

# CLIMATE+HEALTH

## Climate and Health Adaptation Plan for the Public Health Network of the Upper Valley

November 2015

Prepared by:  
Public Health Council of the Upper Valley  
With Assistance From:  
Upper Valley Lake Sunapee Regional Planning Commission

# Acknowledgements

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- Greg Norman and Wes Miller, Dartmouth-Hitchcock Community Health;
- Anne Duncan-Cooley, Upper Valley Housing Coalition (UVHC) and Upper Valley Strong;
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- Public Health Council of the Upper Valley partner organizations and communities.
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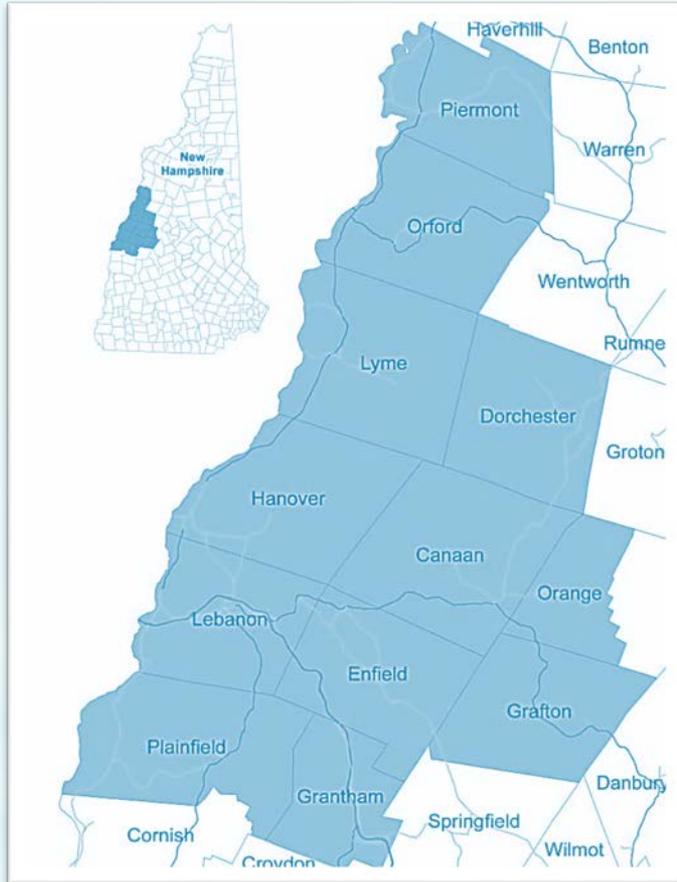
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### *About the Public Health Council*

The Public Health Council of the Upper Valley (PHC) is hosted in partnership with Dartmouth-Hitchcock Community Health.

The PHC is a group of organizations, municipalities, schools, advocates, and businesses working together to create a more healthy, safe, supportive, and vital Upper Valley. The PHC is one of thirteen Regional Public Health Networks in New Hampshire and is distinct in that its partner organizations serve communities in New Hampshire and Vermont.

The New Hampshire communities in the PHC's region are Piermont, Orford, Lyme, Hanover, Lebanon, Plainfield, Dorchester, Canaan, Enfield, Grantham, Orange, and Grafton.

[LINK TO PHC WEB PAGE](#)

# Executive Summary

The CLIMATE+HEALTH initiative seeks to increase community and individual resilience to the health impacts of climate change starting with this Upper Valley Region Climate and Health Adaptation Plan.



*Slayton Hill, Lebanon (2013)  
Photo: UVLSRPC*

## **Regional Assessment**

The regional assessment included:

- Analysis of regional geography and demographics;
- Review of existing preparedness and hazard mitigation plans and related reports (reference material on back page);
- Identification of region-specific climate risks and vulnerable populations;
- Determination of effective short-term interventions.

## **Climate Risks**

The increased likelihood of extreme heat and severe weather events will have negative health impacts.

## **Health Vulnerabilities**

Diminished access to health care or decreased quality of life due to weather events brought about by climate change.

## **Affected Populations**

This plan focuses on the region's senior population; many of whom live in rural areas and require assistance to maintain a good quality of life.

## **Interventions and Outcomes**

This Plan identifies three focus areas for short-term interventions to increase community and individual resilience to the health impacts of climate change within one year:

### **Outreach, Education, Training**

Develop a coordinated and consistent education and outreach program among partners at multiple operational levels from public education to specialized training for partner organizations.

### **Partnerships**

Strengthen existing healthcare and preparedness partnerships. Identify and engage new partners to improve regional capacity and fill gaps in service.

### **Health Data**

There is very limited health-care data correlated to climate change indicators and no effective data specific to the region. Develop methodologies to collect and analyze health data to create a baseline and track trends to evaluate the effectiveness of recommended interventions.

# Introduction

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Historically, most New Hampshire communities have had to recover from floods, winter storms, hurricanes, and other natural disasters. These events are not new to New Hampshire residents and some pride themselves in their resilience, or their ability to recover quickly and thrive. Changing climatic conditions will have significant long-term impacts on quality of life factors including community health.

CLIMATE+HEALTH seeks to begin helping communities, organizations, and individuals develop methods to adapt to the negative health impacts of climate change.

This Climate and Health Adaptation Plan identifies measurable, short-term solutions to climate-related health concerns for particularly

vulnerable populations in the region. This Plan presents an approach to support a more resilient region with improved community health in the context of the region's geography, demographics, and anticipated health concerns in the face of a changing climate.

This plan seeks to:

- Identify climate-related health risks and likely impacts to vulnerable populations;
- Evaluate baseline data that would help track climate and health changes to identify health trends and quantify the effectiveness of interventions and outcomes;
- Initiate the process of a broader action plan for community and individual resilience and improved health.

## *New Hampshire State Climate Action Plan*

This climate and health adaptation initiative is an outgrowth of the 2009 NH State Climate Action Plan ([available online](#)) through its recommendation that the public health community identify and protect the vulnerable populations at risk for climate impacts. The 2009 plan recommends:

- Public health and emergency response agencies collaborate with other agencies and organizations to develop effective public outreach;
- Partner organizations share relevant data and information;<sup>33</sup>
- Educate and empower public health officials to prepare for health-related and social impacts resulting from climate change.

# Introduction

## *CLIMATE+HEALTH Partners*

The CLIMATE+HEALTH initiative begins with this Plan and will rely on regional partners to follow the Action Plan and recommendations. This project work is the product of close collaboration among PHC partners and new partner organizations who share a common interest in addressing climate change and its impacts upon community health and quality of life in the Upper Valley.

- Dartmouth-Hitchcock Medical Center
- Public Health Council of the Upper Valley
- Regional Coordinating Committee for Emergency Preparedness
- Upper Valley Adaptation Workgroup
- Upper Valley Lake Sunapee Regional Planning Commission
- Upper Valley STRONG
- NH DHHS, Division of Public Health Services
- NH Department of Environmental Services

## *Project Timeline*

Plan development and engagement with partner organizations followed an accelerated schedule from June to September 2015.

## *Anticipated Next Steps*

With this plan, CLIMATE+HEALTH partners can begin short-term interventions immediately. Certain interventions will be easy to complete and others may prove more challenging. Measures of community health resilience and adaptation will be critically important. Regional health outcomes will take time to measure, and often take many years to change.

