

Federal Highway Administration

# Climate Change Adaptation Peer Exchanges: Comprehensive Report

The Role of State Departments of Transportation and Metropolitan Planning Organizations in Climate Change Adaptation

Summary of three peer exchanges held 2011 – 2012

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## 1. Introduction and Background

Between April 2011 and May 2012, the Federal Highway Administration (FHWA) convened three peer exchanges on the role of State Departments of Transportation (DOTs) and Metropolitan Planning Organizations (MPOs) in climate change adaptation. The peer exchanges were held at the following dates and locations:

- Minimizing the Impacts of Climate Change on Transportation Systems in the Midwest: Indianapolis, IN, April 28 - 29, 2011.
- Integrating Climate Change Adaptation into Agency Programs, Projects, and Operations: Oakland, CA, June 13 - 14, 2011.
- Minimizing the Impacts of Climate Variability and Change on Transportation Systems in New England: Cambridge, MA, May 8 – 9, 2012.

The purpose of the peer exchanges was to facilitate an exchange of ideas among transportation officials regarding strategies to assess and reduce the vulnerability of their transportation assets and services to projected changes in climate. Since the projected changes in climate and agency objectives differed by region, FHWA tailored each exchange to the region's needs. However, there were similarities among the exchanges. For example, all three exchanges discussed climate change vulnerability assessment, the need for increased collaboration, and communication strategies. The format of these peer exchanges alternated presentations from participants with facilitated group discussions. The small group size and the informal atmosphere allowed for easy information sharing and capacity building among peers.

The Midwest Peer Exchange focused on integrating climate change adaptation into emergency management from both an MPO and DOT perspective. During the first day, Directors of MPOs in Indiana (or their delegates) gathered to discuss emergency planning and integration of climate change adaptation into Hazard Mitigation Plans. During the second day, Midwestern state DOTs discussed criticality and vulnerability of assets, state hazard mitigation planning efforts, and addressing adaptation in asset management and operations decisions.

During the West Coast Peer Exchange, California DOT (Caltrans), Oregon DOT (ODOT), and Washington State DOT (WSDOT) collaborated and discussed strategies for assessing climate change risks, incorporating adaptive strategies into asset management and operations, and communicating climate change adaptation. Since Washington, Oregon, and California have each taken progressive approaches to addressing climate change impacts and vulnerabilities, this peer exchange offered an opportunity for the DOTs in these states to share experiences, challenges, and lessons learned.

Finally, the New England Peer Exchange provided an opportunity for Metropolitan Planning Organizations (MPOs) and Regional Planning Commissions (RPCs) in New England to discuss methods of assessing vulnerability and potential opportunities for collaboration and partnership. New England has faced a series of extreme weather events over the past few years, including Hurricane Irene in 2011. MPOs and RPCs in New England are at the forefront of responding to these events and preparing for future weather changes. A representative from the Southeast Florida Regional Climate Change Compact also attended this workshop and shared best practices for coordinating among MPOs on sea level rise vulnerability in southeast

Florida. During this exchange, local planning organizations shared experiences, challenges, and lessons learned.

This report synthesizes the key themes and lessons from the peer exchanges, including examples of effective practices presented by participants. It includes the following sections:

- **Section 2 – Best Practices and Strategies for Overcoming Common Challenges** summarizes the common challenges identified during these peer exchanges as well as the solutions that participants proposed for overcoming these challenges.
- **Section 3 – Future Needs and Participant Recommendations** provides an overview of the needs and recommendations made during the peer exchanges.

Appendices A and B contain the peer exchange participant lists and agendas, respectively. Appendix C contains a list of all the resources identified during the peer exchanges as helpful sources of information on vulnerability assessment and adaptation. Reports covering each exchange individually are available on the FHWA Climate Change Adaptation website.<sup>1</sup>

## 2. Best Practices and Strategies for Overcoming Common Challenges

DOTs and MPOs in the Midwest, West Coast, and New England regions are coping with different climate impacts and operating in unique political and social contexts. However, as agencies in these regions begin planning for projected changes in climates, they are experiencing similar challenges. This section of the report outlines these common challenges and documents the strategies that agencies recommended for overcoming them.

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### Developing Guidance and Information for Climate Vulnerability Assessments

#### Challenge: Methods of Evaluating Vulnerability and Risk

There are not yet established best practices for evaluating climate change vulnerability or integrating climate change considerations into existing risk mitigation efforts. DOTs and MPOs often struggle with identifying the climate change impacts that will matter at a local scale and understanding the alignment of climate change impacts with decision making. In addition, the amount of projected climate data available can be overwhelming, and it is difficult for agencies to determine which scenarios, models, and data to use in assessing vulnerability.

#### Value of Top-Down Leadership and Guidance

Strong leadership at every level is critical to motivating and directing successful vulnerability assessment and adaptation planning efforts. For example, in California, Oregon, and Washington, direction from state legislatures and governors has been integral to sparking action at the state DOT level. Since these agencies are responding to direction from the State, they do not need to spend resources justifying the importance and relevance of climate change to stakeholders. Participants in both the Northeast and Midwest peer exchanges observed that building relationships and trust, both within and across agencies, is a critical first step for both hazard mitigation and adaptation planning. Since effective adaptation will require cross-cutting work, increased collaboration with state DOTs, municipalities, universities, and federal

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<sup>1</sup> [http://www.fhwa.dot.gov/environment/climate\\_change/adaptation/workshops\\_and\\_peer\\_exchanges/](http://www.fhwa.dot.gov/environment/climate_change/adaptation/workshops_and_peer_exchanges/)

agencies, particularly FEMA, is needed. Often, leadership plays an important role in encouraging this type of cross-agency collaboration.

In addition to political leadership, guidance from the State on which data sources to use, which climate scenarios to consider, and which policies should address adaptation is valuable for DOTs and MPOs. During the West Coast Peer Exchange, participants noted that state-level direction forcing agencies to cooperate and share information was very helpful in shaping adaptation policy. For example, Washington State has mandated that government agencies use climate data from the University of Washington's Climate Impacts Group (CIG). California Executive Order S-13-08 directs state agencies planning construction projects in areas vulnerable to sea level rise to begin planning for potential impacts. The state has developed statewide sea level rise projections to support these planning efforts. State DOTs can also provide this type of technical guidance to MPOs and internal staff working at the project and planning level. For example, in May of 2011, Caltrans released its [Guidance on Incorporating Sea Level Rise](#), which the Caltrans Planning staff and Project Development teams use in order to determine whether and how to incorporate sea level rise concerns into the programming and design of Department projects.

