

# Watershed Academy Webcast

## Climate Resilience:

### What to Expect, How to Prepare, and What You Can Learn from Others

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#### Slide: Climate Resilience: What to Expect, How to Prepare, and What You Can Learn from Others

##### Erika Larsen

Good afternoon, and welcome to today's webcast titled "Climate Resilience: What to Expect, How to Prepare, and What You Can Learn from Others." This webcast is sponsored by EPA's Watershed Academy and EPA's Office of Wetlands, Oceans, and Watersheds, also known as OWOW. I'm Erika Larsen, and I will be moderating today's webcast along with Jared McKee, who's an ORISE Fellow working with EPA's National Estuary Program. Thank you all for joining us today.

#### Slide: Webcast Logistics

We'll start by going over a few housekeeping items. First, I'd like to briefly summarize some of the features of today's webinar. We hope you have lots of questions. Type your questions in the "Questions" box on your control panel and click "Send." If your control panel is not showing, simply click on the small orange box with the white arrow to expand it. If you have any problems viewing the broadcast just let us know in the "Questions" box, and we will post an answer in that same box. The webcast will be archived for later viewing on EPA's Watershed Academy webcasts page at [www.epa.gov/watershedwebcasts](http://www.epa.gov/watershedwebcasts). A PDF copy of the slides is also posted on the Watershed Academy website. Participants are eligible to receive a certificate for their attendance at the end of the webcast. Directions for obtaining this certificate will be presented at the conclusion of the presentation. The materials in this webcast have been reviewed by US EPA staff for technical accuracy. However, the views of the speakers and the speakers' organizations are their own and do not necessarily reflect those of US EPA. Mention of commercial enterprises, products, or publications does not mean that US EPA endorses them.

## **Slide: Overview of Today's Webcast**

Now that we have completed the discussion of housekeeping items, let's kick off today's webcast.

This webcast will focus on climate resilience, which is the capacity of an individual, community, or institution to dynamically and effectively respond to shifting climate impacts while continuing to function at an acceptable level. During this webcast, our first speaker will share findings from the most recent National Climate Assessment report concerning climate change and water resources. Our second speaker will share some information about a new resource from EPA to help communities prepare for climate change impacts. The workbook, titled "Being Prepared for Climate Change: A Workbook for Developing Risk-Based Adaptation Plans," helps users to create a vulnerability assessment and identify adaptation actions to address their vulnerability. The third and last speaker will explain how the workbook has been used in a pilot project with the San Juan Bay National Estuary Program.

Without further delay, let me introduce our speakers. Our first speaker is Paul Fleming, manager of the Climate Resiliency Group for the Seattle Public Utilities. He is responsible for leading climate change research initiatives, assessing climate risks, developing adaptation and mitigation strategies, and establishing collaborative partnerships. Mr. Fleming is also an active participant in several national and international efforts focused on water and climate change. He was appointed to the National Climate Assessment Development Advisory Committee, which oversaw the development of the 2013 US National Climate Assessment for the federal government. He was a co-convening lead author of the Water Resources chapter and a lead author of the Adaptation chapter of the National Climate Assessment.

Our next speaker, Michael Craghan, serves as a lead for EPA's Climate Ready Estuaries Program in the Office of Wetlands, Oceans, and Watersheds. Michael Craghan has been working in science, education, and public policy regarding the environment and hazards for more than 20 years. He has taught in both the Geography and the Marine Science departments at Rutgers University and for the Earth and Atmospheric Science Department at City College of New York. He has also worked on climate change projects for the Committee on the Human Dimensions of Global Change at the National Academy of Sciences. He has worked for the National Flood Insurance Program as an engineer in FEMA's Mitigation division. He has a B.S. in Civil Engineering, and an M.S. and Ph.D. degrees in Geography.

Kasey Jacobs is the partnership and outreach coordinator for the Caribbean Landscape Conservation Cooperative and San Juan Bay National Estuary Program. Prior to this, Kasey served in Puerto Rico's Coastal Zone Management Program in the Department of Natural and Environmental Resources as a NOAA Coastal Management Fellow. Originally from Long Island, New York, and south Florida, Kasey completed her Bachelor of Science in Marine and Environmental Science from South Hampton College and graduated with a Master's degree from the Yale School of Forestry and Environmental studies.

One final note, we will try to answer as many questions as possible throughout this webcast. However, due to the high number of participants, not all questions will be answered. But please do contact the speakers after the webcast. The speakers' contact information is on one of our final slides and on the Additional Resources document posted at [epa.gov/watershedwebcasts](http://epa.gov/watershedwebcasts). And with that, we'll begin our presentation. I'll now turn it over to

Paul Fleming to provide a brief overview of the findings of the Water chapter of the National Climate Assessment. Paul, the floor is yours. Take it away.

### **Paul Fleming**

There we go. Great. Thanks for that introduction, and I'm happy to be here virtually with all of you. So -- can you see my -- there we go. Okay, great.

### **Slide: Overview of the Process and Findings of 2014 NCA Water Resources Chapter**

So I'm going to provide a quick overview of the National Climate Assessment, particularly the Water chapter.

### **Slide: Outline**

We'll talk about some of the key findings and key messages from the National Climate Assessment and sort of the process that went into that and then hopefully have some time for discussion at the end of my presentation, at least a couple of questions, and then maybe some additional discussion at the end of the third presentation. So without further ado, let's dive in.

### **Slide: NCA Topline Messages**

The National Climate Assessment is a statutorily required report that's supposed to be done every four years, so it's maybe the Olympics of assessments. And it's focused on documenting the observed and projected impacts of climate change across multiple sectors and all regions of the US. It was released in May of this year, and the key top-line messages were pretty profound and direct. And here they are. One is that climate change, or human-induced climate changes, is not an issue of the future. It's something that has moved into the present. So it's something that we are dealing with, and Americans across the US are already feeling the effects of climate change and the effects of certain types of extreme weather events. And that the impacts are evident throughout the US and across many of the key sectors that drive our economy. And finally, that we are not passive players in terms of how climate change -- the scope and breadth of climate change that can occur, nor in terms of the impacts that may occur, as well. We have -- there are actions that we can take to manage both the breadth of climate change that can occur as well as the impacts. So those are sort of the four key top-line messages from the entire report, and now I'm going to just talk a little bit about the report itself and the process that went into it.

### **Slide: Vision of the NCA**

The vision of the NCA was to advance this inclusive, broad-based, and sustained process for assessing the impacts of climate change, and ultimately it wants to be in support of decision making across the United States, so not just a document and a report that's relevant to the federal family -- that's paramount -- but also, again, in support, hopefully, of decision making across all levels of the society and the US. And it ties nicely into the third goal of the Global Change Research Program's Strategic Plan.

### **Slide: Sectors**

The structure of the report – I'm having trouble advancing here. There we go. There are multiple sectors that are looked at. So they're listed here, and, again, I'm going to focus a bit here on water resources. But many of the other sectors have equivalent treatments and in-depth exploration of observed and projected impacts of climate change in their sectors.

### **Slide: Cross-Cuts**

There are also some new topics that were explored in this version of the National Climate Assessment that try to take more of a systemic approach to the impacts, recognizing that impacts of climate change aren't necessarily contained within a sector. They can cut across, for instance, energy, water, and land. Clearly, there's a strong nexus between those three arenas, so it's important to think about climate change simultaneously in terms of how it can affect those three sectors. Urban systems, infrastructure, and vulnerability is another one. So a really nice advancement in terms of thinking about climate change a bit more holistically, and these chapters represent that advancement.

### **Slide: Sustained Assessment**

We also wrote a special report -- and I had the privilege of being a co-convening lead author on this special report -- on sustained assessment. And if you go back to the Olympics idea, when you -- I'm not an Olympic athlete, but if you are, when you're done with the Olympics, you don't go home and basically sit on the couch and eat Fritos for the next three or four years. You continue to train. And so we thought, in meeting the obligations of -- the statutory obligations of doing a report every four years, it would be helpful and prudent to have a sustained approach that maintains some of the capacity that is built up as the federal government prepares these reports, but also use that time in between the four-year cycle to really engage with multiple sectors, non-governmental players, private sector to advance our overall societal understanding and capacity to prepare for climate change. So we wrote this report that tried to lay out what we thought would be a good approach to doing that, to building that sustained capacity, to both assess and prepare for the impacts of climate change. And that's a report that's posted on the National Climate Assessment website, as well.

### **Slide: Climate Change Impacts in the United States: Chapter 3 Water Resources**

So let's move on to the Water chapter. And the next several slides are going to be graphically dense. So the good thing is that all of these graphs you can find on the National Climate Assessment website, either in the Climate chapter or the Water Resources chapter. And if you haven't had a chance to look at that website, I really encourage you to do so. It's a phenomenal website, a ton of information, a lot of supporting background information. Almost all of the graphs, if not all of them, that are in the report are online, and the supporting research that supports the graphical information is there. So really, a phenomenal website, and it's worth checking out. So the Water Resources chapter, I was one of the co-convening lead authors, and Aris Georgakakos at Georgia Institute of Technology was the other lead. Phenomenal researcher, both nationally and internationally, on the issue of climate change in water, so I had the really good fortune to work with him. And we had a fabulous team of lead authors that were plucked from federal agencies, USGS, NASA, Core of Engineers, the private sector, T.C. Richmond from Van Ness Feldman, which is a law firm in Seattle, and she was co-

chair of the National Climate Assessment Development Advisory Committee, and academia, as well as research organizations, so a really strong group of authors.

