**4: Vermont Profile & Hazard Assessment**

Vermont Profile

Vermont is located astride the Green Mountains at the center of three ranges of the Appalachians, with the Adirondacks to the west and the White Mountains to the east. Vermont encompasses 9,250 square miles of landmass.

Population Trends:

Geographically, Vermont is the sixth smallest state and the second least populated. The population of Vermont was 625,741 based on the 2010 Census and is estimated to have increased to 643,077 based on the 2020 Census, an increase of approximately 2.77%. As the maps below indicate (Figures 17 & 18), there have been relatively minor changes in population statewide since 2010. Some counties have experienced slight gains (most notably Chittenden, +11,778), and other counties have experienced decreases (most notably Rutland, -1,070).

With a population density of approximately 69.78 persons per square mile, most Vermonters live in small, rural communities with populations of several hundred to several thousand people. The largest city is Burlington, with a population of 44,743 (2020 Census).

A net increase in population of 4,864 was recorded from July 2020 – July 2021, corresponding with the height of the COVID-19 pandemic[[1]](#footnote-2). The 2020-21 influx represented a big change from before the pandemic. It followed a net loss in 2019 and totaled more than two and a half times the number of people arriving in 2018. Nearly 95 percent of the migration to Vermont came from within the U.S. The exception was Chittenden County, with a third of the newly settled coming from outside the country. Several counties across Vermont saw growth in population, including Grand Isle, Orange, Windsor, and Franklin counties. Addison, Rutland, and Bennington counties did not have an increase in population according to 2020-2021 census data.

Vermont is experiencing an increase in population due to its climate resilience, as compared to other regions of the United States. The EPA has ranked Vermont fourth in a nationwide assessment of resilience to extreme weather events brought on by climate change[[2]](#footnote-3). The authors of the 2014 State Climate Assessment wrote that Vermont may become a receiving state for regional climate refugees[[3]](#footnote-4). Climate refugees are settling in Vermont to find more permanent and affordable housing with a lower threat of relocation due to natural hazards[[4]](#footnote-5). With the potential for a high migration rate into the State, Vermont must be able to provide resources such as housing and career opportunities to the new population, which puts pressure on existing and future development.

Development and Housing Trends:

Historically, communities and infrastructure have often been sited in valleys and near water bodies, both globally and in Vermont. This development pattern was based on the assumption that rivers and coastlines would not shift or change course, which in turn relied on an assumption that climate conditions would remain relatively static. Today, New England residents are living in a changing climate with increased precipitation and stronger storms that were predicted to increase in climate change models, and many communities find themselves and their infrastructure increasingly vulnerable to natural disasters like flooding. With the benefit of time, it is now understood that rivers and water bodies naturally adjust and change course, again threatening much of the infrastructure that lies in their path.

With current and projected increases in populations due to both the COVID-19 pandemic and climate migration, development planning must account for expected growth while maintaining community values. The VT Climate Action Plan published in December 2021 urges cities and towns to follow a compact settlement pathway, following Vermont’s existing village center development patterns. Compact settlement refers to developing within already urbanized centers, as opposed to uninhabited areas. Compact settlement provides health, economic, and environmental benefits. The structure provides a network of resources to community members and protects the environment by preventing forest fragmentation[[5]](#footnote-6).

At the turn of the century Vermont experienced a development trend that then tapered off as rural population growth stagnated and decreased. Between 2000 and 2010, there was a total net increase of 28,157 housing units statewide, compared to the following decade 2010-2020 with a total net increase of 11,779 units. This statistic shows a substantial decrease in net development trends between two decades, but the pandemic and climate migration could potentially alter this pattern. Vermont saw the most substantial increase in population in the last decade with almost 5,000 people moving into the state from 2020-2021, which could be attributed to remote work, and an interest in the Vermont lifestyle[[6]](#footnote-7). With an increase in population comes an increased demand for housing. In comparing the 2017 and 2021 ACS estimates, there has been a net increase of 2,413 housing units, which could partially represent the population trends associated with COVID-19 and climate change. However, it is important to consider that people may move into existing homes, temporarily living in second homes, or staying with family. Many communities in Vermont have a high percentage of second homes with their owners living elsewhere for most the year. According to a survey on climate refugees in Vermont conducted through the University of Vermont, 44 out of 232 participants stated they purchased a home in Vermont as their second home[[7]](#footnote-8).

A review of all Local Hazard Mitigation Plans shows that the vast majority of communities report very little development, if any, since the 2018 State Hazard Mitigation Plan and that vulnerability has remained the same and is not projected to change. To get a better understanding of local development, VEM staff asked Regional Planning Commissions (RPCs) to note significant changes in development trends within their regions over the past five years and their impact on vulnerability, included in Table 12 below. Regions reporting no significant changes in development are not included.

