CHAPTER 7: ACTION PLAN

Mitigation Goals and Objectives

The Hazard Mitigation Committee met on October 18, 2023, to develop goals, which are adapted from the State of New Hampshire Multi-Hazard Mitigation Plan (2018).

Goals

The following are the goals of this Plan:

- Minimize loss and disruption of human life, property, the environment, and the economy due to natural, technological, and human-caused hazards through a coordinated and collaborative effort between federal, State, and local authorities to implement appropriate hazard mitigation measures.
- Enhance protection of the general population, citizens, and guests of Strafford before, during, and after a hazard event through public education about disaster preparedness and resilience, and expanded awareness of the threats and hazards through mitigation activities.
- Promote continued comprehensive hazard mitigation planning to identify, introduce, and implement cost effective hazard mitigation measures.
- Address the challenges posed by climate change as they pertain to increasing the risk and impacts of the hazards identified within this plan.
- Provide resources to residents of Strafford, when needed, to become more resilient to hazards that impact the town's critical support services, critical facilities, infrastructure, economy, environment, historical & cultural treasures and private property.
- Develop and implement programs and strategies to promote hazard mitigation to protect infrastructure throughout the town to reduce risk with respect to natural, technological, and human-caused hazards.

Natural Hazard Objectives

The following are the natural hazard objectives of this Plan:

- Reduce long-term flood risks through assessment, identification, and strategic mitigation of at risk/vulnerable infrastructure (dams, stream crossings, roadways).
- Minimize illnesses and deaths related to events that present a threat to human and animal health.
- Implement plan development, outreach, and public education to reduce the impact from natural disasters.
- Ensure mitigation strategies consider the protection and resiliency of natural, historical, and cultural resources.

Technological Hazard Objectives

The following are the technological hazard objectives of this Plan:

- Ensure technological hazards are responded to appropriately and to mitigate the impact on citizens.
- Identify and respond to emerging contaminates.
- Enhance public education of technological hazards to assist in the prevention and mitigation of hazard impacts on the population.

- Ensure emergency responders are properly equipped and trained to respond, contain, and mitigate incidents involving technological hazards.
- Reduce the possibility of long-term utility outages by implementing mitigation reduction measures such as line clearing and removal of nuisance trees, as well as ensuring back-up power is in place and tested.
- Lessen the impact of technological hazards on communications infrastructure.

Human-Caused Hazard Objectives

The following are the human-caused hazard objectives of this Plan:

- Advocate that grants related funding processes allow for expedient and effective actions to take place at the community and State-level.
- Identify Critical Infrastructure and Key Resources (CIKR) risks or vulnerabilities and protect or harden infrastructure against hazards.
- Improve the ability to respond and mitigate cyber events through increased training, exercising, improved equipment, and utilizing accepted technologies.
- Foster collaboration between federal, State, and local agencies on training, exercising, and preparing for mass casualty incidents and terrorism Ensure local assets (e.g., non-profits, UNH, schools, nursing homes, and other facilities and populations to protect) are prepared for all phases of emergency management including training and exercising on reunification.

Development of Action Items

The Hazard Mitigation Committee determined that any strategy designed to reduce personal injury or damage to property that could be done prior to an actual disaster would be listed as a potential mitigation strategy.

This decision was made even though not all projects listed in Table 30 (Mitigation Actions) and Table 31 (Implementation Plan) are fundable under FEMA grant programs. The committee determined that this Plan was in large part a management document designed to assist the Town officials in all aspects of managing and tracking potential emergency planning strategies. For instance, the committee was aware that some of these strategies are more properly identified as readiness issues; however, did not want to “lose” any of the ideas discussed during these planning sessions and thought this method was the best way to achieve that objective.

The committee identified twenty-two (22) new strategies to implement during the life of this Plan. These strategies are intended to supplement existing programs that are already in place. When identifying new strategies, the committee balanced several factors including capacity to implement strategies, priority projects, existing strategies, policies and programs, hazard ranking, and whether a strategy will reduce risk associated with multiple hazards.

Prioritization of Action Items

A technique known as a STAPLEE evaluation, which was developed by FEMA, was used to evaluate new mitigation strategies based on a set of criteria (see below). The STAPLEE method is commonly used by public administration officials and planners.

