Localizing Sea Level Rise Projections for Decision-Makers

https://www.eesi.org/briefings/view/041320data

April 2020

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Daniel Bresette

Good afternoon everyone. Thanks for joining us this Monday afternoon at the start of our Climate Adaptation Data Week online briefing miniseries. I'm Dan Bresette, executive director of the Environmental and Energy Study Institute, and on behalf of everyone in EESI I hope our briefing audience today is hanging in there and feeling well. Today marks the one-month mark from the first time we moved a briefing online to encourage social distancing. It feels like a lot longer than a month ago, and we probably still have quite a way to go before we see you again in an in-person EESI briefing, but we must keep up our work to build awareness of the policy challenges and solutions to advance climate mitigation, adaptation, and resilience, so thanks for being with us today.

For those joining us for the first time, EESI has undertaken a briefing series to explore climate change solutions and resilience strategies in coastal communities across the U.S. These briefings are intended to inform policymakers and the general public about the challenges and barriers to improving the resilience of coastal communities, and very importantly share some success stories about how adaptation can be cost effective, nature-based, and equitable. If you've missed our briefings to date, be sure to visit www.eesi.org for video recordings and written summaries. We still have two more areas to explore: Alaska next Tuesday, April 21st, and on a date to be determined, Puerto Rico and the US Virgin Islands. When you visit our website, you can sign up for our biweekly Climate Change Solutions newsletter to help stay informed and up to date.

Today and the rest of this week we're doing something new for this briefing series and EESI. Since our last briefing on Hawaii and resilience financing strategies on March 20th, as we said we would do, we took stock of how our new online briefing model was working. Thanks to everyone who offered feedback, and I still encourage everyone to take a few moments and complete our survey after today. While we will continue to hold online briefings that follow our traditional in-person model, a four- or five-person panel in a 90-minute format, we also

get a little creative. The dynamics of an in-person briefing are just different than they are online, and so are the logistics and planning. Given this new medium, what can we do now that before would have been too much? How could we adapt to our new circumstances? One idea that we are kicking off today is a week-long regularly scheduled briefing miniseries to explore a topic in greater detail. This miniseries will feature shorter individual briefings with fewer panelists, and the exchange between moderator, and in the case of this week moderator and co-moderator, and experts would lend itself to a more conversational style. You can find the complete schedule in this briefing miniseries online www.eesi.org.

So here we are on the first day to hear from two experts about the topic *Localizing Sea Level Rise Projections for Decision-Makers*. After the presentation, my colleague Amber Todoroff and I will co-moderate a discussion and you can participate too by following us on Twitter @EESIOnline and by sending us your questions. You can also send your questions to EESI@EESI.org.

Today we're hosting two experts. Let me introduce them now and then get out of the way of their presentations. Let me welcome Dr. Ian Miller, Washington Sea Grant's Coastal Hazards Specialist. Ian works out of Peninsula College in Port Angeles and the University of Washington's Olympic National Resources Center in Forks. Ian works with coastal communities and public agencies on the Olympic Peninsula to strengthen their ability to plan for and manage coastal hazards including tsunamis, chronic erosion, coastal flooding, and other hazards associated with climate change. After Ian we will welcome Nicole Faghin, who has worked for 30 years as a land use and environmental planner and lawyer specializing in coastal zone management and waterfront planning issues. At Washington Sea Grant, Nicole focuses on alternative shoreline stabilization, coastal resiliency, and working waterfront issues. Among her projects, Nicole helps local governments develop their capacity to address sea-level rise. She also manages Green Shores for Homes, a multi-agency effort to create a voluntary rating system for shoreline homeowners who want to support healthy marine ecosystems. Ian, Nicole, welcome, and I'll turn it over to you. Really looking forward to your presentations today.

Ian Miller

Thank you so much everybody. My name is Ian Miller, Coastal Hazard Specialist of Washington Sea Grant. I'm going to be your part one speaker on this presentation focused on innovations to support sea level rise planning with a focus in Washington State, and then as Dan mentioned Nicole is going to follow me. We're going to focus on a project that we recently wrapped up that had as an element this effort to localize sea level rise projections to better support coastal managers and decision makers with the hopes that sea level rise would be incorporated in the planning efforts. Most of what I'm going to focus on is embedded in the updated Sea Level Rise Assessment that we published in 2018, which is so shown here on the screen and is available at WACoastalNetwork.com.

Before I get there, though, let me just introduce Washington Sea Grant. Washington Sea Grant is a National Oceanic and Atmospheric Administration program and we are housed at the University of Washington, although as Dan mentioned, many of our staff are distributed around the state like myself, and we fund and conduct marine research, education, and outreach programs throughout the state of Washington to support the health and sustainable use of our marine resources. We've got a variety of focus areas, and as Dan implied I work in the area of coastal hazards and coastal resilience, as does Nicole. So let me dive into the main content today, the main purpose.