During the New England Peer Exchange, representatives from MPOs echoed the importance of coordinated guidance on climate projections. To provide a real-life example, a member of the Southeast Florida Regional Climate Change Compact attended this peer exchange. In the absence of state-wide guidance on sea level rise scenarios for Florida, the four county members of the Southeast Florida Regional Climate Change Compact adopted a single set of sea level rise projections and inundation maps for the region. Using this set of projections allowed the four counties to advocate and communicate more effectively with a unified voice. In addition, these projections provide the basis for designating adaptation priority areas, focusing investments and service expansions, and modifying design standards.

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## **Managing Resource Constraints and Streamlining Processes**

### **Challenge: Addressing Climate Change with Limited Resources**

Transportation agencies manage multiple, interacting stressors while planning, programming and designing, projects. Often, resources are barely sufficient for maintaining the status quo for transportation operations and investments. Participants from each exchange noted the challenge of considering climate change as a new risk at a time when agencies are currently struggling to maintain existing operations.

### **Integrating Vulnerability Assessment and Adaptation into Existing Practices**

Participants at each of the three peer exchanges recommended integrating vulnerability assessment and adaptation into existing decision-making processes, particularly asset management and emergency management. Considering climate change as one of many risks to be considered in existing decision-making processes, rather than a separate issue requiring its own framework, lowers barriers to adaptation.

### ***Asset Management***

Most vulnerability assessments require information on the location and condition of transportation assets. Asset management systems often collect and manage this type of information in order to help DOTs and MPOs locate and evaluate their assets, monitor performance, and make informed investment decisions. During the Midwest Peer Exchange, Stephen Gaj of FHWA's Office of Asset Management defined asset management as, "a strategic and systematic process of operating, maintaining, upgrading and expanding physical assets effectively throughout their lifecycle." As part of asset management efforts, transportation agencies collect data on the location and attributes of the assets that they own and operate in order to understand the tradeoffs associated with continued investment in those assets. For example, DOT representatives from the Midwestern Peer Exchange noted that understanding the location of culverts in the floodplain can help identify assets at risk. Since effective adaptation requires understanding existing vulnerabilities in a transportation system, data collected for asset management purposes can inform climate change vulnerability assessments.

WSDOT's Bridge Office has already started considering how climate change could be integrated into their Bridge Engineering Information System (BEIST). BEIST is an asset management system that provides a central location for file storage, including photographs, inspection records, maintenance fixes, and ground line surveys. When WSDOT combines the information contained in BEIST with sea level rise inundation maps, the agency is able to estimate the site-specific vulnerability of bridges.

### ***Emergency Management***

Emergency management and hazard mitigation plans provide another avenue for "mainstreaming" climate change adaptation into decision making. Not only is extreme weather event preparation an important adaptation strategy, but post-disaster reconstruction can provide opportunities to rebuild infrastructure to a higher standard or relocate it out of hazardous areas. For example, following Tropical Storm Irene in August of 2011, there was massive flooding damage to Vermont's infrastructure, including downcutting and undermining of roads, channel enlargement, and debris jamming and avulsion. Vermont DOT's timely response to Hurricane Irene depended on existing systems, including the online bridge and culvert tool and the state's culvert inventories. Due to the fact that these systems had been organized in advance, Vermont was able to map all damaged locations within two and a half weeks of the storm. Following Tropical Storm Irene, Vermont has been pursuing innovative techniques for managing riverine flood risk, including designing river channels to allow room for flooding and natural channel migration. In the areas identified as important floodplains, the State would like to provide communities with incentives for either elevating or relocating built structures.

During the Midwest Peer Exchange, MPO participants noted that county hazard mitigation plans provide a natural vehicle for climate change adaptation. In 2000, Congress passed the Disaster Mitigation Act, which requires communities to profile their natural hazards, assess the risk to the community or state, and identify strategies to mitigate future losses in order to be eligible for federal disaster funds. In the Midwest, the Polis Center has helped counties use Hazus-MH, a tool maintained by FEMA, to develop Multi-Hazard Mitigation Plans. The Polis

Center has quantified flood risks for more than 2,000 non-coastal counties and is helping Wisconsin, Minnesota, and Indiana update flood mitigation plans. Participants at this exchange emphasized the importance of updating flood plain maps to accurately reflect risk.

### ***Long-Range Planning***

Long-range planning provides a third avenue for incorporating climate change considerations into existing decision-making frameworks. For example, the Boston Region MPO is conducting hazard mapping in order to identify areas where transportation infrastructure may be vulnerable to natural hazards and to inform the security evaluation of proposed transportation projects. The MPO has an interactive web tool ([www.bostonmpo.org/hazards](http://www.bostonmpo.org/hazards)) that maps the transportation network, natural flood zones, bridge condition, emergency routes, and emergency support facilities. The tool links to the MPO's database of Transportation Improvement Program (TIP) projects and can be used to determine whether proposed projects are located in areas exposed to flooding, storm surge, or sea level rise.

During the New England Peer Exchange, the participants agreed that incorporating climate change considerations into evaluation criteria can help MPOs prioritize projects. In addition, the earlier that climate risks are considered in the planning process, the greater the ability of the MPO to intervene in the project.

### **Adaptation as a Co-Benefit**

Participants at the three peer exchanges also recommended prioritizing programs and projects that increase resilience as a co-benefit, rather than a main focus. For example, WSDOT's fish passage program is installing bigger culverts which will not only improve fish passage, but will also increase the system's capacity to handle future stream flows. Caltrans has also now started designing for 100 year storms and using drilled shafts. Since increasing resilience to climate change is just one of several benefits resulting from these projects, it is easier to communicate and justify the need for these programs.

