New England
Climate Adaptation
PROJECT

Stakeholder Assessment
Dover, New Hampshire

PRODUCED BY:
Massachusetts Institute of Technology Science Impact Collaborative
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About the MIT Science Impact Collaborative

The Massachusetts Institute of Technology Science Impact Collaborative (MIT SIC) is a research group focused on developing and testing new ways of harmonizing science, politics and public policy in the management of natural resources and resolution of environmental disputes. MIT SIC's tools and approaches include collaborative adaptive management, joint fact-finding, scenario planning, collaborative decision-making and multi-stakeholder engagement, and the use of role-play simulation exercises.

MIT SIC was established in 2003 with initial support from the United States Geological Survey. Today, the research group has numerous partners and supporters, ranging from the U.S. National Estuarine Research Reserve System to the Dutch research organization TNO. By engaging in community-based action research projects, MIT SIC researchers—including doctoral students, masters students, and faculty from the MIT Department of Urban Studies and Planning—train emerging environmental professionals while simultaneously testing the latest environmental planning methods and providing assistance to communities and policy-makers who seek our help.

Visit the MIT Science Impact Collaborative website for more information: http://scienceimpact.mit.edu

About the Consensus Building Institute

The Consensus Building Institute (CBI) is a not-for-profit organization founded in 1993 by leading practitioners and theory builders in the fields of negotiation and dispute resolution. CBI's experts bring decades of experience brokering agreements and building collaboration in complex, high-stakes environments — and possess the deep understanding required to tackle negotiation and collaboration challenges in our practice areas. CBI's Founder, Managing Directors, and many of our Board members are affiliated with the Program on Negotiation at Harvard Law School and the MIT-Harvard Public Disputes Program.

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About the Great Bay National Estuarine Research Reserve

The National Estuarine Research Reserve System (NERRS) is a network of 28 areas representing different biogeographic regions of the United States that are protected for long-term research, water-quality monitoring, education, and coastal stewardship. The reserve system is a partnership program between the National Oceanic and Atmospheric Administration (NOAA) and the coastal states. Reserve staff work with local communities and regional groups to address natural resource management issues, such as non-point source pollution, habitat restoration and invasive species. Through integrated research and education, the reserves help communities develop strategies to deal successfully with these coastal resource issues. Reserves provide adult audiences with training on estuarine issues of concern in their local communities. They offer field classes for K-12 students and support teachers through professional development programs in marine education. Reserves also provide long-term water quality monitoring as well as opportunities for both scientists and graduate students to conduct research in a "living laboratory."

Located on the Great Bay Estuary in New Hampshire, the Great Bay National Estuarine Research Reserve encompasses 10,235 acres, including approximately 7,300 acres of open water and wetlands. It is managed by the New Hampshire Fish and Game Department and is supported by the Great Bay Stewards. Great Bay is often referred to as "New Hampshire's hidden coast."

Visit the Great Bay National Estuarine Research Reserve website for more information: http://www.greatbay.org/index.htm

Executive Summary

This stakeholder assessment was prepared by a collaborative team of researchers from MIT and the Great Bay National Estuarine Research Reserve, in cooperation with the Consensus Building Institute and the City of Dover Planning Department. The primary purpose of this assessment is to inform the development of a role-play simulation designed specifically for Dover. Eighteen people from Dover, representing a broad range of views and experiences in the City, were interviewed for this assessment.

Awareness and Level of Concern about Climate Change

Based on the interviews, this assessment finds that although Dover residents do not tend to refer to changes they have observed in the climate as "climate change," they are generally aware of, and concerned about, more extreme storms and rising temperatures. While a few interviewees had strong opinions about "climate change adaptation," and were well informed about climate science and adaptation options, most were unclear about what these terms actually mean, or at least what they mean for Dover.

Providing information about climate change and climate change projections to interviewees did seem to affect their level of understanding of climate-related concerns. About halfway through the interviews, the research team shared some historical climate data about Dover, and a grid showing climate change projections for temperature, precipitation, and sea level rise. As the interviewees reviewed these numbers, it seemed that the climate change picture came into focus, and interviewees felt better equipped to talk about specific climate-related concerns.

The City of Dover has also already taken a number of notable steps to prepare for climate change (if not under that name). Emergency resources have been improved, zoning ordinances have been updated, the Hazard Mitigation Plan and Capital Improvement Plan are up-to-date, and many improvements have been made to the sewer and storm water infrastructure.

Identified Risks and Vulnerabilities

Nonetheless, climate-related risks remain and are expected to get worse. The most frequently mentioned issue of concern was, by far, flooding from the Cochecho and Bellamy rivers during extreme storms. Flooding from sea level rise was also mentioned, but less frequently and with less specificity about the impacts it could cause. Since flooding from the rivers has happened previously, people know exactly which structures and other assets are vulnerable, while the effects of sea level rise remain to be seen. Beyond flooding, different people worry about different things, but most concerns are related to potential human health impacts, such as the effects of heat waves on the elderly and those without air conditioning, the risk of having less snowpack to recharge the aquifer that supplies Dover's drinking water, and the consequences of power loss during storms. Some people are highly concerned about environmental impacts, including erosion and the loss of wetlands, salt marshes, and biodiversity.