**JUNE 2015**

- Develop project work plan
- Review background materials and support documents
- Assemble Project Advisory Team and identify project partners
- Review background information and local planning documents
- Engage Public Health Council and UVAW
- Evaluate local climate risks to public health

**JULY 2015**

- Ongoing outreach and coordination with partners and Project Advisory Team
- Identify vulnerable populations and health outcomes of concern
- Assess interventions and feasibility

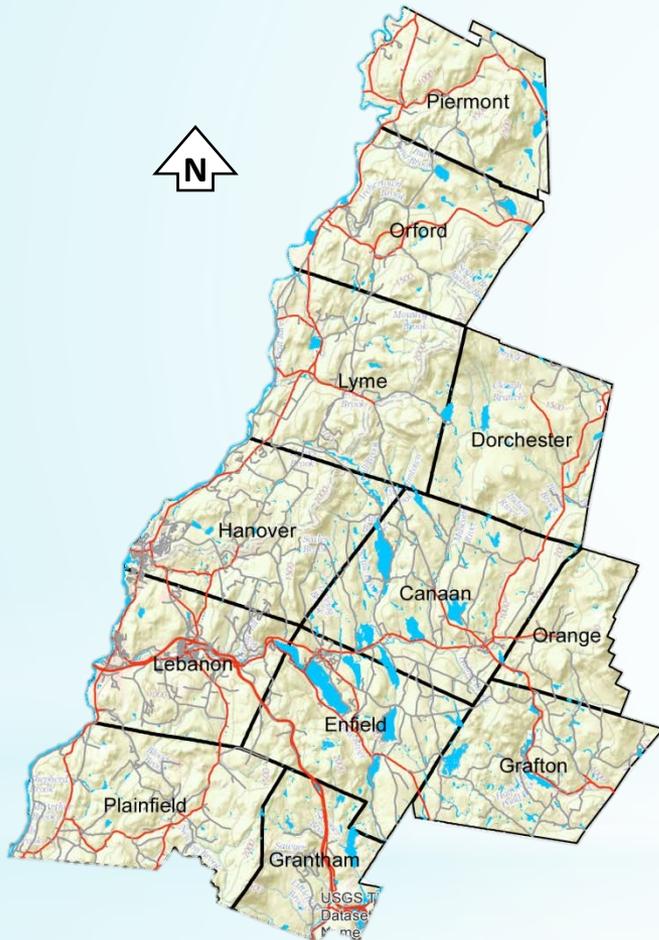
**AUGUST 2015**

- Review draft plan, target populations, outcomes, interventions with Project Advisory Team
- Present draft to PHC and UVAW for response and discussion surrounding interventions

**SEPTEMBER 2015**

- Final Plan development
- Final review of vulnerable populations, health outcomes, and interventions with PHC and UVAW

# Regional Overview - Geography



CLIMATE+HEALTH Project Area

The PHC service area includes 12 municipalities in Grafton and Sullivan counties. Half of these communities form part of New Hampshire’s western border along the Connecticut River where there are relatively level swaths of highly productive agricultural land. The landscape transitions eastward into hills with steep slopes, and generally more rocky soils and ledge.

As land development expanded since the 1700’s the region’s physical geography limited the type of development:

- Industrial communities, like Lebanon and Enfield, formed along rivers to harness the water power;
- Larger farms occupied the lands adjacent to the Connecticut River;
- The remaining lands consisted of low density, principally agrarian and residential uses around small village centers.

Development patterns during the post-industrial decades generally reflect the established settlement patterns. Lebanon and Hanover form a regional population and employment center and, with the exception of the Connecticut River Valley where agricultural uses are still prominent, the remainder of the Region is largely forested land, with scattered farms and low density residential development.

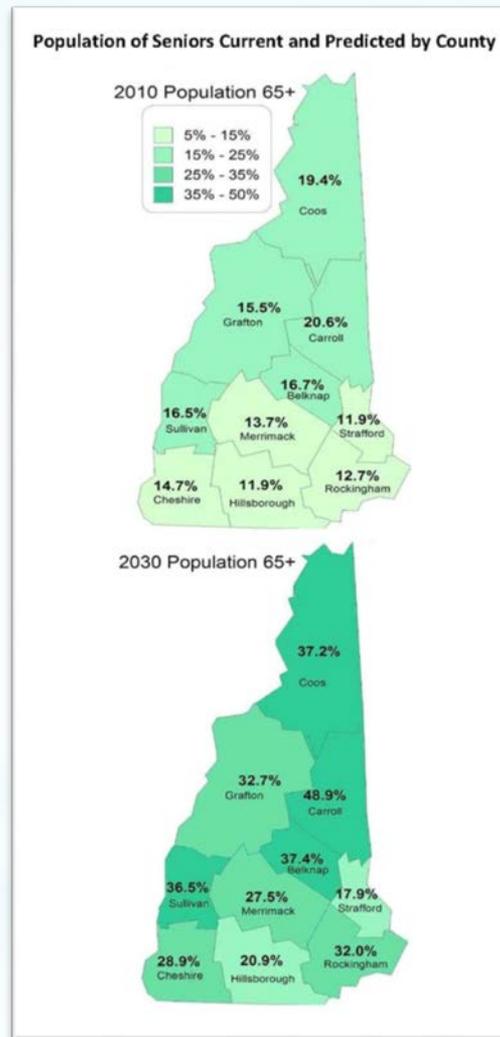
Most residences are scattered along rural roads with limited utility services at varying levels of repair. These lower density rural areas tend to have a proportionately high elderly population (see the analysis maps in the Appendix). In a geographic context these rural areas are more vulnerable to the negative impacts of flooding or extreme weather events because there is little or no redundancy in the infrastructure. A damaged road, power line, or telephone line may isolate individuals from essential health services.

# Regional Overview - Demographics

At the time of the 2010 U.S. Census, nearly 15% of New Hampshire citizens were over the age of 65. In the Upper Valley, 17% of residents are over 65 years old. This population cohort will rise steadily as “baby boomers” age over the next 25 years.

Demographic projections indicate the proportion of senior citizens in the region will double by 2040.

Senior populations are broadly distributed in the service area with relatively higher senior populations in the rural communities. For example, Grantham will likely have a higher concentrations of seniors; likely attributable to an attractive retirement lifestyle communities, access to health and community services, proximity to essential services. In its report, [Senior Housing Perspectives \(2014\)](#), the NH Center for Public Policy Studies reported on the trend that this aging population will, “age in place.”



With few public transportation options outside of the Lebanon-Hanover employment center, those who do not drive or own a vehicle will be unable to access health care, community services, and other activities without outside assistance. Growing demand for services that support seniors aging in place avoids the much higher costs of providing institutional care, but also exposes the aging population to isolation in rural areas.

	PHC Total Pop	Pop 65 yrs +	Percent 65 yrs +
2010 Census	44,020	7,568	17%
2015 Est.	44,015	9,098	21%
2025 Est.	45,463	13,354	29%
2040 Est.	46,676	16,727	36%

*Population estimates based on [projections prepared by NH OEP.](#)*

# Regional Overview - Climate Change

There is a substantial body of scientific and planning studies addressing the impacts of climate change on New Hampshire (see the Reference Material at the end of this report). The region's residents are witness to the impacts of climate change trends with broad and complex impacts to the natural and cultural landscapes.

