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Climate Adaptation and Resiliency Planning for New England Communities: First Steps and Next Steps

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Executive Summary



Hurricane Irene tearing Vermont roads and bridges apart and Superstorm Sandy ripping through coastal areas; such phenomenal events are being joined by more frequent rain, tide and wind impacts that are disrupting communities and risking property and lives. New challenges arise from weather events that are driven by a less stable climate. The key difference between what communities already plan for and climate adaptation planning is the level of uncertainty about how impacts may change in the future and the potentially enormous and devastating damages that a community may sustain.

This Guide presents an overview of that task, with links to the rapidly expanding guidelines and tools available to local governments and a suggested way of thinking about this responsibility as an extension of what local governments are already doing.

This Guide focuses on the leading cause of hazard declarations in the Northeast caused by the effects of weather on water: **flooding** (temporary covering of land by water) and **inundation** (permanently losing land to higher water) in riverine and coastal communities. Because this is

such a dynamic field, with resources becoming available continuously, no guide can be comprehensive. This Guide connects town officials with the most widely used resources, and easily accessible links to climate information, in-depth guidelines and assessment tools, and current funding resources broken out for each New England state.

This guide distills core approaches to adaptation planning for local leaders and provides new ideas about how towns can navigate the difficult decisions that may emerge during implementation of this approach.

Section 1 on vulnerability and risk assessment presents a stepwise approach to moving from a general understanding of your community's exposure to drawing on more specialized tools and expertise. **Section 2 on adaptation action** examines how some actions may be modifications or expansions of existing natural hazard mitigation efforts such as floodplain management, though other actions may be new to your locality. Adaptation can become most feasible by focusing on risks and actions that are no-regrets and which may have co-benefits over time. **Section 3 addresses the question of how to pay for adaptation** that is part of existing tasks and roles of local government, including capital programming, operations & maintenance and guiding physical development and conservation. The continuing push to develop and fund better stormwater management that many localities are involved in, for example, is critical to New England and its evolving environment, and part of climate adaptation.



Exposure: A Practical Issue that is Beyond Debate

Many Americans are aware of the debates over whether climate change is real, and even if it is, whether or not it is a natural phenomenon or if human activities play a significant role. This debate is important but it is also beside the point as increasing severity of storms, a well-established century-long trend of sea level rise, and increased damages to public and private property are increasingly being observed at the local level.

Local governments have a duty to protect the public from the impacts of hazards such as floods, hurricanes and stormwater events that cause disruption and damage. Such impacts are increasing, whatever the argument is about a changing climate. Just in 2011, for example, the U.S. experienced 16 one-billion-dollar disasters from weather and water-related extreme events (Smith and Katz 2013), and regions are experiencing losses that have never occurred before. Superstorm Sandy caused massive unprecedented damage to the New York region. Hurricane Irene damaged or destroyed 500 miles of roads and 200 bridges in Vermont and Connecticut. What would become the 2007 Patriot’s Day storm started in the Southwestern states, ripped across the country, through New England, and ended in Canada, causing \$264 million in damages and 18 deaths. Regional events are devastating but so are the more localized ones. In July, 2015, up to six inches of rain pounded parts of Central Vermont, including Barre and Plainfield, causing a bridge to wash out and damaging up to 30 buildings. On September 30, 2015, a torrential downpour of up to 10” in parts of Maine, aggravated by a high tide, caused damages to cars and buildings, power outages, closings and general disruptions.

Recent Billion Dollar Storms Just in the Northeast

Storm	Billion \$	Deaths
Hurricane Sandy, Oct 2012	\$65	159
Hurricane Irene, Aug 2011	\$14	45
Tropical storm Lee, Sept 2011	\$2	21
Northeast severe weather, flooding, March 2010	\$3	11

Source: [NOAA](#)

Long-term climate adaptation can seem daunting, but it is a task that is not different from other policy and management duties that local government faces now. Addressing it is important to successfully deal with ongoing community infrastructure and service needs to support a resilient local economy and environment. Finally, an essential first and continuing step is to engage the

public early in the adaptation planning process. Local governments and knowledgeable citizen leaders and staff know how to organize effective engagement. Putting boundaries on the question of climate risk is not essentially different than long-range questions of where the local, and global, economy may take your community in the future. Thoughtful decisions can be made now that have future benefits under conditions that may vary.

This Guide

How can local governments address these water-driven natural hazard events? The goal of this guide is to offer assistance on how to increase resiliency and avert loss and social disruption in medium sized and small New England communities with limited staff and resources. This Guide presumes that New England's climate is changing, and that municipalities and similar entities are significantly responsible for mitigating the risks associated with this change. It is intended for use by planners and local decision makers with a range of technical capability, who want to start (or continue) to become a more resilient community that can respond to, and withstand, the next deluge.

The sections of this guide follow a 3-step approach common to effective local adaptation initiatives:

- 1) Assess vulnerability and risks:** What are your community's hazard exposures and what is vulnerable and at stake given those hazards? What is the probability of an impact occurring? How big an impact are you willing to prepare for and when do you want to start prepare? now or later?
- 2) Develop strategies for adaptation & resilience:** What can be done now and in the future to reduce the probability that damages and disruptions will occur? What can be done to reduce the extent of damage if flooding or inundation occurs, why is ongoing monitoring important, and
- 3) Assess financing opportunities:** What resources are available now? What innovative resources can be developed and who are potential partners including state and federal agencies, the business community and non-profit organizations? Importantly, who can pay and who should pay for adaptation today and in the future?

Definition of Terms

The terminology used to communicate climate change science and policy is arcane precisely because it needs to be specific, and are about topics that are complex and interwoven across many disciplines. We use the EPA

www3.epa.gov/climatechange/glossary.html and the Intergovernmental Panel on Climate Change Fourth Assessment Report PCC ipcc.ch/publications_and_data/ar4/wg2/en/annexessglossary-a-d.html definitions for terms used in this report:

▣ Adaptation

Adjustment or preparation of natural or human systems to a new or changing environment which moderates harm or exploits beneficial opportunities.

▣ Adaptive capacity (in relation to climate change impacts)

The ability of a system to adjust to [climate change](#) (including [climate variability](#) and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences

▣ Climate

Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands of years. The classical period is 3 decades, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. A simple way of remembering the difference is that climate is what you expect (e.g. cold winters) and 'weather' is what you get (e.g. a blizzard)

▣ Climate Change

Climate change refers to any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among others, that occur over several decades or longer.

▣ Climate Model

A quantitative way of representing the interactions of the atmosphere, oceans, land surface, and ice. Models can range from relatively simple to quite comprehensive.

▣ Co-Benefit

The benefits of policies that are implemented for various reasons at the same time including climate change mitigation acknowledging that most policies designed to address greenhouse gas mitigation also have other, often at least equally important, rationales (e.g., related to objectives of development, sustainability, and equity).

▣ Global Warming

The recent and ongoing global average increase in temperature near the Earth's surface.

▣ Mitigation

A human intervention to reduce the human impact on the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks.

▣ Hazard mitigation

Policies and actions that help reduce risk and create safer, more disaster resilient communities from natural and technological hazards.

▣ No regrets policy

A policy that would generate net social

and/or economic benefits irrespective of whether or not **anthropogenic climate change** occurs

■ **Resilience:** a capability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to social well-being, the economy, and the environment

■ **Storm Surge**

An abnormal rise in sea level accompanying a hurricane or other intense storm, whose height is the difference between the observed level of the sea surface and the level that would have occurred in the absence of the cyclone.

■ **Uncertainty**

An expression of the degree to which a value (e.g., the future state of the **climate system**) is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from quantifiable errors in the data to ambiguously defined concepts or terminology, or uncertain **projections** of human behaviour. Uncertainty can therefore be represented by quantitative measures (e.g., a range of values

calculated by various models) or by qualitative statements (e.g., reflecting the judgement of a team of experts).

■ **Vulnerability**

The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed; its sensitivity; and its adaptive capacity.

■ **Weather**

Atmospheric condition at any given time or place. It is measured in terms of such things as wind, temperature, humidity, atmospheric pressure, cloudiness, and precipitation. In most places, weather can change from hour-to-hour, day-to-day, and season-to-season. A simple way of remembering the difference is that climate is what you expect (e.g. cold winters) and 'weather' is what you get (e.g. a blizzard).

■ **100-Year Flood Levels**

Severe flood levels with a one-in-100 likelihood of occurring in any given year.

These terms relate to each other: hazard mitigation reduces the long-term effects of climate change from global warming; adaptation and hazard mitigation reduce the potential for damages to occur; reduced damages make it easier to recover; resilience incorporates recovery, which is the ability of a system or economy or environment to bounce back; and vulnerability is the amount of damage that could occur for any given size of event, which in turn depends on how much mitigation is done.

Why Should Communities Care?



Most of the discussion of climate change in the press focuses on steps to reduce the extent of climate change in the future through “greenhouse gas mitigation”. On December 13, 2015, a landmark global accord reached by 195 nations in Paris will commit nearly every nation in the world to reduce greenhouse gas emissions. The success of the historic accord depends on global peer pressure, as each nation will reports its progress every 5 years, and the actions of future generations.

US Senate members have called the Paris accord “an unattainable deal, based on a domestic energy plan that is likely illegal, that half the states have sued to halt, and that Congress has already voted to reject”

Source: NYTimes. (2015)

Even with opposition in the Senate, the Paris accord will place enormous global peer pressure on the U.S. to keep its commitment to reducing emissions. Federal policy changes, incentives, and funding of programs would give states much needed assistance to begin or continue local efforts to reduce global greenhouse gas levels.

Ten of the hottest years ever recorded occurred within the past eleven years, and sea levels have risen in New England steadily over the 20th century. Although the global problem seems overwhelming, there is good reason for local communities to be actively involved in climate change mitigation. Global climate change is actually realized at the local level, and municipal infrastructure and services can be seriously damaged by climate hazards.

Adaptation to a Changing Climate

While some consequences may still lie in the future, the decisions to plan for and address those consequences are ones localities all confront today. Every year coastal and river towns must decide how much development they will permit in shore-adjacent or riparian lands. In much of New England, where towns were settled to take advantage of their water-based locations, the development or re-development of such areas is an immediate question. In many coastal towns, a major part of the economy and the property tax base rests on ground that is easily washed away or subject to increasingly regular inundation.

Moreover, much of the public's investments in infrastructure, including roads and transportation systems, water and sewer facilities, and energy production are located on or near water.



This infrastructure is critical not only to the residents of coastal and riparian towns, but to the resilience of entire regions and states. A great deal of this infrastructure is old or outdated and will require significant new investment in the next decade, which presents both a challenge to find the resources but also an opportunity to build for a future that must accommodate even greater stresses and threats.

The question that municipalities face is not whether to develop a “climate change adaptation strategy”, but whether to make decisions already scheduled or upcoming in ways that take account of climate change, existing and future hazards, and to consider new courses of action that will have potential and future benefits beyond hazard mitigation. Federal policies to fund mitigation actions are starting to include adaptation actions so communities can be pro-active about planning for their future needs, while addressing hazard mitigation presently. Assistance by organizations like ICLEI USA (International Council for Local Environmental Initiatives, Local Governments for Sustainability Network) have responded to emerging Federal program changes by assisting communities incorporate adaptation planning into their climate action plans.

EXPANDING CLIMATE ACTION PLANS (CAPS) TO INCLUDE ADAPTATION

ICLEI has been helping communities around the world with their Local Governments for Sustainability network. They use a five-milestone framework that provides a standardized and simple way for local governments to measure, monitor, report and establish targets on greenhouse gas emission reduction <http://www.iclei.org/details/article/changing-climate-changing-communities-guide-and-workbook-for-municipal-climate-adaptation.html>.

The five steps are sound planning steps grounded in emissions reduction strategies. Keene, NH worked with ICLEI to reduce their GHG emissions by 10% below 1995 levels, and is on track to meet the goal by 2015. Keene reaffirmed this commitment in its Community Goals of 2003, and in addition has committed to expanding their climate protection efforts to include climate adaptation. Keene is working with ICLEI to develop a Milestone process specifically designed to assess the community's vulnerability to climate impacts and establish a methodology to enhance its resiliency to them.

Source:

https://www.ci.keene.nh.us/sites/default/files/Keene%20Report_ICLEI_FINAL_v2.pdf

The question of adaptation goes beyond the hazard mitigation policies of today, since the 100-year floodplain of tomorrow may be larger in a vulnerable location in your community. Critical public infrastructure that everyone depends on may be more at risk or newly at risk. As one state DOT infrastructure engineer put it at the second annual New England Infrastructure and Climate Network¹ workshop, "Now we can't just provide design services (to one standard) we have to be risk managers as well."

There are numerous other effects of climate change, such as health risks, slow but significant and costly degradation of economies due to stresses on regional agriculture and other sectors which we do not address here, although the same emerging approach we suggest may be used to examine those risks as well. The most important thing to remember about climate change is that the changes are global, but the effects are very local.



¹ (ICNet), University of New Hampshire in 2014, funded by the National Science Foundation

Adaptation Under Uncertainty

Even the basic principles of flood and storm hazard mitigation are less certain now.

For example, the Flood Insurance Rate Maps (FIRMs) identify 100-year-base-flood areas of vulnerability for every community in the United States and are the cornerstone of the elevation requirements and flood extent delineations of the National Flood Insurance Program (NFIP) for the Special Flood Hazard Areas. However, because the basic measurements of the climate are changing, there are areas of the country where the amount of precipitation - its frequency, volume and duration of events - are changing. In some areas, at some point, the size of a flood previously classified as a 1% return probability (i.e., 100-year event) may now be a 50- or 75-year storm (which could double the annual probability of major storms occurring).

Weather events are variable, but the evidence of both continuing events as well as climate modeling (to be discussed in the next section) are that more impacts and ones not seen before are more, not less, likely in the future. In fact, the most recent National Climate Assessment forecasts that precipitation in the New England states is likely to *increase on average by 71%* as the century continues. This is the highest increase or decrease currently modeled for anywhere in the nation.

HAZARD MITIGATION PLANNING AND FUNDING

Hazard mitigation includes actions that reduce the loss of life, injuries and property damage before the impact occurs. After more than three decades of efforts to promote pre-disaster hazard mitigation for flooding and storm impacts, the Disaster Management Act of 2000 (DMA 2000) expanded the small mitigation planning money for states and localities under the National Flood Insurance Program (NFIP) and the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 (Stafford Act). These acts have increased incentives by making more federal aid available for mitigation planning before Presidentially declared disasters via the states, and with added funds for post-disaster mitigation planning to prevent repeated impacts in the same place. DMA 2000 also provides the option to reduce federal funds for damages that have been repetitive to the same asset within a ten-year period, where no local mitigation planning took place after prior events.

All six New England states have State Hazard Mitigation Plans in place. FEMA (Federal Emergency Management Authority, US Department of Homeland Security) requires all states, (including Territories and the District of Columbia) and federally recognized tribes and local governments to develop and adopt hazard mitigation plans as a condition to receiving non-emergency and disaster assistance, including Hazard Mitigation Assistance (HMA). FEMA grant programs include the Pre-Disaster Mitigation Program (PDM), the Hazard Mitigation Grant Program (HMG), and the Flood Mitigation Assistance Program (FMA). States are required to update their plans every five years to be eligible for the agency's mitigation funding. Since 2010, FEMA has disbursed more than \$4.6 billion to states and territories as part of these programs.

www.fema.gov/hazard-mitigation-planning

Resilience



Resiliency is an emerging concept that incorporates recovery, which is the ability of a system or economy or environment to bounce back from a damaging event. In ecological science resilience refers to the ability of an ecosystems, or populations of living things and their environment, to return to a successful level of function in response to changing conditions that threaten its viability.

The idea is that a resilient community is able to absorb shocks and continue or regain essential functions within a time frame that doesn't cause prolonged or permanent undesired change or continued losses.

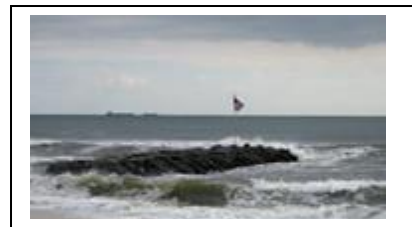
Human community resilience may also involve moving to a higher level of function after a loss, through adaptive learning and action. Whether talking about hazard mitigation or resilience, however, taking action before an impact occurs is the most effective path. The challenge is to decide to pursue adaptation by identifying what needs to be done, and when to feasibly carry out such actions, even given uncertainty.

A very good source of information is the [US Climate Resilience Toolkit](#) that offers topic related information on how to start taking local action and which tools can be helpful. Here are a few excerpts of New England case studies:

Training Sessions Build Capacity for Recovery and Planning

The impact of Hurricane Sandy emphasized the need for coastal communities along the East Coast to prepare for future hazards and the impacts of climate change. Several groups participated in training sessions to help them use data and tools to inform their planning efforts.

[Read more](#)



Exploring Adaptation Options for Water Infrastructure at Sea Level

In Massachusetts, Manchester-by-the-Sea's wastewater treatment plant is located right on the coast. The town's water utility is working with the EPA's Climate Ready Water Utilities program to consider its adaptation options.

[Read more](#)



Small Water Utility Builds Flood Resilience

Based on their locations, many water and wastewater utilities face an inherent risk of flooding. Here's how a small drinking water utility recognized its risk and took steps to reduce it.
[Read more](#)



Climate Preparedness Workshops Provide a Head Start Toward Resilience

After a series of extreme weather events, the City of Bridgeport, Connecticut, looked for ways to prepare for future storms. Their planning process had just started when they got hit again...
[Read more](#)



Extreme Rainfall Analyses Can Point to Right Size for Culverts

Across most of the United States, the heaviest rainfall events have become heavier and more frequent. New tools can help decision makers choose culverts with appropriate capacities for the future.
[Read more](#)



1. Assessing Vulnerability – How Big a Problem Is It?



Even with the uncertainty brought on by a non-stationary climate, there is accessible information and data for communities to assess major possible vulnerabilities, which is the focus of this section.

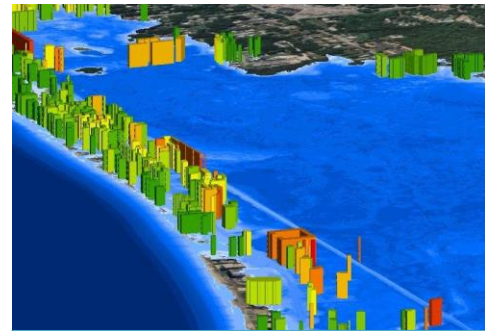
Vulnerability is a matter of what is there now (or in the future) that numerous models can help us visualize and understand.

These models can help us understand what the physical vulnerabilities are to communities and regions. Risk is different from vulnerability; it is the probability that vulnerabilities will be tested.

Risks come from three sources, two embedded in natural processes and one embedded in political processes. One source of risks is the pace and extent of climate change.

That climate change is occurring is beyond doubt, but the future pace depends on factors such as global economic growth, changes in fossil fuel use, and the stability of key areas such as the polar ice. It is a function of the degree of climate change, sea level rise, and random factors such as the number and tracks of tropical and extra-tropical storms that hit any part of New England over time.

Another source of risk is measured by how much risk communities are willing to accept in a future scenario. The third source of risk is whether and how governments will respond in the future to the increasing damages resulting from a nonstationary climate.



COAST Model output of future economic damages from sea level rise at Old Orchard Beach, Maine, 2011

Climate Change Effects and Vulnerabilities in the Northeast:

- Heat waves, coastal flooding, and river flooding will pose a growing challenge to the region's environmental, social, and economic systems. This will increase the vulnerability of the region's residents, especially its most disadvantaged populations.
- Infrastructure will be increasingly compromised by climate-related hazards, including sea level rise, coastal flooding, and intense precipitation events.
- Agriculture, fisheries, and ecosystems will be increasingly compromised over the next century by climate change impacts. Farmers can explore new crop options, but these adaptations are not cost- or risk-free. Moreover, adaptive capacity, which varies throughout the region, could be overwhelmed by a changing climate.
- While a majority of states and a rapidly growing number of municipalities have begun to incorporate the risk of climate change into their planning activities, implementation of adaptation measures is still at early stages.

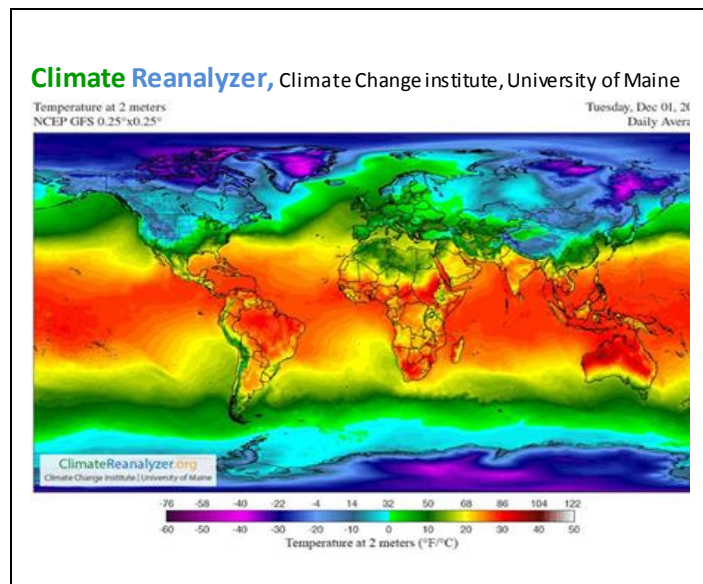
Source: [National Climate Assessment](#), [GlobalChange.gov](#)

Future Climate Risks: Climate Models, Use, and Limitations

Forecasting Models

How much could the climate change? How much might sea level rise? The answer to these questions lies in the future but actions are needed in the present. Seeing the future requires that we be able to take what we know about the forces that shape the climate, most importantly the amount of heat in the atmosphere and oceans, and see how these “drivers” will change in the future, which is what climate models are designed to do. They are the essential first step in thinking about adaptation.

The models are multiple computer-based pictures of the future that have been developed about possible rates and degree of climate change. These simulations of the future are based on the physics of the global air-ocean system in what are known as GCMs, or General Circulation Models (also called Global Circulation Models), and more recent RCMs, Regional Climate Models. The modeling also takes into account the trends in human contributions of greenhouse gases largely from energy use, but also agricultural, forestry and urban development trends. These scenarios are different assumptions about human decisions on a large scale and are known as RCPs, Representative Concentration Pathways, commonly referred to as “Emissions Scenarios.”



While GCMs model the expected conditions for areas of 100 to 200 square kilometers, such as average temperature, RCMs continue to be developed to simulate those conditions at finer scales of less than 100 square kilometers, so that more localized future conditions can be understood. Limits of computing power and understanding of physical processes over long time periods (decades) constrain these future-analytical models.

But with almost two dozen such modeling efforts underway across the globe, general trends have some degree of consensus, including at the sub-national level in the United States. The most current summary of this U.S. information is in the 2014 National Climate Assessment (NCA3) available [here](#). As noted earlier, this summary assessment indicates that New England can expect to become wetter, warmer (with temperatures much like the Carolinas for some by 2100) and be subject to a significant degree of sea level rise affecting coastlines. Although RCMs are a little better than GCMs

at predicting extreme events like storms and flooding, extreme event forecasting is still very uncertain.

No models can tell you that there will be a specific flood or hurricane next year or what the magnitude will be or even if there will be any at all for a specific time period. However, the physical trends are ones that support the likelihood of greater rather than less flooding, with possibly greater flood extents and depths. This is because the intensity and duration of rainfall and the amplified effects on coasts and tidal rivers from sea level rise are higher, and storm surges are consequently greater.

Appendix C includes two overview examples of how climate information from the models can inform general understanding of long-term changes. The first example is of New England regional climate maps showing how average temperatures may change over the entire region given global mean temperature changes of 1, 2 and 3 degree Centigrade. These are one of a series of GCM/RCM-derived maps developed by and displayed on the web site of the Infrastructure-Climate Network (ICNet) at the University of New Hampshire. The second is the consensus sea level rise estimate adopted by the four-county Southeast Florida Regional Compact of local governments for common planning information. Appendix D also includes examples of how multi-jurisdictional organization and regional collaborations can help leverage shared information resources adaptation planning.

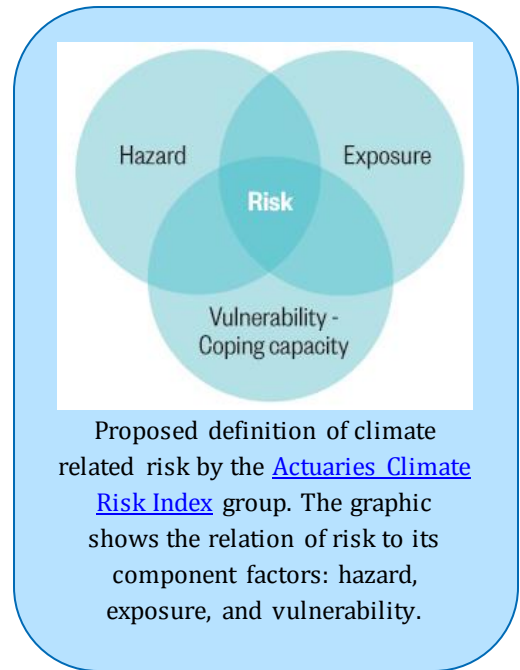
Risk and Scenarios

Risk is a matter of judgment and choice rather than computation. It is a reflection of the community's tolerance to take a chance at a future scenario with a changing climate and more extreme weather events.

The task is to decide which model provides useful information for planning, given a community's risk tolerance.

The risks to communities from climate change exist as a complex mix of factors, and although communities cannot know their *absolute* risks, they can identify their *acceptable* risks. Answering the question "how big a problem is climate change" can best be thought of as placing a collective bet in a game communities have no choice about playing.

Perhaps the most common approach to handling uncertainty and incomplete information is to use scenarios. Almost all of the major forecasts of climate change and its effects rely on constructing a number of scenarios where key factors, such as the extent of polar ice melting or change in fossil fuel use can be varied in order to assess their effects on the change in temperature. Because there are so many variables in this complex relationship, it can seem quite daunting to decide which scenarios are relevant for planning.



"No-regrets" strategies

Are there current problems that need to be addressed and are expected to grow worse with climate change? A "no-regrets" approach means tackling issues in a way that benefit the municipality and its constituents regardless of how a particular climate forecast pans out.
Chicago Metropolitan Agency for Planning (CMAP), 2013

All ranges of scenarios contain a high and low scenario and, which can be viewed as "best" and "worst" case scenarios. In deciding on acceptable risks, a community can ask: "do we want to prepare for the worst case scenario?" If the costs are low, then that is perhaps the best choice. But preparing for the "worst case" scenario is rarely low cost. The next question is "can we prepare for the best case scenario"? Costs may be lower, but how safe is the "best" case.

Caught between the high cost of the greatest safety and the uncertain safety of the lowest cost, the temptation is to pick a "middle" scenario to plan for. That may be the best choice, but potentially a better choice is to plan for the best case scenario, while avoiding those steps that foreclose taking action if actual risks are much higher. This "no regrets" strategy is best for reflecting the changing nature of the information about the climate and its effects. Not everything has to be done in the present, but options should not be foreclosed which prevent effective action in the future.

To decide what bet a town will make, one can answer these questions:

- What's at stake? This is the purpose of the vulnerability assessment.
- How safe is safe enough?
- Should we be prepared for the worst case scenarios (high change, high frequency, high damage)?
- Being safe will cost the most; if towns choose to spend less and accept more risks, will it be a safe bet that things will be no worse than if a safer choice was made?
- Are communities willing to bet that the resources will be available if things turn out worse than anticipated?
- Are communities willing to bet that the resources will be there if nothing is done now?
- Are communities willing to bet that the federal and state policies won't require that the town be responsible for significantly larger costs of damage recovery in the future than in the past?

All of this can be considered a form of sensible self-insurance. For example, if there was a few percent chance of a catastrophic fire in a home or business, one would insure against that possibility, as most people do (Wagner and Weitzman, 2015). Current scientific thinking at the Intergovernmental Panel on Climate Change (IPCC) puts the probability of global temperature rising 6 degrees Centigrade (10.8 Fahrenheit) in this century, causing catastrophic effects, at somewhere between 0 and 10%. Towns may not be ready to decide where to place their bets because the information needed to decide what is the best bet is not available. That is the purpose of adaptation planning. But regardless, the wheel is spinning and communities must eventually place their bets.

A *robust action* is one that would be valuable even under different future conditions. For example, a growing number of communities are adding “freeboard” or additional required feet of elevation of the first habitable floor in their Special Flood Hazard Area zoning and building regulation. In the best case, where the future 100-year (one percent annual probability) flood is not too different, this will provide a safety factor. In a worse case, where floods exceed current regulatory (100 year) flood levels, the extra elevation heights could make the difference between moderate damage and disaster for property owners. A common example of a *co-benefits action* is to protect open space in vulnerable areas of floodplains and adjacent areas when such lands also provide other community benefits such as recreation or tourism value.

More Risk to Consider: Government Policies



The final risk is not always recognized in climate change discussions: It is the question of whether and how *governments* will respond in the future to the increasing damages resulting from a nonstationary climate. Traditional hazards like flood and drought and earthquakes generally affect one region at a time and so the nation has been able to get by with dealing sequentially with one or two problems at a time. But climate change fundamentally alters the situation.

Serious disruptions and impacts, if not disasters as well, will become more the norm, not the exception. The damages from storms that we now consider routine will increase to greater levels. The number of federally declared disasters has increased over 400% in the last two decades, and the Federal Government has spent \$400 for every person on disaster relief in the country in just the past three years. Given ongoing debates about the Federal budget, which are unlikely to change greatly in the foreseeable future, an additional level of risk is the issue of responding to disasters and rebuilding for the future.

Uncertainty: Will the Nation Bail You Out?

The Federal Emergency Management Agency is making it tougher for governors to deny man-made climate change. Starting next year, the agency will approve disaster preparedness funds only for states whose governors approve hazard mitigation plans that address climate change. Beginning in March 2016, states seeking preparedness money will have to assess how climate change threatens their communities. Governors will have to sign off on hazard mitigation plans. While some states, including New York, have already started incorporating climate risks in their plans, most haven't because FEMA's old 2008 guidelines didn't require it. The challenges posed by climate change, such as more intense storms, frequent heavy precipitation, heat waves, drought, extreme flooding, and higher sea levels, could significantly alter the types and magnitudes of hazards impacting states in the future," FEMA wrote in its new procedures.