Adaptation Challenges and Opportunities

Like all coastal communities, Dover will have to find ways to adapt to a climate that is increasingly hotter and wetter, but the way forward is a puzzle. Dover is a small community with limited resources and no end of demands on public and private resources. Interviewees expressed some doubt about the community's readiness to deal with climate change adaptation due to (assumed) widespread disbelief in climate change or lack of awareness or education about what it could really mean for Dover. Many people (nearly all interviewees) mentioned the tax cap as a financial impediment to taking proactive measures. Some simply said that adapting to climate change is not urgent enough to be a priority because they believe that it will not impact them in their lifetime.

Still, many of the interviewees expressed confidence in Dover's capacity to learn about climate change impacts and pursue adaptation options if the public becomes more informed. They shared a number of ideas about how to get there, and were generally supportive of the City taking proactive measures to explore these opportunities.

Project Overview

The Massachusetts Institute of Technology Science Impact Collaborative is working with four National Estuarine Research Reserve (NERR) sites and the Consensus Building Institute to test an innovative way to help coastal communities understand and prepare for the potential impacts of climate change. Under the direction of Professor Lawrence Susskind and PhD Candidate Danya Rumore, and through a grant from the NERRS Science Collaborative, the team is engaging four New England communities located near four NERRS sites in testing the use of role-play simulations as a means to educate the public about climate change threats and to help communities explore ways of decreasing their vulnerability and enhancing their resilience. This project is referred to as the New England Climate Adaptation Project or NECAP. One of the NERR sites is the Great Bay National Estuary Research Reserve in New Hampshire, and the nearby community they chose to engage is the City of Dover. The project partner in Dover is the City Planning Department.

The purpose of this stakeholder assessment is to guide the project team in developing a role-play simulation specifically for Dover. The role-play will include several roles representing the range of interests and concerns that actual stakeholders in Dover might bring to a collaborative decision-making process about an important local issue. The assessment was designed to reveal the different attitudes and perspectives of Dover residents regarding the management of climate change risks.

With assistance from the Dover City Planning Department, the project team developed an initial list of approximately 20 interviewees who could represent views from a variety of stakeholder groups, including elected and non-elected City officials, social service providers, business owners, environmental advocates, and citizens from across the political spectrum. Over the course of approximately six weeks, eighteen stakeholders in Dover were interviewed. Please see Appendix A for a complete list of interviewees.

The interviews took place in-person, led by Carri Hulet with other project staff. The interviewers sought to understand the interviewees' general background, their connection to Dover, their views on local decision-making, local climate change-related risks, and any local activities underway to reduce those risks. During the course of the interview, participants reviewed a table of climate change projections for precipitation, temperature, and sea level rise over the next 100 years, and were asked about their reactions to the forecasts. Please see Appendix B for the interview protocol and Appendix C for the climate change projections.

Interviews were confidential unless the interviewee gave permission for their name and quotations to be shared. Interviewees were informed that the assessment would attempt to articulate the in-

terests, concerns, and ideas generated from the interviews in summary format, without attributing any single idea to a particular individual, even if they gave permission to be quoted. The purpose of this methodology is to focus the assessment on key ideas and issues, rather than on the individuals who expressed them. The interviewees were given the chance to review the draft assessment and make any corrections or additions to the assessment before it was made public. Any errors or omissions in this assessment are the sole responsibility of the NECAP team.

Key Findings

During the interviews, participants were asked about their top priorities for Dover generally, and their awareness of, or interest in, climate change adaptation[1] specifically.

This "Key Findings" section seeks to capture the perspectives shared by participants in response to the interview questions. At times, their perspectives contradict one another, and in some cases they overlap. The statements are an expression of viewpoints, understanding, and opinions. The assessment is not an attempt to create an independent set of "facts" on the issue; rather, the goal is to uncover the range of views, interests, and values that exists among Dover stakeholders with regard to these issues. Given this purpose, the project team has not verified statements for factual accuracy.

Key Players

For the purposes of this assessment, the "key players," were the individuals and institutions likely to be most invested in, or affected by, climate change adaptation and planning. It is clear from the interviews that people expect the full spectrum of City government, from elected officials to local agencies and departments, to be involved in policymaking, funding, and implementation of any activities Dover undertakes to adapt to climate change. Other key players, it is assumed, will be engaged in specific activities that are of particular interest to them. For example, development interests will be most interested in changes to zoning codes or building requirements. Environmental interests will be concerned with the City's compliance with state or federal regulations that impact the environment, and everyone is interested in funding. Generally speaking, it seems clear from the interviews that most interviewees see the connections between all of these issues and the resultant need for coordination among stakeholders in City-led activities to adapt to climate change.