CLIMATE+HEALTH focuses on the core impacts climate change will likely have on public health. A broader review of climate change effects upon the region is available in the reference documents listed at the end of this report.

Overall, southern New Hampshire has been getting warmer and wetter over the last century, and the rate of change has increased over the last four decades. Historic trends and climate model forecasts track a broad range of likely outcomes for climate change. Public health impacts can be associated with the following climate change indicators:

## *Temperature*

### Historic Trends:

- Average annual maximum temperatures have warmed 1.1 to 2.6°F (depending on the station) with the greatest warming in winter (1.6 to 3.4°F).
- The number of days with minimum temperatures less than 32°F has decreased.
- The length of the growing season is two to four weeks longer.

### Projected Trends:

- Mid-century annual average temperatures may increase 3 to 5°F, and end-of-century annual average temperatures may increase 4 to 8°F.
- Average summer temperatures may be up to 11°F warmer (compared to the historical average from 1980 to 2009).
- The frequency of extreme heat days is projected to increase dramatically.
- Extreme cold temperatures are projected to occur less frequently, and extreme cold days will be warmer.

### Likely Health Impacts:

- Longer growing seasons will affect individuals with allergies, asthma, and cardiovascular illnesses by increasing the duration and severity of pollen events.
- As the region's landscape changes with development increased air pollution (e.g. emissions from vehicles and commercial/industrial sources) will affect individuals with asthma and cardiovascular illnesses.
- Increased number and severity of hot days will result in increased incidents of heat mortality and morbidity.
- Northward expansion of insects due to regional warming increases exposure to vector borne diseases (e.g. Lyme disease, Eastern Equine Encephalitis) and other pathogens.

# Regional Overview - Climate Change & Temperature

Indicators	Historical* 1980-2009	Change from historical (+ or -)					
		Short Term 2010-2039		Medium Term 2040-2069		Long Term 2070-2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
<b>Minimum Temperature (°F)</b>							
Annual TMIN	34.5	1.7	2.0	2.9	5.1	3.8	8.8
Winter TMIN	12.8	2.3	2.6	3.6	5.6	5.0	9.3
Spring TMIN	31.2	4.0	2.5	5.6	5.2	6.8	8.5
Summer TMIN	54.9	1.6	2.2	2.8	5.6	3.5	9.8
Fall TMIN	35.3	0.3	1.7	0.6	5.0	1.1	8.3
<b>Maximum Temperature (°F)</b>							
Annual TMAX	57.2	1.7	1.7	3.0	4.8	4.1	8.3
Winter TMAX	33.4	1.7	1.6	2.5	3.5	3.6	6.1
Spring TMAX	55.7	2.5	1.5	4.9	4.7	6.6	8.7
Summer TMAX	79.6	1.8	2.1	3.3	5.7	4.1	9.6
Fall TMAX	59.7	0.9	1.7	1.3	5.3	1.5	8.6
<b>Temperature Extreme (days per year)</b>							
<32°F	164.0	-9.5	-10.9	-15.8	-25.5	-19.5	-43.9
<0°F	16.0	-7.0	-5.1	-7.8	-10.6	-9.0	-14.2
>90°F	6.7	4.2	5.2	11.1	21.7	16.2	47.3
>95°F	1.0	0.8	1.2	2.7	7.0	5.1	21.8
<b>Temperature Extreme (°F)</b>							
TMAX on hottest day of year	93.1	1.8	1.4	3.0	4.8	4.6	9.0
TMIN on coldest day of year	-15.8	4.0	4.4	6.2	10.2	8.0	17.4
<b>Growing Season (days)</b>	162.0	11.1	12.0	17.0	28.6	20.4	48.7

Climate Grid from [Climate Change in Southern NH](#) (2014) with historic and projected temperature trends. Discussion of modeling a climate future on Page 9.

# Regional Overview - Climate Change & Precipitation

## Precipitation

### Historic Trends:

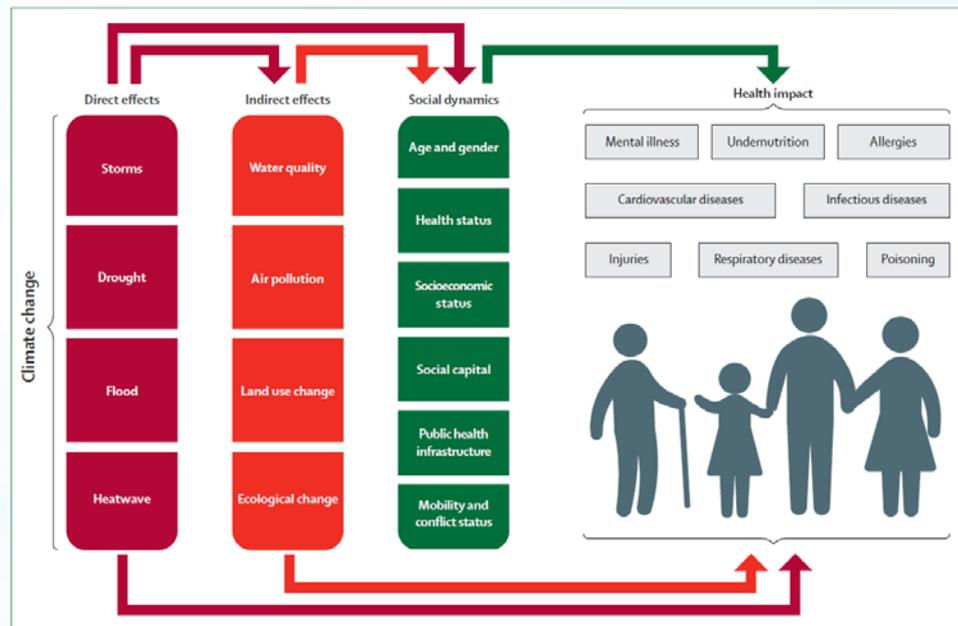
- Annual precipitation has increased 12 to 20 percent.
- Extreme precipitation events have increased across the region, which are evident from Federally declared disasters statewide over the last 20 years.

### Projected Trends:

- Annual average precipitation is projected to increase 17 to 20 percent by end-of-century.
- Extreme weather events will likely occur more frequently and with more severity.
- The frequency of extreme precipitation events may increase significantly. Under the high emissions scenario, storm events that drop more than four inches of precipitation in forty-eight hours are projected to increase two- to three-fold by the end of the century.

### Likely Health Impacts:

- Increased exposure to injury or death during or immediately after an extreme weather event.
- Increased likelihood of individual isolation in rural areas - lost access to health care and services.
- Water and food-borne diseases after an event.
- Increased respiratory illnesses due to poor indoor air quality because of post-flood mold or dust.
- Exposure to hazardous materials in flood sediment.
- Mental health impacts from stressors of forced relocation, personal loss of property, and/or post traumatic stress disorder.



