church: Yes Town Office: No	Assure maintenance program
Municipal Plans		
Town / Municipal Comprehensive Plan	2019	None at this time
Town of Charleston Road Inventory and Capital Budget Plan	2019	None at this time
Hazard Specific Zoning (slope, wetland, conservation, industrial, etc.)	Utilize most current state regs	None at this time
Highway Access (curb cut) Policy	Application process, review by Highway Dept. Foreman with final approval by Selectboard	None at this time

Participation in National Flood Insurance Program (NFIP) and Floodplain/Flood Hazard Area Ordinance	No, the town elects not to Participate.	Residential homes or businesses in the floodplain is not an outstanding concern for the town and the barrier to obtaining mortgages would serve has a deleterious consequence to participating. SFHA mapping update is needed.
Culvert and bridge Inventory	2020	https://vtculverts.org/map https://vtculverts.org/bridges#list

5.3 Town of Charleston All-Hazards Mitigation Goals

The following goals were developed by the planning team, vetted during a warned community meeting and approved during the development of this plan:

- Reduce at a minimum, and prevent to the maximum extent possible, the loss of life and injury resulting from all hazards.
- Mitigate financial losses and environmental degradation incurred by municipal, educational, residential, commercial, industrial and agricultural establishments due to various hazards.
- Maintain and increase awareness amongst the town's residents and businesses of the damages caused by previous and potential future hazard events as identified specifically in this Local All-Hazards Mitigation Plan.
- Recognize the linkages between the relative frequency and severity of disaster events and the design, development, use and maintenance of infrastructure such as roads, utilities and storm water management and the planning and development of various land uses.
- Maintain existing municipal plans, programs and ordinances that directly or indirectly support hazard mitigation.
- Develop a mechanism for formal incorporation of this Local All-Hazards Mitigation Plan into the multi-jurisdictional municipal comprehensive plan as described in 24 VSA, Section 4403(5). This mechanism will be developed by the Joint Planning Commission, Selectboard and NVDA and integrate the strategies into the existing town plan as annexes until the next formal update occurs, where a section devoted to mitigation planning will be integrated into the plan.
- Develop a mechanism for formal incorporation of this Local All-Hazards Mitigation Plan, particularly the recommended mitigation actions, into the town operating and capital plans & programs as they relate to public facilities and infrastructure within political and budgetary feasibility. The Joint Planning Commission will review the plan and use language/actions from it to inform the integration and update process. Town Meeting Day will serve as the formal time that mitigation strategy budgetary considerations will be approved and incorporated into the town budgets.

5.4 Mitigation Actions

5.4.1 Current Capabilities and Need for Mitigation Actions

In following FEMA guidance, the following mitigation action categories form the basis of the town's future mitigation actions. The planning team, after considering the basic and generalized format of the 2005 plan, decided to adopt this approach for this update and all future mitigation work. For each mitigation action to follow, an indication of group will be given with the abbreviations listed below:

Mitigation Action Groups:

(P) Prevention: Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and storm water management regulations.

(PP) Property Protection: Actions that involve the modification of existing buildings or infrastructure to protect them from a hazard, or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, flood proofing, storm shutters, and shatter-resistant glass.

(PEA) Public Education & Awareness: Actions to inform and educate citizens, elected officials, and property owners about potential risks from hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.

(NRP) Natural Resource Protection: Actions that, in addition to minimizing hazard losses also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.

(SP) Structural Projects: Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include storm water controls (e.g., culverts), floodwalls, seawalls, retaining walls, and safe rooms.

5.4.1. Current Capabilities, Progress and Need for Mitigation Actions

The Town Plan's goals and policies that support hazard mitigation and the existing mitigation actions demonstrate the variety of policies and actions forming the foundation of this All Hazards Mitigation Plan Update. As with most towns in the state, mitigating flood-prone areas is a continuous effort that sees increased attention following a major event. The town remains aware and diligent in keeping up with mitigation actions for all municipal systems. There exists a collaborative spirit that not only is valued but serves to enhance efficiency of action what needs to be done. The Town regards its current hazard mitigation efforts carried out by the road departments as adequate to address winter storm impacts to local roads, however temporary road closure due to winter storms may isolate parts of town. Winter storms are often the cause of the power loss and telecommunications failure. Tree trimming and vegetation management coupled with maintaining adequate repair vehicles and personnel are the primary means of mitigation. However, the town can incorporate the use of public information to support community resilience during a power outage. As part of the strategies defined in this plan, the town will develop a plan for mass communication and, if telecommunication lines are down, a method for

alerting residents of the alternate means of information dissemination and/or protocol (e.g. shelter logistics). Major infrastructure that has seen repeated damage due to flooding is a concern for the town and they are active in identifying priorities, working with State Transportation and Natural Resource Agencies as means to increasing infrastructure resilience.

Progress in Mitigation Efforts

During 2017-2018, the Town completed two FEMA 404 Hazard Mitigation Program projects on highways that saw repeated washout and closure during Tropical Storm Irene and other recent storms. The first was replacement of double culverts with a precast box culvert with natural stream bed over Mad Brook on Cole Road, a town-to-town connector. The second was to build the road surface and upgrade the ditch and culvert network on Hudson Rd, a Class 2 highway and major state highway connector adjacent to the Clyde River flood plain. Both projects will prevent or reduce damages caused by future disasters, reduce future highway repair costs, and mitigate the discharge of stormwater and pollutants into the watershed. Both projects were made possible because the Town adopted a Local Hazard Mitigation Plan in 2016. As well, the Better Roads Program provides grants and technical assistance to help the Town avoid erosion and flash floods resulting from road design and construction. A full status summary of proposed mitigation actions names in the last approved plan are included in the Appendix B. Because road infrastructure is considered the highest priority for the town, progress information is included here.