General Interests

Dover residents and officials enjoy living and working in Dover. Generally speaking, the interviewees expressed pride in the City, and a sense of satisfaction in the way the City functions. When asked to identify their main Dover-related interests or concerns, people responded with many of the standard issues with which all cities struggle (e.g. local economic growth and commercial development, tight budgets and taxes, creating jobs, and protecting the elderly and low-income families). One person nicely summed up the sentiments expressed by many by naming "stewardship" as the governing principle by which the residents and the City government should view their relationships to the City and its resources.

1 The term "climate change adaptation" here refers to any activities that are undertaken by the City or its population to modify infrastructure, lifestyles, spending, or any other behavior in order to adjust to a changing climate.

Funding for local projects is a major concern. An overwhelming number of people said the tax cap[2] is a policy that makes it difficult to "get anything done." Many said that they believe Dover ends up paying more for things later, because of the cap, than it would if money were made available to spend proactively, or in advance of crises. Some also mentioned that the current City Council is fragmented, and that the lack of cohesion can be an impediment to progress.

Climate-Related Interests

In addition to the general community concerns mentioned above, Dover stakeholders expressed interest in matters that are directly linked to the climate and climate change. These are discussed in much greater detail below, but in summary, the climate-related concerns fell broadly into two categories: natural resource protection or environmental stewardship, and protecting residents' health and safety during natural disasters, such as Nor'easters or hurricanes.

Awareness and Level of Concern about Climate Change Risks

One of the most interesting findings from the interviews is that Dover stakeholders are much more aware of climate change risks than they realize. They do not talk about climate change in scientific vernacular (using terms such as "increasing instances of extreme precipitation," "greater climate variation and unpredictability," or "increasing average temperatures"). But they have noticed changes in the weather, which they readily reference. Common phrases that came up frequently in the interviews were "freak storms," "less snow (and less snowpack)," "wetter snow," and "hotter summers." Dover stakeholders have observed these trends and adopted various measures to adapt to them already (see the section Current Local Activity below).

In addition, both awareness about what climate change is and levels of confidence that anything can be done about it are quite variable. Most interviewees said they "believe" in climate change and are worried about it – even those who struggled to articulate clearly what it is. No one fully denied observing changes in the weather, but some questioned whether the changes are truly indicative of a trend, or simply haphazard variations. Even among those who acknowledge a trend toward hotter, wetter conditions, there is disagreement about whether the changes are induced by human activities or part of a natural cycle. More than one interviewee said the scientists need to "get their act together" and come to some kind of consensus, while others cited the scientific community's confidence that climate change is real and caused by humans as support for their concerns about it. A related view expressed by at least one interviewee was a belief that efforts in the name of "sustainability" are actually a foil for the government to limit growth and weaken property rights.

While a few of the people interviewed were up-to-date on global discussions about climate change and its effects, none of the people interviewed (except the Planning Department staff) were familiar with climate change data or projections specific to Dover, to New Hampshire,

2 Dover's "tax cap" refers to a method the city adopted in 2007 to limit spending increases. It does this by limiting municipal property tax increases and budget increases from year to year to no more than is commensurate with inflation and the cost of new construction. The budget limitation can be overridden by a City Council vote with a 2/3 majority. See Dover City's Charter Article VI, Section 3.1 Limitation on Property Tax Levy Increase.

or even to New England. Almost without exception, the first several questions in the interviews about "climate change" and "climate change adaptation" were met with relatively vague answers that lacked any uniformity in language or concepts, except occasional references to "sea level rise" or "global warming." Some of the responses focused more on climate change mitigation (i.e. reducing greenhouse gas emissions) than adaptation (i.e. preparing for climate change impacts). About halfway through the interview, however, when the participants were presented with a table of information that included historical climate data on Dover[3] from 1980 – 2009, and projections to 2100 for a few climate measures (see Appendix C), most of the interviews took a dramatic turn toward specifics.

Not surprisingly, interviewees had a tendency to focus on the niche category of risks that was most relevant to them. This meant some were particularly interested in hotter summer days, while others focused on increased precipitation or sea level rise. In some cases, the information presented was not easily absorbed, while other interviewees made quick connections between the numbers on the page and what they could mean in terms of impacts on day-to-day life. One person observed that living in Dover in 50 years could be like living in Virginia today, and then proceeded to list all the ways that life is different in the mid-Atlantic than in New England. A few individuals noted the "vicious cycle" of climate change, stating that hotter days could mean more air conditioning, which requires more energy that is usually produced by the burning of fossil fuels, which means more greenhouse gases, and more climate change. Notably, the one thing every stakeholder mentioned upon seeing the grid is that flooding will get worse in Dover if precipitation increases. Without exception, flooding was at the top of the interviewees' climate-related concerns.