Table 29: Prioritization "STAPLEE" Method		
S	Social	Is the proposed strategy socially acceptable to the community? Is there an equity issue involved that would result in one segment of the community being treated unfairly?
T	Technical	Will the proposed strategy work? Will it create more problems than it solves?
A	Administrative	Can the community implement the strategy? Is there someone to coordinate and lead the effort?
P	Political	Is the strategy politically acceptable? Is there public support both to implement and to maintain the project?
L	Legal	Is the community authorized to implement the proposed strategy? Is there a clear legal basis or precedent for this activity?
E	Economic	What are the costs and benefits of this strategy? Does the cost seem reasonable for the size of the problem and the likely benefits?
E	Environmental	How will the strategy impact the environment? Will it need environmental regulatory approvals?

The Hazard Mitigation Committee evaluated each mitigation strategy using the STAPLEE and ranked each of the criteria as poor, average, or good. These rankings were assigned the following scores: *Poor=1; Average=2; Good=3.*

The following questions were used to guide further prioritization and action:

- Does the action reduce damage?
- Does the action contribute to community objectives?
- Does the action meet existing regulations?
- Does the action protect historic structures?
- Can the action be implemented quickly?

The prioritization exercise helped the committee evaluate the new hazard mitigation strategies that they had brainstormed throughout the multi-hazard mitigation planning process. While all actions would help improve the Town's multi-hazard and responsiveness capability, funding availability will be a driving factor in determining what and when new mitigation strategies are implemented.

Table 30: Mitigation Actions								
New Mitigation Projects	S	T	A	P	L	E	E	Total
When new FEMA flood maps are available, update flood hazard overlay maps and evaluate the need to incorporate additional freeboard requirements to increase building height or otherwise amend the existing ordinance.	3	3	3	3	3	3	3	21
Upgrade bridge on Barn Door Gap Road over the Big River.	3	3	3	3	3	3	3	21
Make FEMA NFIP Public Awareness materials available at the Town Offices for new and existing homeowners.	3	3	3	3	3	3	3	21
Continue to provide salt and sand for residents at the Town Shed.	3	3	3	3	3	3	3	21
Distribute educational material about the dangers of carbon monoxide and winter storm survival to residents. Post material to website, Facebook, and make available in Town Hall and library.	3	3	3	3	3	3	3	21
Provide educational brochure about drinking water, including well maintenance and testing, impacts of drought, and additional resources.	3	3	3	3	3	3	3	21
Add the Strafford Hazard Mitigation Plan Update 2023 to the Town website.	3	3	3	3	3	3	3	21
Educate Town staff and officials about emergency response protocols in the event of a hazardous material spill. Provide material at transfer station.	3	3	3	3	3	3	3	21
Improve communication and coordination with National Guard regarding the plan for the training center to become a regional training center.	3	3	3	3	3	3	3	21
Encourage homeowners to stabilize slopes with rip-rap or vegetation to reduce vulnerability of seasonal lake homes to erosion.	3	3	3	3	3	3	3	21
Allocate funds for additional training for fire department staff.	3	3	3	3	3	3	3	21
Determine the need and feasibility of a culvert upsize to Willey Pond Road 0.5 miles in from Parson's Hill Road.	3	3	3	3	3	3	3	21
Develop strategy to increase awareness of the need for a Citizen Emergency Response Team and post information on Town's website.	3	3	3	3	3	3	3	21
Continue to provide outreach assistance to elderly and special needs populations by organizing staff and coordinating within Town departments. Look into options for residents staying home.	3	3	3	3	3	3	3	21
Coordinate with the NH Division of Forests and Land and the Division of Parks and Recreation to conduct a GIS-based mapping to identify potential access points and fire needs.	3	3	3	3	3	3	3	21
Maintain transportation infrastructure by identifying and assessing potential areas of concern in order to have better emergency access.	3	3	3	3	3	3	3	21
Set aside funds in order to purchase equipment, cots, pillows, blankets, etc. for both emergency shelters.	3	3	3	3	3	2	3	20
Address fire roads and reach out to property owners to help maintain those roads.	2	3	3	3	3	3	3	20
Consider options for fire suppression.	2	3	3	2	3	3	3	19