Source: *Inside Climate News* (Mar 18, 2015)

How the United States will organize itself to deal with the already baked-in consequences of climate change, to say nothing of the consequences if we follow our current course of doing very little to mitigate future climate change, is as big, or perhaps even bigger an unknown than the extent of climate change. The IPCC has recognized this by noting that over longer time periods, social uncertainty, or not knowing what decisions our nation and others will make in the future, is greater than the physical uncertainty in the environment and the scientific uncertainty of the analytical tools or models at our disposal. The four emissions scenarios the IPCC scientists have defined so

that modelers can use common frameworks are not prophecies or forecasts. They are simply the envelope within which global human activity might affect the climate. However, in recent years, many modelers have stopped using the lowest emissions scenario, “RCP 2.6,” because those levels are already going to be exceeded in reality. “Climate change (risk) is unlike any other environmental problem, really unlike any other public policy problem. It’s almost uniquely global, uniquely long-term, uniquely irreversible, and uniquely uncertain (and) unique in the combination of all four (Wagner and Weitzman, 2015).

Assessing Local Vulnerability

Vulnerability is a term that is widely used in discussions of climate change, and like so many other terms that are used, it has multiple meanings. The best way to think about vulnerability is to think about the answers to three questions:



1) What could be damaged?

- ▣ What is physically located where flooding could affect it? Examples include residences, businesses, infrastructure, natural resources, and recreational resources.
- ▣ What systems depend on those parts of the community whose physical location makes them vulnerable? Damage to arterial roads or critical infrastructure like water and sewer or health care facilities raise the stakes in possible damages.

Visualization Tools for Assessing Vulnerability	
Global Warming Art:	http://www.globalwarmingart.com/wiki/Special:SeaLevel
NOAA Sea Level Rise Viewer:	http://coast.noaa.gov/digitalcoast/tools/slr
USGS Sea Level Rise Viewer:	http://cegis.usgs.gov/sea_level_rise.html
Climate Central Sea Level Rise Viewer:	http://sealevel.climatecentral.org/
The Nature Conservancy: Coastal Resilience Tool	
<i>Video Introduction:</i>	http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/connecticut/explore/coastal-resilience-tool.xml
<i>The Nature Conservancy Tool:</i>	http://coastalresilience.org/
The Northeast Climate Impacts Assessment (NECIA), The Cornell Precipitation Atlas:	http://precip.eas.cornell.edu/
Connecticut Department of Energy and Environmental Protection:	http://www.ct.gov/deep/cwp/view.asp?a=2705&q=480782

Appendix A is an inventory of these and other available tools to visualize local vulnerability.

2) How much damage could occur?

- All of the discussions of climate change and its effects are shrouded in uncertainty. Most of the studies therefore present a range of possibilities, usually in the form of high, medium, and low scenarios. The extent of possible damages different in each scenario, so it is important to think of the damage question as a range of possibilities rather than a single estimate (as many people do when they gravitate to the medium scenario).
- How high will the waters get? The answer to this is unknown, but reasonable estimates can be made of the range of possibilities.
- How often? Inundation (permanently converting current dry lands to water-covered lands) will occur later, but floods (temporary covering by water) will grow with increasing storm surge in coastal areas and increasing rain fall in all areas.
- What is the susceptibility of assets to flood damage? Is there open space to absorb floodwaters? Are buildings built to be more or less susceptible to flood damage? What is located on the first floors of buildings?

Tools for Assessing Local and Regional Damages	
NOAA Digital Coast:	http://coast.noaa.gov/slr/
The Infrastructure and Climate Network (ICNet):	http://theicnet.org/?page_id=46
Hazus by FEMA:	https://msc.fema.gov/portal/resources/hazus
COAST	
Substantial Damage Estimator (SDE) by FEMA:	https://toolkit.climate.gov/tool/substantial-damage-estimator
Surging Seas by Climate Central:	http://sealevel.climatecentral.org/
University of Connecticut Guide to Interactive Mapping Tools of Sea Level Rise:	http://blog.circa.uconn.edu/2015/09/23/interactive-mapping-tools-for-sea-level-rise-and-storms-a-review-and-user-guide/
Massachusetts Office of Coastal Zone Management: Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning. (pdf):	http://www.mass.gov/eea/docs/czm/stormsmart/slr-guidance-2013.pdf
Maps of Sea Level Rise in New Hampshire Coast:	http://www.granit.unh.edu/Projects/Details?project_id=264

Appendix C includes brief descriptions of three computer-based tools for vulnerability analysis and potential damage identification that local governments can use: HAZUS from FEMA; VAST, the Federal Highway Administration’s new vulnerability analysis tool; and COAST, which has been used in Maine, New Hampshire, Massachusetts, New York, and in other US regions.

3) Can we recover from damages, for how long, how much will it cost, and who will pay?

- Since floods are not new to New England neither is recovery. Most damages to buildings can be fixed. But if climate change means that damages will be larger and more frequent, the traditional reliance by vulnerable communities on Federally-backed insurance and Public Assistance is becoming a less adequate option as storms increase in frequency and intensity and cause great damage without prompting Presidential Disaster Declarations that allow FEMA funding for recovery.

Using these questions we can answer the question “how big a problem do we have” by thinking of a continuum from most vulnerable to least vulnerable.

Most vulnerable:

- Large amounts of buildings and systems physically located in historically flooded areas and in areas with the highest likelihood of being affected by climate change no matter which range of possible damages is chosen.
- High concentration of businesses and the local economy in exposed areas such that floods could result in long periods of reduced economic activity.
- Damages that make repairs of structures more expensive than removing structures. The most vulnerable areas will be those where complete replacement will be cheaper than repairing very soon.
- Existing public and private insurance that either does not cover flooding or covers substantially less than the current value and thus reimbursement for damages will have to depend on public funding.
- All of the above occur under even the lowest level of possible changes in flooding resulting from climate change.

Least vulnerable:

- Buildings that are set well back from rivers and shorelines with significant natural buffering between the buildings and the water.
- Critical systems like transportation, water and sewer, or health care located outside exposed areas so that any flooding would result in minimal disruptions.

- Buildings that are elevated or otherwise constructed so that flooding will do minimal damage.
- Adequate insurance to cover what damages may occur.
- All of the above occur under any scenario of climate change, including the highest scenarios.

Every town's vulnerability lies somewhere between these two extremes. Indeed within each town there will be areas that are more and areas that are less vulnerable. The task is to find the location on these dimensions and begin to plan accordingly.

2. Developing Adaptation Actions



A growing number of New England municipalities have developed vulnerability information that incorporates climate change considerations, with assistance in many cases from federal, state and nonprofit organizations. Making decisions about longer-term priorities for uncertain future conditions is a great challenge for local officials and staff when priorities for next year's budget are pressing.

Adaptation Planning Guides

There are numerous adaptation planning guides that provide advice and tools for a stepwise process toward climate adaptation planning and action. They approach the problems from different perspectives such as resilience, mitigation, or community vulnerability, but each provides a good overview of the complete range of steps that need to be considered. A pattern can be distilled from these guidelines, and they present a way for communities to start to understand their preparedness and resilience to disasters, to identify problems to address before the next disaster, and where scarce resources should be allocated. These sources also help communities meet the requirements under the Code of Federal Regulations (CFR) Title 44 – Emergency Management and Assistance §201.6, which is a condition for FEMA assistance.

Steps in Adaptation Planning

- 1) Build a team/ build local capacity
- 2) Identify local hazards and future climate impacts
- 3) Identify critical actions
 - a) Type and scope of actions, least to most vulnerable
 - b) Prioritize choices, risk, criticality
 - c) Robust low-or-no-regrets actions
 - d) Monitor and adjust actions
- 4) Explore financing options and set action priorities

In general, most guidelines present the following stepwise process that communities can take in their adaptation plans: **Appendix B** provides a resource directory with web links for adaptation and resilience planning guidelines from other communities, to use as examples.

Figure 2 illustrates how complex some guidelines can become. The [Virtual Framework for Climate Adaptation Planning](#) by the Federal Highway Administration (FHWA, 2015) illustrates components of a comprehensive adaptation planning effort to help local and regional transportation agencies implement the FHWA's [Climate Change and Extreme Weather Vulnerability Assessment Framework](#). The guide's goal is to help assess the vulnerability of transportation assets to climate change and extreme weather events. .

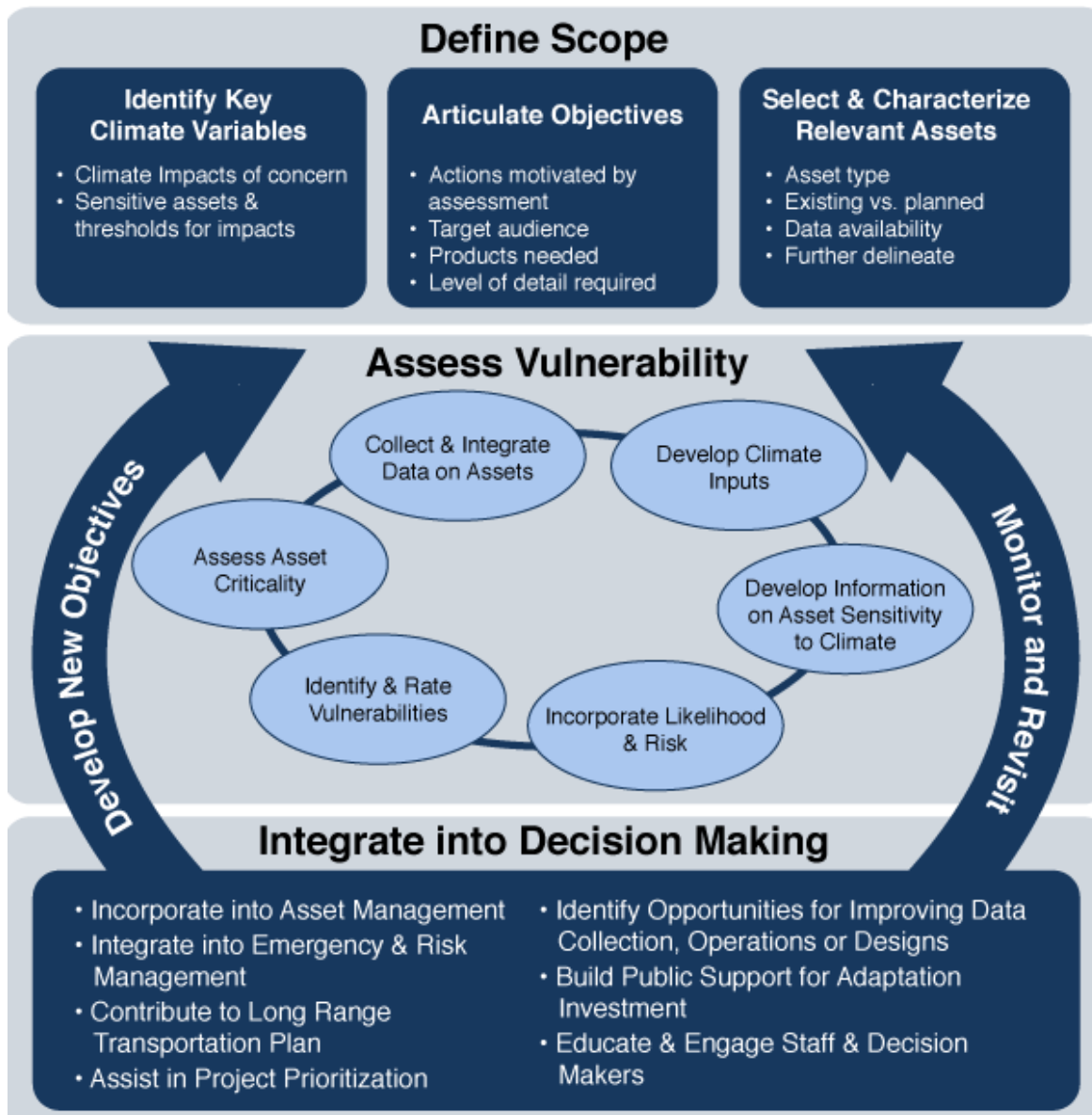


Figure 2: FHWA On-Line Virtual Framework for Climate Adaptation Planning

Adaptation Planning in New England



All six New England States have completed State Adaptation Plans that can be used as a source of information for their respective municipalities that are also completing adaptation plans or should in the future. There is great variety among the state plans, but they can serve as guidelines for municipal adaptation planning and vulnerability assessment.

[Connecticut](#) and [Rhode Island](#) have reports on expected state impacts, and they identify adaptation actions. [Massachusetts](#) has a Global Warming Solutions Act, and set up Committees to report on adaptation strategies. Massachusetts has also issued two rounds of Green Bonds to finance critical infrastructure replacements. [Maine](#) has a report to the Governor focusing on measures to reduce greenhouse gas emissions and recommendations for adaptation strategies. [New Hampshire](#) has a gubernatorial-appointed Task Force that developed reports with detailed frameworks for including adaptation measures to planning and programmatic activities. In [Vermont](#), a Governor’s Commission developed a Climate Adaptation Report and there is also a Planning for Flood Recovery and Long-Term Resilience report, developed with USEPA assistance after Hurricane Irene’s millennial impacts.

Climate Central lists each state’s score on how prepared they are in the [States at Risk: America’s Preparedness Report Card](#)

The [Clean Air-Cool Planet Survey of Northeast Communities](#) in 2011 gives an overview of climate preparedness in the Northeast ([Source: Cakex.org](#)). Following are some highlights:

Northeast communities are concerned about climate change impacts.

- Over half who responded are already doing some form of climate preparedness planning.
- Another third are concerned, but are unsure what steps to take or lack capacity.
- Sea-level rise, increased precipitation, floodplain changes, and public welfare and health are the impacts of greatest concern.

In order to adapt, they need technical, communications, and financial assistance.

- The need most often ranked as a top priority (by 35 percent of respondents) is help with infrastructure vulnerability assessments.
- Other technical needs ranked as important include updated floodplain maps (19%) local climate/scientific data (15%) and help with creating adaptation plans (15%).
- “Convincing the public that climate change is happening” is the education and outreach need most often ranked as primary (21%), followed closely by “lack of national leadership and education awareness campaign” (19%).

- Many said they needed help making adaptation action a priority in their communities at a time of constrained human and financial resources.
- Communities need financial assistance and additional staff capacity: 77 percent noted that they do not have the resources to integrate climate preparedness across their departments, although they would like to.

Increased coordination, collaboration and resource sharing is a high priority.

- Representatives from government at every level identified a need to work across disciplines, agencies and organizations on this issue.
- Projects undertaken at a regional level—in a watershed or within the jurisdiction of a regional planning commission, for instance—are beginning to deliver tangible results and are benefiting from economies of scale.
- Climate adaptation-focused networks are rapidly developing within and between Northeast states. Their aim is to connect data “providers” with “consumers,” avoiding duplication of efforts and conducting knowledge transfer
- Partnerships with NGOs, universities and/or the private sector have been vital to the progress of many existing community climate preparedness efforts.

Types of Adaptation Actions

Various guides to action, new innovations in analyzing benefits and costs of action and other advice on adaptation are using some form of the following to think about overall choices: Given a risk, we can:

1. Ignore it (no action),
2. Fortify against it,
3. Accommodate it or
4. Retreat from it

For a simple example, consider a river or flood risk. It can be fortified against with seawalls or levees or flood-proofing of structures to some height. Or the water-borne risk can be accommodated by elevating structures so as to let high water flow through them. Or property can be abandoned through some means—such as buyouts—to remove the exposure and hence the risk. Or the risk can be ignored.



In reality, many such adaptive decisions are even more complicated. Floodgates that only close off first level building openings or underground entrances (such as to subways and garages) are beginning to be designed for critical facilities that cannot be protected any other way if future water is sometimes higher. These adaptive bets are costly but the risks in damages and disruption of community functions and economic activity may be even greater. At the same time, as Gilbert F. White, the voice of modern flood management, began to argue in the 1930s, reliance on structural solutions alone to fortify against nature's forces has not been adequate as a sole human adjustment strategy.

This guide cannot instruct you on how to analyze each specific risk and actions to be designed and evaluated in response, but we provide a framework for understanding and organizing potential actions and priorities, some of which may warrant detailed analysis of risk versus benefits and operational feasibility.

The Scope of Adaptation Actions

Many local officials and staff will have experience with some adaptation actions given that hazard mitigation like floodplain regulation, not to mention land conservation in vulnerable locations, are among the much larger array of tools. This section gives you an overview of how existing actions as well as new and even innovative ones fit into adaptation strategy.

It is useful to think about developing planning objectives for adaptation and then developing and prioritizing strategies of action to meet each objective. The City of [Chicago's Climate Action Plan](#)

presents a format that can apply to most communities, large or small. For example, consider the objective of protecting a downtown street network where access could be impaired or blocked by increasing stormwater or coastal flooding events indicated by the vulnerability and risk assessment. This may be important from an economic as well as safety standpoint for all communities.

Strategies can range from improving drainage, to accommodating more water periodically, ([Copenhagen](#) has done this for an entire neighborhood) to elevating roads. Actions must be tailored to each local situation and needs, including its resource capacity. Existing public efforts such as stormwater management (SWM) and construction requirements for development must be assessed in terms of whether non-stationary (changing) climate conditions should be addressed on top of already existing hazard risks.

A recent 2012 report supported by NOAA on [Cost-Efficient Climate Change Adaptation in the North Atlantic](#) includes many examples from New England states of emerging action. It classifies actions into twelve (12) types that are summarized as six here for brevity:

1. Plans
2. Administrative/Process
3. Local Internal Policy
4. Local Regulation/Law
5. Gray Infrastructure
6. Green & Natural Infrastructure

1. Plans:

Most of the newly published guides to adaptation planning from federal and some state agencies suggest that the local comprehensive land use plan should be amended to take climate change into account in its policies for future development. The modern view of planning in the profession recognizes that local development futures are the product of an [ecology of plans](#) (Hopkins and Zapata 2007)—some public and some the result of nonprofit and private entities. At the very least, local comprehensive plans and local Hazard Mitigation Plans should be linked, but they often are not. New England is also the home of the land trust movement in America, and those organizations' plans are crucial to maintaining critical natural infrastructure in open spaces. In recent years local land use and land trust plans have become more coordinated than before, but all need to address climate. Even beyond that, the plans of major private and quasi-public enterprises including utilities and hospital complexes need to have consistent approaches to adaptation.

2. Administrative Process and Local Internal Policy:

One of the abiding lessons of Hurricane Irene for the State of Vermont has been the need to take account of river corridor (fluvial) dynamics at every level of decision—from

designing new roads to repair and maintenance of drainage, rip-rap and other elements that have often been handled one way out of habit. The state DOT (VTrans) is leading an effort to provide guidance and training support on these practices, including climate future considerations, to the many small towns in Vermont. In New Hampshire some state environmental regulations regarding stormwater management on new construction have been amended to require considering available information on future climate-driven precipitation. A growing number of local planning boards are adopting internal policies to consider climate adaptation needs for major development projects consistent with their comprehensive plans. Considering best available information about future change is an internal policy that can be adopted locally for maintenance practices, for capital improvements programming and other functions. One decision of this type for coastal and tidal river communities is to reexamine the Mean High Water (MHW) and Mean Higher High Water (MHHW) standards used for planning, capital public works and regulation—to take into account new SLR conditions combined with astronomical and king tides. This change in the standard can affect existing and new shoreline setback regulations.

3. Local Regulation:

Enhancing floodplain elevation requirements with freeboard (extra height) above the NFIP base flood elevation (the one percent return probability or 100-year flood) has been mentioned earlier as a prudent strategy using existing tools. Some New England communities are also adopting innovative mechanisms to support this important adaptation. One supportive tool is to compile and make available to landowners a flood zone home elevation database. Because elevation can conflict with structure height limits in the zoning ordinance, another mechanism being tried in some jurisdictions is to provide for height limit waivers when freeboard is voluntarily incorporated into construction. One locality has adopted a freeboard incentive program where landowners electing to add elevation receive a modest rebate of \$500 on fees and permits. Given the flood and storm surge moderating effect of wetlands (discussed under natural infrastructure below), enhanced setback or buffer requirements around wetlands as well as existing federally-defined floodplains are important adaptation measures for some local situations. As always, regulatory changes can be challenging for local government and constituents but well-targeted measures can enhance and leverage adaptation strategies. Cluster zoning, subdivision and planned unit development regulations are frequently listed as an adaptation strategy, but depend again on local landscape conditions and opportunities to preserve mitigation benefits of that landscape through design of the land use project.

4. Gray Infrastructure:

Taking account of future changing conditions is increasingly important to the hard public infrastructure maintained by local government: anything involving pipes and culverts, wastewater and water facilities, streets and roads. Increased precipitation in

New England is having subtle and hard-to-measure effects on the working life of infrastructure and hence the costs to local, state and federal funders. However, we have already experienced new road washouts from non-disaster rainfall events, increased maintenance and clean-up costs from both winter and non-winter storms including ice storms, future threats to fixed facilities like coastal wastewater works requiring new decisions about their future maintenance and even location, and many instances of public as well as private stormwater and drainage installations failing. Taking future conditions into account in capital investment is an important frontier and needs to be part of annual budgeting as well as capital improvements programming deliberations. Another vital aspect of adaptation of gray infrastructure is linking it to green and natural infrastructure. Green infrastructure—designed measures to retain stormwater on-site—and natural infrastructure—preservation of the runoff- and flood-moderating functions of wetlands and floodplains—increases the resilience of gray infrastructure.

5. **Green & Natural Infrastructure:**

Green infrastructure such as Low Impact Development (LID) measures discussed earlier have become a common practice in smart growth development as well as a response to NPDES Phase II stormwater requirements. Open space preservation for multiple purposes and benefits has long been a high concern for New England communities and a region that is the national birthplace of the local land trust institution. As noted in discussing gray infrastructure, all of these elements need to be tied together as part of adaptation. The benefits of protecting the hydraulic (water management) functions of floodplains and wetlands have been discussed, but another object lesson from the Irene experience in Vermont is worth noting here.

The behavior of Otter Creek during Hurricane Irene provides an important lesson about how Vermont and other states could *enhance* flood resiliency. The Otter originates in the foothills of the Green Mountains and runs through Rutland and Addison counties before it empties into Lake Champlain. During Tropical Storm Irene, river flow rates measured at the gauge in Rutland spiked to over 18,000 cubic feet per second (cfs). The river was nine feet above flood stage and nearly four feet above the previous record. Forty river miles downstream in Middlebury, the Otter flows right through the center of town. A flow rate of 18,000 cfs there would have devastated the downtown. Instead, the creek's peak discharge rate barely exceeded 6,000 cfs.

This dampening of the Otter's flow was no accident. Between Rutland and Middlebury, floodwaters spilled onto intact areas of floodplain, slowing down and releasing energy. Much of the floodplain in this area is in agriculture, but there are also extensive intact wetlands, including thousands of acres of seasonally flooded forested swamp, which soaked up river flow and released it slowly over days. The Otter's floodplains and wetlands act as a first line of defense against downstream flooding, significantly reducing property loss and

public safety risks.” (See: Vermont Agency of Natural Resources. 2011. [Resilience: A Report on the Health of Vermont’s Environment: p.8.](#))

In some cases retreat—converting a currently human-occupied area to natural infrastructure—may be necessary. Coastal communities subject to sea level rise and riverine communities with highly vulnerable but occupied floodplain areas are more frequently considering buyouts of properties after catastrophic flooding. This little-used practice began to be considered more seriously after the Great Midwest Floods of 1993 in which the U.S. Army Corps of Engineers and the U.S. Department of Housing and Urban Development took unprecedented action to pursue buyouts. Rolling easements are now a technique being examined for both phased buyouts where expected future conditions of inundation from sea level rise call for retreat. Strategic protection of areas that may be future storm-moderating wetlands is also now being considered. For example, the New England EFC sponsored an initial study of such protection priorities in the Ipswich River Basin of Massachusetts in 2015, using MAST (Marsh Adaptation Strategy Tool) which is based on the COAST tool mentioned earlier.

In sum, the positive news is that New England localities have many landscape assets and benefits that can be tapped to increase adaptive resilience, opportunities to work with neighboring local governments to maximize those benefits, and possible actions that can have multiple benefits at the same time.

Prioritizing Adaptation Choices



Once adaptation actions are identified and evaluated for their applicability to local needs, communities are faced with the challenge of deciding on the priority and the timing of possible actions. This is an emerging area of practice. For example, the [COAST or Coastal Adaptation Sea Level Rise Tool](#) is

designed to help evaluate a small number of adaptation alternatives for a given area for sea level rise, storm surge and flooding expected damages. The costs of the adaptation actions analyzed are compared to the avoided damage costs of no-action to aid decisions.

But even before such an analysis is done, a community must scope out the range of adaptation work that may be needed based on vulnerability and risk assessment, and other considerations. For example, a low-probability but high consequence risk, such as a new flood extent beyond experience with 100-year and even 500-year events, may be a priority for an area whose function is critical to the community such as water and wastewater facilities, hospitals, or roads that provide the only access to residential areas. But otherwise, the costs of addressing such a risk may not be warranted.

Such possible effects are illustrated by Superstorm Sandy in 2012 by Hurricane Irene's impacts on Vermont and Connecticut. The current standard of the "100 Year" flood, which is the most widely accepted risk level and embodied in federal, state and local legislation, has already been surpassed in many places.

Timing and the no-regrets approach discussed earlier are also considerations, as is the feasibility of taking action

COAST in Action

In summer 2011 the US EPA's Climate Ready Estuaries Program awarded funds to the Casco Bay Estuary Partnership (CBEP) in Portland, Maine, and the Piscataqua Region Estuaries Partnership (PREP) in coastal New Hampshire, to further develop and use COAST in their sea level rise adaptation planning processes. The New England Environmental Finance Center worked with municipal staff, elected officials, and other stakeholders to select specific locations, vulnerable assets, and adaptation actions to model using COAST. The EFC then collected the appropriate base data layers, ran the COAST simulations, and provided visual, numeric, and presentation-based products in support of the planning processes underway in both locations. The Coast in Action report helped galvanize support for the adaptation planning efforts. Through facilitated meetings they also led to stakeholders identifying specific action steps and begin to determine how to implement them. (Merrill, 2012).

with available resources, existing organization and ongoing practices, such as the maintenance of infrastructure. Another element of timing discussed earlier is the avoidance of actions that preclude or block adaptation measures in the future when they may be needed. The monumental example of this is the continued major urban development at the water's edge in many parts of Florida and the Gulf Coast without long-term adaptation built in where sea level rise is a known future.

The task of exploring, debating and setting community-wide adaptation strategies is not solved by the old method of setting risks and choosing to act on those of highest expected value (i.e. losses). Following is a simple framework that distills emerging ideas about this challenge.

Consider the following table that outlines three major considerations for thinking about adaptation actions **using a hypothetical situation** in a municipality. Three likewise hypothetical but representative adaptations are to be evaluated, each of which has been identified as potentially needed. The first is a coastal road in a downtown that is likely to be vulnerable to more frequent and deeper flooding in major storms that occur at highest tides. The second action involves the different matter of making road and drainage works maintenance and repair decisions that take into account changing climate-driven water hazards. The third is protection of a critical floodplain from hydraulic modification.

The first of the three factors to consider in prioritizing these actions is the level of risk, which is the product of both likelihood and magnitude of impact. To this can be added the criticality of what is exposed to the risk. Criticality may mean a road segment that provides the only access to an area, or best access to a critical facility such as a hospital, or is simply in a critically important location such as a central business district. Second of the three factors is the resource capacity of the community. That includes the fiscal capacity to pay for adaptation, but like any expenditure matter, also includes the administrative and political feasibility of acting. Third and final is that issue of timing, so uniquely important to longer-term climate adaptation. Can an action be taken later? Are some actions best taken now because postponement may just increase costs?

As Hurricane Sandy was whipping the Eastern Seaboard, leaving Manhattan below the Empire State building partially flooded and almost entirely without power, New York Governor Andrew Cuomo wryly told President Barack Obama that 'We have a 100-year flood every two years now.'" (Source: G. Wagner & M. Weitzman. 2015. [Climate Shock: The Economic Consequences of a Hotter Planet](#), Princeton University Press)

Factors:	Action 1-Move a Road That is Critical Access	Action 2-Adapt Ongoing Repairs	Action 3-Protect a Critical Floodplain
Risk & Importance	Very High Impact Uncertain Future	Small Risk Each Year But Costs Add Up	Moderate or Greater Flood Mitigation Potential
Feasibility	Expensive, Low	Could Modify Repairs for Resilience	May Require Purchases- Could Have Co-Benefits
Timing: Now, Later	Can Wait and See for Awhile	Sooner Saves More in Longer-Run	Has Benefits Anytime, But Not If Conversion Happens

Action 1 represents that road that provides important access to downtown economic, service and employment activity. It is highly at risk if conditions deteriorate to a high level over the next several decades but less so if flooding and sea level rise do not increase at the fastest pace. Adapting this infrastructure will be very expensive—whether through elevation or realignment of the road or armoring the area—and will involve costs and controversy with numerous landowners. However, there is still time to monitor trends and build understanding and support for action that may be needed.

Action 2 represents all the year-to-year maintenance and repair decisions made concerning road, drainage and facility infrastructure. The opportunity here is to repair it back better to take changing climate into account—for example, increasing culvert and other drainage capacities, or modifying vulnerable areas of facility structures during maintenance. These are many small actions that if managed to take future climate into account may add up to valuable avoided future deterioration or damage over years. Although this may cost more, it is incremental and prudent and can be managed internally. However, one issue is that state and federal sources of assistance can provide obstacles to changing practices and funding their costs. The sooner the changes in practice are put into effect if possible, the more cost may be avoided in the future.

