



ROADMAP TO SUPPORT LOCAL CLIMATE RESILIENCE: LESSONS FROM THE RISING TIDES SUMMIT

C. FORBES TOMPKINS AND NATHAN COGSWELL

EXECUTIVE SUMMARY

Costly extreme weather events in the United States are occurring more frequently and becoming more severe. The National Oceanic and Atmospheric Administration (NOAA) found that coastal flooding has increased significantly—between 300 and 925 percent—on the coasts of the contiguous U.S. since the 1960s. These increasing impacts do not care about a person’s political affiliation and are disrupting the everyday lives of Americans across the country by damaging homes, destroying infrastructure, and interrupting economic activity. As climate change continues to amplify the scale and magnitude of these impacts, the need to increase support for local resilience is becoming an urgent priority.

Action on resilience has been increasing at all levels of government. At the federal level, President Obama established the State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience (Task Force) in November 2013. The Task Force recommended, in November 2014, that the federal government support local climate resilience efforts around the country. The administration has taken important steps to follow through on those recommendations, including the recent release of a Presidential Memorandum on climate change and national security. In addition, in October 2016, the White House released a report summarizing climate resilience initiatives taken by this administration that outlines additional climate resilience strategies federal agencies and communities can take. At the Congressional level, recent proposals to address climate resilience through the National Mitigation Investment Act and the

CONTENTS

Executive Summary.....	1
Introduction.....	5
The Rising Tides Summit.....	7
The Current Policy Landscape of Resilience Initiatives.....	10
Regional Resilience Case Studies	13
Fundamental Climate Resilience Issues	16
Eight Climate Resilience Policy Opportunities for the New Administration and Congress.....	17
Conclusion.....	25
Appendices	26
References.....	33
Endnotes	36

Working Papers contain preliminary research, analysis, findings, and recommendations. They are circulated to stimulate timely discussion and critical feedback and to influence ongoing debate on emerging issues. Most working papers are eventually published in another form and their content may be revised.

Suggested Citation: Tompkins, C. F. and N. Cogswell. 2016. “Roadmap to Support Local Climate Resilience: Lessons from the Rising Tides Summit.” Working Paper. Washington, DC: World Resources Institute. Available online at <http://www.wri.org/publication/lessons-from-risings-tides-summit>.

Repeatedly Flooded Communities Preparation Act have gained bipartisan support. There may also be bipartisan common ground on moving quickly on infrastructure legislation. Updating the nation's infrastructure has been a priority for President-elect Trump, and Congressional Democratic leaders have indicated a willingness to work with him on an infrastructure and jobs bill in 2017. Incorporating resilience into infrastructure investments can help optimize return on investments and ensure taxpayer dollars are not squandered on investments that cannot withstand future impacts of climate change.

States play a necessary role in helping guide and support local resilience initiatives, in addition to serving as intermediaries between federal and local governments. However, only 14 states have implemented comprehensive plans to address impacts associated with climate change. At the local level, bipartisan recognition is growing among local elected officials regarding the urgent need for action to build resilience to climate-related impacts like sea level rise, increasing coastal flooding, and more extreme weather.

The Rising Tides Summit (Summit), held in October 2015, brought together a bipartisan group (17 Republicans, 16 Democrats, and 3 Independents) of local elected officials (Summit officials) from 18 of the 23 U.S. coastal states. At the Summit, local officials shared their experiences and discussed the role the federal government could play in supporting community efforts to become more resilient. Summit officials met with high-level federal officials from NOAA, Federal Emergency Management Agency (FEMA), and U.S. Army Corps of Engineers (USACE). Summit participants noted that, while recent developments in resilience are encouraging, communities across the country are nowhere near being sufficiently resilient. Many existing climate resilience efforts are fragmented and limited in scale and resources, and have not yet been in place long enough for their effectiveness to be comprehensively assessed.

Summit officials also noted the need for more information about available resilience-focused programs. In response, this paper provides an overview of key federal, public-private, and civil society efforts to build resilience in order to expand awareness of the scope and scale of resources available to communities. We also highlight examples of existing projects being pursued by some Summit officials and others around the country to address climate impacts and threats.

Summit officials called for additional support to build local resilience. We synthesize the discussions into a roadmap of eight overarching policy opportunities that could significantly help local governments and communities build climate resilience. Central to these opportunities is the need for sustainable funding mechanisms. However, effective use of any funds will also require clear climate resilience standards and increased transparency on how pre- and post-disaster funds are spent.

For each of the eight opportunities, we discuss the need for action and provide examples of recent federal progress, along with actions the federal government can take to further enhance local climate resilience. These actions are presented as illustrative examples of how local resilience around the country could be advanced and are based on a literature review of more prescriptive resilience policy recommendations.

Who Participated in the Rising Tides Summit?

Elected officials:

- 20 mayors
- 10 city/county council members
- 6 state senators/delegates

From 18 U.S. states:

- AL, CA, DE, FL, GA, ME, MD, MA, MS, NH, NC, NJ, NY, OR, RI, SC, TX, VA

Federal agencies:

- FEMA
- NOAA
- USACE

For a full list, see Appendix A.

Increase Incentives for Pre-Disaster Resilience

Localities are willing to implement resilience measures, but Summit officials identified the lack of incentives to proactively address disaster risk as one of their greatest challenges. Shifting the distribution of federal disaster support to provide additional pre-disaster resilience resources can incentivize communities to proactively address risk and save taxpayer dollars in avoided future damages. FEMA has begun the rule-making process for a new “disaster deductible” policy that would require states to pay a deductible before receiving federal disaster assistance; states could lower their deductible by implementing pre-disaster resilience initiatives. To continue progress, the federal government could:

- Provide additional pre-disaster assistance by increasing appropriations for FEMA’s Pre-Disaster Mitigation program.
- Advance the proposed disaster deductible from a concept into a comprehensive policy that encourages states to implement pre-disaster measures.

Advance Integration of Resilience into Planning, Design, Management, and Investment

Decisions regarding public infrastructure, land-use management, and public investments at the state and local levels can commit taxpayer dollars to projects with lifetimes that last decades. In the absence of accounting for future impacts associated with climate change, infrastructure investments and land-use commitments can have costly long-term ramifications (e.g., high maintenance costs, public health and safety risks, and stranded assets, among others). The federal government has recently proposed regulations requiring that measures be taken to reduce flood risk to all future federal investments within floodplains. To build on recent action, the federal government could:

- Ensure that long-term infrastructure investments and commitments incorporate future climate-related risks by requiring that all federally funded projects, across all agencies, incorporate the best available climate data and projections.

- Make federal disaster assistance dependent on the extent to which states have planned for and taken steps to reduce future risks associated with the changing climate.

Improve Interagency and Intergovernmental Coordination and Support

Summit officials noted that one major challenge to developing and implementing resilience strategies is the inadequate coordination between federal agencies, state, and local governments. Disaster assistance and guidance is often fragmented horizontally between federal agencies and vertically between levels of government, introducing the risk of conflict, redundancy, and extensive delays in providing assistance to impacted communities. Recent efforts like FEMA’s Mitigation Integration Task Force and associated pilot projects are bringing together partners and represent steps in the right direction. For additional sustained and all-inclusive efforts, the federal government could:

- Create a national Center for Resilience within the National Security Council to provide technical on-the-ground support for states and communities working to advance climate resilience initiatives, while reducing administrative red tape associated with federal assistance requests.
- Establish a task force to improve intergovernmental coordination on resilience and to advise the proposed Center for Resilience. The task force should be a permanent body modeled after the President’s State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience with revolving membership of local elected officials and tribal leaders.

Prioritize Pre-Disaster Support for Vulnerable Populations and Most At-Risk Communities

Small towns, low-income communities, Native communities, and vulnerable populations are often the most at risk and most impacted by climatic changes. Options to address risk in these communities can be uniquely limited and require advanced support and assistance because of a lack of financial resources, historic inequities, and systematic underinvestment in necessary infrastructure. The climate change subcommittee of the

Federal Interagency Working Group on Environmental Justice is assessing equity in their resilience work. In addition, the federal government could:

- Require that a portion of federal disaster assistance be allocated to address the resilience needs of the poorest and most at-risk communities. This could include funding pre-disaster training for local government officials, emergency responders, and community leaders in high-risk communities.
- Prioritize developing relocation guidance as a resource for communities considering relocation as an effective and necessary solution.

Expand Public-Private Partnerships (PPPs) to Supplement Government Resilience Efforts

Acting alone, federal, state, and local governments cannot address the extent of climate resilience challenges. These challenges can be partially addressed through more effective PPPs. While the number of PPPs assisting communities and states with building resilience has grown in recent years, most are limited in their duration, scale, and financial resources. One recent successful example is the National Disaster Resilience Competition, through which the federal government and private foundations recently awarded \$1 billion to states and communities to implement resilience initiatives. To help expand PPPs, the federal government could:

- Make initiatives like the recent National Disaster Resilience Competition a recurring federal budget item for agencies tasked with providing disaster assistance.
- Convene federal agencies and the private sector to develop financing mechanisms such as tax credits that provide incentives for resilience-based retrofits to the built environment.

Promote Nature-based and Multi-Benefit Resilience Initiatives

Reducing carbon pollution can increase the long-term benefits and effectiveness of resilience measures by limiting the magnitude of climate-related risks. Resilience measures incorporating natural and green infrastructure can help protect communities from climate impacts while providing co-benefits including carbon sequestration, and improved water and air quality, quality of life, and public health. The Department of Housing and Urban Development (HUD) released the Green Infrastructure and Sustainable Community Initiative report in 2015, which provides examples of existing green infrastructure projects. In the new administration, the federal government could:

- Encourage the implementation of green and nature-based solutions by increasing the federal cost-share for this type of resilience investment.
- Offer technical support to states and localities developing resilience strategies that include carbon reduction co-benefits such as reduced energy consumption, increased efficiency of transportation systems, and advancing the transition to cleaner energy systems.

Enhance Disaster Resilience-focused Metrics and Economic Impact Assessments

Vulnerability assessments of extreme weather and climate impacts have typically been limited to direct impacts to high-value assets (e.g., businesses, property, homes, and critical infrastructure). Better inventory and value assessment of non-economic assets (e.g., ecosystems and cultural heritage) and indirect disaster losses (e.g., the number of days a business is closed in the aftermath of an extreme weather event) can enhance the accuracy of cost-benefit assessments related to resilience strategies. Communities also need metrics to understand whether or not they have improved their resilience. In summer 2016, the FEMA-led Mitigation Framework Leadership Group released draft assessments of indicators and measures of community resilience. To build on this progress, the federal government could:

- Develop a tool that allows localities and states to better document costs, damages, and losses caused by climate-related events. The tool should be hosted by FEMA and provide guidance on accounting for impacts to non-economic assets and other indirect costs to allow for the full spectrum of losses to be documented.
- Convene federal agencies, state and local governments, and the private sector to develop comprehensive resilience metrics that help localities understand and monitor the state of their climate resilience.

Enrich Usefulness of Resilience-related Data to Increase Public Awareness

Atmospheric and oceanic observational data and online storage capacity are growing rapidly, allowing the general public to more easily access data relevant to climate-related risks and resilience. Data collection and presentation efforts should be coordinated between governments and local academic institutions to ensure that these efforts are appropriate to the needs of stakeholders. The recently announced Partnership for Resilience and Preparedness, a PPP launched out of the White House Climate Data Initiative, will help address this need by mobilizing and deploying data to support climate resilience. However, to do more, the federal government could:

- Update the U.S. Climate Resilience Toolkit to more effectively serve as an online clearinghouse for more granular disaster-related information that includes local climate and oceanic trends, extreme weather and coastal flooding damages, recovery and resilience spending, resilience case studies, and funding opportunities.
- Communicate location-specific data to allow the public and decision-makers to better understand local ramifications of increasing coastal flooding and extreme weather events, and provide policymakers with the necessary information to account for resilience in their decisions.

INTRODUCTION

Climate change contributes to increasingly costly extreme weather and climatic events being felt by communities across the United States.¹ According to the National Oceanic and Atmospheric Administration (NOAA), coastal flooding has increased between 300 and 925 percent in locations along all three coasts of the contiguous United States since the 1960s.² These events close roads, damage infrastructure, disrupt businesses, and impact the everyday routines of ordinary citizens regardless of their political affiliations. The magnitude of these increasing impacts is amplified by sea level rise and the fact that coastal counties account for nearly half of all U.S. gross domestic product and are home to more than 123 million Americans.³ The growing scale of these impacts illustrates the urgent need for local community resilience.

The federal government has recognized the increasing need for resilience and has taken action in recent years to better support local resilience initiatives. During his second term, President Obama established the State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience (Task Force). The Task Force convened state, local, and tribal elected officials from across the country to identify priority resilience issues and potential solutions. Ultimately, the Task Force presented a number of recommendations for supporting local climate resilience efforts and the administration has since taken important steps toward addressing them. For example, the Department of Housing and Urban Development (HUD) partnered with the Rockefeller Foundation on the National Disaster Resilience Competition that awarded funding to more than a dozen states and cities to implement resilience plans. The U.S. Army Corps of Engineers (USACE) led the development of a post-Hurricane Sandy comprehensive North Atlantic study that created a framework for local and state governments in the region to make informed coastal risk management decisions. A Presidential Memorandum on climate change and national security directs all federal agencies to fully consider the impacts of climate change in the development and implementation of all plans and policies pertaining to national security.⁴ In addition, the Federal Emergency Management Agency (FEMA) has proposed standards that would reduce flood risks on all buildings built within floodplains. The White House Council on Climate Preparedness and Resilience published a report, in October 2016, detailing these and other climate resilience actions taken by the current

“We will harness technology and make smarter decisions on how we build and utilize our infrastructure.”

—PRESIDENT-ELECT DONALD TRUMP

“We can work together to quickly pass a robust infrastructure jobs bill.”

—NANCY PELOSI, MINORITY LEADER,
US HOUSE OF REPRESENTATIVES

administration. The report also serves as a guide for sustaining and coordinating resilience efforts between federal agencies and stakeholders moving forward.⁵

Bipartisan efforts to address resilience have emerged in Congress. Representatives Curbelo (R-FL) and Sires (D-NJ) recently proposed the National Mitigation Investment Act that would provide incentives for new state building codes and authorize a comprehensive study of disaster costs and losses. Another bill with bipartisan support, the Repeatedly Flooded Communities Preparation Act proposed by Representatives Royce (R-CA) and Blumenauer (D-OR), would address issues related to repetitive loss properties under the National Flood Insurance Program.

Next year is also likely to see a bipartisan effort to renovate the country’s crumbling infrastructure. Both President-elect Trump and Congressional Democratic leaders have emphasized the need to address the nation’s dated infrastructure. As infrastructure legislation is developed, including consideration of climate resilience

will help guarantee taxpayer money is spent wisely through investments that can endure the impacts of climate change.

States also play a vital role in overseeing and assisting local policies and programs. They typically serve as a liaison between federal and local governments. For example, federal agencies like FEMA work directly with state agencies to provide pre- and post-disaster assistance that states then distribute to the local communities. While localities often benefit from the support provided by their state, only 14 states have implemented plans to address the impacts and threats of climate change.

At the frontline of acute climate-related impacts and threats are local communities, and a growing number of local governments are taking action by building climate resilience. More than at any other level of government, bipartisan agreement and cooperation is growing at the local level around the urgent need to address climate-related threats. The Rising Tides Summit (Summit) brought together a bipartisan group (17 Republicans, 16 Democrats, and three Independents) of mayors and other local elected officials (Summit officials) from 18 of the 23 coastal U.S. states to confront issues like increasing coastal flooding, sea level rise, and more extreme weather (see Appendix A for the full list of participants). Held in New Hampshire in October 2015, the Summit connected these mayors and other local elected officials with key high-level federal officials from FEMA, USACE, and NOAA (see Appendix B for the Summit agenda).

Several important takeaways emerged during the Summit:

- Summit officials stressed that, while encouraging progress has been made to increase local resilience to climate-related threats, additional support from the federal government is necessary to help local governments boost their resilience.
- Summit officials were greatly concerned not only about coastal-specific impacts, like coastal flooding and sea level rise, but also about extreme weather events that are damaging non-coastal communities.
- Summit officials displayed varying levels of awareness of the scope and scale of existing federal, public-private, and civil society programs designed to help build local resilience to climate-related threats.

- Summit officials identified key ways in which the federal government can help advance resilience at the local and state levels to benefit coastal and non-coastal communities alike.

As a follow-up to the Summit, this working paper is designed to capture and build on the Summit's fundamental takeaways. We summarize key discussions, present examples of recent and ongoing resilience actions, and identify ways the federal government can support local communities addressing climate resilience.