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## **Communicating and Coordinating with Stakeholders**

### **Challenge: Lack of Coordination and Information Sharing among Communities**

Participants mentioned the need for increased collaboration between MPOs, DOTs, federal agencies, universities, and other stakeholders engaged on this issue. For example, during the Midwest Peer Exchange, participants agreed that lack of information sharing between agencies is one of the biggest barriers to hazard mitigation. Participants also noted that, in many cases, coordinating and communicating within a single agency can also be daunting. For example, communicating climate change issues within Caltrans is difficult because Caltrans has over 20,000 staff located in 12 district offices and headquarters. Relevant climate change adaptation information needs to be directed to a wide range of staff across disciplines and offices, making frequent discussions challenging.

### **Building Relationships and Establishing Trust with Key Stakeholders**

According to peer exchange participants, it is difficult to overstate the importance of public process and stakeholder engagement in vulnerability assessment and adaptation planning.

Communication and stakeholder engagement were major themes in all three peer exchanges, and participants agreed that successful communication can be considered a type of adaptation in and of itself. During the Northeast Peer Exchange, participants noted that if the public or other target audience doesn't buy into the vulnerability assessment, they may not support the resulting adaptation actions.

The appropriate method of engaging stakeholders will vary according to the agency context and objectives. It is very important to plan for a specific target audience, and agencies often engage different groups of stakeholders in stages. For example, both ODOT and WSDOT began vulnerability assessment processes strategies by conducting interviews with on-the-ground personnel, such as maintenance staff. WSDOT conducted regional workshops across the state in order to solicit institutional knowledge of system vulnerabilities in a structured environment. ODOT conducted a workshop on adaptation that focused on engineers and technical services people. Not only did these workshops allow ODOT and WSDOT to gather important institutional knowledge, they also fostered ownership of the assessment results across the entire agency. During the West Coast Peer Exchange, these agencies noted that successful engagement of internal staff requires listening to them and incorporating their feedback and perspective. If these staff members are engaged and feel that they can take ownership of the strategy, they may be more willing to provide valuable leadership and insight.

### **Facilitating Information Sharing and Coordination among Agencies**

One of the main purposes of these peer exchanges was to facilitate information sharing and coordination among agencies. The participants were interested to learn how different agencies have approached climate change planning, implementation, and communication. The peer exchanges also created an opportunity for DOT, MPO, Federal agency, and university attendees to make valuable connections.

### **Coordinating Planning Processes within Agencies**

State DOTs and MPOs have a strong interest in integrating climate change adaptation, hazard mitigation, and transportation planning into a holistic planning process. In many communities, hazard mitigation occurs separately from local planning processes, including transportation planning. This practice can sometimes result in land use and transportation planning that inadvertently encourages development in hazardous areas. Communities are increasingly working to integrate hazard mitigation planning into local planning processes. For example, Chittenden County MPO in Vermont is currently working with a Department of Housing and Urban Development (HUD) grant to integrate climate change adaptation, hazard mitigation, and transportation into a single planning document.

### **Challenge: Communicating the Need for Climate Change Adaptation**

Communicating the need for climate change adaptation is challenging for several reasons. First, people often assume that "climate change" issues refer exclusively to mitigation. Organizations and government agencies often house climate change adaptation efforts within traditional environmental programs, even though adaptation impacts multiple programs, including asset management, risk mitigation, operations, and planning. In addition, since the national



discussion on climate change has focused on mitigation policies and debates around the science of climate, the term climate change has become politicized. Second, it is difficult to communicate the range of uncertainty associated with climate projections. For example, agencies are often concerned about releasing detailed inundation maps, which might alarm and alienate coastal property owners because it is difficult to describe the specific assumptions and uncertainties associated with these maps.

### **Strategies for Effective Communication**

In order to avoid confusing the issue of climate change adaptation with the politics of climate change mitigation, participants at the Midwest and Northeast Peer Exchanges recommended using the terms “extreme events,” “event management,” “multi-hazard management,” and “resilience” as effective terms for communicating impacts and adaptation issues.

Another strategy for communicating the need for adaptation is to expand conceptions of sustainability to include resilience. For example, participants at the West Coast Peer Exchange noted that messaging around sustainability can be targeted for specific audiences. They also recommended communicating that climate change adaptation is simple, good business practice that should be integrated throughout the agency.

## **3. Future Needs and Participant Recommendations**

MPO and DOT representatives at the three regional peer exchanges identified needs for additional support in order to begin adapting to climate change impacts. They also recommended potential next steps for the Federal Highway Administration and other federal agencies interested in supporting state and local adaptation efforts.

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### **Single Source for Adaptation Best Practices and Technical Resources**

As these peer exchanges demonstrated, adaptation and vulnerability assessment are not “one-size-fits-all” processes. Each agency will need to assess vulnerability and integrate adaptation into its operations in the way that makes the most sense given that agency’s context and objectives. However, peer exchange participants noted that they felt overwhelmed by the amount of data and resources available. There is currently no single place that MPOs and DOTs can visit in order to get information on best practices in the field, case studies, and frameworks for planning the vulnerability assessment and adaptation process. Peer exchange participants at all three exchanges expressed the need for organized guidance from a single source. While each agency will use these resources differently, it would be helpful to document best practices and case studies so that MPOs and DOTs have potential models to follow and frameworks to consider. It is important that this single source of information be targeted for transportation audiences. For example, during the New England Adaptation Peer Exchange, representatives from the MPOs observed that MPO-focused resources on adaptation planning are not currently available.

Beyond the need for a single, organized source of adaptation information, participants also identified needs for specific types of technical guidance. Commonly identified technical needs included:

- *Tools to help identify vulnerabilities to climate change, including tools to identify and prioritize vulnerable assets.* For example, during the New England Peer Exchange, participants discussed the Lamprey River Project, which produced updated flood maps based on projected precipitation, rather than historical precipitation data. Participants at each of the three exchanges were interested in updated flood maps as one tool for integrating climate change into planning processes.
- *Tools to help agencies communicate impacts and adaptation options, both within the agency and to the public.* For example, during the New England Peer Exchange, participants recommended the [NOAA Sea Level Rise Viewer](#) as a useful tool for communicating the risks of sea level rise. This tool displays potential future sea levels and provides simulations of sea level rise at local landmarks.
- *Guidance on moving from the vulnerability assessment stage to the adaptation implementation stage.* For example, during the West Coast Peer Exchange, the participants requested additional guidance from FHWA on appropriate next steps after a risk or vulnerability assessment. While they noted that most DOTs are not yet at this stage of planning, they emphasized that guidance on this topic will be valuable in the future.
- *Guidance on integrating adaptation into project planning, programming, and design.* Implementation of adaptation measures will be needed at the planning level and the project level. There is no existing guidance that addresses the full spectrum of adaptation options across this continuum in any of the three participating West Coast state DOTs.