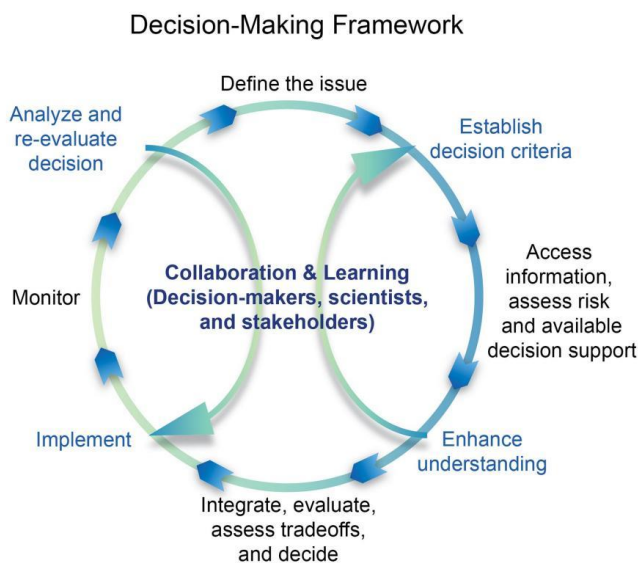
Finally, **Action 3** involves protecting a floodplain as natural infrastructure for flood control, as described earlier in the Otter Creek case in Vermont during Hurricane Irene. National Flood Insurance Program participation requires that structures in the floodplain be elevated to the 100-year return flood level but that of course does not provide the natural floodwater control that open floodplains provide. Preserving critical floodplains as well as wetlands where the largest volumes of water may be captured makes sense for current hazards let alone greater ones in the future. Once floodplains are converted to a built scenario, reversal is very expensive—although in the aftermath of the Great Midwest Floods of 1993 such buyouts to restore river capacity have become more frequent. Existing floodplain and wetland protection is in fact of some urgency. One favorable aspect for feasibility is that such areas have co-benefits as open space for human enjoyment and as buffers protecting both water quality and biodiversity.

The above exercise using a hypothetical set of circumstances demonstrates the merit and urgency of different adaptation actions that require multiple considerations. Such a process is necessary to identify those actions that require more detailed and expert cost-benefit analysis and investigation of how to pay for action.

Monitoring

Monitoring plays an important role in climate change adaptation. Climate adaptation monitoring is an ongoing process because natural, social, political and economic conditions constantly change. Ongoing monitoring is a key component of the climate adaptation framework. There are two basic types of monitoring:

- 1) **Implementation monitoring** is used to assess whether the objectives and goals previously set have been achieved. The implementation monitoring is focused on an internal review of community’s accountability, team structure, performance, legislative barriers and financials aspects.
- 2) **Impacts monitoring** is used to collect data about essential climate variables such as temperature, humidity, sea level rise, stormwater, wind speed, natural disasters, precipitation etc.



Source: U.S. National Climate Assessment (2014)
[Responses / National Climate Assessment](#)

Using a Decision-Making Framework

The term “adaptive management” is used to refer to a specific approach in which decisions are adjusted over time to reflect new scientific information and decision-makers learn from experience. The National Research Council (NRC) contrasts the processes of “adaptive management” and “deliberation with analysis.” Both can be used as part of an “iterative adaptive risk management framework” that is useful for decisions about adaptation and ways to reduce future climate change, especially given uncertainties and ongoing advances in scientific understanding. Iterative adaptive risk management emphasizes learning by doing and continued adaptation to improve outcomes. It is especially useful when the likelihood of potential outcomes is very uncertain. An idealized iterative adaptive risk management process includes clearly defining the issue, establishing decision criteria, identifying and incorporating relevant information, evaluating options, and monitoring and revisiting effectiveness. Source: GlobalChange.gov

The [*Guide and Workbook for Municipal Climate Adaptation, Canada, ICLEI*](#) lays out a process for how to monitor a community adaptation effort successfully. Based on collected data, modifications can be made if necessary. A properly planned and implemented monitoring program should include multiple tools and consider a variety of processes and systems so it can provide input to the adaptation strategy and vulnerability assessment.

Three steps for successful monitoring:

- 1) *Assess new information and review drivers:* Consider whether and to what extent there has been a change in political leadership, public opinion, or economic factors that may have had an effect on the community's adaptation efforts, and may have constrained implementation progress.
- 2) *Track implementation progress and select actions:* Tracking results is an important part of the climate adaptation process to see if progress has been made to move closer to the set goals and objectives. Tracking of the community's progress can provide valuable data to update the implementation status of the adaptation actions, and to identify whether these actions that are helping to improve adaptive capacity and achieve the climate adaptation vision.
- 3) *Evaluate the effectiveness of actions:* Use indicators that reflect the baseline against which to measure the effectiveness of community's adaptation actions. The indicators also help to assess how your community's vulnerabilities are changing based on implemented actions and whether these actions increase or decrease your community's adaptive capacity or sensitivity to climate change impacts.

3. Financing Adaptation



In an era when public budgets are already highly stressed, finding the funding to take action can be extremely difficult. In the absence of the kind of national leadership that led to the creation of the interstate highway system, finding the funds to pay for adaptation will require creativity and innovation. While a great deal of effort has gone into developing resource materials to help communities identify vulnerabilities, assess risks, and choose appropriate adaptation actions, the subject of financing all this activity has received little attention nationally. State and local governments have developed approaches unique to their circumstances, increasingly innovative, and some of which may be applicable elsewhere.

In this section we summarize state and local government approaches that may be applicable, the drawbacks of the “disaster” approach to adaptation, and finally suggest some possible areas where innovative approaches may be developed.

The financing of adaptation has historically been focused on the post disaster recovery process through the Federal Emergency Management Agency (FEMA) and the President’s Disaster Relief Fund. Many communities undertake few adaptation actions on their own except to voluntarily comply with the National Flood Insurance Program (NFIP) Community Resilience Standards Program. Many communities expect to deal with any disasters that occur with NFIP subsidized insurance policies for residential landowners, and FEMA Public Assistance funds to state and local agencies for major disasters.

The NFIP is just one of four major insurance sources for damages from flooding:

- Private property and casualty insurers: cover private properties, but property and casualty insurers exclude flood damage having shifted all that risk to the NFIP. And not all property owners have flood insurance: the rate is estimated to be between 50% to 75% of landowners in designated flood hazard areas under the NFIP. Unless the property has changed ownership and mortgagors have required it, many vulnerable properties remain uncovered.
- Property and casualty Insurers: provide protection against risk to property, such as fire, theft, or weather damages, in the form of specialized type of insurance for a variety of disasters (flood, earthquake, etc.).
- Reinsurance: or the insurance that insurance companies buy against major disasters that require payments in excess of reserves.
- Self-insurance: If a federal disaster is declared, the state and local governments are on the hook for 10% to 20% of the costs of recovery. If a federal disaster is not declared, then

state and local governments must pay all the public sector recovery costs, including debris cleanup and removal, repairs to infrastructure and the personnel costs of the disruption.

There is no systematic accounting of the public's self-insurance exposure to disasters, but estimates are that the Federal Government currently spends about \$400 per person per year in disaster payments. New England's share of this spending would be \$5.9 billion. Payments by state and local governments for damages are not available for New England.

The "Disaster Approach" is waiting for the losses and seeing what happens. That approach has the virtue of placing little stress on current resources, and the federal commitment to recover from major disasters like Hurricanes Sandy and Irene has shown that, at least for the largest events, it may make some sense. But consider that the amount of money that the Federal Government has set aside to cover disasters in any one year is less than 10% of current needs. The rest comes from borrowing. Add to this the likelihood that the frequency and severity of damaging weather will increase and what have been minor damages that could be fixed within regular budgets will become much more routine. The desirability of relying on the disaster approach begins to diminish.

Innovative Financing Opportunities

Much like the best workshops on how to control your personal finances, successful adaptation finance depends on re-examining how you think about it. The following are some considerations:

Build adaptation into what you are already doing:

- Planning for facilities routinely incorporates life cycle costing, but life cycle costing rarely incorporates uncertainties like climate change and sea level rise,
- Many options for adaptation, such as armoring and buffering, create external benefits which, if monetized, could help pay for adaptation,

The [Congressional Research Service Report](#) of January, 2015, raises the question of whether Congress will change FEMA's policy to automatically replace local and state infrastructure lost to flooding and extreme events.

"Since 1953 the number of declarations issued each year has steadily increased. For example, the average number of major disaster declarations issued from 1960 to 1969 was roughly 19 per year. In contrast, the average number of major disaster declarations issued from 2000 to 2009 was 56 per year. The highest number was declared in 2011, with 99 major disaster declarations.

Declarations are of congressional concern for at least two reasons: (1) congressional oversight of appropriations and the federal budget has led to an awareness of expenditures for disaster assistance, and (2) some are skeptical that declarations are solely made to provide disaster relief. They argue that declarations have become political tools—especially during election years—to gain political favor. Advocates of this position point to incidents which, in their view, could have been handled without federal assistance."

Source: [Congressional Research Service](#)

- Every year there are routine maintenance, repair, and upgrades to facilities; consider including adaptation measures in these,
- Taking sea level rise and climate change into account could increase resilience.

Redirect Flow of Funds

- In a variation on the long standing concept of industrial revenue bonds, state and local governments have been issuing “green bonds” to support environmental projects including renewable energy developments. Extending the concept to adaptation actions could be possible. Nearly \$3 billion in bonds have been sold globally, and US states like Massachusetts, Hawaii, Connecticut, CA and some others are leading the way. Exponential increases are expected in the issuance of green Bonds in the coming years.
- Many states and local governments have land conservation funds designed to protect scenic resources, wildlife habitat, etc. Such funds could be used for purchasing buffering lands or to reserve lands for possible retreat in the future.
- Estuarine Restoration: Federal, state, and local funds are flowing to restoring estuaries to natural conditions. In many locations these could be a prime source of buffering lands.

Massachusetts is clearly leading the New England states in using issue green bonds. The state has sold two rounds of green bonds to date, the first round in June 2013 was for \$100 million followed by a second round in September 2014 for \$350 million. The state received more bids than it could accept during the second round of sales.

Until these green bonds were available, local governments and city agencies in Massachusetts were using conventional bonds and risky tax hikes, like the rest of New England is still doing. Green bonds are used for many purposes including: Land Acquisition, Open Space Protection & Environmental Remediation, River Revitalization and Preservation & Habitat Restoration, Energy Efficiency & Conservation, and Clean & Drinking Water.

Connecticut issued a \$60 million green bond to its municipalities in November of 2014. Going forward, CT plans to issue more "green bonds," tying them specifically to environmentally friendly projects including energy efficiency, sustainable land use and waste management, conservation, clean transportation, and clean water or drinking projects. Connecticut anticipates that over 120 municipalities will take advantage of the funds being directed to the Clean Water Program.

Reference: [Mass Green Bonds Impact Report, January, 2015](#)

- Investing in protective infrastructure can be cost effective. Grey infrastructure like levees and dams, or increasingly, Green Infrastructure such as wetland creation or protection, porous pavement, bio-swales and green roofs can contain extreme weather events or lower damages.
- When there is an increase in municipal property values or investments, the resulting increase in tax revenue is a “tax increment”. Tax increment financing can be used for critical natural infrastructure projects, and can be part of a climate action strategy. If properly designed, a project using tax increment revenue can be self-financing.
- Catastrophe Bonds are a recent innovation to provide backing to insurance and reinsurance companies. The funds might be adaptable to investment by municipal bond banks in order to raise funds for adaptation.
- The largest water systems investments in the U.S. currently are for managing water quality impacts of stormwater disposal. In addition to incorporating climate change into the design of these efforts, stormwater management could be part of adaptation.

Undertake Organizational Innovation

New organizations may be needed to fund adaptation. Towns in which a major portion of their tax base consists of properties likely to be damaged or destroyed by sea level rise may need to create larger taxing jurisdictions to back bonds. Special taxing jurisdictions, such as [Levee Boards in Louisiana](#) might be created to fund adaptation measures with necessary state enabling legislation. But short of statewide institutional change, local governments have tools for action. The Long Creek Watershed Management District in Maine (see sidebar) is an innovative example in the New England context of using a traditional mechanism—benefit assessment districts—in new ways. Appendix D here, on information tools and needs, also includes a case study of the southern Maine Sea Level Adaptation Working Group (SLAWG) and other examples of organizational innovations in New Hampshire and Florida created to acquire needed information and technical assistance which can also form the basis for organizing further funding mechanisms, especially on a multi-jurisdictional basis.

Insurance and Self Insurance

- Developing an accurate picture of the extent of self-insurance and developing costing models that send the right price signals would provide a much more complete picture of financial exposure.
- A comprehensive four-layer insurance scheme may lessen the impact to individuals:
 - The first layer is individual self-insurance (this is equivalent to the deductible on an insurance policy) to reduce moral hazard. The amount of self-insurance could vary with income.

- Layer two is the purchase by homeowners of private disaster insurance (they conceive of an all-hazards policy bundled with traditional homeowners coverage).
- The third layer is reinsurance and catastrophe bonds purchased in the private market by primary insurance companies. The fourth layer is a form of government backstop against truly large losses, either in the form of a state fund, multistate pool, and/or federal reinsurance for catastrophe layers. The authors of this scheme (Kunreuther and Pauley 2006) suggest that this layering scheme would need to be coupled with restrictions on disaster aid; assistance for low-income homeowners, and adoption of risk reduction measures, such as building codes and land use regulations (Kousky, 2012).
- Congress recently asked the National Academy of Sciences to investigate the idea of “community-based flood insurance” in which an entire local jurisdiction would have some level of coverage, priced according to their mitigation efforts—rather than relying only on individual landowner insurance policies. This is an idea akin to the fourth layer noted, on a local basis. Localities currently can participate in the Community Rating System (CRS) incentive of the NFIP which reduces individual land owners’ insurance costs for the federally-backed coverage based on mitigation efforts. But less than 10 percent of the 19,492 municipalities and 3,033 county governments in the U.S. Currently participate in the CRS hazard mitigation incentive.

Available Financing for Adaptation



Available financing for adaptation efforts have not kept pace with the demand for Federal, state and local needs. EPA has estimated that nationally, more than \$600 Billion is needed nationally during the next 20 years to maintain and improve its water infrastructure. Currently, most funding is provided by FEMA after presidentially declared disasters, and there are some other grants and funds available from FEMA for hazard mitigation planning and

implementation that are administered by state agencies. But this doesn’t address the national demand for water infrastructure programs. There are also Small Business Administration Disaster Loan Programs, Clean Water Act Section 319 grants to Tribes, Army Corps of Engineers Flood Control Works and Emergency Rehabilitation and Emergency Streambank and Shoreline Protection programs, and Small Flood Control grants.

States vary with their programs to assist their municipalities with available funds for adaptation purposes, some of which includes funds for water infrastructure. Massachusetts has issued two rounds of Green Bonds available for critical infrastructure replacement and in 2014 Governor Patrick announced a \$50 million grant program mostly for cities and towns to shore up protections around energy services, and some for critical coastal infrastructure and dam repair. Connecticut has also offered green bonds to their cities and towns.

But some relief may be on the way in the form of a new initiative by the Obama Administration's Build America Investment Initiative that was launched in June 2015. It a new program to create opportunities for state and local governments to expand Public-Private Partnerships and to increase the use of federal credit programs. The new Water infrastructure and Resiliency Finance Center recognizes the effects of climate change on communities' water infrastructure and is building on the states' familiarity and success with the State Revolving Fund programs to explore innovative financing tools, PPPs and non-traditional finance concepts. It will encourage the financing of climate-resilient water infrastructure projects that integrate water efficiency, water reuse, and green infrastructure. ([Water World, 2015](#)).

The Obama administration also proposed the Qualified Public Infrastructure Bond (QPIB) as a new financing option for communities that combines public ownership and private sector management and operations expertise that currently cannot reap the benefits of municipal bonds. "QPIBs will extend the benefits of municipal bonds to public-private partnerships, like partnerships that involve long-term leasing and management contracts, lowering the cost of borrowing and attracting new capital" A similar existing program, the Private Activity Bond (PAB), has been used to support financing of more than \$10 Billion for roads, tunnels and bridges. The QPIB had a long legislative process to negotiate, with hearings beginning with the House Ways and Means Committee and the Senate Finance Committee ([WaterWorld, 2015](#), and [The Public Finance Tax Blog](#)).

"Unlike PABs, the QPIB bond program will have no expiration date, no issuance caps, and interest on these bonds will not be subject to the alternative minimum tax" said the White House. "These modifications will increase the QPIBs impact as a permanent, lower-cost financing tool to increase private participation in building the nation's public infrastructure"

White House (2015)

A list of grant funding available for implementation of climate change adaptation projects and programs can be found for each New England state in Appendix D. The matrix for each state describes the state specific programs mentioned above as well as FEMA's existing programs and other federal and private sources of funding. These sources are subject to change as new programs emerge and existing ones amended.

Stormwater Utilities – Opportunities for Innovation

Stormwater Utilities are an example of just one innovation for local response to fund stormwater management, which is a climate change issue. New England climate trends discussed in this Guide only point to more demands placed on stormwater management in the future. With less than two-dozen such utilities in effect in New England localities, they present a vital example of possibilities for innovation. Around the country, some limited innovations like watershed funds, also suggest the challenge of funding a spectrum of actions to manage water.



Unmanaged stormwater runoff from extreme weather events can create 3 major problems for communities and regions:

- 1) flooding from large volumes of water in a short amount of time,
- 2) water pollution from the contaminants the water is carrying, and
- 3) repair costs of water infrastructure that stresses municipal budgets

Creating local stormwater utilities can help fund the cost of stormwater management, including regulatory compliance, planning, maintenance, capital improvements, and repair and replacement of infrastructure. Local governments are using funding from the stormwater utility mechanism to employ techniques like low impact development (green infrastructure in combination with grey infrastructure) that allow infiltration, evapotranspiration, and reuse of stormwater, to manage the potential harm from pollution loading into water bodies and overloading of local drainage systems. Improved and systematic stormwater management is a part of better flood management, especially if changes due to climate trends are incorporated, and hence part of adaptation. A number of New England states are requiring consideration of changing precipitation conditions due to climate in their stormwater regulations that local governments must follow and which represent state level compliance with the Clean Water Act.

All the New England States have enabling legislation for forming stormwater utilities, but the states vary with regard to the number of utilities they have. Massachusetts is leading the pack with 7 stormwater utilities that are working in cooperation and sharing resources. Maine has 5 utilities, including one in the state's largest city, Portland, and Vermont has 3. Rhode Island has a number of planned utilities, including one that would bring together 9 municipalities in a regional approach, and several New Hampshire towns are exploring options.

**Greenland Meadows Commercial
Development,
Greenland, NH**

A shopping mall in New Hampshire was developed using a LID stormwater design, porous pavement and a built gravel wetland to achieve a zero-net discharge. Construction costs were 11% less than conventional construction costs because the need for large drainage pipes or curbing was avoided. Porous pavement by itself costs more than traditional asphalt pavement, but considering the **TOTAL** costs of LID projects often make them economically feasible and preferable. This development was not (at the time) part of a stormwater utility, but the big box stores in the mall were keenly aware that they may in the future be asked to pay a stormwater utility fee based on their impervious surface, therefore pre-empting future costs.

Source: University of New Hampshire Stormwater Center

Most of these states are exploring stormwater management options based on their need to alleviate flooding issues as well as compliance to regulatory requirements, and the concept has been expanded in some areas of the nation to create watershed funds to deal with water systematically, including addressing climate adaptation needs.

The [**Local Government Stormwater Financing Manual**](#) by the EPA Region 3 Environmental Finance Center at the University of Maryland provides a foundation for local officials to “move forward by focusing on perhaps the most important financing attribute: leadership and the ability to move communities towards effective action”. The manual takes municipal leaders through the process of being effective and creating policies and programs to finance new stormwater utilities.

Stormwater Utility Case Study

#1: The Long Creek, Maine, Watershed Management District is an example of innovative leadership and organization. The Long Creek Restoration Plan was the result of a two-year collaborative effort of four municipalities, area businesses, nonprofits and state agencies. By 2009, Maine was requiring all property owners of 1 impervious acre or more to be permitted. The state offered a voluntary permit option for property owners within the watershed. District members represent 91% of the impervious cover in the watershed. Funding for the program is achieved through the commitment of participating landowners to pay \$3,000 per impervious acre for the next 10 years. Participants are saving up to half of what they'd spend on an individual permit, and credits are offered for landowners who install BMP's (like impervious surfaces, raingardens, gravel wetlands, and other green infrastructure), or take on maintenance or "good housekeeping" tasks. THE Funding program has also been leveraged – the utility received \$2 million in ARRA funding for two demonstration projects that provided proof of concept for pervious paving and streamside plantings. Other grant support included EPA 319 and Maine Department of Environmental Protection funds which made planning the plan development stakeholder engagement possible.

(Environmental Finance Center, University of Maryland, 2014)

Stormwater Utility Case Study

#2: The City of Lenexa, Kansas, established three financing mechanisms to help cover the various costs associated with stormwater management. To help cover the capital costs of upgrading and repairing the existing stormwater system, voters approved in 2000 a 1/8th cent sales tax that would sunset within 5 years. The sales tax generated \$7.2 million dollars and voters were apparently so pleased with the stormwater upgrades that they approved an extension for another 5 years. To cover the long term operation and maintenance of the stormwater system, the City Council in 2000 approved a stormwater utility that collects approximately \$66 annually from residential properties and a fee from commercial and non-residential properties that is based amount of stormwater runoff generated by the property. The fee is collected as a special assessment on the Johnson County property tax bill. To cover the costs for increasing services and capacity in the stormwater system, the City in 2004 implemented a one-time fee "capital" development charge that developers pay when they apply for a permit. The idea is that "growth pays for growth."

Sources:

http://www.lenexa.com/rainandrecreation/about_us.html and

December 6, 2012 presentation by Jennifer Cotting, Environmental Finance Center, University of Maryland.

Conclusion

This Guide presents a way of thinking about climate adaptation as an extension to what local governments are already doing, and provides towns with resource links to assess, to plan, and to fund local adaptation plans.

The first step is to assess local vulnerability using tools that vary from the simple and free visualization type of tools, to a deeper assessment of local conditions. Building local support by engaging stakeholders in the process is the key to a successful planning process. The second step is to identify and prioritize adaptation measures. We suggest viewing these tasks as modifications or expansions of existing natural hazard mitigation efforts that communities already do, and to develop “no-regrets” programs. Finally, funding priority projects is the third and most difficult step for most communities. This guide lists traditional and innovative ideas and options, including new federal funding options for public-private partnerships, stormwater financing options, and unique funding sources available to the New England states.

References

Adapting to Climate Change: Planning a Climate Resilient Community. (2007). Keene, New Hampshire. Retrieved August 1, 2015 from:

https://www.ci.keene.nh.us/sites/default/files/Keene%20Report_ICLEI_FINAL_v2.pdf

Bagley, K. (2015, March 18). "FEMA to States: No Climate Planning, No Money." Inside Climate News Retrieved September 1, 2015 from: <http://insideclimatenews.org/news/18032015/fema-states-no-climate-planning-no-money>

Bierbaum, R., Holdren, J. P., MacCracken, M., Moss, R. H., Raven, P. H., & Schellnhuber, H. J. (2007). *Confronting climate change: Avoiding the unmanageable and managing the unavoidable. Scientific expert group report on climate change and sustainable development*, prepared for the 15th Session of the Commission on Sustainable

Development from: http://www.globalproblems-globalsolutions-files.org/unf_website/PDF/climate%20change_avoid_unmanagable_manage_unavoidable.pdf

Bøgeskov, L. (2013, August 29). "Danish capital adapts successfully to changing climate. Design to Improve Life." Retrieved September 30, 2015, from <https://designtoimprovelife.dk/danish-capital-adapts-succesfully-to-changing-climate/>

Canadell, P. (2014). A warmer and more polluted world. GCP: Global Carbon Project. CSIRO Marine and Atmospheric Research. Retrieved October 1, 2015, from <http://www.globalcarbonproject.org/>

Chicago Climate Task Force. (2011). Chicago Climate Action Plan. Retrieved August 1, 2015 from <http://www.chicagoclimateaction.org/filebin/pdf/finalreport/CCAPREPORTFINALv2.pdf>

Clean Air–Cool Planet (2011). *Preparing for the changing climate: a northeast-focused needs assessment*. Clean Air Cool Planet. Retrieved July 1, 2015 from: http://www.climateaccess.org/sites/default/files/CACP_Preparing%20for%20the%20Changing%20Climate.pdf

Chicago Metropolitan Agency for Planning (CMAP) "Climate Adaptation Guidebook for Municipalities in the Chicago Region", US Department of housing and Urban Development (HUD) Sustainable Communities Regional Planning Grant. www.cmap.illinois.gov

Colgan, C. S., Yakovleff, D., & Merrill, S. B. (2013). *An Assessment of the Economics of Natural and Built Infrastructure for Water Resources in Maine*. Portland, ME: University of Southern Maine. New England Environmental Finance Center.

Croope, S. V. (2009). "Working with HAZUS-MH." Newark, DE: University Transportation Center, University of New Delaware. Retrieved September 15 from http://www.researchgate.net/publication/40513088_Working_with_HAZUS-MH.

Cutting, J. (2012). Green Infrastructure Financing. Lecture presented during Growing Your Green Infrastructure Workshop at the University of Massachusetts-Amherst, December 6, 2012.

Emmer, R., Swann, L., Schneider, M., Sempier, S., Sempier, T., & Sanchez, T. (2008). *Coastal resiliency index: A community self-assessment*. Louisiana sea grant, Mississippi-Alabama sea grant consortium. Retrieved September 1, 2015 from Mississippi-Alabama Sea Grant Consortium website: http://masgc.org/assets/uploads/publications/662/coastal_community_resilience_index.pdf

Favero, P. (2014). *Local Government Stormwater Financing Manual: A Process for Program Reform*. The Environmental Finance Center, University of Maryland

Federal Highway Administration. (2012). *Climate Change and Extreme Weather Vulnerability Assessment Framework (FHWA-HEP-13-005 ed.)*. Washington, DC: US Department of Transportation.

FEMA Local Mitigation Planning Handbook. (2013). Retrieved September 1, 2015 from FEMA website: http://www.fema.gov/media-library-data/20130726-1910-25045-9160/fema_local_mitigation_handbook.pdf

Frumhoff, P. C., McCarthy, J. J., Melillo, J. M., Moser, S. C., & Wuebbles, D. J. (2007). *Confronting climate change in the US Northeast. A report of the northeast climate impacts assessment*. Union of Concerned Scientists, Cambridge, Massachusetts. Retrieved September 24, 2015 from: http://www.esf.edu/girc/library/documents/ConfrontingClimateChangeintheUSNortheast_2007.pdf.

Hayhoe, K., Stoner, A., & Swain, S. (2014). *The ICNet (Infrastructure and Climate Network) – Climate Maps*. University of New Hampshire, Engineering Research Center. Retrieved September 30, 2015, from http://theicnet.org/?page_id=46.

Hopkins, L. D., & Zapata, M. (Eds.). (2007). *Engaging the future: Forecasts, scenarios, plans, and projects*. Cambridge, MA: Lincoln Institute of Land Policy.

ICLEI. (2007, April 11). ICLEI's Climate Resilient Communities Program Addresses Adaptation, Vulnerabilities. Retrieved August 1, 2015 from: <http://www.iclei.org/details/article/icleis-climate-resilient-communities-program-addresses-adaptation-vulnerabilities.html>

Karl, T. R. (2009). *Global climate change impacts in the United States*. Cambridge University Press.

Kousky, C., & Walls, M. (2014). Floodplain conservation as a flood mitigation strategy: Examining costs and benefits. *Ecological Economics*, 104, 119-128.

Kunreuther, H., & Pauly, M. (2006). *Insurance decision-making and market behavior*. Boston, MA and Delft, NL: Now Publishers Inc.

Kunreuther, H., & Pauly, M. (2006). Rules rather than discretion: Lessons from Hurricane Katrina. *Journal of Risk and Uncertainty*, 33(1-2), 101-116.

Ledbetter, S. (2015, July 21), "Gov. Tours Hard-hit Central Vermont after Flooding Forces Evacuations". WPTZ..

Lindsay, B., & McCarthy, F. (2015). *Stafford Act Declarations 1953-2014: Trends, Analyses, and Implications for Congress* (R42702 ed.). Washington, DC: Congressional Research Service.

Massachusetts State Treasurer's Office. (2015). *Investing in a Greener, Greater Commonwealth - MassGreenBonds, 2013 Series D*. Final Investor Impact Report Boston, MA: State of Massachusetts Executive Department. From:
<http://www.massbondholder.com/sites/default/files/files/Second%20Green%20Report%20-%20FINAL.pdf>

Masterson, J., & Peacock, W. (2014). *Planning for community resilience: A handbook for reducing vulnerability to disasters*. Covelo, CA. Island Press.

Melillo, J. M., Richmond, T. C., & Yohe, G. W. (2014). Climate change impacts in the United States: the third national climate assessment. US Global change research program, 841. Retrieved September 1, 2015 from <https://data.globalchange.gov/report/nca3>

Merrill, S., P. Kirshen, D. Yakovleff, S. Lloyd, C. Keeley, and B. Hill. (2012). COAST in Action: 2012 Projects from New Hampshire and Maine. New England Environmental Finance Center Series Report #12-05. Portland, ME: Environmental Finance Center, University of Southern Maine.

Miller, K. (2015, August 3). New emissions limits for power plants go easy on Maine. *Portland Press Herald*. Retrieved from <http://www.pressherald.com/2015/08/03/obama-carbon-emissions-plan-to-have-limited-maine-impact/>

[Morin, Amy \(2014\). "13 Things Mentally Strong People Don't Do: Take Back Your Power, Embrace Change, Face Your Fears, and train Your Brain for happiness and Success" New York, NY., Harper Collins Publishing](#)

Pace, J. (2015, August 3). Obama's power plant regulations shove climate change into presidential race. *Portland Press Herald*. Retrieved September 30, 2015, from <http://www.pressherald.com/2015/08/03/obama-carbon-emissions-plan-to-have-limited-maine-impact/>

Peacock, W. Training Presentation, Texas A&M. University Hazard Reduction and Recovery Center.

Philip, A. (2014). "Sustaining Champions of Climate Adaptation in Coastal Communities: A Northern New England Study." New Hampshire Sea Grant. National Sea Grant College Program of the U.S. Department of Commerce's National Oceanic and Atmospheric Administration. Durham, NH: University of New Hampshire Sea Grant.

Schechtman, J., & Brady, M. (2013). *Cost-efficient climate change adaptation in the North Atlantic*. Storrs, CT: National Oceanic and Atmospheric Administration (NOAA) and Sea Grant and North Atlantic Regional Team, University of Connecticut.