First, we summarize Summit presentations and discussions to provide context regarding the priority resilience issues with which this working paper is concerned (see Appendix C for more detailed descriptions of the discussions). Because the resilience issues and opportunities outlined by mayors and other local elected officials at the Summit pertain to both coastal and non-coastal communities, this working paper is relevant nationwide.

To highlight some actions already underway across the nation, we provide a synopsis of recent public, public-private, and civil society climate resilience-focused initiatives taking place around the nation, several of which were highlighted during the Summit. We then offer brief case studies of existing initiatives addressing climate-related impacts and threats being led by Summit officials and others in regions around the country. Importantly, our summary of resilience initiatives is meant to serve as a resource that can help inform communities and states interested in resilience but unfamiliar with the scope of existing opportunities and strategies.

Next, we present an overview of three foundational issues evident during the Summit that must be addressed in order to optimize the impact of the types of support discussed by Summit officials. We then identify eight principal federal policy opportunities that can help communities build resilience to impacts like sea level rise and increasingly extreme weather based on our review of the Summit discussions. For each of the eight opportunities, we outline the need to take action and provide recent examples of relevant federal initiatives that align with the recommendations and work of the Task Force. To help guide the Trump administration and Congress, we list examples of constructive roles the federal government can play to help local governments become more climate resilient.

Who Participated in the Rising Tides Summit?

Elected officials:

- 20 mayors
- 10 city/county council members
- 6 state senators/delegates

From 18 U.S. states:

- AL, CA, DE, FL, GA, ME, MD, MA, MS, NH, NC, NJ, NY, OR, RI, SC, TX, VA

Federal agencies:

- FEMA
- NOAA
- USACE

For a full list, see Appendix A.

Taking these sections together, this working paper aims to help translate the discussions at the Summit into a policy roadmap by outlining pathways that can increase resilience in communities around the country. For local elected officials, the discussions and summaries of existing support programs and case studies can serve as resources for future initiatives. By acting on the high-level priority opportunities identified through the Summit, the federal government can supplement local leadership building a more sustainable future for the country through increasing local resilience to climate-related stressors like sea level rise, increasing coastal flooding, and more extreme weather. In order to capitalize on the full potential of these opportunities, additional research and action by all levels of government, the private sector, and academia will be necessary to address the three foundational issues outlined in this paper.

THE RISING TIDES SUMMIT

At the Summit, a bipartisan group of nearly 40 mayors and other local elected officials detailed the growing challenge of effectively dealing with coastal flooding, sea level rise, and extreme weather events. They discussed the need to move beyond partisan politics to change federal policies to help them build the resilience of their communities in the face of these growing threats. They also met with high-level representatives from key federal agencies for several roundtable discussions. Below, we

“The water that is coming in your neighbor’s door does not care whether you’re a Republican or Democrat.”

—CHRIS STOLLE, VA STATE DELEGATE, REPUBLICAN

summarize discussions that took place during the Summit. Additional details of the panels and sessions are provided in Appendix C.

The variety of communities and states represented at the two-day Summit created an environment conducive to peer-to-peer engagement and lesson-sharing related to community experiences in dealing with the impacts of coastal flooding, sea level rise, and extreme weather events. In addition to networking with other local elected officials grappling with similar climate-related resilience challenges, Summit officials benefited from keynote presentations by, and roundtables with officials from NOAA, FEMA, USACE, and a recently retired Navy Rear Admiral (RADM). Specifically, the federal officials outlined the role their agency plays in climate resilience, planning, and disaster relief.

Federal Voices

NOAA Administrator Dr. Kathryn Sullivan noted that NOAA is striving to advance local resilience efforts by providing more real-time data and information that can help inform communities when planning for climate-related threats. Roy Wright, FEMA’s Deputy Associate Administrator for Insurance and Mitigation, underscored how his agency is scaling up efforts to help communities integrate resilience into decision-making through community outreach and federal disaster assistance policy changes. Lawrence Cocchieri, USACE’s Deputy Director of National Planning at the Center for Coastal Storm Risk, presented on USACE’s latest comprehensive initiative—the North Atlantic Coast Comprehensive Study (NACCS)—which has developed a detailed template for how all levels of government can better assess and address climate-related risk in the North Atlantic.

NOAA Oceanographer Dr. William Sweet explained the science and implications of sea level rise and coastal flooding during his presentation on increased nuisance flooding and the risk it poses to the future resilience of vulnerable coastal communities. Recently retired RADM Jonathan White, an oceanographer and former head of the Navy’s climate change task force, outlined the science of climate change. He also detailed the Navy’s concerns and efforts to address the issue, and the need for parallel investments in building resilience and reducing greenhouse gas emissions. Summit officials indicated that presentations on climate science from credible messengers like RADM White and Dr. Sweet were effective in helping them to better understand the implications of climate change and the need for action.

Local Voices

Each presentation by federal officials was followed by roundtable discussions with Summit officials. These roundtable discussions covered a range of challenges, successes, and needs in addressing climate-related issues as identified by the local elected officials. During these discussions, numerous themes were touched on and often repeated, which shaped our list of federal opportunities.

For instance, local and federal officials echoed the importance of including resilience in pre-disaster planning during every roundtable discussion. While Summit officials expressed a broad willingness to invest in pre-disaster resilience, they stressed that **federal disaster assistance needs to better encourage proactively addressing climate-related risks**. Several of the mayors and other local elected officials suggested that, based on current FEMA policies, implementing proactive disaster resilience measures could reduce the community’s likelihood of receiving federal disaster assistance. That is, if losses from an extreme weather event do not reach FEMA’s damage threshold, the community might not qualify for federal assistance. Thus, some communities are wary of taking resilience measures to lessen future losses if that means they might no longer be eligible for federal assistance. Instead, the Summit officials noted that federal policy should actively support pre-disaster action and should ensure that communities remain eligible and considered for post-disaster aid when needed. In addition to the need for additional pre-disaster incentives, Summit and federal officials underscored the importance of shifting from a focus on “building back” to encouraging “building ahead” with future climate-related

risks in mind. Studies such as the USACE-led NACCS—commissioned in response to Hurricane Sandy—were discussed as potential resources to help address gaps in pre- and post-disaster planning but Summit officials suggested that much **more needs to be done to effectively help the most at-risk communities to plan ahead.**

Another key issue highlighted by Summit officials is the **lack of easily understandable and useful data** on climate-related risks and economics. Elected officials indicated that a central clearinghouse of information that includes disaster costs, disaster recovery and resilience spending, and resilience grant opportunities would be a useful resource to help advance local efforts. Some Summit officials noted that NOAA datasets did not clearly present data in formats they found useful. As such, local elected officials expressed frustration that this lack of easily digestible and shareable data restricts their ability to effectively communicate the magnitude of risk from climate-related threats to their constituents. Local officials reiterated the **difficulty of educating their constituents about the need for resilience** without more usable data and better communication tools and resources.

Regarding the **economics of resilience planning and implementation**, officials noted that some significant losses from extreme weather and climate-related events (e.g., lost business days, supply chain disruptions, reduced tourism) are rarely documented. Similarly, the economic value of co-benefits from natural and green infrastructure measures (e.g., sequestering carbon pollution, filtering air and water, preserving the cultural identity of communities) are not well represented in cost-benefit assessments. Further, Summit officials argued for better utilization of offshore and riverine dredged materials. Currently, USACE's least-cost calculations of dredge material removal do not consider the potential benefits that dredged sand can offer nearby communities undergoing dune and beach renourishment projects. Summit officials also noted that other dredged materials such as silts and non-beach quality sands could also be used in resilience projects and measures. With improved documentation of climate-related losses and more comprehensive accounting of potential benefits, officials suggested that cost-benefit assessments of resilience measures could become more accurate and useful for decision-makers.

“We need to work together; local communities, regional communities, and at a state and federal level to help all of our communities move forward and be prepared for the next event.”

—DONNA HOLADAY, MAYOR, NEWBURYPORT, MA,
DEMOCRAT

Another constant theme throughout the federal presentations and roundtable discussions was the **need for improved coordination within the federal government and between all levels of government** related to resilience programs and policies. Summit officials expressed frustration with the disjointed nature of resilience planning within government, which tends to reduce the effectiveness of resilience measures, delay project approval and acquisition of assistance, and create unnecessary administrative red tape. Each federal official acknowledged the lack of coordination as a pressing issue but noted the coordination between federal agencies in the aftermath of Hurricane Sandy as an encouraging example upon which the federal government is working to build.⁶

While the main focus of the roundtable discussions revolved around resilience issues directly related to the federal government, many noted that the federal government alone cannot comprehensively address these issues. Both local elected officials and federal agency officials noted the need for private sector engagement and the **need to enhance the role of public-private partnerships (PPPs)**. Local elected officials cited recent PPPs like Rebuild by Design, the National Disaster Resilience Competition, and Rockefeller's 100 Resilient Cities Challenge as providing essential financial and technical support to vulnerable communities looking to build resilience.

Summit and federal officials also discussed the viability of **natural and green infrastructure as a resilience strategy**. For example, densely populated cities like Hoboken, New Jersey found green infrastructure to be more visually appealing to their constituents than gray infrastructure. Nature-based solutions also provide valuable non-resilience co-benefits, such as improving the quality of life within the community and increasing the appeal of the community to businesses and potential homeowners.

THE CURRENT POLICY LANDSCAPE OF RESILIENCE INITIATIVES

The massive damages caused by Hurricane Katrina and Hurricane Sandy provide stark reminders of the extent to which communities and states are underprepared for today's climate. Following these events, communities may now be more aware of the need for developing resilience but may not be aware of recent initiatives, led by the public and private sectors, which offer support for local resilience work. In an effort to address the concerns voiced by Summit officials that they might be missing out on potential resources due to a limited capacity to seek them out, we offer the following overview of programs and policies designed to encourage and support local and state resilience.

We focus on programs that have an explicit connection to resilience and hazard mitigation. However, a variety of other federal programs that are not explicitly meant to increase resilience could be used to advance resilience initiatives. For example, the Department of Transportation's (DOT) TIGER (Transportation Investment Generating Economic Recovery) grant program is designed to provide assistance with building and repairing freight and passenger transportation networks.⁷ Though not explicitly designed to help communities build resilience, some grantees build resilience into their use of TIGER funds. In one instance, TIGER funds were used to elevate a highway along the Tamiami Trail in Florida, thereby restoring natural water flows and reducing flood risks.⁸ Another example is HUD's Choice Neighborhoods grant program that focuses on transforming struggling neighborhoods through a comprehensive approach centered on three areas: housing, people, and neighborhood.⁹ Through this program, new housing units in Norwalk, Connecticut are being built more than six feet above the floodplain and a community park is being upgraded with storm-resilient infrastructure.¹⁰

The following list provides a sense of the range of resources available, but does not capture the full scope and scale of recent and existing federal, public-private, and civil society programs. The federal programs are generally grant programs whereas the public-private and civil society programs have tended to be competition-based. While some of these programs are not actively providing funding, we include them to illustrate models that could be considered by future programs. We provide this list as a resource only; we do not assess the effectiveness, equity, or efficiency of these programs.

Federal Programs

Army Corps of Engineers Silver Jackets Program

The Silver Jackets program develops teams in each state that involve multiple federal, state, local, and tribal agencies who work together to reduce flood and other natural disaster risks and enhance disaster recovery. Silver Jacket teams generally consist of members from FEMA, USACE, the U.S. Geological Survey, the National Weather Service, and various state agencies. The goal of each Silver Jackets team is to create a state-led interagency team in every state that pulls from multiple programs and perspectives to provide cohesive solutions.¹¹ While teams are unique in each state, they attempt to increase collaboration and information-sharing in order to tap into unique knowledge and expertise across agencies.

Community Development Block Grant Program (CDBG)

The CDBG Program is focused on economic development, housing rehabilitation, and neighborhood rehabilitation. In general, CDBG funds must primarily benefit low- and moderate-income persons. In disaster response, CDBG funds are not allowed to substitute for FEMA or Small Business Association funding when they are available. Rather, CDBG can supplement other federal funding and can fund hazard mitigation activities.¹² The CDBG is determined on a formula basis and is not available after every Stafford Act major disaster declaration.

Community Rating System (CRS)

The CRS incentivizes communities to implement floodplain management activities. By implementing these measures, National Flood Insurance Program (NFIP) policyholders in the community receive discounted NFIP premiums. The discounts range from 5 to 45 percent.

These incentives support the three goals of the CRS program: reduce flood damage, support insurance aspects of NFIP, and deliver a comprehensive approach to floodplain management.^{13, 14}

Flood Mitigation Assistance (FMA)

A companion to the NFIP, the FMA grant program seeks to eliminate and reduce NFIP claims by supporting state and local efforts to mitigate the risk of flooding at NFIP-covered properties. The program is funded through annual Congressional appropriations. The federal cost share is set at 75 percent; however, this may increase up to 100 percent for severe repetitive loss properties.^{15, 16}

Hazard Mitigation Grant Program (HMGP)

The HMGP provides post-disaster funds to help states implement hazard mitigation measures and is triggered by a Stafford Act major disaster declaration. HMGP funding is based on the amount of Stafford Act assistance awarded. In contrast, where Stafford Act Public Assistance (PA) or Individual Assistance (IA) is made available only to portions of the state affected by a disaster, HMGP is generally made available to the entire state. States must provide 25 percent of applicable costs.^{17, 18}

Partnership for Sustainable Communities

The Partnership for Sustainable Communities (PSC) is a partnership of the Environmental Protection Agency (EPA), DOT, and HUD. PSC works by helping to coordinate the actions of these federal agencies, working on a variety of issues including climate change adaptation, resilience, and hazard risk mitigation. For example, PSC is helping states incorporate climate change into their FEMA hazard mitigation plans, supporting the National Disaster Resilience Competition, and joining other agencies and organizations in developing and promoting the Green Infrastructure Collaborative.¹⁹

Pre-Disaster Mitigation Program (PDM)

The PDM program provides assistance, both financial and technical, for pre-disaster hazard mitigation measures. As with the HMGP, the state cost share is 25 percent. To ensure equitable access to funds, PDM has set a minimum level of funds for each state.^{20, 21}

NOAA Regional Coastal Resilience Grants

The Regional Coastal Resilience grants aim to improve the preparation, response, and recovery of regional coastal communities. The grant awards priority to comprehensive science-based solutions and collaborative partnerships.

State Hazard Mitigation Planning

In order to encourage states to plan and implement hazard mitigation activities to minimize the impact of disaster events, every three years states are required to submit, and have FEMA approve, State Hazard Mitigation plans. States can complete a more comprehensive planning process for an Enhanced State Hazard Mitigation plan and be eligible for additional federal funding. Furthermore, states without an approved hazard mitigation plan are not eligible for non-emergency PA, HMGP, PDM, FMA, and Fire Management Assistance Grants. States must now incorporate future risk, including but not limited to those risks from climate change, in their hazard mitigation plans.²²

Public-Private

B|More Resilient

A collaboration between the American Institute of Architects Baltimore and Baltimore City led to a design competition to help transform the city's vacant housing stock into more resilient buildings. The competition has been completed and the designs of the four winners addressed the issues of creating resilience to urban heat island effects and stormwater management.²³

Boston Living with Water

Because of the threats posed by rising seas, the City of Boston, together with a variety of public and private partners, hosted a design competition focusing on building resilient communities. The plans focused on three different sites and types of challenge: buildings, neighborhoods, and infrastructure. Competitors submitted their plans addressing the challenges at one, two, or three sites. One observer noted that all submissions "treated the rising sea level as a positive design force in Boston's built environment."²⁴

National Disaster Resilience Competition (NDRC)

This program was a collaboration between HUD and the Rockefeller Foundation. The competition consisted of two phases: to understand disaster recovery needs and vulnerabilities and to develop approaches and plans to address the needs identified in the first phase. The competition attempts to reduce losses from future disasters by ensuring that plans take account of the lessons of past disasters.²⁵

Resilience AmeriCorps

With support from the Rockefeller Foundation and Cities of Service, the Corporation for National Community Service and other federal partners created the Resilience AmeriCorps initiative. As a pilot program, AmeriCorps VISTA members were placed in 10 cities across the country for two-year periods. The members will work in these communities to build community resilience to extreme weather events and other stressors.²⁶ With additional support from Lutheran Services in America and Catholic Charities USA, the program expanded to 28 cities. Resilience AmeriCorps members have also been assigned to the finalists of the NDRC.