In addition to the feedback from RPCs, several communities were added to Table 12 below based on the review of currently approved LHMPs (for more information on this review process, see: State & Local Capabilities). Predominately, LHMPs report that little, if any, development has taken place since their previous Plan and that vulnerability has remained the same and is not projected to change.

|  |  |  |
| --- | --- | --- |
| **Table 12: Changes in Development by Region** | | |
| **Region** | **Municipality** | **Changes in Development & Vulnerability** |
| ACRPC | Middlebury | Mitigation project in East Middlebury creates a false sense of security. Development of athletic fields in the floodplain increased flood depths downtown. |
| BCRC | Bennington | Putnam Block hotel project will increase development downtown in the floodplain, though the project will include flood-proofing of new and existing buildings and is supporting a downtown. |
| CCRPC | Montpelier | Several developments are planned in the City of Montpelier within the floodplain, including a hotel and a distillery. All new development will be required to follow Montpelier’s NFIP standards. |
| CCRPC | Jeffersonville Village | Vulnerable has been reduced due to FEMA-funded projects, including the Greenway Trail Bridge replacement project and floodplain restoration, and drainage improvements downtown that are currently underway. |
| CCRPC | Grand Isle | There has been a decline in agricultural use of land, a small amount of additional residential development along existing roadways and the shoreline, and some commercial development along Route 2. This development has not occurred in hazard-prone areas. |
| CVRPC | Barre City, Northfield, Middlesex | Home buyout projects have restored the floodplain to reduce and eliminate risk from flooding. |
| CVRPC | Plainfield | Home buyouts at risk from landslide and fluvial erosion have eliminated risk for specific properties. |
| NVDA | Concord, Maidstone, Westmore, Barnet | Conversion of seasonal homes to year-round use causes more use of old septic systems close to lakes – creating potential for contamination to surface waters. Roads that used to only be used seasonally are now used year-round. |
| RRPC | Brandon | Box culvert was built to allow the Neshobe River to pass through downtown during heavy flows and reduce vulnerability in town. |
| TRORC | Woodstock | Major infrastructure was rebuilt in floodplain after Irene; the village area is highly vulnerable to inundation and fluvial erosion. |
| WRC | Brattleboro | While no significant development has happened in Brattleboro according to their most recent LHMP, a pending Pre-Disaster Mitigation project for property buyouts and floodplain restoration on the Whetstone Brook will lower flood levels in Brattleboro. |
| WRC | Dover | Changes are expected due to Mount Snow Resort development, possibly including changes to flood patterns due to snowmaking water in a different watershed. |
| WRC | South Newfane | Home sales are lagging, due perhaps to flooding issues; the town may begin to depopulate. |

Transportation:

There are 14,17410 miles of maintained public roadways, including 2,331 of state highways

and 378 miles of interstate and 139 Class-1 town highways in Vermont. The remaining mileage is municipally-owned and managed. Of the state-owned highway system, 806 miles are federally designated National Highway System (NHS) (Figure 21). Transportation systems that run north to south within the State are I-89 (northwestward from White River Junction to the Canadian border, serving both Montpelier and Burlington), I-91 (northward from the Massachusetts border to the Canadian border, connecting Brattleboro, White River Junction, St. Johnsbury, and Newport), and I-93 (northern terminus at I-91 in St. Johnsbury, connecting the northern part of Vermont with New Hampshire).

Other significant routes include U.S. Route 5 (running south to north along the eastern border of Vermont, parallel to I-91 for its entire length in the State), U.S. Route 7 (running south to north, along the western border of the State, connecting Burlington, Middlebury, Rutland, and Bennington) and Vermont Route 100 (running south to north almost directly through the center of the State, providing a route along the full length of the Green Mountains).

East-west routes include U.S. Route 2 (crossing northern Vermont from west to east, and connecting the population centers of Burlington, Montpelier, and St. Johnsbury), U.S. Route 4 (crossing south-central Vermont from west to east, from the New York border in the Town of Fair Haven, through the City of Rutland, and across to Killington and White River Junction), U.S. Route 302 (traveling east from Montpelier and Barre, into New Hampshire and Maine), Vermont Route 9 (running across the southern part of the State from Bennington to Brattleboro), and Vermont Route 105 (crossing the northernmost parts of Vermont and connecting the cities of St. Albans and Newport).