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### **Guidance on Evaluating Adaptation Options**

Very few resources exist to help DOTs and MPOs evaluate and compare adaptation options. Participants at all three peer exchanges highlighted the need for information on the costs of adaptation and emphasized that very little cost information is currently available. They noted that cost information is likely to be very context-specific but that even if exact cost estimates are not available, it would be helpful to understand relative costs. For example, during the West Coast Peer Exchange, participants suggested that potential candidates for immediate adaptation options would include high-cost, long-lived infrastructure programs, long-term programs with a high cost of failure, and high-value programs with a high cost of failure. The Southeast Florida Regional Climate Change Compact is one example of a program that has developed costs of sea level rise. The Compact created cost estimates using information from existing flood control efforts. For example, Miami-Dade County requested \$19.5 million in FEMA funding to repair road systems damaged from extreme weather and the cost of one forward pump is \$3.4 million dollars.

DOTs and MPOs are also interested in understanding the cost of inaction, or the cost of not adapting to climate change. Understanding costs of inaction is important for putting adaptation costs in perspective. That is, adaptation measures that initially may seem expensive may appear more cost-effective when considering the costs associated with *not* adapting.

During the New England Peer Exchange, participants noted that it may become necessary to abandon certain high-risk, non-critical infrastructure on the coast; however, better understanding of the costs of other adaptation options would help them understand situations where abandonment makes sense.

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### **Collaboration and Leadership on Implementing Adaptation**

The MPO and DOT representatives at these three exchanges recommended specific best practices for overcoming the barriers and challenges described in this report. One of the major barriers to adaptation efforts across the region is lack of collaboration among local, state, and federal agencies. Proactively building partnerships among these agencies is an adaptation best practice because it helps agencies integrate climate change considerations across different types of planning. For example, Vermont is working closely with local communities to develop hazard mitigation plans and flood management strategies that tie into state-level adaptation efforts.

Collaboration and partnership are also of critical importance at the federal level. State DOTs and MPOs across the country benefit from federal leadership and cooperation. For example, participants at all three peer exchanges noted the importance of having a state-sanctioned source of climate projection data. However, with the exception of a few areas, most states have not specified which models, data, scenarios, and time frames DOTs and MPOs should use in adaptation planning. Similarly, participants noted that the FEMA flood maps and the NOAA rainfall atlas are two very important sources of hazard information that should be updated to account for changing climate patterns. Participants also discussed the need to review transportation design standards and potentially provide new guidance on how to use them under conditions of climate change. Meeting these demands, and supporting DOTs and MPOs as they address climate change impacts will require involvement from multiple agencies and organizations, including FEMA, FHWA, and AASHTO. Since no single agency is capable of providing all of the information and services needed to inform decision making, meeting the climate challenge will require increased coordination among federal agencies and their partners.

## **Appendix A: Participant Lists**

# 2011 FHWA/INDOT Adaptation Peer Exchanges

## Minimizing the Impacts of Climate Change on Transportation Systems in the Midwest LIST OF PARTICIPANTS – MPO Peer Exchange, April 28<sup>th</sup>

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# 2011 FHWA/INDOT Adaptation Peer Exchanges

## Minimizing the Impacts of Climate Change on Transportation Systems in the Midwest

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# FHWA West Coast Climate Change Adaptation Peer Exchange

## Integrating Climate Change Adaptation into Agency Programs, Projects, and Operations

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# 2012 FHWA Climate Change Adaptation Peer Exchange – New England Region

## Minimizing the Impacts of Climate Variability and Change on Transportation Systems in New England

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Dan Camara	Strafford Regional Planning Commission	<a href="mailto:dcamara@strafford.org">dcamara@strafford.org</a>
<i>Rhode Island</i>		
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Name	Affiliation	Email
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Heather Holsinger	Federal Highway Administration - HQ	<a href="mailto:heather.holsinger@dot.gov">heather.holsinger@dot.gov</a>
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Leigh Levine	Federal Highway Administration - NH	<a href="mailto:Leigh.Levine@dot.gov">Leigh.Levine@dot.gov</a>
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<i>Volpe National Transportation Systems Center, U.S. Department of Transportation</i>		
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William Gordon	Federal Transit Agency - Region 1	<a href="mailto:william.gordon@dot.gov">william.gordon@dot.gov</a>
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<i>Miami-Dade County</i>		
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<b>ICF International</b>		
Anne Choate	Vice President	<a href="mailto:AChoate@icfi.com">AChoate@icfi.com</a>
Emily Rowan	Associate	<a href="mailto:ERowan@icfi.com">ERowan@icfi.com</a>

## **Appendix B: Meeting Agendas**

# 2011 FHWA/INDOT Adaptation Peer Exchanges

## Minimizing the Impacts of Climate Change on Transportation Systems in the Midwest

Indiana Government Center North  
Room N755  
100 North Senate Avenue  
Indianapolis, Indiana 46204

### MPO Peer Exchange—FINAL AGENDA

**Thursday, April 28, 2011, 1:00-4:15 pm**

<b>1:00 PM</b>	Welcome and Introductions
<b>1:15 PM</b>	Setting the Stage (approx. 20 minutes per presentation) <i>Presentation:</i> Climate change in the Midwest (Dev Niyogi, Purdue University) <i>Presentation:</i> Vulnerability and risk assessment: FHWA Conceptual Model; climate change risk assessment examples from transportation agencies (Heather Holsinger, FHWA) <i>Presentation:</i> Overview of hazard mitigation planning process and climate linkages (Laura Danielson, the Polis Center)
<b>2:15 PM</b>	Break
<b>2:25 PM</b>	Facilitated Discussion (approx. 30 min per topic) Recent experiences with severe weather, and planning for future events Reducing vulnerability and increasing capacity to deal with climate events
<b>3:25 PM</b>	Break
<b>3:35 PM</b>	Facilitated Discussion, cont'd (approx. 30 min) Collaborating with agencies beyond the MPO (and barriers to doing so)
<b>4:05 PM</b>	Wrap-up Discussion/ Lessons Learned
<b>4:15 PM</b>	Adjourn