Direct and Indirect Impacts of Climate Change on Health and Wellbeing

Source: [Health and Climate Change](#), 2015, The Lancet Commissions

# Regional Overview - Climate Change & Precipitation

Indicators	Historical* 1980-2009	Change from historical (+ or -)					
		Short Term 2010-2039		Medium Term 2040-2069		Long Term 2070-2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
<b>Precipitation (inches)</b>							
Annual mean	43.8	4.3	3.1	5.4	5.9	7.4	8.8
Winter mean	9.8	1.2	0.9	1.5	1.5	2.1	2.9
Spring mean	10.9	1.1	1.1	1.7	1.6	2.1	2.7
Summer mean	11.4	1.7	1.0	1.3	2.0	2.2	1.6
Fall mean	11.6	0.5	0.2	1.0	0.9	1.1	1.6
<b>Extreme Precipitation (events per year)</b>							
1" in 24 hrs	10.4	1.6	1.6	2.2	2.8	2.9	4.3
2" in 48 hours	3.7	2.0	2.0	1.0	3.0	1.5	4.2
<b>Extreme Precipitation (events per decade)</b>							
4" in 48 hours	4.3	2.6	0.7	3.9	4.0	6.1	7.6
<b>Snow-Covered Days</b>	105	-9.6	-16.3	-15.0	-37.1	-23.7	-52.9

Climate Grid from [Climate Change in Southern NH](#) (2014) with historic and projected precipitation trends.

*Climate Change in Southern New Hampshire* modeled future climate projections for southern New Hampshire simulated temperature and precipitation from four Global Climate Models and adjusted to New Hampshire using regional historical weather observations. These future climate projections followed two:

**Lower Emission Scenario:**

Global improvements in energy efficiency and development of renewable energy results in reduced emissions of heat-trapping greenhouse gases below 1990 by the end of the twenty-first century.

**Higher Emissions Scenario:**

Fossil fuels are assumed to remain a primary energy resource and emissions of heat-trapping greenhouse gases grow to three times those of today by the end of the century.

# Health Impacts of Tropical Storm Irene



*Photo: Kerosene oil release in a Waterbury mobile home park. Source: Vermont ANR Spill Team*

In late August 2011, Tropical Storm Irene pummeled the slopes and valleys of Vermont with heavy rain and wind. Rainfall totals of 3-5" were recorded throughout the state. Ten of Vermont's 17 major river basins experienced intense flooding. Major floodwaters and debris poured through river ways and communities, from the Mad River valley south to the Deerfield River, affecting 225 municipalities. In many areas, flood levels reached or exceeded those of the historic 1927 flood.

As is the case throughout New England, climate data show that Vermont is experiencing more extreme rain events, which is predicted to continue. The impacts of Tropical Storm Irene provide some insight surrounding such challenges to communities. Beyond the damage to roads, bridges, state facilities, and private residences, the flooding brings with it significant public health impacts.

## *Public health impacts of Tropical Storm Irene*

- Contamination of public water systems infiltrated by waste water
- Destruction of public water systems and broken pipes affected public water supplies
- Contamination of submerged wells with chemicals or pathogens
- Exposure to hazardous waste and fuel spills
- Injuries and drowning
- Gastrointestinal diseases caused by viruses, bacteria and protozoa in contaminated water
- Asthma attacks from greater amounts of pollen, dust, and mold spores in damaged housing
- Mental health impacts related to stress, anxiety, sleeplessness, and substance abuse

# Climate Risks and Health

Projected climate change will have complex and significant impacts on the natural landscape, ecosystems, communities, and social networks. CLIMATE+HEALTH conducted an assessment of known plans and reports that address similar challenges.

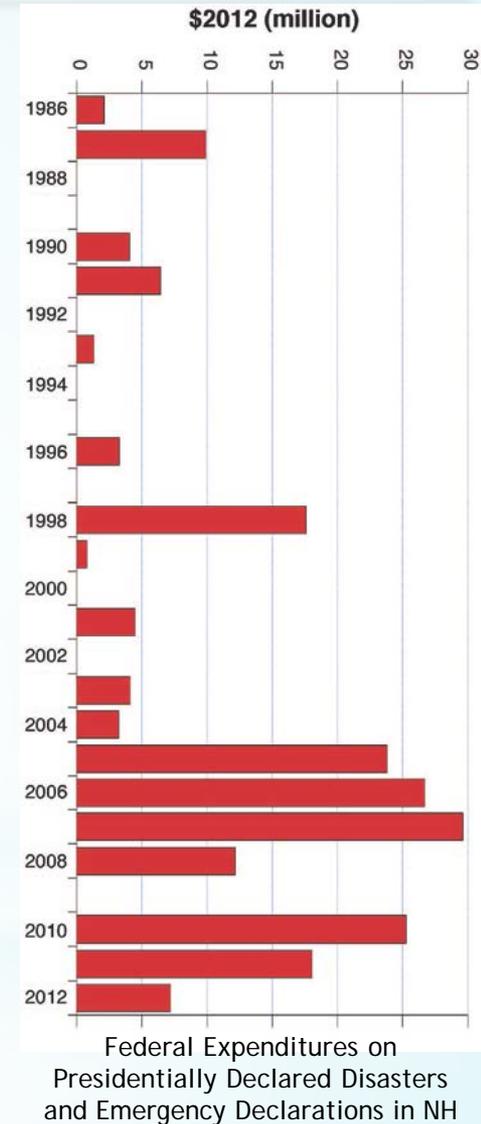
The community Hazard Mitigation Plans tend to identify flooding and

severe weather events, like winter storms, among the highest risk natural hazards. Climate models project severe weather events will become more severe and frequent.

This is consistent among climate change studies. A detailed analysis of federally declared disasters from 1986 to 2012 indicate a historic trend corroborating this position.

Town	NFIP Participant	Current Plan on File	Next Update
Canaan	Y	2011	2016
Dorchester	Y	2014	2019
Enfield	Y	2009	In Review
Grafton	N	Never Done	-
Grantham	Y	2008	In Process
Hanover	Y	2015	2020
Lebanon	Y	2010	2015
Lyme	Y	2011	2016
Orange	N	2010	2015
Orford	Y	2010	2015
Piermont	Y	2012	2017
Plainfield	Y	2014	2019

Summary of Community Participation in the National Flood Insurance Program (NFIP) and Hazard Mitigation Plans



# Health Vulnerability Assessment

The Upper Valley is becoming more vulnerable to extreme heat events, extreme precipitation events, as well as, severe weather events.

The following tables provide a detailed evaluation of eight unique climate-related health burdens, or vulnerabilities. Project partners participated in a vulnerability assessment and provided input and guidance for most of the listed priorities. Some of the vulnerabilities were not identified by partners, but were included in reference documents and identified as low priority health vulnerabilities to the region, which should be considered in long-term planning efforts.

Prioritizing health vulnerabilities was based on a qualitative assessment process that considered likely impacts to the region considering characteristics in the regional overview.

The three high priority health vulnerabilities for the region are:

- Increasing hospitalizations and deaths from extreme heat events;
- Increased incidents of injury and exposure to disease and contaminants after extreme weather events;
- Increased negative impacts to mental health due to isolation and stress from the above.