### **Slide: Water Resources Chapter Themes**

We broke the chapter into a couple of different sections. We looked at and examined the observed and projected impacts of climate change on the water cycle -- so the fluxes, the storages, water quality -- then moved into how those observed and projected changes have and are going to affect water supply, water demand, and then moved into what does that mean in terms of vulnerabilities, and, ultimately, what does that mean for institutional responses and the management of water resources? So there was a clear sort of architecture to our chapter that hopefully makes a fair amount of sense to the reader. And I'll dive into different aspects of those elements of the chapter now.

### **Slide: Observed U.S. Temperature and Precipitation Change**

So again, what we tried to do, and what was attempted to be done throughout the NCA in all 30-plus chapters, was to look at observed changes as well as projected changes, to break those down along regional lines, particularly along the regional lines that are established in the National Climate Assessment, to go further, if we could, spatially, to provide more refined spatial information, as well as temporal. So where we could provide seasonal breakdowns of projected or observed impacts, we tried to do that, as well. So we tried to get as refined as we could, given the knowledge base in the research community as well as space limitations for the report itself. This slide looks at the observed temperature and precipitation changes across the US. And basically, what we see is warming throughout the US in all regions on the left. And then, on the right, we see most regions experiencing wetter conditions -- not consistently across the US, but some regions experiencing drier conditions, as well.

### **Slide: Temperature Projections**

In terms of projections going forward, basically what we see are consistent -- consistently, projections are indicating warming in the coming decades that are going to range from three to ten degrees Fahrenheit, again, across the US.

### **Slide: Very Heavy Precipitation Change [1958-2012]**

In terms of precipitation changes, we have experienced and have seen very heavy increases in precipitation events, or the very heavy events have increased. So the top one percent of daily events have increased pretty much across the US, again, Hawaii being an outlier there. And that's expected to continue going forward. And that -- so a one-in-20 year event may be something like a one-in-15 or one-in-five by 2100.

### **Slide: Precipitation Projections**

And at the same time, we're seeing a somewhat similar story in terms of projections going forward, that we can see, again, if you think about a seasonal basis, spring reductions in the Southwest and increases in the Northeast, Midwest, and Alaska. And dry spells are expected to increase in most regions, so heavier rainfall events accompanied by longer periods between rainfall events.

### **Slide: Observed Soil Moisture Changes [1988-2012] (1 of 2)**

A topic that we, I think, did a nice job in a pretty limited way, though, is the issue of soil moisture and the relationships between soil moisture ET, evapotranspiration, and water supply and groundwater and flooding. I think there was a nice advancement in terms of those interrelationships. This slide shows some of the observed changes in soil moisture across the US at the annual scale. And again, we're seeing drying trends in many regions.

### **Slide: Observed Soil Moisture Changes [1988-2012] (2 of 2)**

This one provides a breakdown at the seasonal level. And again, we explored what those potential impacts could be on stream flow, recharge, agriculture.

### **Slide: Projected Changes in SWE, Runoff, & Soil Moisture**

We looked at snow pack and snow water equivalent -- and this is particularly salient in the West -- and decreases, projected decreases in snow water equivalent in vast swaths of the West, particularly in the lower Southwest. That has implications, again, for runoff as well as soil moisture, and projected to see significant reductions in runoff in California, Arizona, and the central Rockies and reductions in soil moisture across the Southwest. So again, in the chapter, what we try to do is draw and establish that kind of connective tissue between these phenomena, both observed and projected, and what it means for the resource.

### **Slide: Projected Streamflow Changes [Western US]**

This is the graph that we modified a bit that was pulled from a Bureau of Reclamation report that looked at projected changes in stream flow at, again, at a seasonal basis, April to July, December to March, and annual. And generally, that we see observed increases in the northern states, and that's projected to continue going forward. Generally, decreases are observed and projected to occur in the southern states, and that peak flows may occur earlier due to earlier snow melt. And that, again, real implications for reservoir management and potentially for water rights and the like.

### **Slide: Flood Magnitude Trends [1920 – 2008]**

Observed changes in flooding, so we see decreases in trends in the Southwest, increases in the Midwest and Northeast.

### **Slide: Flood Factors and Expected Trends**

And with respect to flooding, we attempted to delineate and differentiate the different types of flooding and the conditions that support them. So we looked at flash and urban flooding and argued or made the assertion that that's expected to increase going forward. Riverine flooding, though, is a bit uncertain and is tied up to several factors that can provide context for whether river flooding occurs. And then coastal flooding, and given sea level rise, we're expected to see increases in that in many of the coastal areas.

### **Slide: Groundwater Availability**

Groundwater doesn't necessarily get the same level of attention and maybe is a bit harder to discern, the climate signal, compared to surface water. And it's not necessarily as well monitored as surface water systems. So what -- we, though, did explore kind of interrelations between surface water and groundwater and, again, ET, soil moisture, and the like. This graph shows the different types of aquifers that exist across the US, and then we indicated or showed where groundwater is a larger source of supply or makes up -- what percentage of overall withdrawals is tied to groundwater across the US, and that's the graphic on the right. We note that groundwater can be relied on and turned to during drought times, and so integrated groundwater management, surface water management is crucial. And clearly, there's been a lot of good work done in examining the losses of groundwater in California, for instance, that predated and are occurring now with the drought there. And that there's a combination of effects from climate change and water use changes that will drive groundwater vulnerability and supply going forward. And of course, geology, rainfall intensity, recharge are all tied up into groundwater availability, as well. And note that coastal aquifers may be particularly vulnerable given stormwater -- I'm sorry, coastal flooding and storm surge.

### **Slide: Water Use [Withdrawals]**

This slide shows the sort of relative role of withdrawals across the US and what do they typically go for, be it thermoelectric power plants, irrigation and livestock, aquaculture, municipal and industrial sources of supply. Generally, the largest withdrawals occur in the drier western states, and those are primarily for crop irrigation and agricultural purposes. In the East, the withdrawals are tied primarily to municipal, industrial, and thermoelectric uses. And again, groundwater has a significant role to play in many parts of the US as a primary source of supply.

So that's kind of the second part of our chapter. Again, the first part looking at the water cycle changes, both observed and projected, how those kind of cascade into the resource, and then our final chapter or section was really about the institutional and management responses and implications.

### **Slide: Climate Change Impacts on Water Management**

And, you know, we start off by saying that climate change will likely generate new risks or exacerbate existing ones that may pose challenges for the water resource management sector and challenges that may not be able to be met with existing practices. So it's a heads up that we may need to alter the current way that we manage water resources and that, going forward, increasing resilience and adaptive capacity are really critical opportunities to strengthen management in light of the projected impacts of climate change. And that's, in effect, a kind of professionalization of this issue. How do you look at those impacts and put in place the strategies that will serve you well going forward in time? We -- the NCA is not a policy prescriptive document. We steer away from that. But we do note some of the adaptation strategies that have been deployed and may be useful going forward. Given the uncertainty of what the changes may mean, flexibility and adaptive management strategies are going to be really critical. And that could be particularly relevant for reservoir management. We note the importance of stormwater and groundwater management and integrated management between those two as opportunities to potentially move from one source to the other if one is being particularly compromised during a drought. Stronger monitoring and assessment of

statewide water use and greater coordination amongst stakeholders. We also talk about ultimately integrating climate considerations into infrastructure design and management and construction. But, you know, if you think about the flavor of the examples, at least here, it's multi-faceted. It's not just about building big, new things, but it's also about our management strategies and better information, more dynamic and flexible approaches to managing infrastructure systems.

### **Slide: Summary**

So those are the – a very quick overview of about two years or so of work. And I would encourage you to take a look at the chapter if you haven't already. Again, I hope it will provide some of that connective tissue that I mentioned that will pull together the graphs that I skimmed over pretty quickly. In summary, I think it's a pretty good assessment and extensive assessment of the water cycle and water resource impacts, again, both observed and projected across the US and highlighting the implications and the interconnections between different aspects of the water cycle as well as the resource itself, and what does that mean for management of that resource. The NCA did a really nice job of providing what we call traceable accounts, so a supporting documentation of each of the key messages that emerge from the different chapters, and so -- to really provide, again, this sort of traceability. How did you get to this key message? What did you base that statement on? And I think went a little bit further in terms of putting in these impacts, both observed and projected, into the context of what do you do about it? What are some responses that can be taken to deal with those impacts and going forward? And there is an Adaptation chapter itself that is not focused just on water but is focused on adaptation at large, which does a nice job of, I think, advancing the thinking of what is happening currently in the US, and what are some strategies going forward.

So that's my summary. I'm happy to take some questions now or can also ask some at the end of the third presentation. Oh, I should say again, here's the website for the climate assessment. And again, I would encourage you to take a look at that.

### **Slide: Questions**

And I wouldn't be anywhere without Aris Georgakakos. This presentation was really pulled from much of his work as well as some of the information provided to me by NCA staff as well as USGCRP staff. Thank you.

### **Erika Larsen**

Okay, great. Thanks, Paul, for that excellent presentation. I think we all have a better understanding now of the key findings of the Water chapter of the National Climate Assessment. So now we'll have some time for questions for Paul Fleming. Jared will pose the questions from the audience to you, Paul.