Rebuild by Design

Following Hurricane Sandy in October 2012, Rebuild by Design was developed as a design competition to encourage innovative and creative proposals to build local resilience. After completing the design competition, seven proposals have been selected and are currently being implemented in the Northeast. The Rebuild by Design program became the model for the NDRC created in June 2014. The program was built and largely supported by the Rockefeller Foundation.²⁷

RE.invest

The RE.invest initiative joins eight cities with private firms across the engineering, law, and finance sectors to ensure resilient infrastructure systems. RE.invest works to achieve four main goals: easing the burden on government, mobilizing resources to protect communities, increasing the resilience of vulnerable cities, and improving integrated planning capacity at the local level.²⁸

Private Sector / Philanthropic

100 Resilient Cities Challenge

Sponsored and organized by the Rockefeller Foundation, 100 Resilient Cities Challenge attempts to build social, economic, and physical resilience in 100 cities across the globe. The 100 cities selected for participation received funding from Rockefeller to hire a “Chief Resilience Officer,” technical support in developing a comprehensive resilience strategy, and access to the 100 Resilient Cities network to share lessons learned and practices with other member cities. Twenty-three of the 100 cities are in the United States.²⁹

Global Impact Competition: Miami

Sponsored by the Knight Foundation and Singularity University, the 2015 Global Impact Competition in Miami addressed the short-term problem of sea level rise in South Florida. The open competition allowed innovators to submit their projects in hopes of winning the opportunity to participate in Singularity University’s Graduate Studies Program.³⁰

Kresge Foundation

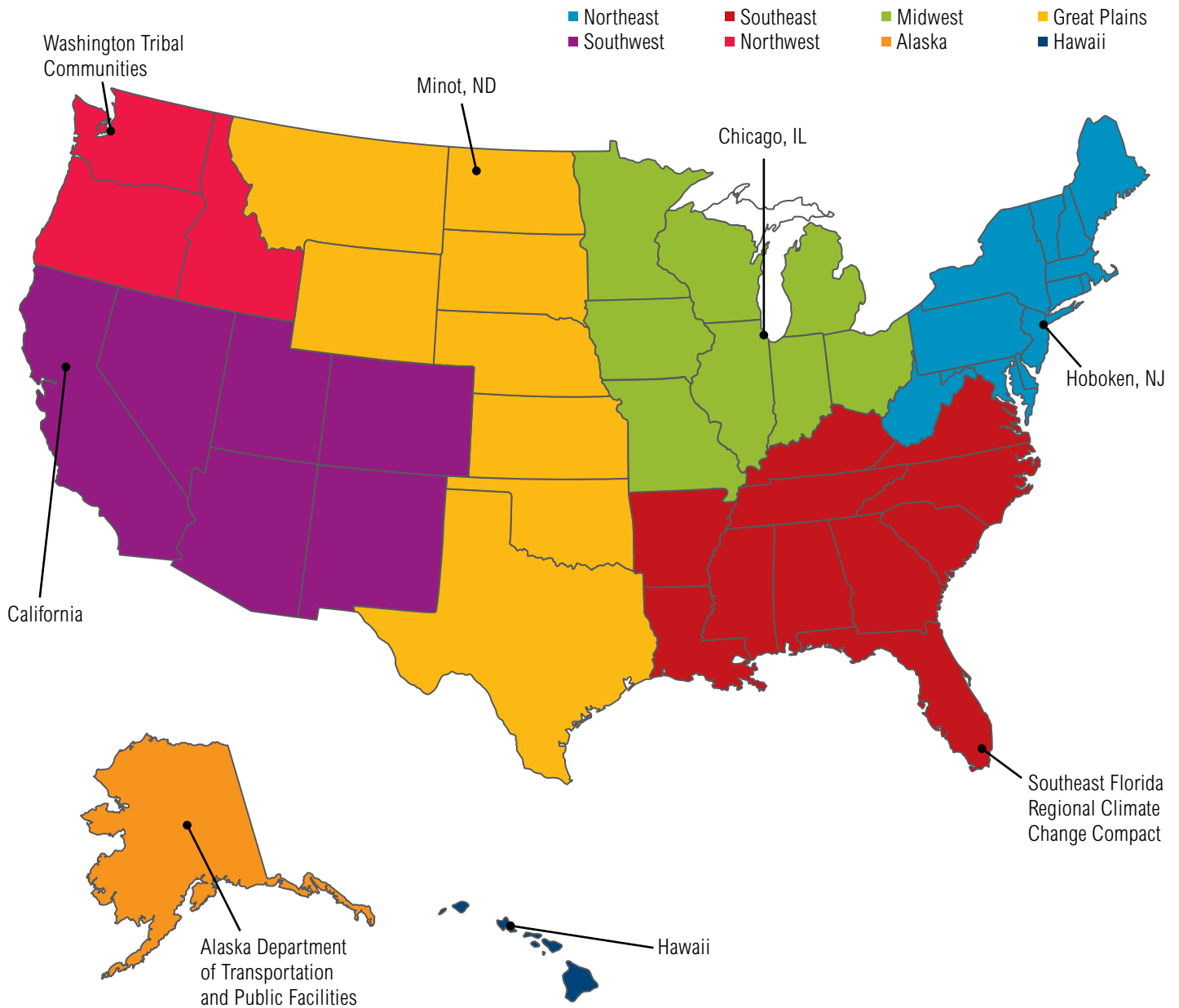
The Kresge Foundation operates two programs related to climate resilience: Climate Resilience and Urban Opportunity, and Climate Resilience in Coastal Cities and Regions. The Climate Resilience and Urban Opportunity program focuses on improving the resilience of low-income communities through targeted interventions.³¹ The Climate Resilience in Coastal Cities and Regions program concentrates on building comprehensive climate resilience in the face of sea level rise, storm surge, salt-water intrusion, and other coastal threats.³²

REGIONAL RESILIENCE CASE STUDIES

One of the key components of the Summit was peer-to-peer exchanges and the opportunity for elected officials to learn from the experiences of others. This component played out through various roundtable discussions, networking, and breakout sessions. From the interactions, it was evident that local governments are often the leaders in action taken to address increasing climate impacts.

This working paper carries that peer-to-peer learning component of the Summit forward by highlighting resilience initiatives in eight regions across the country that have been identified by the National Climate Assessment. Some of the case study regions and their respective communities were featured at the Summit while others are drawn from other resources and WRI’s Climate Impacts Project. These case studies are meant to illustrate the spectrum of resilience actions underway around the country and provide a resource for communities and

Figure 1 | **Map of Selected Regional Cases**



states that have yet to develop their own resilience plans. Inclusion of a community's efforts in these case studies is not meant to suggest that the community has completed its resilience efforts or that additional effort is unnecessary, but rather to highlight a sample of local governments around the country that have already decided to take action.

NORTHEAST

Hoboken, NJ

Hoboken, New Jersey experienced major damage from Hurricane Sandy in the fall of 2012. More than 1,800 homes and businesses were flooded and FEMA paid out more than \$125 million in Individual and Public Assistance. In response, Hoboken developed a 12-Point Resiliency Plan which includes a disaster recovery plan, a resiliency task force, updating floodplain management ordinances, installing flood pumps, and a green infrastructure strategic plan. The green infrastructure strategic plan includes utilizing urban parks for stormwater retention, a "green streets" program, and a bioswale and bioretention demonstration project at City Hall.³³

Hoboken's flood risk management policies and programs earned it the designation of a Role Model City of the United Nations Office for Disaster Risk Reduction's "Making Cities Resilient" campaign. Hoboken joined 44 other global cities and became the second U.S. city (San Francisco was the first).³⁴

In addition, Hoboken joins two other northern New Jersey municipalities in sharing \$230 million awarded by the Rebuild by Design competition. The award for Hoboken's proposal, entitled "Resist, Delay, Store, Discharge," will allow the city to implement its comprehensive water management strategy.³⁵

SOUTHEAST

Southeast Florida Regional Climate Change Compact

The Southeast Florida Regional Climate Change Compact (also known as the Four County Compact and hereafter referred to as the Compact) is a first-of-its-kind bipartisan collaboration between Broward, Miami-Dade, Monroe, and Palm Beach Counties to coordinate and plan climate mitigation and adaptation action. The Compact has established a Southeast Florida Regional Climate Action Plan that includes 110 action items. The Compact's leadership on climate action was a key contributing factor in

the decision of the Florida State Legislature to recognize local designation of Adaptation Action Areas, that is, areas identified as vulnerable to sea level rise and related climate impacts.^{36, 37, 38}

Communities included within the Compact are actively taking initiatives to become more resilient in the face of rising sea levels and more frequent tidal flooding. For example, cities like Hollywood, Pompano Beach, and Fort Lauderdale have installed backflow prevention devices to prevent seawater from flowing into drainage systems. Broward County has developed advanced hydrologic models that integrate future climate conditions and sea level rise to guide the development of regional resiliency standards. Monroe County is currently developing engineering analysis to assess available options for solving tidal flooding issues after some areas in the county saw up to 16 inches of tidal flood water remain for several weeks in October 2015. Miami Beach has committed to spending \$400 million to replace old gravity pipes with pumps and elevate roads and seawalls. Miami Beach has also produced recommendations for private-sector developers to design projects to withstand higher flood levels. The total package of action, coordination, and cooperation within the region establishes the foundation for continued resilience-building regionally and presents useful lessons for communities considering similar action.³⁹

MIDWEST

Chicago, IL

Designated as one of Rockefeller's 100 Resilient Cities, Chicago is already working to improve and enhance its resilience.^{40, 41} Two examples of Chicago's actions are presented here.

The Chicago Trees Initiative combines the efforts of public and private partners such as the Chicago Botanic Garden, the Morton Arboretum, and the USDA Forest Service to expand the city's tree canopy. Trees will help with stormwater management by absorbing additional rainfall. The increased canopy will also mitigate the urban heat island effect.⁴²

The city's "Adding Green to Urban Design" plan encourages sustainable urban development. Though not directly or explicitly aimed at resilience, the plan demonstrates how green, sustainable projects contribute to resilience.⁴³ For example, the city's Green Alley program increases

resilience by reducing flooding and combined sewer overflows by controlling stormwater runoff into the city's sewer system. The Green Alley program also mitigates health impacts from extreme heat by using high-albedo pavement to reduce the urban heat-island effect.⁴⁴

GREAT PLAINS

Minot, ND

In northwestern North Dakota, Minot suffered a devastating flood in June 2011, which forced the evacuation of 12,000 people—about one-quarter of the city's population. Minot is home to the Minot Air Force Base as well as significant energy and agricultural activity. Minot recently won \$74.3 million from HUD's NDRC to help address issues like the severe flooding of 2011.⁴⁵ Minot was one of only 13 communities and states selected as winners out of 40 NDRC finalists.⁴⁶

Minot's application for NDRC was notable for its wide-ranging community involvement. After holding over 60 public meetings, Minot was able to learn how to make its communities more resilient to extreme storms and flooding and produce an informed project proposal. With the development of this project, Minot has shifted its flood risk-reduction efforts from a solely infrastructural approach to a strategy that incorporates a mix of green infrastructure and non-structural techniques. Minot is also planning to buy out vulnerable properties and move the City Hall outside of the flood plain. As an NDRC winner, Minot now has the resources to implement its resilience planning.⁴⁷

SOUTHWEST

California

Following bipartisan approval by the legislature, in September 2016, California Governor Jerry Brown signed into law Assembly Bill 2800, which addresses the need to include climate science in infrastructure projects.⁴⁸ The bill outlines three objectives:

1. State agencies must account for current and future impacts of climate change in infrastructure planning, developing, and investment.
2. The Natural Resources Agency must establish a Climate-Safe Infrastructure Working Group to examine how to integrate scientific climate data in infrastructure engineering.

3. The Working Group will present recommendations to the state legislature on how to best integrate scientific data and how to facilitate communication processes between scientists and engineers.⁴⁹

NORTHWEST

Resilience and Adaptation Planning from Washington Tribal Communities

In the State of Washington, climate change is threatening the culture and lifestyle of several Native American tribal communities. In response, two tribes have taken action to assess their climate vulnerabilities and plan to adapt. The Swinomish Tribe completed its "Climate Adaptation Action Plan" in October 2010 and the Jamestown S'Klallam Tribe developed its "Climate Vulnerability Assessment and Adaptation Plan" in August 2013.

The Swinomish Climate Adaptation Action Plan details the projected impacts in various areas including coastal resources, upland resources, community infrastructure, and physical health. For each potential impact, the plan outlines goals and action items. The report then devotes a chapter to potential adaptation options and tools, and provides guidance for evaluating which tools might be most appropriate in specific contexts.⁵⁰

The Jamestown S'Klallam Tribe plan highlights various areas of concern such as impacts to salmon, wildfires, transportation, water supply, wastewater, and the 7 Cedars Casino. For each item of concern, the plan discusses potential impacts and outlines resilience-building actions. Each resilience action is further assessed in terms of its cost, ease of implementation, community support, timing of action, and whether a partnership would be required.⁵¹

ALASKA

Alaska Department of Transportation and Public Facilities

Thawing permafrost is wreaking havoc across Alaska causing concrete pillars beneath houses to crumble and fissures to open up in lawns.⁵² These effects can be especially damaging to the state's transportation infrastructure and can threaten the stability of roadways.⁵³

Near Fairbanks, parts of Goldstream Road have become unstable as a result of permafrost thawing and heaving. In order to build a more stable roadway, the Alaska Department of Transportation and Public Facilities is tearing up parts of the road and inserting layers of insulation boards—similar to those used in walls—before repaving on top of the insulation. The insulation will reduce heat transfer from the roads, which accelerates thawing, and will protect the roads from thawing resulting from increased temperatures.⁵⁴

HAWAII

Hawaii

In 2014, the Hawaii State Legislature passed the Hawaii Climate Adaptation Initiative Act to “address the effects of climate change in order to protect the State’s economy, health, environment, and way of life.” The Act established a statewide Interagency Climate Adaptation Committee.⁵⁵

The Interagency Climate Adaptation Committee is currently developing a statewide Sea Level Rise Vulnerability and Adaptation Report to detail the extent of Hawaii’s vulnerability to erosion, flooding, and tsunamis. Hawaii is the nation’s only island state and the rate of sea level rise is expected to increase. Erosion is threatening 70 percent of Hawaii’s beaches and is already responsible for 13 miles of lost beach. The Sea Level Rise Vulnerability and Adaptation Report will inform the development of a Climate Adaptation Plan for the state.⁵⁶ The report is an important first step toward Hawaii’s resilience to these coastal threats.

FUNDAMENTAL CLIMATE RESILIENCE ISSUES

Summit officials discussed federal opportunities that could provide additional support for local resilience efforts. Three fundamental issues emerged, which will limit the potential of each resilience opportunity if left unaddressed.

Sustainable Climate Resilience Financing Mechanisms

Lack of sufficient funding resources is a key challenge facing localities looking to implement climate resilience strategies. Resilience competitions have become more common in recent years as a federal and private sector strategy to financially support proactive climate resilience initiatives. However, competition-based resources cannot

satisfy the nationwide need for additional funds to support climate resilience. More extensive and sustainable financing mechanisms need to be developed to unlock federal and private sector funding for communities. Given that low-income communities face disproportionate risks and impacts from climate change, financing mechanisms need to take special account of their needs.

Federal Disaster Assistance Transparency

Each year, the federal government provides billions of dollars to support local and state efforts to address disaster recovery and resilience. This magnitude of annual spending warrants extensive transparency to ensure that it is used effectively and efficiently, but transparency is sometimes less than optimal. Presidential Disaster Declarations (PDDs), which provide federal support when a state does not have the capacity to cope with a natural disaster, represent one such example. FEMA provides a recommendation to the president on whether to declare a disaster but FEMA’s recommendation is protected under executive privilege. The president retains broad authority to declare a disaster but does not have to provide any information as to how or why he came to his decision. Furthermore, granular data regarding how PDD Public Assistance (PA) is spent by states is not readily available to the public. Greater transparency of the PDD decision-making process and how federal disaster assistance funding is used by state and local governments would enable better assessment and monitoring of the effectiveness of these programs and grants. Greater transparency would also help ensure taxpayer dollars are spent prudently.

Climate Resilience Standards

More comprehensive standards are needed to determine which initiatives qualify as addressing climate resilience. For example, some Summit officials consider beach renourishment to be a resilience strategy that protects against increasing coastal flooding and sea level rise. Others view beach renourishment as a temporary and unsustainable investment that does not adequately establish resilience. Another issue is the need to identify standards of success for resilience-focused projects. Simply completing an initiative deemed a “climate resilience project” does not necessarily equate to project success. Developing these types of standards can help determine whether a project increases resilience and the project’s effectiveness.