Vermont has 520 interstate bridges, 1,835 bridges on state highways, and 1,642 town highway long (over 20’) structures. VTrans also maintains 1,265 short structures, which include bridges and culverts with spans from six to twenty feet, as well as over 50,000 smaller culverts. The state operates 30 Park and Ride lots and has assisted in the development of 66 municipal lots.

A VTrans survey conducted in 2016 found that the vast majority of Vermonters (91%) travel in a personal vehicle frequently, with 88% commuting to work in a personal vehicle or carpool. The next largest transportation category was walking, with 45% of respondents walking as a means of transport multiple times per week or month[[8]](#footnote-9). Fourteen percent reported biking frequently, while 8% noted frequent use of public transportation.

Utilizing the 5-year estimates from the 2021 American Community Survey it was found that the vast majority of Vermont workers over the age of 16 (82%) commute to work in a personal vehicle or by carpooling. The next largest transportation category was walking, with 4% of respondents walking as a primary means of transportation to work. 1% reported using public transit and 2% reported biking as the main method to commute to work. All while 12% reported that they were primarily working from home and not commuting to work[[9]](#footnote-10).

Vermont is served by Burlington International Airport (BTV) as its main commercial airport, with Rutland-Southern Regional Airport (RUT) acting as a non-primary commercial airport. Vermont maintains 16 public airports, 10 of which are owned by the state. Vermont has eleven different bus companies (Figure 22), two ferry companies (Lake Champlain Transportation Co. and Fort Ticonderoga Ferry) and three rail service lines throughout the State. The State of Vermont also has a program called Go Vermont[[10]](#footnote-11), which is a resource for travelers who want to reduce the cost and environmental impact of driving. It provides information on bus routes, biking, or walking and features a free carpool/vanpool matching service and ridesharing tips. The State is served by Amtrak’s Vermonter and Ethan Allen Express passenger lines, the New England Central Railroad, the Vermont Railway, and the Green Mountain Railroad. The Ethan Allen Express serves Rutland, Castleton Middlebury, Vergennes, and Burlington, while the Vermonter serves Saint Albans, Essex Junction, Waterbury, Montpelier, Randolph, White River Junction, Windsor, Bellows Falls, and Brattleboro, with a planned extension to Canada terminating at Montreal. Vermont possesses 578 miles of active rail lines 305 miles of which are owned by the State.

Vulnerable Populations & Frontline Communities:

Natural hazards can affect everyone in Vermont, but some populations may be more vulnerable to certain types of events, or more significantly impacted during events. It is crucial to consider populations who may have limited access to information and resources due to demographic barriers. The Social Vulnerability Index (SVI)[[11]](#footnote-12) defines overall vulnerability by summarizing four themes: socioeconomic status, household composition and disability, minority status and language, and housing and transportation. Figure 23 depicts this overall score by census block, broken into four relative categories of overall vulnerability. In addition to social vulnerability and the impact on people, vulnerability will also be considered within the realm of the built environment, the natural environment, and the economy, which may vary with each subsequent hazard. These categories are defined below under the “Hazard Impacts” section as they will be considered within each subsequent hazard profile. While many defining factors of vulnerability may overlap between hazards, specific variables significant to each hazard will be discussed in its profile, as well as in Section 5.

Vermonters over the age of 65 is a specific social demographic that is potentially more vulnerable to certain events, such as extreme heat. According to the 2021 ACS, 20.6% of Vermont was over the age of 65, above the national average of 16.8%. Populations over 65 years of age account for a fifth of Vermont’s total population, meaning a large portion of the State could be particularly more vulnerable to hazard events. Figure 24 the percent population over 65 by county, with the most significant population in Essex County (23%, 1,408 people).

Vulnerability can also be economic. Based on estimates from the ACS, Vermont’s median household income was estimated at $72,431 in 2021, slightly above the national average of $69,717. To better account for cost of living in Vermont, Vermont’s Joint Fiscal Office develops a report biennially that determines a livable hourly wage for Vermonters[[12]](#footnote-13). This analysis estimates how much an individual would need to make, at a minimum, in order to live in Vermont based on a variety of family configurations and assuming employer-sponsored healthcare. The overall livable wage rate in 2022 was defined as $31,886 in individual income for a full-time worker in a two-person household without children. That equates to a household income of $63,773, which is considerably below the median household income for Vermont, but just below the national average median household income.

The below table includes the various household types considered in the report and their corresponding livable wage figures. These figures were calculated assuming a 40-hour week, 52 weeks a year (Hourly Wage X 40 hours/week X 52 weeks/year).