### **Jared McKee**

All right, Paul. Are you ready? We've got some good questions now from our audience, and I'll start with this one. "If we lose surface water, does that mean we automatically lose groundwater?"



### **Paul Fleming**

Huh – well, I don't necessarily think that's the case. And I'll take a little bit of an easy route off in terms of saying it depends on locale. I would imagine that you could have evaporative losses perhaps accelerated that happen at the same time that recharge is occurring. And, you know, you could – I think you could have enhanced recharge, for instance, that could mean that you "lose" surface water that is being directed towards -- recharged to aquifers, either through passive means or through active injection of surface water into groundwater. So I don't think it's that simple to say loss of surface water means loss of groundwater. But again, I think it would depend upon sort of the multiple factors in play in a given location.

### **Jared McKee**

All right. Next question, "Which climate model was used for the prediction of future climate conditions?"

### **Paul Fleming**

There were multiple models used in the NCA. I don't know offhand the list of models, but it wasn't a single model. It was a multi-model suite of outputs that were used for the projections embedded in the report. And these, I believe, were derived from the CMIT (ph) 5 process.

### **Jared McKee**

Okay. "What are some example actions identified in the Adaptation chapter that could be undertaken by state water quality agencies?"

### **Paul Fleming**

State water quality agencies in particular, I think our adaptation strategies were pretty high-level and they didn't necessarily speak to water quality. But I think, to the degree that more flexible rule curves for reservoir management could better manage, for instance, turbidity or, you know, due to extreme weather events, that might be a strategy worth exploring. I think the inclusion of climate considerations into infrastructure design and construction could be a way to better ensure that infrastructure decisions and the infrastructure itself is built in a way that's better able to be responsive to and prepared for changing conditions going forward. So that's kind of a longer-term play. I think that monitoring – we talk about enhanced – you know, better monitoring of our environment. You know, that, I think, could tie in potentially to enhanced water quality management. Those are some initial ideas. But again, we didn't peg, necessarily, adaptation strategies to water quality, per se, but I think those might be some ideas that we did talk about that could be relevant.

### **Jared McKee**

Okay. Let's see if we can take a little different direction here. Someone wants to know, "How will the NCA team communicate the findings to the politicians who will greatly impact the nation's policy towards water resources and climate change?"

### **Paul Fleming**

Well, you know, I think that -- this was released in May of 2014. I had an opportunity to go back for the release, and a couple of authors from multiple chapters did go and had a briefing for congressional staff, both in the House and Senate side. So we had a chance to meet with them and communicate at the staff level. I think there was maybe one representative when we briefed the House. But that's – I think it's really in the hands of the federal family now to

determine how they want to communicate these changes. You know, this information was made available to congress and, of course, the administration. And again, we had those briefings. You know, this is just me. I kind of expected there to be more kind of hearings on this topic, and maybe that's still forthcoming, perhaps after the midterms. I'm not really sure. But again, I think this is probably a better question for like the USGCRP and perhaps some members of the administration to ask them in terms of their strategy for utilizing the information in this assessment and how they intend to communicate it going forward. But what I described is what I've seen thus far.

**Jared McKee**

Great, great. I'll give you a little easier one. Did you look at water quality changes or just quantity changes?

**Paul Fleming**

Yeah we -- yeah, that's maybe a hard one. We did look at water quality. I feel it's not as well articulated as the water quantity changes. So there is a section in there about water quality. We have a couple of graphs that look at stratification issues in, I think, Lake Tahoe and, I believe, Lake Superior and talk about, you know, how climate change could affect water quality, recognizing that, you know, it's a bit complex. I mean, this is all complex, but -- you know, all animals are equal. Some are more equal than others. Water quality might be a little bit more complex in terms of the multiple factors that go in, resonant time, temperature, turbidity, things like that. So there is a section in there. If you're a water quality expert, it may be somewhat self-evident. But we did explore that, as well, in addition to surface water and groundwater.

**Jared McKee**

All right. I guess I'll maybe give you one more before we move along. "How does my community use the info from the NCA?"

**Paul Fleming**

Right. That's a really good question. I think it depends probably upon where you are. You know, if climate change is a new issue and you're really wanting to understand what the implications may be, I think the National Climate Assessment can provide a really good, comprehensive look at the wealth of issues that climate change can affect. And to a certain degree, you'll get -- some of that information will have relevance for the region in which you operate. And it may have relevance for your community, your direct community, but it probably won't necessarily trace all the way down to your community. But I think it can be a good way of opening up the discussion, understanding -- you know, if you understand what your current vulnerability is, be it extreme events or coastal flooding, I think the NCA can help advance sort of initial discussions. If you are someone who has used climate data to make projections of what it means for your water supply -- that's something Seattle has done a couple or three times now -- the NCA will be more of a potentially supportive document to say, look, it makes sense that we're doing this. This is something that's happening across the US. But it may not be the place for you to go to get -- it won't be the place for you to go to get specific information about what climate change means for your water supply. So I think its usefulness -- it's useful, and the depth and extent of that usefulness is going to depend upon really where you are in the spectrum of engagement on this issue, from helping to educate and inform what this may mean at a very high level, to indicating that, you know -- something that's a report that can be

supportive of your existing actions. You know, we need to be looking at this because, look, the NCA indicates that this is – that climate change has these type of implications across society and across sectors. So I think it's useful in that regard, and going forward, again, at least from my perspective, the hope will be that its relevance to decision making across society will increase over time, hopefully through a sustained assessment process.

## **Slide: Being Prepared for Climate Change: A Workbook for Developing Risk-Based Adaptation Plans**

### **Erika Larsen**

Okay. Thanks so much, Paul, for those excellent answers. We'll now turn it over to Michael Craghan, lead for EPA's Climate Ready Estuaries Program in the Office of Wetlands, Oceans, and Watersheds. He will go over the new workbook on being prepared for climate change. Go ahead, Michael.

### **Michael Craghan**

Hello, and thank you to everyone attending online today. I'm going to talk about the "Being Prepared for Climate Change" workbook, which is a new tool that EPA has to help with climate change adaptation. I will give an overview of the workbook steps and some insight into why and how to use it.

## **Slide: Climate Ready Estuaries**

So just a brief side bar so you understand where this workbook came from, the Climate Ready Estuaries Program is part of EPA's Oceans and Coastal Protection division in the Office of Wetlands, Oceans, and Watersheds. Six years is ancient for a program dedicated to climate change adaptation. But since 2008, CRE has been working with the National Estuary Programs and the coastal management community to assess climate change vulnerabilities, to develop and implement adaptation strategies, and to help them engage and educate stakeholders. Among the things that Climate Ready Estuaries tries to do for everyone is provide technical guidance and assistance about climate change adaptation. The CRE team created this workbook to fill an identified need for a guide to risk-based climate change adaptation.

## **Slide: Vulnerability Assessment + Implementing an Action Plan Climate Change Adaptation**

Before getting too far along today, the question of what climate change adaptation is and what a vulnerability assessment is should be clarified. We think of climate change adaptation as having two halves. The first half is a vulnerability assessment, and the second half is about reducing climate change risks. The vulnerability assessment is an organization-oriented document. It is focused on an organization, not a place. A vulnerability assessment is a ranked description of how climate changes would keep an organization from reaching its goals. The second half of climate change adaptation is an action plan, and the action plan tells how an organization can meet its goals despite the risks. Users take their vulnerability assessment and plan for their biggest problems. And an organization that wants to be successful will adapt if it needs to.

## **Slide: Being Prepared for Climate Change: A Workbook for Developing Risk-Based Adaptation Plans (1 of 2)**

In September of 2014 -- so just a few weeks ago -- EPA's Office of Water published the "Being Prepared for Climate Change" workbook. This is a guide for place-based organizations, such as counties, communities, watershed associations or a park or reserve, to do risk-based climate change adaptation. It's a step-by-step guide to creating a vulnerability assessment and then using the vulnerability assessment to write an action plan. The workbook is a tool to help an organization achieve its goals even as the climate changes.

### **Slide: Why Risk-Based Plans?**

The subtitle of the workbook talks about developing risk-based adaptation plans. People tend to be wary of risk management, but it doesn't have to be scary. Really, it's just a decision support system that matches up very well with familiar strategic planning. Risk management is about an organization, the organization's goals, and whether it can achieve them. This process won't force you somewhere you don't want to go. Users make their own decisions based on their own priorities. Since you provide all the context, data, and analysis, the output will simply be your own understanding of your own situation. A risk management process will help users find problems that might be overlooked and avoid surprises. It will help users assess risks differently than they would have because they will be looking at them systematically and in context. It will help users find strategies that can address more than one risk and let them be more efficient. Risk management will help users make better decisions because they will be looking across their whole organization, and it will help organizations have a better chance of reaching their goals. Users get a better understanding of their system. They have a reference and a great communication tool.

### **Slide: How Do You Decide What to Do?**

A place-based organization that manages environmental resources is unfortunately looking at a lot of problems from climate change. We just heard about a lot of them that might be coming our way in the prior presentation. But the broader the organization's mission is, the more problems are coming its way. If you have five or six goals and half a dozen climate change stressors, and crossing each of them yields four or five risks, well, they multiply up fast. One watershed program identified more than 150 risks to what it tries to do. In a meeting, when we handed the workbook's checklists to another group, they lamented that almost all of the risks applied to them. A large number of risks is a problem that most local governments and place-based organizations will face, and it raises a fundamental question. How do you decide what to do if you don't have the resources to do everything you need to do? Well, a risk-based plan will help you find the answers to that question.