Table 5-2: Summary of Infrastructure Project Status: All Completed except Church Hill (not needed)

Location	Total Cost	From State or FEMA	Town Budget	Additional Funding Needed	Completion Date
Site #1					
#3 Church Hill/ #47 Mill Street	$ 21,374	$ 4,800	$ 6,000	$ 10,574	9/1/2015
# 2 Durgin Rd	$ 116,680	$ 80,000	$ 6,000	$30,680	9/1/2015
Site#2					
#39 Cole Road	$ 173,713	$ 134,259	$ 6,000	$ 33,453	9/1/2016
Site#3					
#1 Hudson Road	$379,444	$ 284,585	$ 6,000	$ 88,861	9/1/2017
Site#4					
#3s Twin Bridge Road	$ 362,990	$ 272,242	$6,000	$ 84,747	9/1/2018
Site#5					
#1 Hudson Road	$ 38,000	$ 34,200	$ 3,800	$ 0	9/1/2019
Total Est. Budget	$ 1,092,201	$ 810,082	$ 33,800	$ 248,315	

5.4.2 Specific Mitigation Actions

The following actions define the mitigation measures to be taken by the town in the next five years:

Action #1: Improve road infrastructure and municipal systems protection programs Action #2: Improve resilience to severe winter storms Action #3: Reduce impact of extreme cold durations Action #4: Raise public awareness of hazards and hazard mitigation actions Action #5: Continue fluvial geomorphology assessments in collaboration with DEC and develop strategies and regulatory actions in response to identified risk Action #6: Reduce risk and impact of a pandemic event

Below, each of the six actions listed above are explained below:

Action #1: Improve road infrastructure and municipal systems protection programs
Group: SP, NRP, PP
Lead Responsible Entity: Town of Charleston Road Foreman
Potential Partner Entities: Vermont Agency of Natural Resources; Vermont Agency of Transportation; NVDA, Agency of Commerce and Community Development
Timeframe: 2021-2026
Funding Requirements and Sources: FEMA or other hazard mitigation grants; FHWA grants; VAOT grants; Municipal Operating and Capital budgets only if sufficient.
Progress since 2016: The Road Foreman continually monitors road and storm water management capabilities. All bridges and culverts have been electronically accounted for and the town is diligent in maintaining a comprehensive road plan that serves to guide action. The Town of Charleston Road Inventory and Capital Budget Plan (2015-2020) specifies actions, areas of road erosion, estimated costs of repair and future needs with supporting mapping.

Specific Identified Tasks:
Infrastructure Assessment for Storm water Vulnerability – Funding and staff resources permitting, assess the vulnerability and operational capability of municipal-owned roads, culverts and other storm water management infrastructure to predicted storm water and snowmelt in areas with a documented history of recurring problems. The infrastructure will be evaluated regularly prior to replacement or upgrades of the existing infrastructure. Separate analyses of all infrastructure in each municipality is not intended or warranted.
Infrastructure Assessment for Fluvial Erosion/Landslide Vulnerability – Funding and staff resources permitting, assess the operational capability and vulnerability of municipal-owned roads, culverts, bridges and other infrastructure to fluvial erosion of varying severity as determined by Strategy #1 above.
Culvert Upgrades - Upgrade culverts and ditching along various roads to mitigate against repeated damages from storm water or spring snowmelt.
Continued Monitoring of Vulnerable Infrastructure - Monitor various bridges and culvert locations that have erosion and scouring concerns.

Road Improvements - Within political and financial restraints, consider re-engineering certain sections of roads to lower overall maintenance costs, improving snow plowing speeds and improve overall capability of roads to handle current and projected traffic volumes. Specific projects include:

1. **Twin Bridge** (East end): During high rain events, water level can rise to increase risk of damage. Culverts require further assessment and may need upgrade.
2. **Hudson Road** (East end): This section requires a build-up and ditching to prevent water from entering into current ditch and holding there without adequate drainage. Culverts assessment and upgrades may be required.
3. **Center School Rd**: Repave and upgrade ditching/culverts to handle stormwater. The town has an article on the town meeting warning to expend 2020 surplus funds for this purpose (pending voter approval)

Rationale / Cost-Benefit Review: Conducting vulnerability assessments facilitates a targeted and effective approach to road and storm water management infrastructure. This will prove useful in the development and implementation of municipal capital and operating plans as well as the development and implementation of grant-funded mitigation projects. Some areas suffer low-level but consistent damage during heavy rains and snowmelt. Mitigating against these problems would reduce short- and long-term maintenance costs and improve the flow of traffic for personal and commercial purposes during flooding events.

Action #2: Maintain and improve resilience to severe winter storms
Group: SP, PP, PEA.

Primary Responsible Entities: Town of Charleston; NVDA Emergency Planning services, American Red Cross, POS Shelter staff.
Potential Partner Entities: LEPC#10; Charleston Fire Chief, ARC's Sheltering Initiative Program
Timeframe: January 2021 – April 2026
Funding Requirements and Sources: DEMHS or FEMA hazard mitigation funding; existing programs, contingent on available resources and funding.
Charleston Elementary School has been identified as the primary emergency shelter. The school does not have an emergency generator. However, HMGP grant approved for generator installation and award awaiting Hazard Mitigation plan approval. Plymouth Church is the secondary shelter and it does have a generator in place.
Specific Identified Tasks:

1) Maintain Existing Shelter Capability: Maintain and improve capabilities of existing shelters. Notification procedures and shelter staffing is a priority for the town and intends to move forward on planning and public involvement. More formalized training is required and the ARC's "Shelter Initiative Program" can be used at no cost to the town to enhance both shelter management knowledge and sheltering supply cache.
2) Reduce risk of power failure due to ice storms: Enhance collaboration between town and private electric company as means of increasing efficiency of mitigation efforts and restoration when systems are down. Maintain function of generators.
3) Notification: Develop a notification/communication plan that conveys essential sheltering information using school phone system and back-up methodology (email, text, etc.)
4) Residential Programs: Provide guidance and communication to residents on the structural and mechanical actions that can occur to reduce risk to severe winter storms (e.g.

weatherproofing, anchoring, alternative heating sources, tree trimming, financial programs, etc.). Develop awareness on enhanced vulnerability of mobile home parks to storm events related to percentage of grand list value.