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| --- | --- | --- | --- | --- |
| **Table 13: 2022 Basic Needs Budget Wages, Per Earner – Vermont’s Basic Needs Budget** | | | | |
| **Family Type** | **Urban Annual Salary** | **Rural Annual Salary** | **Urban Household Salary** | **Rural Household Salary** |
| **Single Person** | $41,662.40 | $39,104.00 | $41,662.40 | $39,104.00 |
| **Single Parent, One Child** | $73,840.00 | $64,480.00 | $73,840.00 | $64,480.00 |
| **Single Parent, Two Children** | $95,513.60 | $82,097.60 | $95,513.60 | $82,097.60 |
| **Two Adults, No Children** | $31,428.80 | $32,344.00 | $62,857.60 | $64,688.00 |
| **Two Adults, Two Children**  **(one wage earner)** | $77,854.40 | $76,356.80 | $77,854.40 | $76,356.80 |
| **Two Adults, Two Children**  **(two wage earners)** | $54,017.60 | $50,585.60 | $108,035.20 | $101,171.20 |
| Source: https://ljfo.vermont.gov/assets/Subjects/Basic-Needs-Budgets/8924c89cea/2022-Basic-Needs-Budget-and-Livable-Wage-report-FINAL-1-17-2023.pdf | | | | |

Climate Change Trends Observed

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 1.5°F rise in temperature since 1900, with most of that warming occurring since 1970. Over the same time period Vermont has been getting warmer and wetter, with an average air temperature increase of 4°F in winter and 2°F in summer[[13]](#footnote-14). This 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[[14]](#footnote-15).

The Intergovernmental Panel on Climate Change (IPCC) forecasts a temperature rise between 1.5°F and 5°F by 2100, 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 change[[15]](#footnote-16). 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 (including building, transportation, and energy infrastructure) 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 below are likely to be exacerbated by changes in climate, either directly or indirectly. This section begins to review changes in our global and regional climate, which are further addressed in the hazard profiles, including:

* **Precipitation:** Inundation Flooding & Fluvial Erosion; Drought; Wildfire; Landslides; Snow Storm; Ice Storm
* **Temperature:** Extreme Cold; Extreme Heat; Drought; Wildfire; Invasive Species; Infectious Disease; Snow Storm; Ice Storm
* **Snow Cover:** Snow Storms; Ice Storms; Drought; Wildfire

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 2023 SHMP, addressed in each of the pertinent hazard profiles and incorporated into all relevant mitigation actions.

|  |  |  |
| --- | --- | --- |
| **Table 14: Observed Climate Trends – Vermont’s 2017 Forest Action Plan** | | |
| **Parameter** | **Trend** | **Projections** |
| **Temperature** | | |
| Annual Temperature | Increase | By 2050, projected increase in average annual temperature by 3.7-5.8° F; by 2100, increase by 5.0-9.5° F. |
| Seasonal Temperature | Increase | By 2050, projected increase in average winter temperature (December, January, February) by 4.3-6.1° F; average summer temperature (June, July, August) by 3.8-6.4° F |
| Hot Days > 90°F | Increase | More frequent and more intense; by the end of the century, northern cities can expect 30-60+ days with maximum daily temperatures >90° F |
| Cold Days < 0°F | Decrease | Reduction in days with minimum daily temperatures <0° F |
| Variability | Increase | Greater variability (more ups and downs) |
| **Hydrology** | | |
| Annual Precipitation | Increase | By the end of the century, projected total increase of 10% (about 4” per year) |
| Season Precipitation | Variable | More winter rain, less snow; by 2050, winter precipitation could increase by 11-16% on average; little change expected in summer, but projections are highly variable |
| Heavy Rainfall Events | Increase | More frequent and intense |
| Soil Moisture | Decrease | Reduction in soil moisture and increase in evaporation rates in the summer |
| Snow | Decrease | Fewer days with snow cover (by the end of the century, could lose one-fourth to more than one-half of snow-covered days); increased snow density |
| Spring Flows | Earlier, Reduced Volume | Earlier snowmelt, earlier high spring flows with reduced volume; could occur ten days to >2 weeks earlier |
| Summer Low Flows | Increase | Extended summer low-flow periods; could increase by nearly a month under high emissions scenario |
| Ice Dynamics | Changing | Less ice cover and reduced ice thickness |
| **Extreme Events** | | |
| Flood Events | Increase | More likely, particularly in winter and particularly under the high emissions scenario |
| Number of Short-Term Droughts | Increase | By the end of the century, under high emissions scenario, short-term droughts could occur as much as once per year in some places |
| Storms | Increase | More frequent and intense (ice, wind, etc.) |
| Fire | Increase | More likely |
| **Phenology** | | |
| Growing Season | Increase | By the end of the century, projected to be 4-6 weeks longer |
| Onset of Spring | Earlier | By the end of the century, could be 1 to almost 3 weeks earlier |
| Onset of Fall | Later | By the end of the century, could arrive 2-3 weeks later |
| *Source: fpr.vermont.gov/sites/fpr/files/Forest\_and\_Forestry/Vermont\_Forests/Library/2017\_VT\_ForestActionPlan.pdf* | | |