### **Slide: Vulnerability Assessment**

The workbook has five steps for a vulnerability assessment. Communication and consultation are important in every step but are especially important at the start of the process. So there's an emphasis right in Step One. Talking with management, staff, and stakeholders about your plan and asking for help or input will ensure you get a better product. In Step Two, users formally bring in their organization's goals. These are not new goals. They are the same goals they already have. This is not a new plan. Climate change adaptation helps you be successful at what you are already trying to do. In Step Three, users identify what their climate change

risks might be. This is a structured brainstorm about how climate stressors will interact with the goals. The workbook has checklists to help with risk identification, and there are pointers to other resources that can help, like the National Climate Assessment. In Step Four, users analyze the set of problems they just identified. The two principle elements of a risk are consequence and likelihood, and in this step, users develop an initial characterization of how likely each risk is to occur and how bad it would be if it did. In Step Five, users evaluate their situation. They use the consequence and likelihood determinations from Step Four to compare risks and determine which ones are the biggest threats.

### **Slide: Risk Evaluation**

The consequence/probability matrix that users create in workbook Step Five is the main output of the vulnerability assessment. The matrix is a visualization of the organization's situation. It's a tool that helps users understand the risk analysis they completed in Step Four. The consequence of a risk – low, medium, or high – is plotted along the horizontal axis. Its likelihood – again, low, medium, or high – is plotted along the vertical axis. Each risk is thus placed into one of nine boxes based on its analyzed consequence and likelihood. When you use a risk management tool like a CP matrix, the big problems jump out. The risks in the three red boxes of the upper right are highly likely to occur and will be really bad when they do. Conversely, the three green boxes in the lower left aren't of much concern at all. Those problems are not likely to occur and wouldn't matter much if they did. An organization that may be facing more than a hundred risks from climate change now has a vulnerability assessment and a risk management tool to help it figure out what its biggest problems are and where to focus its energy. It shouldn't spend resources on little problems that don't matter – the green ones. In contrast, if it wants to meet its goals, then an organization must work on the red risks. Organizations must address their red risks. Otherwise, they are just awaiting the failures that they themselves said are highly likely to occur.

### **Slide: Action Plan**

With limited resources, users might not be able to mitigate all of their problems. But after completing a vulnerability assessment, the highest risks will be known. Now in action planning, people will decide how to decrease those risks and raise the sustainability of their system. Workbook Step Six is another context step. Here, users examine the political, regulatory, and cultural situation that will affect what adaptation choices they can make. In Step Seven, they decide at a high level whether to mitigate, transfer, accept, or avoid each of the risks in the vulnerability assessment. These are technical terms, but mitigate means to take action to lower a risk. Not every risk needs to be acted on. Some can just be accepted if the consequences are minor. Perhaps a problem can be fixed by someone else as part of their project or as part of routine maintenance. And some onsets are decades away and don't need attention right now. But some risks do need a response. If users elect to mitigate a risk, then Steps Eight (a) and Eight (b) will help them figure out how to do that. Step Eight (a) shows how to look at a system from a risk reducing perspective, and it points to documents where options are listed and discussed. In step Eight (b), actions that seem to have potential are screened to find which are the best for the organization.

## **Slide: Mitigating Actions**

An organization is looking for actions that will work, that it can afford, and that won't bring other problems. Some actions will just be better than others, and when a good set is developed, then the actions that reduce the most risk will rise to the top of the list. Steps Nine and Ten wrap up the action plan. Users create a system to track mitigating actions and which risks they address. Monitoring and review keep tabs on the actions and keep the vulnerability assessment up to date.

The aim of the action plan ask to reduce as much organizational risk as possible. So focus on the true problems. The red risks from the vulnerability assessment are the biggest threats. If a mitigating action reduces the likelihood or consequence of a risk, then the risk would be re-plotted closer to the lower left of the matrix and you have a success. Over time, if you find that you no longer have any red risks, then you are well on your way to being climate ready.

## **Slide: A Risk-based Climate Change Adaptation Plan**

We started out asking the question, "How do you decide what to do if you don't have the resources to do everything you need to do?" The risk management approach in the "Being Prepared for Climate Change" workbook helps users answer that question for their own organization in their own place and situation. The vulnerability assessment highlights the biggest risks. The action plan points to the actions that give the best risk reduction.

## **Slide: Is this Workbook for You?**

So is this workbook for you? Do you have environmental goals, perhaps about ecology, tourism, drinking water, public health, or emergency management? Do you think climate change might affect what you try to accomplish? Does it seem that hotter temperatures, drought, increasing storminess, or sea level rise might somehow make your goals harder to achieve? Do you foresee many different kinds of risks? Do you have partners and stakeholders that you want to keep happy as you move forward? Do you have resource constraints? Or could you use some decision support? Is this workbook for you? Yes.

## **Slide: Being Prepared for Climate Change: A Workbook for Developing Risk-Based Adaptation Plans (2 of 2)**

The "Being Prepared for Climate Change" workbook is online at the EPA website. You can go to the Climate Ready Estuaries resource directory to find the workbook, the risk identification checklists, as well as other climate change adaptation resources. Thank you.

## **Slide: Questions?**

### **Erika Larsen**

All right. Thank you, Michael, for the information on this workbook. We now have some time for questions from the audience. Go ahead, Jerod.

### **Jared McKee**

All right, Michael. First question, "How is the workbook different than other adaptation tools that are out there? "

**Michael Craghan**

Yeah, that's a good question. In fact, my boss wanted to know that before we started working on it. There's lots of good tools out there. NOAA has a bunch of tools on how to rate adaptation plans and vulnerability assessments, and ICLEI had something that we took a real close look at when we started. But this is the first that's risk-based. This is the first that has people look at their climate change problems from a risk management perspective. And one of the nice advantages of looking at it from a risk perspective is that it really points you towards the climate change problems that you should focus your attention on.

**Jared McKee**

All right. "Could you explain what you meant when you said we must work on the red risks?"

**Michael Craghan**

Yeah. So this is, you know, your own risk plan. The users decide for themselves what the – you know, how likely these risks are to occur, and they decide for themselves how bad they would be. When they come up – when they say that a risk has a very high likelihood of happening and will be – have really bad consequences if it does happen, then, really, that says you have to do something about it. Otherwise, you're just going to sit back and just wait for the bad things to happen. And you know, that's not why organizations exist. And if there's an opportunity to do something about it, then you really should.

**Jared McKee**

Great. Okay. "Would this workbook be useful for inland states, as well, where drought and flash flooding are common?"

**Michael Craghan**

Yeah, the workbook really is designed for any place-based organization anywhere. It's got a focus on water stressors, because we're the EPA Office of Wetlands, Oceans, and Watersheds, but it talks about seven different kinds of climate change stressors. There's warmer summers, warmer winters, warmer water temperatures, increasing drought, increasing storminess, sea level rise, and ocean acidification. So users just decide for themselves what stressors are in play and take it from there.

**Jared McKee**

All right. "Does this adaptation plan have regulatory requirements, or will it act as a prerequisite to access federal grants?"

**Michael Craghan**

There's – for most of the world, this is not going to be a mandate or be a prerequisite. For some of our partners who may be accepting grants from EPA, I think at some point there may be a requirement to have a vulnerability assessment in place. But that's not in place right now, so we'll just have to see. But right now, it's not a requirement for anything.

**Jared McKee**

All right. Just a few more here. "Is this guide something that a community can use without the help of a consultant with expertise in these areas?"

### **Michael Craghan**

I guess it – what I would say is you don't need the – you probably don't need the advice of people that you aren't already consulting. So if you are a city and you have an engineering staff, or you manage a park or a wildlife refuge and you have technical experts that you talk to anyway, then those are the people that will help you create a vulnerability assessment. You know, a lay person who doesn't know much about climate change or environmental science will probably need to find some help, but hopefully, if those are issues for them, they already know who those people are who can help them. But, you know, the more people that you bring into the process, the better it will be. So if you have an opportunity to bring in someone from the local college or university, or you know people at a federal agency who can help you, or there's professionals who consult on climate change, then bringing them in can help you. But I don't think it's necessary unless you think that you need it.

### **Jared McKee**

Great. Well, Michael, of course we've got to ask one of these questions. You can't have a question and answer without a question about money. "The biggest challenge is associating cost to the level of risk." Excuse me. "The biggest challenge is associating cost to the level of risk. Can you give an example of how to do that?"

### **Michael Craghan**

How to associate how much – well, I'm not sure if it's the cost that – you know, the damages or the unwanted consequences of their risk or whether it's the cost of responding to the risk. You know, the workbook methodology is very generic. It's got to work for lots of different users all over the place. So we don't really get into the level of quantifying dollars or telling people how to quantify costs and benefits. This takes a qualitative approach. It's a planning level document, and we sort of say, you know, is the consequence going to be high, medium, or low, and leave that up to the users to decide for themselves whether, you know, high consequence is going to be really bad for what they're trying to accomplish or not. And then in terms of, you know – again, this is a planning level document – trying to get a handle on which adaptation responses they might want to elect, we, again, take a qualitative approach and say, is this something you can handle as part of your routine operations? Is this something that you might need to do fundraising or a bond for? Is it so expensive that you might need, you know, external help, like maybe you need a state or federal agency to do this? So we put these in qualitative categories for planning purposes. But when it's time to actually do or implement a project, then that's when we really need to get into how much it costs and what the benefits are.