Identified Climate Change Risks and Vulnerabilities

Participants were asked to identify specific vulnerabilities in Dover related to the climate or climate change. As mentioned above, their climate-related concerns fell broadly into two categories: natural resource protection or environmental stewardship, and protecting residents' health and safety, both in the long-term and during natural disasters (such as storms like Nor'easters or hurricanes).

This section provides greater detail on the concerns regarding environmental stewardship, and further unpacks the residents' health and safety category into the following risk-specific subtopics: Flooding and Non-Potable Water Infrastructure, Potable Water and Drought, Increased Temperatures, Power Loss, Air Quality, Recreation and Tourism, and Development.

Environmental Stewardship

Many interviewees mentioned Dover's natural beauty, its location between two tidal rivers, and its sparsely developed outlying areas as key distinguishing characteristics they enjoy about the City. Some expressed concern about protecting the rivers' edges from erosion. Some said the impacts of development on fish and wildlife worries them. A few people said that agriculture and home farms or gardening are issues of concern.

3 The historical data is from a weather station in Durham, NH, which serves as a climate proxy for Dover.

Interviewees noted a number of potential risks to the environment as a result of climate change. One stakeholder expressed concern that it is very difficult to obtain conservation land in Dover, especially along the waterfront, to try to increase the amount of open space and provide a buffer for sea level rise and storm surge. This is partially because a lot of waterfront property in Dover is very expensive or already privately owned, and private property rights are highly valued.

Other environmental risks identified by stakeholders were threats to wetlands and salt marshes, impacts on small farms/crops, and erosion along the Cochecho and Bellamy rivers. Interviewees expressed concern about climate change risks to the food chain, noting that any change to any link in the chain, from algae to humans, will affect all others.

Health and Safety of Residents

Flooding and Non-Potable Water Infrastructure

Flooding, which has historically affected the city, was one of the most frequently identified climate risks in Dover. According to an interviewee, one reason flooding is such a big issue in Dover is that the City has more coastal waterfront property than any other community in New Hampshire.

In the interviews, stakeholders expressed concern about a number of potential causes of flooding. Some interviewees noted that flooding can occur during the confluence of high tides and storms. The two rivers in Dover are both tidal up to their dams, and tidal variation is reportedly 6.5 to 7 feet. Dover is also the funnel for all the water in the county. One interviewee said approximately 170 miles of watershed bottlenecks in the center of the city, which is why Dover often experiences the biggest impacts from storms a couple of days after the rain has stopped. Some stakeholders also mentioned that flooding could be caused by a combination of run-off and drainage problems, particularly because there is a lot of impervious surface in the City.

Stakeholders also identified several potential impacts that could occur as a result of flooding. One set of flooding risks was associated with the current wastewater and stormwater systems. One interviewee noted that an extreme storm like Sandy could overwhelm sewer pump stations and lead to flooding in lower areas or power outages in higher areas. Some interviewees expressed concern that, although the sewer system is in good shape, most of the drainage system is old, and it has many undersized and/or leaky pipes. Other interviewees noted that the separation of the sewer and stormwater systems is not yet complete and, as a result, increased storms can overtax the wastewater treatment plant, which already has difficulty meeting water quality standards for effluent. Some interviewees expressed concern about how climate change could affect shellfish, including oysters, but did not identify the mechanisms that they thought might cause the impact.

Another flooding risk identified by stakeholders was that a rising water table could flood basements. Interviewees expressed concern that development in Dover continues in places prone to flooding. This includes development along the two tidal rivers as well as in other areas. In

"Trouble Spots" in Dover (as identified during stakeholder interviews)	
Downtown	
Broadway near New York Street	Central Avenue Bridge
Cochecho River behind the dam	Ela Street
Henry Law Park	Kelley's Row Restaurant
Oak Street	Sawyer Woolen Mill
Snows Court	
Dover Point	
Cote Drive	Dover Point Road and Center Drive
Hilton Park area	Spur Road
Wentworth Terrace	
Other	
Barbadoes Pond	Bellamy Reservoir, near Tolend Road and French Cross Road
Bellamy Road culvert	Cochecho Country Club and the development on Fairway Drive
North end of Sixth Street	Sewer pump stations
Waterfront property	Willand Pond

The table to the left shows areas in Dover that were identified by interviewees as "trouble spots" or, in other words, flood prone properties.

addition, some stakeholders expressed concern that insurance continues to cover properties in flood-prone areas.

Potable Water and Drought

Interviewees expressed concern about maintaining the viability of Dover's drinking water supply, since all of the water in the City comes from eight wells. A community services employee confirmed that there are two water storage tanks in the City, but otherwise, "people drink what we pump." One concern expressed in the interviews was that if there is not enough snowpack in the winter, or if there is drought in the summer, there will not be enough water to drink. Another

concern was that drought could also have indirect impacts on the City. For example, limited drinking water could constrain future development and drought could lead to fires.