# 2011 FHWA/INDOT Adaptation Peer Exchanges

## Minimizing the Impacts of Climate Change on Transportation Systems in the Midwest

Indiana Government Center North, Room N755  
100 North Senate Avenue  
Indianapolis, Indiana 46204

### State DOT Peer Exchange—FINAL AGENDA

Friday, April 29, 2011, 8:30 am to 4:30 pm

<b>8:30 AM</b>	Welcome/ Introductions
<b>9:00 AM</b>	Climate Change in the Midwest and Impacts on Transportation <i>Presentation:</i> Overview of climate change in the Midwest (Dev Niyogi, Purdue University, 20 min) <i>Discussion:</i> DOT experiences with climate events (45 min)
<b>10:05 AM</b>	Current FHWA Adaptation Activities <i>Presentation:</i> Vulnerability and risk assessment conceptual model and pilots, peer exchanges, etc. (Heather Holsinger, 20 min)
<b>10:25 AM</b>	Break
<b>10:40 AM</b>	Climate Change and Asset Management <i>Presentation:</i> Impacts of global climate change on highway infrastructure (Brian Beucler and Dan Ghere, FHWA, 30 min) <i>Presentation:</i> Supporting existing infrastructure in a changing climate (Steve Gaj, FHWA, 15 min) <i>Discussion:</i> Planning for climate change in asset management, and barriers to action (35 min)
<b>12:00 PM</b>	Lunch
<b>1:00 PM</b>	Climate Change and Operations <i>Presentation:</i> Climate change impacts on transportation operations (Greg Johnson, Michigan DOT, 20 min) <i>Discussion:</i> Planning for climate change in operations, and barriers to action (30 min)
<b>1:50 PM</b>	Hazard Mitigation Planning <i>Presentation:</i> Overview of hazard mitigation planning process and climate linkages (John Buechler, the Polis Center, 20 min) <i>Discussion:</i> State DOT involvement in State hazard mitigation planning, incorporation of climate effects into the planning process, opportunities for leveraging resources/sharing info (45 min)
<b>2:55 PM</b>	Break
<b>3:10 PM</b>	Round Table Discussion Strategies for incorporating climate change adaptation into DOT processes
<b>4:15 PM</b>	Wrap-up Discussion/Lessons Learned
<b>4:30 PM</b>	Adjourn

# 2011 FHWA West Coast Climate Change Adaptation Peer Exchange

## Integrating Climate Change Adaptation into Agency Programs, Projects, and Operations

California Department of General Services  
 Elihu Harris State of California Office Building  
 2nd Floor Conference Center, Room 9  
 1515 Clay Street, Oakland, CA 94612

### *Final Agenda*

Day 1 - June 13 <sup>th</sup>	
9:30 AM	<b>Welcome/ Introductions</b> <ul style="list-style-type: none"> <li>• Welcoming remarks from FHWA (Mike Culp, FHWA)</li> <li>• Participant self-introductions</li> </ul>
<b>Assessing Risks and Vulnerabilities</b>	
10:00 AM	<b>Understanding Climate Change Impacts on Transportation Assets and Services</b> (20 min + 5 min of Q&A per presentation) <ul style="list-style-type: none"> <li>• Recent examples of climate change risk/vulnerability assessments in transportation (Anne Choate, ICF International)</li> <li>• WSDOT Pilot Project and using information from pilot workshops (Sandy Salisbury and Mark Maurer, WSDOT)</li> </ul>
10:50 AM	<b>Break</b>
11:05 AM	<b>Understanding Climate Change Impacts on Transportation Assets and Services , cont'd</b> <ul style="list-style-type: none"> <li>• Towards Adapting at the Project Level (Kelly Dunlap, Caltrans) (20 min + 5 min of Q&amp;A)</li> </ul>
11:30 AM	<b>Implementing Risk Assessments at the State DOT Level – <i>Facilitated Discussion</i></b>
12:15 PM	<b>Lunch</b>
1:15 PM	<b>FHWA Risk Assessment Conceptual Model Pilot Project: Stakeholder Engagement and Using Study Results</b> (20 min + 5 min Q&A) (Joe LaClair, San Francisco Bay Conservation and Development Commission)
1:40 PM	<b>Conducting Risk Assessments at Smaller Scales— <i>Facilitated Discussion</i></b>
2:30 PM	<b>Break</b>
<i>Day 1 agenda continued on next page</i>	

## Day 1 - June 13th (cont'd)

### Incorporating Adaptive Strategies into Asset Management and Operations

**2:45 PM** **Integrating Adaptation into Management of Highway Assets and Operations**  
(20 min + 5 min of Q&A per presentation)

- Using the Bridge Engineering Information System (BEIST) to assess risk and inform adaptation strategies (Casey Kramer, WSDOT)
- Implementation of adaptation measures: case studies and international examples (Rob Hyman, FHWA)

**3:35 PM** **Implementing Adaptation Strategies — *Facilitated Discussion***

**4:45 PM** **Day 1 Wrap-up**

**5:00 PM** **Day 1 Closing**

## Day 2 - June 14<sup>th</sup>

**8:00 AM** **Recap of Day 1 (Anne Choate, ICF International)**

### Communicating the Need for Climate Change Adaptation

**8:15 AM** **Internal and External Communication**

- FHWA communication activities and complying with CEQ adaptation implementation guidance (Mike Culp, FHWA, 10 min + 5 min of Q&A)
- Communication strategies, successes, and challenges (Seth Stark, WSDOT) (20 min + 5 min of Q&A)
- Communication strategies, successes, and challenges (Margi Bradway, ODOT) (20 min + 5 min of Q&A)
- Communication strategies, successes, and challenges (Garth Hopkins, Caltrans) (20 min + 5 min of Q&A)

**9:45 AM** **Break**

**10:00 AM** **Communication Strategies — *Break Out Discussion***

*Group 1: Internal Communications*

*Group 2: External Communications*

**11:00 AM** **Communication Strategies— *Full Group Discussion***

*One representative from each group reports on break out group discussions*

**11:30 AM** **Round Table Discussion: Lessons Learned**

**11:45 AM** **Wrap-Up**

**12:00 PM** **Adjourn**



# 2012 FHWA Climate Change Adaptation Peer Exchange – New England Region

## Minimizing the Impacts of Climate Variability and Change on Transportation Systems in New England

*Volpe National Transportation Systems Center  
55 Broadway  
Cambridge, MA 02142*