### **Jared McKee**

All right. Well, as we're getting close to time, I'm going to ask one more question. And I'm going to ask this question only because it's going to lead you into our next presentation. "What is the expected time span of completing a comprehensive vulnerability assessment?"

### **Michael Craghan**

The answer is it depends on how complicated your organization is. If you are a big organization that covers a big geography and you're going to have lots of different problems, then it's going to take you longer than if you're just a little organization with a narrow scope. But I think that this planning level qualitative analysis that we're talking about here could probably be done – I mean, if you really got everybody together and they had their homework



done, maybe a week or two. But I think probably over the course of a couple of months you could get what the workbook envisions.

**Slide: Assessing the San Juan Bay Estuary Program’s Vulnerabilities to Climate Change**

**Erika Larsen**

Okay, great. Thanks, Michael, for those good answers. We’ll now give the mic to Kasey Jacobs, the Partnership and Outreach Coordinator for the Caribbean Landscape Conservation Cooperative in San Juan Bay National Estuary Program, who will share a case study of the San Juan NEP.

**Kasey Jacobs**

Thank you, and good afternoon. Buenos Tardes. Thanks for your interest in the Watershed Academy and learning more about these different efforts and especially your interest in learning about what the San Juan Bay Estuary Program did as the national pilot for the first five steps of the Climate Ready Estuaries workbook. Remember, there are ten. We piloted the first five, just the part one, the vulnerability assessment portion.

**Slide: [Image, San Juan (1 of 3)]**

But for those who are joining us who are unfamiliar with the city of San Juan – and don’t feel bad if you are. Most people can’t locate it on a map, which I’m going to help you with right now. I’m going to give you a little Puerto Rico 101. We are a commonwealth of the United States, located in the Caribbean, in the Greater Antilles. Kind of count three islands down from Florida, and you’ll find us here. The main island of Puerto Rico is about 100 miles long and 35 miles wide.

**Slide: [Image, San Juan (2 of 3)]**

The city of San Juan is on the north coast of the island, the Atlantic Ocean side, the southern side, of course, being the Caribbean Sea. San Juan is the capital of Puerto Rico and the most populous, with about 395,000 residents. And that, of course, does not include the millions of tourists that we get annually, both from the mainland as well as from other countries.

**Slide: [Image, San Juan (3 of 3)]**

You can see from this aerial photo how developed the city is. In fact, Puerto Rico is tied with New Jersey for the highest population density in the United States.

**Slide: [Map, San Juan]**

Even though we are so developed, at the San Juan Bay Estuary Program, we call San Juan la ciudad de las aguas, or the city of waters. And you can see that on this slide, on this map. You can see why we call it that. There are four main lagoons, many canals, rivers, and creeks, and the ocean, of course, which all make up the watershed and jurisdiction of the San Juan Bay Estuary Program. Daily living in San Juan is very much connected to both the water from the sky, from the sea, and frequently, more and more, coming from the streets.

### **Slide: Methods: Step One, Communication and Consultation**

And I can tell you that because I live in the heart of San Juan in a famous neighborhood called Santurce. It is the biggest and most populated of all the barrios in San Juan. There are a lot of communities within an eight-mile radius of where I live that are at the front lines of climate change, communities that the San Juan Bay Estuary Program has been working with for years to make the connections between our everyday lives and behaviors to the health of our lagoons, rivers, canals, bays, and all the corresponding ecosystems. Families and businesses all around the watershed have a stake in whether or not we successfully adapt our infrastructure and ecosystem. Also, there are thousands of traditionally under-represented and marginalized citizens that live and depend on the San Juan Bay Estuary. Without adaptation initiatives, the quality of daily lives of these communities will worsen, along with the health of the estuary, which is something I'm going to talk about a little bit later. And by going through the five steps of the vulnerability assessment process in the workbook that Michael just described, we came to the conclusion that all of our goals and the progress we've made since the program was started in 1993 are vulnerable to climate change. I'm going to go through the first five steps as we went through them, and I'm going to pull out a couple examples from the steps so you can see how we went about our work.

So Step One is communication and consultation, where you inform key people about the vulnerability assessment and ask for their input. We did this through a workshop with the Estuary Program's technical advisors as well as through informal meetings with staff and other stakeholders, with the staff of the EPA Office of Water, and other program directors of the National Estuary Program.

### **Slide: Methods: Step One, Communication and Consultation [Table]**

The September 2012 invitational workshop with the technical advisors was conducted with 26 invited specialists from federal and local agencies, international and local non-governmental organizations, university programs, a neighboring National Estuarine Research Reserve we're near, and the private sector in September 2012. And the workshop described the CRE program. At the time, it was a draft workbook, so we went through the draft workbook. And then, through a hands-on workshop, participants helped us begin with Step Three, which is the risk identification process that I'll discuss in a couple of steps. The participants also provided recommendations to the San Juan Bay Estuary staff for the continuation of the vulnerability assessment, where they wanted to see it go, how they thought it could be used, things like that.

### **Slide: Methods: Step Two, Establishing the Context for the Vulnerability Assessment, Goals of the Program**

We then moved to Step Two, where you establish context for the vulnerability assessment. And it's important to remember that this vulnerability assessment was completed to determine the potential risk from climate change to the program of the San Juan Bay Estuary, not to the San Juan Bay Estuary itself. However, as we'll see later, in order to determine vulnerabilities to the program's goals and objectives, we had to go into the watershed, into the communities, the scientific studies that had already been done in the area, to see how the ecosystems, resources, wildlife, people of the system would also be affected. For Step Two, we identified the current goals and objectives of the program so that we could determine how to proceed

with Step Three for the risk identification. I'm not going to read through the goals. They're available at the website, [estuario.org](http://estuario.org).

**Slide: Methods: Step Two, Establishing the Context for the Vulnerability Assessment, Objectives of the Program**

But there's a number of goals that have been with the program since 2000 and then a number of objectives that were recently updated right before we started the pilot for the Climate Ready Estuaries workbook. So you can see objectives like identifying the major stressors impacting the system; developing action plans to remediate the existing problems; conserve and enhance the integrity of the known highly valuable natural resources in the system and restore, to the extent possible, those areas; and address the major concerns of the citizens and user groups regarding the quality of the system; and promote the public awareness regarding estuarine resources and involvement in the development of an effective management plan for the system. And you can see that the program objectives are very much, for the San Juan Bay Estuary, directed towards the communities that live around the estuary. Not all, of course, organizations and programs are alike. So it's really important in Step Two to kind of define what are your objectives and goals.

**Slide: Methods: Step Two, Establishing the Context for the Vulnerability Assessment [Table]**

So we then took all – we went through those, and we took them, and together with the staff, we put them into a table that we provided as a template in the workbook. And we also identified whether those objectives were a clean water theme or not. And that helps later with the prioritization process that Michael mentioned.

**Slide: Methods: Step Three, Risk Identification [Table]**

The next step is Step Three, the risk identification process. Using the 100 climate risk examples from the workbook, we added and deleted based on the San Juan Bay Estuary Program context and identified where the risks came from. So you can see in this example for pollution control, which the objective identified for the San Juan Bay Estuary was water and sediment quality, aquatic debris, and they have objectives of new actions of solid waste management and green infrastructure. So just looking at that table that we completed of the different examples, you can see that there are different – parentheses after the different risks. And those tell you whether or not they were identified by the EPA workbook or by a local partnership that we're part of called the Puerto Rico Climate Change Council or other sources. So we went through those very clearly, looking to see which ones were appropriate for the San Juan Bay Estuary Program. And going through this process, we identified 167 risks, which were narrowed down and prioritized later in the process. The list of identified possible risks were the result, as I mentioned, of the invitational workshop with members of our Scientific and Technological Advisory Committee and invited guests, three community workshops, field trips, and independent discussions with environmental justice community members, fishermen in the lagoons, and forest managers in the Pinones State Forest – also, from local and global scientific sources, and then, of course, the guidance from the EPA's workbook. Some of those steps I'm going to go into in a little bit more detail. The discussions with the estuary communities were particularly productive as we were able to listen and learn from the experiences and opinions of those who live in different parts of the estuary system.

### **Slide: Methods: Step Three, Risk Identification**

So one of the ways we did that, as I mentioned, was three different community workshops. You can see a flyer here from one of them which, my apologies, it is in Spanish. I didn't want to alter the graphics too much because that is not my forte. But in English, it's the workshop for the evaluation of risks in the communities of the San Juan Bay Estuary. Two of the three workshops were specific to environmental justice communities, and the other was to the recreational activities and the businesses around the estuary. The workshop programs included an introduction to the Climate Ready Estuaries Initiative, to the draft workbook. We also did a Climate Change 101 presentation describing the science, the global impacts, the island-wide Puerto Rico impacts, and then selected risks to the estuary determined in the initial risk identification and then also to what the workshop was geared towards. The rest of the workshop was discussion-based – workshops, I should say. They were discussion-based. We had a number of open discussion questions that we took the participants through, but we also used live polling, where each participant was given a handset, and we had a number of multiple choice questions that they were able to anonymously give their answers to. And then we used the answers of those live polling questions to inform the next step, the risk analysis step, but also to open up the conversation during the workshops, to dig a little bit deeper into the perspectives and the experiences of the participants, especially about the questions about what risks and challenges they're already facing in their different communities. In addition to these workshops, one-on-one consultations were also conducted throughout the process. An expert list to consult, which was comprised of members from the Climate Change Council and from relevant agencies and university programs.