# Health Vulnerability Assessment

CLIMATE EXPOSURE OR VULNERABILITY	PATHWAYS – DIRECT & INDIRECT	HEALTH EFFECTS & IMPACTS	EVIDENCE FOR RELEVANCE TO YOUR REGION	DATA SOURCE FOR YOUR REGION	PRIORITY FOR YOUR REGION
Increasing occurrence of extreme heat events from increasing temperature (increase in days over 90°F)	Increase indoor & outdoor heat, people without cooling and outdoor workers suffer heat stress	Heat stroke, heat cramps, heat exhaustion, death, exasperation of chronic illness (e.g. respiratory, renal, and cardiovascular disease)	Climate models forecast the number of days in excess of 90°F may double by 2040 and triple by the end of the century	Climate Change in Southern New Hampshire, 2014; Vermont Climate Change Health Effects and Adaptation, 2011	<b>High Priority</b> – health impacts likely for the general population and likely severe impacts on vulnerable populations
Increased extreme precipitation and occurrence of extreme weather events	Increase in days with heavy rain or snowfall (likely to be unpredictable), resulting in flooding, power outages, disruption of services, contaminated water supplies, release of hazardous materials into floodwaters	Injury, drowning, death, water- and food-borne infectious diseases, carbon monoxide poisoning, respiratory illnesses from mold in buildings, exposure to hazardous materials in sediment, food and water insecurity, mental health impacts	Increased frequency of extreme weather events in New Hampshire and Vermont; location and scale of impacts unpredictable; recent events within region and adjacent regions indicate likely future occurrences	Climate Change in Southern New Hampshire, 2014; Climate Change and Human Health in New Hampshire, 2014; Lessons Learned from Irene: Building resiliency as we rebuild, 2012; Vermont Climate Change Health Effects and Adaptation, 2011	<b>High Priority</b> – extreme and severe weather events can have significant short-term and long-term health effects
Threats to mental health	Direct effects of post-disaster impacts on mental health, indirect effects of climate-induced stress from post-disaster economic and social stressors	Individuals with existing mental illnesses and vulnerable populations most impacted by stresses from property or personal losses, displacement, and financial burdens	Anecdotal evidence shared by individuals involved in recovery efforts, no effective data addressing mental health impacts of extreme weather events	Climate Change and Human Health in New Hampshire, 2014; Tropical Storm Irene: A Retrospective on Mental and Emotional Impacts on Vermont Communities, Three Years Later, 2014	<b>High Priority</b> – project partner experience with past events indicated climate change-related events negatively impact mental health, particularly among vulnerable populations

# Health Vulnerability Assessment (cont.)

CLIMATE EXPOSURE OR VULNERABILITY	PATHWAYS – DIRECT & INDIRECT	HEALTH EFFECTS & IMPACTS	EVIDENCE FOR RELEVANCE TO YOUR REGION	DATA SOURCE FOR YOUR REGION	PRIORITY FOR YOUR REGION
Longer Growing Seasons	Increase in the number of days over 32°F, allergic plants bloom earlier and later, people inhale greater amounts of pollen and/or more days of exposure	Aggravation of respiratory diseases, increasing asthma occurrence and severity, changing timing and duration of hay-fever	No air quality and/or pollen-related data being collected in the region; findings based on national and international research	Climate Change in Southern New Hampshire, 2014; Climate Change and Human Health in New Hampshire, 2014; Vermont Climate Change Health Effects and Adaptation, 2011	<b>Moderate Priority</b> – important to track health indicators and air quality to correlate trends
Longer Growing Seasons	Increase in the number of days over 32°F, extended season for disease vectors like ticks or mosquitoes, potential increase in rodent populations exposing people to more pathogens	Lyme and West Nile Virus diseases, rodent urine, fecal, and saliva-related asthma and viral diseases, other possible diseases that occur in warmer climates may occur in the region	Incidence of diseases increasing with climate change trends; limited data available on the regional level	Climate Change in Southern New Hampshire, 2014; Climate Change and Human Health in New Hampshire, 2014; Vermont Climate Change Health Effects and Adaptation, 2011	<b>Moderate Priority</b> – health and climate data tracking necessary to evaluate trends
Water and food security, food and water-borne diseases	Direct effects for loss of food sources or quality of food, flooding may contaminate wells and other water supplies, power outages can cause food spoilage and introduce pathogens	Crop contamination, increased food-borne diseases, food and water insecurity, water supply contamination, pathogens may cause outbreaks among population	No effective data available	Climate Change and Human Health in New Hampshire, 2014; Vermont Climate Change Health Effects and Adaptation, 2011; Lessons Learned from Irene: Building resiliency as we rebuild, 2012	<b>Moderate Priority</b> – severe weather events and water supply outages have significant impacts on other facets of regional health

# Health Vulnerability Assessment (cont.)

CLIMATE EXPOSURE OR VULNERABILITY	PATHWAYS – DIRECT & INDIRECT	HEALTH EFFECTS & IMPACTS	EVIDENCE FOR RELEVANCE TO YOUR REGION	DATA SOURCE FOR YOUR REGION	PRIORITY FOR YOUR REGION
Decreased air quality	Increase in ozone pollution, people inhale pollutants	Aggravation of other respiratory diseases, increased asthma occurrence	Limited Air quality, ozone, and other particulate pollutants are not actively monitored in this region; ozone and air pollution are not immediate health concerns	Climate Change and Human Health in New Hampshire, 2014; Vermont Climate Change Health Effects and Adaptation, 2011	<b>Low Priority</b> – long-term health burden to track along with likely changes in air quality as regional development patterns change; two days or fewer each year exceeding NAAQS in Grafton County (WISDOM, 2003-2008)
Increasing duration and intensity of UV radiation from ozone depletion.	Increase in warm days for sun bathing, people expose skin to sunlight more often	Skin cancer, cataracts	Grafton County identified as having highest incidence of melanoma in NH; incidence of melanoma significantly increases with age, but incidence rates for all ages not increasing over time	Vermont Climate Change Health Effects and Adaptation, 2011; NH Health WISDOM online database	<b>Low Priority</b> – important issue for community health, but connection between rates of incidence is complex and difficult to quantify; specific issue not identified by project partners
Seasonal surface water quality due to increasing water temperature	Increased exposure to water-borne microbes or toxic conditions affecting swimmers and recreational water users	Microbiologic gastrointestinal diseases from viruses or bacteria; blue-green algae bloom-related poisoning	Increasing concern for New England states	Vermont Climate Change Health Effects and Adaptation, 2011	<b>Low Priority</b> – specific issue not identified by project partners

# Affected Populations

CLIMATE+HEALTH programs will, over time, promote health interventions to make individuals and communities more resilient to the impacts of climate change. This plan focuses on those populations likely to be most affected by climate change-related health threats.

The Health Vulnerabilities Assessment identified increasing exposure to extreme heat and severe weather events as priority issues in the region. An assessment of the most affected populations considered those most impacted by these high priority vulnerabilities.

The assessment relied heavily on geographic information and analyses using readily available demographic information from the US Census and the NH Social Vulnerability Index. Primary health data sources, including the NH DHHS Health WISDOM online database, have limited data at the PHC or community level.

Additional input from project partners was based on specific

extreme weather emergency response and recovery experience.

The principal findings of this assessment found the most affected populations from a climate change-related event would be the elderly and lower income populations.

## Elderly Population

Regionally there is a significant proportion of 65+ yr. old residents who are aging in place. Given the rural character of the region climate-related risks include:

- Isolation if a severe weather event damages roads or utilities
- Loss of medical services for the chronically ill
- Exposure to water and food-borne illnesses.

## Lower Income Population

Tropical Storm Irene revealed an important fact: residents with limited financial resources cannot recover quickly from losses sustained from a severe weather event. This makes lower income populations particularly vulnerable.



*Photo: Jennifer Hauck, Valley News*

## **Flash Floods Hammer Lebanon**

A severe rainstorm on July 2, 2013 caused flash flooding throughout Lebanon and other communities in the region. The sudden high volume run-off from the rain caused significant wash-out damage to the Slayton Hill Road and a recently completed affordable housing complex.