Schwab, J. (2014). *Planning for post-disaster recovery: Next Generation*. Chicago, IL: American Planning Association. Retrieved September 1, 2015 from APA website:
https://www.planning.org/pas/reports/pdf/PAS_576.pdf

Smith, A., & Katz, R. (2013). US billion-dollar weather and climate disasters: data sources, trends, accuracy and biases. *Nat Hazards*, 67(2), 387-410. <http://dx.doi.org/10.1007/s11069-013-0566-5>

Technical Ad hoc Work Group. (2011, April). A Unified Sea Level Rise Projection for Southeast Florida. Retrieved September 30, 2015, from
<http://www.southeastfloridaclimatecompact.org/wp-content/uploads/2014/09/sea-level-rise.pdf>

UNH Stormwater Center. (2011). Greenland Meadows LID Case Study: Economics and Water Quality. Retrieved September 30, 2015, from <http://www.unh.edu/unhsc/recent-projects/greenland-meadows-lid-case-study-economics-and-water-quality>

Wagner, G., & Weitzman, M. (2015). *Climate shock: The economic consequences of a hotter planet*. Princeton, NJ: Princeton Univ. Press.

Appendix A: Climate Change Tools Resource Directory



Climate Adaptation Tools Resource Directory

New England Environmental Finance Center | February 2016

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Background and Purpose

A number of web-based and software tools have emerged in recent years to help local governments plan for climate adaptation and mitigation in their communities. This resource guide profiles the best of these tools, broken out into categories. For each tool, we specify the type of tool it is, its topical focus area, and a brief description of its purpose.

The categories of tools include:

- **Adaptation/mitigation modeling:** Computer-based models incorporate mathematics and physical data to understand and predict behavior. Mitigation models are used to understand the long-term risk and hazards of climate change to human life and property. Adaptation models are used to understand how to adjust to climate change (including climate variability and extremes) to moderate potential damage, and to take advantage of opportunities, or to cope with the consequences.
- **Decision-making:** Guides for possible paths of action or alternative paths with consequent tradeoffs.
- **Visualization:** Visual representation of data, to aid decision making including maps, charts, tables, videos, etc.
- **Datasets:** A collection of data records organized according to particular variables for computer processing.
- **Related resources:** Any charts, tables, or information that helps people understand climate related data.

Focus Areas:

- 1) **ASSESSMENT OF REGIONAL DAMAGES**
- 2) **CLIMATE DATA AND NATURAL DISASTER IMPACT**
- 3) **COASTAL SEA LEVEL RISE**
- 4) **WATER QUALITY**
- 5) **PLANNING AND CONSERVATION**
- 6) **RISK AND VULNERABILITY ASSESSMENT**

The Tools Resource Directory may also be accessed on the New England Environmental Finance Center's website [here](#).

1) ASSESSMENT OF REGIONAL DAMAGES

Name and Web Link	Organization & Weblink	Tool Type	Focus Area	Website	Description
Vulnerability Assessment Scoring Tool (VAST)	Federal Highway Administration	Decision Support	Assessment of Regional Damages	https://www.fhwa.dot.gov/environment/climate_change/adap	The tool was developed to help State DOTs, MPOs, and other organizations implement an indicator-based vulnerability screen. An indicator-based screen is one method for assessing vulnerability, and relies on two key premises: 1) Vulnerability is a function of exposure, sensitivity, and adaptive capacity. 2) Certain characteristics of assets can serve as indicators of their exposure, sensitivity.
Risk Management Strategies for Coastal Communities	US Army Corps of Engineers	Visualization tool and model	Assessment of Regional Damages	http://www.usace.army.mil/CompStudy.aspx	The Coastal Hazards System (CHS) is a coastal storm hazard data storage and mining system. It stores comprehensive, high-fidelity, storm response computer modeling results including climatology, surge, total water levels, waves, and currents and corresponding measurements. Extremal statistics and epistemic uncertainties of the processes are also stored, and the data
ICNet Climate Maps	Infrastructure and Climate Network (ICNet)	Visualization Tool	Assessment of Regional Damages	http://theicnet.org/?page_id=46	The ICNet created a series of maps to illustrate the projected changes in these precipitation and temperature conditions in the northeast U.S. as global mean temperature (GMP) increases.
Substantial Damage Estimator	FEMA	Decision Support	Assessment of Regional Damages	http://toolkit.fema.gov/tool/substantial-damage-estimator	The Substantial Damage Estimator (SDE) 2.0 tool was developed by the Federal Emergency Management Agency (FEMA) to assist state and local officials in determining "substantial damage" for residential and non-residential structures. The tool can be used to assess flood, wind, wildfire, seismic, and other forms of damage. It helps communities provide timely substantial damage
Climate maps and Data	NOAA climate.org	Visualization tool	Assessment of Regional Damages	https://www.climate.gov/maps	NOAA's website climate.org provides climate data and maps to visualize climate.

Name and Web Link	Organization & Weblink	Tool Type	Focus Area	Website	Description
Sea Level Rise: Understanding Applying Trends Future Scenarios Analysis and Planning	Massachusetts Office of Coastal Zone Management	Decision Support	Assessment of Regional Damages	http://www.s.gov/eea/doc/czm/stormsrt/slr-guidanc2013.pdf	The study provides background information on local and level rise, summarize the best available sea level rise and provide general guidance in the selection and level rise scenarios for coastal vulnerability assessments, and decision making.
GRANIT - Maps of Sea Level Rise in New Hampshire	University of New Hampshire	Visualization and model	Assessment of Regional Damages	http://www.granit.unh.edu/Projects/Details?object_id=264#	The impact of the higher 100-year flood elevations in Series of ten maps that cover the NH seacoast, Piscataqua and Great Bay. These maps show stillwater flood depths for flood elevations of six feet, nine feet, and twelve feet higher high water (MHHW). (MHHW is the average of high water elevation of each tidal day; values are NOAA.)

2) CLIMATE DATA AND NATURAL DISASTER IMPACT

Landfire	USGS	Decision Support, Model	Climate data and Natural Disaster Impact	http://www.landfire.gov/	The LANDFIRE Data Access Tool (LFDAT) is an ArcGIS toolbar developed by the Rocky Mountain Research Station and distributed by the Wildland Fire Management RD&A Fuels and Fire Ecology Program. The tool allows users to interact with the LANDFIRE Data Distribution Site and download LANDFIRE data directly from ArcMap.
Environment America's Weather Map	Environment America	Knowledge-sharing	Climate data and Natural Disaster Impact	http://environmentamerica.org/page/america/hi ng-close-home-global-warming-fueling-extreme-weather-a	The interactive extreme weather map shows disasters in the United States over the last five years and stories of the people and communities who have endured those disasters.

Name and Web Link	Organization & Weblink	Tool Type	Focus Area	Website	Description
CAKEX	Cakex – Climate Adaptation Knowledge Exchange	Decision Support, Visualization and knowledge Sharing	Climate data and Natural Disaster Impact	http://www.cakex.org/tools	The Tools section of CAKE directs you to the wealth of tools available online to help you process climate change information and make adaptation decisions. Climate change information can seem daunting but there are a lot of efforts underway to make it more manageable. Within each Tools entry, you can also find related Case Studies, Virtual Library resources, and Directory entries in the green sidebar; these links provide users with more detailed
StormsmartCoasts	Stormsmart Group -Climate Change Information	Visualization Tool, Model	Climate data and Natural Disaster	stormsmartcoasts.org/	Helps coastal professionals find and share information on weather and climate hazards.
USFS Climate Change Resource Center (CCRC)	USDA - Forest Service Climate Change Resource Center	Decision Support, Visualization Tool, Model	Climate data and Natural Disaster Impact	http://www.fs.usda.gov/ccrc/	A web-based, national resource that connects land managers and decision makers with useable science to address climate change in planning and application. Actively managing forests and other ecosystems so they can adapt to climate change is a form of risk management. It can help to maintain the many benefits we receive from ecosystems, and avoid future costs that might come from
NorEaST – Stream Temperature Data Inventory	NorEast Climate Science Center – University of MA at Amherst	Database, Visualization Tool	Climate data and Natural Disaster Impact	http://wim.usgs.gov/NorEaST/	Northeast Climate Consortium, provide scientific information, tools, and techniques that managers and other parties interested in land, water, wildlife and cultural resources can use to anticipate, monitor, and adapt to climate change in the Northeast region.

Template for Assessing Climate Change Impacts and Management Options (TACCIMO)	USDA - Forest Service - Climate Change Resource Center	Decision Support, Knowledge-sharing	Climate data and Natural Disaster Impact	http://www.tacc.imo.sgcp.ncsu.edu/	<p>The CCRC provides information about climate change impacts on forests and other ecosystems, and approaches to adaptation and mitigation in forests and grasslands. The website compiles and creates educational resources, climate change and carbon tools, video presentations, literature, and briefings on management relevant topics, ranging from basic climate change information to details on specific management responses</p>
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Name and Web Link	Organization & Weblink	Tool Type	Focus Area	Website	Description
NEclimateUS.org (NExUS)	NExUS	Knowledge-sharing	Climate data and Natural Disaster Impact	http://www.nclimateus.org/nexus/daps	NEclimateUS.org (a.k.a. 'NExUS') is a searchable online database that provides a gateway to climate information for the Eastern US, Atlantic Canada and the maritime region known as the Northwest Atlantic. NExUS summarizes available data, tools, plans and reports; climate-related organizations; ongoing projects; and needs for climate
Climate Change Database (Canada)	Government of Canada – Natural Resources Canada	Decision Support	Climate data and Natural Disaster Impact	http://www.nrca.gc.ca/evaluation/resources	Presents knowledge on climate change impacts and adaptation for Canadians. Contains scientific reports that assess, critically analyze and synthesize the growing knowledge base on the issue
LMI-ClicKE (Climate Change Knowledge Engine)	LMI ClicKE	Knowledge-sharing tool	Climate data and Natural Disaster Impact	http://www.clicke.lmi.org/index.php/Home	Presents open-source data in a way that is accessible to nonscientific leaders in the public and private sectors. Contains resources to explore, analyze, evaluate, and compare nearly 3,000 scientific findings related to climate
Ecosystem Indicator Mapping Tool	The Gulf of Maine Council on the Marine Environment	Knowledge-sharing	Climate data and Natural Disaster Impact	http://www.ofmaine.org/2/esip-monitoring-organizations-2/	The EcoSystem Indicator Partnership (ESIP) is a committee of the Gulf of Maine Council on the Marine Environment. ESIP is developing indicators for the Gulf of Maine and integrating regional data for a new Web-based reporting system for marine ecosystem monitoring. Activities of ESIP center on convening regional practitioners in six indicator areas: coastal development, contaminants and pathogens,
Climate Services Manomet	Manomet	Knowledge-sharing	Climate data and Natural Disaster Impact	https://www.manomet.org/publications-tools/cli-mate-service	Manomet scientists work to identify the most effective and promising solutions to climate change by synthesizing the rapidly evolving research on the interplay between climate change and natural systems. Through engagement with a diverse set of stakeholders including corporations, governmental agencies, nonprofit organizations and private landowners we put this knowledge into practice and

Name and Web Link	Organization & Weblink	Tool Type	Focus Area	Website	Description
USGS Derived Downscaled Climate	USGS	Visualization Tool, Model	Climate data and Natural Disaster	http://cida.usgs.gov/climate-visualization/	This web portal allows visualization and downloading of future climate projections from a group of "statistically downscaled" global climate models (GCMs).
Climate Reanalyzer	The Climate Change Institute – University of	Visualization Tool, Model	Climate data and Natural Disaster	http://cci-reanalyzer.org	Under development by the Climate Change Institute at the University of Maine, this tool provides an intuitive platform for visualizing a variety of weather and climate datasets
Maine Futures Community Mapper	University of Maine & the Maine's Sustainability Solutions	Visualization Tool, Model	Climate data and Natural Disaster Impact	http://www.maine.gov/naturalresources/landusefutureuses.org/mapper	An interactive mapping tool that allows users to examine current and future land use in their town, region, and watershed. Focus is Maine.
Climate Wizard	The Nature Conservancy	Visualization Tool	Climate data and Natural Disaster	http://www.climatewizard.org	Enables technical and non-technical audiences to access leading climate change information and visualize the impacts anywhere on Earth.
Climate Data in Northeastern United States	Cornell University Northeast Regional Climate Center	Visualization tool	Climate data and Natural Disaster Impact	http://www.northeastclimatecenter.cornell.edu/	Northeast Regional Climate Center Daily Observations, Climate Norms, Precipitation, and Extreme Precipitation
Historic Hurricane Tracks	NOAA	Visualization tool	Climate data and Natural Disaster	https://www.nhc.noaa.gov	National Oceanic Atmospheric Administration Storms for specific locations, dates, storm details and reports
HAZUS	FEMA	Model	Climate data and Natural Disaster Impact	www.fema.gov/hazus	A nationally applicable standardized methodology, HAZUS contains models for estimating potential losses from earthquakes, floods and hurricanes. The tool uses Geographic Information Systems (GIS) technology to estimate physical, economic and social impacts of disasters.

3) COASTAL SEA LEVEL RISE

Name and Web Link	Organization & Weblink	Tool Type	Focus Area	Website	Description
CanVis	NOAA Digital Coast	Visualization Tool	Coastal Sea Level Rise	http://coast.noa.gov/digital-coast/tools/ca	An easy-to-use visualization tool that allows users to “see” potential community impacts from coastal development or sea level rise.
SRL Viewer	NOAA	Visualization Tool	Coastal Sea Level Rise	http://coast.noa.gov/slr/	Provides coastal managers and scientists with a preliminary look at sea level rise and coastal flooding impacts.
SLAMM -Sea Level Affecting Marshes Model	Warren Pinnacle Consulting, Inc.	Model	Coastal Sea Level Rise	http://warrenpinnacle.com/project/SLAMM	Simulates the dominant processes involved in wetland conversions and shoreline modifications during long-term sea level rise.
Massachusetts Office of Coastal Zone Management’s StormSmart Coasts Program	State of Massachusetts – Energy and Environmental Affairs	Decision Support	Coastal Sea Level Rise	http://www.mass.gov/eea/agencies/czm/pr ogr	Provides information, strategies, and tools to help communities and people working and living on the coast to address the challenges of erosion, flooding, storms, sea level rise, and other climate change impacts.
Coastal Flood Exposure Mapper	NOAA office of Coastal Management	Visualization Tool	Coastal Sea Level Rise	http://coast.noa.gov/digital-coast/tools/flood-exposure	Supports users undertaking a community-based approach to assessing coastal hazard risks and vulnerabilities by providing maps that show people, places, and natural resources exposed to coastal flooding.

Name and Web Link	Organization & Weblink	Tool Type	Focus Area	Website	Description
Surging Seas	Climate Central	Visualization Tool, Model	Coastal Sea Level Rise	http://sealevel.climatecentral.org/	Interactive map showing threats from sea level rise and storm surge to all 3000+ coastal towns, cities, counties and states -See more at: http://sealevel.climatecentral.org/#sthash.G4qXUqWK.dpuf SEE ALSO http://sealevel.climatecentral.org/responses/plans for Plans Actions and Resources
USGS Sea Level Rise Viewer	USGS	Visualization Tool	Coastal Sea Level Rise	http://cegis.usgs.gov/sea_level_rise.html	Global climate datasets are available for population, land cover, and elevation. The 30 arc-sec resolution of the data are not sufficient to provide details in local areas for results of global warming and the associated melting of icecaps. The data provide global trends of rising water and allow identification of broad areas where large numbers of people could be affected.

4) WATER QUALITY

Manuals and Guides to Reduce Water Pollution	Maine Department of Environmental Protection	Knowledge-sharing	Water Quality	http://www.maine.gov/dep/land/watersheds/materials.html	Collection of manuals and guides: Buffers, Plant List, Conservation Practices, BMPs, Rain Collection, Roads, Stormwater, Lakes & Streams
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OpenNSPECT	NOAA	Model	Water Quality	http://coast.noaa.gov/digitalcoast/tools/opennspect	Enables users to investigate potential water quality impacts from development, other land uses, and climate change.
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5) PLANNING AND CONSERVATION

Name and Web Link	Organization & Weblink	Tool Type	Focus Area	Website	Description
Flood Resilience: A Basic Guide for Water and Wastewater Utilities	EPA	Knowledge-sharing	Planning and Conservation	http://www.epa.gov/sites/production/files/2015-08/documents/	The U.S. Environmental Protection Agency (EPA) developed this guide to help drinking water and wastewater utilities become more resilient to flooding. ¹ In the approach, the utility would examine the threat of flooding, determine impacts to utility assets and identify cost-effective mitigation options.
InVEST - Integrated Valuation of Environmental Services and	Natural Capital Project	Model	Planning and Conservation	http://www.naturalcapitalproject.org/InVEST	A suite of software models used to map and value the goods and services from nature that sustain human life.
CommunityViz	Place Ways	Decision Support, Visualization Tool	Planning and Conservation	http://placeways.com/communityviz	Provides an advanced-yet-accessible framework for planners and citizens to learn and make choices about the future of places.
NatureServe Vista	Nature Serve	Decision Support	Planning and Conservation	www.natureserve.org/vista	A free ArcGIS extension that automates advanced spatial analyses to help users integrate conservation with many types of planning, such as land use and natural resource management, marine spatial planning and marine protected areas, infrastructure and transportation, energy

Legislative Tracker	Georgetown Climate Center	Decision Support	Planning and Conservation	http://www.georgetownclimate.org/federal-act/legislative-tracker	Developed by the Georgetown Climate Center, this website tracks federal legislation that affects adaptation, energy, greenhouse gas emissions, and transportation policies. The Center also analyzes key legislation and identifies how pending bills could impact existing state policies and programs.
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6) RISK AND VULNERABILITY ASSESSMENT

Name and Web Link	Organization & Weblink	Tool Type	Focus Area	Website	Description
SoVI - Social Vulnerability Index	Hazard and Vulnerability Research Institute	Visualization Tool	Risk and Vulnerability Assessment	www.sovius.org	Assesses the social vulnerability of U.S. counties to environmental hazards. It shows where there is uneven capacity for preparedness and response and where resources might be used most effectively to reduce the pre-existing vulnerability.
Coastal Resilience 2.0	Coastal Resilience - The Nature Conservancy	Visualization Tool, Decision Support,	Risk and Vulnerability Assessment	http://www.coastalresilience.org	Tools and apps to assess vulnerability to coastal hazards including current and future storms and sea level rise scenarios.
Risk Mapping, Assessment and Planning (RiskMAP)	FEMA	Decision Support, Visualization tool	Risk and Vulnerability Assessment	http://www.fema.gov/risk-mapping-assess	FEMA is working with federal, state, tribal and local partners across the nation to identify flood risk and help reduce that risk through the Risk Mapping, Assessment and Planning (Risk MAP) program.
RAINE Database	EPA	Knowledge-sharing	Risk and Vulnerability Assessment	http://www.epa.gov/raine	The Resilience and Adaptation in New England (RAINE) database is a collection of vulnerability, resilience and adaptation reports, plans and webpages at the state, regional and community level.
Adaptation Database and Planning	ICLEI Local Governments for Sustainability	Decision Support, Model	Risk and Vulnerability Assessment	http://www.iclei.usa.org/tools/adapt	Walks users through the process of assessing your vulnerabilities, setting resiliency goals, and developing plans that integrate into existing hazard and comprehensive planning efforts.

Flood Insurance Rate Maps (FIRMs)	FEMA	Decision Support, Visualization and knowledge sharing	Risk and Vulnerability Assessment	https://msc.fema.gov/portal	The official maps of communities on which FEMA has delineated both the special hazard areas and the risk premium zones applicable to the community.
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Name and Web Link	Organization & Weblink	Tool Type	Focus Area	Website	Description
Sea Level Rise Explorer	Global Warming Art	Visualization tool and model	Risk and Vulnerability Assessment	http://www.glob.alwarmingart.com/wiki/Special	The Sea level Rise Explorer allows to explore the regions of the Earth that are most vulnerable to sea level rise. The sea level data appearing in the maps is based primarily on version 2 of NASA's Shuttle Radar Topography Mission (SRTM), with post-processing by CGIAR to fill-in voids using data from other sources.
Northeastern Climate Impact Assessment (NECIA)	Union of Concerned Scientists (UCS)	Knowledge-sharing	Risk and Vulnerability Assessment	http://www.ucsusa.org/global_warming/science_and_impacts	A web-based database 'Northeast Climate Data' can be accessed from the website. This database provides registered users with free access to most of the climate data generated for the NECIA project, including projected changes this century in temperature, precipitation, relative humidity, snow cover, and more that can be expected in the Northeast under higher and lower emissions scenarios.
Cornell Precipitation Atlas	Cornell University	Visualization Tool	Risk and Vulnerability Assessment	http://precip.eas.cornell.edu/	An interactive web-based tool for extreme precipitation analysis in New York and New England
Connecticut Coastal Hazards Mapping Tool	Department of Energy and Environmental Protection, UCONN	Visualization Tool	Risk and Vulnerability Assessment	http://ctecoapp1.uconn.edu/ctcoastalhazards	The Connecticut Coastal Hazards Viewer is an online mapping tool designed to allow users access to several pertinent suites of data for coastal Connecticut. Presented here are data representing sea level rise, high-resolution coastal elevation, hurricane storm surge, coastal erosion, and environmental observations such as tides, water
Forest Adaptation Climate Change Response Network	The Northern Institute of Applied Climate Science (NIACS)	Decision Support	Risk and Vulnerability Assessment	http://www.forestadaptation.org/	The Framework is a collaborative, cross-boundary approach among scientists, managers, and landowners to incorporate climate change considerations into natural resource management. It provides an integrated set of tools, partnerships, and actions to support climate-informed conservation and forest management.

Name and Web Link	Organization & Weblink	Tool Type	Focus Area	Website	Description
National Stormwater Calculator	US Environmental Protection Agency	Decision Support	Risk and Vulnerability Assessment	http://www2.epa.gov/water-research/nation	EPA's National Stormwater Calculator (SWC) is a desktop application that estimates the annual amount of rainwater and frequency of runoff from a specific site anywhere in the United States (including Puerto Rico). Estimates are based on local soil conditions, land cover, and historic
Low Impact Development (LID)	US Environmental Protection Agency	Decision Support	Risk and Vulnerability Assessment	http://water.epa.gov/polwaste/green/	LID is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site
Climate Resilience Evaluation & Awareness Tool (CREAT)	US EPA	Decision Support, Model	Risk and Vulnerability Assessment	http://water.epa.gov/infrastructure/waterse	Developed by EPA, this software tool assists drinking water and wastewater utility owners and operators in understanding potential climate change threats and in assessing the related risks at their individual utilities.
CCVI - NatureServe Climate Change Vulnerability Index	NatureServe	Model	Risk and Vulnerability Assessment	https://connect.natureserve.org/science/climate-change/cc	Identifies plant and animal species that are particularly vulnerable to the effects of climate change. By enabling those responsible for managing lands to assess species' relative vulnerability—as well as the relative importance of factors contributing to such assessments—the Index can help them prioritize management strategies for climate change adaptation and develop actions that increase the

Appendix B: Climate Change Adaptation Guidelines Directory



Climate Adaptation Guidelines Resource Directory

New England Environmental Finance Center, February, 2016

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Background and Purpose

This resource directory is a collection of climate adaptation planning process guidelines from various communities in the US, Canada and EU. These resources can be useful to communities who want to see examples of the process other communities developed to address local climate adaptation, mitigation, and resilience programs, and gives them guidance on how to begin developing their own unique plans.

Each guideline has a geographic area of focus, the source, a brief description of the guideline content, and an assessment of the guideline's level of difficulty of use in a climate adaptation planning process.

This resource guide is a work in progress, and we are constantly updating and refining it with important emerging tools.

The Guidelines Resource Directory may also be accessed on the New England Environmental Finance Center's website [here](#).

Name of Guideline	Area of Focus	Type	Website/URL	Description
Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use	Legal guidance to communities	Decision Support	http://www.georgetownclimate.org/sites/www.georgetownclimate.org/files/AdaptationToolKit.pdf	The Adaptation Tool Kit explores 18 different land-use tools that can be used to preemptively respond to the threats posed by sea-level rise.
Preparing for Climate Change: A Guidebook for Local, Regional and State Governments	Process guidance	Decision Support	http://cses.washington.edu/db/pdf/snoveretalgb574.pdf	The guidebook is designed to help local, regional, and state governments prepare for climate change by recommending a detailed, easy-to-understand process for climate change preparedness based on familiar resources and tools.
Tools for Coastal Climate Adaptation Planning	Process guidance	Decision Support, Knowledge-sharing tool	http://www.natureserve.org/sites/default/files/publications/file_s/ebm-climatetoolsguide-final.pdf	The purpose of the guide is to provide the information necessary for coastal natural resource managers and community planners to select appropriate tools for their projects. The guide focuses on spatially explicit solutions for climate-related planning.
LMI-ClicKE (Climate Change Knowledge Engine)	Process guidance	Knowledge-sharing tool	http://clicke.lmi.org/index.php/Home	The tool for the easy consumption of climate change data. The tool combines open-source semantic web technology and data from the public domain in a way that is accessible to nonscientific leaders in the public and private sectors

Name of Guideline	Area of Focus	Type	Website/URL	Description
Getting to Resilience: A Community Planning Evaluation Tool	Process guidance	Knowledge-sharing tool, Decision support	http://www.prepareyourcommunitynj.org/	The online self assessment process is a tool to assist communities to reduce vulnerability and increase preparedness by linking planning, mitigation, and adaptation. Assessment of preparedness in relation to FEMA's Community Rating System and Sustainable Jersey.
Connecticut Adaptation Resource Toolkit (CART)	Process guidance	Decision Support	http://www.ct.gov/deep/cwp/vie.w.asp?a=4423&q=531864&depNav_GID=2121	CART was developed to help local government staff, committee members and active participants in Connecticut have instant access to climate change adaptation resources thereby enabling them to easily and meaningfully benefit their communities.
Handbook for Small Canadian Communities - Planning	Process guidance	Decision Support	http://www.fcm.ca/Documents/tools/PCP/climate_change_adaptation_planning_handbook_for_small_canadian_communities_EN.pdf	The purpose of the Handbook is to help small Canadian communities to prepare and implement a Climate Change Adaptation Plan (CCAP). The Handbook focuses on small Canadian communities because of pressing need in these communities for assistance to address the impacts of climate change.
Policy Guide on Planning and Climate Change	Process guidance	Decision Support	https://www.planning.org/policy/guides/pdf/climatechange.pdf	Climate Change Policy Guide recommends a policy framework to assist communities in dealing with climate change and its implications.

Name of Guideline	Area of Focus	Type	Website/URL	Description
Municipal Climate Change Action Plan Guidebook	Process guidance	Decision Support	http://atlanticadaptation.ca/site/s/discoveryspace.upei.ca.cas/files/Appendix%201%20-%20MCCAP%20Guidebook_0.pdf	<p>The purpose of this guide and the accompanying template is to help municipalities prepare Municipal Climate Change Action Plans (MCCAP) that meet the municipal obligation described in the 2010 - 2014 Municipal Funding Agreement. The guide aims to help municipalities reduce greenhouse gas emissions and identify priorities for climate change adaptation.</p>
California Planning Adaptation Guide	Process guidance	Decision Support	http://resources.ca.gov/climate/safeguarding/adaptation_policy_guide/	<p>The Adaptation Planning Guide provides guidance to support regional and local communities in proactively addressing the unavoidable consequences of climate change. It was developed cooperatively by the California Natural Resources Agency, California Emergency Management Agency.</p>
Planning and Policy in Atlantic Canada	Process guidance	Decision Support	http://atlanticadaptation.ca/site/s/discoveryspace.upei.ca.cas/files/Climate%20Adaptation%20Planning%20and%20Policy%20in%20Atlantic%20Canada.pdf	<p>Guide incorporates successful planning models for the future by integrating sustainability concepts. To reduce risks and enable communities to take advantage of the opportunities from climate change, planning and policy development are based on sound data developed through multi-disciplinary research.</p>

Name of Guideline	Area of Focus	Type	Website/URL	Description
Planning to Adaptation to Climate Change - Guidelines for Municipalities, EU	Process guidance	Decision Support	http://base-adaptation.eu/plan ning-adaptation-climate-c hang e-guidelines-municipalitie	The aim of the Guidelines is to propose a practical and operational support to local governments that are interested in starting a process of adaptation, to develop adaptation plans to climate change at local level.
Community Rating System – A Local Official's Guide to saving lives, preventing property damage, reducing the cost of flood insurance	Process guidance	Decision Support	https://www.fema.gov/media-library/assets/documents/16104	This brochure introduces the National Flood Insurance Program (NFIP) Community Rating System (CRS) as a way of promoting the awareness of flood insurance
Adapting to Climate Change: A Planning Guide for State Coastal Managers	Process guidance	Decision Support, Knowledge-sharing tool	http://coastalmanagement.noa a.gov/climate/docs/adaptation guide.pdf	This guide offers a framework for state coastal managers to follow as they develop and implement climate change adaptation plans in their own states. State coastal managers, and their counterparts in local governments, are at the forefront of adapting to climate change.
Overview of Online Resources for Climate Adaptation Policies relating to New England on Regional, State and Local Level	Data source	Knowledge-sharing tool	http://docs.rwu.edu/cgi/viewcontent.cgi?article=1020&context=law_ma_seagrant	This report represents an overview of adaptation strategies and policies that are being implemented to address sea level rise due to climate change in the coastal states of New England. This report examines some of the varying ideas and actions throughout the region regarding coastal municipal adaptation strategies

Name of Guideline	Area of Focus	Type	Website/URL	Description
Managing Municipal Infrastructure in a Changing Climate	Process guidance	Decision Support	http://atlanticadaptation.ca/discoveryspace.upei.ca/assets/files/DEC-00306-Infrastructure%20Workbook%20%28Web	The workbook is designed to be completed municipal officials and staff in a group over a period of 3 hours. It guides participants through a series of exercises, beginning with a discussion of municipal infrastructure, how it is planned, constructed and maintained.
Climate Adaptation Guidebook for Municipalities in the Chicago Region	Process guidance	Decision Support	http://www.cmap.illinois.gov/livability/sustainability-climate-change/climate-adaptation-toolkit	This guidebook is meant to aid municipalities in the Chicago region that are interested in adapting their planning and investment decisions to a changing climate. Essentially, this means improving resilience to future weather impacts
Adapting to the Rise – A Guide for Connecticut's Coastal Communities	Process guidance	Decision Support	http://www.ct.gov/ctrecovers/lib/ctrecovers/TNC_Adapting_to_the_Rise.pdf	The guide is intended to provide town planners, elected officials and concerned citizens with a basic understanding of several areas of focus related to adapting to immediate and future flooding projections.