### **Slide: [Images and Promotional Flyer in Spanish]**

All the communities -- whether through the workshops, the field trips, the one-on-one consultations -- reported that contaminated water and flooding events were already greatly affecting the activities of families and businesses. Some were able to tell stories of past hurricane events and how their communities were isolated due to flooding or due to not having electricity or other services. And in one of the workshops, it was even mentioned that, after Hurricane Hugo, they were completely disconnected from the rest of the metropolitan area up to as much as six months, which was quite shocking for us to learn during those workshops. This information, as I mentioned, was then used to inform the risk analysis and risk evaluation steps, and that's an important point for any vulnerability assessment. It's not that climate change is going to create new vulnerabilities for these programs and communities, but rather, it will exacerbate already existing vulnerabilities. In Puerto Rico, coastal erosion, flooding from the sea and from the rivers is already occurring with great frequency. In fact, there's a new campaign in Puerto Rico – it's a partnership level -- being called "Puerto Rico san Playas," or "Puerto Rico without Beaches," because of how dramatic coastal erosion and coastal flooding have been in recent years. So the question isn't so much will these events happen and to what frequency and intensity, but it's kind of more how will that frequency and intensity change, since we're already experiencing that. And that's something that Paul mentioned in the first presentation and consistent with the first major finding of the National Climate Assessment.

### **Slide: Methods: Step Four, Risk Analysis [Table]**

So all this information goes into this giant spreadsheet that you can see on your screen. Step Four is the risk analysis step, and as you can tell, there's way too much that goes into the spreadsheet, and this continues down when you scroll on the screen through it. So I'm not

going to be able to go through all of the 167 risks with you. So what I did is I pulled out one row from the spreadsheet to go through the process of a risk analysis for one climate stressor.

#### **Slide: Methods: Step Four, Risk Analysis [Chart (1 of 2)]**

So we're going to do that on the next couple of slides. See, this graphic is much easier to read than that giant spreadsheet. So what you do is you go through, identifying by the climate stressor, which can be the climate parameter, temperature, precipitation, how things are changing; going through the risks, so that's pulling out one from the 167 risks that we identified; identifying whether it's positive or negative – and this is a key part. This is something that oftentimes is not discussed. Climate change will have positive effects on different communities and ecosystems. So when you're pulling out these risks, you don't just identify the ones that are negative risks or negative changes. You identify positive ones, as well. And it's important to identify which one that risk is. Then you identify whether it's low, medium, or high consequence, low, medium, or high likelihood, what the spatial scale of the impact will be. Will it just be in one lagoon, one community, or will it be watershed wide? The time until the problem outcome begins, which can be that problem is already occurring or that problem will occur at the end of the century. The habitat type, so again, is it a lagoon? Is it a coastal forest? Is it an urban area? What's the habitat type that that risk is for? Where was the risk identified? So was it identified by the EPA workbook, or was it identified in a workshop or from a consultant or a technical advisor? If available, what is the scientific source? And then, the corresponding confidence that you have in that risk and how you categorize that risk. That's a really important column so that you can go through later when you're prioritizing and seeing if you have to do a little bit more work for that row of the risk analysis or whether it's sufficient for – you have a high certainty in what you described. Whether it was mentioned in the workshops, if you did workshops for your process, and then any important notes.

#### **Slide: Methods: Step Four, Risk Analysis [Chart (2 of 2)]**

So just to show you again, pulling from one of those rows for the climate stressor of warmer water, one of the risks that was identified was harmful algal blooms may be more likely. This, of course, for anyone – any of our participants who work with coastal systems or estuarine systems, you know that this is a negative impact or effect on the estuary, so we categorize that as of high consequence, of a high likelihood, and of a high spatial scale of impacts because we have so many estuaries and lagoons that already experience harmful algal blooms. We categorized this time scale as it will begin to occur within 15 to 30 years. And what we meant by that was the change would occur within 15 to 30 years of being more frequent or more likely. The habitat type is lagoons, bays, and canals. This risk was identified both in the workbook and also in a State of the Climate report that was done for Puerto Rico. We did identify scientific sources. We have one listed there on the screen, Bauman et al, 2010, and we deemed this analysis for this one risk to be we have high confidence in what we put. Yes, it was mentioned in the workshops, which is super important, because that means not only was it something important to the staff and to the program, but also to the community members around the estuary. And then I didn't list all the notes, but we, of course, had notes from more specific details of how we arrived at those answers.

### **Slide: Water Quality of the San Juan Bay**

So as mentioned, this is a stressor that is already occurring in the bay and the lagoons of the watershed.

### **Slide: Fish Kills**

And just to show you from one example, this is a photo from June of this year of the fish kill from one of those events. I want to point out that each of the processes that we went through each of the five steps included consultation before moving on to the next step. But the most intensive peer review came after the risk analysis, so it came after that filling out that entire spreadsheet. With 167 risks identified, a peer review for each individual analysis was not possible. However, the analyses with the lowest confidence or the organizational objectives with the highest engaged reviewers received an in-depth peer review through one-on-one review sessions. Before moving on to Steps Six through Ten of the workbook, the report will go through another review with the full Scientific and Technical Advisory Committee. That's kind of our next step after – now that we've completed the first five steps of the process.

### **Slide: Methods: Step Five, Evaluation/Comparing Risks [Table]**

So getting close to the end, the final step, Step Five, is evaluation and comparing risks. The risk analysis spreadsheet that was used, we put those risks and that information into a risk matrix like the one you see here. This one is for recreational activities in and on the water, which is one of the objectives of the program. The risks were placed in the appropriate box based on the scores they received from the analysis, which translate to being high, medium, or low for consequences and likelihood. The trick here is making sure you don't have all of the risks in high, or in those red boxes, because that will make your prioritization later, through Steps Six through Ten for the adaptation actions, a lot more difficult. We struggled with that a bit, and having group discussions and consensus on the more uncertain risks, having the peer review, the workshops, all that helps to make sure that we had a more manageable spread of the risks so that it would be low, medium, and high and not all shoved into the red ones.

### **Slide: Modifications/Lessons (1 of 3)**

The San Juan Bay Estuary Program process we went through was the same as laid out in the Climate Ready Estuaries guidebook, with a few modifications, though, since we were using the draft guidebook and our process, our pilot was informing how the guidebook – sorry, the workbook -- was finalized. And so I'm going to share a couple of the principle modifications that we went through at the San Juan Bay Estuary Program, and that was that we put a strong emphasis on engaging the environmental justice communities that live and work around the bays, lagoons, and canals of the estuary system. As I mentioned, engagement occurred via the workshops and individual conversations, the field visits, both with this one – or actually, eight communities of one of the canals, fishermen in the lagoons, forest managers. And so this was, for us, for our program objectives, having an environmental justice focus was really key for us. And so that really determined how we went about the process. But, as Michael mentioned, it depends on your program for how you modify the process.

### **Slide: Modifications/Lessons (2 of 3)**

A second modification that we made was that the original draft didn't explicitly advise to look for and utilize previously conducted state or regional vulnerability assessments. But because the San Juan Bay Estuary Program staff were active participants in the Climate Change Council, we drew heavily from a recently completed report called the State of the Climate 2010-2013 for the risk identification analysis. And that's the report that you see on the screen. And that allowed us to really go a little bit deeper, to have scientific sources for each of the risks identified, and then also, depending on how you look at it -- maybe not so great for the process -- of expanding that initial list of 100 to 167.

### **Slide: Modifications/Lessons (3 of 3)**

So we were able to get a lot of information based off on other works that the San Juan Bay Estuary Program has done in partnership. And additionally, we added three columns to the risk analysis spreadsheet that were not included in the first draft. And that was "Where was risk identified?" meaning, again, was it identified by the EPA, by the Climate Change Council, or by different scientific studies, or by the workshops. We added the "Notes" part, and we changed the "Source confidence" to "Scientific source confidence," and we really utilized that heavily, as I already mentioned.

### **Slide: Final Report**

In September of last year, my project partner and I completed the final report, which is available at the website, [estuario.org](http://estuario.org). And to continue this work, the San Juan Bay Estuary Program will be doing action planning for climate change risks to estuary water quality and habitat. The program stakeholders and advisory committee members will use the vulnerability assessments with this project to continue developing an adaptation plan for the organization's pollution control and estuary habitat goals. The highest risks that were identified, in those ones that are in red, will be selected for more detailed analysis and the development of individual solutions. The San Juan Bay Estuary Program are answering these calls for action, both from nationally and from the communities of the estuary, by assisting with the implementation of adaptation strategies, collaborating with other partners, and disseminating educational materials such as a "New Citizens Guide to Climate Change" in Spanish that we've developed. Most recently, the program was involved in a congressional briefing to congress, organized by the Latino Climate Action Network, where director Javier Laureano was one of the three Puerto Rican subject matter experts selected to present. So this work is already informing a number of other initiatives. The health of the estuary, of the businesses and tourism operations around the estuary, and especially the health of our environmental justice communities depend on an informed and empowered watershed. And to facilitate that process, the estuary program first needed to know how climate change could affect their program. The CRE workbook pilot project was a key step, both for San Juan and for the National Estuary Program.