While there were no injuries during the event, it took weeks to restore the housing complex and re-establish the displaced residents and years to reconstruct Slayton Hill Road.

Such events can cause significant stress and could exacerbate existing mental illness among displaced residents.

# Affected Populations - Elderly, Lower Income

CLIMATE EXPOSURE OR VULNERABILITY	PATHWAYS – DIRECT & INDIRECT	HEALTH EFFECTS & IMPACTS	VULNERABLE POPULATIONS AND PLACES	EVIDENCE OF RISK FOR FOCUS POPULATIONS	LOCATIONS OF POPULATIONS AT RISK
Increasing occurrence of extreme heat events from increasing temperature (increase in days over 90°F)	Increase indoor & outdoor heat, people without cooling and outdoor workers suffer heat stress	Heat stroke, heat cramps, heat exhaustion, death, exasperation of chronic illness (e.g. respiratory, renal, and cardiovascular disease)	People with lower income, elderly, those living alone or isolated or without AC. People with asthma, or COPD FOCUS POPULATIONS: <b>Elderly and lower income population</b>	<b>SOCIAL VULNERABILITY INDEX (SVI):</b> <ul style="list-style-type: none"> <li>Population 65 yrs +</li> <li>Population living below poverty level</li> </ul> <b>OTHER DATA:</b> <ul style="list-style-type: none"> <li>Housing units more than 30 years old</li> </ul>	Rural areas where there is greater likelihood of isolation and loss of services if there is a power outage; housing age and quality may affect personal or household resilience
Increased extreme precipitation and occurrence of extreme weather events	Increase in days with heavy rain or snowfall (likely to be unpredictable), resulting in flooding, power outages, disruption of services, contaminated water supplies, release of hazardous materials into floodwaters	Injury, drowning, death, water- and food-borne infectious diseases, carbon monoxide poisoning, respiratory illnesses from mold in buildings, exposure to hazardous materials in sediment, food and water insecurity, mental health impacts	People with lower income and elderly, unprotected water supply systems for individual households or communities, residents on isolated rural roadways FOCUS POPULATIONS: <b>Elderly and lower income population</b>	<b>SVI:</b> <ul style="list-style-type: none"> <li>Population 65 yrs +</li> <li>Population living below poverty level</li> </ul> <b>OTHER DATA:</b> <ul style="list-style-type: none"> <li>Floodplains (FEMA Mapping)</li> <li>Location of households in floodplains (no data available)</li> <li>Non-redundant road network</li> </ul>	Rural areas where there is greater likelihood of isolation and loss of services if extreme weather event causes road closures (e.g. wash-outs or blizzard conditions), power outages and/or loss of communications due to downed overhead utilities
Threats to mental health	Direct effects of post-disaster impacts on mental health, indirect effects of climate-induced stress from post-disaster economic and social stressors	Individuals with existing mental illnesses and vulnerable populations most impacted by stresses from property or personal losses, displacement, financial burdens	People living in disaster affected areas or otherwise directly impacted by an event, individuals with existing mental illness FOCUS POPULATIONS: <b>Elderly and lower income population</b>	<b>SVI:</b> <ul style="list-style-type: none"> <li>Population under 65 without health insurance</li> <li>Population living below poverty level</li> <li>Population with a disability</li> </ul> <b>OTHER DATA:</b> <ul style="list-style-type: none"> <li>Reports summarizing mental health impacts of extreme weather events</li> </ul>	Rural areas have relatively higher populations vulnerable to threats to mental health including likely existing mental illness and personal or household resilience (lower income households have lesser capacity for resilience)

# Interventions and Outcomes

CLIMATE+HEALTH focuses on increasing regional resilience to the health impacts of climate change. This assessment focuses on short-term interventions and outcomes for the target vulnerable population.

The regional assessment and analysis of interventions and outcomes revealed:

- There are significant opportunities for multi-sector partnerships to increase regional resilience.
- Regional emergency response and affiliated agencies address the primary impacts of a severe weather event (e.g. - injury, evacuation, short-term housing and health care).
- Recent experience with Tropical Storm Irene and other localized events reveals there is a need to broaden community and organizational preparedness for long-term recovery efforts.

## *Principal Interventions*

This Climate and Health Adaptation Plan identifies three focus areas for short-term interventions to increase community and individual resilience to the health impacts of climate change.

### **1) Outreach, Education, and Training**

Develop a broad, coordinated education and outreach program among health care, preparedness, and resilience partners at multiple operational levels. This includes multi-media outreach for the public (e.g. public health announcements, severe weather alerts, recommended actions to mitigate impacts), resilience trainings for regional partners, specialized trainings for organizations serving target populations.

### **2) Partnerships**

This resilience effort spans beyond this initiative or any other individual organization. It is important to strengthen relationships with existing partner

organizations and engage new partners to avoid unnecessary organizational overlap and redundancy. Identifying key stakeholders (both existing PHC partners and others) with a gap analysis would be an important first step.

### **3) Health Data**

Guidance documents for this plan stressed the need to quantify likely health outcomes due to the recommended interventions. Unfortunately, there is very limited health-related data correlated to weather events or other climate change indicators; particularly for the high priority vulnerabilities identified in this assessment. It is necessary to establish a baseline of health and climate data, and then to track that data over time to evaluate the effectiveness of future interventions. ReThink Health of the Upper Connecticut River Valley is assessing a regional health measurement system and may be able to inform statewide data development programs by DHHS.

# Interventions and Outcomes

ENVIRONMENTAL EXPOSURE	HEALTH EFFECTS & IMPACTS	BASELINE PUBLIC HEALTH DATA	GOAL FOR REDUCTION IN PUBLIC HEALTH IMPACTS	INTERVENTION TYPE Primary, Secondary, Tertiary	INTERVENTION STRATEGY	INTERVENTION ACTIVITY
Increased exposure and excess heat (increase in days over 90°F) from 200% to 400%	Increased heat stress leads to heat-related hospital admissions, injury, and death	Average count of 125 heat-related hospital visits per year (1998-2009) NH WISDOM online database	Reduce rate of heat-related hospital visits by 50% in the region before 2020	Primary, Secondary	Increase awareness of heat-related illness and ways to prevent it	<ul style="list-style-type: none"> <li>Public outreach and education through training and media</li> <li>Training for regional partner organizations</li> </ul>
				Primary, Secondary	Improve personal resilience to extreme weather events	<ul style="list-style-type: none"> <li>Sponsored home weatherization for vulnerable populations</li> <li>Develop local partnerships for community-based relief centers</li> </ul>
				Secondary	Increase tracking of at risk populations during extreme weather events	<ul style="list-style-type: none"> <li>Continued home check-ups by organizations conducting home visits</li> <li>Train regional communities in local practices to identify and track local vulnerable populations</li> </ul>
				Secondary	Improve tracking of heat-related illnesses	<ul style="list-style-type: none"> <li>State and regional partners develop data collection and tracking standards</li> </ul>