5) Monitor roads for safe and effective plowing: Efficient snow removal is the foundation to winter storm (snow) events, assuring roads are plowable before winter remains an important facet of highway department functions. Increase communication with rail as deemed necessary to assure safe train travel during heavy snow/ice events.
6) Increase awareness of ICS structure and recommended practices: The town can mitigate the effects of a severe winter by understanding how a large-scale storm is managed when the State EOC is operational. Additional awareness of local-level roles and responsibilities during statewide event is a mitigation action.

Rationale / Cost-Benefit Review:
This mitigation action serves to reduce the economic impact and risk to both human and animal (livestock and pet) health and safety during severe winter storm events by reducing risk and enhancing the mechanisms of winter storm mitigation in the long term. More formalized policy formation in both staffing and notification procedures, especially pertaining to vulnerable populations where transportation and special needs are a concern could potentially significantly reduce the physical, psychological and social impacts of a disaster.

Action #3: Reduce impact of extreme cold durations
Group: PEA, PP, SP
Risk or Hazard Addressed: Risk to infrastructure, livestock and residents
Primary Responsible Entities: Town of Charleston, Island Pond and Newport EMS and NVDA.
Potential Partner Entities: Vermont EMS, LEPC
Timeframe: 2021 – 2026
Funding Requirements and Sources: Financial factors may produce barriers to change. Strategic planning and understanding of the total scope of needs and potential for change is logical first-step.

1) Economic Resilience: Establish program for assistance in paying heating bills during crisis situations, if not already required by state law. Develop and sustain a program that serves to connect resource organizations with residents in need of support services.
2) Maintain Existing Shelter Capability: Maintain and improve capabilities of existing shelters. Notification procedures and shelter staffing is a priority for the city and intends to move forward on planning and public involvement. More formalized training is required and the ARC's "Shelter Initiative Program" can be used at no cost to the town to enhance both shelter management knowledge and sheltering supply cache.
3) Assess Vulnerable Population— Develop an awareness of the most at-risk community members during an evacuation and/or sheltering event. Focusing on those that lack resources or capability to reach facilities when in need and create plans, including outreach protocol on how to address this potential hurdle.
4) Notification and Education – Investigate and develop a notification/communication plan that conveys essential sheltering information. Educating citizens regarding the dangers of extreme cold and the steps they can take to protect themselves when extreme temperatures occur by sustaining a process that serves to disseminate educational

resources for homeowners and builders on how to protect pipes, including locating water pipes on the inside of building insulation or keeping them out of attics, crawl spaces, and vulnerable outside walls. Inform homeowners that letting a faucet drip during extreme cold weather can prevent the buildup of excessive pressure in the pipeline and avoid bursting through a yearly public service campaign.

Rationale / Cost-Benefit Review:

With an increase in extreme weather, including cold, there is a need to protect property and the population. Given the magnitude of population dependence on social services, indicating economic and other social vulnerabilities, effective outreach, education and collaboration with resources supports this mitigation action category.

Action #4: Raise public awareness of hazards and hazard mitigation actions
Group: PEA
Risk or Hazard Addressed: Risk to property, residents
Primary Responsible Entities: Town of Charleston, Charleston Fire Chief, NVDA, LEPC and ARC
Timeframe: 2021-2026

1) Hazard Resilience for Property Owners- Develop and maintain education materials to inform property owners on how to protect their homes and businesses through accepted hazard resilience actions (e.g. securing their structures from high winds, elevating their electrical equipment/furnaces in basements, protecting from lightning strikes by grounding electrical outlets, etc.).
2) HMGP Awareness: Attend informational sessions on the HMGP funding opportunities for acquisition, elevation and flood-proofing projects. Work with CVRPC to develop an information brochure for residents.
3) School Programs: Assure the school is structurally ready to handle natural hazard risks to the greatest extent possible. Continue school programs to raise student awareness of hazards, safety, preparedness and prevention. Explore establishing the school emergency notification system as the primary methodology for all emergency notification procedures and build in the contact information accordingly.
4) Family Programs – Continue family programs, such as car safety seat and bike safety programs, to raise family awareness of hazards, safety, preparedness and prevention.
5) Fire Prevention Programs – Continue National Fire Prevention Week and other programs to raise public awareness of fire hazards, safety, preparedness and prevention.
6) Other hazard awareness programs – Develop public awareness programs, based on all-hazards needs. Programs to address mobile home park mitigation opportunities, pandemic hazards, preparedness and mitigation may be appropriate as directed by the state department of health and its jurisdictional offices of local health

Rationale / Cost-Benefit Review: Improved public awareness could potentially significantly reduce the loss of life and property damage through ongoing, formal, ongoing, public information campaigns that address property protection actions (flood proofing, elevation, anchoring mobile homes/propane tanks, electric and water system elevation, electric grounding, etc.) Improved awareness would also build understanding and public support for municipal mitigation actions to reduce potential infrastructure and liability costs.

Action #5: Continue fluvial geomorphology assessment and develop strategies in response to identified risks in addition to investigating increased mapping of the SFHA
Primary Responsible Entities: NVDA, Agency of Natural Resources (VT ANR) (for assessments and mapping); Town of Charleston Selectboard (for ordinance changes and other actions).
Potential Partner Entities: Nonprofits, other Town of Charleston officials, and other appropriate entities.
Timeframe: 2021 – 2026
Funding Requirements and Sources: Through EMPG funding, NVDA can assist in enhanced mapping of the floodplain within the town. Continuation of assessments and strategy development is contingent upon individual municipalities and/or regional and local organizations, securing funding in partnership with ANR. The level of municipal participation is contingent upon the level of participation asked of staff and that such work would not hinder the ability of municipal staff to carry out their day-to-day municipal duties.