Increased Temperature

In the interviews, people showed concern about the potential impacts of extreme heat or cold on infrastructure and health. People said that extreme temperatures could increase power outages. Several stakeholders also expressed concern about the effects of extreme heat on the elderly, some of whom do not have air conditioning in their homes. Another heat issue was the impact of higher temperatures on community services staff who work outside.

Warmer temperatures during the day could increase the amount of water on the roads. This water could then turn into ice at night if temperatures fall below freezing. More ice could lead to more accidents and damage to infrastructure.

Power Loss and Other Impacts Associated with Storms

Some interviewees identified power loss as a concern associated with storms, mainly due to trees and branches being blown over or weighed down by snow and falling on power lines. Since the City is wholly dependent on the regional power grid for electricity, some said, the risk is not isolated to incidences in Dover. The City could lose power due to downed lines in neighboring communities.

Some stakeholders identified specific risks associated with power loss, such as the loss of operating sewer pump stations (some of which have generators, but not all). The most common concern expressed about power loss was the health risk to the elderly if they were without power on very hot or very cold days.

Air Quality

One interviewee expressed concern that climate change could lead to worsening air quality in the atmosphere. This individual did not identify the specific mechanism by which this could occur, but someone else expressed concern that a wetter climate could cause more problems with mold in homes. This was seen as a particular threat to the elderly and others who already suffer from respiratory problems.

Recreation and Tourism

Interviewees also identified potential climate change impacts on recreation and tourism. These risks were seen more as changes to recreation than threats (except to the ski industry), as it was acknowledged that people will substitute one activity for another (i.e., while fewer people will ski in New England, more people will golf).

Current Local Activity

Interviewees were asked to identify current or past activities that the City has undertaken to adapt to climate change. As stated previously, the answers to this question were sometimes arrived at in a roundabout way because most interviewees do not think of their activities in terms of climate change adaptation. Nonetheless, Dover has done, or is currently doing, a number of things to adapt to observed and anticipated changes in the weather. These fall broadly into the categories of Policy and Planning, Infrastructure and Development, and Emergency Preparedness.

Policy and Planning

Dover's most explicit climate change-related effort is the collaboration between the City Planning team and MIT/NERRS on the New England Climate Adaptation Project (for which this assessment was written). Dover's City Planners are hopeful that this effort will raise awareness and catalyze action among residents and officials on further adaptation efforts in the future. The Planning Department is also considering replacing the Land Use chapter in the master plan with a Stewardship chapter, which would take a more holistic approach to related issues, such as energy use and conservation, land use, and environmental protection.

Another early effort by the City to prepare for the impacts of climate change includes using the economic downturn to update zoning requirements, siting regulations, and codes, such as the requirement that new roads and parking lots be built with permeable pavement. Dover also dedicates funds specifically to the land trust to conserve land around water supplies like wells and aquifers.

In addition, Dover regularly revises its Hazard Mitigation Plan (an assessment of risks and hazards), many of which are climate related. The Hazard Mitigation Plan helps inform the Capital Investment Plan.

Infrastructure and Development

There are a number of recent or current efforts in the City aimed at improving infrastructure and increasing Dover's resilience to weather-related impacts like flooding. Some interviewees identified a long-term project in Dover to separate stormwater and sewer lines. Efforts to keep debris out of the pipes by regularly cleaning catch basins have considerably helped prevent flooding in the city.

To help mitigate flooding, the City has dredged the Cochecho and made significant improvements to Willand Pond. When Watson Road was rebuilt, riprap was used in the foundation to avoid erosion. One stakeholder said Dover has done a great job with soil conservation and reforestation.

The City has also invested in a number of generators to mitigate impacts from power loss during storms or other emergencies. There are generators for all of the streetlights and two of the three high-rise public housing units. All but three pump stations have back up generators.

Emergency Preparedness

Interviewees generally expressed strong confidence in Dover's capacity to respond well to major storm events. The officials who are involved in emergency response confirmed that, especially with a couple of days of notice, they can mobilize response teams. In recent years, emergency services have planned ahead by having increased overtime to accommodate emergencies due to unpredictable events. The Emergency Operations Center has been "smartened up," and more attention has been paid to training firefighters, police, and community services staff on disaster preparedness. During power outages, the police have distributed cell phones to people without power, and run generators on the traffic lights to free up officers to help with more direct needs. The City has provided shelters and cooling huts during prolonged heat waves, and pumps to remove water from homes and businesses after floods. The police are also equipped for adverse conditions with all-wheel drive cruisers.

A few stakeholders observed that the City is much better prepared than the general public to deal with disasters. There was little confidence among interviewees that individual households in Dover pay much attention to preparing themselves for emergencies.

Proposed Ways to Manage Risk

It is clear that many Dover stakeholders are interested in doing more to prevent or mitigate impacts from climate change. As one interviewee put it, "If Mother Nature is trying to kill ya, you gotta protect yourself."

Broadly speaking, stakeholder suggestions focused on planning ahead and making sense of the financial implications of any proposed action. Several people emphasized the importance of estimating and comparing the cost to act now with the costs of delay.