Since the beginning of the 20th century, average temperatures in Vermont have increased about 3°F. With the last 11 year period (2010-2020) being the warmest period on record. The intensity of Vermont winters and extreme winter cold has also decreased, with Vermont’s freeze free period lengthening by 3 weeks since 1960. On average, lakes and ponds are thawing one to three days earlier per decade. Annual average precipitation has increased around 6” since the 1960s, with the largest increases occurring in the mountainous regions of the state. Winter and spring precipitation is projected to increase throughout this century and warming will increase the proportion of that precipitation that will fall as rain.

According to the 2018 National Climate Assessment, the average annual precipitation in the United States has increased by approximately 4% since 1901[[16]](#footnote-17). Of particular note, the Assessment also identifies the northern U.S. as being more likely to experience above average precipitation in the winter and spring, with even wetter conditions expected under a high greenhouse gas emissions scenario. In addition to higher annual precipitation in both the observed record and projected models, the northeastern United States is also projected to experience more frequent, heavier rainfall events. Since 1991, the incidence of these heavy precipitation events has been 38% above average for the northeast[[17]](#footnote-18).

HAZARD ASSESSMENT

A risk assessment is used to measure the potential loss of life, personal injury, economic impact, and property damage resulting from natural hazards by analyzing the vulnerability of people, the built environment, the economy and the natural environment. VEM staff used several methods to identify risks in Vermont, including the evaluation of historical data, consideration of changing climate trends, and feedback from stakeholders. This examination involved an extensive review of natural disasters in Vermont, both declared and undeclared. Man-made and technological hazards are covered extensively in the 2018 Vermont State Emergency Management Plan (SEMP), which follows a risk assessment methodology similar to that used in this Plan. Accordingly, the following sections of the risk assessment identify the natural hazards that Vermonters can expect to face over the next fifty years and beyond, and the mitigation strategies section reviews the actions underway or planned to address these hazards and risks. As noted in the 2018 SHMP, and confirmed again in the 2023 SHMP, the natural hazards not incorporated are coastal erosion, expansive soils, Karst topography, sinkholes, tsunamis and volcanoes. These hazards are considered non-significant, unlikely hazards in Vermont and therefore do not warrant extensive review and consideration in this Plan.

Hazard Events

Since 2018 Vermont has assessed the impacts of hazard events rather than the events themselves, as it is the impacts, not the events, that can be mitigated. This approach was continued in 2023 Plan update. For example, inundation flooding, fluvial erosion, and wind can be associated with a hurricane event, but can also impact the State outside of a hurricane event.

A history of Vermont disaster declarations is included in Appendix 4.

Hazard Impacts

A task group composed of subject matter experts from the Steering Committee, VEM, and the National Weather Service ranked natural hazard impacts as part of the hazard assessment process. Table 16 presents that ranking, determined by multiplying the probability of occurrence by an average score for potential impact to the Built and Natural Environments, People, and Economy. Future probability included an assessment of potentially changing locations of hazard impacts, range of intensities, frequency and duration. This tool can be used for determining hazard mitigation priorities within the State and Local Hazard Mitigation Plans. The column headers are not perfectly siloed. Basic definitions are provided below to better understand the potential impacts under each column header, but each category is cross-cutting and related to the others. Additionally, it is an imperfect process to rank slow-moving hazards, with creeping impacts such as drought or invasive species, using the same criteria as fast-moving hazards such as inundation flooding. Additionally, crossing-cutting issues and other challenges will be further discussed within Section 5 of the Plan. Specific hazard impacts on the built and natural environments, people, and economy are expanded upon in each hazard profile.

Table 17 details the hazard assessment ranking criteria used in Table 16. Hazard ranking is determined by frequency of occurrence (probability) and potential impact. *Minor economic disruption* is considered isolated and very short-term – characterized by employees unable to make it to work or businesses closed for 1-3 days, and supply chain issues lasting less than a few weeks. *Short-term economic impact* has further-reaching and longer-lasting impacts, but the state will recover in less than 5 years. Both minor economic disruption and short-term economic impact will be most detrimental to low-income individuals and communities that may not have savings necessary to weather a temporary loss of work. In addition to economic impacts, hazard events can severely impact quality of life for individuals and communities. Certain Individuals and communities may feel the brunt of hazards more so than others depending on several factors. Vermont’s Climate Action Plan defines Frontline Communities as those who feel the “worst and first” consequences of climate change. Through the hazard ranking process, the Steering Committee was instructed to think about the impact of each hazard on frontline communities.