Specific Identified Tasks
Fluvial Geomorphic Assessments - Funding permitting, conduct Phase I and Phase II fluvial geomorphic assessments on streams and waterways in Charleston. If using PDM funding, individual municipalities may select only a subset of streams upon which to perform these assessments and therefore may choose to assess only those sections of streams wherein the history of flood and erosion damage, the history of channel management, and the proximity of existing or potential development or public infrastructure to the active channel makes an assessment a priority. Justification should be provided for streams, watersheds, or stream reaches not selected for fluvial assessment. Fluvial assessments shall be conducted as guided by the VT ANR Fluvial Geomorphic Assessment Protocols.
Fluvial Erosion Hazard Mapping - Within a year of completed geomorphic assessments for a waterway, funding permitting, a GIS provider (NVDA) should rate the fluvial erosion hazard for each assessed reach, and develop a fluvial erosion hazard map for the waterway, using the GIS extension known as SGAT (or Stream Geomorphic Assessment Tool) for assessed stream reaches. As assessments are completed, a map of all assessed waterways in the town should be created. This data will undergo town review and QA/QC by VT ANR before a final map is drawn.
River Corridor Management Plans – River Corridor Management Plans (RCMP) are encouraged for waterways where Phase I and Phase II assessments have been completed. Creating such a plan requires additional fieldwork and work with local landowners to identify acceptable reach-based management options that enable stream systems to reach equilibrium conditions. Management measures may include stream corridor buffer planting, culvert replacement and roadway improvements, berm removal, and corridor easements. Under Act 110, the Agency of Natural Resources will be identifying best management practices for shorelands and river corridors, and will be providing financial incentives, such as grants and pass-through funding. While the town relies on state regulations for zoning and other regulations, incorporating a RCMP into the Town Plan will only serve to increase the town's awareness in this crucial facet of mitigation planning.
Fluvial Erosion Hazard Mitigation Implementation - Within five years of completing the final fluvial erosion hazard map, the town will draft strategies to avoid or mitigate losses from the identified fluvial erosion hazards. These strategies may include the adoption and implementation

of programs, mechanisms or regulations to prevent endangerment of persons and property in riparian corridor areas from fluvial adjustment processes. Efforts could range from a relatively simple, public information campaign about the map to the adoption of a municipal ordinance or by-law that restricts development in such hazard areas.

Rationale / Cost-Benefit Review:
Continuing this project will require a sustained succession of grants, state appropriations and other funding to complete assessments in Charleston. Successful completion will provide municipal and regional benefits. The municipality's fluvial erosion areas would be adequately and electronically mapped. This will enable the municipality to make residents and businesses aware of fluvial erosion hazards and potentially lead to municipally-directed programs, mechanisms and regulations that further mitigate against this hazard, protecting existing structures and infrastructure. Identifying fluvial erosion hazard areas could also help the municipality restrict future development in hazardous areas, if that should be an advantage to the town in the future. More accurate knowledge of fluvial geomorphology will enable the community to have a better understanding of hazard areas and what mitigation measures might most effectively address those concerns. Flooding is the most common and most significant hazard that can trigger a Federal disaster declaration in Charleston. Along with an update to the flood hazard area maps, identifying the fluvial erosion hazard areas provides improved opportunities for the community to mitigate potential losses and gauge future development initiatives.

Action #6: Reduce risk and impact of a pandemic event
Group: PEA, PP, SP
Risk or Hazard Addressed: Risk to infrastructure, environment and residents
Lead Responsible Entities: Town of Charleston, ACCD, VDH
Timeframe: 2021 – 2026
Potential Partner Entities: VEM, FEMA
Funding Requirements and Sources: Pandemic planning funding is secondary to financial stability funding in response to potential economic consequences not known to be a serious consequence of infection mitigation efforts. State and Federal funding are primary sources with limited but important local opportunities.

Specific Identified Tasks:

1) Work with facility leads on understanding risk factors and what can be done to mitigate and enhance training and skills for response
2) Enhance awareness and planning for COVID-19-related mandates, communication, isolation and quarantine logistics for residents, municipal operations and maintaining economic stability
3) Maintain process for funding acquisition related to COVID-19
4) Develop and maintain continuity of operations plans for critical positions

5.4.3 Prioritization of Mitigation Strategies

Descriptions of specific projects, where available, are listed in Section 5.4.2 and in Table 5-3 below. Because of the difficulties in quantifying benefits and costs, it was necessary to utilize a simple "Action Evaluation and Prioritization Matrix" in order to effect a simple prioritization of the mitigation actions identified by the jurisdiction. The following list identifies the questions (criteria) considered in the matrix so as to establish an order of priority. Each of the following criteria was rated according to a numeric score of "1" (indicating poor), "2" (indicating below average or unknown), "3" (indicating good), "4" (indicating above average), or "5" (excellent).

- Does the action respond to a significant (i.e. likely or high risk) hazard?
- What is the likelihood of securing funding for the action?
- Does the action protect threatened infrastructure?
- Can the action be implemented quickly?
- Is the action socially and politically acceptable?
- Is the action technically feasible?
- Is the action administratively realistic given capabilities of responsible parties?
- Does the action offer reasonable benefit compared to its cost of implementation?
- Is the action environmentally sound and/or improve ecological functions?

The ranking of these criteria is largely based on best available information and best judgment, as many projects are not fully scoped out at this time. The highest possible score is 45.