Name of Guideline	Area of Focus	Type	Website/URL	Description
Managing Municipal Infrastructure in a Changing Climate	Process guidance	Decision Support	http://atlanticadaptation.ca/discoveryspace.upei.ca.acas/files/DEC-00306-Infrastucture%20Workbook%20%28Web	The workbook is designed to be municipal officials and staff in a group over a period of 3 hours. It guides participants through a series of exercises, beginning with a discussion of municipal infrastructure, how it is planned, constructed and maintained.
Preparing for Climate Change: A Northeast-Focused Needs Assessment	Process guidance	Decision Support	http://www.climateaccess.org/sites/default/files/CACP_Prepari	This report presents a snapshot of the needs of local, regional and state governments in undertaking such climate preparedness efforts.
Planning for Flood Recovery and Long-Term Resilience in Vermont	Process guidance	Decision Support	http://www2.epa.gov/smart-growth/planning-flood-recovery-and-long-term-resilience-vermont	This guide is focused on long-term flood resilience planning in Vermont. In 2012, in the wake of Irene, the state of Vermont requested Smart Growth Implementation Assistance from EPA and the Federal Emergency Management Agency (FEMA).
State of Maryland Climate Change and Coast Smart Construction Infrastructure Siting and Design Guidelines	Process guidance	Decision Support	http://climatechange.maryland.gov/publications/state-of-maryland-and-climate-change-and-coast-smart-construction-infrastructure-siting-and-design-guideline	Recommendations for the siting and design of State structures, as well as other infrastructure-based projects in Maryland

Name of Guideline	Area of Focus	Type	Website/URL	Description
Managing Municipal Infrastructure in a Changing Climate	Process guidance	Decision Support	http://atlanticadaptation.ca/discoveryspace.upei.ca/cas/files/DEC-00306-Infrastucture%20Workbook%20%28Web-Email%20Quality%29.pdf	The workbook is designed to be completed municipal officials and staff in a group over a period of 3 hours. It guides participants through a series of exercises, beginning with a discussion of municipal infrastructure, how it is planned, constructed and maintained.
Massachusetts Climate Change Adaptation Report	Process guidance	Decision Support	http://www.mass.gov/eea/e-mgmt-recycling/air-quality-en-house-gas-and-climate-change/climate-change-adaptation-report.html	This report, prepared by EEA and the Massachusetts Climate Change Adaptation Advisory Committee, is the first broad of climate change as it affects Massachusetts, the impacts of this multiple sectors ranging from natural infrastructure, public health, and the also provides an analysis of potential strategies.
New Hampshire Handbook on Energy Efficiency & Climate Change	Process guidance	Decision Support	http://www.nhenergy.org/uploads/1/6/7/3/16738072/nh_hand	This handbook gives New Hampshire brief introduction on how to help mitigate climate change at the local level. Community-scale activities such as energy benchmarking and efficiency upgrades will not only reduce your town's fossil fuel emissions and important public statement about values priorities.

Appendix C: Climate Information, Tools and Examples

Climate Information, Tools and Examples for Vulnerability Assessment Including Analysis and Organization

1. Using and Communicating General Climate Change Information

New England municipalities already have information resources with which to start assessing exposures as a step towards adaptation. The Flood Insurance Rate Maps (FIRMs) that delineate Special Flood Hazard Areas along water bodies and coasts may not define all of the vulnerable lands and the possible depths of flood or storm surge in the future. But they identify the baseline. Along coastlines, estimates of the possible range of sea level rise—already long occurring in New England—can be used to envision how storm surges may increase. Introductory information on how different sea level increases may affect New England coastlines and generalized areas of flood risk can be interactively viewed with the National Oceanic and Atmospheric Administration (NOAA) Digital Coast web site’s sea level risk viewer [here](#). Figure D-1 illustrates how the broad climate of future New England that climate modeling indicates can be visualized for beginning discussions with these state-by-state climate shift maps.

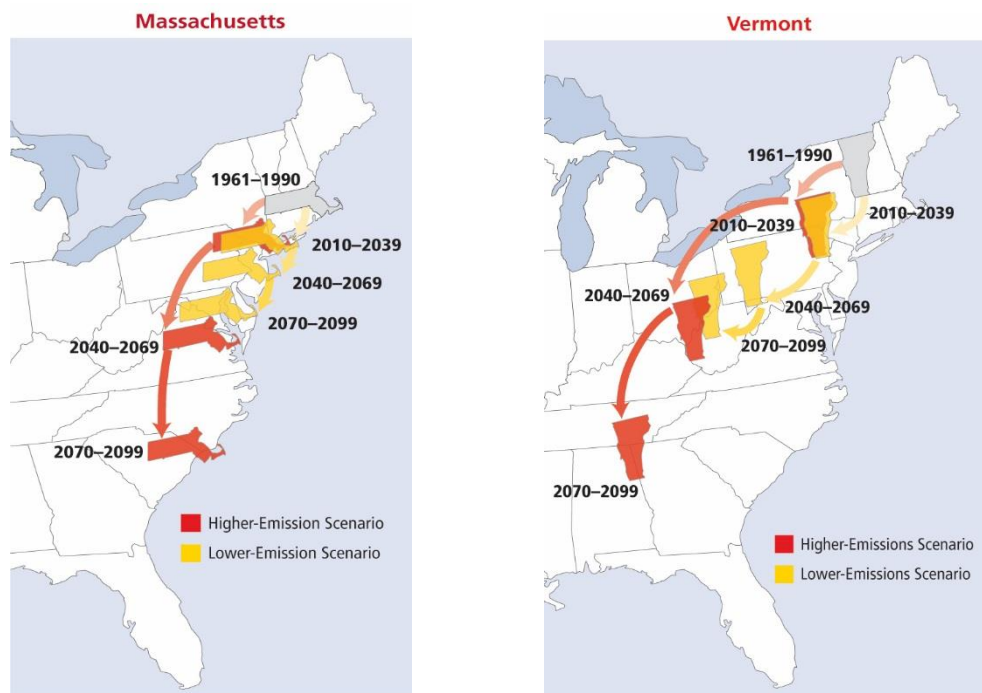


Figure D-1. Potential Climate Migration in New England States. SOURCE: Frumhoff et al. 2007

Another New England-based overview tool has been developed by ICNet—The Infrastructure-Climate Network, which is a New England-focused National Science Foundation-funded project based at the University of New Hampshire. ICNet’s website [here](#) includes a set of “Climate Maps” under “Tools and Resources” that give a uniquely organized perspective on future climate indicators for New England and the Northeast states of NY, PA, NJ and DE. These maps were specially prepared by a climate science team for ICNet. They show the 1971-2000 history of 21 precipitation and temperature indicators and then show the distribution of change in those indicators under increases of global mean temperature of 1°, 2°, and 3° Centigrade over the coming century. Figure D-2 is an example showing annual precipitation trends under different GMT. While very large scale, these maps give an idea of changes the region could face. The ICNet web site provides documentation of the full set of maps as well as links to a series of recorded webinars on climate change and civil infrastructure.

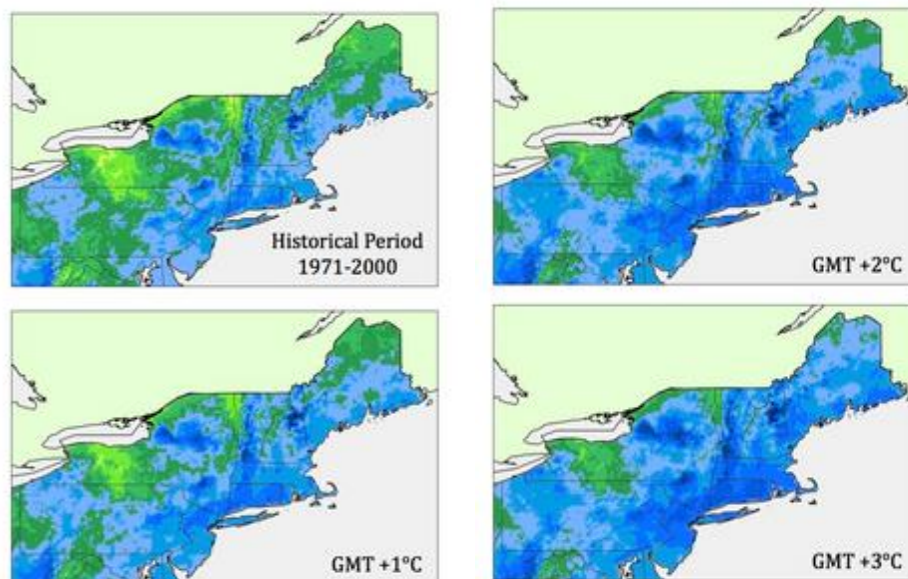


Fig. D-2: NE Regional climate simulations showing average annual precipitation trends under 1, 2, 3 degree global mean temperature (GMT) increases to 2100. Green= less, blue=greater, indicating relative vulnerability to change. SOURCE: www.The ICNet.org, University of New Hampshire.

The Cornell Precipitation Atlas, developed starting in 2010 and available [here](#), provides new analyses of expected precipitation in the region. It is organized to also give some introductory perspective to non-specialists as well. The National Oceanic and Atmospheric Administration is in the process of developing new IDF (intensity-duration-frequency) curves to replace those from the 1950s-60s.

Combining such information with local knowledge of where infrastructure, transportation resources and other critical facilities, as well as existing private development, are located is a next step in identifying vulnerability and beginning to characterize risks. Local institutional knowledge of where vulnerabilities may be developing is also important but often overlooked in the press of day-to-day responsibilities. For example, maintenance records of nuisance and moderate-level damages to transportation infrastructure and public facilities can be an indicator of where bigger vulnerabilities may develop with increasing precipitation intensity, duration and frequency (IDF) in the future. Experience with recent storm-water management improvements also provide a prospective look at the future.

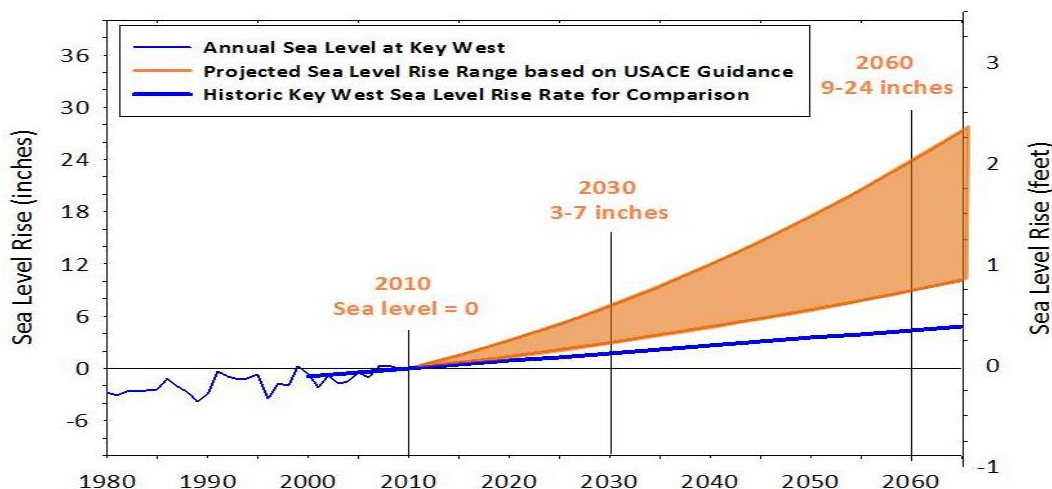


Figure D-3. Southeast Florida Climate Compact Consensus Sea Level Rise Assumptions

At the largest scale of New England’s overall climate, the 2007 Synthesis Report of the Northeast Climate Impacts Assessment, “Confronting Climate Change in the U.S. Northeast: Science, Impacts and Solutions” (available [here](#)) has helped put potential change in perspective with maps (see illustration for Vermont and Massachusetts) of the future climate of the state’s in terms of becoming like that of other states depending on those uncertain emission scenarios.

More detailed information on future flood and storm impacts requires specific investigation of local conditions affected by global forces. In Florida, given the urgency of growing storm hazards, the four urban counties stretching from Palm Beach to the Florida Keys (Palm Beach, Broward, Miami-Dade and Monroe) have collaborated on studies of sea level rise (SLR) and adopted a common estimate of possible SLR ranges in 2030 and 2060 that is the basis for the Southeast Florida Regional Climate Compact. (Figure D-3).

2. Computer-Based Tools for Vulnerability Analysis: HAZUS, VAST, COAST

Large scale information such as the above examples are becoming accessible to New
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England communities at low or no cost, but they are discussion-starters only. Sea level rise viewers, noted earlier in this Guide, are useful as well but not based on specific local conditions. Locally-adjusted information derived from new detailed analysis are needed for more advanced planning.

Once general vulnerabilities have been identified, a more detailed local assessment can be made to identify potential damages to assets such as public infrastructure and real property. First order damage assessment: local GIS resources, public works databases, and property tax revenues. More detailed analysis possible with three tools: The first, is **FEMA's HAZUS** tool which can be run at a simple level by most local staff and enable beginning estimates of the magnitude of possible losses due to storm and flood damage; it is also capable of more sophisticated analyses with more data and programming. The second, **FHWA's VAST** tool for transportation infrastructure, can give you ideas of how to organize a local analysis of asset vulnerability. The third, **COAST**, is designed like HAZUS to estimate losses to real property if no actions are taken but also is used to model the benefits in avoided damage versus costs of adaptation actions over time from all floods and storms that may occur.

HAZUS

HAZUS, developed by FEMA, is available to communities for free download. HAZUS is a Geographic Information System (GIS) based tool to assist localities with analyzing expected losses to community public and private assets in flood, hurricane and earthquake hazard areas. A community can use HAZUS which incorporates the U.S. Army Corps of Engineers Depth Damage Function (DDF) data for structures and other social, demographic and economic data with the local Special Flood Hazard Area and storm surge mapping information as identified in the National Flood Insurance Program. HAZUS uses the Federal Emergency Management Agency's accepted methodology for estimating potential losses from these disaster impacts.

Increasingly, HAZUS is being used by states and communities in support of risk assessments that perform economic loss scenarios for certain natural hazards and rapid needs assessments during hurricane response. Other communities are using HAZUS to increase hazard awareness. Using HAZUS can be a foundation step for then assessing locality-specific vulnerabilities affected by the changing climate.

There are three levels of HAZUS: Level 1 gives a basic estimate of losses based on national databases and expert-based analysis parameters included in the HAZUS software, such as the US Army Corps DDF estimates. This is commonly referred to as an "out-of-the-box" or "default" loss estimate. It is the easiest version for communities to use, but it requires the users to have [ArcGIS](#) with [ArcView](#) license level. In addition, the ArcGIS Spatial Analyst extension is required for the Flood Model and a digital elevation dataset for the study area, preferably from LIDAR radar data. Level 2 provides more accurate loss estimates by including detailed information on local hazard conditions and/or by replacing the national default inventories with more accurate local inventories of buildings, essential facilities and other infrastructure. Level 3 state-of-the-art loss

estimates include all the hazard and inventory improvements in a Level 2 study in addition to expert adjustment of analysis parameters. It requires the participation by earth scientists, structural engineers, land use planners and/or emergency managers to provide an accurate inventory and assessment of community vulnerability, as well as, a high degree of expertise in HAZUS' architecture and file structure.

HAZUS has been widely used in research studies to estimate annual avoided flood damages and thus avoided costs due to mitigation and now adaptation. These example illustrate what is at stake in mitigation and adaptation choices. Kousky (2012) used HAZUS to estimate whether a greenway in a floodplain could alleviate economic damages in the future if it was preserved instead of developed. Kousky concluded that without the protected land of the greenway, average annual flood damages to property in the St. Louis County floodplains of the Meramec River and its tributaries would be approximately 59% higher than under current conditions.

Colgan (2013) used HAZUS to estimate the avoided costs due to increased flooding as a result of wetland loss in three watersheds in York County, Maine. Multiple very large, very low probability floods occurred within one twelve month period, in 2006 and 2007 in York County. The probability of this sequence happening naturally is roughly 1/250,000 but the fact that it has already happened in York County underscores the importance of planning and investing even for seemingly remote possibilities.

Flood damages were calculated for unprotected wetlands in York County (which makes them unavailable to attenuate floods and mitigate flood damages) and the expected values if those wetlands were available to provide flood control services. The differences between these two estimates are the avoided flood damages and the benefits of conserving the wetlands. These net benefits are estimated to total over \$275 million on an expected present value basis, with an overall benefit/cost ratio of more than 18 to 1.

The example below shows HAZUS output for direct economic losses to buildings and income for Sussex County, Delaware in a modeled flood scenario, from a white paper on HAZUS by Silvana Croope, P.E., Ph.D. of the Delaware Department of Transportation, who is also a member of ICNet (Croope 2009 available [here](#)).

HAZUS Level 1 will model 10, 50, 100, 200 and 500 year return probability floods using standard hydrologic data for regions of the United States. Utilizing the higher levels of the HAZUS tool requires an investment in local data—especially digital land use/property records—and specific expertise. Examples of sources of such expertise that may be available include universities and soil and water conservation districts in some areas, state agencies able to tap national coastal zone management program support and national estuary projects (NEPs).

The Colgan et al. 2013 study of adaptation benefits for York County, Maine was sponsored by the state's chapter of The Nature Conservancy. The NHCAW regional collaboration illustrated earlier gives an example of the range of partners that may be involved.

VAST

The Federal Highway Administration (FHWA) has been partnering with state and local transportation agencies to increase the resilience of the transportation system. FHWA has a number of tools and resources available. The ***Vulnerability Assessment Scoring Tool*** or **VAST** (2015) is a spreadsheet tool that supports conducting a quantitative, indicator-based vulnerability screen of critical transportation assets. The FHWA's ***Climate Change and Extreme Weather Vulnerability Assessment Framework*** ([here](#)) is a comprehensive handbook for transportation agencies on how to assess their vulnerability to climate change and extreme weather events. It gives an overview of key steps in conducting vulnerability assessments and using VAST with in-practice examples to demonstrate a variety of ways to gather and process needed information. The framework is comprised of three key steps: defining study objectives and scope; assessing vulnerability; and incorporating results into decision making. Local governments may find these tools useful for organizing a vulnerability screen for their transportation assets.

Most approaches combine the institutional or knowledge of stakeholders—in this case transportation agency staff from design engineers to field maintenance supervisors—with modeled information from climate, sea level risk and flood modeling. In one of multiple examples in the FHWA guide, the Washington State DOT adapted a cost/risk assessment workshop model used on Oregon to gather such information. Workshops with WSDOT employees who knew each state district area well, such as the maintenance supervisor and their staff were asked "What keeps you up at night?" to help identify current vulnerabilities that may be exacerbated in the future. Using projected climate information from the University of Washington and other available information, workshop participants considered likely future climate changes to sea level, temperature, precipitation, wind, and fire risks. They then assigned an impact rating to each highway segment or asset ranging from 1 to 10 using an impact rating scale scorecard. The WSDOT's workshop participants considered asset criticality ratings as they rated the vulnerability of each facility or segment of highway. The ratings from the workshops were collected into a central database and used to create maps identifying the vulnerability level of each roadway segment or asset. This scale represented three characterized risks from "Reduced Capacity" (scale values 1 to 3: immediate limited use still available) to "Temporary Operational Failure" (scale values 4 to 6: minor damage/disruption restorable within 60 days) to "Complete Failure" (scale values 7 to 10: total loss or ruin of asset). Another example illustrates (below) asset risk characterization for part of the Honolulu International Airport.

With some information on climate-driven flood and storm hazards and future trends in the landscape (e.g., location and future of floodplains, assets and development exposed to SLR), even smaller local governments can combine that information with local knowledge to begin characterizing risks to community resilience in this manner (Figure D-4).

Risk Level in Year 2050	TheBus 811 Middle Street	Low Vulnerability, Low Structural Impact
	HDOT Highways Division Oahu District Baseyard 727 Kakoi Street	Low-Moderate Vulnerability, Low Structural Impact
	Honolulu International Airport and Access	Low Vulnerability, Low Structural Impact
Risk Level in Year 2100	TheBus 811 Middle Street	Low-Moderate Vulnerability, Low-Moderate Structural Impact
	HDOT Highways Division Oahu District Baseyard 727 Kakoi Street	High Vulnerability, High Structural Impact
	Honolulu International Airport and Access	Low-Moderate Vulnerability, Low Structural Impact

Fig. D-4 Sea Level Rise Risk Assessment for Honolulu Airport, HI State Assets Using VAST
SOURCE: Federal Highway Administration, USDOT

COAST

The COastal Adaptation to Sea level rise **T**ool (COAST) was developed to provide communities with benefit-cost analysis for adaptation actions they might undertake in response to the combined threats of sea level rise and storm surge. The COAST approach is unique as it requires communities to provide social judgments about what level of future impact to analyze as well as providing the technical results in a way that empowers stakeholders to actively engage in discussions about their future. Being stakeholder driven, and using locally derived data on vulnerable assets and candidate adaptation actions wherever possible, COAST results generate deliberation and engagement with the adaptation need. COAST also includes analytical tools for calculating the cumulative damage to real property from a variety of storms (i.e., 10, 50 and 100-year return probabilities) over a study period including one-time events defined by the user. COAST output is in the form of 1) files compatible with Google Earth and 2) tables showing cumulative expected damages for the selected vulnerable asset under the adaptation scenarios stakeholders have developed, that allow cost-benefit analysis of candidate adaptation actions. The current versions of COAST with a number of enhancements is available from GEI, Inc.

3. Innovative Regional Approaches

Collaboration with neighboring jurisdictions to acquire information about future change can be done at a New England scale too. In southern Maine, for example, four small localities—Saco, Scarborough, Old Orchard Beach and Biddeford—have worked with the Southern Maine Planning and Development Commission, the State of Maine Geological Survey and other resources to develop common vulnerability information for their shared coastline in Saco Bay. This partnership—called SLAWG—the Sea Level Rise Adaptation Working Group—is as much a national innovation as Southeast Florida’s effort. Learn more about SLAWG [here](#) and similar efforts like the New Hampshire Coastal Adaptation Working Group (NHCAWG) in the sidebar.

SLAWG & NHCAW—Regional and Collaborative Approaches

SLAWG’s first accomplishment was a shared Vulnerability Assessment of the built and natural environments in Saco Bay to 2 feet of SLR (agreed upon by the Group) on top of the Highest Annual Tide (HAT) and the historic 1% (“100 year”) storm event (February 7, 1978 storm) for each community in Saco Bay. The Assessment identified potentially vulnerable buildings, transportation infrastructure, and wetland migration areas.

Approaches like SLAWG have several benefits. One is that multiple local governments which share rivers and/or coastlines can combine efforts to acquire the best available analyses of their hazards rather than going it alone. A second benefit is that common information can help form the basis for coordinated adaptation approaches across a shared landscape that does not stop at borders. Beach and coastal erosion and changes in flood extent and impacts up- or down-stream are some of the negative consequences of uncoordinated action. A third benefit is subtle but vital: Having such vulnerability information can allow leaders and staff decide on what parameters to use in analyzing the level of vulnerability that is acceptable. The four SLAWG jurisdictions agreed on such parameters to deal with uncertainty and move ahead on adaptation planning with realism in the face of that uncertainty. There are other adaptation collaborations recently initiated in New England, although the emphasis has been on coastal in part due to the risks of sea level but also due to extensive technical assistance and research programs of NOAA and of Sea Grant programs at several of the New England states land grant universities. The Merrimack Valley Coastal Adaptation Workgroup in Massachusetts encompasses eight towns throughout that watershed and is volunteer-driven (Philip 2014).

The New Hampshire Coastal Adaptation Workgroup (NHCAW) involves municipalities, their regional planning agencies, nonprofit environmental organizations, two universities and substantial assistance from NOAA programs at UNH. The broad collaborate illustrated below is a noteworthy model for joint efforts.



Appendix D: State Funding Matrices

The New England State Funding matrices may also be accessed on the New England Environmental Finance Center's website [here](#)

Connecticut - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
State of Connecticut	State issued "Green Bond" a joint initiative through the Department of Energy and Environmental Protection (DEEP) and State Treasurer's Office	The state is selling "Green Bonds" to fund critical wastewater infrastructure projects statewide through the State's Clean Water Program.	\$60 million, to be included as part of a larger \$300 million General Obligation bond issue (November 2014).	http://www.ct.gov/deep/cwp/view.asp?Q=555452&A=4568	General Information: 1 (877) 55 CT BONDS 1(877) 552-8266
The Connecticut Department of Emergency Services and Public Protection Division of Emergency Management and Homeland Security	Buffer Zone Protection Program (BZPP) under the Homeland Security Grant Program	This program provides funding for the equipment, management, and administration to protect, secure, and reduce the vulnerabilities of identified critical infrastructure and key resource (CI/KR) sites.	Depends on annual allocations	http://www.ct.gov/emhs/cwp/view.asp?a=1910&q=411688	Strategic Planning & Grants 860-685-8038, Rita Stewart rita.stewart@ct.gov
FEMA Administered by: The Connecticut Department of Emergency Services and Public Protection Division of Emergency Management and Homeland Security	Pre-Disaster Mitigation Program (PDM)	Provides funds to States, territories, Indian Tribal governments and communities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event	Federal funding for this nationally competitive grant program is generally an annual allocation (subject to Congressional appropriation).	http://www.ct.gov/emhs/lib/demhs/hmgrp/2015/pdmfact2015.pdf	Gemma Fabris at gemma.fabris@ct.gov

Connecticut - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
FEMA Administered by: The Connecticut Department of Emergency Services and Public Protection Division of Emergency Management and Homeland Security	Hazard Mitigation Grant Program (HMGP)	Helps communities implement hazard mitigation measures following a Presidential major disaster declaration. Hazard mitigation is any action taken to reduce or eliminate long term risk to people and property from natural hazards.	Open: Following a Presidential Major Disaster Declaration MA EMA disperses funds to FEMA approved projects.	http://www.ct.gov/demhs/cwp/view.aspx?a=4062&q=544	State Hazard Mitigation Officer: Emily Pysh 860-256-0837 Deputy State Hazard Mitigation Officer: Gemma Fabris 860-256-0846 demhs.hmgp@ct.gov
FEMA Administered by: The Connecticut Department of Emergency Services and Public Protection Division of Emergency Management and Homeland Security	Flood Mitigation Assistance Program	Assists states and communities in implementing cost-effective measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program (NFIP).	The Notice of Funding Opportunity announcements are posted on Grants.gov	http://www.ct.gov/demhs/cwp/view.aspx?a=4062&q=544144&PM=1	State Hazard Mitigation Officer, emily.pysh@ct.gov
FEMA and US Department of Homeland Security	Public Assistance Program	To provide supplemental Federal disaster grant assistance for debris removal, emergency protective measures, and the repair, replacement, or restoration of disaster-damaged, publicly owned facilities and the facilities of certain Private Non-Profit (PNP) organizations. The PA Program also encourages protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process.	Open: Once a disaster has occurred, and the State has declared a state of emergency, The President then makes the decision whether or not to declare a major disaster or emergency. Following a Presidential Major Disaster Declaration MA EMA disperses funds to FEMA approved projects.	http://www.ct.gov/demhs/cwp/view.aspx?a=4062&q=515032	State Hazard Mitigation Officer: Emily Pysh 860-256-0837 Deputy State Hazard Mitigation Officer: Gemma Fabris 860-256-0846 demhs.hmgp@ct.gov

Connecticut - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
US Department of Housing and Urban Development	Community Development Block Grant (CDBG) Program	Program works to ensure decent affordable housing, to provide services to the most vulnerable in our communities, and to create jobs through the expansion and retention of businesses.	Ongoing - application dates throughout the year	http://www.ct.gov/doh/site/default.asp	Mr. Dimple Desai, Community Development Director Department of Housing 505 Hudson Street Hartford, CT 06106 Phone: (860) 270-8012 Dimple.Desai@ct.gov
Environmental Finance Center - University of Maryland	Local Government Stormwater Financing Manual	EFC's Local Government Stormwater Financing Manual was inspired by and written for local government leaders. Public sector financing in general, and stormwater financing specifically often appear to be inaccessibly complicated and technical to even experienced public officials. Therefore, rather than try to address the myriad of issues associated with stormwater financing, the main strategy was to provide a foundation for local officials to move forward by focusing on perhaps the most important financing attribute: leadership and the ability to move communities towards effective action.	--	http://efc.umd.edu/localgovernmentstormwaterfinancingmanual.html	Environmental Finance Center, 1210 Preinkert Field House, (Building 054), College Park, MD 2074
EPA New England	Funding Stormwater Factsheet	This document is intended to assist local stormwater managers to alleviate the significant expense of construction, operation and maintenance of a municipal separate storm sewer system (MS4). The costs of stormwater programs, increased by regulatory requirements (stormwater Phase I or Phase II), flooding concerns, water quality issues (including total maximum daily loads, or TMDLs) and population growth, may be subsidized through a stormwater utility or various other methods detailed in this document.	--	www.epa.gov/region1/npdes/stormwater/assets/pdfs/FundingStormwater.pdf	EPA New England—Thelma Murphy murphy.thelma@epa.gov 617-918-1615 Rob Adler adler.robert@epa.gov 617- 918-1396
US Department of Agriculture, Natural Resource Conservation Service	Watershed Surveys and Planning	To provide planning assistance to Federal, state and local agencies for the development or coordination of water and related land resources and programs in watersheds and river basins.	No funding has been authorized since FY 2008.	http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wsp/	Arthur Ramthun, State Conservation Engineer, Tolland, Connecticut, (860) 871-4030, arthur.ramthun@ct.usda.gov
US Department of Agriculture, Natural Resource Conservation Service	Watershed Protection and Flood Prevention	To provide technical and financial assistance in planning and executing works of improvement to protect, develop, and use of land and water resources in small watersheds.	Ongoing	http://www.nrcs.usda.gov/wps/portal/nrcs/main/ct/programs/planning/wfp/	Arthur Ramthun, State Conservation Engineer, Tolland, Connecticut, (860) 871-4030, arthur.ramthun@ct.usda.gov