# Interventions and Outcomes (cont.)

ENVIRONMENTAL EXPOSURE	HEALTH EFFECTS & IMPACTS	BASELINE PUBLIC HEALTH DATA	GOAL FOR REDUCTION IN PUBLIC HEALTH IMPACTS	INTERVENTION TYPE Primary, Secondary, Tertiary	INTERVENTION STRATEGY	INTERVENTION ACTIVITY
Increased health impacts from loss of basic services and/or isolation due to extreme weather events causing degraded quality of life	Increased risk of degraded health due to untreated chronic illness or personal disability where utility services (e.g. electric & telephone) and/or home care visits are necessary, mental and emotional stress for affected populations	Reported cases of isolation and health needs not being met (no data available at this time)	Reduce incidents where vulnerable populations are isolated from necessary health care (no metric at this time)	Primary, Secondary, Tertiary	Increase tracking of at risk populations during weather events	<ul style="list-style-type: none"> <li>Develop methods to aggregate locations of vulnerable populations for use by emergency responders without violating privacy</li> </ul>
				Primary, Secondary	Increase community-based resilience practices during long-term recovery efforts	<ul style="list-style-type: none"> <li>Train community volunteer groups in practices to assist local populations in need</li> <li>Train residents in personal resilience practices</li> </ul>
Threats to mental health	Individuals with existing mental illnesses and vulnerable populations most impacted by stresses from property or personal losses, displacement, financial burdens	Mental health impacts from extreme weather events including post traumatic stress, incidents of depression, worsened mental illness (no data available at this time)	Reduce incidents of post traumatic stress, or depression due to extreme weather events (no metric at this time)	Primary	Increase community-based resilience practices during long-term recovery efforts	<ul style="list-style-type: none"> <li>Train community volunteer groups in practices to assist local populations in need</li> <li>Train residents in personal resilience practices</li> </ul>
				Secondary, Tertiary	Increase access to mental health counseling during and after severe weather events	<ul style="list-style-type: none"> <li>Develop mental health counseling intervention plans with partner organizations</li> <li>Increase crisis intervention training for community first responders</li> </ul>

# Action Plan

The CLIMATE+HEALTH initiative will commence with the following action plan based on the regional assessment findings in this report.

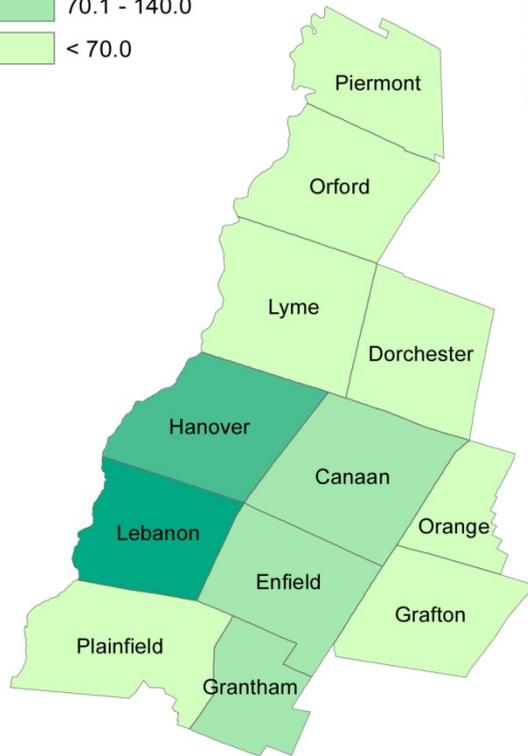
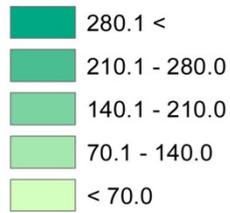
**Goal:**  
Increase community and individual resilience to the health impacts of climate change.

**Target Population:**  
Seniors (65+ years old)  
**Target Timeline:**  
Within one year.

Strategy	Level of Action	Potential Partners	Performance Measure
<b>Objective: Provide effective outreach and education to increase personal and community resilience.</b>			
<b>Strategy:</b> Develop severe weather event media packets and coordinated plans among partners to release information prior to a forecast event.	<ul style="list-style-type: none"> <li>● Region</li> <li>○ State</li> </ul>	Municipalities; PHC; Regional Coordinating Council (RCC); UVAW	Number of media packets prepared (each tailored to a specific event); Coordinated outreach plan among partner organizations
<b>Strategy:</b> Team with partner organizations to host public forums about health and climate change issues and community resilience.	<ul style="list-style-type: none"> <li>● Region</li> <li>○ State</li> </ul>	PHC; RCC; FEMA; UVAW	Individuals attending, commitments to furthering personal resilience, volunteer commitments for community resilience groups
<b>Objective: Strengthen regional partnerships and capacity for partner organizations.</b>			
<b>Strategy:</b> Train partner organizations who work directly with the target population regarding outreach and health impacts of climate change.	<ul style="list-style-type: none"> <li>● Region</li> <li>○ State</li> </ul>	Municipalities; PHC; DHHS (as advisor)	Number of trainings, individuals /organizations represented at trainings, organization commitments to resilience partnerships
<b>Strategy:</b> Conduct assessment of regional organizations to identify gaps in services and possible new partner organizations to fill gaps.	<ul style="list-style-type: none"> <li>● Region</li> <li>○ State</li> </ul>	Municipalities; PHC; DHHS (as advisor)	Assessment results, existing partners participating in process, new organizations identified, new organization commitments to partnership
<b>Objective: Expand health impacts of climate change tracking data.</b>			
<b>Strategy:</b> Participate with state to develop data sources and tracking strategies.	<ul style="list-style-type: none"> <li>● State</li> <li>● Region</li> </ul>	PHC; DHHS	Partner organization commitments to assist with overall data effort, action plan for next steps

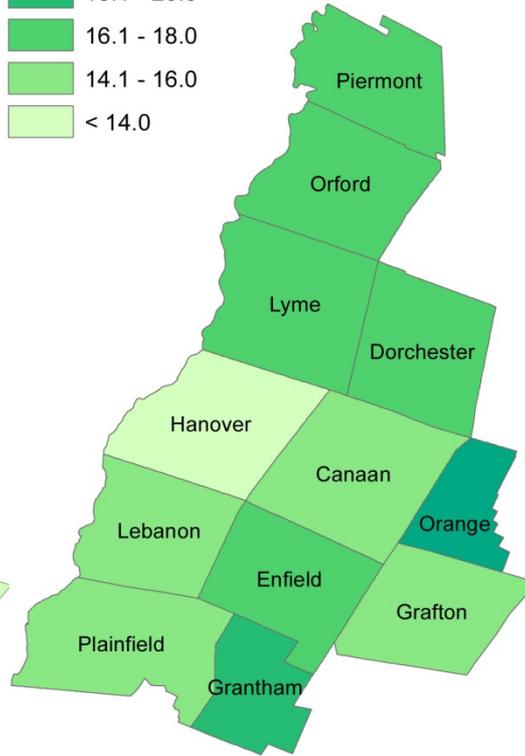
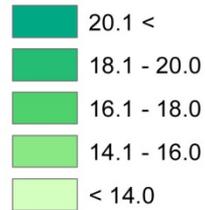
# Appendix - Analysis Maps