It is anticipated that, as municipalities begin to implement the goals and actions of their Mitigation Strategies, they will undertake their own analysis in order to determine whether or not the benefits justify the cost of the project. Also, most proposed FEMA mitigation projects will undergo a benefit-cost analysis using a FEMA BCA template and approved methodology.

The ranking of these criteria is largely based on best available information and best judgment of project leads. For example, all road improvement projects were initially identified by Road Foreman and approved for inclusion in this plan by the road commission. It is anticipated that, as the town begins to implement the goals and actions of their Mitigation Strategies, they will undertake their own analysis in order to determine whether or not the benefits justify the cost of the project. Also, most proposed FEMA HMGP mitigation projects will undergo a benefit-cost analysis using a FEMA BCA template and approved methodology.

Table 5-2 Charleston action evaluation and prioritization matrix

Scoring: 1=Poor 2=Below Average or unknown 3=Average 4=Above Average 5=Excellent

Rank	Mitigation Action	Responds to high hazard	Funding potential	Protection value	Time to implement	Social and Political acceptance[1]	Technical feasibility	Admin feasibility	Benefit to Cost	Environmental advantage	TOTAL
2	Improve road infrastructure and municipal systems protection programs	5	4	5	2	5	4	4	5	4	38
3	Improve resilience to severe winter storms	2	5	5	4	5	5	4	5	2	37
4	Reduce impact of extreme cold durations	3	2	4	2	3	2	2	3	3	24
5	Reduce risk and impact of a pandemic event	5	4	5	4	5	3	3	5	1	35
1	Raise public awareness of hazards, hazard mitigation and disaster preparedness	4	5	5	5	5	5	5	5	3	43
6	Continue fluvial geomorphology (in coordination with state recommendations and protocol) assessments and develop strategies in response to any identified risk	3	2	4	2	2	2	2	3	3	23

5.5 Implementation and Monitoring of Mitigation Strategies

5.5.1. Public Involvement following Plan Approval

After formal adoption, which will occur at warned, documented meetings for each respective jurisdiction, the town and villages will continue to maintain web-presence of the mitigation plan with an opportunity for community input available on its website. Additionally, the town will hold an annual public meeting after performing the annual progress report for the mitigation plan to discuss achievements and the following year's implementation plan. The update will occur at the April Selectboard meeting concurrently with the update of the Local Emergency Management Plan (LEMP). At town meeting, the town will present mitigation information and provide the public an opportunity to increase understanding and involvement with planning

[1] *All mitigation actions outlined in this plan are, and will continue to be, consistently assessed for feasibility related to the social, political, and financial factors that are inherent to town operations.*

efforts. The town will also notify its neighboring municipalities of the availability of information for review and any significant risks and/or mitigation actions that have an impact on surrounding towns.

5.5.2. Project Lead and Monitoring Process

The town's Selectboard chair is the project lead and will work in conjunction with the Selectboard, town clerk, residents and NVDA to complete the yearly progress report included in the plan. The town will create a mitigation action collection system that will be used as the source of future updates following the annual evaluation that will occur in conjunction with the progress report using the Plan Implementation Matrix provided below. The Town Clerk will assure that all road improvement projects are tracked in collaboration with the Road Foreman. While mitigation actions are, by default, often addressed at monthly Selectboard meetings. The town will schedule one meeting annually to formally assess the plan after the annual progress report has been completed. Once the plan is approved by FEMA, the calendar will begin for annual review.

5.5.3 Plan Evaluation and Update Process

The town's Selectboard chair will lead the plan evaluation process as part of the annual progress report. Prior to town meeting and in preparation for the annual town report, a mitigation section will be included that provides an executive summary for the public that addresses the following topics:

- Status of recommended mitigation actions for the five-year planning period
- Identification of barriers or obstacles to successful implementation or completion of mitigation actions, along with possible solutions for overcoming risk
- Identification of a lead person to take ownership of, and champion the Plan if different from Selectboard Chair
- An approach to evaluating future conditions (i.e. socio-economic, environmental, demographic, change in built environment etc.)
- Discussion of how changing conditions and opportunities could impact community resilience in the long term
- Discussion of how the mitigation goals and actions support the long-term community vision for increased resilience

By engaging in the annual evaluation, the town will have a viable method for capturing the facets of efficacy and areas needing revision and improvement in its mitigation plan. The town is committed to "institutionalizing" mitigation into its normal operating procedures and with approval of this plan, embarks on the formal incorporation of mitigation actions and discussion, maintaining an awareness that involves not only the Selectboard, Town Clerk and Road Foreman but also the community at large, including the organizations represented by the current planning team. Along these lines, the town will maintain a contact list of the current planning team and make revisions as required, including the team on the evaluation process each year. Through this consistent attention resulting from the evaluation process, progress reports and communication in the annual town report, the town will achieve the consistency required to enhance resilience through planning, assessment and actions devoted to mitigation.

5.5.4. Plan Update Process

The Plan update will be led by the Selectboard Chair and Town Clerk. Depending on funding availability, the town may elect to acquire the assistance of NVDA and/or a consultant to update the plan following a declared disaster and/or the next five-year planning cycle. To assure that the Plan does not expire, the town will begin the update process within no less than six months of the current Plan's expiration date. Following a disaster and during the recovery phase, the town will use the experience to assess the current Plan's ability to address the impact of the most recent disaster and edit the plan accordingly. Using the annual progress reports and evaluation narratives as a guide, along with perceived changes in risk or vulnerabilities supported by data and/or observation, strategies will be captured in accordance with FEMA guidelines, which include reconvening the planning team during the update process. The town will establish a "Mitigation File" that documents all evaluations and progress reports, along with actions, especially related to infrastructure improvement projects. While the progress reports are designed to capture the specific actions the town has accomplished related to implementation, keeping a narrative list with dates on all actions relatable to mitigation (e.g. school drills, LEOP updates, Fire Safety Awareness, meetings, etc.), will provide the town the bulk of information required in the update process.