Maine - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
US Department of Agriculture, Rural Development - administered by State Office in Maine	Emergency Community Water Assistance Grants	<p>This program helps eligible communities prepare for, or recover from, an emergency that threatens the availability of safe, reliable drinking water for households and businesses. Eligible applicants:</p> <p>Most State and local governmental entities, Nonprofit organizations, Federally recognized Tribes</p> <p>What kind of event can qualify as an emergency? Drought or flood, Earthquake, Tornado or hurricane, Disease outbreak Chemical spill, leak or seepage, Other disasters</p>	Applications for this program are accepted through your local RD office year round	http://www.rd.usda.gov/programs-services/emergency-community-water-assistance-grants/me	<p>Community Program Contacts:</p> <p>Michael G. Rollins Area Specialist (207) 990-3676 ext. 327 michael.rollins@me.usda.gov (Serving the counties of: Penobscot, Piscataquis, Somerset, Washington, and Aroostook)</p>
US Department of Agriculture, Rural Development - administered by State Office in Maine	Water & Waste Disposal Loan & Grant Program	<p>Provides funding for clean and reliable drinking water systems, sanitary sewage disposal, sanitary solid waste disposal, and storm water drainage to households and businesses in eligible rural areas.</p> <p>This program assists qualified applicants that are not otherwise able to obtain commercial credit on reasonable terms. Eligible applicants include:</p> <p>Most State and local governmental entities Private non-profits Federally-recognized Tribes</p>	Applications for this program are accepted through your local offices year round	http://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program/me	<p>Scott Emery, P.E. Civil Engineer scott.emery@me.usda.gov Telephone: (207) 990-9121 Facsimile: (855) 589-1098</p>
US Department of Agriculture, Natural Resource Conservation Service in Maine	Emergency Watershed Protection Program Flood Plain Easements	The Emergency Watershed Protection (EWP) Program was set up by Congress to respond to emergencies created by natural disasters. It is designed to relieve imminent hazards to life and property caused by floods, hurricanes, tornadoes, windstorms, fires, and other natural occurrences. Maine Emergency Watershed Program Floodplain Easements is funded by the American Recovery and Reinvestment Act of 2009 (Recovery Act)	Ongoing	http://www.nrcs.usda.gov/wps/portal/nrcs/main/me/programs/financial/ewp/	<p>Dan Baumert, State Conservation Engineer, 207-990-9555, or email dan.baumert@me.usda.gov</p>
US Department of Agriculture, Natural Resource Conservation Service in Maine	Emergency Watershed Protection Program	<p>The Emergency Watershed Protection (EWP) Program was set up by Congress to respond to emergencies created by natural disasters. It is designed to relieve imminent hazards to life and property caused by floods, hurricanes, tornadoes, windstorms, fires, and other natural occurrences.</p> <p>The purpose of (EWP) is to help groups of people with a common problem. It is generally not an individual assistance program. All projects undertaken must be sponsored by a political subdivision of the state, such as a city, town, county, or conservation district.</p> <p>The program is administered by the USDA Natural Resources Conservation Service (NRCS), which provides technical and financial assistance to preserve life and property threatened by excessive erosion and flooding.</p>	Ongoing	http://www.nrcs.usda.gov/wps/portal/nrcs/main/me/programs/financial/ewp/	<p>Dan Baumert, State Conservation Engineer, 207-990-9555, or email dan.baumert@me.usda.gov</p>

Maine - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
Department of Health and Human Services -Maine Center for Disease Control and Prevention	Local Source Water Protection Grant Program	This grant is available for the protection of public drinking water sources.	Applications must be postmarked by March 31, 2016 Available annually	http://www.maine.gov/dhhs/mecdc/environmental-health/dwp/imt/documents/SWPgrantApplication.pdf	Erika Bonenfant at (207) 287-5681 or e-mail erika.bonenfant@maine.gov
Department of Agriculture, Conservation and Forestry - Grants and Community Recreation Bureau of Parks and Lands in Maine	Land & Water Conservation Fund Grant	The Land and Water Conservation Fund Act of 1964 (LWCF) was established to assist federal, state and local governments in the acquisition and/or development of public outdoor recreation facilities. Administered at the federal level by the National Park Service and at the state level by the Bureau of Parks and Lands in the Maine Department of Agriculture, Conservation and Forestry, LWCF grants can provide up to 50% of the allowable costs for approved acquisition or development projects.	Deadline - annually in November	http://www.maine.gov/dacf/parks/grants/land_water_conservation_fund.html	Grants and Community Recreation Bureau of Parks and Lands 124 State House Station Augusta, Maine 04333 207-287-4962 Doug Beck, Outdoor Recreation Supervisor E-mail address: Doug.Beck@maine.gov
Department of Health and Human Services -Maine Center for Disease Control and Prevention	Maine CDC Drinking Water Program - Land Acquisition Loans	The Maine Drinking Water Program (DWP) believes that ownership, easements, or other legal control of the land around a drinking water source is the most effective means of drinking water supply protection. Land Acquisition Loans are low interest loans available to community or non-profit, non-community public water systems for the purchase of land and/or conservation easements necessary for source water protection. Land Acquisition Loans are administered by the DWP and serviced through the Maine Municipal Bond Bank	There is no deadline for Land Acquisition Loan applications.	http://www.maine.gov/dhhs/mecdc/environmental-health/dwp/imt/documents/LandAcquisitionLoanFactSheet.pdf	Erika Bonenfant at (207) 287-5681 or e-mail erika.bonenfant@maine.gov
Federal Emergency Management Agency (FEMA), Administered by Maine Emergency Management Agency	Pre-Disaster Mitigation Program (PDM)	Pre-Disaster Mitigation (PDM) provides funds to states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are to be awarded on a competitive basis. Cost Share: 75% Federal Funds/25% State or Local Funds If subgrantee is a small impoverished community, the cost share is 90% Federal Funds/10% State or Local Funds	If a grant program is open for application, an announcement will be posted on the Mitigation program front page. http://www.maine.gov/ema/mitigation/index.shtml	http://www.maine.gov/mema/mitigation/mema_mit_grants.shtml http://www.maine.gov/tools/whatsnew/attach.php?id=53919&an=1	Maine Emergency Management Agency 72 State House Station 45 Commerce Drive Augusta, Maine 04333 800-452-8735 (toll-free, in-state only) 207-624-4400 TTY: Maine Relay 711 FAX: 207-287-3178

Maine - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
Federal Emergency Management Agency (FEMA), Administered by Maine Emergency Management Agency	Hazard Mitigation Grant Program (HMGP)	<p>The Healthy Communities Grant Program is EPA New England's main competitive grant program to work directly with communities to reduce environmental risks to protect and improve human health and the quality of life. The Healthy Communities Grant Program will achieve this through identifying and funding projects that:</p> <ul style="list-style-type: none"> -Target resources to benefit communities at risk -Assess, understand, and reduce environmental and human health risks -Increase collaboration through community-based projects <p>Achieve measurable environmental and human health benefits Advance emergency preparedness and resilience</p>	If a grant program is open for application, an announcement will be posted on the Mitigation program front page. http://www.maine.gov/mema/mitigation/index.shtml	http://www.maine.gov/mema/mitigation/mema_mit_grants.shtml	Maine Emergency Management Agency 72 State House Station 45 Commerce Drive Augusta, Maine 04333 800-452-8735 (toll-free, in-state only) 207-624-4400 TTY: Maine Relay 711 FAX:207-287-3178
Federal Emergency Management Agency (FEMA), Administered by Maine Emergency Management Agency	Flood Mitigation Assistance Program (FMA)	<p>The Flood Mitigation Assistance (FMA) program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP).</p> <p>FEMA provides FMA funds to assist States and communities implement measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program.</p> <p>Cost Share: 75% Federal Funds/25% State or Local Funds, 90% Federal Funds/10% State or Local Funds with Severe Repetitive Loss Strategy</p>	If a grant program is open for application, an announcement will be posted on the Mitigation program front page. http://www.maine.gov/mema/mitigation/index.shtml	http://www.maine.gov/mema/mitigation/mema_mit_grants.shtml	Maine Emergency Management Agency 72 State House Station 45 Commerce Drive Augusta, Maine 04333 800-452-8735 (toll-free, in-state only) 207-624-4400 TTY: Maine Relay 711 FAX:207-287-3178
Federal Emergency Management Agency (FEMA), Administered by Maine Emergency Management Agency	Severe Repetitive Loss (SRL)	The Severe Repetitive Loss (SRL) grant program was authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, which amended the National Flood Insurance Act of 1968 to provide funding to reduce or eliminate the long-term risk of flood damage to severe repetitive loss (SRL) structures insured under the National Flood Insurance Program (NFIP).	If a grant program is open for application, an announcement will be posted on the Mitigation program front page. http://www.maine.gov/mema/mitigation/index.shtml	http://www.maine.gov/mema/mitigation/mema_mit_grants.shtml	Maine Emergency Management Agency 72 State House Station 45 Commerce Drive Augusta, Maine 04333 800-452-8735 (toll-free, in-state only) 207-624-4400 TTY: Maine Relay 711 FAX:207-287-3178
Federal Emergency Management Agency (FEMA), Administered by Maine Emergency Management Agency	Repetitive Flood Claims	<p>The Repetitive Flood Claims (RFC) grant program was authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004 (P.L. 108-264), which amended the National Flood Insurance Act (NFIA) of 1968 (42 U.S.C. 4001, et al).</p> <p>Up to \$10 million is available annually for FEMA to provide RFC funds to assist States and communities reduce flood damages to insured properties that have had one or more claims to the National Flood Insurance Program (NFIP).</p> <p>Cost Share: 100% Federal Funds/0% State or Local Funds</p>	Please note: 07/2013 - The Biggert Waters Flood Insurance Reform Act of 2012 eliminated the SRL program.	http://www.maine.gov/dacf/flood/info_for/local_officials.shtml	Maine Floodplain Management Program Department of Agriculture, Conservation and Forestry 93 SHS/Williams Pavilion 17 Elkins Lane Augusta, Maine 04333-0093

Maine - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
Federal Emergency Management Agency (FEMA), Administered by Maine Emergency Management Agency	Community Disaster Loan Program	The Federal Emergency Management Agency (FEMA) provides direct loans to local governments to offset the loss of tax or other revenues as a result of a major disaster. The local government must demonstrate a need to maintain local governmental functions such as police and fire protection, or water and sewer services. Loans are not to exceed 25% of the local government's annual operating budget for the fiscal year in which the major disaster occurs, up to a maximum of \$5 million.	Upon declaration of a major disaster, one may apply for assistance through the Governor's authorized representative.	http://www.fema.gov/community-disaster-loan-program	Public Assistance Branch, Recovery Division FEMA, DHS 500 C Street SW, Washington, DC 20472
Environmental Finance Center - University of Maryland	Local Government Stormwater Financing Manual	EFC's Local Government Stormwater Financing Manual was inspired by and written for local government leaders. Public sector financing in general, and stormwater financing specifically often appear to be inaccessibly complicated and technical to even experienced public officials. Therefore, rather than try to address the myriad of issues associated with stormwater financing, the main strategy was to provide a foundation for local officials to move forward by focusing on perhaps the most important financing attribute: leadership and the ability to move communities towards effective action.	--	http://efc.umd.edu/localgovernmentstormwaterfinancingmanual.html	Environmental Finance Center, 1210 Preinkert Field House, (Building 054), College Park, MD 2074
EPA New England	Funding Stormwater Factsheet	This document is intended to assist local stormwater managers to alleviate the significant expense of construction, operation and maintenance of a municipal separate storm sewer system (MS4). The costs of stormwater programs, increased by regulatory requirements (stormwater Phase I or Phase II), flooding concerns, water quality issues (including total maximum daily loads, or TMDLs) and population growth, may be subsidized through a stormwater utility or various other methods detailed in this document.	--	www.epa.gov/region1/npdes/stormwater/assets/pdfs/FundingStormwater.pdf	EPA New England—Thelma Murphy thelma.murphy@epa.gov 617-918-1615 Rob Adler adler.robert@epa.gov 617- 918-1396
US Small Business Administration	SBA Disaster Loan Program	SBA provides low-interest disaster loans to businesses of all sizes, private non-profit organizations, homeowners, and renters. SBA disaster loans can be used to repair or replace items damaged or destroyed in a declared disaster: real estate, personal property, machinery and equipment, and inventory and business assets. If a loan application is approved, a recipient may be eligible for additional funds to cover the cost of improvements that will protect property against future damage. Examples of improvements include retaining walls, seawalls, sump pumps, etc. Mitigation loan money would be in addition to the amount of the approved loan, but may not exceed 20 percent of total amount of disaster damage to real estate and/or leasehold improvements, as verified by SBA to a maximum of \$200,000 for home loans	Ongoing	https://www.sba.gov/content/disaster-loan-program	1-800-659-2955 (TTY: 1-800-877-8339) or e-mail disastercustomerservice@sba.gov

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Organization	Program	Purpose	Application Dates	Website	Contact
NOAA - University of Maine	Maine Sea Grant	The Maine Sea Grant College Program invites full proposals for research projects to be funded in the period February 2016 through January 2018. Through our biennial request for proposals, we strive to sponsor a diverse research portfolio that links the scientific capacity of Maine with the needs of coastal stakeholders. Assuming no changes in the federal Sea Grant appropriation and the requirements of the non-research components of the Maine Sea Grant program, an estimated \$450,000 will be available to support research projects over the two-year funding period. Total two year requests are limited to \$150,000 in Sea Grant funds (including all direct and indirect costs). Maine Sea Grant is administered by the University of Maine, but the research competition is open to faculty and staff at any public or private research or higher education institution in the state.	Preliminary proposal deadline: 4:30 p.m., EST, Friday 27 February 2015	http://www.seagrant.umaine.edu/funding/research	Damian C. Brady Assistant Director for Research Preferred phone number: 207.563.8102
Federal Emergency Management Agency (FEMA), Administered by Department of Agriculture, Conservation and Forestry in Maine	National Flood Insurance Program	The National Flood Insurance Program (NFIP) enables homeowners, business-owners, renters, and governments to purchase flood insurance coverage where premium rates are generally lower than standard actuarial rates. Generally, physical damage to buildings or personal property "directly" caused by a flood is covered by flood insurance. For example, damages caused by a sewer backup are covered if the backup is a direct result of flooding. However, if the backup is caused by some other problem, the damages are not covered. Most NFIP Policies include Increased Cost of Compliance (ICC) coverage. This coverage can provide up to \$30,000 of the cost to elevate, demolish, or relocate homes. If your community declares a home "substantially damaged" or "repetitively damaged" by a flood, FEMA will require the owner to bring the home up to current community standards.	Ongoing	http://www.maine.gov/dacf/flood/flood_insurance.shtml	Maine Floodplain Management Program Department of Agriculture, Conservation and Forestry 93 SHS/Williams Pavilion 17 Elkins Lane Augusta, Maine 04333-0093
Federal Emergency Management Agency (FEMA) administered by Maine Emergency Management Agency	FEMA Public Assistance (PA) Grant Program	The Federal Emergency Management Agency (FEMA) provides funding so communities can quickly respond to and recover from major disasters or emergencies declared by the President. Grant assistance is available for the following activities: Debris removal Emergency protective measures The repair, replacement, or restoration of disaster-damaged, publicly owned facilities and the facilities of certain private non-profit organizations The protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process The Federal share of assistance is not less than 75% of the eligible cost for emergency measures and permanent restoration. The grantee (usually the state) determines how the non-federal share (up to 25%) is split with the subgrantees (eligible applicants).	Depends on Major Disaster Declarations	http://www.maine.gov/mema/recovery/mema_recovery_fed.shtml	Maine Emergency Management Agency 72 State House Station 45 Commerce Drive Augusta, Maine 04333 800-452-8735 (toll-free, in-state only) 207-624-4400 TTY: Maine Relay 711 FAX:207-287-3178

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Organization	Program	Purpose	Application Dates	Website	Contact
US Department of Housing and Urban Development administered by Maine Department of Economic & Community Development	Community Development Block Grant (CDBG) Program	<p>The primary purpose of the CDBG program is the development of viable communities by providing decent housing, suitable living environments, and expanding economic opportunities, principally for low and moderate income people. The program is sponsored by the US Department of Housing and Urban Development (HUD).</p> <p>Each year the State of Maine receives a formula allocation of funding from the Department of Housing and Urban Development to be distributed to eligible Maine communities under the Community Development Block Grant Program.</p> <p>In 1982 the State of Maine began administering the CDBG Program to assist units of local government in various community projects in areas ranging from infrastructure, housing, downtown revitalization to public facilities and economic development.</p>	Several types of grants - Deadlines throughout the year, offered annually or biannually	http://www.maine.gov/decd/meocd/	<p>Department of Economic & Community Development Burton Cross Building, 3rd Floor 111 Sewall St Augusta, ME 04330-6830</p> <p>Phone (207) 624-9800</p>
US Department of Agriculture, Natural Resources Conservation Service, Maine	Watershed Surveys and Planning	To provide planning assistance to Federal, state and local agencies for the development or coordination of water and related land resources and programs in watersheds and river basins.	No funding has been authorized since FY 2008.	http://www.nrcs.usda.gov/wps/portal/nrcs/main/me/programs/planning/wfp/#	<p>Natural Resources Conservation Service 967 Illinois Avenue, Suite #3 Bangor, ME 04401</p> <p>Telephone: (207) 990-9100, Extension 3</p>
EPA New England	Healthy Communities Grant Program	<p>The Healthy Communities Grant Program is EPA New England's main competitive grant program to work directly with communities to reduce environmental risks to protect and improve human health and the quality of life. The Healthy Communities Grant Program will achieve this through identifying and funding projects that:</p> <ul style="list-style-type: none"> -Target resources to benefit communities at risk -Assess, understand, and reduce environmental and human health risks -Increase collaboration through community-based projects -Build institutional and community capacity to understand and solve environmental and human health problems -Achieve measurable environmental and human health benefits -Advance emergency preparedness and resilience 	Every year	http://www.epa.gov/region1/eco/uep/hcgp.html	Sandra Brownell, brownell.sandra@epa.gov or 617-918-1797).

Massachusetts - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
State of Massachusetts	State issued "Green Bond" (series D green bonds)	The state is selling "Green Bonds" to fund environmentally beneficial projects for Land Acquisition, Open Space Protection & Environmental Remediation, River Revitalization and Preservation & Habitat Restoration, Energy Efficiency & Conservation, and Clean & Drinking Water	Varies: The state sold \$100 million in bonds in June 2013, and \$350 million in September 2014.	http://www.massbondholder.com/	Contact the Commonwealth: Tel: 800-535-1144. Email at massbondholder@tre.state.ma.us . Commonwealth of Massachusetts Treasurer's Office Debt Management Department 3 Center Plaza, Suite 430 Boston, MA 02108
Executive Office of Energy and Environmental Affairs – administered by the Massachusetts Office of Coastal Zone Management	Massachusetts Coastal Community Resilience Grant Program	This grant program provides financial and technical resources to advance new and innovative local efforts to increase awareness of climate impacts, identify vulnerabilities, and implement measures to increase community resilience (i.e., the ability to endure impacts associated with coastal storms and the effects of erosion, flooding, and sea level rise and to respond, recover, and adapt to consequences). This grant program is open to the 78 municipalities located within the Massachusetts coastal zone.	Unknown. The 2016 Request for Responses (RFR) is now closed.	http://www.mass.gov/eea/agencies/czm/program-areas/storm-smart-coasts/grants/	Patricia Bowie, Coastal Resilience Specialist, Massachusetts Office of Coastal Zone Management 251 Causeway Street, Suite 800 Boston, MA 02114 patricia.bowie@state.ma.us 617-626-1186
Executive Office of Energy and Environmental Affairs (EEA)	Dam and Seawall Repair or Removal Program	A series of grant programs designed to support local climate preparedness efforts, combat the effects of coastal storms, erosion and sea level rise, and protect coastal communities, allows for the repair and removal of dams, levees and seawalls to help restore ecological systems, improve public safety and protect key public assets. Grants of up to \$1,000,000 are available for dam and levee projects, and up to \$3,000,000 for coastal protection projects.	Applications can be found on the CommBuys website and will be accepted until July 14, 2015.	http://www.mass.gov/eea/waste-mgmt-recycling/water-resources/preserving-water-resources/water-laws-and-policies/water-laws/draft-regs-re-dam-and-sea-wall-repair-or-removal-fund.html	John Clarkeson, Executive Office of Energy and Environmental Affairs, ADA coordinator 617-626-1161, 100 Cambridge Street, Suite 900, Boston, MA 02114 john.clarkeson@state.ma.us
Federal Emergency Management Agency (FEMA) Administered by Massachusetts Emergency Management Agency	Pre-Disaster Mitigation Program (PDM)	Provides funds to States, territories, Indian Tribal governments and communities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event	Federal funding for this nationally competitive grant program is generally an annual allocation (subject to Congressional appropriation).	http://www.mass.gov/eopss/agencies/mema/hazard-mitigation/grants/pre-disaster-mitigation-pdm-grant-program.html	Mass EMA: Ph: (508) 820-2000 Fax: (508) 820-2030 FEMA: http://www.fema.gov/pre-disaster-mitigation-grant-program

Massachusetts - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
Federal Emergency Management Agency (FEMA) Administered by Massachusetts Emergency Management Agency	Hazard Mitigation Grant Program (HMGP)	Helps communities implement hazard mitigation measures following a Presidential major disaster declaration. Hazard mitigation is any action taken to reduce or eliminate long term risk to people and property from natural hazards.	Open: Following a Presidential Major Disaster Declaration MA EMA disperses funds to FEMA approved projects.	http://www.mass.gov/eopss/agencies/mema/hazard-mitigation/grants/hazard-mitigation-grant-program-hmgp.html	Mass EMA: Ph: (508) 820-2000 Fax: (508) 820-2030 FEMA: http://www.fema.gov/hazard-mitigation-grant-program
Federal Emergency Management Agency (FEMA) Administered by Massachusetts Emergency Management Agency	Flood Mitigation Assistance Program	Assists states and communities in implementing cost-effective measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program (NFIP).	The Notice of Funding Opportunity announcements are posted on Grants.gov	http://www.mass.gov/eopss/agencies/mema/hazard-mitigation/grants/flood-mitigation-assistance-fma-grant-program.html	Mass EMA: Ph: (508) 820-2000 Fax: (508) 820-2030 FEMA: http://www.fema.gov/flood-mitigation-assistance-grant-program
FEMA and US Department of Homeland Security	Public Assistance Program	To provide supplemental Federal disaster grant assistance for debris removal, emergency protective measures, and the repair, replacement, or restoration of disaster-damaged, publicly owned facilities and the facilities of certain Private Non-Profit (PNP) organizations. The PA Program also encourages protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process.	Open: Once a disaster has occurred, and the State has declared a state of emergency, The President then makes the decision whether or not to declare a major disaster or emergency. Following a Presidential Major Disaster Declaration MA EMA disperses funds to FEMA approved projects.	http://www.fema.gov/public-assistance-local-state-tribal-and-non-profit http://www.mass.gov/eopss/agencies/mema/recovery/public-assist/public-assistance.html	MA disaster recovery specialists contact numbers at: http://www.mass.gov/eopss/agencies/mema/recovery/public-assist/public-assistance.html
Environmental Finance Center - University of Maryland	Local Government Stormwater Financing Manual	EFC's Local Government Stormwater Financing Manual was inspired by and written for local government leaders. Public sector financing in general, and stormwater financing specifically often appear to be inaccessibly complicated and technical to even experienced public officials. Therefore, rather than try to address the myriad of issues associated with stormwater financing, the main strategy was to provide a foundation for local officials to move forward by focusing on perhaps the most important financing attribute: leadership and the ability to move communities towards effective action.	--	http://efc.umd.edu/localgovernmentstormwaterfinancingmanual.html	Environmental Finance Center, 1210 Preinkert Field House, (Building 054), College Park, MD 2074

Massachusetts - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
EPA New England	Funding Stormwater Factsheet	This document is intended to assist local stormwater managers to alleviate the significant expense of construction, operation and maintenance of a municipal separate storm sewer system (MS4). The costs of stormwater programs, increased by regulatory requirements (stormwater Phase I or Phase II), flooding concerns, water quality issues (including total maximum daily loads, or TMDLs) and population growth, may be subsidized through a stormwater utility or various other methods detailed in this document.	--	www.epa.gov/region1/npdes/stormwater/assets/pdfs/FundingStormwater.pdf	EPA New England—Thelma Murphy murphy.thelma@epa.gov 617-918-1615 Rob Adler adler.robert@epa.gov 617- 918-1396
Metropolitan Area Planning Council	Stormwater Utility/Funding Starter Kit	MAPC and project partners developed a Stormwater Utility/Funding Starter Kit to help municipalities take control of local water quality issues via a long-term funding source for stormwater management, which is encouraged by the U.S. Environmental Protection Agency and The Massachusetts Department of Environmental Protection. Massachusetts municipalities are authorized under Massachusetts General Laws to establish a stormwater management authority, empowering them to charge fees to property owners, just as traditional utilities are allowed to charge fees for electricity, drinking water, and sewer services (MGL Chapter 40 Section 1A, Chapter 40A Section 5, Chapter 44 Section 53F-1/2, and Chapter 83 Section 16).	--	http://www.mapc.org/Stormwater_Financing	Julie Conroy, Senior Environmental Planner, MAPC Environmental Division at jconroy@mapc.org or 617-933-0749.
Town of Reading - Massachusetts	Stormwater Funding FAQs	Municipal level information about Stormwater Funding	--	http://www.readingma.gov/collector/pages/storm-water-faqs	Department of Public Works, Engineering Division at (781) 942-9082, 16 Lowell Street Reading, MA 01867 781-942-9001
US Department of Housing and Urban Development	Community Development Block Grant (CDBG) Program	Program works to ensure decent affordable housing, to provide services to the most vulnerable in our communities, and to create jobs through the expansion and retention of businesses.	Ongoing - application dates throughout the year	http://www.mass.gov/hed/community/funding/community-development-block-grant-cdbg.html	Department of Housing and Community Development 100 Cambridge Street, Suite 300 Boston, MA 02114 Phone: (617) 573-1100 Fax: (617) 573-1120 TTY 617-573-1140 www.mass.gov/dhcd
US Department of Agriculture, Natural Resource Conservation Service	Watershed Surveys and Planning	To provide planning assistance to Federal, state and local agencies for the development or coordination of water and related land resources and programs in watersheds and river basins.	No funding has been authorized since FY 2008.	http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wsp/	Office of Grants and Technical Assistance Executive Office of Energy and Environmental Affairs 100 Cambridge Street, Suite 900 Boston, MA 02114, EEAgrants@state.ma.us

Massachusetts - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
US Department of Agriculture, Natural Resource Conservation Service	Watershed Protection and Flood Prevention	To provide technical and financial assistance in planning and executing works of improvement to protect, develop, and use of land and water resources in small watersheds.	Ongoing	http://www.nrcs.usda.gov/wps/portal/nrcs/main/ma/programs/planning/wpf/	Office of Grants and Technical Assistance Executive Office of Energy and Environmental Affairs 100 Cambridge Street, Suite 900 Boston, MA 02114, EEAgrants@state.ma.us
US Department of the Interior, National Park Service	Land and Water Conservation Fund Grants	To acquire and develop outdoor recreation areas and facilities for the general public, to meet current and future needs.	The grant is not offered every year	http://www.mass.gov/eea/grants-and-tech-assistance/grants-and-loans/dcs/grant-programs/massachusetts-land-and-water-conservation-fund.html	Melissa Cryan (617) 626-1171 melissa.cryan@state.ma.us
Executive Office of Energy and Environmental Affairs (EEA) in Massachusetts	Massachusetts Environmental Trust (MET)	The Massachusetts Environmental Trust (MET) is a grant program within the Executive Office of Energy and Environmental Affairs. Our mission is to support projects that support innovative approaches to protect and restore natural resources. Funded through the sale of environmental license plates and legal settlements, MET is one of the largest sources of grant funds for water resources in the Commonwealth. Since its founding, MET has awarded over \$20 million in grants to organizations protecting and enhancing the Commonwealth's water resources and natural environments.	The Request for Responses (RFR) for the FY2015 General Grant Program can be downloaded from this page or from www.commbuys.com .	http://www.mass.gov/eea/grants-and-tech-assistance/grants-and-loans/mass-enviro-trust/met-grants.html	Bill Hinkley, Program Manager william.hinkley@state.ma.us Phone (617) 626-1177 Kate McDermott, Program Coordinator kathleen.mcdermott@state.ma.us Phone: (617) 626-1075
Office of Energy and Environmental Affairs	Dam and Seawall Repair or Removal Program	The Dam and Seawall Repair or Removal Program offers financial resources to qualified applicants for projects that share our mission to enhance, preserve, and protect the natural resources and the scenic, historic and aesthetic qualities of the Commonwealth of Massachusetts. The Dam and Seawall Repair or Removal Fund was established in 2013 by the Massachusetts Legislature to promote public health, public safety, and ecological restoration. These funds have been supplemented with monies authorized in the EEA Environmental Bond. To date, over \$15,000,000 has been awarded to communities throughout Massachusetts, leveraging an additional \$8,000,000 in local and federal matching funds	Application deadline: July 15, 2015	http://www.mass.gov/eea/waste-mgmt-recycling/water-resources/preserving-water-resources/water-laws-and-policies/water-laws/draft-regs-re-dam-and-sea-wall-repair-or-removal-fund.html	Evanice Torres, Executive Office of Energy and Environmental Affairs, ADA coordinator, at 617-626-1161, 100 Cambridge Street, Suite 900, Boston, MA 02114.