It was clear that most stakeholders expect the City to take the lead. No one put forward a "grassroots" or private sector-led proposal, though many suggested that getting the public involved and informed is a top priority (see more below). Instead, the specific suggestions on ways to thoughtfully adapt to climate change included:

- Dover City should develop an Adaptation Plan to guide development and other relevant decision-making. This kind of plan should drive development toward low impact designs and retrofits for storm water management (i.e. bioswales, rain gardens, permeable pavement). The plan would also include the purchasing of flood-prone properties that could be used for flood protection or buffers. This was also referred to as a "Sustainability Plan."
- Revisit the Hazard Mitigation Plan with climate change adaptation in mind, so that any program or project related to adaptation will be queued up in the Capital Improvements Plan.
- Generally speaking, it was suggested that dialogue about climate change should be framed in terms of energy consumption and conservation.

Challenges and Opportunities for Moving Forward on Adaptation Action

In the interviews, participants were asked to identify opportunities that already exist to support or encourage adaptation activities. Respondents were also asked to identify what challenges they think limit the City's ability to take advantage of these opportunities.

Challenges

Most stakeholders said that the biggest challenge to climate change adaptation in Dover is that people do not "believe" in climate change.[4] The interviewees claimed that skeptics think there is no scientific consensus about anthropogenic (human-caused) climate change and/or that scientists have inadequate data. One person's direct statement that "scientists need to get their act together" illustrates this belief. Some interviewees said that they believe climate variation is natural and does not have anything to do with greenhouse gas emissions, so they are resistant to anything that sounds like activism. More than one interviewee said that people will not believe in climate change until a catastrophic event affects them.

Another major challenge identified by stakeholders is that adaptation is not a priority in the City. Several people commented on tight city budgets and other priorities. A number of respondents said that the impacts seem too far away to worry about now. One person said that development decisions are based on return on investment, so without a City policy requiring climate-sensitive designs, no one is going to pursue them.

When thinking about conservation or retreat options along the shore of the Great Bay or the rivers, some stakeholders said that adaptation efforts are hindered by conflict between conservation goals and respect for private property rights.

A couple of stakeholders stated simply that people are resistant to change.

Budgets, Costs, and Logistics

Interviewees also expressed concern about the cost associated with potential climate change impacts. One person was concerned about the financial ramifications of an increased need for air conditioning in the summer. Another person noted the high potential cost for more training for fire, police, and community services staff on emergency preparedness. Storms are costly, said one person, and Dover would have to pay for storm damage, despite the spending cap. Adding to this potential problem, in a Sandy-like event, one interviewee noted that Dover would probably not be the first community to receive resources from federal or state government. This person hypothesized that in an event of enough magnitude to dramatically impact Dover, other waterfront communities would be equally or more damaged, and would probably get aid before Dover.

4 Only a few of the interviewees held these beliefs personally. Most of these claims were made by others who said *they* believed in climate change, but they thought that a major challenge to overcome in Dover is widespread disbelief.

Several logistical concerns were also mentioned. One logistical concern was the difficulty of differentiating between public and private responsibilities, especially when funding rebuilding efforts, as illustrated by Katrina and Sandy. The line between what is public responsibility and what is private responsibility, the comments stated, already has some gray area, and damage from extreme weather events can complicate this already fuzzy distinction.

Opportunities

Interviewees were asked for recommendations on what opportunities or actions would be appropriate for Dover. From their responses, it was very clear that people think the City has a big opportunity to raise awareness. Stakeholders also mentioned the need for better information, evidence, or data, and suggested a number of policy and infrastructure improvements. Often, it came up in conversation that certain opportunities were worth pursuing regardless of the effects of climate change. Adaptation advocates would call these "no-regrets" decisions.

Communication, Public Education, and Public Engagement

Many stakeholders thought that communicating climate change information to the public could help catalyze climate change adaptation efforts in Dover. There were a number of suggestions as to how to do this. Many interviewees recommended communicating climate change effects in laymen's terms and/or visually making projected changes more understandable. For example, some interviewees suggested creating visualizations of sea level rise and storm surge, or graphically representing increases in costs for air conditioning. Other recommendations included explaining what a couple more inches of rain would mean to Dover residents, and comparing the projected future climate of Dover with the current climates of other states. "Will it be more like Seattle," someone asked, "or Washington D.C.?"

Some stakeholders also recommended explaining what climate change means for trees, crops, fish, and wildlife and thus what it means for fishermen, hunters, gardeners, and farmers. One interviewee believed there was a need to explain the relationship between rain, snowpack, groundwater, and drinking water. Another stakeholder recommended having a long-term Dover resident talk about what Dover was like 60 years ago, in order to illustrate how much can change in a single lifetime. Someone recommended reminding people of the Willand Pond flooding a few years ago to illustrate what future flooding could be like.