The ***Built Environment*** is comprised of the manmade structures and infrastructure in our communities, including municipal water systems, dams, homes, bridges, roads, wastewater treatment plants, electrical and communication systems, libraries, medical facilities, fire stations, and town halls. Features of the built environment can be both functionally and culturally valuable to the people living there. After a disaster, the impacts to the built environment are some of the most visible.

***Natural Environment*** encompasses natural resources and ecosystems, but also the natural features integrated with our communities including urban trees and agricultural land. Water, soil, air, forest products, fish and wildlife are all natural resources. Ecosystems include lakes, forests, meadows, and rivers. Ecosystem services are the processes of the natural environment producing benefits to humans such as flood control and water filtration by wetlands. In the absence of human intervention, the natural environment can withstand natural disturbances, and depends on natural hazards to maintain normal ecosystem function. It is due to human dependence on the natural environment for food, water quality, and other natural resources, and human influence on the natural environment, particularly climate change impacts on ecosystem health, that we are concerned with hazard impacts to the environment.

***People*** refers to both life and well-being of those who live in, work in, or visit Vermont. Hazard mitigation planning centers around protecting life and property. Hazards can be deadly, but there are many other impacts of hazards that need to be accounted for. A few examples of potential hazard impacts to people are loss of housing, loss of childcare, displacement, food insecurity, unemployment, illness, psychological trauma, depression, and loss of life.

***Economy*** captures the economic impacts of hazards that can lead to short and long-term financial hardships. Hazards can cause agricultural losses, decline in tourism, damages to storefronts and goods for sale, loss of employers and jobs, and disruption in supply chains. There is also the substantial cost of paying for recovery from hazard events for the state, municipalities, individuals, nongovernmental organizations, and businesses.

**Table 16: Hazard Assessment:**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 16: Hazard Assessment** | | | | | | | |
| **Hazard Impacts** | **Probability** | **Potential Impact** | | | | | **Score\*:** |
| Built  Environment | People | Economy | Natural  Environment | **Average:** |
| Fluvial Erosion | 4 | 4 | 4 | 4 | 4 | 4 | 16 |
| Inundation Flooding | 4 | 4 | 4 | 4 | 2 | 3.5 | 14 |
| Heat | 4 | 2 | 4 | 3 | 2 | 2.75 | 11 |
| Wind | 4 | 3 | 2 | 2 | 2 | 2.25 | 9 |
| Snow | 4 | 2 | 3 | 2 | 1 | 2 | 8 |
| Ice | 3 | 2 | 3 | 3 | 2 | 2.5 | 7.5 |
| Drought | 3 | 1 | 3 | 3 | 3 | 2.5 | 7.5 |
| Infectious Disease Outbreak | 3 | 1 | 4 | 4 | 1 | 2.5 | 7.5 |
| Cold | 3 | 2 | 3 | 2 | 2 | 2.25 | 6.75 |
| Invasive Species | 3 | 2 | 1 | 3 | 3 | 2.25 | 6.75 |
| Landslides | 3 | 3 | 2 | 1 | 2 | 2 | 6 |
| Wildfire | 2 | 3 | 3 | 3 | 3 | 3 | 6 |
| Earthquake | 2 | 2 | 2 | 2 | 2 | 2 | 4 |
| Hail | 3 | 1 | 1 | 2 | 1 | 1.25 | 3.75 |
| \*Score = Probability x Average Potential Impact | | | | | | | |

|  |  |  |
| --- | --- | --- |
| **Table 17: Hazard Assessment Ranking Criteria** | | |
|  | **Frequency of Occurrence:**  Probability of a plausibly significant event impacting the community or regional scale based on previous occurrences and climate change projections. | **Potential Impact:**  Severity and extent of damage and disruption to built and natural environments, people, and the economy |
| **1** | Unlikely: <1% probability of occurrence per year | Negligible: isolated occurrences of minor built or natural environmental damage, potential for minor injuries, health, or well-being impacts, or minimal economic disruption. |
| **2** | Occasionally: 1–10% probability of occurrence per year, or at least one chance in next 100 years | Minor: isolated occurrences of moderate to severe built or natural environmental damage, potential for injuries or health or well-being impacts, minor economic disruption. |
| **3** | Likely: >10% but <75% probability per year, at least 1 chance in next 10 years | Moderate: severe built or natural environmental damage on a community scale, injuries, fatalities or impacts to individual and community well-being, short-term economic impact. |
| **4** | Highly Likely: >75% probability in a year | Major: severe built or natural environmental damage on a community or regional scale, multiple injuries or fatalities or severe long-term impacts to individual and community well-being, significant long-term economic impact. |