Massachusetts - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
Office of Energy and Environmental Affairs- Division of Conservation Services	Massachusetts Local Acquisitions for Natural Diversity (LAND) Program	The LAND Program (formerly the Self-Help Program) was established in 1961 to assist municipal conservation commissions in acquiring land for natural resource protection and passive outdoor recreation purposes. The grant provides reimbursement funding for the acquisition of land or a conservation restriction, as well as for limited associated acquisition costs. Lands acquired may include forests, fields, wetlands, wildlife habitat, unique natural, historic or cultural resources, and some farmland. Access by the general public is required.	Offered annually. Application deadline: July 15, 2015	http://www.mass.gov/eea/grants-and-tech-assistance/grants-and-loans/dcs/grant-programs/massachusetts-local-acquisitions-for-natural.html	Melissa Cryan (617) 626-1171 Melissa.Cryan@state.ma.us
Office of Energy and Environmental Affairs- Division of Conservation Services	Conservation Assistance for Small Communities	Reimbursement funding for preparation of real property appraisals, Open Space & Recreation Plans (OSRPs), other planning in support of land conservation, and/or development of Open Space Residential Design (OSD)/Natural Resources Protection Zoning (NRPZ) bylaws. Available to all communities with a population of 6,000 people or fewer. Funding is non-competitive; all eligible applicants will receive contracts on a rolling basis until all available funding is allocated. Participants must have an executed state contract prior to commencing work.	Next application period is expected in the Spring of 2016.	http://www.mass.gov/eea/grants-and-tech-assistance/grants-and-loans/dcs/grant-programs/conservation-appraisals.html	Celia Riechel 617-626-1187 Celia.Riechel@State.MA.US
Office of Energy and Environmental Affairs	Coastal Pollutant Remediation (CPR) Grant Program	The Coastal Pollutant Remediation (CPR) Grant Program was established in 1996 by the Massachusetts Legislature to help communities identify and improve water quality impaired by nonpoint source (NPS) pollution. The CPR program provides funding to Massachusetts municipalities to assess and treat stormwater pollution from paved surfaces and to design and construct commercial boat waste pumpout facilities. Since 1996, more than \$9 million in CPR grants have been awarded.	Every year	http://www.mass.gov/eea/agencies/czm/program-areas/coastal-water-quality/cpr/	Contact Adrienne Pappal for more information about the CPR Grant Program at (617) 626-1218 or adrienne.pappal@state.ma.us.
Office of Energy and Environmental Affairs	MassBays Healthy Estuaries Grant Program	In October 2015, MassBays announced the availability of funds under a new Healthy Estuaries Grant Program. The Healthy Estuaries Grant Program is a revision of MassBays' previous Research and Planning Grant Program. This grant program fills the funding gap between development of a concept for improving estuarine conditions and its implementation. By directing funding to planning, assessment, and prioritization steps, MassBays can advance well thought-out and resilient restoration and resource management projects. MassBays grant funds are dedicated to supporting local planning efforts and progress on protecting, restoring, and enhancing estuarine habitats (e.g. seagrass beds, salt marshes, beaches) and informing management efforts to reduce stressors (e.g. wastewater, stormwater, habitat fragmentation) and advance the goals of MassBays' Comprehensive Conservation and Management Plan.	Next application period expected late summer/early fall 2017.	http://www.mass.gov/eea/agencies/mass-bays-program/grants/	Prassede Vella Massachusetts Bays National Estuary Program 251 Causeway Street, Suite 800 Boston, MA 02114 (617) 626-1217 Prassede.Vella@state.ma.us

Massachusetts - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
Office of Energy and Environmental Affairs - Division of Waterways	Rivers and Harbors Grant Program	The Division of Waterways may also provide state funding assistance to municipalities to address waterways-related problems that may otherwise be beyond their financial capacity to effectively pursue. These funds require matching funds shared by a non-state source; this is known as the local cost share. The local cost share is a percentage of the entire project including design, permitting, and construction costs. Cost share for projects is a maximum of 75% state & at least 25% local funding for dredging and beach nourishment resulting from dredging. All other projects, including beach nourishment not through a dredging project, the state share shall be a maximum of 50% and the local share will be at least 50%. These funds are derived from capital appropriations of the General Court, the Rivers and Harbors Act, or other funding sources assigned.	Ongoing	http://www.mass.gov/eea/agencies/dcr/services-and-assistance/grants-and-technical-assistance/	Kevin P. Mooney, (781) 740-1600 x103
EPA New England	Healthy Communities Grant Program	The Healthy Communities Grant Program is EPA New England's main competitive grant program to work directly with communities to reduce environmental risks to protect and improve human health and the quality of life. The Healthy Communities Grant Program will achieve this through identifying and funding projects that: <ul style="list-style-type: none"> -Target resources to benefit communities at risk -Assess, understand, and reduce environmental and human health risks -Increase collaboration through community-based projects -Build institutional and community capacity to understand and solve environmental and human health problems -Achieve measurable environmental and human health benefits -Advance emergency preparedness and resilience 	Every year	http://www.epa.gov/region1/eco/uep/hcgp.html	Sandra Brownell, brownell.sandra@epa.gov or 617-918-1797).
American Rivers and NOAA	Community-Based Restoration Program River Grants - Stream Barrier Removal Grants	The American Rivers-NOAA River Grants program funds stream barrier removal projects in the Northeast, Mid-Atlantic, Northwest, South-Atlantic and California. Applications are being evaluated based upon the following priority criteria: (1) ecological merits of the project, (2) technical feasibility of the project, (3) timeliness in completion of funded phase; (4) benefits provided to the local community, and (5) financial clarity and strength of the application. Grants are provided for three distinct project phases: Construction, Engineering Design and Feasibility Analysis. The maximum award request is \$150,000.	Biannually	http://www.americanrivers.org/initiative/grants/projects/american-rivers-and-noaa-community-based-restoration-program-river-grants-2/	Brian Graber 136 West St. Suite 5 Northampton, MA 01060 Office Phone: 413-584-2183

New Hampshire - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
NH Department of Environmental Services (NHDES) - Watershed Assistance Section	Watershed Assistance Grants	Funds for NHDES Watershed Assistance Grants are appropriated through the U.S. EPA guidance requires that a "substantial majority" of funds must be used to restore impaired waters. If a need is demonstrated, NHDES may award grants for projects that will protect high quality waters. Projects must address watersheds identified as high priority, or implement existing watershed plans. Although there is no minimum or maximum limit on project budgets and grant requests, NHDES anticipates selecting five to eight projects this year.	Annually in July	http://des.nh.gov/organization/divisions/water/wmb/was/categories/grants.htm	Jillian McCarthy (603) 271-8475 Jillian.McCarthy@des.nh.gov
NH Department of Environmental Services (NHDES)	Local Source Water Protection Grant Program	This grant is available for the protection of public drinking water sources. Applicants can receive up to \$20,000 for projects with no match requirement. The grants are available to water suppliers, municipalities, regional planning agencies, non-profit organizations, educational institutions, conservation districts, and state agencies. Protection projects funded through this program have included delineation of wellhead protection areas, inventorying potential contamination sources, development of local protection ordinances, groundwater reclassification, shoreline surveys, drinking water education and outreach activities, and controlling access to sources. Applications are due the first week of November each year.	The application for the 2017 round of grants is due in November	http://des.nh.gov/organization/divisions/water/dwgb/dwsp/p/lswp_grants.htm	Amy Hudnor (603) 271-2950 amy.hudnor@des.nh.gov
US Department of the Interior, National Park Service	Land & Water Conservation Fund Grant	The State of New Hampshire and its governmental subdivisions (counties, cities, towns, and school districts) are eligible to apply to the Land and Water Conservation Fund grant-in-aid program. Projects must be for outdoor recreation. Land acquisitions can include purchase for new or additional parklands, access to water-based public recreation opportunities, conservation and natural area preserves, open space and scenic area protection, and lands for future development of outdoor recreation opportunities. Park development can include new outdoor recreation facilities and expansion or rehabilitation of existing areas and facilities. This is a 50/50 matching grant program with funding provided on a reimbursement basis. Costs eligible for reimbursement must be incurred within the project period with a start date based upon National Park Service application approval. The local match must be demonstrated in cash or in-kind donations of labor, professional services, materials, real property, and equipment.	January - Annually	http://www.nhstateparks.org/partner-and-community-resources/grants/land-and-water-conservation-fund-grant.aspx	Bill Gegas, LWCF Program Specialist; Eric Feldbaum - Community Recreation Specialist (603) 271-3556, or lwcf@dred.nh.gov.

New Hampshire - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
NH Department of Environmental Services (NHDES) - Watershed Assistance Section	Water Supply Land Protection Grants	<p>Purpose: To assist in the protection of community and non-transient non-community drinking water supplies by providing grant funds for the acquisition of land or conservation easements.</p> <p>Eligibility: New Hampshire municipalities and non-profit 501(c)(3) organizations having water supply or land conservation as a principal mission are eligible to apply. The land has to be within the Source Water Protection Area (SWPA) for an existing, proposed, or future water supply (contact DES for assistance with that determination) and it must be from a willing seller</p>	November 15, 2015	http://des.nh.gov/organization/divisions/water/dwgb/dwsp/land_acqui/	Holly Green NHDES Drinking Water and Groundwater Bureau 29 Hazen Drive; PO Box 95 Concord, NH 03302-0095 (603) 271-3114 (603) 271-0656 (fax) holly.green@des.nh.gov Sarah Pillsbury (603) 271-1168 sarah.pillsbury@des.nh.gov
Federal Emergency Management Agency (FEMA), Administered by Homeland Security and Emergency Management Agency in New Hampshire	Pre-Disaster Mitigation Program (PDM)	<p>Pre-Disaster Mitigation (PDM) provides funds to states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event.</p> <p>Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are to be awarded on a competitive basis and in addition to the amount allocated by the State of New Hampshire.</p> <p>Cost Share: 75% Federal Funds/25% State or Local Funds If subgrantee is a small impoverished community, the cost share is 90% Federal Funds/10% State or Local Funds</p>	Federal funding for this nationally competitive grant program is generally an annual allocation (subject to Congressional appropriation).	http://www.nh.gov/safety/divisions/hsem/HazardMitigation/pdm.html https://apps.nh.gov/blogs/hsem/?page_id=839	State Mitigation Officer: Beth Peck New Hampshire Homeland Security and Emergency Management 33 Hazen Drive Concord, NH 03301 Office: 603-223-3655 Cell: 603-892-4026 E-Mail: Elizabeth.Peck@dos.nh.gov
Federal Emergency Management Agency (FEMA), Administered by Homeland Security and Emergency Management Agency in New Hampshire	Hazard Mitigation Grant Program (HMGP)	<p>Provides funds to States, Territories, Indian, Tribal Governments, local governments, and eligible private non-profits following a Presidential major disaster declaration. The Hazardous Mitigation Grant Program (HMGP) differs from the other Hazard Mitigation Assistance programs because it is awarded following a declared disaster where as the other programs are awarded on an annual basis. The key purpose of HMGP is to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not wasted during the reconstruction process following a disaster.</p> <p>Cost Share: 75% Federal Funds/25% State or Local Funds</p>	Ongoing	http://www.nh.gov/safety/divisions/hsem/HazardMitigation/hmgp.html https://apps.nh.gov/blogs/hsem/?page_id=839	State Mitigation Officer: Beth Peck New Hampshire Homeland Security and Emergency Management 33 Hazen Drive Concord, NH 03301 Office: 603-223-3655 Cell: 603-892-4026 E-Mail: Elizabeth.Peck@dos.nh.gov

New Hampshire - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
Federal Emergency Management Agency (FEMA), Administered by Homeland Security and Emergency Management Agency in New Hampshire	Flood Mitigation Assistance Program (FMA)	<p>The Flood Mitigation Assistance (FMA) program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP).</p> <p>FEMA provides FMA funds to assist States and communities implement measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program.</p> <p>Cost Share: 75% Federal Funds/25% State or Local Funds, 90% Federal Funds/10% State or Local Funds with Severe Repetitive Loss Strategy</p>	Funding is only available following an official presidential disaster declaration; however projects can be planned prior to such an event.	http://www.nh.gov/safety/divisions/hsem/HazardMitigation/fma.html https://apps.nh.gov/blogs/hsem/?page_id=839	State Mitigation Officer: Beth Peck New Hampshire Homeland Security and Emergency Management 33 Hazen Drive Concord, NH 03301 Office: 603-223-3655 Cell: 603-892-4026 E-Mail: Elizabeth.Peck@dos.nh.gov
Federal Emergency Management Agency (FEMA), Administered by Homeland Security and Emergency Management Agency in New Hampshire	Severe Repetitive Loss (SRL)	<p>The Severe Repetitive Loss (SRL) grant program was authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, which amended the National Flood Insurance Act of 1968 to provide funding to reduce or eliminate the long-term risk of flood damage to severe repetitive loss (SRL) structures insured under the National Flood Insurance Program (NFIP).</p> <p>Purpose: To reduce or eliminate claims under the NFIP through project activities that will result in the greatest savings to the National Flood Insurance Fund (NFIF).</p> <p>Cost Share: 75% Federal Funds / 25% State or Local Share, 90% Federal Funds / 10% State or Local Funds with Repetitive Loss Strategy</p>	Ongoing	https://www.nh.gov/safety/divisions/hsem/HazardMitigation/srl.html	State Mitigation Officer: Beth Peck New Hampshire Homeland Security and Emergency Management 33 Hazen Drive Concord, NH 03301 Office: 603-223-3655 Cell: 603-892-4026 E-Mail: Elizabeth.Peck@dos.nh.gov
Federal Emergency Management Agency (FEMA), Administered by Homeland Security and Emergency Management Agency in New Hampshire	Community Disaster Loan Program	The Federal Emergency Management Agency (FEMA) provides direct loans to local governments to offset the loss of tax or other revenues as a result of a major disaster. The local government must demonstrate a need to maintain local governmental functions such as police and fire protection, or water and sewer services. Loans are not to exceed 25% of the local government's annual operating budget for the fiscal year in which the major disaster occurs, up to a maximum of \$5 million.	Communities may apply for assistance following a declaration of a major disaster	http://www.fema.gov/community-disaster-loan-program	State Mitigation Officer: Beth Peck New Hampshire Homeland Security and Emergency Management 33 Hazen Drive Concord, NH 03301 Office: 603-223-3655 Cell: 603-892-4026 E-Mail: Elizabeth.Peck@dos.nh.gov

New Hampshire - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
Federal Emergency Management Agency (FEMA), Administered by Office of Energy and Planning in NH	National Flood Insurance Program	The National Flood Insurance Program (NFIP) enables homeowners, business-owners, renters, and governments to purchase flood insurance coverage where premium rates are generally lower than standard actuarial rates. Generally, physical damage to buildings or personal property "directly" caused by a flood is covered by flood insurance. For example, damages caused by a sewer backup are covered if the backup is a direct result of flooding. However, if the backup is caused by some other problem, the damages are not covered. Most NFIP Policies include Increased Cost of Compliance (ICC) coverage. This coverage can provide up to \$30,000 of the cost to elevate, demolish, or relocate homes. If your community declares a home "substantially damaged" or "repetitively damaged" by a flood, FEMA will require the owner to bring the home up to current community standards.	Property owners (including municipalities) can apply for flood insurance at any time as long as their community participates in the NFIP.	http://www.nh.gov/oep/planning/programs/fmp/insurance.htm	Jennifer Gilbert, CFM, ANFI State Coordinator Voice: (603) 271-1762 Fax: (603) 271-2615 Email: jennifer.gilbert@nh.gov
Federal Emergency Management Agency (FEMA), Administered by Office of Energy and Planning in NH	FEMA Public Assistance (PA) Grant Program	The Federal Emergency Management Agency (FEMA) provides funding so communities can quickly respond to and recover from major disasters or emergencies declared by the President. Grant assistance is available for the following activities: Debris removal Emergency protective measures The repair, replacement, or restoration of disaster-damaged, publicly owned facilities and the facilities of certain private non-profit organizations The protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process The Federal share of assistance is not less than 75% of the eligible cost for emergency measures and permanent restoration. The grantee (usually the state) determines how the non-federal share (up to 25%) is split with the subgrantees (eligible applicants).	Public Assistance grants are available only after a Presidential Disaster Declaration. FEMA, the state and local agencies will work together to conduct a preliminary damage assessment and determine if such a declaration is necessary.	https://www.nh.gov/safety/divisions/hs/em/	Michael Poirier, state coordinating officer, N.H. Homeland Security and Emergency Management (HSEM) (603) 271-2231 / 1-800-852-3792
US Department of Housing and Urban Development	Community Development Block Grant (CDBG) Program	The primary purpose of the CDBG program is the development of viable communities by providing decent housing, suitable living environments, and expanding economic opportunities, principally for low and moderate income people. The program is sponsored by the US Department of Housing and Urban Development (HUD). CDFA distributes CDBG grants to New Hampshire's cities, towns, and counties.* A nonprofit agency may also apply through its municipality or county as a sub-recipient of CDBG money. All eligible municipalities and counties can apply for up to \$500,000 in CDBG funds per year. Typically, each year the New Hampshire CDBG program receives approximately \$8-10 million from HUD to use towards the CDBG Programs: Economic Development Housing, Public Facilities Emergencies and Unanticipated Events Feasibility Studies After set-asides of approximately \$100,000 for feasibility studies and \$500,000 for emergency grants, CDFA divides the remaining allocation, with half going to economic development and the other half going to housing and public facilities projects.	Deadlines annually	http://www.nhcdfa.org/block-grants/	CDFA, New Hampshire Community Development Finance Authority 14 Dixon Avenue, Suite 102 Concord, New Hampshire 03301 Tel: 603-226-2170 Fax: 603-226-2816 Email: webmaster@nhcdfa.org

New Hampshire - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
US Department of Agriculture, Rural Development	Emergency Community Water Assistance Grants	<p>This program helps eligible communities prepare for, or recover from, an emergency that threatens the availability of safe, reliable drinking water for households and businesses.</p> <p>Eligible applicants: Most State and local governmental entities, Nonprofit organizations, Federally recognized Tribes</p> <p>What kind of event can qualify as an emergency? Drought or flood, Earthquake, Tornado or hurricane, Disease outbreak Chemical spill, leak or seepage, Other disasters</p>	Applications for this program are accepted through your local RD office year round	http://www.rd.usda	Vermont New Hampshire Ted Brady, State Director 87 State Street Suite 324, P O Box 249 Montpelier, VT 05601 (802) 828-6000 or (802) 828-6080 (802) 828-6018 Fax
US Department of Agriculture, Rural Development	Water & Waste Disposal Loan & Grant Program	<p>Provides funding for clean and reliable drinking water systems, sanitary sewage disposal, sanitary solid waste disposal, and storm water drainage to households and businesses in eligible rural areas.</p> <p>This program assists qualified applicants that are not otherwise able to obtain commercial credit on reasonable terms. Eligible applicants include: Most State and local governmental entities Private non-profits Federally-recognized Tribes</p>	Applications for this program are accepted through your local RD office year round	http://www.rd.usda	Vermont New Hampshire Ted Brady, State Director 87 State Street Suite 324, P O Box 249 Montpelier, VT 05601 (802) 828-6000 or (802) 828-6080 (802) 828-6018 Fax
US Department of Agriculture, Natural Resource Conservation Service	Emergency Watershed Protection Program Flood Plain Easements	The Emergency Watershed Protection (EWP) Program was set up by Congress to respond to emergencies created by natural disasters. It is designed to relieve imminent hazards to life and property caused by floods, hurricanes, tornadoes, windstorms, fires, and other natural occurrences. New Hampshire Emergency Watershed Program Floodplain Easements is funded by the American Recovery and Reinvestment Act of 2009 (Recovery Act)	Ongoing	http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wfpo/	Jade Nield NRCS - NH State Conservation Engineer Phone: (603) 868-9931, ext. 112 Fax: 855-428-0332
US Department of Agriculture, Natural Resource Conservation Service in New Hampshire	Emergency Watershed Protection Program	<p>The Emergency Watershed Protection (EWP) Program was set up by Congress to respond to emergencies created by natural disasters. It is designed to relieve imminent hazards to life and property caused by floods, hurricanes, tornadoes, windstorms, fires, and other natural occurrences.</p> <p>The purpose of (EWP) is to help groups of people with a common problem. It is generally not an individual assistance program. All projects undertaken must be sponsored by a political subdivision of the state, such as a city, town, county, or conservation district.</p> <p>The program is administered by the USDA Natural Resources Conservation Service (NRCS), which provides technical and financial assistance to preserve life and property threatened by excessive erosion and flooding.</p>	Ongoing	http://www.nrcs.usda.gov/wps/portal/nrcs/main/nh/programs/financial/ewp/	Jade Nield NRCS - NH State Conservation Engineer Phone: (603) 868-9931, ext. 112 Fax: 855-428-0332

New Hampshire - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
EPA New England	Healthy Communities Grant Program	<p>The Healthy Communities Grant Program is EPA New England's main competitive grant program to work directly with communities to reduce environmental risks to protect and improve human health and the quality of life. The Healthy Communities Grant Program will achieve this through identifying and funding projects that:</p> <ul style="list-style-type: none"> -Target resources to benefit communities at risk -Assess, understand, and reduce environmental and human health risks -Increase collaboration through community-based projects -Build institutional and community capacity to understand and solve environmental and human health problems -Achieve measurable environmental and human health benefits -Advance emergency preparedness and resilience 	Every year	http://www.epa.gov/region1/eco/uep/hcgp.html	Sandra Brownell, brownell.sandra@epa.gov or 617-918-1797).
New England Grassroots Environmental Fund	Seed grants	Seed grants are geared to groups launching new projects and/or evolving the scale of an existing project. Grants are intended to support community groups who represent the most exciting energy in the environmental movement that are not being reached by traditional funders. The Fund interprets the word 'environment' broadly and will provide funding for a wide range of activities. Whole systems-thinking is critical to initiatives focused on making our environment better, healthier and more sustainable.	Ongoing	https://grassrootsfund.org/dollars/seed-grants	Ally Philip Ally@grassrootsfund.org or Leigh Cameron leigh@grassrootsfund.org, 603-905-9915
New England Grassroots Environmental Fund	Grow grants	Grow grants are geared to established groups who are ready to expand the scope of their work. Grow groups often have 1+ year experience running community projects and are ready to take on (pieces of) local system strategy around their issue. Grants are intended to support community groups who represent the most exciting energy in the environmental movement that are not being reached by traditional funders. The Fund interprets the word 'environment' broadly and will provide funding for a wide range of activities. Whole systems-thinking is critical to initiatives focused on making our environment better, healthier and more sustainable.	Deadlines: March 15 & September 15 (expect decisions early June & December)	https://grassrootsfund.org/dollars/grow-grants	Ally Philip Ally@grassrootsfund.org or Leigh Cameron leigh@grassrootsfund.org, 603-905-9915

Rhode Island - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
State of Rhode Island Department Environmental Management - Office of Water Resources	Bay Watershed Restoration Fund (BWRF)	The goal of the Narragansett Bay and Watershed Restoration Fund is to restore and protect the water quality, enhance the economic viability and environmental sustainability of Narragansett Bay and the state's watersheds. This Fund is meant to provide funding assistance for the feasibility analysis, design, construction and/or rehabilitation of nonpoint source water pollution control facilities, stormwater pollution control projects including the evaluation and/or development of a dedicated sustainable funding mechanism for stormwater pollution abatement, and riparian buffer and aquatic habitat restoration projects. In order to achieve its goal the monies from Narragansett Bay and Watershed Restoration Fund are apportioned between three sub-funds; 1) Nonpoint source water pollution abatement 2) Stormwater pollution abatement including the evaluation and/or development of a dedicated sustainable funding mechanism for, and 3) Riparian buffer and aquatic habitat restoration activities that will result in water pollution reduction and/or water quality protection of the waters of the state.	Varies from year to year and by sub-program	http://www.dem.ri.gov/pubs/regs/regs/water/nbwsrbf3.pdf	Jay Manning jay.manning@dem.ri.gov Gregg Cassidy gregg.cassidy@dem.ri.gov Office of Water Resources 235 Promenade Street Providence, RI 02908 Telephone: (401) 222-3961 x4403 Fax: (401) 222-3564
RI Water Resources Board	Water Facilities Assistance	Since 1983, the Water Resources Board has administered a grant program to finance up to 50% of design and construction costs for new public water supply facilities. Funding for this program is provided through periodic general obligation bonds passed by statewide voter referendum. To date, over twenty major system improvements benefiting fourteen water districts have been funded. The program allowed construction of the Bristol County Water Authority (BCWA) interconnection to the Providence and East Providence water systems, relieving the historically troublesome supply problems for Barrington, Bristol and Warren. The Board continues to work with BCWA regarding rehabilitation of aging supply, transmission, and treatment facilities. The Water Facilities Assistance Program has been a model of cooperation between state government and local water suppliers.	Ongoing	http://www.wrb.ri.gov/work_programs_wfassistance.html	Kenneth Burke, ken.burke@wrb.ri.gov One Capitol Hill, 3rd Floor Providence, RI 02908 Telephone: (401) 574-8409 Fax: (401) 574-8401
Rhode Island Department of Environmental Management	Rhode Island Open Space Grants	This program provides up to 50% matching grants to Land Trusts, Municipalities and Environmental Organizations for the acquisition or protection of Open Space in Rhode Island. The program offers Grants \$250,000 - \$400,000 maximum for the acquisition of fee simple, development rights or conservation easements on environmentally sensitive land. The grant applications are reviewed and scored by the Rhode Island Natural Heritage Preservation Advisory Committee. Final awards are made by the Natural Heritage Preservation Commission.	Several rounds of applications throughout the year	http://www.dem.ri.gov/programs/bpoladm/plandev/grants.htm	Lisa Primiano, Land Conservation Program Rhode Island Department of Environmental Management Division of Planning & Development 235 Promenade Street Providence, RI 02908 Telephone: (401) 222-2776, X 4307 lisa.primiano@dem.ri.gov
FEMA & Rhode Island Emergency Management Agency	Pre-Disaster Mitigation Program (PDM)	Pre-Disaster Mitigation (PDM) provides funds for hazard mitigation planning and the implementation of mitigation projects prior to a disaster. The goal of the PDM program is to reduce overall risk to the population and structures, while at the same time, also reducing reliance on Federal funding from actual disaster declarations. Funding is available on an annual basis (as appropriated). For Rhode Island communities, PDM has traditionally been the most popular way to receive an award to create or update a local hazard mitigation plan. Sub-applicants may also pursue funds through the Hazard Mitigation Grant Program for mitigation planning. For more information on the mitigation planning processes, please visit the Mitigation Planning page.	Federal funding for this nationally competitive grant program is generally an annual allocation (subject to Congressional appropriation).	http://www.riema.ri.gov/resources/citizens/mitigation/index.php	Rhode Island Emergency Management Agency 645 New London Avenue Cranston, RI 02920 Phone: (401) 946-9996 Fax: (401) 944-1891

Rhode Island - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
Environmental Finance Center - University of Maryland	Local Government Stormwater Financing Manual	EFC's Local Government Stormwater Financing Manual was inspired by and written for local government leaders. Public sector financing in general, and stormwater financing specifically often appear to be inaccessibly complicated and technical to even experienced public officials. Therefore, rather than try to address the myriad of issues associated with stormwater financing, the main strategy was to provide a foundation for local officials to move forward by focusing on perhaps the most important financing attribute: leadership and the ability to move communities towards effective action.	--	http://efc.umd.edu/localgovernmentstormwaterfinancingmanual.html	Environmental Finance Center, 1210 Preinkert Field House, (Building 054), College Park, MD 2074
EPA New England	Funding Stormwater Factsheet	This document is intended to assist local stormwater managers to alleviate the significant expense of construction, operation and maintenance of a municipal separate storm sewer system (MS4). The costs of stormwater programs, increased by regulatory requirements (stormwater Phase I or Phase II), flooding concerns, water quality issues (including total maximum daily loads, or TMDLs) and population growth, may be subsidized through a stormwater utility or various other methods detailed in this document.	--	www.epa.gov/region1/npdes/stormwater/assets/pdfs/FundingStormwater.pdf	EPA New England—Thelma Murphy murphy.thelma@epa.gov 617-918-1615 Rob Adler adler.robert@epa.gov 617-918-1396
US Department of Agriculture, Rural Development	Emergency Community Water Assistance Grants	This program helps eligible communities prepare for, or recover from, an emergency that threatens the availability of safe, reliable drinking water for households and businesses. Eligible applicants: Most State and local governmental entities, Nonprofit organizations, Federally recognized Tribes What kind of event can qualify as an emergency? Drought or flood, Earthquake, Tornado or hurricane, Disease outbreak Chemical spill, leak or seepage, Other disasters	Applications for this program are accepted through your local RD office year round	http://www.rd.usda.gov/programs-services/emergency-community-water-assistance-grants	Scott Soares, State Director 451 West Street Amherst, MA 01002-2999 Voice: 1 (800) 352-8015 (toll free) or (413)
US Department of Agriculture, Rural Development	Water & Waste Disposal Loan & Grant Program	Provides funding for clean and reliable drinking water systems, sanitary sewage disposal, sanitary solid waste disposal, and storm water drainage to households and businesses in eligible rural areas. This program assists qualified applicants that are not otherwise able to obtain commercial credit on reasonable terms. Eligible applicants include: Most State and local governmental entities Private non-profits Federally-recognized Tribes*	Applications for this program are accepted through your local RD office year round	http://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program	Scott Soares, State Director 451 West Street Amherst, MA 01002-2999 Voice: 1 (800) 352-8015 (toll free) or (413)