EIGHT CLIMATE RESILIENCE POLICY OPPORTUNITIES FOR THE NEW ADMINISTRATION AND CONGRESS

The resilience-based policies and initiatives already underway around the country signal that all levels of government have begun to recognize the need for resilience and are taking action. However, in spite of recent progress, Summit officials made it abundantly clear the federal government has a key role to play in helping local governments increase their resilience to climate-related threats. Summit officials stressed that, if communities are to become more resilient, federal policies must provide more effective support, incentives, and guidance. This sentiment is echoed by the Task Force.⁵⁷ In the Task Force's report to the President, Mayor Karen Weitkunat of Fort Collins, Colorado states, "Community investments in resilience pay off in protecting human life, minimizing loss, and lowering recovery costs. Federal agencies should incentivize local policy implementation and investments in hazard-prone areas to protect life and property."⁵⁸

Here, we present eight principal opportunities for improving support for resilience. They are distilled from Summit discussions led by the bipartisan group of mayors and other local elected officials. These resilience actions can lead to better support for resilience initiatives at the local and state level. In describing each resilience opportunity, we provide examples of progress made through recent federal actions. We conducted a comprehensive literature review to help define the need for further action and to offer specific examples of federal action items that could advance local and state resilience with respect to each overarching opportunity. Many of these action items are drawn from more prescriptive policy recommendations made by the Georgetown Climate Center, National Academies of Sciences, the Task Force, and other groups or initiatives that have engaged with officials from all levels of government around climate resilience.^{59, 60, 61}

Increase Incentives for Pre-Disaster Resilience

Need for action:

Research suggests that every \$1 invested in pre-disaster resilience can save an average of \$4 in future damages.^{62, 63} In spite of findings supporting the cost-effectiveness of pre-disaster resilience measures, only 14 states have implemented comprehensive state adaptation

“Very much the policies are set up in a way where we’re reactive instead of proactive.”

—DAWN ZIMMER, MAYOR, HOBOKEN, NJ, DEMOCRAT

plans.⁶⁴ Further, most existing federal policies associated with providing disaster assistance tend to focus on post-disaster recovery rather than promoting pre-disaster resilience.⁶⁵

According to local elected officials at the Summit, one significant obstacle impeding comprehensive investment in pre-disaster resilience is the prohibitively high cost of most existing resilience measures. An exacerbating factor is that states and communities that choose to implement proactive disaster resilience measures to limit future damage could be at risk of receiving little or no post-disaster relief assistance if they do not meet damage thresholds for federal assistance.⁶⁶ This can create a disincentive to invest in pre-disaster resilience measures that would reduce damage from future extreme weather events. Additionally, the imbalance between federal assistance for disaster recovery and resilience means that states and localities interested in investing in resilience measures may have to delay taking action until after being impacted by a major disaster, prolonging the exposure of assets and populations to avoidable risk.⁶⁷

The tendency of states and communities to favor reactive post-disaster recovery over pre-disaster resilience could be addressed if the federal government were to establish additional policies that encourage proactive resilience initiatives.⁶⁸ The effectiveness of these proactive measures is enhanced when support is provided to address systematic risks facing the broader community rather than for individual, site-specific projects.⁶⁹

Recent federal progress:

- In January 2016, FEMA issued advanced notice of proposed rulemaking for a disaster deductible. The deductible would require states to meet certain financial commitments before being eligible for FEMA PA financing. States could receive credits toward the deductible by implementing approved measures that mitigate disaster risk. The deductible would increase investment and incentives for pre-disaster preparedness and resilience.⁷⁰
- The aforementioned Resilience AmeriCorps pilot program was announced in July 2015 and serves the purpose of assisting communities lacking the capacity to plan and implement necessary measures to address climate risks. The program provides additional capacity to support pre-disaster initiatives, and supports and encourages communities to take action to improve resilience.⁷¹
- In April 2015, DOT announced \$500 million in competitive grants to fund transportation projects geared toward assisting localities with building transportation that is resilient to threats like flooding and storm damage.⁷²

Federal action items:

- The new administration should reward exemplary pre-disaster action (e.g., Enhanced Hazard Mitigation Plans or the Community Rating System) with access to additional federal funding or by increasing the federal match of resilience-oriented investments.⁷³
- Congress should increase the funding available for FEMA's Pre-Disaster Mitigation program by appropriating additional funds or by increasing the federal cost-share in the program.
- Congress should pass legislation that establishes a price on carbon and a portion of the revenue should be devoted to funding needed resilience measures within states.⁷⁴

“We have to find a way to build forward to the risks we’re facing, the changing risks we’re facing, the tomorrow that we’re going to face.”

—DR. KATHRYN SULLIVAN, ADMINISTRATOR, NOAA

Advance Integration of Resilience into Planning, Design, Management, and Investment

Need for action:

The increasingly costly impacts of coastal flooding and extreme weather events repeatedly demonstrate that existing infrastructure, building codes, and land-use management practices are not sufficiently resilient to the current climate.⁷⁵ The design life of most critical infrastructure is typically measured in decades, so it is important that project planning and design take into account the best available climate data and projections to help ensure the viability of infrastructure throughout its expected lifetime.^{76, 77}

However, resilient project planning and design is hindered by the lack of resilience best practices and planning tools that incorporate climate data. This presents a challenge to state and local governments as they seek to address the growing risks posed by rising seas, coastal flooding, and extreme weather and incorporate resiliency in their development plans.

Recent federal progress:

- In August 2016, FEMA proposed regulations to increase the resilience of federally funded projects in and around floodplains. If finalized as proposed, all projects receiving federal funds from FEMA—buildings, roads, and even private homes using FEMA

disaster recovery funds—will be subject to these regulations. The regulations would require that projects build at one of three levels:

- two feet above the 100-year floodplain (“critical actions” must be built three feet above the 100-year floodplain);
- at the 500-year floodplain; or
- as determined using the best scientific data that incorporates climate science.

FEMA provides guidance to help funding recipients determine which option is likely the most appropriate, based on project type.⁷⁸

- In July 2015, the Office of Management and Budget (OMB) directed all agencies to consider climate change impacts in all proposals for construction of federal facilities and include these considerations in budget requests. These requirements have been included in OMB’s 2016 guidance as well.^{79, 80}
- In May 2015, the administration released a *Guide to Infrastructure Planning and Design* under the Build America Investment Initiative. The guide discusses the role of planning and design in infrastructure and notes that pre-development processes should include assessments of climate impacts and resilience.⁸¹

Federal action items:

- Congress should make the amount of federal disaster assistance available to states contingent on the degree to which state governments have incorporated climate data and projections into project planning and design. However, in some instances, FEMA has the authority to alter cost-share requirements for post-disaster spending. In the absence of additional Congressional action, FEMA could consider using its authority to increase the federal cost share and provide additional post-disaster funds.
- The new administration should require resilience be included in all stages of potential federally funded projects. Resilience should be considered in project development and in the application for funding. Agencies should explicitly note resilience goals as a decision criterion for funding applications.

- The president should establish a Center for Resilience. The Center should create resilience project planning guidance and make case studies and technical assistance more readily available so that states and local governments can better incorporate climate resilience in land-use management, and project planning, design, and construction.⁸²
- Federal agencies should support state and local resilience efforts by developing financing mechanisms that recognize the long-term benefits of incorporating resilience in land-use management and project planning.⁸³

Improve Interagency and Intergovernmental Coordination and Support

Need for action:

Federal, state, and local government agencies offer varying types of resilience assistance but often lack vertical and horizontal coordination.⁸⁴ This piecemeal approach to resilience assistance can impact the effectiveness of support by creating the potential for redundancy and conflict with other resilience-oriented policies and programs. The administration and federal agencies have made progress in recent years toward improving inter-agency and intergovernmental coordination around resilience,⁸⁵ but poor coordination remains common across all levels of government.

Summit officials found applications and documentation associated with federal disaster assistance programs and policies to be inconsistent, duplicative, and complicated by administrative red tape. These challenges can be

“An area where everyone can agree is the ability to coordinate better among agencies.”

—STEVE ABRAMS, COMMISSIONER,
PALM BEACH COUNTY, FL, REPUBLICAN

magnified for communities that lack the capacity to seek out, apply for, and use the full extent of available federal disaster assistance.

Recent federal progress:

- In September 2016, President Obama issued a Presidential Memorandum on climate change and national security. The memorandum established a framework for coordination and required federal agencies take actions to ensure climate impacts are considered in national security doctrine, policies, and plans.⁸⁶
- FEMA has established a Mitigation Integration Task Force. The Task Force will develop an associated pilot project to work with state, local, and tribal partners to leverage resources for disaster recovery efforts. Training meetings and courses have been held, beginning in October 2015, to advance integrated mitigation efforts.⁸⁷
- The White House convened an interagency task force to promote policies that consider the value of ecosystem services in federal decision-making. In October 2015, the effort resulted in a White House Memorandum providing guidance and a methodological framework for integrating assessments of ecosystem services into relevant programs and projects.⁸⁸

Federal action items:

- Congress should require that, in order for localities and states to receive the full amount of post-disaster, non-emergency Public Assistance, the state must develop a comprehensive climate resilience plan (i.e., in addition to or incorporated within FEMA-approved Hazard Mitigation Plans). These plans would be useful to ensure that federal and state efforts to build resilience are aligned.
- The proposed Center for Resilience should improve interagency and intergovernmental coordination of climate resilience-based support.⁸⁹ The Center should be overseen by the National Security Council to ensure effective coordination between federal disaster resilience policies and programs. This coordination could help expedite the processing time of assistance requests while reducing administrative costs and allowing for more efficient delivery of on-the-ground technical support.

- The president should establish a permanent local leaders task force designed to share lessons and offer guidance for improved coordination on resilience and to inform the priorities of the proposed Center for Resilience. The task force could be patterned after the President's State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience with revolving membership from local elected officials and tribal leaders.
- Federal agencies could improve the effectiveness and efficiency of federal disaster assistance by coordinating documentation requirements for similar types of projects within federal disaster funding programs (i.e., block grant-like structures).⁹⁰ For example, federal disaster assistance is typically project- and location-specific, which can create the potential for a multitude of pre- and post-disaster assistance requests from counties and states following a single extreme event. Given that extreme events can span multiple counties and even states, the federal government could better streamline the disaster assistance process by encouraging regional partnerships and requests. The proposed Center for Resilience could support regional climate resilience needs related to federal disaster funding programs. If done effectively, this could help streamline the documentation and application process for local governments seeking federal disaster assistance.

Prioritize Pre-Disaster Support for Vulnerable Populations and Most At-Risk Communities

Need for action:

The capacity of small towns, low-income communities, communities of color, Native communities, and other vulnerable populations to address resilience to coastal flooding, more frequent and severe heat waves, heavy downpours, and other extreme weather can be constrained by lack of resources, limited access to emergency services, ineffective communication systems, systematic under-investment in infrastructure, historic inequalities, and restricted evacuation capacity. Pre-existing limitations like these can place communities and populations at disproportionate risk. Without additional support, guidance, and tools (and resources to ensure that communities can use them) from the federal government, the risks faced by these populations and communities from incidences of coastal flooding and extreme weather will continue to increase.⁹¹

Given the extent of contributing factors and variables involved in determining vulnerability to coastal flooding and extreme weather, identifying populations most at risk to current and future sea level rise and extreme weather can be challenging.

The risk of coastal inundation and extreme weather is also beginning to reach levels where the most viable option for some communities is to relocate. For instance, Native Alaskan villages including Shishmaref, Kivalina, and Newtok have been considering or planning for relocation for more than a decade. The first case of community resettlement in the lower 48 states is now underway in Isle de Jean Charles, Louisiana.^{92, 93} The question of whether to relocate because of climate-related impacts will become an increasingly pressing one for more and more communities, like Tangier Island, Virginia, in the not too distant future.⁹⁴

Recent federal progress:

- The Environmental Justice Interagency Working Group developed a subcommittee to focus on climate change impacts in June 2015. The subcommittee's work concentrates on impacts on vulnerable populations, the needs of vulnerable populations, and ensuring that federal actions in vulnerable communities meet the standards of environmental justice. The subcommittee is also working on a Climate Justice Initiative with the aim of including equity in adaptation and resilience work.⁹⁵
- EPA released its Environmental Justice Screening and Mapping Tool ("EJSCREEN") in June 2015. The tool combines demographic and environmental data with detailed maps to allow users to identify locations with vulnerable and exposed populations.⁹⁶
- In February 2015, the Department of Interior (DOI) announced that it will provide additional funding for projects through the Tribal Climate Resilience Program to encourage climate change planning and adaptation efforts. DOI committed to providing \$8 million for tribal projects.⁹⁷

Federal action items:

- Federal agencies should identify the most vulnerable communities to facilitate targeted interventions, for example, the deployment of advanced warning systems for coastal flooding and extreme weather in locations where populations require extended lead-times for pre-disaster preparedness and evacuation.⁹⁸

By initiating cross-agency coordination and data integration into joint tools and guidance, the proposed Center for Resilience could assist in identifying the most at-risk communities.

- The president should prioritize establishing a task force to determine how best to support the most at-risk and vulnerable populations before disaster strikes. Members of the task force should include representatives of low-income communities and communities of color that are most affected by climate impacts and extreme weather, along with officials from all levels of government, academia, and the private sector.
- Federal agencies should develop and offer additional tools, information, and other support that empower the most at-risk communities to determine their own resilience strategy. At-risk communities should not be asked to sign on to frameworks that were shaped and designed without an opportunity for community participation. Additional resources necessary to ensure that communities can use federal tools should be provided.
- Federal agencies involved in resilience planning should incorporate measures and issues of equity into all stages of resilience planning: project design, application processes, and selection criteria.⁹⁹
- The new administration should develop guidance and support systems for communities considering relocation. If done successfully, such guidance could help increasingly vulnerable communities to assess their risk tolerance, determine whether relocation would be an acceptable option for the community, and ensure that relocation is completed in an effective and equitable manner.

Expand Public-Private Partnerships to Supplement Government Resilience Efforts

The need for action:

Increased federal support will be a critical component in overcoming existing impediments to scaling state and local resilience in the United States, but federal assistance alone will not be sufficient. The private sector must also play a significant role if resilience is to reach maturation in the country. The broad need for resilience requires that multiple actors—federal government, state and local governments, the private sector, and community-based organizations—all work toward building more resilient

communities. If done effectively, scaling up PPPs can help to fill existing voids in resilience and enhance federal resilience initiatives.¹⁰⁰ However, while PPPs can help provide critical resources to local and state resilience efforts they are typically designed as one-off programs.

Recent federal progress:

- NOAA, EPA, DOI, USACE, and the Department of Agriculture (USDA) announced a voluntary effort to collaborate with non-federal stakeholders to conserve and restore landscapes across the country in April 2016. The Resilient Lands and Waters Initiative aims to ensure that landscapes and watersheds are resilient to drought, wildfire, and other impacts of climate change. The Initiative began working in four areas: southwest Florida, Hawaii, Puget Sound, and the Great Lakes. Additional landscapes have already been added as progress has been made.¹⁰¹
- The NDRC provided opportunities for states and communities recently affected by disasters to participate in a competitive program. In January 2016, the NDRC awarded \$1 billion across 13 states and communities to support the implementation of resilience plans.¹⁰²
- In April 2015, the U.S. Department of Energy (DOE) announced the “Partnership for Energy Sector Climate Resilience.” The voluntary partnership includes 18 electric utility companies and hopes to share best practices, provide recognition of proactive action, and develop resilience strategies. The partners and DOE will develop resources for risk-based decision-making in the resilience context.¹⁰³

Federal action items:

- Congress should appropriate funds annually to support resilience PPPs. This type of federal commitment would signal program sustainability beyond a one-off opportunity for businesses and encourage increased engagement from the private and civil society sectors.
- The proposed Center for Resilience should convene federal agencies, local governments, and the private sector to assess lessons learned and develop potential PPP strategies that ensure that resilience-focused PPPs effectively serve their social purpose while meeting the interests of the private sector.

- The new administration should explore how to better incentivize resilience-oriented retrofits in the private sector’s built environment. Incentives, like tax credits, could encourage the private sector and developers to incorporate resilience measures (e.g., storm-resistant windows, additional roof strappings) in their building design.¹⁰⁴ Congressional action would be necessary for issuing tax credits.

Promote Nature-based and Multi-Benefit Resilience Initiatives

Need for action:

The link between increasing greenhouse gas emissions and warming global temperatures is well-established.^{105, 106} Excess heat being stored in the ocean and atmosphere is amplifying coastal flooding through sea level rise and storm surge while providing additional fuel for extreme weather events.^{107, 108, 109} To safeguard communities from present and future impacts of coastal flooding, more intense and frequent heat waves, heavy downpours, and other extreme weather, parallel efforts on resilience and greenhouse gas emissions reductions are needed.

In addition to carbon sequestration, green infrastructure provides many other co-benefits. It can help reduce the urban heat island effect by providing shade and surfaces that absorb less heat than grey infrastructure. It can reduce flooding from heavy rainfall by managing and absorbing stormwater. Green infrastructure can also help reduce crime and improve human health. Access to community gardens can provide fresh and local food.^{110, 111}

The longer greenhouse gas emissions go unabated, the greater the impacts of coastal flooding, sea level rise, and extreme weather will be.¹¹² The direct relationship between carbon emissions, sea level rise and extreme weather, and the scale of investment needed to achieve and maintain resilience standards under increasingly severe conditions, creates a clear incentive to implement resilience measures that produce co-benefits like carbon sequestration and energy efficiency.