The hazards and explanations of their relative probability and impact scores are detailed in the individual hazards assessment sections below. While these hazards are profiled individually, this Plan and the hazard assessment sections recognize that hazards, like their impacts, do not occur in silos; many of the hazards are inter-related and often occur in tandem. To highlight the most significant relationships, the fluvial erosion and inundation flooding assessments were combined. Each individual hazard assessment section also references the other pertinent hazards and their content, when applicable.

Jurisdictional Risk Assessments:

In an effort to validate the risk assessment completed by the Steering Committee, and as one of the metrics used to assess local vulnerability, VEM staff asked RPCs to rank the same list of hazards based on the perceived vulnerability in their respective regions. RPCs ranked vulnerability on a scale from 1-14, with 1 being the most significant and 14 being the least significant. Table 20 represents the responses from each RPC, with an average score based on all responses, ordered from most to least significant. The results of this analysis closely matched the hazard ranking completed by the Steering Committee, further confirming Vermont’s most significant hazards (i.e. Fluvial Erosion, Inundation Flooding, Ice and Snow).

**Table 20: Hazard Assessment Ranking by Regional Planning Commission**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Hazard Impact** | **2023 Average** | **Change from 2018** | **ACRPC** | **BCRC** | **CCRPC** | **CVRPC** | **LCPC** | **NRPC** | **NVDA** | **RRPC** | **MARC** | **TRORC** | **WRC** |
| **Inundation Flooding** | **1.8** | **0.4** | 7 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 |
| **Ice** | **3.6** | **1.0** | 2 | 4 | 4 | 2 | 4 | 2 | 5 | 4 | 6 | 3 | 4 |
| **Fluvial Erosion** | **3.7** | **-1.4** | 6 | 2 | 1 | 8 | 8 | 5 | 3 | 1 | 2 | 4 | 1 |
| **Wind** | **4.1** | **1.0** | 1 | 3 | 6 | 3 | 3 | 4 | 2 | 3 | 4 | 13 | 3 |
| **Snow** | **4.5** | **0.0** | 3 | 5 | 5 | 4 | 2 | 6 | 6 | 6 | 5 | 2 | 5 |
| **Cold** | **5.9** | **1.5** | 4 | 8 | 8 | 6 | 5 | 3 | 4 | 5 | 8 | 5 | 9 |
| **Heat** | **8.0** | **3.1** | 5 | 9 | 9 | 9 | 6 | 12 | 7 | 8 | 9 | 6 | 8 |
| **Drought** | **8.3** | **1.0** | 10 | 10 | 7 | 10 | 7 | 8 | 8 | 9 | 7 | 8 | 7 |
| **Infectious Disease** | **8.5** | **1.5** | 8 | 6 | 3 | 5 | 10 | 9 | 10 | 14 | 12 | 7 | 10 |
| **Wildfire** | **10.0** | **-1.2** | 11 | 11 | 11 | 12 | 12 | 10 | 12 | 7 | 3 | 9 | 12 |
| **Invasive Species** | **10.2** | **-2.2** | 12 | 7 | 10 | 13 | 11 | 13 | 9 | 10 | 11 | 10 | 6 |
| **Hail** | **10.9** | **-1.4** | 9 | 12 | 12 | 7 | 9 | 11 | 11 | 11 | 13 | 12 | 13 |
| **Landslides** | **11.6** | **-3.2** | 13 | 14 | 13 | 11 | 13 | 7 | 13 | 12 | 10 | 11 | 11 |
| **Earthquake** | **13.8** | **-0.7** | 14 | 13 | 14 | 14 | 14 | 14 | 14 | 13 | 14 | 14 | 14 |

In June of 2023 177 of the 281 jurisdictions in Vermont had FEMA-approved Local Hazard Mitigation Plans (63%). In a review of these approved plans, VEM mitigation staff identified natural hazards that were addressed by more than 10 individual jurisdictions (Table 21). The analysis confirms that the most significant concerns at the State level are consistent with reality at the regional and local levels, with Flooding, Fluvial Erosion and Ice Storm and Winter Storms and ranking as the most significant hazards. Extreme Heat was not included in a minimum of 10 LHMPs in 2017, and has since been included in 36 plans across Vermont.