Rhode Island - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
United States Department of Agriculture Natural Resources Conservation Service Rhode Island	Emergency Watershed Protection Program	<p>The Emergency Watershed Protection (EWP) Program was set up by Congress to respond to emergencies created by natural disasters. These emergencies must result in life and property threatening impacts in order to qualify for assistance under the program. It is not necessary for a national emergency to be declared to be eligible. EWP assists groups of people with a common problem rather than providing assistance on an individual basis. NRCS administers the program and provides technical assistance.</p> <p>The Emergency Watershed Protection (EWP) Program consists of the traditional Emergency Watershed Protection (EWP) Program for recovery and the Floodplain Easement Program (EWP-FPE).</p> <p>All projects undertaken through the traditional recovery program require sponsorship by a political subdivision of the State such as a city, town, county, conservation district, or Tribal organization. The sponsor secures land rights and funds 25 percent of the project cost either in cash or in-kind contributions.</p>	Ongoing	http://www.nrcs.usda.gov/wps/portal/nrcs/main/ri/programs/financial/ewp/	R. Phou Vongkhamdy, STC USDA - Natural Resources Conservation Service 60 Quaker Lane, Suite 40 Warwick, RI 02886
United States Department of Agriculture Natural Resources Conservation Service Rhode Island	Emergency Watershed Protection Program Floodplain Easement (EWP-FPE)	<p>The Emergency Watershed Protection - Floodplain Easement Program (EWP-FPE) provides an alternative measure to traditional EWP recovery, where it is determined that acquiring an easement in lieu of recovery measures is the more economical and prudent approach to reducing a threat to life or property.</p> <p>The easement area will be restored to the maximum extent practicable to its natural condition. Restoration utilizes structural and nonstructural practices to restore the flood storage and flow, erosion control, and improve the practical management of the easement.</p>	Last Applications were accepted in 2014. (Hurricane Sandy)	http://www.nrcs.usda.gov/wps/portal/nrcs/main/ri/programs/financial/ewp/	R. Phou Vongkhamdy, STC USDA - Natural Resources Conservation Service 60 Quaker Lane, Suite 40 Warwick, RI 02886
National Park Service, U.S. Department of the Interior, Administered by Division of Planning and Development Department of Environmental Management in Rhode Island	Land and Water Conservation Fund	The Land and Water Conservation Fund (LWCF) has provided funding to help protect some of Rhode Island's most special places and ensure recreational access for hunting, fishing and other outdoor activities. Rhode Island has received approximately \$72 million in LWCF funding over the past five decades, protecting places such as the Great Salt Pond National Wildlife Refuge and the Roger Williams National Memorial.	Future grant rounds to be announced	http://www.dem.ri.gov/programs/bpoladm/plandev/grants.htm	Brandon Helm, The Wilderness Society, brandon_helm@tws.org or Chief Division of Planning and Development Department of Environmental Management 235 Promenade Street Providence RI 02908 Tel: 401-222-2776 ext 4301

Rhode Island - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
US Department of Housing and Urban Development & Agency of Commerce & Community Development - Department of Housing & Community Development	Community Development Block Grant Disaster Recovery Funds	HUD provides flexible grants to help cities, counties, and States recover from Presidentially declared disasters, especially in low-income areas, subject to availability of supplemental appropriations. In response to Presidentially declared disasters, Congress may appropriate additional funding for the Community Development Block Grant (CDBG) program as Disaster Recovery grants to rebuild the affected areas and provide crucial seed money to start the recovery process. Since CDBG Disaster Recovery (CDBG-DR) assistance may fund a broad range of recovery activities, HUD can help communities and neighborhoods that otherwise might not recover due to limited resources.	Ongoing - application dates throughout the year	http://www.planning.ri.gov/community/development/disaster/	Laura Sullivan CDBG-DR Program Manager (401) 222-6844, laura.sullivan@doa.ri.gov June House, CDBG-DR Technical Assistance & Compliance Specialist (401) 222-2079, june.house@doa.ri.gov
United States Department of Agriculture, Natural Resources Conservation Service Rhode Island	Conservation Technical Assistance	The Natural Resources Conservation Service provides conservation planning and technical assistance to individuals, groups and units of government. These clients develop and implement conservation plans to protect, conserve and enhance their natural resources. When providing assistance, NRCS focuses on the sound use and management of soil, water, air, plant and animal resources. NRCS helps clients manage their resources in a way that prevents resource degradation, ensures sustainability, allows for productivity and respects the client's needs. Conservation planning can make improvements to livestock operations, crop production, soil quality, water quality, hay land, forestland and wildlife habitats. The process also integrates ecological and economic considerations in order to address private and public concerns.		http://www.nrcs.usda.gov/wps/portal/nrcs/main/ri/about/	R. Phou Vongkhamdy-Service Center Staff State Conservationist 60 Quaker Lane, Suite 40 Warwick, RI 02886-0111 Phone: 401-828-1300, then press 1 Fax: 855-924-4748

Vermont - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
VT DEC Watershed Management Division	Vermont Watershed (Conservation License Plate) Grants	A wide variety of watershed projects are eligible, including protection, restoration and enhancement of habitat, water quality, recreation, and/or cultural/historic resources, and monitoring and education	Annually. Applications for 2016 are being accepted	http://www.watershedmanagement.vt.gov/lakes/html/p_watershedgrants.htm	Rick Hopkins, VTDEC, 802-490-6115; rick.hopkins@vermont.gov
VT DEC Watershed Management Division	Ecosystem Restoration Grants	Projects designed to improve water quality, including but not limited to projects that: improve natural stream stability, incorporate the science of fluvial geomorphology in river corridor and floodplain management decisions, minimize flood hazards by protecting or restoring river corridors, floodplains, and wetlands, and improve in-stream and riparian habitat; mitigate the effects of stormwater runoff from developed land areas, including downtowns and gravel roads; promote green infrastructure** and low impact development practices; protect and restore riparian wetlands; re-establish lake shoreline native vegetation and related shoreline erosion corrections; directly address in-lake (internal) phosphorus loading conditions; and enhance the environmental sustainability of agricultural lands. **Green Infrastructure is defined as strategically selected network of open spaces that conserve ecosystem functions and values that are beneficial to communities.	2 rounds of submissions per year. The deadline for proposal submittal is 4:30pm on October 14, 2015.	http://www.watershedmanagement.vt.gov/erp.htm	Kari Dolan 802-490-6113 kari.dolan@state.vt.us
Vermont Department of Environmental Conservation (DEC)	Clean Water Act Section 319 Nonpoint Source Pollution Control	The goal of the program under the federal Clean Water Act is to support restoration or implementation activities located in watersheds that are impaired by nonpoint source pollution and that are addressed by strategies or actions contained in watershed restoration plans. The total amount of 319 grant funds available is determined each year. Vermont DEC has not offered Section 319 grant funds since FFY2011.	Check website for details.	http://www.watershedmanagement.vt.gov/grants.htm	Rick Hopkins, VTDEC, 802-490-6115; rick.hopkins@vermont.gov
Vermont Department of Environmental Conservation (DEC)	Clean Water Act Section 604b Water Quality Management Planning	The federal Clean Water Act mandates Vermont DEC passes through as grants 40% of its annual 604b award to the Regional Planning Commissions (RPC) to conduct water quality planning activities of state or regional importance. Municipalities are encouraged to approach their respective RPC to discuss climate change adaptation and/or stormwater issues of concern.	N/A. DEC notifies each RPC when annual funding becomes available and to define eligible planning activities.	N/A	Rick Hopkins, VTDEC, 802-490-6115; rick.hopkins@vermont.gov

Vermont - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
Lake Champlain Basin Program (LCBP)	Implementing Opportunities for Action	The LCBP works in partnership with government agencies from New York, Vermont, and Quebec, private organizations, local communities, and individuals to coordinate and fund efforts which benefit the Lake Champlain Basin's water quality, fisheries, wetlands, wildlife, recreation, and cultural resources. Since 1992, the LCBP has awarded nearly 1,000 grants to local organizations to support a variety of pollution prevention, habitat restoration, and other projects that help to improve the quality of Lake Champlain. In that same time period, LCBP and its partner organizations also have funded numerous projects conducted by universities, consultants, research foundations, nonprofit organizations, and others. These projects include scientific research, best management demonstration projects, education and outreach efforts, and other initiatives that are key to implementing LCBP's management plan known as Opportunities for Action.	Annually. Check web site for further details.	www.lcbp.org	Bill Howland, LCBP, 802-372-3213, whowland@lcbp.org
New Hampshire Charitable Foundation (NHCF)	Upper Connecticut River Mitigation and Enhancement Fund (MEF)	The purpose of the MEF is to provide financial assistance to projects that will restore, protect, and/or enhance the CT River ecosystem affected by the Fifteen Mile Falls (FMF) hydroelectric project, or that will serve as mitigation for some of the impacts of the project. MEF supports implementation of restoration and protection projects within the Connecticut River watershed upstream of the confluence of the White River and the Connecticut River at White River Junction, VT and West Lebanon, NH. There are three MEF project categories and proposals should address one or more of the following resource categories: River Restoration—Projects that improve or enhance water quality, fisheries, fish passage (i.e. dam removal, culvert restoration) and habitat for river-dependent species. Wetland Restoration, Protection and Enhancement—Projects that restore or enhance wetlands to mitigate for wetlands lost or adversely affected by the FMF hydroelectric project (upstream and downstream from the FMF project area) Shoreland Protection—Projects that restore or protect buffers and eroding river or stream banks within the watershed. Eligible applicants include nonprofit organizations, community organizations, educational institutions and federal, state or local government agencies.	Annually until MEF is depleted. Concept papers as preliminary proposals typically due in December. Check web site for additional details.	www.nhcf.org/mef	Kevin Peterson, NHCF, 603-263-8370, kp@nhcf.org
Vermont Agency of Transportation, Municipal Assistance Bureau	Better Backroads Program	The purpose of the Vermont Better Backroads Program is to promote the use of erosion control and maintenance techniques that save money while protecting and enhancing Vermont's lakes and streams. Funds, subject to availability, will be distributed as small grants to municipalities and local organizations to address town or private road erosion problems.	Annually. Check web site for additional details.	http://vtransengineering.vermont.gov/bureaus/mab/better-back-roads	Alan May, VTrans, 802-828-4585, alan.may@vermont.gov

Vermont - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
Vermont Department of Environmental Conservation (DEC)	Municipal Pollution Control	Facilities planning and final design, facility enlargement, refurbishment, general pollution control, Stormwater projects, Municipalities to re-loan to homeowners for repair/replacement of their on-site systems.	Ongoing	http://www.anr.state.vt.us/dec/fed/grants.htm	State of Vermont Agency of Natural Resources Department of Environmental Conservation Winslow Ladue, Financial Management Program Manager, Facilities Engineering Division, for more information at (802) 498-7374
Department of Environmental Conservation - Agency of Natural Resources in Vermont	Clean Water State Revolving Fund (CWSRF)	Using a combination of federal and state funds, state CWSRF programs provide loans to eligible recipients to: -construct municipal wastewater facilities, -control nonpoint sources of pollution, -build decentralized wastewater treatment systems, -create green infrastructure projects, -protect estuaries, and -fund other water quality projects.	Ongoing	http://www.anr.state.vt.us/dec/fed/financial/docs/CWSRF-loan-program%2010-SEP-15.pdf	Bryan Redmond (802) 585-4900 bryan.redmond@vermont.gov
US Department of Agriculture, Rural Development	Community Facilities Direct Loan & Grant Program	This program provides affordable funding to develop essential community facilities in rural areas. An essential community facility is defined as a facility that provides an essential service to the local community for the orderly development of the community in a primarily rural area, and does not include private, commercial or business undertakings.	Applications for this program are accepted year round	http://www.rd.usda.gov/programs-services/community-facilities-direct-loan-grant-program	Ted Brady, State Director 87 State Street Suite 324, P O Box 249 Montpelier, VT 05601 (802) 828-6000 or (802) 828-6080 (802) 828-6018 Fax www.rd.usda.gov/vt www.rd.usda.gov/nh

Vermont - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
Vermont Agency of Natural Resources	Vermont Community Climate Change Grants	<p>The purpose of this grant program is to promote the implementation of innovative energy efficiency and renewable energy solutions by Vermont communities. Specific goals include:</p> <p>Reduce use of fossil fuels through improved efficiency and increased use of renewables in municipal buildings and operations; Educate and encourage action by Vermont residents and businesses to improve energy efficiency and increase renewable energy use;</p> <p>Encourage municipal officials, representatives of local volunteers groups and nonprofit organizations to work cooperatively to promote energy efficiency and renewables; and,</p> <p>Encourage Vermont towns to work in partnership with other towns to improve efficiency and increase use of renewables.</p> <p>Coordinate with Efficiency Vermont, the Clean Energy Development Fund and the state weatherization program to ensure that all available programs are being utilized in the most cost-effective manner</p>	Last offered in 2009	http://www.anr.state.vt.us/air/Planning/docs/Climate%20Change%20Grant%20Background%20and%20Guidance%201212a.pdf	Don Einhorn Vermont Department of Environmental Conservation 103 South Main Street West Office Building Waterbury, VT 05671
State of Vermont - Public Service Department	Clean Energy Development Fund - Small Scale Renewable Energy Incentive Program (SSREIP)	In 2005, the Vermont General Assembly established the Vermont Clean Energy Development Fund (CEDF) through Act 74 (30 V.S.A. § 8015). The purpose of the Fund is to increase the development and deployment of cost-effective and environmentally sustainable electric power resources – primarily with respect to renewable energy resources, and the use of combined heat and power technologies - in Vermont.	Ongoing	http://publicservice.vermont.gov/topics/renewable_energy/cedf	Andrew Perchlik - Clean Energy Development Fund VT Public Service Department 112 State Street Montpelier, VT 05620-2601 Email: andrew.perchlik@state.vt.us
The Vermont Community Foundation	Lake Champlain and Tributaries Restoration Fund	<p>Grants will be awarded for new initiatives, one-time special projects, or continuing funding for outstanding, existing programs that address one or more of purposes listed below:</p> <ul style="list-style-type: none"> -Protect, restore and enhance the ecosystem integrity and ecological connectivity of the community of aquatic life in the Lake Champlain ecosystem and its tributaries. -Protect, restore and enhance lake sturgeon and their habitats in the Lake Champlain basin and its tributaries. -Restore a self-sustaining land-locked Atlantic Salmon population in Lake Champlain through habitat restoration and fish monitoring programs. -Protect the riparian zones along Lake Champlain tributaries for the benefit of the ecological and recreational resources through the purchase of land easements. <p>\$5,000-\$50,000 grants to organizations for the protection, restoration, and enhancement of Lake Champlain's ecosystem.</p>	5:00 p.m. on December 15, 2015.	http://www.vermontcf.org/Nonprofits/AvailableGrants/LakeChamplainandTributariesRestorationFund.aspx	Lauren Bruno 802-388-3355 ext. 222 lbruno@vermontcf.org
The Vermont Community Foundation	The Kelsey Trust	<p>The grants are limited to organizations and projects that serve the people and protect the natural environment of the Lake Champlain Basin. Click here for a map of the Basin.</p> <p>The Trust focuses on:</p> <ul style="list-style-type: none"> • Environment - We are particularly interested in programs aimed at protecting Lake Champlain and its tributaries, the Green Mountains, and the Adirondacks 	Spring Grant - Letter of Interest deadline is May 1, Winter Grants is November 1	http://www.vermontcf.org/Nonprofits/AvailableGrants/KelseyTrust.aspx	Kim Haigis 802-388-3355 ext. 244 khaigis@vermontcf.org

Vermont - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
High Meadows Fund	Various grants	The High Meadows Fund promotes vibrant communities and a healthy natural environment while encouraging long term economic vitality in Vermont. The changing climate is already impacting Vermont's communities and working landscape. It is urgent that Vermonters adapt to those changes while also lowering their contribution to climate change. We bring this sense of urgency to our three areas of focus: <ul style="list-style-type: none"> · Land Use: Encouraging working farms and forests, compact settlements, and watershed land use that protects communities, soil, and water quality. · Energy: Improving buildings and transportation systems in order to lower fossil fuel use. · Sustainable Agriculture: Promoting healthy soil and expanding agricultural markets. 	By invitation only; please see http://www.highmeadowsfund.org/introducing-your-ideal/ for more information	http://www.highmeadowsfund.org/	77 College Street Suite 3B Burlington VT 05401 T: 802-388-3355 x241 Email: hmf@vermontcf.org
Federal Emergency Management Agency (FEMA), Administered by Vermont Emergency Management Division of Emergency Management and	Hazard Mitigation Grant Program (HMGP)	Provides funds to States, Territories, Indian, Tribal Governments, local governments, and eligible private non-profits following a Presidential major disaster declaration. The Hazardous Mitigation Grant Program (HMGP) differs from the other Hazard Mitigation Assistance programs because it is awarded following a declared disaster where as the other programs are awarded on an annual basis. The key purpose of HMGP is to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not wasted during the reconstruction process following a disaster. Cost Share: 75% Federal Funds/25% State or Local Funds	Applications are due to DEMHS by November 6, 2015.	http://floodready.vermont.gov/find_funding/hazard_mitigation_assistance http://vem.vermont.gov/mitigation	State Hazard Mitigation Officer Ray Doherty (ray.doherty@vermont.gov; 802-241-5258) or Hazard Mitigation Planner Lauren Oates (lauren.oates@vermont.gov; 802-241-5363)
FEMA, Administered by Vermont Emergency Management Division of Emergency Management and Homeland Security	Flood Mitigation Assistance Program (FMA)	The Flood Mitigation Assistance (FMA) program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP). FEMA provides FMA funds to assist States and communities implement measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program. Cost Share: 75% Federal Funds/25% State or Local Funds, 90% Federal Funds/10% State or Local Funds with Severe Repetitive Loss Strategy	Applications are due to DEMHS by November 6, 2015.	http://floodready.vermont.gov/find_funding/hazard_mitigation_assistance http://vem.vermont.gov/mitigation	State Hazard Mitigation Officer Ray Doherty (ray.doherty@vermont.gov; 802-241-5258) or Hazard Mitigation Planner Lauren Oates (lauren.oates@vermont.gov; 802-241-5363)

Vermont - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
FEMA, Administered by Vermont Emergency Management Division of Emergency Management and Homeland Security	Community Disaster Loan Program	The Federal Emergency Management Agency (FEMA) provides direct loans to local governments to offset the loss of tax or other revenues as a result of a major disaster. The local government must demonstrate a need to maintain local governmental functions such as police and fire protection, or water and sewer services. Loans are not to exceed 25% of the local government's annual operating budget for the fiscal year in which the major disaster occurs, up to a maximum of \$5 million.	Communities may apply for assistance following a declaration of a major disaster	http://www.vincta.org/vertical/sites/%7B753BB31A-8921-4599-9D2F-A7995421225B%7D/uploads/Traditional_Community_Disaster_Loan_Fact_Sheet.pdf	State Hazard Mitigation Officer Ray Doherty (ray.doherty@vermont.gov; 802-241-5258) or Hazard Mitigation Planner Lauren Oates (lauren.oates@vermont.gov; 802-241-5363)
Environmental Finance Center - University of Maryland	Local Government Stormwater Financing Manual	EFC's Local Government Stormwater Financing Manual was inspired by and written for local government leaders. Public sector financing in general, and stormwater financing specifically often appear to be inaccessibly complicated and technical to even experienced public officials. Therefore, rather than try to address the myriad of issues associated with stormwater financing, the main strategy was to provide a foundation for local officials to move forward by focusing on perhaps the most important financing attribute: leadership and the ability to move communities towards effective action.	--	http://efc.umd.edu/localgovernmentstormwaterfinancingmanual.html	Environmental Finance Center, 1210 Preinkert Field House, (Building 054), College Park, MD 2074
EPA New England	Funding Stormwater Factsheet	This document is intended to assist local stormwater managers to alleviate the significant expense of construction, operation and maintenance of a municipal separate storm sewer system (MS4). The costs of stormwater programs, increased by regulatory requirements (stormwater Phase I or Phase II), flooding concerns, water quality issues (including total maximum daily loads, or TMDLs) and population growth, may be subsidized through a stormwater utility or various other methods detailed in this document.	--	www.epa.gov/region1/npdes/stormwater/assets/pdfs/FundingStormwater.pdf	EPA New England—Thelma Murphy (murphy.thelma@epa.gov 617-918-1615) Rob Adler (adler.robert@epa.gov 617- 918-1396)

Vermont - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
University of Vermont and SUNY Plattsburgh	Lake Champlain Sea grant	<p>To promote ecosystem-based approaches that foster a healthy and diverse ecosystem and provide for sustainable human use and enjoyment of Lake Champlain, the basin, and surrounding waters;</p> <p>-To restore terrestrial and aquatic ecosystems in the Lake Champlain Basin and surroundings</p> <p>-To strengthen the economic base of local communities through sustainable development, particularly of lake-dependent businesses and those industries offering tourism and recreation opportunities; and</p> <p>-To provide scientifically sound information about regional climate change and its potential impacts on local communities, and to help communities plan for and implement practices that mitigate these impacts</p>	Deadline for Full Proposal: Monday, August 31, 2015, 5pm	http://www.uvm.edu/seagrant/request-proposals-2016	Elissa Schuett elissa.schuett@uvm.edu or Breck Bowden at breck.bowden@uvm.edu.
VT DEC Watershed Management Division	National Flood Insurance Program	The National Flood Insurance Program (NFIP) provides a source of flood insurance for buildings in communities that choose to participate. Nearly ninety percent of communities in Vermont participate in the NFIP. Flood insurance is available for buildings and their contents anywhere in participating communities. Without access to the NFIP, flood insurance from private sources may be unavailable or prohibitively expensive. To participate in the NFIP a community must regulate all new development in high risk Special Flood Hazard Areas to ensure that new development is safe from flood damage.	Property owners (including municipalities) can apply for flood insurance at any time as long as their community participates in the NFIP.	http://floodready.vermont.gov/find_funding/flood_insurance	Rebecca Pfeiffer, CFM rebecca.pfeiffer@state.vt.us, Vermont River Corridor and Floodplain Manager Agency of Natural Resources, Department of Environmental Conservation, Watershed Management Division 1, National Life Drive, Main 2, Montpelier, VT 05620-3522
Federal Emergency Management Agency (FEMA), Administered by Vermont Emergency Management Division of Emergency Management and Homeland Security	FEMA Public Assistance (PA) Grant Program	<p>A grant is made to the State of Vermont, which authorizes sub-grants to eligible applicants. Funding is provided through the Federal Emergency Management Agency (FEMA), in accordance with Public Law 93-288, as amended by the Stafford Act.</p> <p>Public assistance grants are provided on a cost-share basis, with percentages established in the state-federal agreement, and a federal share of no less than 75 percent. The program provides funding for debris removal, implementation of emergency protective measures and permanent restoration of infrastructure.</p> <p>The program also encourages protection from future damage by providing assistance for hazard mitigation measures during the recovery process. The State works with FEMA to manage the program and administer the funding.</p>	Public Assistance grants are available only after a Presidential Disaster Declaration. FEMA, the state and local agencies will work together to conduct a preliminary damage assessment and determine if such a declaration is necessary.	http://vem.vermont.gov/publicassistance	Kimberly Canarecci, State Public Assistance Officer, 802-585-4209 and/or kim.canarecci@vermont.gov

Vermont - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
The ERAF Program is managed by the Recovery and Mitigation Section of DEMHS in conjunction with the management of Public Assistance.	Emergency Relief and Assistance Fund	The Emergency Relief and Assistance Fund (ERAF) provides State funding to match Federal Public Assistance after federally-declared disasters. Eligible public costs are reimbursed by federal taxpayers at 75%. For disasters after October 23, 2014, the State of Vermont will contribute an additional 7.5% toward the costs. For communities that take specific steps to reduce flood damage the State will contribute 12.5% or 17.5% of the total cost.	Ongoing	http://floodready.vermont.gov/find_funding/emergency_relief_assistance	45 State Drive Waterbury, VT 05671-1300 (800) 347-0488 or (802) 244-8721 (Voice)
DEMHS and local VTrans District Administrator	VTrans – Town Highway Disaster Assistance	VTrans offers assistance to municipalities before, during and after disaster events that affect town highways. This support is described in Section 6 of the VTrans Orange Book and includes: -Technical Assistance -Road and Bridge Standards -Town Highway Emergency Fund -Federal Highway Administration's Emergency Relief (ER) Program -Equipment Loans -VTrans – 511 Online Map – road closure and delay information -VTrans – Vermont Disaster Resource Center – for active disaster information -VTrans – Temporary Bridges -VTrans - Municipal Road and Bridge Standards Summary	Ongoing	http://floodready.vermont.gov/find_funding/post-disaster_funds#VTrans%20-%20Town%20Highway%20Disaster%20Assistance	Scott Rogers Director Operations Division 1 National Life Drive Montpelier, Vermont 05633-5001 Tel: 802-828-2709 Fax: 802-828-2848, aot-opswebmaster@vermont.gov
Agency of Commerce & Community Development - Department of Housing & Community Development	Municipal Planning Grants	The Municipal Planning Grant Program encourages and supports planning and revitalization for local municipalities in Vermont. Awarded annually and administered by the Department of Housing and Community Development, the Municipal Planning Grant Program works to strengthen Vermont by funding local planning initiatives that support statewide planning goals. Since 1998, the Municipal Planning Grant Program has provided over \$10.6 million to 230 cities and towns across Vermont to help breathe new life into communities, plan for future growth and development and improve quality of life	September 30, 2015, 7:00 PM	http://accd.vermont.gov/strong_communities/opportunities/funding/municipal_planning_grants/mpgfy16	Annina Seiler: annina.seiler@state.vt.us or 802.828.1948
US Department of Housing and Urban Development & Agency of Commerce & Community Development - Department of Housing & Community Development	Community Development Block Grant Disaster Recovery Funds	HUD provides flexible grants to help cities, counties, and States recover from Presidentially declared disasters, especially in low-income areas, subject to availability of supplemental appropriations. In response to Presidentially declared disasters, Congress may appropriate additional funding for the Community Development Block Grant (CDBG) program as Disaster Recovery grants to rebuild the affected areas and provide crucial seed money to start the recovery process. Since CDBG Disaster Recovery (CDBG-DR) assistance may fund a broad range of recovery activities, HUD can help communities and neighborhoods that otherwise might not recover due to limited resources.	Ongoing	http://accd.vermont.gov/strong_communities/opportunities/funding/cdbgdr	Cindy Blondin, Grants Specialist 802-828-5219, cindy.blondin@vermont.gov

Vermont - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
United States Department of Agriculture Natural Resources Conservation Service Vermont	Conservation Technical Assistance	The Conservation Technical Assistance (CTA) program provides voluntary conservation technical assistance to land-users, communities, units of state and local government, and other Federal agencies in planning and implementing conservation systems. This assistance is for planning and implementing conservation practices that address natural resource issues. It helps people voluntarily conserve, improve and sustain natural resources.		http://www.nrcs.usda.gov/wps/portal/nrcs/detail/vt/technical/cp/cta/?cid=nrcs142p2_010559	USDA NRCS VT State Office 356 Mountain View Drive, Suite 105 Colchester, Vermont 05446 Telephone: 802-951-6796 Fax: 855-794-3677
US Department of Agriculture, Rural Development	Emergency Community Water Assistance Grants	This program helps eligible communities prepare for, or recover from, an emergency that threatens the availability of safe, reliable drinking water for households and businesses. Eligible applicants: Most State and local governmental entities, Nonprofit organizations, Federally recognized Tribes What kind of event can qualify as an emergency? Drought or flood, Earthquake, Tornado or hurricane, Disease outbreak Chemical spill, leak or seepage, Other disasters	Applications for this program are accepted through your local RD office year round	http://www.rd.usda.gov/programs-services/emergency-community-water-assistance-grants	Ted Brady, State Director 87 State Street Suite 324, P O Box 249 Montpelier, VT 05601 (802) 828-6000 or (802) 828-6080 (802) 828-6018 Fax www.rd.usda.gov/vt www.rd.usda.gov/nh
US Department of Agriculture, Rural Development	Water & Waste Disposal Loan & Grant Program	Provides funding for clean and reliable drinking water systems, sanitary sewage disposal, sanitary solid waste disposal, and storm water drainage to households and businesses in eligible rural areas. This program assists qualified applicants that are not otherwise able to obtain commercial credit on reasonable terms. Eligible applicants include: Most State and local governmental entities Private non-profits Federally-recognized Tribes"	Applications for this program are accepted through your local RD office year round	http://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program	Ted Brady, State Director 87 State Street Suite 324, P O Box 249 Montpelier, VT 05601 (802) 828-6000 or (802) 828-6080 (802) 828-6018 Fax www.rd.usda.gov/vt www.rd.usda.gov/nh
United States Department of Agriculture Natural Resources Conservation Service Vermont	Emergency Watershed Protection Program	The Emergency Watershed Protection (EWP) Program was set up by Congress to respond to emergencies created by natural disasters. It is designed to relieve imminent hazards to life and property caused by floods, hurricanes, tornadoes, windstorms, fires, and other natural occurrences. The purpose of (EWP) is to help groups of people with a common problem. It is generally not an individual assistance program. All projects undertaken must be sponsored by a political subdivision of the state, such as a city, town, county, or conservation district. The program is administered by the USDA Natural Resources Conservation Service (NRCS), which provides technical and financial assistance to preserve life and property threatened by excessive erosion and flooding."	Ongoing	http://www.nrcs.usda.gov/wps/portal/nrcs/main/vt/programs/planning/ewp/	USDA NRCS Vermont State Office 356 Mountain View Drive, Suite 105 Colchester, Vermont 05446 Telephone: 802-951-6796* Fax: 855-794-3677

Vermont - Funding Sources for Climate Change Adaptation



Organization	Program	Purpose	Application Dates	Website	Contact
US Department of the Interior, Dept. of Forests, Parks and Recreation Agency of Natural Resources in Vermont	Land and Water Conservation Fund	The Land and Water Conservation Fund Program (LWCF) became effective in January 1965 to create parks and open spaces, protect wilderness and forests, and provide outdoor recreation opportunities. Funds are derived from federal recreation fees, Outer Continental Shelf (OCS) revenues from leasing oil and gas sites in coastal waters, federal surplus real property sales, and a portion of federal motorboat fuel taxes. Funds are apportioned to federal agencies, and to the 50 states and 6 territories through the U.S. Department of the Interior National Park Service (NPS). In Vermont, LWCF is administered by the Vermont Department of Forests, Parks & Recreation. LWCF grants provide up to 50% matching assistance to the state and local governments.	Every year in February	http://fpr.vermont.gov/recreation/grants/lwcf	Jessica Savage at 802-249-1230 or jessica.savage@state.vt.us
EPA New England	Healthy Communities Grant Program	The Healthy Communities Grant Program is EPA New England's main competitive grant program to work directly with communities to reduce environmental risks to protect and improve human health and the quality of life. The Healthy Communities Grant Program will achieve this through identifying and funding projects that: -Target resources to benefit communities at risk -Assess, understand, and reduce environmental and human health risks -Increase collaboration through community-based projects -Build institutional and community capacity to understand and solve environmental and human health problems -Achieve measurable environmental and human health benefits -Advance emergency preparedness and resilience	Every year	http://www.epa.gov/region1/eco/uep/hcgp.html	Sandra Brownell, brownell.sandra@epa.gov or 617-918-1797).