### Agenda

Day 1 (May 8, 2012)	
<b>8:30 AM</b>	<p><b>Welcome/ Introductions</b></p> <p>Welcoming remarks from FHWA (Heather Holsinger, FHWA)</p> <p>Participant self-introductions, including introductory remarks on what their organization is doing related to climate change adaptation and/or what they wish to get out of this exchange</p>
<b>Setting the Stage</b>	
<b>9:30 AM</b>	<p><b>Climate Variability and Change in New England</b></p> <p><i>Presentation:</i> Dr. Cameron Wake, University of New Hampshire (30 min + 15 min Q&amp;A)</p>
<b>10:15 AM</b>	<p><b>Exploring the Impacts of Climate Variability and Change on Transportation Assets and Services</b></p> <p><i>Presentation:</i> Heather Holsinger, FHWA (20 min + 10 min Q&amp;A)</p>
<b>10:45 AM</b>	<b>Break</b>
<b>11:00 AM</b>	<p><b>Potential Transportation Impacts from Climate Change</b></p> <p><i>Facilitated Discussion:</i> What concerns participants most? Where are they already seeing impacts from climate variability and change? What barriers do they see in addressing these impacts? (35 min)</p>
<b>Climate Change Vulnerability Assessments</b>	
<b>11:35 AM</b>	<p><b>US DOT Support of Climate Change Vulnerability Assessments</b></p> <p><i>Presentation:</i> Vulnerability and risk assessment conceptual model and pilots, peer exchanges, FTA pilots, Gulf Coast Study (Heather Holsinger and Becky Lupes, FHWA; Anne Choate, ICF 25 min + 10 min Q&amp;A)</p>
<b>12:10 PM</b>	<b>Lunch</b>
<b>1:10 PM</b>	<p><b>FHWA Vulnerability Assessment Framework</b></p> <p><i>Facilitated Discussion:</i> Walk through the FHWA vulnerability assessment model. Brief overviews of each of the components of the framework, and then discussion of how each component could be conducted by the MPOs (60 min)</p>
<b>2:10 PM</b>	<p><b>Lessons from Transportation Vulnerability Analyses: the Cape Cod Pilot Project</b></p> <p><i>Presentation:</i> Cape Cod Pilot Project, Lindsey Morse (Volpe) and Clay Shofield (Cape Cod Commission) (20 min + 10 Q&amp;A)</p>

Day 1 (May 8, 2012)	
2:40 PM	Break
2:55 PM	<p><b>Lessons from Transportation Vulnerability Analyses: Examples from New England</b></p> <p><i>Panel with Q&amp;A:</i> Cliff Sinnott (Rockingham Planning Commission), Sarah Bradbury (Northern Middlesex Council of Governments), and Nicole Davis (South Western Regional Planning Agency) (35 min)</p> <p><i>Facilitated Discussion:</i> What are common lessons learned from across these presentations? What are the biggest barriers to progress? What are necessary elements for success? (45 min)</p>
4:15 PM	Day 1 Wrap-up
4:30 PM	Day 1 Closing

Day 2 (May 9, 2012)	
8:30 AM	Recap of Day 1 (Anne Choate, ICF International)
<b>Opportunities for Collaboration</b>	
8:45 AM	<p><b>Examples of Successful Cross-Agency Collaboration on Adaptation</b></p> <p><i>Presentation:</i> Coordination across state and local agencies for adaptation planning (Ellen Mecray, NOAA, 20 min + 10 min Q&amp;A)</p> <p><i>Presentation:</i> Developing a multi-county pact for preparing for climate change, Debbie Griner (Miami-Dade County, 20 min + 10 min Q&amp;A)</p>
9:45 AM	<p><b>Additional Opportunities for Collaboration</b></p> <p>Round table discussion (25 min)</p>
10:10 AM	Break
<b>Adaptation Planning</b>	
10:25 AM	<p><b>Integrating Adaptation into Existing Decision-Making Processes</b></p> <p><i>Presentation:</i> Integration of climate change into hazard mitigation processes (Michele Boomhower, Chittenden County, 20 min + 10 min Q&amp;A)</p> <p><i>Presentation:</i> Integration of climate change into long-range transportation plans (Anne McGahan and Maureen Kelly, Boston Region Metropolitan Planning Organization, 20 min + 10 min Q&amp;A)</p> <p><i>Presentation:</i> Mainstreaming Adaptation, Nan Johnson (FEMA) (20 min + 10 min Q&amp;A)</p>
11:55 AM	<p><b>Reducing Barriers to Implementation</b></p> <p><i>Facilitated Discussion:</i> Which planning processes present opportunities for adaptation planning? How does risk tolerance impact study design, approaches for integration with other activities, and treatment of uncertainty? Which stakeholders need to be involved and how can collaboration be encouraged? What tools are needed to support this work? (30 min)</p>
12:25 AM	Meeting Wrap Up
12:30 PM	Adjourn

## **Appendix C: Resources for More Information**

# Resources for More information

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## Identified During the FHWA Adaptation Peer Exchanges

### TRANSPORTATION ADAPTATION INFORMATION

#### GENERAL ADAPTATION ACTIVITIES

##### Transportation and Climate Change Adaptation Peer Exchanges and Workshops

- Workshops on Integrating Climate Change with Transportation Planning (October, November 2010) <http://www.fhwa.dot.gov/hep/climate/workshops/index.cfm>
- Educating the Public on Climate Change Issues: DOT and MPO Best Practices (June 2010) [http://www.fhwa.dot.gov/hep/climate/educating\\_the\\_public/index.cfm](http://www.fhwa.dot.gov/hep/climate/educating_the_public/index.cfm)
- December 2009 Exchange [http://www.fhwa.dot.gov/hep/climate/peer\\_exchange/peer00.cfm](http://www.fhwa.dot.gov/hep/climate/peer_exchange/peer00.cfm)
- December 2008 Exchange <http://www.fhwa.dot.gov/planning/statewide/pwsacci.htm>