Table 30: Mitigation Actions								
New Mitigation Projects	S	T	A	P	L	E	E	Total
Manage town owned properties to include a strategy to limit accumulation of woody debris on forest floor when undertaking projects on town-owned property and encourage property owners to implement NH Division of Forests and Land best management practices for wildfire prevention.	2	3	3	2	3	2	3	18
Upgrade Scribner to Cross Road to reduce vulnerability to flooding.	3	3	3	3	3	1	1	17
Revisit the need to open up Class VI roads to improve emergency access.	2	3	3	2	2	1	1	14

Implementation of Action Items

After reviewing the finalized STAPLEE numerical ratings, the Hazard Mitigation Committee prepared to develop the Implementation Plan (Table 31). To do this, the Hazard Mitigation Committee developed an implementation plan that outlined the following:

- ∴ Type of hazard
- ∴ Affected location
- ∴ Type of Activity
- ∴ Responsibility
- ∴ Funding
- ∴ Cost Effectiveness; and
- ∴ Timeframe

The following questions were asked to develop an implementation schedule for the identified priority mitigation strategies.

- **WHO?** Who will lead the implementation efforts? Who will put together funding requests and applications?

- **WHEN?** When will these actions be implemented, and in what order?

- **HOW?** How will the community fund these projects? How will the community implement these projects? What resources will be needed to implement these projects?

In addition to the prioritized mitigation projects, Table 31, Implementation Plan, includes the responsible party (WHO), how the project will be supported (HOW), and what the timeframe is for implementation of the project (WHEN)

New Mitigation Projects	Type of Hazard	Responsible Local Agent	Funding	Cost Effectiveness	When
				Low: < $10K	6 months – 1 year
				Medium: $10K-$50K	2-3 years
				High: > $50K	4-5 years
When new FEMA flood maps are available, update flood hazard overlay maps and evaluate the need to incorporate additional freeboard requirements to increase building height or otherwise amend the existing ordinance.	Flooding	BI	Town budget	Low	4-5 years
Upgrade bridge on Barn Door Gap Road over the Big River.	All	RA	Town budget	High	6 mos. – 1 year
Make FEMA NFIP Public Awareness materials available at the Town Offices for new and existing homeowners.	Flooding	EMD, TH	Town budget	Low	6 mos. – 1 year
Continue to provide salt and sand for residents at the Town Shed.	Extreme Winter Weather	RA	Town budget	Low	6 mos. – 1 year
Distribute educational material about the dangers of carbon monoxide and winter storm survival to residents. Post material to website, Facebook, and make available in Town Hall and library.	Extreme Winter Weather	EMD	Town budget	Low	6 mos. – 1 year
Provide educational brochure about drinking water, including well maintenance and testing, impacts of drought, and additional resources.	Drought, Emerging Contamin-ants	BI	Town budget	Low	6 mos. – 1 year
Add the Strafford Hazard Mitigation Plan Update 2023 to the Town website.	All	TC	Town budget	Low	6 mos. - 1 year
Educate Town staff and officials about emergency response protocols in the event of a hazardous material spill. Provide material at transfer station.	Hazardous Materials	FC, HO	Town budget	Low	6 mos. – 1 year
Improve communication and coordination with National Guard regarding the plan for the training center to become a regional training center.	All	FC, PC	Town budget	Low	6 mos. – 1 year
Encourage homeowners to stabilize slopes with rip-rap or vegetation to reduce vulnerability of seasonal lake homes to erosion.	Flooding, Erosion	BOS	Town budget	Low	6 mos. – 1 year
Allocate funds for additional training for fire department staff.	Fire, All	FC	Town budget	Medium	2-3 years
Determine the need and feasibility of a culvert upsize to Willey Pond Road 0.5 miles in from Parson's Hill Road.	Flooding	RA	Town budget	Low	6 mos. – 1 year
Develop strategy to increase awareness of the need for a Citizen Emergency Response Team and post information on Town's website.	All	TC	Town budget	Low	6 mos. – 1 year
Continue to provide outreach assistance to elderly and special needs populations by organizing staff and coordinating within Town departments. Look into options for residents staying home.	All	FC, WO	Town budget	Low	6 mos. – 1 year
Coordinate with the NH Division of Forests and Land and the Division of Parks and Recreation to conduct a GIS-based mapping to identify potential access points and fire needs.	Fire	FC	Town budget	Low	2-3 years