Some federal policies limit the potential cost-effectiveness of nature-based resources because their structure discourages the incorporation of nature-based initiatives into resilience investments. For example, Summit officials recommended better utilization of riverine and offshore dredged materials. Summit officials noted that USACE

policies requiring dredge materials to be disposed of in the least cost-intensive manner do not account for the potential resilience benefits those materials could provide. Current practices often result in offshore disposal of resources that could be used for dune and beach renourishment projects. This narrow view can result in communities paying additional taxpayer dollars to transport sand in from distant locations while locally available sand qualified for renourishment projects is disposed of nearby.

Recent federal progress:

- In December 2015, FEMA released a fact sheet providing overview information about the use of green infrastructure in FEMA's Hazard Mitigation Assistance grant programs. The fact sheet discusses the methods and benefits of incorporating green infrastructure into hazard mitigation activities.¹¹³
- In August 2015, the Obama Administration released a report, *Ecosystem-Service Assessment: Research Needs for Coastal Green Infrastructure*, which details the areas in which federal research can support the consideration of coastal green infrastructure in resilience, decision-making, and risk reduction. The report is a resource for planners and decision-makers that provides information about considering and incorporating green infrastructure.¹¹⁴
- Released in February 2015, the Green Infrastructure and Sustainable Community Initiative report details 30 case studies of green infrastructure projects and discusses lessons learned from these projects. The report serves as a resource for communities looking to implement and improve green infrastructure in their community.¹¹⁵

Federal action items:

- The new administration should require that all federally funded resilience investments include the assessment of nature-based solutions as alternative to, or in combination with, grey infrastructure.
- Congress and FEMA could encourage implementing nature-based solutions and green infrastructure by increasing the federal match for pre-disaster resilience grants that incorporate nature-based infrastructure and carbon sequestration.^{116, 117}

- Federal agencies like USACE and EPA should provide additional technical support to states and communities to allow them to better understand and capitalize on the full spectrum of benefits offered by nature-based resilience strategies. EPA and USACE have expertise in green infrastructure and should share that expertise with state and local governments.
- Congress, in coordination with USACE, should update USACE policies and programs involving the relocation of dredged materials to allow for their use in community resilience initiatives. Dredged sand materials can be used for dune and shoreline protection, and other materials, such as non-beach quality sands, can be used more broadly to protect infrastructure and create coastal habitats.

Enhance Disaster Resilience-focused Metrics and Economic Impact Assessments

Need for action:

Modeling and forecasting of sea level rise, coastal flooding, and extreme weather events and their respective risks have advanced considerably in the last decade, allowing states, communities, and businesses to better grasp their levels of risk and vulnerability. While these advances have been encouraging, better accounting for vulnerability beyond high-value assets (e.g., direct damage to insured property, homes, and critical infrastructure) remains an urgent need for decision-makers and planners.¹¹⁸ The lack of a comprehensive inventory and valuation system for non-economic assets (e.g., ecosystems and cultural heritage) can lead to overly conservative cost-benefit assessments of resilience measures involving green infrastructure.¹¹⁹

A more comprehensive evaluation of social, cultural, and environmental assets is needed to account for a more complete spectrum of disaster resilience benefits. Economic losses (e.g., disrupted supply chains, reduced tourism, lost business days) caused by increasing coastal flooding and extreme weather need to be better understood and accounted for.¹²⁰ Additionally, the lack of resilience metrics makes it challenging for local governments to measure and track their level of resilience or develop best practices.

Recent federal progress:

- The Mitigation Framework Leadership Group released a draft concept paper of potential indicators and measures of community resilience in June 2016.

Developed jointly by FEMA and NOAA, the paper is designed as a resource to develop common terminology, promote collective outcomes, and identify data gaps constraining development of metrics.¹²¹

- In December 2015, the National Fish and Wildlife Foundation released a contracted report that recommends metrics to measure the socio-economic benefits of the Hurricane Sandy Coastal Resiliency Competitive Grant program. The report presents metrics to measure human health and safety, property and infrastructure protection and enhancement, economic resilience, and community competence and empowerment.¹²²
- The Comprehensive Economic Development Strategy Content Guidelines, published in January 2015 by the U.S. Economic Development Administration, encourage communities to include resilience concepts in long-term plans. The guidelines suggest that resilience considerations include climate change and other shocks. The Economic Development Administration notes that regional action to implement resilience measures can improve economic durability.¹²³

Federal action items:

- Federal agencies should develop cost-benefit case study evaluations of pre- and post-disaster resilience investments.
- FEMA should develop a publicly available tool that allows states and localities to create a dataset of direct and indirect costs and damages incurred from coastal flooding and extreme weather.
- The U.S. Global Change Research Program should lead efforts to aggregate federal and non-federal resilience case studies from around the country and make them more readily available to the public, thus helping to inform communities with similar risk profiles. These additional case studies could be highlighted in the existing Climate Resilience Toolkit. Increased availability and visibility of case studies could lead to their adoption elsewhere and help to better determine the cost-benefit of resilience measures.

- Congress should pass legislation to authorize additional research that examines the impacts of coastal inundation and natural disasters on communities and the effectiveness of disaster assistance spending. For example, the recently proposed National Mitigation Investment Act would authorize, among other things, a comprehensive study of disaster costs and losses through the National Advisory Council.¹²⁴
- FEMA's Mitigation Framework Leadership Group should actively engage stakeholders from academia, local governments, non-governmental organizations, and business to provide feedback on their draft indicators and measures of community resilience. If done right, metrics such as a nationally applicable local resilience scorecard could be an invaluable asset enabling uniform and comparable assessments of resilience. Governments and stakeholders could evaluate and monitor their capacity to withstand and recover from the impacts of coastal flooding and extreme weather.¹²⁵

Enrich Usefulness of Resilience-related Data to Increase Public Awareness

Need for action:

As previously mentioned, recent advances in science and technology have enhanced our capability to forecast climate and weather, providing communities with greater preparation time for impending threats like coastal flooding and extreme weather events.^{126, 127} Advances in computational capacity have also allowed the grid resolution of weather and climate models to increase by more than a power of ten, providing a more localized understanding of impacts and vulnerability.¹²⁸

These improvements are encouraging, but it remains a challenge to provide this information in forms that are easily comprehensible and adjusted for varying levels of expertise. WRI addressed similar issues in the context of linkages between development and adaptation in the report, *Weathering the Storm*, which discusses the importance of data availability and tailoring data to community needs.¹²⁹ The Open Government Initiative and U.S. Climate Resilience Toolkit are examples of federal efforts to address these pressing issues, but decision-makers can still be overwhelmed by the overabundance of information and the lack of guidance as to where pertinent information is being hosted and how to utilize it.^{130, 131}

Recent federal progress:

- The White House Office of Science and Technology Policy, World Resources Institute, U.S. Global Change Research Program, and a network of partners launched the Partnership for Resilience and Preparedness (PREP) in September 2016. PREP aims to mobilize and deploy data from the public and private sectors to support climate resilience. PREP further hopes to support the open sharing of data on a variety of open-sourced platforms. These open data goals will lead to increased collaboration, innovation, capacity-building efforts, and climate data standards.¹³²
- In April 2015, NOAA expanded the Coastal Flood Exposure Mapper to include the entire U.S. east coast and the Gulf of Mexico. The tool is now available online through the Climate Resilience Toolkit. The risk-mapping tool lets users examine how their location, populations, and infrastructure could be affected under different flood scenarios.¹³³
- In December 2014, the White House announced a Climate Education and Literacy Initiative. The Initiative aims to connect students and ordinary citizens with climate information. A variety of federal agencies have made commitments such as convening workshops, providing communication/outreach training, and leveraging digital games.¹³⁴

Federal action items:

- FEMA should lead efforts to create a clearinghouse of disaster information that includes data related to coastal flooding and extreme weather impacts, such as direct and indirect costs, economic disruptions, loss of life and injuries, disaster recovery and resilience spending, and resilience funding opportunities.^{135, 136, 137} All data need to be presented clearly and succinctly so that data are accessible by all—members of the public, expert researchers, and decision-makers.
- The new administration should increase public awareness of the implications of sea level rise and increasingly extreme weather.¹³⁸ By providing better training for the public and decision-makers through locally adapted education and communications tools and resources, the risks and implications of increasing

coastal flooding, sea level rise, and extreme weather events can be better understood by the public and accounted for by policymakers.¹³⁹

- Federal agencies should support additional in-person and online trainings to improve public awareness and climate data comprehension.
- Federal agencies should include requirements in all resilience-based federal grants that the successes, failures, and lessons learned be adequately documented and made available to decision-makers and the public. This information could be invaluable as local officials look to improve and expand their resilience projects while educating their community about the need for climate resilience.

CONCLUSION

The bipartisan gathering of nearly 40 mayors and other local elected officials at the Rising Tides Summit is proof that political ideology has no place in decision-making regarding climate resilience. As a group, Summit officials made it clear that in order to develop adequate resilience to the growing climate-related risks they need additional federal leadership, support, and guidance.

Promising resilience initiatives have been undertaken in recent years at all levels of government and within the private and philanthropic sectors. Numerous federal policies and projects have contributed to building a more resilient nation. However, while this progress has been encouraging, much more needs to be done. Local officials will be looking to the Trump administration to play a constructive role in supporting local resilience efforts.

President-elect Trump has emphasized his interest in addressing our nation's infrastructure needs. The opportunities highlighted in this paper can provide guidance to the new administration for ensuring that its investments help communities and local governments enhance their resilience to threats like sea level rise and increasingly extreme weather while addressing their infrastructure needs. Factoring in resilience to these growing threats will help ensure taxpayers' dollars are spent in a financially responsible manner.

APPENDIX A: RISING TIDES SUMMIT PARTICIPANTS

STATE	PARTICIPANTS
Alabama	Mayor Jeff Collier (Dauphin Island), State Delegate Randy Davis (District 96)
California	Mayor Shelly Higginbotham (Pismo Beach), Mayor Edward Selich (Newport Beach)
Delaware	Mayor Ted Becker (Lewes)
Florida	Commissioner Steve Abrams (Palm Beach County), Commissioner Patricia Asseff (Hollywood), Mayor Jim Cason (Coral Gables), Commissioner Chip LaMarca (Broward County), Mayor Cindy Lerner (Pinecrest)
Georgia	Mayor Jason Buelterman (Tybee Island)
Maine	State Delegate Robert Foley (District 7), Selectman Torbert Macdonald (York)
Maryland	Councilman Christopher Trumbauer (Anne Arundel County)
Massachusetts	Mayor Donna Holaday (Newburyport)
Mississippi	Mayor Billy Hewes (Gulfport), Mayor Leo McDermott (Pass Christian), Mayor Connie Moran (Ocean Springs)
New Hampshire	Selectman Priscilla Jenness (Rye), Mayor Bob Lister (Portsmouth), State Senator Nancy Stiles (District 24), Selectman Mary-Louise Woolsey (Hampton)
North Carolina	Mayor Sheila Davies (Kill Devil Hills), Town Councilman Steve Shuttleworth (Carolina Beach), Commissioner Robert Zapple (New Hanover County)
New Jersey	Township Committee Member Eric Port (Greenwich), Mayor Dawn Zimmer (Hoboken)
New York	Mayor Norman Rosenblum (Mamaroneck)
Oregon	Mayor Arline LaMear (Astoria)
Rhode Island	Mayor Scott Avedisian (Warwick)
South Carolina	State Delegate Robert Brown (District 116), Mayor Bill Keyserling (Beaufort)
Texas	Mayor Michel Bechtel (Morgan's Point), Mayor Glenn Royal (Seabrook)
Virginia	State Senator Adam Ebbin (District 30), State Delegate Chris Stolle (District 83)
Roundtable and concurrent session discussion leaders:	<ul style="list-style-type: none"> ■ Lawrence Cocchieri, Deputy Director, National Planning Center for Coastal Storm Risk Management, U.S. Army Corps of Engineers ■ Dr. Kathryn Sullivan, Administrator, NOAA ■ William Sweet, Oceanographer, Center for Operational Oceanographic Products and Services, NOAA ■ Jonathan White, Rear Admiral (Ret.), U.S. Navy ■ Roy Wright, Deputy Associate Administrator for Insurance and Mitigation, FEMA

APPENDIX B: RISING TIDES SUMMIT AGENDA

	TIME	ROOM/ LOCATION	ACTIVITY
FRIDAY, OCTOBER 23	6:30pm	Rose	<ul style="list-style-type: none"> ■ Welcome reception: wine and beer with hors d'oeuvres ■ Brief welcome remarks from hosts Senator Stiles and Mayor Lister ■ Remarks from Peter Egleston, Founder, Smuttynose Brewery
	8:00pm		Dinner on your own
SATURDAY, OCTOBER 24	8:00am	Hampton/Exeter	<ul style="list-style-type: none"> ■ Breakfast ■ Welcoming remarks from Mayor Lister and Senator Stiles ■ Participant introductions
	9:15am		Break
	9:30am	Hampton	Keynote speech and roundtable: Dr. Kathryn Sullivan, Administrator, NOAA
	10:45am		Break
	11:00am	Hampton	<ul style="list-style-type: none"> ■ Challenges and successes in local adaptation <ul style="list-style-type: none"> □ Senator David Watters (New Hampshire) □ Mayor Dawn Zimmer (Hoboken, NJ) □ Delegate Chris Stolle (Virginia) □ Dr. Jennifer Jurado (Director, Environmental Planning and Community Resilience Division, Broward County, Florida)
	12:15pm		Break
	12:30pm	Hampton/Exeter	<ul style="list-style-type: none"> ■ Lunch <ul style="list-style-type: none"> □ Keynote speech and roundtable: Jonathan White, Rear Admiral (Ret.), U.S. Navy
	2:00pm	Hampton/Exeter	Keynote speech and roundtable: Roy Wright, Deputy Associate Administrator for Insurance and Mitigation, FEMA
	3:30pm Concurrent sessions	Portsmouth	<ul style="list-style-type: none"> ■ Tidal flooding and storm surge: what the future holds. Discussion with Dr. William Sweet, Oceanographer, Center for Operational Oceanographic Products and Services, NOAA
		Hampton	<ul style="list-style-type: none"> ■ Communicating coastal risks to constituents and the media—moderated discussion
4:45 pm		Break	
6:30 pm	Seashell Oceanfront Pavilion, Hampton Beach State Park	Reception: wine and beer with hors d'oeuvres	
8:00 pm		Dinner on your own	

APPENDIX B: RISING TIDES SUMMIT AGENDA, CONTINUED

	TIME	ROOM/ LOCATION	ACTIVITY
SUNDAY, OCTOBER 25	9:00am	Hampton/Exeter	Pancake breakfast
	10:00am	Hampton/Exeter	Keynote speech and roundtable: Lawrence Cocchieri, Deputy Director, U.S. Army Corps of Engineers National Planning Center for Coastal Storm Risk Management
	11:15am		Break
	11:30am	Hampton/Exeter	Concluding session
	12:30pm		Departure

APPENDIX C: DETAILED DESCRIPTION OF RISING TIDES SUMMIT PRESENTATIONS, PANEL SESSIONS, AND ACCOMPANYING ROUNDTABLE DISCUSSIONS

Presentation and Roundtable Discussion: Dr. Kathryn Sullivan (NOAA)

During her remarks, Administrator Kathryn Sullivan outlined the goal of NOAA as being to transform science and observations into information that fits decision frameworks throughout society. From a resilience standpoint, she noted that the country cannot afford to wait for another Hurricane Sandy, and that the impacts of Sandy made the federal government painfully aware that federal assistance programs and policies were oriented toward building back instead of building ahead.

Administrator Sullivan went on to underscore that a transition is taking place within the federal government to shift its reactive tendencies in the direction of being more proactive and accounting for the changes in climate already afoot and that lie ahead. In particular, she noted that NOAA is striving to find ways to help communities incorporate resilience in their design and planning efforts by providing real-time data and information that takes into account various societal, economic, and ecological implications of the changing climate. The need for better coordination between levels of government and within the federal government to enhance the effectiveness of community resilience was also noted. The Hampton Roads Sea Level Rise Preparedness and Resilience Intergovernmental Pilot Project was mentioned as a recent example of progress being made in tackling the challenge head-on.