5.5.5. Implementation Matrix for Annual Review of Progress

The following table is intended to aid municipal officials in implementing the mitigation actions for Charleston, and to facilitate the annual monitoring of the plan.

Table 5-3 Charleston All-Hazards Mitigation Plan Implementation Matrix

Action	Responsible Entity	Timeline	Specific Identified Tasks	Annual Progress
Improve road infrastructure and municipal systems protection programs	Town Road Foreman and associated municipal systems managers	Spring 2021- Fall 2026	Infrastructure Assessment for Storm Water Vulnerability	
	Town Road Foreman	Spring 2021- Fall 2026	Assessment for Fluvial Erosion, Landslide Vulnerability	
	Town Road Foreman	Spring 2021- Fall 2026	Culvert Upgrades	
	Town Road Foreman and associated municipal systems managers	Spring 2021- Fall 2026	Continued Monitoring of Vulnerable Infrastructure	
	Town Road Foreman	Spring 2021- Fall 2026	Road Improvements **Twin Bridge** (East end): During high rain events, water level can rise to increase risk of damage. Culverts require further assessment and may need upgrade. **Hudson Road** (East	

			end): This section requires a build-up and ditching to prevent water from entering into current ditch and holding there without adequate drainage. Culverts assessment and upgrades may be required. Repave Center School Rd and upgrade ditching/culverts to handle stormwater. The town has an article on the town meeting warning to expend 2020 surplus funds for this purpose, so it's up to voters to approve.	
Action	Responsible Entity	Time Line	Specific Identified Tasks	Annual Progress
Maintain and improve resilience to	Town EMD, Selectboard	Spring 2021- Fall 2026	Maintain Existing Shelter Capability	

severe winter storms				
	Town EMD, Selectboard	Spring 2021- Fall 2026	Reduce risk of power failure due to ice storms	
	Town EMD, Selectboard	Spring 2021- Fall 2026	Notification	
	Town EMD, Selectboard, Fire Chief	Spring 2021- Fall 2026	Residential Programs	
	Town Road Foreman	Spring 2021- Fall 2026	Monitor roads for safe and effective plowing	
	Town EMD, Selectboard	Spring 2021- Fall 2026	Increase awareness of ICS structure and recommended practices	
Action	Responsible Entity	Timeline	Specific Identified Tasks	Annual Progress
Reduce impact of extreme cold durations	Town, NVDA, School, local/regional assistance organizations.	Fall 2021- Fall 2026	Economic Resilience	
	Town EMD and Selectboard	Fall 2021- Fall 2026	Maintain Existing Shelter Capability	
	Selectboard, NVDA, School, local/regional assistance organizations.	Fall 2021- Fall 2026	Notification and Education	
	Fire Chief, Planning Commission, Town	Fall 2021- Fall 2026	Assess Vulnerable Population	

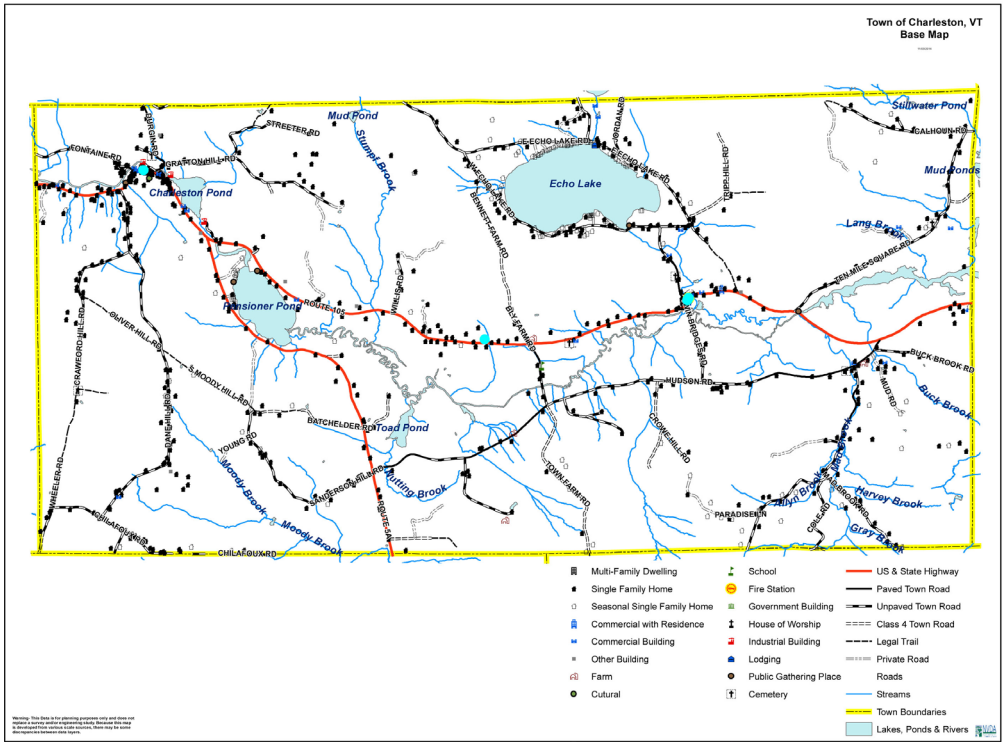
	EMD/THO			
Action	Responsible Entity	Time Line	Specific Identified Tasks	Annual Progress
Raise public awareness of hazards and hazard mitigation actions	Town EMD, Fire Chief, LEPC, NVDA	Spring 2021- Fall 2026	Hazard Resilience for Property Owners	
	Selectboard	Spring 2021- Fall 2026	HMGP Awareness	
	Schools and Selectboard	Spring 2021- Fall 2026	School Programs	
	Planning Commission, Clerks	Spring 2021- Fall 2026	Family Programs	
	Fire Chief, LEPC	Spring 2021- Fall 2026	Fire Prevention Programs	
	Fire Chief, LEPC, NVDA	Spring 2021- Fall 2026	Other Hazard Awareness Programs	
Action	Responsible Entity	Timeline	Specific Identified Tasks	Annual Progress
Continue fluvial geomorphology assessments in collaboration with DEC and develop strategies and regulatory actions in response to identified risks	Department of Environmental Conservation, NVDA, Agency of Natural Resources (VT ANR), Selectboard	Spring 2021- Fall 2026	Fluvial Geomorphic Assessments	
	Department of Environmental	Spring 2021- Fall 2026	Fluvial Erosion Hazard Mapping	