New Mitigation Projects	Type of Hazard	Responsible Local Agent	Funding	Cost Effectiveness	When
				Low: < $10K	6 months – 1 year
				Medium: $10K-$50K	2-3 years
				High: > $50K	4-5 years
Maintain transportation infrastructure by identifying and assessing potential areas of concern in order to have better emergency access.	All	RA	Town budget	Medium	2-3 years
Set aside funds in order to purchase equipment, cots, pillows, blankets, etc. for both emergency shelters.	All	EMD	Town budget & grants	Medium	2-3 years
Address fire roads and reach out to property owners to help maintain those roads.	Fire	BOS	Town budget	Low	6 mos. – 1 year
Consider options for fire suppression.	Fire	FC, PB	Town budget	Low	2-3 years
Manage town owned properties to include a strategy to limit accumulation of woody debris on forest floor when undertaking projects on town-owned property and encourage property owners to implement NH Division of Forests and Land best management practices for wildfire prevention.	Fire	FW, CC	Town budget	Low	4-5 years
Upgrade Scribner to Cross Road to reduce vulnerability to flooding.	Flooding	RA, EMD	Town budget & grants	High	4-5 years
Revisit the need to open up Class VI roads to improve emergency access.	All	FC	Town budget	Low	2-3 years

CHAPTER 6: CLIMATE CHANGE

Increased Frequency and Intensity of Severe Weather Events

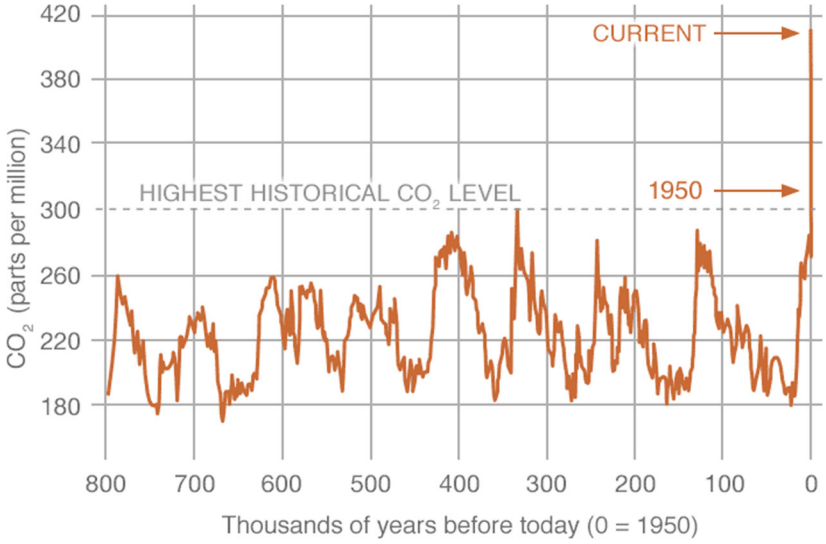
Introduction

According to the National Aeronautics and Space Administration's (NASA) Global Climate Change, there have been seven cycles of glacial advance and retreat over the last 650,000 years, with most of these changes driven by fluctuations in the Earth's orbit that alter the amount of solar energy the planet receives, especially in the northern hemisphere, combined with the powerful **ice-albedo feedback loop** (ice is more reflective than land or water surfaces). Other influences on Earth's climate on shorter timeframes (annual to century scales) include variations in solar output and volcanic eruptions that generate particles that reflect sunlight, which can brighten the planet and cool the climate. These processes are natural and will continue to affect the planet's climate; however, an extensive and ever-growing body of scientific evidence—the IPCC's Fifth Assessment and the Fourth National Climate Assessment for example— point to human activities, and especially the burning of fossil fuels, as being responsible for the warming of the planet over the past 50 years.