### **Slide: ¡Gracias! [Thank You]**

Thank you for your time, and I look forward to your questions. I'm sure there will be many as others move through the workbook steps, now that you all have your hands on it at the National Estuary Program website. So my contact information -- my e-mail is there if anyone would like to have further conversations that we can't have on the webinar. Thank you.

## **Erika Larsen**

Okay, great. Thanks so much, Kasey. Very great presentation. So we do have time for a few more questions, but first I have a few final announcements. First, if your question does not get asked today or you would like to contact our speakers, you can find their contact information on this slide.

### **Slide: Speaker Contact Information**

Their contact information is also posted on the Additional Resources information posted on the Watershed Academy website at [epa.gov/watershedwebcasts](http://epa.gov/watershedwebcasts).

### **Slide: Next Watershed Academy Webcast: December 2014**

Our next webcast will be in December. Please check back with you at [epa.gov/watershedwebcasts](http://epa.gov/watershedwebcasts) for more details on the December webcast.

### **Slide: Participation Certificate**

Also, please don't forget to download the certificate. The certificate can be downloaded from EPA's server through the link on this slide. Please type this link into your browser to download the PDF document. You can personalize this certificate with the names of everyone watching from your location. Finally, when the webcast is over, an evaluation survey will be shown on your computer screen. We encourage you to answer the evaluation and give us feedback as we always try to listen to the feedback and improve our webcasts. So now we'll have time for a few more questions for Kasey and all of our speakers.

### **Slide: Questions**

#### **Jared McKee**

All right, Kasey, I guess we'll start with you here. And the first question is – I guess it's an opinion. "What do you think about EPA's workbook when you use it in your case study at San Juan? Is it easy to follow? Anything that doesn't work? What's your overall opinion?"

#### **Kasey Jacobs**

I definitely found it easy to follow, easy to use. And honestly, an example of that is with our project partners, with community members, obviously the draft -- and I believe, still, the final -- is in English, which is sometimes a challenge, working in a Spanish speaking territory. And with that challenge in mind, still people were able to get through the steps. They understand what we were doing. It was not a complicated process at all to go through. I would say the hardest part for me was the risk analysis part, and that's, again, that big spreadsheet. A lot of that is also trying to remember, for each of the different parts that you're categorizing, there's a legend that tells you for consequence, for likelihood, for time scale, spatial scale, and kind of having to remember the different codes and that whole part, flipping back and forth. So again, because we were working through it when it was a draft, we actually didn't have all the templates that were available at the time. So some of that we had to build, and then that, of course, informed Michael's work to complete the guidebook. But I think the risk analysis, Step Four, is definitely – that was the most challenging one. And then, again, also, because we would go through peer review with that, and so it would be kind of a training for the peer reviewer for what does the code mean or what does – how do we break this down? And



actually, I found those conversations, though, very – it's going to sound geeky, but I'm a climate geek – but exciting. It would really – having different opinions for each of those individual cells of the spreadsheet really just opened up a whole lot of – I got new information but also new questions, and so it was the most challenging, but it was also the most fun, I think.

**Jared McKee**

Well, you heard it here first. The workbook is exciting. All right. Just a quick question about the website. "Is the report available in English?" Someone is looking for it, and they only see it in Spanish.

**Kasey Jacobs**

Oh, that's interesting, because it's actually only available in English, the final report. There are a number of blogs and other things that describe the process that are in Spanish. So if you go to the Estuario website, which is in English and Spanish -- a lot of it, though, is in Spanish – you should be able to find the final report. Am I allowed to click back to that slide real quick? Just to show you the final report, if you search in the website for "Assessing the San Juan Bay Estuary Program's vulnerabilities to climate change," it should come up. And if it doesn't, please e-mail me, and I can send it as an attachment for the report.

**Jared McKee**

I'm glad you said that. Can you also say what your e-mail is again?

**Kasey Jacobs**

[kaseyrjacobs@caribbeanlcc.org](mailto:kaseyrjacobs@caribbeanlcc.org). And it's right on the screen, on the bottom.

**Jared McKee**

Perfect. "Did you run into any resistance/opposition from any stakeholders in compiling your report?"

**Kasey Jacobs**

I think – I wouldn't say opposition, but more we were advised many times that climate change is important to the watershed of the San Juan area, but that there are also a lot of existing problems that we need to deal with first. And that's a conversation that I think any jurisdiction of the United States and any country that works on climate change needs to have, is -- we have this tendency to label things as this is climate change adaptation, and it sounds like it's something new. But what we're really talking about is mitigation of risks, so reduction of risks. So if communities are having challenges now, and changes in climate will worsen those challenges, then this process has been very beneficial for both perspectives. So I wouldn't say it was opposition, but it was definitely just more of a conversation that needed to happen a lot, that we were going to be addressing their interests and their challenges as much as they were tied to the program's objectives and goals. So when they were mentioning, you know, we have a lot of issues where our water quality or water quantity or drought problems, coastal erosion, massive flooding anytime it rains, things like that were part of it. But if they had challenges that were not climate related in this process, probably wouldn't change that. So it was just a conversation, not so much opposition.

**Jared McKee**

Okay. “How long did it take to do all this work? It seems so complicated.”

**Kasey Jacobs**

We were actually trying to think the other day of how long it took. It was under a year. And again, this is just the first five steps, so under a year for the first five steps. I was part-time and so was my project partner, so you could probably -- if you had full-time staff devoted to it, it would be less than that. Again, we expanded the scope of the initial -- of the workbook now because of our strong focus in communities and environmental justice communities. So you could very much go through this process and have it be a lot simpler and with less meetings and less stakeholders and things like that. So I would say, to do it the way we did it, factor about a year into it. But it just depends on your program and on the number of goals and objectives of your project. I just showed glimpses on the slides of pulling from one example. But those risk matrices, the risk identification tables, those are pages and pages and pages long. If your program has less goals and objectives, then it will take a whole lot less time.

**Jared McKee**

Got you. Just because we’re on the topic of risk, and then I’ll leave you alone and backtrack to Michael. But, “Can you describe again how you identified so many risks? And then, with 167 of them, does it feel hopeless?”

**Kasey Jacobs**

Well, the first 100 risks, definitely I’ll pass that to Michael because those are based on the workbook, the template or the example 100 risks. That’s a process I was not involved in. The 167, I wouldn’t say it feels hopeless, especially since the San Juan Bay Estuary Program, again, being around since 1993, they’re very integrated into the community. They have so many partners that are really effective. Each one -- those 167 are divided amongst different objectives and different programs -- or different programs within the program. So it’s not like one staff member has to deal with 167, or one project coordinator. So they really would get divided amongst the different programs. But it’s also important, because you go through the risk analysis process, you can identify what is low, medium, and high and then really try to adjust the higher risks because of their likelihood and their consequences on to the estuary program. So it’s really -- and I probably should quantify -- and based off of this question, I will do that now for future -- but the number of those that are divided amongst those low, medium, and high in the risk matrices, because it’s not 167. So it’s less than that. But again, I think if you’re working in an area or if your program or whatever organization you’re in has connections to other organizations, agencies, partnerships, community members, I think you can tackle the risks, whatever the number is that you come up with.

**Jared McKee**

Great, Kasey. I’m going to give you a chance to catch your breath because, all of the sudden, you have a lot of questions. But since I said I’m going to go back to Michael, here’s one for you. “Could you please explain why you focus of the vulnerability assessment was not place-based? Is the risk-based evaluation not inherently place based?”

**Michael Craghan**

There’s a focus in the workbook on organizations, and the organizations that we are -- that are the primary users for this will be place-based organizations. So there’s a link between what will

happen in the place and what will happen to an organization that does environmental work in that place. But what we were trying to focus on with the workbook is that there's an organization that's out there that's trying to do things, that has goals, and it has work plans, and it's spending money and resources to try and improve the situation there. And it should – the organization should focus on the things the organization does. And there are, you know, examples of what we call impact studies that are different than vulnerability assessments, where an impact study would try and take a look at all the things that might happen in the place. But it's the introduction of goals that an organization has that brings in the element of risks. So, like, an island doesn't have risks. Things can happen to an island, but it doesn't get risk. So a river doesn't have risks. The things that people want to see in the river are at risk. So it's really, when you take a risk approach, you have to sort of step back and say what are the goals and what – are the goals at risk? And that's an organization type of questions.

**Jared McKee**

Great. All right. Kasey, I'm going to try to combine a few questions here to make it easier for you. "How receptive was the general public in terms of participation in the workshops offered?" And then, after you've answered that, maybe just kind of let people know, "Were there any challenges, and, if so, how do you overcome them?"

**Kasey Jacobs**

Challenges with the workshops?

**Jared McKee**

With the workshops and getting people involved.