##### AASHTO Transportation and Climate Change Resources Center—State and Local Adaptation Activities

- [http://climatechange.transportation.org/climate\\_adaptation/state\\_local.aspx](http://climatechange.transportation.org/climate_adaptation/state_local.aspx)

##### Integrating Climate Change into the Transportation Planning Process – FHWA (July 2008)

- <http://www.fhwa.dot.gov/hep/climatechange/>

##### FHWA Transportation and Climate Change Newsletter (Ongoing)

- <http://www.fhwa.dot.gov/hep/climatechange/newsletter>

#### RISK AND VULNERABILITY ASSESSMENTS

##### FHWA Climate Change Vulnerability and Risk Assessment Conceptual Model Pilots (Ongoing)

- <http://www.fhwa.dot.gov/hep/climate/pilots.htm>

##### Impacts of Climate Variability and Change on Transportation Systems and Infrastructure—Gulf Coast Study (Ongoing)

- [http://www.fhwa.dot.gov/hep/climate/gcs\\_overview.htm](http://www.fhwa.dot.gov/hep/climate/gcs_overview.htm)

##### *Literature Review: Climate Change Vulnerability Assessment, Risk Assessment, and Adaptation Approaches* - FHWA (July 2009)

- <http://www.fhwa.dot.gov/hep/climate/ccvaraaa.htm>

##### Coastal Resilience (The Nature Conservancy)

- <http://coastalresilience.org/>

## ASSESSING CLIMATE CHANGE EFFECTS AND IMPACTS

### ***Regional Climate Change Effects: Useful Information for Transportation Agencies - FHWA (May 2010)***

- [http://www.fhwa.dot.gov/hep/climate/climate\\_effects/effects00.cfm](http://www.fhwa.dot.gov/hep/climate/climate_effects/effects00.cfm)
- Also available in PDF:
  - Report and Appendix A: Detailed Methodology  
[http://www.fhwa.dot.gov/hep/climate/climate\\_effects/climate\\_effects.pdf](http://www.fhwa.dot.gov/hep/climate/climate_effects/climate_effects.pdf)
  - Appendix B: Regional Maps  
[http://www.fhwa.dot.gov/hep/climate/climate\\_effects/climate\\_effects\\_appb.pdf](http://www.fhwa.dot.gov/hep/climate/climate_effects/climate_effects_appb.pdf)
  - Appendix C: Climate Change Effects Typology Matrix  
[http://www.fhwa.dot.gov/hep/climate/climate\\_effects/climate\\_effects\\_appc.pdf](http://www.fhwa.dot.gov/hep/climate/climate_effects/climate_effects_appc.pdf)

### ***The Potential Impacts of Climate Change on U.S. Transportation – Transportation Research Board (TRB) Special Report 290 (2008)***

- [http://www.trb.org/Main/Blurbs/The\\_Potential\\_Impacts\\_of\\_Climate\\_Change\\_on\\_US\\_Transportation\\_156825.aspx](http://www.trb.org/Main/Blurbs/The_Potential_Impacts_of_Climate_Change_on_US_Transportation_156825.aspx)

### ***Bulletin of the World Meteorological Organization, Weather and climate change implications for surface transportation in the USA - Marjorie McGuirk, Scott Shuford, et. al. (April 2009)***

## GENERAL CLIMATE CHANGE RESOURCES

### **US Environmental Protection Agency (EPA)—climate change website**

- <http://www.epa.gov/climatechange/>

### **Intergovernmental Panel on Climate Change (IPCC)—Fourth Assessment Report**

- [http://www.ipcc.ch/publications\\_and\\_data/publications\\_and\\_data\\_reports.shtml](http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml)

## GENERIC CLIMATE CHANGE AND TRANSPORTATION RESOURCES

### **US Department of Transportation—Transportation and Climate Change Clearinghouse**

- <http://climate.dot.gov/>

### **FHWA—Highways and Climate Change**

- <http://www.fhwa.dot.gov/hep/climate>

### **FHWA Transportation and Climate Change Newsletter (Ongoing)**

- <http://www.fhwa.dot.gov/hep/climatechange/newsletter>

### **National Academy of Sciences**

- <http://nas-sites.org/americasclimatechoices/>

## REGION-SPECIFIC ACTIVITIES AND REPORTS

### MIDWEST

#### Midwestern Regional Climate Center

- <http://mcc.sws.uiuc.edu/>

#### Purdue Climate Change Research Center

- <http://www.purdue.edu/discoverypark/climate/>

#### The Polis Center at Indiana University Purdue University-Indianapolis

- <http://www.polis.iupui.edu/>

#### State Hazard Mitigation Plans

- Ohio— <http://ema.ohio.gov/mitigationplan2011.aspx>
- Indiana— <http://www.in.gov/dhs/3181.htm>
- Illinois— [http://www.state.il.us/iema/planning/documents/Plan\\_III\\_MitigationPlan.pdf](http://www.state.il.us/iema/planning/documents/Plan_III_MitigationPlan.pdf)
- Michigan— Plan completed very recently, and not yet available online. Likely to be posted on the following website: [http://www.michigan.gov/msp/0,1607,7-123-1593\\_3507---,00.html](http://www.michigan.gov/msp/0,1607,7-123-1593_3507---,00.html)
- Kentucky— <http://www.kyem.ky.gov/assistance/hazardmitigation> (plan not yet available online)

#### FEMA Resources

- FEMA Multi-Hazard Mitigation Planning <http://www.fema.gov/plan/mitplanning/>
- Hazus-MH, <http://www.fema.gov/plan/prevent/hazus/>
- Risk MAP [https://www.fema.gov/plan/prevent/fhm/rm\\_main.shtm](https://www.fema.gov/plan/prevent/fhm/rm_main.shtm)

#### State Climatologist <http://www.stateclimate.org/>

#### Silver Jackets <http://www.nfrmp.us/state/>

#### FHWA's Sustainable Highways Self-Evaluation Tool <http://www.sustainablehighways.org/>

### CALIFORNIA, OREGON, AND WASHINGTON STATE

#### CALIFORNIA

#### California Climate Adaptation Strategy (<http://www.climatechange.ca.gov/adaptation/>)

- Infrastructure Working Group - Adaptation Strategies <http://www.climatechange.ca.gov/adaptation/infrastructure/>
- *Vulnerability of Transportation Systems to Sea Level Rise* – Submitted by Business, Transportation and Housing Agency; Prepared by Caltrans (February 2009) [http://www.climatechange.ca.gov/adaptation/documents/2009\\_Preliminary\\_Trans\\_Assessment.pdf](http://www.climatechange.ca.gov/adaptation/documents/2009_Preliminary_Trans_Assessment.pdf)