One person suggested working with DoverListens, a new civic group in Dover focused on community dialogue. One interviewee suggested developing a system of local ambassadors in Dover whose purpose would be to share information about climate change with others. This program, the person suggested, could be organized around neighborhood blocks, or through the elementary schools' Parent Teacher Associations. A person who had been involved with quarterly community discussions to discuss fears and concerns about Y2K in the year prior to 2000 said that something similar could be organized again. More than one person said Dover is good about choosing an issue that is important to the community and getting people involved in it.

Several interviewees recommended focusing efforts on people who are "open-minded," or at least younger because they are most likely to be around to deal with climate change impacts. On the other hand, a couple of interviewees said that Dover should leverage its mature residents with expertise and time to offer, rather than spending money on "expert consultants."

One person suggested that the Planning Department do a community survey to learn what people in Dover already know, and then build from there. A survey by the Chamber of Commerce was also recommended to learn what the business community thinks.

Use/Improve the Data and Projections

In general, the interviewees were impressed with the data and downscaled projections, and thought others should see them, too. A few people said that looking at the numbers made the threats of climate change "more real," while others said they help "prove" that climate change is happening. Some people made specific recommendations to improve the numbers they looked at in the interview, such as lengthening the historical timeframe beyond 1980, and adding a wind category.

One person questioned the results of the models and said it would help to see how well they predict reality by plugging in information from forty years ago, projecting forward to today, and comparing the results with the actual meteorological data on record. Another person said it would be good to see how these projections compare to historical trends to demonstrate how different the changes are from natural fluctuations.

Another idea that came up many times was to measure and evaluate the risks of various impacts and the costs of action or inaction in order to compare the value of costs now versus costs later.

Infrastructure or Policy Changes

Some interviewees focused their advice on infrastructure or policy changes. One person said it is critical that Dover plans for future development in a manner that accounts for climate change, for example, by prohibiting development in floodplains and requiring the use of low-energy cooling systems.

From a funding perspective, a couple of people mentioned applying for state emergency management funds for specific projects like upgrading motors for wells and pumps, or installing emergency lighting. Someone else suggested seeking federal grants for conservation efforts like fixing leaks in water and sewer systems. Energy efficiency was mentioned several times by different people, but they did not articulate a specific connection between energy efficiency and adaptation efforts.

One person said that improvements to the stormwater system, including requiring on-site detention, would decrease the incidence of flooding from backed-up stormwater pipes. Others recommended making waterways deeper (dredging riverbeds that have filled in with sediment over time), doubling up open space for both recreation and conservation, designing another location on the river to catch floodwaters (similar to Henry Law Park), and adapting a recreation program to a wetter, hotter environment.

Appendix A. List of Interviewees

Name	Position/Role
Gary Bannon	Recreation Director
Anna Boudreau	Strafford Rivers Conservancy Executive Director
Bill Boulanger	Community Services
Ken Costello	Resident
Tim Dargin	Federal Savings Bank
Jaimie Donovan	Public Health Officer
Richard Driscoll	Fire Chief
May Glovinski	Housing Authority
Dana Lynch	Local engineer
George Maglaras	Marina owner and current County Commissioner, former Mayor of Dover
Don and Sue Medbery	Residents
Jack Mettee	Waterfront Committee in charge of redeveloping a piece of city property along the river
Chris Parker	Planning and Community Development
Doug Steele	Community Services Director (Public Works)
Dave Terlemezian	Police Captain
Dean Trefethen	Mayor
Karen Weston	City Council and local business owner (family grocery store)

Appendix B. Interview Protocol

General Background

1. Please confirm your name, title, and affiliation.
2. Could you briefly explain what your organization does?
3. What is your connection to Dover?
4. Briefly, what are the top issues you would like to see your community address in the next five to ten years?

Local Risks

5. In what ways might climate change affect your community in the next few decades?
6. What specific climate change risks or impacts are you most concerned about? If none, why?
7. We have here a map of the city. Which specific locations on the map do you think are the most vulnerable to the climate change risks we have been discussing?
8. How prepared do you believe your community is to handle the impacts you have named?

Local Activity, Context & Politics

9. What is your connection to climate change adaptation work, if any?
10. Are there actions underway (currently or in the planning stages) to reduce the vulnerability of your community to climate change risks?
    a. If so, what are they?
11. What obstacles does your community face when working to reduce climate change risks? What would it take to overcome these obstacles?
12. What do you think are the biggest opportunities for taking action in your community?

Data

13. We have been looking through federal and state forecasts of climate change risks facing your city. I'd like to show you a few numbers. Do you have any preliminary reactions to these forecasts?
14. What data or information about climate change risks would be most helpful to your community at this point?

Decision-making

15. We are going to organize some community meetings to talk about climate change risks that may be facing your city. Who do you suggest we invite?
16. Are there specific organizations in your community who might want to co-host such an event?