**Kasey Jacobs**

Yes. So I would say, overall, everyone was very receptive. I think, typically in workshops, you know, you always – especially, I think, with climate change topics, you always get folks who kind of in the beginning are quiet and are listening and trying to see, okay, what are you guys doing? What's your agenda? How does that affect me? And you kind of get that initial 30 minutes of that. Angela and I, when we were designing the workshops, along with the staff of the estuary program, we knew that was going to happen because we do lots of workshops within the watershed, just about every month. So we wanted to make it interactive from the start. And so that's why we brought in the live polling, the open discussions. We also did the workshops in their communities, so we went to them, to their community centers, and I think that made a big difference. So I would say, yes, very receptive, lots of ideas. But it does take that. You really need to design the workshops with those things in mind. So it's not just showing up, saying, "We're going to present to you and then ask you questions." I don't know any workshop where that can be effective. But especially in this process, where you're identifying risks, you have to analyze the risks, you have to consider all these different factors of the program objectives and the community objective, you really need to spend a lot of time designing the workshops to the people that you're trying to reach. So I think, because we did put a lot of our time on that, they were receptive. Challenges with that, as you can probably tell from my lack of accent, I am not from Puerto Rico. But I live there. I've been working on climate change for over four years now. I was presenting the Climate Change 101 part based off of work that we did with [Spanish], the Climate Change Council. And I would say one of the challenges there was finding messaging that works in both English and Spanish that also brought in the scientific sources that we were dealing with -- because we wanted the

workshops to also be informative, not that just we were taking information from the community, but that we were also providing information and resources for them, too. So I would say that was, personally, for me, a challenge but also something that I found exciting. And because it was a team that did this, it was really great that way. What was not a challenge but that helped us, I think, be successful in this was that we worked with existing partnerships and existing community organizations that the San Juan Bay Estuary Program has a long history of working with. And I think that's why we didn't have more challenges than otherwise we would have, because we were able to really use the past successes of the program to continue to be able to work through the workbook.

**Jared McKee**

Great. And that's the second time you've heard the workbook described as exciting. Paul, are you still there?

**Paul Fleming**

I am.

**Jared McKee**

Hey, Paul, I've got another question for you. "Did Seattle Public Utilities use AWWA's water audit methodology? And, if so, has it been a useful tool in informing conservation on the water supply side?"

**Paul Fleming**

Have we used AWWA's water audit methodology? I don't know. The conservation group is separate from my climate resiliency group, and I'm not sure to what degree we've used that methodology. But I do know we've had a pretty comprehensive conservation program, multi-sectorial, focused on financial incentives, technical assistance, behavioral modification, as well as using rates to send signals. And we've also seen dramatic reductions in non-revenue water. So I very well may have used that tool, but I just don't know.

**Jared McKee**

Great. Well, we still have a little bit more time, and I have a lot more questions, so I guess we'll just keep it going for a while. OWOW's very own Nancy Larsen would like to know, "How did you change CCMP actions as a result?"

**Kasey Jacobs**

I can tell you we have not yet. And that is because we – again, going through the full workbook, it's the ten steps, and we piloted the first five. The next step for the San Juan Bay Estuary Program -- and they have received report from the National Estuary Program to do this -- is to continue with the next part, Part Two, to start identifying the adaptation actions, prioritizing the adaptation actions, and moving forward with those. So it's definitely envisioned that if those high risks that were identified could be reduced by changing CCMP objectives, then that would be something that would be looked at, but I can't speak to whether that would happen or not because we haven't gone through Steps Six through Ten.

**Jared McKee**

If you don't mind, could you tell the listeners what a CCMP is?

**Kasey Jacobs**

Comprehensive Conservation Management Plan. I had to think for a second.

**Jared McKee**

Perfect. Sorry. And one more, “Did you encounter any climate change skeptics, and how did you convince them if you did?”

**Kasey Jacobs**

We did not, not in our process, no. I’m trying to think if there was anything like that that came up, but we did not, and I really do think it’s because the communities that we worked with, the businesses, too – because, again, one of the three workshops was with businesses and recreationists in the estuary, not the environmental justice communities – were already seeing the impacts. So it wasn’t – really wasn’t a hard sell at all in our estuary. And Michael could speak to how the San Juan Bay Estuary Program was selected, but I would imagine that, based on the fact that we are on the front lines of climate change, we are an island, might have factored into that.

**Jared McKee**

Okay. Hey, Paul, another one for you here. “What are some good examples of stormwater management policy, design, or retrofit?” They specifically ask for the Chesapeake Bay region, but we’ll try to keep it pretty general here. “And could you speak to assessing vulnerabilities to water resources associated with climate events?”

**Paul Fleming**

So the first question is good examples of stormwater management policy?

**Jared McKee**

Yeah.

**Paul Fleming**

And then how to assess vulnerability of water resources to climate change?

**Jared McKee**

Yes.

**Paul Fleming**

Okay. Well, I’m not a stormwater expert, but I know there’s been – it’s a really active issue in terms of stormwater management and trying to move towards adding in green stormwater infrastructure into sort of the conventional gray practices, and those are kind of crude representations of two ends of the spectrum. I know that Philadelphia is doing a lot of work in that space, New York City, San Francisco, Seattle is doing a lot. We have a land use code or stormwater code that requires certain levels of detention on site for new construction or retrofit of a certain size so, in effect, trying to get development to pay as it goes, so to speak. And of course, we have a capital program of infrastructure that we manage now and build out that’s focused on trying to address multiple issues around flooding, water quality, habitat issues, so putting public dollars on the table, conditioning development in the private sector. And we also have a really aggressive green stormwater infrastructure program in place, and we have

designated staff that work on that. We have established a policy to increase the amount of stormwater managed by green stormwater infrastructure seven-fold, up to 700 million gallons a year by 2025, I believe. And that's going to rely on both our expenditure of dollars as well as private sector development. We have a program called Rain Wise that incentivizes on-site management of stormwater and will pay up to, I think, 90 to almost 100 percent of the costs of building rain gardens, putting in cisterns on private property, so really trying to get that segment of our land base actively involved in managing stormwater. So those are some examples that I know of here. And again, there's a group in the Maryland area, I think, the Low Impact Development Center. I believe Neil Weinstein, I think, is the head of that. They've done a lot of great work advancing this issue of stormwater management and green infrastructure. I think the Center for Neighborhood Technology in Chicago is another good resource in that arena. But a lot of activity happens at the municipal level. I just don't work on it directly, but that's what I know about.

In terms of vulnerability of water resources, we have used climate models, climate model output to do that type of work and are in the midst of our third study to look at the impacts of climate change on water supply, using what we call a chain of models approach, where you take climate model output, you downscale it, and you feed it into a hydrology model and ultimately into a system model. We're also doing kind of a bottom-up approach, so we're identifying, or have identified, some system-specific thresholds of relevance to us or conditions that get our attention and are querying the climate projections to see how more frequently those conditions will be met or exceeded compared to historic to give us a sense of, again, a very Seattle-specific understanding of what's important to us and how climate may affect that. So I think embracing the use of climate data, either through a top-down chain of models approach or through a bottom-up querying of the climate projections with your specific issues of concern, is a good way to utilize the science, utilize the evolution that's occurring in the scientific arena, and try to figure out how to tailor it to your specific situation. So that's one way, I think, of stepping into this vulnerability assessment space.

**Jared McKee**

Great, Paul. Thank you. And I guess we're going to end now here with you, Michael. I'm going to give you a compound question. Are you ready?

**Michael Craghan**

Okay.

**Jared McKee**

All right. First, "Can you recommend resources that provide cost information for both risk and mitigation?" And second, for our regional people here, "Are the regional offices going to be enlisted to help roll out the assessment to our external and internal stakeholders?"

**Michael Craghan**

I don't know of any place that provides dollars to do things. And I don't know if I could recommend one because everybody's context is going to be different; everybody's scale and problems are going to be different. And the workbook methodology is a planning-level methodology to help you figure out where your biggest problems are and start you on the way to get – to identify what some of the solutions might be. But it's not a guide to doing project level adaptation. And once you sort of have your priorities set at the planning level, then you're

going to have to dial down into traditional project management approaches to figure out costs and benefits. The Climate Ready Water Utilities Program here at EPA has sort of order of magnitude cost numbers that are associated with, you know, threats to infrastructure. So if you have a pump station or treatment plant or pipelines, then they can sort of put you in sort of order of magnitude numbers. But again, everything is so contingent on unique situations that I don't think there is a way to give a dollar value in that way. The second half of the question, Jerod, could you repeat that?

**Jared McKee**

It was, "Are the regional offices going to be enlisted to help roll out the assessment to external and internal stakeholders?"

**Michael Craghan**

The National Climate Assessment or the workbook?

**Jared McKee**

Workbook.

**Michael Craghan**

The workbook. I sure hope the EPA regions will be involved. You know, this is really a resource for our stakeholders at the state and local level. And so the people at EPA that are most in touch with the state and local people are in our regional offices, so I hope they will be great ambassadors for the workbook and will be recommending it to the people they work with when it's something that will be useful for them.

**Jared McKee**

Thanks, Michael.

**Erika Larsen**

Okay, great. At this time I would like to conclude today's webcast. Thank you, Paul Fleming, Michael Craghan, and Kasey Jacobs, for talking to us today about climate resilience and water resources. And thank you to Jerod for serving as our Q/A moderator. And of course, thanks to all of you who joined us today. This ends our webcast. Thanks again for joining.