As of November 2020, concentrations of carbon dioxide (CO_2) in the Earth's atmosphere have reached 415 parts per million (ppm). For context, according to ice core samples, $C0_2$ concentrations never

exceeded roughly 300 ppm over the last 400,000 years and studies have shown that human activities have raised atmospheric concentrations of $C0_2$ by 47% since pre-industrial levels in 1850.

Figure 2: Proxy Measurements of CO_2 taken from Reconstruction of Ice Cores



Atmospheric levels of other greenhouse gases, including methane, nitrous oxide, and CFC have also risen over the past several decades as well. This increase in atmospheric greenhouse gases is primarily responsible for the rise in the planet's average surface temperature of about 1.6°F since the late 1800s, with most of the warming occurring in the last 50 years. Nineteen of the twenty warmest years on record have happened since 2001. This warming trend is considered extremely likely to continue.

These increases in temperature have affected the Earth's climate in many ways. Ocean temperatures have warmed, the Greenland and Antarctic ice sheets are rapidly losing mass, glaciers are retreating all over the world, global sea-level is rising, snow cover has decreased, and the number of record high temperatures and intense rainfall events has been increasing since the 1950s.

Climate Change in New Hampshire

Greenhouse Gas Emissions

The New Hampshire Department of Environmental Services (NHDES) conducts an annual greenhouse gas (GHG) emissions inventory that tracks the six main GHG's, including carbon dioxide, methane, nitrous oxide, and three industrial process gases (hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride). According to 2017 data, carbon dioxide makes up the majority of NH's GHG emissions (92%), primarily due to burning fossil fuels for heat, electricity, and to power motor vehicles. GHG sources are usually categorized into the following sectors: transportation, electricity generation, residential, commercial, industry, waste and wastewater, and agriculture. Transportation is the predominant sector, producing an estimated 47% of the state's GHGs.

Fortunately, a large majority of NH is forested, with these areas acting as a carbon sink. This process, called **carbon sequestration**, could be responsible for absorbing and storing nearly 25% of CO_2 emissions from the burning of fossil fuels in the state. Intact forested ecosystems are also a major factor in climate resiliency for New Hampshire. It is estimated that a 40-acre forest in northern New Hampshire holds the same amount of carbon as 53,000 automobile tanks of gasoline. Large undeveloped and unfragmented forested blocks are also very important for wildlife and biodiversity conservation and as of 2019, 47% of large forest blocks in the state are permanently conserved. **Climate corridors,** identified by the Nature Conservancy as part of their Resilient and Connected Landscapes project, facilitate tree and wildlife species range shifts as temperatures and habitat continue to change. Intentionally keeping areas forested and protected is a natural safeguard for fresh drinking water and clean air for local communities and offers numerous benefits for the state overall, both now and in the future.

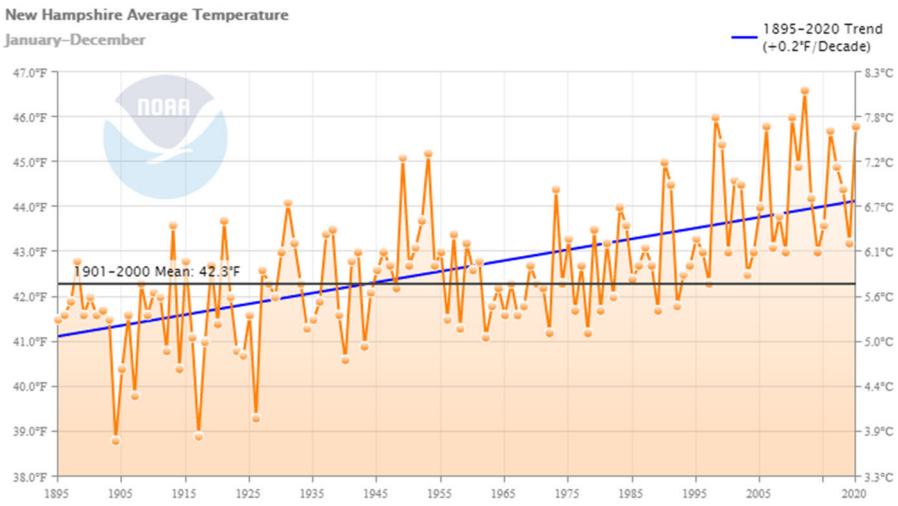
Air Pollution

New Hampshire has a network of 13 air quality monitoring stations that continuously monitor air pollutants. NHDES staff track progress in reducing air pollution and inform the public about air quality in their communities and any necessary health precautions. New Hampshire's regulated air pollutant levels have generally dropped since the 1970s, but air quality in many parts of the country still fails to meet health-based air quality standards. While the impact of climate change on the production of fine particulate matter pollution has been inconclusive, warmer temperatures associated with climate change will increase ozone production and ozone concentrations in urban areas. This is likely to lead to more pollution-related cardiorespiratory illness and death in the state.