Other

17. Who else do you think I should talk to about these issues?

Appendix C: Downscaled Climate Projections

These projections were generated as output from four different global climate models (GCM) that have been well-established and evaluated in the peer-reviewed scientific literature: the US National Oceanic and Atmospheric Administration's Geophysical Fluid Dynamics Laboratory (GFDL) CM2.1; the United Kingdom Meteorological Office's Hadley Centre Climate Model version 3 (HadCM3); and the National Center for Atmospheric Research's Parallel Climate Model (PCM) and Community Climate System Model Version 3 (CCSM3). These models have different climate sensitivities, where sensitivity refers to the amount of temperature change resulting from a doubling of atmospheric C02 concentrations relative to pre-industrial times. GFDL, CCSM3, and HadCM3 have medium sensitivity; and PCM has a low sensitivity.

Each global model produces output in the form of geographic grid-based projections of daily, monthly, and annual temperatures, precipitation, and other climate variables. Global climate models operate on the scale of hundreds of miles, which is too coarse a resolution to distinguish changes across different towns and cities in a given region, such as New England. However, scientists used state-of-the-art statistical downscaling models to capture historical relationships between large-scale weather features and local climate, and use these to translate future projections down to the scale of local weather station observations. In this project we used a relatively new statistical downscaling model, the Asynchronous Regional Regression Model.[5] This report uses the projections downscaled to the meteorological station in Portsmouth, NH, because it is the closest station to Dover.

Two different climate change scenarios drove the projections from the global climate models: a high emissions scenario (A1fi) and low emissions scenario (B1). The high emissions scenario assumes that the world will experience economic growth dependent primarily on fossil fuels and that atmospheric concentrations of carbon dioxide reach 940 parts per million by 2100.[6] The low emissions scenario assumes that economies will shift to cleaner, less fossil-fuel intensive technologies, and that atmospheric concentrations of carbon dioxide reach 550 parts per million by 2100 . The purpose of choosing a high emissions and a low emissions scenario is to create a likely range of future climate change that Dover may experience during the 21st century.

The projections are also presented in three time frames: short term, medium term, and long term. The short term refers to the time period between 2010 and 2039, the medium term refers to the time period between 2040 and 2069, and the long term refers to the time period between 2070 and 2099. The historical baseline refers to the years 1980 to 2009. We average the results of the historical baseline period and climate projections over 30 years. This period is long enough to filter out any interannual variation or anomalies, and short enough to show longer climatic trends.

5 More information on the statistical downscaling method used is provided in: Stoner, AMK, K Hayhoe, X Yang and DJ Wuebbles (2012) An asynchronous regional regression model for statistical downscaling of daily climate variables. Int. J. Climatol. DOI: 10.1002/joc.3603.

6 The emissions scenarios and GCM simulations used in this report consist of models that contributed to phase 3 of the Coupled Model Intercomparison Project (CMIP3). These are the results presented in the Intergovernmental Panel on Climate Change (IPCC) Third (2001) and Fourth (2007) Assessment Reports. More recent scenarios combined with CMIP5 climate projections were recently released (September 2013) in the IPCC Fifth Assessment Report.

Climate Change Projections for Dover, NH (Change from Historical)

Indicators	Historical 1980-2009	Change from historical (+ or -)					
		Short Term 2010-2039		Medium Term 2040-2069		Long Term 2070-2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Temperature (F)							
Average annual minimum temperature	35.7	2.4	2.5	3.6	5.6	4.5	8.9
Average winter minimum temperature	15.6	3.0	3.1	4.3	6.2	5.3	9.9
Average summer minimum temperature	55.7	2.4	2.7	3.8	5.8	4.7	9.0
Average annual maximum temperature	58.0	2.3	2.3	3.7	5.6	4.6	9.0
Average winter maximum temperature	35.2	2.2	2.0	3.2	4.1	3.9	6.7
Average summer maximum temperature	79.8	2.5	2.2	4.4	6.8	5.4	10.7
Temperature Extreme *(days per year)*							
Colder than 32 °F	155	-11	-12	-19	-34	-23	-53
Hotter than 90 °F	10	6	7	15	36	21	65
Precipitation (in)							
Annual average	43.6	1.9	2.8	4.1	5.0	5.2	7.2
Winter average	8.4	1.4	1.8	1.8	2.1	2.7	3.7
Summer average	11.4	-0.5	-1.1	-0.2	-0.5	-0.8	-0.4
Extreme Precipitation *(events per year)*							
1" in 24 hrs	10.1	1.0	1.9	2.6	2.9	3.0	4.9
2" in 48 hours	4.4	1.5	1.6	2.6	2.6	3.3	4.6
Extreme Precipitation *(events per decade)*							
4" in 48 hours	8.0	-1.4	-3.4	-0.1	1.7	1.4	3.0
Sea Level Rise *(Increase relative to the year 2000 in feet)*							
		0.5	0.8	1.0	1.7	2.0	4.7

**Most of the data and predictions in this table are based on meteorological information from Durham, which serves as a climate proxy for Dover. The sea level rise information is based on data from Portsmouth, NH*

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