Following Administrator Sullivan's presentation, Summit local officials highlighted a number of their priority interests and concerns in a roundtable discussion. The conversation focused on matters like the limitations of NOAA datasets and whether information existed that could be used by local officials to demonstrate to their constituents the magnitude of community assets vulnerable to coastal flooding today and what is at risk from future sea level rise. Elected officials wanted to know to what degree modeling capabilities existed that could assess the costs and benefits of coastal protection investments that account for avoided long-term inundation. The Summit officials expressed elevated interest in public education and awareness initiatives led by NOAA that can help address challenges local officials face when trying to inform their constituents of the magnitude of the risk posed by sea level rise and increased coastal flooding. Administrator Sullivan noted that NOAA continues to try to make data more available through tools like Digital Coast, and that increased public awareness through initiatives like NOAA's King Tide photo contest are a crucial component of increasing public awareness and driving comprehensive action aimed at scaling resilience across the country. Co-benefits that come with using green infrastructure to protect coastal communities from threats like storm surge were highlighted, but it was acknowledged that the economics of these benefits are not well represented in cost-benefit assessments.

The dialogue extended beyond the threat of sea level rise to the increasing impacts of extreme weather like hurricanes and heavy precipitation events. Interest revolved around the extent to which officials can incorporate NOAA services and guidance into near- and long-term planning to meet these threats. Administrator Sullivan mentioned that technological improvements are being made to near- and long-term forecasting of extreme weather, in addition to better coupling of oceanic and atmospheric threats (e.g., generating forecasts that account for the combined threat of coastal flooding and heavy precipitation). In addition to focusing on hazard mitigation and

resilience as strategies to deal with increasing coastal flooding, sea level rise, and more extreme weather, the conversation involved questions regarding data and information that can inform decisions regarding community retreat. Administrator Sullivan noted that NOAA wants to assist in any way it can to help communities integrate all three aspects of adaptation (i.e., protect, accommodate, and retreat) into local planning and investment decisions.

Presentation and Roundtable Discussion: Mr. Roy Wright (FEMA)

Roy Wright, FEMA's Deputy Associate Administrator for Insurance and Mitigation, spoke about FEMA's efforts relating to protecting the future of the nation's coastal communities. During his remarks, Mr. Wright drove home how difficult it can be for people to grapple with the mental conflict of needing to prepare for extreme events and not wanting to accept that the disaster could occur. Today's climate has amplified the challenge through the rise in disaster costs, risk exposure, and vulnerability, all of which are expected to continue increasing into the future, according to Mr. Wright. He said that FEMA is working to address this challenge by ramping up efforts to provide data and analysis to communities, which can help them take action they would otherwise not be inclined to take. According to Mr. Wright, progress on this front is being made not necessarily by engaging local officials about the risk of climate change, but by helping them to integrate increased resilience into decision-making on issues like land-use planning, economic development, and critical infrastructure.

Mr. Wright said that FEMA and communities are grappling with the challenge presented by the fact that many federal statutes do not adequately account for the risk and reality associated with today's climate. For example, the current structure of FEMA's federal disaster assistance has the potential to introduce a perverse incentive for states to avoid investing in resilience because of the per capita damage threshold that must be met in order to receive PA following a disaster. The threshold can encourage states not to invest in resilience if resilience measures could have the effect of reducing future damage below the threshold necessary to receive federal assistance. Mr. Wright explained that, by establishing more pre-disaster resilience incentives like a disaster deductible, credit can be given for resilience investments that help to safeguard facilities and infrastructure against today's disasters and more extreme weather in the future.

Mr. Wright underscored the value of establishing a recovery and resilience plan pre-disaster as the best way to maximize the effectiveness of assistance provided to communities following a disaster. In spite of this guidance, Mr. Wright's experiences suggest that the current tendency of localities is to account for future risk only in the weeks following a major disaster. He went on to explain that the issue with this approach is that local officials end up not being able to provide adequate answers to the multitude of federal officials asking them what resources they need following a disaster, which results in federal officials determining the answers on behalf of local officials. Because taxpayer dollars are used in recovery assistance, local officials are then held to strict near-future timelines for demonstrating progress but they struggle to meet targets due to lack of preparation. By developing plans now, localities can help guide the recovery process to fit their unique needs and steer near-future investments.

During the roundtable with Summit elected officials, Mr. Wright wanted to learn how FEMA can better inform local risk decisions and how the agency can adapt existing programs to better meet the needs of communities and states. Summit elected officials touched on a number of issues including the need for more engagement with local officials when FEMA is developing or amending policies with local implications (especially in the case of remapping flood zones), better streamlining of disaster-related federal assistance, and a strategy to spread the cost of insurance for catastrophic risk throughout the country. Mr. Wright acknowledged that FEMA and federal agencies need to improve partnering among themselves and with communities in pre- and post-disaster initiatives, and that the federal response to Sandy was an encouraging example of how that can be accomplished. He also stated FEMA is realizing the benefits of community engagement in the developmental stage of remapping flood zones, which include help with verifying data and providing supplemental local data that minimizes the risk of maps needing to be corrected. While he agreed with the principle of needing to drive down the cost of catastrophic events to the national treasury by better accounting for differences in risk across the country, he was not aware of a detailed approach that could equalize risk while still maintaining a necessary price signal.

Summit elected officials also noted that an overwhelming number of National Flood Insurance Program (NFIP) customers often do not understand what their coverage includes. Mr. Wright acknowledged this knowledge gap and informed the local officials that FEMA is working to develop an education initiative that will increase policy clarity with customers prior to disasters occurring. The initiative will also help to outline additional coverage options that customers can choose to improve the quality of their insurance coverage. Further, local officials expressed a desire for cost-benefit assessments that better account for the full spectrum of economic benefits provided by nature-based solutions, as well as enhanced incentives for communities to implement these types of resilience strategies. Mr. Wright agreed that a combination of grey and green infrastructure can help buy down risk, and that federal agencies need to partner more effectively with communities.

Presentation and Roundtable Discussion: Mr. Lawrence Cocchieri, (USACE)

Larry Cocchieri, Deputy Director of USACE's National Planning Center for Coastal Storm Risk, provided an overview presentation of the North Atlantic Coast Comprehensive Study (NACCS)—commissioned by Congress in the aftermath of Hurricane Sandy—to give a sense of the more recent resilience initiatives that USACE has been leading. The purpose of NACCS was to develop a framework for local and state governments to make informed coastal risk management decisions at a granular level. According to Mr. Cocchieri, a secondary benefit of the NACCS was that it made clear a number of growing problems related to coastal risk management and planning. For instance, it shed light on the need for responsibility to be shared by all levels of government to make sure that people are more informed about the risks from climate change and its impacts. Additionally, the report indicated a need for intergovernmental and interagency collaborative solutions that rethink approaches to addressing today's climate. Further, the NACCS helped to identify that resilience and sustainability initiatives must consider a combination of flexible measures because there is no silver bullet to address the issue of increasing risk from climate change and more extreme weather. The NACCS developed nine steps within three tiers of action (comprehensive, state, and local), to be used in an iterative process—in accordance with the user's progress of assessing and addressing risk—and offering a blend of measures that include multiple lines of defense.

As potential pathways forward, Mr. Cocchieri identified these nine coastal flood risk management opportunities stemming from the NACCS report:

- Mitigate future risk with improved pre-storm planning
- Identify acceptable flood risk at a community and state scale
- Prioritize critical infrastructure
- Rebuild with redundancy
- Develop incentives to promote use of resilience measures
- Utilize a collaborative regional governance structure
- Develop Public-Private Partnerships for coastal risk management
- Integrate natural-based features in coastal risk management
- Encourage design flexibility and adaptive management

Similar to experiences described by Administrator Sullivan and Mr. Wright, Mr. Cocchieri felt that Hurricane Sandy provided a great example of how effectively federal agencies and different levels of government can work together in a time of crisis. While encouraged by the experience after Hurricane Sandy, he underscored the need for federal government to more consistently coordinate at that level. In addition to intergovernmental coordination following the historic storm, Mr. Cocchieri said that the post-disaster recovery efforts were also a great example of how effective public-private partnerships (PPPs) can be, and made the case that they need to be increased and better utilized moving forward. His final takeaway from Hurricane Sandy was that the storm highlighted the effectiveness of green and nature-based solutions, and the need for all levels of government to prioritize better understanding the value-add they offer in order to encourage their use as resilience measures.

In the roundtable that followed Mr. Cocchieri's presentation, Summit elected officials wanted to know whether comprehensive studies similar to the NACCS had been completed in other regions, and if not, what would need to happen for such a study to be commissioned. Mr. Cocchieri mentioned a similar study that was undertaken in the Gulf region following Hurricane Katrina, but in most cases the tendency is for comprehensive studies like these to be commissioned by Congress only in the aftermath of major disasters. Summit elected officials made a point of noting that the tendency to commission these types of studies reactively was in conflict with the recommendations in the NACCS, and inquired what Congress had done to make use of these comprehensive studies. While he could not speak for similar assessments, Mr. Cocchieri said he had yet to learn of any response received by USACE from Congress regarding the NACCS, and he agreed that these types of assessments would be more beneficial if done pre-disaster to avoid unnecessary risk. Summit officials were frustrated with USACE's dependence on Congress for its ability to take action. Since the studies were paid for using taxpayer dollars, Summit elected officials suggested that implementation strategies should be established prior to their completion so that the comprehensive studies can actually inform decision-making.

The discussion transitioned to local experiences with USACE and Summit elected officials underlined the need for improved valuations of the true costs and benefits of nature-based resilience measures. For example, some officials took issue with USACE policy that mandates the disposal of dredge materials at least economic cost. The potential exists for dune restoration and

beach renourishment projects to make use of dredge material, but, because the associated benefits of resilience are not accounted for in USACE cost-benefit assessment for dredge material disposal, the sand is often relocated offshore. This can create unnecessary costs for communities, which then also have to allocate taxpayer dollars to transport sand to their beaches from distant locations.

Lack of public awareness, poor communication strategies, and tedious renewal processes associated with resilience projects were also flagged by Summit elected officials as key concerns related to USACE. Mr. Cocchieri agreed that a more efficient renewal process is needed for projects that have stood the test of time, and noted that USACE was partnering with NOAA to develop communications tools to better engage communities about existing projects and findings from comprehensive assessments.

Presentation and Roundtable Discussion: Mr. Jonathan White (retired Navy Rear Admiral)

Former Rear Admiral (RADM) of the Navy, Jonathan White, retired from the Navy just weeks before the Summit. At the Summit, he spoke to Summit elected officials about the science of climate change and resulting impacts that threaten national security and communities throughout the country. RADM White discussed the observed trends and linkages between rising atmospheric concentrations of carbon dioxide, increasing global temperatures, decreasing Arctic sea ice, and observed increases in extreme weather events in the United States and around the world. He explained that the military has recognized the threat of climate change for decades and has outlined the issue as a threat multiplier and one of the greatest threats to national security. Given the scope and scale of the issue and its impacts, the Rear Admiral stressed that there needs to be ownership of the problem at every level of government and in all sectors. He emphasized that the choice is either to act now or react later, and that the military has found that reactively addressing risk can be exponentially more costly than preemptively addressing a problem.

Local elected officials wanted to know how to gain more traction at the state and national levels regarding comprehensive planning and action to address issues like increasing coastal flooding and extreme weather. The Rear Admiral suggested that, in the absence of well-informed people, the right decisions will not be made. While there is an exhaustive amount of evidence that climate change is occurring, the United States needs to do a better job of turning data into action. He emphasized that leadership and funding will not just appear from the federal government, and that localities need to develop plans so they can show what needs to be done and the potential damage that will be avoided. Such action would more effectively make the case for proactive action and federal support than simply pointing out a problem and offering no solution.

Interest from local elected officials also revolved around retreat strategies and the extent to which they exist in the United States or in other countries. RADM White mentioned there is a growing number of instances of retreat in the United States as well as globally, but, to his knowledge, examples of best practices do not yet exist. He also suggested that the limited extent of retreat strategies should not impede efforts of communities to try and determine when retreat becomes a viable option and how it could most effectively and efficiently be carried out, if it comes to that point.

Panel and Roundtable Discussion: Local Adaptation Challenges and Successes

The panel on challenges and successes associated with local adaptation included three local and state elected officials along with a county director of environmental planning and resilience. During presentations and the roundtable discussion that followed, panelists and Summit elected officials stressed the need to shift away from dated federal policies that tend to be reactive with respect to resilience and recovery and toward more proactive and comprehensive resilience planning.

Rather than disjointed and piecemeal approaches, officials emphasized that more collaboration between neighboring local governments and with federal agencies should take place to help maximize collective benefits from combining resources while establishing compatible planning standards that integrate resilience. Summit officials also noted that challenges associated with gaining bipartisan buy-in around issues like climate change, increasing coastal flooding, sea level rise, and more extreme weather can be difficult to overcome despite the broad agreement that regional coordination provides immense value-add. Each panelist had experienced a degree of success in establishing regional and intergovernmental partnerships to address resilience and suggested that a key element in gaining the necessary bipartisan support is concentration on existing and near-future economic impacts.

There was a consensus among Summit elected officials that local governments, rather than the federal government, should lead resilience planning efforts, but that localities cannot develop and implement resilience strategies alone. Public-private partnerships (PPPs) like the Rebuild by Design competition were mentioned as a critical part of financing resilience measures while also helping to ensure coordination with the federal government and providing essential technical guidance. Local officials found that involving the community, private sector, and federal government at each step of local and regional resilience planning helps to expedite the development and implementation of resilience strategies. Additionally, the incorporation of green infrastructure into a resilience strategy was repeatedly mentioned as a useful resilience measure that should be considered where applicable. Among other benefits, elected officials suggested that green infrastructure can help preserve the culture of communities in ways that support their economic vitality (e.g., tourism). Building bigger and higher grey infrastructure (e.g., sea walls) does not achieve this goal.

Concurrent Sessions and Roundtable Discussions:

One of the two concurrent sessions involved a presentation from NOAA's Dr. Billy Sweet; it focused on tidal flooding and what Summit elected officials can expect in the future. After providing an overview of the factors that impact sea level rise at the global and local level (e.g., El Niño and La Niña, subsidence, etc.), Dr. Sweet presented NOAA's latest work on nuisance flooding.¹⁴⁰ This shows that nuisance flooding on all three U.S. coasts has increased between 300 percent and 925 percent since the 1960s and Dr. Sweet discussed what this means for coastal communities and should mean for Summit elected officials. According to Dr. Sweet, flooding events that were once considered rare are becoming more frequent in many coastal communities. He also emphasized that coastal development continues to largely ignore sea level rise, and is therefore committing coastal communities to elevated future risk as rising sea levels continue to encroach on infrastructure.

When asked how much future sea level rise local officials should plan for, Dr. Sweet suggested that officials should have flexible plans, where possible, but recommended incorporating the upper limit of estimates in plans that cannot afford to fail (e.g., sea walls, levees, etc.). Similarly, Summit officials inquired about the projected future intensity of hurricanes and heavy precipitation events, and whether NOAA was working on providing more granular and real-time forecasts for extreme events. Dr. Sweet noted that atmospheric phenomena fall more under the purview of the National Weather Service than National Ocean Service where he works, but that NOAA is beginning to make strides toward interlinking factors involving atmospheric and oceanic flooding threats with the National Water Center located in Tuscaloosa, AL.

Summit elected officials were interested to know more about the number of nuisance flooding days they should plan for in the coming decades. Dr. Sweet noted that the threshold NOAA has established for nuisance flooding is based on the location of tide gauges and is not as important as local officials taking that information and determining locally appropriate thresholds of vulnerability, impacts, and concerns. He expanded on the point by stating that NOAA wants to do as much as it can to make its data and analysis easily understandable for local officials and useful for smart decision-making.

The second concurrent session was a roundtable of Summit elected officials to discuss challenges and successes associated with communicating coastal risk and potential research questions they would like answered.

Officials identified a glaring gap that exists with respect to the state of scientific knowledge and public education and awareness about sea level rise and increasing coastal flooding, and also about the driving force behind the issues—climate change. Constituents often think that extreme weather events, sea level rise, and increasing coastal flooding are issues that impact only people in other countries but not them personally and Summit officials found it difficult to overcome that communications challenge. Conversely, some Summit officials found that people who do acknowledge the growing threat of these issues are often overwhelmed by the scale of the problem and conclude that the problem is bigger than one person, one community, or one country, and question why they should bother taking action. A frustration was evident among local officials that people fail to realize there is a ripple effect from impacts that is felt throughout the country and the wallets of every American taxpayer as a result of extreme weather events. The sense

of the Summit elected officials was that storms categorized as 1-in-100 or 1-in-1,000-year events were now happening multiple times within a matter of years, and officials were curious to know whether their local experience with increasing costly extreme weather events was being repeated at the state and national level.