	Conservation, NVDA, Agency of Natural Resources (VT ANR), NVDA			
	Department of Environmental Conservation, NVDA, Agency of Natural Resources (VT ANR)	Spring 2021- Fall 2026	River Corridor Management Plans	
	Department of Environmental Conservation, NVDA, Agency of Natural Resources (VT ANR)	Spring 2021- Fall 2026	Fluvial Erosion Hazard Mitigation Implementation	
Action	Responsible Entity	Timeline	Specific Identified Tasks	Annual Progress
Reduce risk and impact of a pandemic event	Selectboard. Planning Commission ACCD, VDH, NVDA	Spring 2021- Fall 2026	Work with facility leads on understanding risk factors and what can be done to mitigate and enhance training and skills for response	
	Selectboard, Planning Commission ACCD, VDH, NVDA	Spring 2021- Fall 2026	Enhance awareness and planning for COVID-19-related mandates, communication, isolation and	

			quarantine logistics for residents, municipal operations and maintaining economic stability	
	Selectboard, Planning Commission ACCD, VDH, NVDA	Spring 2021- Fall 2026	Enhance awareness and planning for COVID-19-related mandates, communication, isolation and quarantine logistics for residents, municipal operations and maintaining economic stability	
	Selectboard, Planning Commission ACCD, VDH, NVDA	Spring 2021- Fall 2026	Develop and maintain continuity of operations plans for critical positions	

Appendix A: Charleston Base Map

Note: FEMA has not produced digital flood data for Charleston. Charleston has not been enrolled in the Flood Insurance program, so their maps are the old 11"X 17" which are not included in this plan.



Appendix B: Mitigation Action Status Report (2016-2020)

Charleston Hazard Mitigation Actions from Previous Planning Cycle: Project Status Report

- The following mitigation actions were part of the last approved plan. Narrative on status of those proposed actions are required for the update:
- For each action, the is a subsequent "Status" bar (see below). For each action proposed, please use the following key to provide status information:

Key:
C=Complete
S=Work has started or is ongoing and in progress
P=Work was not started due to political/economic constraints
N/A=Action item, upon further consideration and analysis not deemed necessary for maintaining town function and protecting health and safety of residents
I=Work not started but considered important and will remain as an action item for the next planning cycle.
U=Unknown

Action 1: Continue fluvial geomorphology assessment and develop strategies in response to identified risks in addition to investigating increased mapping of the SFHA.

Fluvial Geomorphic assessments: **(U)** Nothing to report

Fluvial Erosion Hazard Mapping: **(U)** River Corridor maps completed with structure location

River Corridor Management Plan: **(NA)**

Fluvial Erosion Hazard Mitigation Implementation: **(U)** Status of regional mapping is unknown.

Action 2: Improve road infrastructure and municipal systems protection programs

Infrastructure for Stormwater vulnerability: **(S)** MRGP-compliant Road Erosion Inventory is complete. Identified improvements are ongoing and proceeding according to MRGP. A project or two is completed each summer with regular funding support from the Better Roads and Grants-in-Aid state programs.

Infrastructure Assessment for Fluvial Erosion/Landslide vulnerability: **(S)** MRGP-compliant Road Erosion Inventory is complete. Identified improvements are ongoing and proceeding according to MRGP. A project or two is completed each summer with regular funding support from the Better Roads and Grants-in-Aid state programs.

Culvert Upgrades: **(S)** MRGP-compliant Road Erosion Inventory is complete and involves assessment of ditch and culvert condition/erosion. Culvert condition inventory is also maintained on VTCulverts.org. A project or two is completed each summer with regular funding support from the Better Roads and Grants-in-Aid state programs.

Continued Monitoring of Vulnerable Infrastructure: **(S)** As part of the annual meeting with VTrans, state bridge inspection reports are reviewed. Town pursues state engineering and structures grants to bring replacement and resurfacing projects within the town's means. For example, a slab bridge on Hudson Rd (Charleston BR#5) was identified as functionally deficient, with a rating of "3 – Scour Critical." This bridge was replaced in September of 2018 with a precast concrete box culvert with associated repair/shaping of the streambank and scour hole. A VTrans structures grant and preceding VTrans engineering grant supported the project, and all work was done incompliance with applicable standards and Vermont Stream Alteration requirements. Also completed in 2018: cold-plane, remembrance and resurface Durgin Rd Bridge #8 and repair abutment crack supported by VTrans Structures Grant.

Road Improvements:
Priorities shifted during the past 5 years as new state requirements related to the MRGP have focused improvement efforts on high slope segments (over 10%) which must meet standards by 2025. The MRGP Road Erosion Inventory completed in 2019 replaces the 2014 Road Inventory and Capital Budget Plan on which the projects in the summary table were based. Charleston has, however, completed several projects outlined in the 2014 Capital Plan:
Site #1 Church Hill Rd/Mill, Durgin: (C) 2015 Roadway Grant to resurface Class 2 Church Hill Rd and Durgin Rd
Site #2 Cole Rd: (C) (1) In September of 2017 replaced double culverts with an aluminum box culvert
Site #3 Hudson Rd: (C) In 2017 and 2018 upgraded ditching and all culverts along a Hudson Road between Twin Bridges Rd and Center School Road.
Site #4 Twin Bridges Rd: **(I)** The area is monitored on an ongoing basis and has been discussed with VTrans technicians. So far, there is no consensus about an affordable, effective remedy.
Site #5 Hudson near Colburns: completed - new large culvert with concrete headwalls.