## California Department of Transportation Guidance on Incorporating Sea-Level Rise (2011)

- [http://www.dot.ca.gov/hq/tpp/offices/orip/Updated\\_Climate\\_Change/Documents/Sea\\_Level\\_Guidance\\_May2011.pdf](http://www.dot.ca.gov/hq/tpp/offices/orip/Updated_Climate_Change/Documents/Sea_Level_Guidance_May2011.pdf)

## Caltrans Climate Change Branch – Projects and Studies

- [http://www.dot.ca.gov/hq/tpp/offices/orip/climate\\_change\\_projects\\_and\\_studies.html](http://www.dot.ca.gov/hq/tpp/offices/orip/climate_change_projects_and_studies.html)

## Cal-Adapt – Exploring California’s Climate Change Research

- <http://cal-adapt.org/>

## *The Impacts of Sea-Level Rise on the California Coast* – California Climate Change Center (May 2009)

- [http://www2.dot.ca.gov/hq/tpp/offices/orip/Updated\\_Climate\\_Change/Documents/sea\\_level\\_report.pdf](http://www2.dot.ca.gov/hq/tpp/offices/orip/Updated_Climate_Change/Documents/sea_level_report.pdf)

## OREGON

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### *The Oregon Climate Change Adaptation Framework* (December 2010)

- <http://www.oregon.gov/ODOT/TD/CLIMATECHANGE/docs/Oregon.Statewide.Adaptation.Final.pdf>

### ODOT’s Climate Change Adaptation Website

- <http://www.oregon.gov/ODOT/TD/CLIMATECHANGE/adaptation.shtml>

### ODOT’s Sustainability Program

- <http://www.oregon.gov/ODOT/SUS/index.shtml>

## WASHINGTON

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### WSDOT Sustainable Transportation Website and Resources

- <http://www.wsdot.wa.gov/sustainabletransportation/>

### Washington State’s Integrated Climate Change Response Strategy (November 2010) -

[http://www.ecy.wa.gov/climatechange/ipa\\_responsestrategy.htm](http://www.ecy.wa.gov/climatechange/ipa_responsestrategy.htm)

- Topic Advisory Group 1 Archive: Built Environment, Infrastructure and Communities  
[http://www.ecy.wa.gov/climatechange/tag\\_infrastructure.htm](http://www.ecy.wa.gov/climatechange/tag_infrastructure.htm)

### State of Washington, Department of Ecology Clearinghouse: Impacts, Preparation, Adaptation Resources

- [http://www.ecy.wa.gov/climatechange/ipa\\_resources.htm](http://www.ecy.wa.gov/climatechange/ipa_resources.htm)

## NEW ENGLAND

### REGION-WIDE

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StormSmart Coasts <http://stormsmartcoasts.org/>

StormSmart StormReporter <http://stormreporter.stormsmart.org/>

Northeast Climate Impacts Assessment <http://www.northeastclimateimpacts.org/>

- Northeast Climate Data (short process to create account)  
<http://www.northeastclimatedata.org/>
- *Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions*  
<http://www.northeastclimateimpacts.org/pdf/confronting-climate-change-in-the-u-s-northeast.pdf>

**Carbon Solutions New England** <http://carbonsolutionsne.org/>

**CONNECTICUT**

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**Connecticut's 2010 Natural Hazard Mitigation Plan Update**

- [http://www.ct.gov/dep/lib/dep/water\\_inland/hazard\\_mitigation/2010\\_nhmp.pdf](http://www.ct.gov/dep/lib/dep/water_inland/hazard_mitigation/2010_nhmp.pdf)

**The Green Plan: Guiding Land Acquisition and Protection in Connecticut (2007-2012)**

- [http://www.ct.gov/dep/lib/dep/open\\_space/green\\_plan.pdf](http://www.ct.gov/dep/lib/dep/open_space/green_plan.pdf)

**Sentinel Monitoring for Climate Change in the Long Island Sound Ecosystem**

- <http://longislandsoundstudy.net/research-monitoring/sentinel-monitoring/>

**MAINE**

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**Planning for Climate Change – Maine State Planning Office**

- <http://www.maine.gov/spo/landuse/techassist/climatechange.htm>

**University of Maine, Climate Change Institute**

- Maine's Climate Future Report (2009)  
[http://climatechange.umaine.edu/files/Maines\\_Climate\\_Future.pdf](http://climatechange.umaine.edu/files/Maines_Climate_Future.pdf)
- Maine's Climate Change Stakeholder Adaptation Process
- Maine Climate News (Ongoing) <http://umaine.edu/maineclimatenews/>

**Coastal Hazard Resiliency Tools Project, Southern Maine Regional Planning Commission**

- <http://www.smrpc.org/CoastalHazardResiliencyToolsProject/Coastal.htm>

**MASSACHUSETTS**

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**Interagency Transportation, Land Use, and Climate Change Cape Cod Pilot Project**

<http://www.volpe.dot.gov/coi/ppoa/publiclands/projects/interagencyproject.html>

- *A Framework for Considering Climate Change in Transportation and Land Use Scenario Planning: Final Report* (March 2012)  
[http://www.fhwa.dot.gov/environment/climate\\_change/adaptation/resources\\_and\\_publications/cape\\_cod/index.cfm](http://www.fhwa.dot.gov/environment/climate_change/adaptation/resources_and_publications/cape_cod/index.cfm)
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## NEW HAMPSHIRE

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### University of Rhode Island Climate Change Collaborative <http://seagrant.gso.uri.edu/climate/>

- *Climate Change and Rhode Island's Coasts* (2012)  
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### Rhode Island Flood Awareness and Climate Change Task Force

- <http://www.riema.ri.gov/prevention/floods/FACCT.php>

## VERMONT

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- <http://www.anr.state.vt.us/anr/climatechange/Adaptation.html>

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