## Population Density



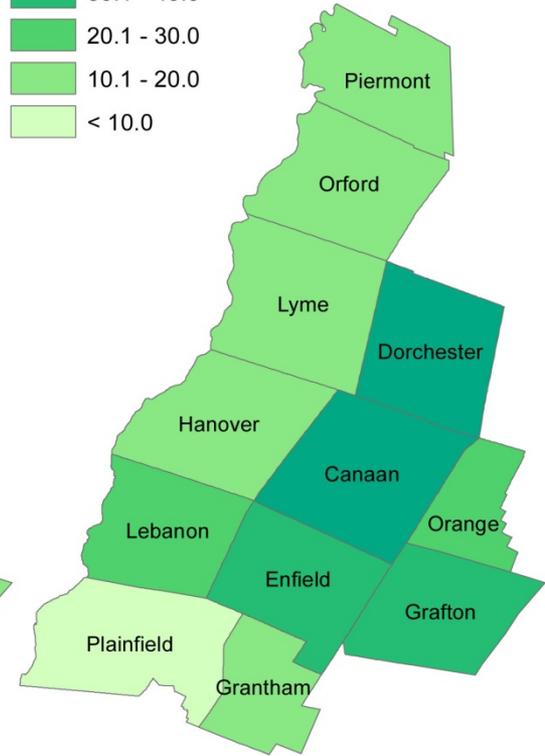
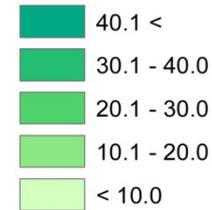
Data Source: 2013 Population Density data from the Economic & Labor Market Information Bureau, NH Employment Security, December 2014.

## Senior Population as a Percentage of Total Population (65+ Years Old)



Data Source: 2013 Population Density data from the Economic & Labor Market Information Bureau, NH Employment Security, December

## Percentage of Senior Population with Income Under 200% Poverty Level



Data Source: U.S. Census Poverty Aggregation Data 2014.  
Map created by UVLSRPC September 2015.

# Appendix - Logic Model for Health Outcomes

INPUTS	ACTIVITIES	OUTPUTS	OUTCOMES
<p><u>Funding/Grants</u></p> <ul style="list-style-type: none"> <li>• CDC/DHHS</li> <li>• FEMA/HSEM</li> <li>• EPA/NHDES</li> <li>• HUD/CDFA</li> <li>• Private Foundations</li> <li>• Resilience Foundations</li> </ul>	<p><u>Public Outreach &amp; Education</u></p> <ul style="list-style-type: none"> <li>• Severe weather media packets</li> <li>• Community and personal resilience training</li> <li>• Guidelines for local resilience practices</li> <li>• Fact sheets identifying available resources</li> </ul>	<p><u>Target Groups</u></p> <p>Populations</p> <ul style="list-style-type: none"> <li>• Elderly</li> <li>• Disabled</li> <li>• Mentally Ill</li> </ul> <p>Partnerships</p> <ul style="list-style-type: none"> <li>• PHC Partners</li> <li>• New Partners</li> </ul> <p>Regional Communities</p>	<p><u>Short-Term Outcomes</u></p> <p>Increased public education and messaging</p> <ul style="list-style-type: none"> <li>• Utilize existing partner community ties with target populations</li> <li>• Work with partners to develop media packets</li> <li>• Strengthen capacity for CLIMATE+HEALTH partner organizations</li> <li>• Partner trainings</li> <li>• Engage new partner organizations</li> </ul>
<p><u>Partners</u></p> <ul style="list-style-type: none"> <li>• State Agencies</li> <li>• Federal Agencies</li> <li>• Regional Public Health</li> <li>• Regional Public Safety</li> <li>• Regional Municipalities</li> <li>• Non-Profits &amp; Agencies with Shared Goals</li> </ul>	<p><u>Ongoing Partner Coordination</u></p> <ul style="list-style-type: none"> <li>• Understand partner roles in climate health adaptation</li> <li>• Identify and address gaps in service</li> <li>• Expand partnerships</li> </ul>	<p><u>Outputs</u></p> <p>Enhance personal and community resilience</p> <ul style="list-style-type: none"> <li>• Outreach for target populations</li> <li>• Identify and track health outcome indicators</li> </ul> <p>Strengthen Regional Partnerships</p> <ul style="list-style-type: none"> <li>• Coordinate climate + health interventions and projects among partners</li> <li>• Develop new partnerships to expand regional capacity</li> </ul>	<p><u>Long-Term Outcomes</u></p> <p>Increased public personal &amp; community resilience</p> <ul style="list-style-type: none"> <li>• Increase number of regional resilience programs with direct community ties</li> <li>• Develop long-term strategies</li> <li>• Evaluate strategies for low/moderate priority health outcomes</li> <li>• Re-evaluate effectiveness of short-term interventions</li> </ul>
<p><u>Specialists/Materials</u></p> <ul style="list-style-type: none"> <li>• Community Health Data</li> <li>• Climate Change Data</li> <li>• Resilience Experts</li> <li>• Local, State, Federal Resilience Plans</li> </ul>	<p><u>Health +Climate Projects</u></p> <ul style="list-style-type: none"> <li>• CLIMATE+HEALTH tracking data</li> <li>• Tracking intervention health outcomes</li> <li>• Promote partner projects</li> </ul>		

# CLIMATE+HEALTH Reference Material

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- Cameron Wake, John Bucci, Semra Aytur, *Climate Change and Human Health in NH, An impact assessment* publication of the sustainability institute at the University of New Hampshire, 2014
- Cameron Wake, Elizabeth Burakowski, et al., *Climate Change in Southern New Hampshire Past, Present, and Future*. 2014. Climate Solutions New England Sustainability Institute
- David Grass, PhD, *Climate Change Adaptation Program*, Vermont Department of Health, Resilient Vermont Solutions Summit, May 21, 2013
- Sacha Pealer, *Lessons from Irene: Building resiliency as we rebuild*, Vermont Agency of Natural Resources, January 4, 2012
- Nick Watts, W Neil Adger, et al., *Health and Climate Change: Policy Responses to protect public health*, The Lancet Commissions, June 23, 2015
- Anthony Costello, Mustafa Abbas, et al., *Managing The Health Effects Of Climate Change*, Lancet and University College London Institute for Global Health Commission, May 16, 2009
- Justin B. Clancy and Jessica Grannis, *Lessons Learned From Irene - Climate Change, Federal Disaster Relief, and Barriers to Adaptive Reconstruction*, Georgetown Climate Center, December 2013
- *Fact Sheet-What Climate Change Means for New Hampshire and the Northeast*, The White House Office of the Press Secretary, May 6, 2014
- *New Hampshire the Resilient Granite State-A Workbook Guide on Climate and Health Adaptation for Regional Public Health Networks*, Healthy New Hampshire, Global Climate Change Implications for Public Health, CDC, April 22, 2015
- Jose Their Montero, MD, MHCDS, *New Hampshire State Health Improvement Plan*, Division of Public Health Services, New Hampshire Department of Health and Human Services
- Victoria Buschman, Caroline Fernandes, Sarah Guth, Anna Mullen, Piper Rosales-Underbrink, *Tropical Storm Irene: A Retrospective on Mental and Emotional Impacts on Vermont Communities Three Years Later*, Environmental Studies Senior Capstone Seminar, In cooperation with the Vermont Department of Health Professor Rebecca Kneale Gould and Diane Munroe, December 15, 2014
- Martin Downs, MPH Project Director, Edward Ihejirika, MB.BS, MS Program Coordinator, Alice R. Ely, MPH Executive Director, *The Upper Valley Healthy Community Project Assessment*, Presented by Mascoma Valley Health Initiative , June 2011
- Lee Karlsson, *Vermont Climate Change Health Effects Adaption, Climate Change Application White Pages Series*, Vermont Agency of Natural Resources, May 2011