Also:
2017 taxpayer funded repave apron of Dane Hill Rd
2019 Roadway Grant to resurface Class 2 Hudson Rd, associated aprons, Fontaine at 105

Erosion/Landslide Mitigation: **(S)** proceeding in accordance with MRGP requirements.

Stormwater projects:
Charleston has received annual support through the Better Roads grant program, and now the Grants-in-Aid Pilot program, and has completed the following improvement projects to reduce erosion and improve stormwater handling, including a few on perennial streams, since the last Local Hazard Mitigation Plan was adopted:
2017 East Echo Lake Rd, Better Roads Category B Grant, ditch upgrade, multiple culvert replacement and crown restoration
2017 Gratton Hill Rd, 3 Better Roads Category B grants, multiple culvert replacement and ditch upgrade
2019 Crawford Hill Rd, VT Grants-in-Aid, replace 36" culvert with concrete head wall
2019 Hinton Hill Rd, VT Grants-in-Aid, stone ditch, new culvert
2017 Dane Hill Rd, VT Grants in aid, stone ditch
2017 taxpayer funded repave apron of Dane Hill Rd
2019 Streeter Rd, Better Roads Category D Grant culvert, multiple culvert replacement including a 36" at stream and ditch upgrades
2019 Ten Mile Square Rd, Better Roads Category D Grant, large culvert upgrade on Lang Brook
2020 Bowen Hill Rd multiple culvert replacement and stone ditches
2021 Town has applied for Better Roads Category B funds to bring Mad Brook Rd up to standards—ditch w/ stone lining, and replace multiple culverts.

Action 3: Maintain and improve capabilities of existing and potential public shelters. (S)
In 2017, volunteer firefighters and community participated in American Red Cross Shelter Basics training, and signed up as shelter volunteers, including food preparation. In 2020, town, school and fire department officials completed an on-site shelter assessment with American Red Cross and a formal shelter agreement is in process. As part of the shelter assessment, the town and school will work toward a generator budget and proposal that could be used to apply for a future grant. As of spring 2020, state emergency management staff were not aware of any current hazard mitigation grants for generators. In 2020, the Town Office was inventoried by Red Cross as a smaller warming/cooling shelter.

Assess Vulnerable Population: **(S)** Lists of high-risk and vulnerable populations is updated annually with the town's Local Emergency Management Plan (LEMP). CARE (Citizens Assistance Registry for Emergencies) forms and info about online registration is made available through the Town Office and town communications.

Rationale/Cost-benefit Review: **(P)** Town resources do not exist for greater planning and staffing.

Action 4: Work to enhance response times of emergency medical services in areas of town where there is a known deficit

Enhance Emergency Response time: **(C)** As some area ambulance services struggled and closed in recent years, Newport Ambulance Service has grown to provide emergency services to all of Charleston and several surrounding towns, expanding to 3 24-hour crews and now covering 300 square miles, compared to 78 in 2017. To improve response time and expand available crews, in 2020 NAS completed construction of a substation in Morgan, Vermont, which is located about 3 miles from West Charleston Village and 6 miles from East Charleston Village. The substation is staffed 24/7 and has improved response time. Charleston maintains a contract with NAS. Charleston Volunteer Fire Department members have also completed medical assist training and work closely with NAS to coordinate staff training and response. In 2017, new equipment to stabilize vehicles and rescue victims after accidents was added. In 2018, added snowmobile and water rescue training and equipment, and new addition to store safely. New tanker in 2019 (3,400 gallon capacity; pumps at 650 gallons per minute) increases effectiveness and mitigate losses.

Action 5: Review and modify evacuation and sheltering plans based on the results of drills and exercises or procedures implemented in an actual incident

Drills: **(S)** Ongoing. Charleston's EMD participates in regular drills along with members of the volunteer fire department in coordination with Local RPC and State EOC. Elementary school conducts regular evacuation and shelter-in-place drills with support from Town officials.

Evacuation and Sheltering Plans: **(S)** EMD/Fire Chief and school principal are in regular communication with Town Officials about any needs based on drills. A couple examples of recent improvements: Taxpayers committed to assisting the volunteer fire department with purchase of a new tanker that can more effectively navigate backroads and more and more homes are located further from main roads.

Action 6: Ensure town and school emergency plans are fully coordinated

Communications: **(S)** As part of local COVID response, Town Officials, Fire Department and School Principal continue to convene the town's EOC. Local Emergency Management Plan is reviewed by Charleston Volunteer Fire Department, Charleston Elementary School, and Town Officials annually and updated to reflect current contacts and resources.

Exercises: **(S)** Town Office is used as evacuation area for school.

Monitor Exercises: **(P)** However, school administration coordinates with town office for evacuation/relocation drills. Town has provided school officials with keys to the town office for use as a drill relocation site when the office is closed.

Action 7:
School Programs: **(S)** This is ongoing part of school district emergency planning overseen by Principal and School Board Directors.

Family Programs: **(P)** Town resources do not allow for staffing such efforts, however, the town clerk's office maintains a resource library of literature and referral contacts that is available for residents.

Fire Prevention: **(S)** In early spring when snow has melted but foliage is yet to green-up, town officials communicate applicable burn bans and remind residents of burn permit requirements on town website and Facebook group. CVFD posts notices and information on their Facebook page.

Other hazard: **(S)** As needed, the town EMD activities the Emergency Operations Center to prioritize emergency needs and provide coordinated communication to the public.