When engaging constituents around issues like climate change, rising seas, increasing coastal flooding, and extreme weather, some Summit officials found that connecting the impacts at a personal level increased issue resonance. The experience of one official was that, by establishing workshops and commissions that connected experts and citizens around how these threats were directly impacting their community, he was able to increase awareness and develop a sense of ownership. By extending the workshops, acceptance of the issues increased within the official's community, as did agreement on the need for action to address them. Other officials succeeded in gaining community support for investing in climate-related resilience measures by offering town halls and tours to constituents to demonstrate where local taxpayer dollars were being spent and what the outcome of the investment would be. As a group, Summit officials felt that, with respect to planning and implementing resilience initiatives, leadership needed to come from the local level and be supplemented by and coordinated with the state and federal government.

When discussing challenges associated with resilience, the group expressed frustration that federal grant and partnership opportunities related to resilience are not aggregated in a central online location that would help local and state officials to learn about and apply for opportunities specific to their risks and needs.

Local officials within the Summit group had experienced success in gaining community support for resilience investment by providing a vision of what success would look like, but most officials cited the need for substantially more resilience best practices and guidance that could help them better understand potential resilience measures and associated benefits. This information could help them communicate to their constituents what could be gained or avoided through investments in resilience using taxpayer dollars. Interest in best practices related to resilience was coupled with interest in the federal government assisting with the development of guidance regarding retreat strategies. Such strategies could help localities understand when they might reach a threshold where relocation is the most viable option and, when that threshold is passed, how to relocate effectively.

REFERENCES

- Abt Associates. 2015. *Developing Socio-Economic Metrics to Measure DOI Hurricane Sandy Project and Program Outcomes*. Available at: https://www.doi.gov/sites/doi.gov/files/uploads/Socio_Economic_Metrics_Final_Report_11DEC2015_0.pdf.
- Aon Benfield. 2016. *2015 Annual Global Climate and Catastrophe Report: Impact Forecasting*. London, UK: Aon Benfield. Available at: <http://thoughtleadership.aonbenfield.com/Documents/20160113-ab-if-annual-climate-catastrophe-report.pdf>.
- Berndt, C. 2015. "How can the Federal Government Prepare Local Communities for Natural Disasters." Presentation at the Environmental and Energy Study Institute Briefing, National League of Cities. Available at: http://www.eesi.org/files/Carolyn_Berndt_040115.pdf.
- Boyd, E. 2011. *Community Development Block Grant Funds in Disaster Relief and Recovery*. Washington, D.C.: Congressional Research Service.
- Bronen, R. 2013. *Climate-Induced Displacement of Alaska Native Communities*. Washington, D.C.: Brookings Institution. Available at: <https://www.brookings.edu/wp-content/uploads/2016/06/30-climate-alaska-bronen-paper.pdf>.
- DOT (U.S. Department of Transportation). 2015. "TIGER 2014 Awards." Washington, D.C.: Department of Transportation. Available at: https://cms.dot.gov/sites/dot.gov/files/docs/TIGER14_ProjectFactSheets.pdf.
- EPA (U.S. Environmental Protection Agency). 2016. "Benefits of Green Infrastructure." Available at: <https://www.epa.gov/green-infrastructure/benefits-green-infrastructure>.
- FEMA (Federal Emergency Management Agency). 2015a. "Climate Resilient Mitigation Activities: Green Infrastructure Methods." Washington, D.C.: Department of Homeland Security. Available at: https://www.fema.gov/media-library-data/1449244221588-e054671affe09301e3b819d213a64ce7/GI_FactSheet_Sept2015_Dec508.pdf.
- FEMA. 2015b. *Hazard Mitigation Assistance Guidance*. Washington, D.C.: Department of Homeland Security. Available at: http://www.fema.gov/media-library-data/1424983165449-38f5dfc69c0bd4ea8a161e8bb7b79553/HMA_Guidance_022715_508.pdf.
- FEMA. 2015c. *State Mitigation Plan Review Guide*. Washington, D.C.: Department of Homeland Security. Available at: https://www.fema.gov/media-library-data/1425915308555-aba3a873bc5f1140f7320d1ebeb18c6/State_Mitigation_Plan_Review_Guide_2015.pdf.
- FEMA. 2016a. "Advance Notice of Proposed Rulemaking: Establishing a Deductible for FEMA's Public Assistance Program." Washington, D.C.: Federal Register. Available at: <https://www.regulations.gov/document?D=FEMA-2016-0003-0001>.
- FEMA. 2016b. "Notice of Proposed Rulemaking: Updates to the Floodplain Management and Protection of Wetlands Regulations to Implement Executive Order 13690 and the Federal Flood Risk Management Standard." Washington, D.C.: Federal Register. Available at: <https://www.regulations.gov/document?D=FEMA-2015-0006-0373>.
- Flato, G., and J. Marotzke. 2013. "Evaluation of Climate Models." In *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment*. 741–866. Edited by T. D.-K. Stocker. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.
- Georgetown Climate Center. 2014. *Preparing Our Communities for Climate Impacts: Recommendations for Federal Action*. Washington, D.C.: Georgetown Climate Center.
- Gomez, A. 2014. "Opportunities to Reduce Federal Fiscal Exposures Through Greater Resilience to Climate Change and Extreme Weather." Congressional testimony before the Committee on the Budget, U.S. Senate. Washington, D.C.: U.S. Government Accountability Office. Available at: <http://www.gao.gov/assets/670/665089.pdf>.
- Homeland Security Advisory Council. 2011. *Community Resilience Task Force Recommendations*. Washington, D.C.: U.S. Department of Homeland Security. Available at: <https://www.dhs.gov/xlibrary/assets/hvac-community-resilience-task-force-recommendations-072011.pdf>.
- HUD (U.S. Department of Housing and Urban Development). 2015a. *Choice Neighborhoods 2015 Grantee Report*. Washington, D.C.: Department of Housing and Urban Development. Available at: <http://portal.hud.gov/hudportal/documents/huddoc?id=CNGranteeReport2015.pdf>.
- HUD. 2015b. *Green Infrastructure and the Sustainable Communities Initiative*. Washington, D.C.: Department of Housing and Urban Development. Available at: <http://portal.hud.gov/hudportal/documents/huddoc?id=greeninfrastructsci.pdf>.
- HUD. 2015c. "National Disaster Resilience Competition: Phase 2 Fact Sheet." Washington, D.C.: Department of Housing and Urban Development. Available at: <http://portal.hud.gov/hudportal/documents/huddoc?id=NDRCFactSheetFINAL.pdf>.
- HUD. 2016. "National Disaster Resilience Competition Grantee Profiles." Washington, D.C.: Department of Housing and Urban Development. Available at: <http://portal.hud.gov/hudportal/documents/huddoc?id=NDRCGrantProf.pdf>.
- ICLEI (International Council for Local Environmental Initiatives), NLC (National League of Cities), Resilient Communities for America, WWF (World Wildlife Foundation), and U.S. Green Building Council. 2014. *Resilient Communities for America Federal Policy Initiative: Recommendations to the President's Task Force on Climate Preparedness and Resilience*. Washington, D.C.: ICLEI. Available at: http://iclei.usa.org/wp-content/uploads/2015/06/RC4A-Federal-Policy-Initiative_Final-Report5-15-14.pdf.
- IPCC (Intergovernmental Panel on Climate Change). 2014. *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. Geneva: IPCC. Available at: www.ipcc.ch/report/ar5/syr/.
- Jamestown S'Klallam Tribe. 2013. *Climate Vulnerability Assessment and Adaptation Plan*. Available at: http://www.jamestowntribe.org/programs/nrs/climchg/JSK_Climate_Change_Adaptation_Report_Final_Aug_2013s.pdf.

- Jurado, J. 2016. Personal Communication. August 28.
- Kelly, C., P. Miranda, E. Auel, G. Taraska, and P. Qian. 2016. *Resilient Midwestern Cities: Improving Equity in a Changing Climate*. Washington, D.C.: Center for American Progress. Available at: <https://cdn.americanprogress.org/wp-content/uploads/2016/04/18135245/ResilientMidwest-report1.pdf>.
- Kennedy, K., M. Obeiter, and N. Kaufman. 2015. *Putting a Price on Carbon: A Handbook for U.S. Policymakers*. Washington, D.C.: World Resources Institute. Available at: http://www.wri.org/sites/default/files/carbonpricing_april_2015.pdf.
- Koch, W. 2013a. "Alaska Builds Differently to Adapt to Climate Change." December 16. *USA Today*. Available at: <http://www.usatoday.com/story/news/nation/2013/10/08/alaska-builds-climate-change/2944803/>.
- Koch, W. 2013b. "Alaska Sinks as Climate Change Thaws Permafrost." *USA Today*. December 16. Available at: <http://www.usatoday.com/story/news/nation/2013/10/08/alaska-sinks--climate-change-thaws-permafrost/2794255/>.
- Kuo, F. E. and W. C. Sullivan. 2001. "Environment and Crime in the Inner City: Does Vegetation Reduce Crime?" *Environment and Behavior* 33(3): 343–367.
- Larsen, L., N. Rajkovich, C. Leighton, K. McCoy, K. Calhoun, E. Mallen, and A. Kwok. 2011. *Green Building and Climate Resilience: Understanding Impacts and Preparing for Changing Conditions*. Ann Arbor, MI: University of Michigan; Washington, D.C.: U.S. Green Building Council. Retrieved from <http://www.usgbc.org/Docs/Archive/General/Docs18496.pdf>.
- Leichty, J. 2016. Personal Communication. April 25.
- Love, N.P. 2009. *FEMA's Hazard Mitigation Grant Program: Overview and Issues*. Washington, D.C.: Congressional Research Service.
- Marks, S.D. 2016. Personal Communication. May 12.
- McCarthy, F.X., and N. Keegan. 2009. *FEMA's Pre-Disaster Mitigation Program: Overview and Issues*. Washington, D.C.: Congressional Research Service.
- McGray, H., A. Hammill, and R. Bradley. 2007. *Weathering the Storm: Options for Framing Adaptation and Development*. Washington, D.C.: World Resources Institute. Available at: http://pdf.wri.org/weathering_the_storm.pdf.
- Melillo, J.M., T.C. Richmond, and G.W. Yohe. 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. Washington, D.C.: U.S. Global Change Research Program. Available at: <http://nca2014.globalchange.gov/>.
- Mitigation Framework Leadership Group. 2016. *Draft Interagency Concept for Community Resilience Indicators and National-Level Measures*. Washington, D.C.: U.S. Department of Homeland Security. Available at: https://www.fema.gov/media-library-data/1466085676217-a14e229a461adfa574a5d03041a6297c/FEMA-CRI-Draft-Concept-Paper-508_Jun_2016.pdf.
- Multihazard Mitigation Council. 2005. *Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities*. Washington, D.C.: National Institute of Building Sciences. Available at: http://c.ymcdn.com/sites/www.nibs.org/resource/resmgr/MMC/hms_vol2_ch1-7.pdf?hhSearchTerms=Natural+and+hazard+and+mitigation.
- NOAA (National Oceanic and Atmospheric Administration). 2013. *The Economic Value of Resilient Coastal Communities*. Silver Spring, MD: National Oceanic and Atmospheric Administration. Available at: <http://www.ppi.noaa.gov/wp-content/uploads/EconomicValueofResilientCoastalCommunities.pdf>.
- NOAA. 2014. "NOAA: 'Nuisance flooding' an Increasing Problem as Coastal Sea Levels Rise." Silver Spring, MD: National Oceanic and Atmospheric Administration. Available at: http://www.noaaneews.noaa.gov/stories2014/20140728_nuisanceflooding.html.
- NOAA. 2015. "A Decade of Progress in Predictions, Outlooks, and Decision Support." Silver Spring, MD: National Oceanic and Atmospheric Administration. Available at: http://www.noaaneews.noaa.gov/advisories/images/Katrina2pg_MAPP2-FINAL.pdf.
- OMB (Office of Management and Budget). 2016. *OMB Circular A-11*. Washington, D.C.: Executive Office of the President. Available at: https://www.whitehouse.gov/omb/circulars_a11_current_year_a11_toc.
- Resilience Council (Council on Climate Preparedness and Resilience). 2016. *Opportunities to Enhance the Nation's Resilience to Climate Change*. Washington, D.C.: The White House. Available at: <https://www.whitehouse.gov/sites/default/files/finalresilienceopportunitiesreport.pdf>.
- Schulte, D.M., K.M. Dridge, and M.H. Hudgins. 2015. "Climate Change and the Evolution and Fate of the Tangier Islands of Chesapeake Bay, USA." *Scientific Reports* 5(17890): 1–7.
- Shreve, C.M., and I. Kelman. 2014. "Does Mitigation Save? Reviewing Cost-Benefit Analyses of Disaster Risk Reduction." *International Journal of Disaster Risk Reduction* 10(A): 213–235.
- SmarterSafer. 2015. *Bracing for the Storm: How to Reform U.S. Disaster Policy to Prepare for a Riskier Future*. Available at: <http://www.smartersafer.org/wp-content/uploads/Bracing-for-the-Storm.pdf>.
- Smith, A.B. and R.W. Katz. 2013. "US Billion-Dollar Weather and Climate Disasters: Data Sources, Trends, Accuracy and Biases." *Natural Hazards* 67(2): 387–410.
- State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience. 2014. *Recommendations to the President*. Washington, D.C.: The White House. Available at: https://www.whitehouse.gov/sites/default/files/docs/task_force_report_0.pdf.
- Swinomish Indian Tribal Community. 2010. *Climate Adaptation Action Plan*. Available at: http://www.swinomish.org/climate_change/Docs/SITC_CC_AdaptationActionPlan_complete.pdf.

The National Academies. 2011. *Building Community Disaster Resilience Through Private-Public Collaboration*. Washington, D.C.: National Academies Press. Available at: <https://www.nap.edu/catalog/13028/building-community-disaster-resilience-through-private-public-collaboration>.

The National Academies. 2012. *Disaster Resilience: A National Imperative*. Washington, D.C.: National Academies Press. Available at: <https://www.nap.edu/catalog/13457/disaster-resilience-a-national-imperative>.

The White House. 2014. "FACT SHEET: Lifting America's Game in Climate Education, Literacy, and Training." Washington, D.C.: The White House. Available at: <https://www.whitehouse.gov/sites/default/files/microsites/ostp/climateed-dec-3-2014.pdf>.

The White House. 2015a. *Executive Order 13693: Planning for Federal Sustainability in the Next Decade*. Washington, D.C.: Federal Register. <https://www.gpo.gov/fdsys/pkg/FR-2015-03-25/pdf/2015-07016.pdf>.

The White House. 2015b. *Memorandum for Executive Departments and Agencies: Incorporating Ecosystem Services into Federal Decision Making*. Available at: <https://www.whitehouse.gov/sites/default/files/omb/memoranda/2016/m-16-01.pdf>.

The White House. 2015c. *Progress Report: Highlighting Federal Actions Addressing the Recommendations of the State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience*. Available at: https://www.whitehouse.gov/sites/default/files/docs/climate_preparedness_report_updated_070915.pdf.

The White House. 2016. *Presidential Memorandum: Climate Change and National Security*. Available at: <https://www.whitehouse.gov/the-press-office/2016/09/21/presidential-memorandum-climate-change-and-national-security>.

Torsell, C.V., and J.C. Nagel. 2015. *Federal Disaster Assistance Response and Recovery Programs: Brief Summaries*. Washington, D.C.: Congressional Research Service.

Troy, A., J. M. Grove, and J. O'Neil-Dunne. 2012. "The relationship between tree canopy and crime rates across an urban-rural gradient in the greater Baltimore region." *Landscape and Urban Planning* 106(2012): 262–270.

Walsh, J., D. Wuebbles, K. Hayhoe, J. Kossin, K. Kunkel, G. Stephens, P. Thorne, R. Vose, M. Wehner, J. Willis, D. Anderson, S. Doney, R. Feely, P. Hennon, V. Kharin, T. Knutson, F. Landerer, T. Lenton, J. Kennedy, and R. Somerville. 2014. "Our Changing Climate." In *Climate Change Impacts in the United States: The Third National Climate Assessment*: 19–67. Edited by J.M. Melillo, Terese (T.C.) Richmond, and G.W. Yohe. Washington, D.C.: U.S. Global Change Research Program. Available at: http://s3.amazonaws.com/nca2014/high/NCA3_Full_Report_02_Our_Changing_Climate_HighRes.pdf?download=1.

Weiss, D.J., and J. Weidman. 2013. *Pound Foolish: Federal Community-Resilience Investments Swamped by Disaster Damages*. Washington, D.C.: Center for American Progress. Available at: <https://www.americanprogress.org/wp-content/uploads/2013/06/FedResilienceSpending.pdf>.

Zambrano-Barragan, Carolina. 2011. "Decision Making and Climate Change Uncertainty: Setting the Foundations for Informed and Consistent Strategic Decisions." In *World Resources 2010–2011: Decision Making in a Changing Climate—Adaptation Challenges and Choices*, by World Resources Institute, United Nations Development Programme, United Nations Environment Programme and World Bank. Washington, D.C.: World Resources Institute. Available at: <http://www.wri.org/our-work/project/world-resources-report/decision-making-and-climate-change-uncertainty-setting>.