Increased Temperature on Land

Temperature is one of the most used indicators for climate change. Historically, New Hampshire has been characterized by cold, snowy winters and mild summers but there has been significant evidence this seasonal definition is changing. According to data from the NOAA National Centers for Environmental Information, since the early 20th century, the average annual temperature in the state has increased by approximately 3°F, and state's maximum temperatures have increased between 0.5°F and 2.6°F. The state's temperature change has been continuously recorded at three meteorological stations in southern New Hampshire (Keene, Durham, and Hanover) for the last century and all three weather stations show consistent long-term minimum and maximum temperature increases. Overall, more than half of the state's warmest years on records have occurred since 1990.

Figure 3: NH Average Temperature Change (1895-2020)

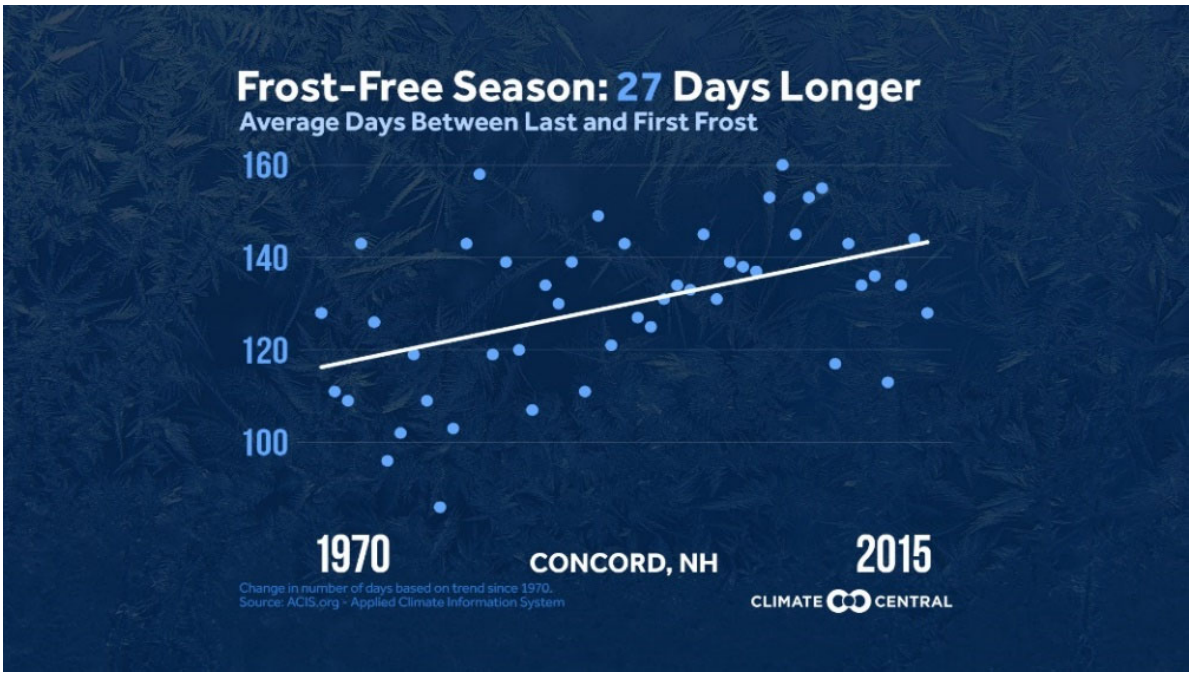


According to Wake et al. 2014, while the number of hot days has increased slightly across southern New Hampshire, there has been a dramatic increase in the rate of winter warming over the last four decades at all three stations, which may be linked to decreases in snow cover through changes in surface albedo, or reflectivity. In general, the number of hot days has increased slightly over the last five decades (+0.8 days per decade) and the number of cold days has reduced significantly. (-5.0 days per decade).