Table 21: Hazards Prioritized in Approved LHMPs

|  |  |  |
| --- | --- | --- |
| **Hazard** | **Approved LHMPs** | **Percent of Approved LHMPs** |
| **Flooding** | 134\* | 100.0% |
| **Fluvial Erosion** | 125 | 93.3% |
| **Winter Storms** | 115 | 85.8% |
| **Ice Storm** | 101 | 75.4% |
| **High Wind** | 87 | 64.9% |
| **Flash Flood** | 69 | 51.5% |
| **Extreme Cold** | 62 | 46.3% |
| **Hail** | 48 | 35.8% |
| **Wildfires** | 47 | 35.1% |
| **Drought** | 46 | 34.3% |
| **Thunderstorms** | 42 | 31.3% |
| **Hurricanes/Tropical Storms** | 39 | 29.1% |
| **Landslides** | 38 | 28.4% |
| **Earthquakes** | 38 | 28.4% |
| **Infectious Disease Outbreak** | 37 | 27.6% |
| **Invasive Species** | 36 | 26.9% |
| **Extreme Heat** | 36 | 26.9% |
| **Extreme Temperatures** | 33 | 24.6% |
| **Dam Failure** | 32 | 23.9% |
| **Tornadoes** | 27 | 20.1% |
| **Ice Jams** | 26 | 19.4% |
| **Lightning** | 26 | 19.4% |

\* There are 134 plans approved between 2017 and 2023. Some plans are multijurisdictional.

The ranking of hazards at the State level verses the regional and local levels does have some discrepancies. Flooding and fluvial erosion are clearly ranked first across the board because many of Vermont’s communities have experienced or seen flooding and fluvial erosion and the devastation it causes firsthand. Similarly, snow and ice rank higher in the local assessment over the State hazard assessment. The greatest discrepancy between the State and local assessments is in the ranking of heat as a priority hazard. Historically speaking, heat has not been a major hazard due to a typically cooler climate given the northerly latitude of Vermont. Annual average temperatures and extreme temperatures are on the rise however, and there are observed impacts to people, environment, and infrastructure that have impacts on the economy. We expect extreme heat to become a more common hazard prioritized in Local Hazard Mitigation Plans over the coming years. Drought and wildfires, which become more likely with rising temperatures, are also expected to rise in the hazard rankings across the State. The State will need to be prepared to provide the technical resources and financial support to address these increasing hazards.

*Note: further discussion on localized vulnerability is addressed in Section 5.*

1. <http://publicassets.org/wp-content/uploads/2022/07/MJB156.pdf> [↑](#footnote-ref-2)
2. <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100SSN6.txt> [↑](#footnote-ref-3)
3. <http://dev.vtclimate.org/wp-content/uploads/2014/04/VCA2014_FullReport.pdf> [↑](#footnote-ref-4)
4. <https://www.mynbc5.com/article/climate-migrants-come-to-vermont-and-the-adirondacks/43222337> [↑](#footnote-ref-5)
5. <https://outside.vermont.gov/agency/anr/climatecouncil/Shared%20Documents/Initial%20Climate%20Action%20Plan%20-%20Final%20-%2012-1-21.pdf> [↑](#footnote-ref-6)
6. <https://www.vermontpublic.org/local-news/2022-08-24/long-known-for-its-dwindling-population-vermont-sees-a-recent-uptick-in-new-residents> [↑](#footnote-ref-7)
7. <https://www.uvm.edu/sites/default/files/Center-for-Research-on-Vermont/docs/Survey_Summary_4-pages.pdf> [↑](#footnote-ref-8)
8. <http://vtrans.vermont.gov/sites/aot/files/planning/documents/planning/Existing%20Conditions%20%20Future%20Trends%206-7-17.pdf> [↑](#footnote-ref-9)
9. <https://data.census.gov/table?q=vermont+transportstion&tid=ACSDT5Y2021.B08141> [↑](#footnote-ref-10)
10. <https://www.connectingcommuters.org/> [↑](#footnote-ref-11)
11. <https://svi.cdc.gov/map.aspx> [↑](#footnote-ref-12)
12. <http://www.leg.state.vt.us/jfo/reports/2017%20BNB%20Report%20Revision_Feb_1.pdf> [↑](#footnote-ref-13)
13. <https://www.healthvermont.gov/health-environment/climate-health/climate-change> [↑](#footnote-ref-14)
14. <http://www.ipcc.ch/> [↑](#footnote-ref-15)
15. <https://climate.nasa.gov/effects/> [↑](#footnote-ref-16)
16. https://nca2018.globalchange.gov/chapter/2#key-message-6 [↑](#footnote-ref-17)
17. https://nca2018.globalchange.gov/chapter/2#key-message-6 [↑](#footnote-ref-18)