ENDNOTES

1. Walsh et al., 2014.
2. NOAA, 2014.
3. NOAA, 2013.
4. The White House, 2016.
5. Resilience Council, 2016.
6. The aforementioned NACCS is one example of federal agency cooperation and coordination following Hurricane Sandy. The NACCS, led by USACE, also included input from the Department of the Interior, National Park Service, U.S. Fish and Wildlife Service, U.S. Geological Survey, NOAA, and FEMA.
7. U.S. Department of Transportation. "About TIGER Grants." Retrieved April 29, 2016, from Department of Transportation: <https://www.transportation.gov/tiger/about>.
8. DOT, 2015.
9. HUD (U.S. Department of Housing and Urban Development). 2016. "Choice Neighborhoods." Retrieved April 27, 2016 from Department of Housing and Urban Development: http://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/programs/ph/cn.
10. HUD, 2015a.
11. U.S. Army Corps of Engineers. n.d.. "About the Silver Jackets Program." Retrieved April 22, 2016, from Silver Jackets: <http://silverjackets.nfrmp.us/Home/About-The-Silver-Jackets-Program>.
12. Boyd, 2011.
13. FloodSmart.Gov. 2016. "About CRS." Retrieved April 5, 2016, from National Flood Insurance Program: https://www.floodsmart.gov/floodsmart/pages/crs/community_rating_system.jsp.
14. FloodSmart.Gov. 2016. "CRS Classes, Credit Points, and Premium Reductions." Retrieved April 5, 2016, from National Flood Insurance Program: https://www.floodsmart.gov/floodsmart/pages/crs/crs_classes.jsp.
15. Federal Emergency Management Agency. 2016. "Flood Mitigation Assistance Grant Program." Retrieved April 5, 2016, from Federal Emergency Management Agency: <https://www.fema.gov/flood-mitigation-assistance-grant-program>.
16. FEMA, 2015b.
17. Love, 2009.
18. Torsell and Nagel, 2015.
19. Partnership for Sustainable Communities. 2015. "About Us." Retrieved April 26, 2016, from Partnership for Sustainable Communities: <https://www.sustainablecommunities.gov/mission/about-us>.
20. Torsell and Nagel, 2015.
21. McCarthy and Keegan, 2009.
22. FEMA, 2015c.
23. AIA Baltimore. n.d. "B-MORE | RESILIENT: Rowhouse Competition 2015." Retrieved April 18, 2016, from AIA Baltimore: <http://www.aiabaltimore.org/competition/resilient/>.
24. Boston: Living with Water. 2016. "About." Retrieved April 18, 2016, from Living with Water: <http://www.bostonlivingwithwater.org/about>.
25. HUD, 2015c.
26. The White House. 2015. "Resilience AmeriCorps Announces Ten Cities for Its Pilot Program to Support Communities in Building Capacity and Technical Support for Climate Resilience." Retrieved May 3, 2016, from The White House: <https://www.whitehouse.gov/the-press-office/2015/08/19/resilience-ameri-corps-announces-ten-cities-its-pilot-program-support>.
27. Rebuild by Design. n.d. "About Rebuild by Design." Retrieved April 6, 2016, from Rebuild by Design: <http://www.rebuildbydesign.org/what-is-rebuild-by-design/>.
28. RE.invest. 2016. "Goals." Retrieved September 9, 2016, from <http://www.reinvestinitiative.org/about-reinvest/>.
29. 100 Resilient Cities. 2016. "100 Resilient Cities Challenge." Retrieved April 11, 2016, from 100 Resilient Cities: http://www.100resilientcities.org/pages/100-resilient-cities-challenge#/-/_/.
30. Southeast Florida Regional Climate Change Compact. n.d. "Announcing: Global Impact Competition in Miami." Retrieved April 18, 2016, from Southeast Florida Regional Climate Change Compact: <http://www.southeastfloridaclimatecompact.org/2015/03/announcing-global-impact-competition-in-miami/>.
31. Kresge Foundation. 2015. "Climate Resilience and Urban Opportunity: Focus Area Overview." Retrieved September 9, 2016, from Kresge Foundation: <http://kresge.org/programs/environment/climate-resilience-and-urban-opportunity>.
32. Kresge Foundation. 2015. "Climate Resilience in Coastal Cities and Regions: Focus Area Overview." Retrieved September 9, 2016, from Kresge Foundation: <http://kresge.org/programs/environment/climate-resilience-coastal-cities-and-regions>.
33. Marks, 2016.
34. City of Hoboken. 2015. "UN Recognizes Hoboken as a Role Model for Resilience." Retrieved May 5, 2016 from City of Hoboken: <http://www.hobokennj.org/2015/03/un-recognizes-hoboken-as-a-role-model-for-resilience/>.
35. City of Hoboken. 2014. "Hoboken Regional Flood Protection Proposal Wins Rebuild by Design Competition." Retrieved May 5, 2016 from City of Hoboken: <http://hobokennj.gov/2014/06/hoboken-regional-flood-protection-proposal-wins-rebuild-by-design-competition/>.
36. Jurado, 2016.
37. Southeast Florida Regional Climate Change Compact. 2014. "About the Compact." Retrieved May 3, 2016 from Southeast Florida Regional Climate Change Compact: <http://www.southeastfloridaclimatecompact.org/>.
38. Southeast Florida Regional Climate Change Compact. n.d. "What is the Southeast Florida Regional Climate Change Compact?" Retrieved May 3, 2016 from Southeast Florida Regional Climate Change Compact: <https://southeastfloridaclimatecompact.files.wordpress.com/2014/05/compact-1-page-flyer-ia-final-sa.pdf>.
39. Leichty, 2016.
40. 100 Resilient Cities. 2016. "Chicago's Resilience Challenge." Retrieved May 4, 2016 from 100 Resilient Cities: http://www.100resilientcities.org/cities/entry/chicago#/-/_/.
41. Berndt, 2015.
42. Morton Arboretum. 2016. "Chicago Region Trees Initiative." Retrieved May 4, 2016 from Morton Arboretum: <http://www.mortonarb.org/science-conservation/chicago-region-trees-initiative>.
43. City of Chicago. 2016. "Adding Green to Urban Design." Retrieved May 4, 2016 from City of Chicago: http://www.cityofchicago.org/city/en/depts/dcd/supp_info/green_urban_design.html.
44. City of Chicago. 2016. "Green Alleys." Retrieved May 4, 2016 from City of Chicago: http://www.cityofchicago.org/city/en/depts/cdot/provdrs/street/svcs/green_alleys.html.

45. City of Minot. 2016. "Minot Awarded \$74.3 Million in HUD's National Disaster Resilience Competition." Retrieved May 5, 2016 from City of Minot: <http://www.minotnd.org/DocumentCenter/View/1447>.
46. City of Minot. 2016. "National Disaster Resilience Competition." Retrieved May 5, 2016 from City of Minot: <http://www.minotnd.org/422/National-Disaster-Resilience-Competition>.
47. City of Minot. 2015. "National Disaster Resilience Competition Phase 2 Application." Retrieved May 5, 2016 from City of Minot: <http://www.minotnd.org/DocumentCenter/Home/View/911>.
48. Climate change: infrastructure planning. A.B. 2800. 2015-2016 Session. 2016. Retrieved November 1, 2016 from: http://leginfo.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB2800.
49. Jarred, M. 2016. "Assembly Floor Analysis: AB 2800." California Legislative Information. Retrieved November 1, 2016 from: http://leginfo.ca.gov/faces/billAnalysisClient.xhtml?bill_id=201520160AB2800.
50. Swinomish Indian Tribal Community, 2010.
51. Jamestown S'Klallam Tribe, 2013.
52. Koch, 2013a.
53. Koch, 2013b.
54. Georgetown Climate Center. 2013. "Alaska Repaving Roads Using Polystyrene Insulation." Retrieved May 5, 2016 from Georgetown Climate Center: <http://www.georgetownclimate.org/resources/alaska-repaving-roads-using-polystyrene-insulation>.
55. State of Hawaii. 2016. "Pili Na Mea A Pau All Things are Related." Retrieved May 9, 2016 from State of Hawaii: <http://climateadaptation.hawaii.gov/>.
56. State of Hawaii. 2016. "Hawaii Climate Adaptation Initiative." Retrieved May 9, 2016 from State of Hawaii: <http://climateadaptation.hawaii.gov/initiative/>.
57. State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, 2014.
58. State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, 2014.
59. Georgetown Climate Center, 2014.
60. The National Academies, 2012.
61. State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, 2014.
62. Multihazard Mitigation Council, 2005.
63. Shreve and Kelman, 2014.
64. Georgetown Climate Center. n.d. "State and Local Adaptation Plans." Retrieved March 30, 2016 from Georgetown Climate Center: <http://www.georgetownclimate.org/adaptation/state-and-local-plans>.
65. Weiss and Weidman, 2013.
66. The National Academies, 2012.
67. SmarterSafer, 2015.
68. Homeland Security Advisory Council, 2011.
69. State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, 2014.
70. FEMA, 2016a.
71. The White House. 2015. "Resilience AmeriCorps Announces Ten Cities for Its Pilot Program to Support Communities in Building Capacity and Technical Support for Climate Resilience." Retrieved May 3, 2016, from The White House: <https://www.whitehouse.gov/the-press-office/2015/08/19/resilience-ameri-corps-announces-ten-cities-its-pilot-program-support>.
72. The White House, 2015c.
73. The National Academies, 2012.
74. Kennedy et al., 2015.
75. Larsen et al., 2011.
76. Gomez, 2014.
77. Weiss and Weidman, 2013.
78. Federal Emergency Management Agency, 2016b.
79. The White House, 2015c.
80. Office of Management and Budget, 2016.
81. The White House, 2015c.
82. Gomez, 2014.
83. State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, 2014.
84. ICLEI et al., 2014.
85. Old Dominion University. 2016. "About the Intergovernmental Planning Pilot Project." Retrieved September 16, 2016 from Old Dominion University: <http://www.centerforsealevelrise.org/about-the-center-for-sea-level-rise/>.
86. The White House, 2016.
87. The White House, 2015c.
88. The White House, 2015b.
89. ICLEI et al., 2014.
90. Georgetown Climate Center, 2014.
91. State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, 2014.
92. Bronen, 2013.
93. HUD, 2016.
94. Schulte et al., 2015.
95. The White House, 2015c.
96. The White House, 2015c.
97. U.S. Department of Interior. 2015. "Interior Department to Announce \$8 Million for Tribal Climate Change Adaptation and Planning Projects." Retrieved September 16, 2016 from Department of Interior: <http://www.bia.gov/cs/groups/public/documents/text/idc1-029389.pdf>.
98. State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience 2014.
99. Kelly et al., 2016.
100. The National Academies, 2011.
101. National Oceanic and Atmospheric Administration. 2015. "DOI, USDA, EPA, NOAA and USACE Announced Additional Resilient Lands and Waters Initiative Sites to Prepare Natural Resources for Climate Change." Retrieved September 16, 2016 from National Oceanic and Atmospheric Administration: <http://www.noaanews.noaa.gov/stories2015/20150624-resilient-lands-waters-initiative-sites-safeguard-natural-resources.html>.
102. U.S. Department of Housing and Urban Development. 2015. "National Disaster Resilience Competition." Retrieved April 18, 2016 from U.S. Department of Housing and Urban Development: <https://www.hudexchange.info/programs/cdbg-dr/resilient-recovery/>.
103. U.S. Department of Energy. n.d. "Partnership for Energy Sector Climate Resilience." Retrieved September 16, 2016 from U.S. Department of Energy: <http://energy.gov/epsa/partnership-energy-sector-climate-resilience>.
104. The National Academies, 2012.
105. Melillo, et al., 2014.
106. IPCC, 2014.

-
107. Smith and Katz, 2013.
 108. Munich RE. 2016. "Loss Events in the U.S. 1980–2015." Retrieved March 15, 2016 from Munich RE: https://www.munichre.com/site/wrap/get/documents_E1925690258/mram/assetpool.munichre.com/wrap/PDF/2015/Loss_events_US_1980-2015.pdf.
 109. Aon Benfield, 2016.
 110. Environmental Protection Agency. 2016. "Benefits of Green Infrastructure." Retrieved September 18, 2016 from Environmental Protection Agency: <https://www.epa.gov/green-infrastructure/benefits-green-infrastructure>.
 111. Troy et al., 2012 and Kuo and Sullivan, 2001.
 112. State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, 2014.
 113. FEMA, 2015a.
 114. The White House. 2015. "Using Green Infrastructure to Enhance Coastal Resilience." Retrieved September 16, 2016 from The White House: <https://www.whitehouse.gov/blog/2015/08/27/using-green-infrastructure-enhance-coastal-resilience>.
 115. HUD, 2015b.
 116. ICLEI et al., 2014.
 117. Georgetown Climate Center, 2014.
 118. The National Academies, 2012.
 119. Georgetown Climate Center, 2014.
 120. The National Academies, 2012.
 121. Mitigation Framework Leadership Group, 2016.
 122. Abt Associates, 2015.
 123. The White House, 2015c.
 124. National Mitigation Investment Act. H.R. 5177. 114th Cong. 2016. Retrieved May 31, 2016 from Representative Curbelo: https://curbelo.house.gov/uploadedfiles/curbelo_pre_disaster_mitigation_5.4.16.pdf.
 125. The National Academies, 2012.
 126. NOAA, 2015.
 127. Flato and Marotzke, 2013.
 128. Flato and Marotzke, 2013.
 129. McGray, et al., 2007.
 130. The White House. 2016. "Open Government Initiative." Retrieved September 16, 2016 from The White House: <https://www.whitehouse.gov/open>.
 131. U.S. Climate Resilience Toolkit. 2016. "U.S. Climate Resilience Toolkit." Retrieved September 15, 2016 from U.S. Climate Resilience Toolkit: <https://toolkit.climate.gov/>.
 132. U.S. Department of State. 2016. "Joint Declaration on Harnessing the Data Revolution for Climate Resilience." Retrieved September 23, 2016 from State Department: <http://www.state.gov/globalgoals/releases/262189.htm>.
 133. The White House, 2015c.
 134. The White House, 2014.
 135. State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, 2014.
 136. Georgetown Climate Center, 2014.
 137. ICLEI et al., 2014.
 138. State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, 2014.
 139. Zambrano-Barragan, 2011.
 140. Flooding that causes road closures, overwhelmed storm drains, and other public inconveniences.

ACKNOWLEDGMENTS

The authors would like to thank the following individuals for their valuable insights, feedback, and critical reviews of this work: Sam Adams, Christina DeConcini, Kevin Kennedy, Kristin Igusky, Ayesha Dinshaw, Katerina Trostmann, Kelly Levin, Bruce Lindsay, Cathleen Kelly, Jeff Collier, Jennifer Jurado, Katy Maher, Stephen Marks, and Victoria Hermann. While our reviewers were very generous with their time and advice, the authors alone are responsible for the content of this working paper.

We would like to thank the federal officials who participated in the Rising Tides Summit. We would also like to thank the 36 local elected officials who attended the Summit. Without their bipartisan leadership and acknowledgment of the need for action to improve our nation's resilience, the Summit and its success would not have been possible. We want to thank the Union of Concerned Scientists as our partners in organizing and producing the Summit.

Additionally, we would like to thank Emily Matthews for copy editing, Jennifer Lockard and Carni Klirs for publication design and layout, and Hyacinth Billings for publication support.

ABOUT THE AUTHORS

C. Forbes Tompkins is a Research Analyst with the U.S. Climate Initiative in the Global Climate Program. His work supports WRI's Climate Impacts Project where he strives to ensure policymakers at all levels of government are aware of climate impacts and efforts to address them. Forbes has served as WRI's scientific representative on the Third National Climate Assessment and U.S. aspects of the Intergovernmental Panel on Climate Change's Fifth Assessment Report. Prior to WRI, he worked at the Institute for Governance and Sustainable Development and on Capitol Hill. Forbes has peer-reviewed publications on extreme weather and the influence of climate change. Forbes has Master's degrees from the Florida Institute of Technology and John's Hopkins University.

Contact: ftompkins@wri.org

Nathan Cogswell is a Research Assistant for the U.S. Climate Initiative in WRI's Climate Program. Nathan supports the Climate Impacts Project. He comes to WRI after having completed his Master's degree in Environmental Resource Policy at George Washington University. Some of Nathan's previous work has been published in peer-reviewed journals.

Contact: nathan.cogswell@wri.org

ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity and human well-being.

Our Challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.



Copyright 2016 World Resources Institute. This work is licensed under the Creative Commons Attribution 4.0 International License.
To view a copy of the license, visit <http://creativecommons.org/licenses/by/4.0/>