Changes in the distribution of hot and cold extreme temperatures can lead to the increased frequency, duration, and intensity of heat waves, increased nighttime warming, longer growing seasons, drought length and intensity, crop failure, and the expansion of suitable habitat for both Lyme disease-bearing ticks and invasive species such as the emerald ash borer.

According to the EPA, accompanying the rising temperatures is a steady lengthening of the United States' **growing season**. The average growing season has lengthened by two to five weeks across the U.S since the beginning of the 20th century, with a particularly large increase over the last 30 years. Since 1970, data collected in Concord, NH shows an increase of 27 days between the first and last frost of the year and in Southern New Hampshire, the growing season has increased by 10 days per decade since 1960.

Figure 4: Length of Frost-Free Season in Concord, NH, 1970-2015



As the Northeast is known for its long, cold winters, and warm to hot summers, this seasonality is an important cultural and economic driver of regional economies such as agriculture, commercial fishing, forest products, and tourism. Cold, snowy winters help support regional tourism such as fishing, hunting, and winter sports. Timber harvesting on wet sites often occurs in the winter when soils are frozen, or snow covered, and maple sugaring depends on sufficient cold winters for adequate sap quantities. Milder winters and early springs are adversely impacting the region's tourism, farming, and forestry activities.

The growing season determines what crops can be grown in a region and changes can have both positive and negative effects. While a longer season can allow farmers to diversify their crops or have multiple harvests from the same plot, it can also limit the types of crops grown, increase the heat stress on crops, encourage invasive species or weed growth, and increase pests and irrigation demands. Farmers will need to combat the northward expansion of the European corn borer and the Western corn root worm on their crops, and the warmer temperatures will likely allow the codling moth—an apple tree pest—to complete a third generation requiring additional insecticide applications.

Increased Temperature in the Ocean

Worldwide, ocean temperatures are also increasing. The Gulf of Maine is warming at an accelerating rate, three times as fast as the average global rate in the last three decades and seven times as fast in the last 15 years. In 2012, during the most intense ocean heat wave in the last three decades, sea surface temperatures in the Gulf of Maine were a record-breaking 69.98°F. These warming temperatures are having cascading effects on environmental and ecological patterns such as marine species migrating northward in search of colder waters, and are already impacting NH fishing grounds with the closure of the Gulf of Maine Shrimp Fishery based on depleted shrimp populations. These

changes also lead to higher levels of evaporation and greater moisture in the air, which contributes to more precipitation and extreme weather events.

As oceans grow warmer, **ocean acidification** increases as well. Several factors contribute to this, an important one being ocean absorption of carbon dioxide from human activity. Another factor is increased pollutants from wastewater and stormwater runoff in coastal waters, which increases net primary production, resulting in higher respiration and carbon dioxide which in turn furthers coastal acidification. Ocean acidification is important because carbonate ions—which are less abundant than hydrogen ions in the seawater—are important block structures for seashells and coral skeletons. Decreases in ions due to acidification make building and maintaining carbonate structures more difficult. Local researchers have recently begun to examine the effects of ocean acidification on marine species in the Gulf of Maine.

More Rainfall and Less Snow

As winter warms in New Hampshire, snowfall and snow cover will continue to decrease (See Increased Temperature on Land). Although snowfall amounts in recent winters have varied, overall snowfall has been decreasing at most monitoring stations and the number of snow-covered days is decreasing throughout the state. This is because as cold seasons warm, more precipitation falls as rain instead of snow. Precipitation across the region has increased in the last century, with the highest number of extreme precipitation events happening in the last decade. Between 1958 and 2010, the northeastern United States experienced a 70% increase in precipitation during heavy rain events. The statewide average for annual precipitation is 44.2 inches, with higher amounts in the southern and eastern parts of the state due to proximity to the Atlantic Ocean. This average in southeastern New Hampshire is projected to increase by 5-10% by mid-century and 7-15% by 2100—with a subsequent increase in flooding. The increase is expected to be greatest in the winter and spring, intermediate in the summer, and lowest in the fall.

These observations in total and seasonal precipitation are due to an increase in the intensity and frequency of individual precipitation events, with the Great Bay watershed showing a 15-38% magnitude increase of extreme daily precipitation since the 1950s. These large precipitation events have contributed to significant springtime flood events in coastal New Hampshire and are projected to increase the risk of future flooding. Extreme precipitation events also cause non-coastal flooding of rivers, streams, roadways, and active agricultural fields which can result in contamination of farmland soils by floodwaters as well as crop failure.

Drought

Drought is yet another prominent extreme weather event that is increasing due to climate change. In the 21st century, droughts have been characterized by hotter temperatures, longer durations, and greater spatial extent with recent years being punctuated by periods of moderate to extreme drought development. Droughts are also exacerbated by growing human demands on water resources. Drought conditions have historically been driven by sea surface temperatures, internal atmospheric variability, and land-atmosphere feedback, but human-caused climate change is increasingly affecting the frequency, intensity, and extent of droughts. While it is projected there will be increased precipitation in New Hampshire, the intensity of naturally occurring droughts is projected to increase as well. This is because higher summer temperatures will increase the rate of depletion of soil moisture during dry spells and the projected increases in average annual precipitation will take place primarily

during the winter and spring. Practically, this could look like rainier winters and springs with more extreme precipitation events and longer periods without precipitation more prone to drought in the summer and fall.

For example, over the past two decades, the state has experienced several significant periods of drought including in 2001-2002; 2015-2016, 2020; and most recently 2021. The most recent drought period only ended due to extreme precipitation in the month of July 2021. The NH Drought Management Program determined that the drought that impacted the state in the early 2000s was the third worst on record, and that recent droughts were due to a combination of a below average snowpack in the spring, little precipitation to recharge the groundwater, and the inability of watersheds to store large volumes of water due to their geology. With extreme variation in environmental conditions due to climate change, drought probability may grow in the future.

The large amount of water resources and relatively sparse population in New Hampshire have tended to minimize the impacts of drought events in the region, but this protection may be endangered in the future with increases in drought frequency or severity combined with population growth and increased development. Increased development means more impervious surfaces, and more impervious surfaces will contribute to additional precipitation runoff and less groundwater recharge during rain and flooding events. Impacts from climate change may cause a 10% increase in annual groundwater recharge rates in the New Hampshire coastal region over the next century; however, increases in impervious surfaces may reduce this recharge 5 to 10%. Land development associated with increases in demand due to population growth will also increase groundwater withdrawals for drinking water and will contribute to intensified groundwater depletion during droughts.

Species Migration and Invasive Species

The timing of biological events (bird migration, wildlife breeding, plant flowering and fruiting) is determined by variables such as seasonal temperature, food availability, and pollination. In the Northeast, flowering dates are occurring one week earlier than the mid-1800s and migratory birds are arriving and breeding earlier, revealing a shift in migratory patterns. Forests are a defining feature of New Hampshire and climate change has the potential to alter the forest species composition, distribution, abundance, and productivity – as well as their associated species— in several ways. While not uniform and depending on the suitable habitat characteristics for species (such as soils, elevation, latitude, and other factors), some tree species will experience decreases in suitable habitat, while others will see expansion of suitable habitat as the climate changes. Decreases in suitable habitat are projected to be greatest in Southern and Coastal New England.

While already a major threat to native New Hampshire ecosystems, nonnative plant and animal species are becoming more of a concern because of their increased potential to outcompete native species. Some nonnative species can establish themselves faster than native species because they lack competitors and are better able to respond to climate change-induced changes such as warmer temperatures, earlier springs, and reduced snowpack. Additionally, the warmer temperatures are likely to expand the ranges of certain invasive species that were previously limited by colder northern temperatures. Fewer days below freezing is leading to increases in rates of pest outbreaks and vector-borne diseases (disease that results from an infection transmitted to humans and other animals by blood-feeding anthropods, such as mosquitos, ticks, and fleas) such as Dengue fever, West Nile Virus,

Lyme disease, and malaria. All these factors can lead to a decline of natural species, increases in nonnative or invasive species, and a reduction in biodiversity.