I'm going to start back in 2014 when Washington Sea Grant conducted and then published a survey that went out to coastal managers and decision makers around the state of Washington and was trying to get a sense for their needs in regards to planning for climate change. What you see in front of you is a table that summarizes some of the results. This is a table of a variety of climate impacts, and the respondents to the survey were asked how important each of these climate impacts was to their community. That's the blue bar, the scale there is percent of respondents from zero to a hundred. And then the red bar is, do you have what you need to plan for that particular impact? So you can see for all these impacts there are gaps. There's a big gap between the importance of the impact and what those planners and decision-makers think they need.

I'm going to hone in on the sea level rise bar, which you see here, where you can hopefully see very clearly this big gap which I'm going to frame as an action gap. We perceive this as something that told us there was something missing in terms of the information available to coastal managers and decision-makers in Washington state in regards to addressing sea level rise or planning for sea level rise in their communities. This one was

particularly interesting to me because in 2012, just two years before that survey, we had had quite a rigorous sea level rise assessment published that was intended to be specific for the West Coast of the United States, including Washington state. This is a publication called *Sea Level Rise for the Coast of California, Oregon, and Washington*. It was a public report published by the National Academies of Science. Again, this was published just two years before that survey, but there were a variety of reasons why we thought, based on our conversations with planners and decision-makers in Washington state, that this was not being incorporated into planning in the ways that one might have expected given the type of report and assessment that this was.

There were two things that I'm going to focus in on that we set out to address in our updated assessment that was published in 2018. One was in the sea level rise scenarios that were embedded in this report, there was a very narrow range of uncertainty. What I mean by that is that the sea level projections themselves were communicated as these narrow lines, these curves if you will, but didn't have a way to communicate really well the uncertainty in sea level rise projections, especially moving into the future. This really became an issue for those planners and managers that we interact with that are quite savvy about following the literature and in particular were focused on some of the projections emerging at that time, especially from places like Antarctica, that suggested much higher magnitudes of sea level rise were possible than were communicated by these very narrow projection ranges. That created questions and confusion about how to address that possibility amongst those managers and decision-makers.

The other thing that we felt was not included in this assessment that was problematic for many of our constituents was that it was not localized for most communities. What that means is that it wasn't clear if the projections as published were intended for an individual location on the Washington coast, and it'll become clear what I mean more specifically about that in just a second. In 2015, we framed and proposed to NOAA a project under the Regional Resilience Grant Program that had four objectives that are listed here on the screen and a wide variety of partners, all of whom I won't list, but there are logos on the left side here. We wanted to support an updated sea level rise and storm surge assessment for coastal Washington. That is the part that I led and it's highlighted in red here, and that I'm going to focus on a little bit more.

We also wanted to build climate resilience principles into state agency processes and plans. We wanted to look for resilience co-benefit from existing planning processes and investments. We didn't want to build new sea level rise-focused programs, but rather figure out how to leverage the investments we were already making in Washington state and then create outreach tools to facilitate implementation of resilience projects and plans. I'm going to focus on that top bullet, some of the innovations we built into the assessment, and then Nicole Faghin is going to follow me and address some of these other bullets.

I'm going to focus in particular on two innovations that we built into that assessment that we felt like addressed some of those shortcomings of the 2012 assessment that we were following up on, and hopefully serve to fill that that action gap that I highlighted at the beginning.

The first thing is we incorporated a probabilistic framework for communicating sea level rise projections. This was published in 2014 by Bob Kopp and I'm including his photograph here just because his contributions and his work really allowed us to do this, so I wanted to make sure that Bob gets the appropriate credit for that contribution. On the lower part of this slide is a graphic representation of what those probabilistic projections are. This is a set of sea level rise projections for Washington state. Down at the bottom you have time out to 2100, and then on the y-axis you have change in average sea level in feet relative to essentially the contemporary average. And then we've got a bunch of lines that feed off from the observed sea level trend in Washington State, and it has very much the same look as sea level projections that you've perhaps seen before, these kind of curves that some of them are quite steep. The difference here, though, and what's been added, are these percentiles that are arrayed along the right-hand side of this figure, which are assessments of likelihood associated with a particular curve. And it's that assessment of likelihood that really gives this probabilistic framework its power. What we think and what we've seen at play is that it allows communities to do some more nuanced decision-making and some more nuanced discussion about sea level rise vulnerabilities depending upon where you work within that likelihood range. This probabilistic framework was one thing that we wanted to and did build into the 2018 sea level rise assessment that we published.

The second thing that we built into it, the second innovation, has to do with localizing. This slide is intended to convey why that's important, especially in a place like Washington state. These are tide gauge data. These are observed sea level data from two locations in Washington state: Neah Bay, Washington, which is on the

tip of the Olympic Peninsula, and Seattle, Washington. These two locations are only about sixty miles apart as the crow flies. What you're seeing here are long time frame sea level trends. The top one in Neah Bay, this record goes back to the mid 1930s, the bottom one from Seattle, the record here goes back to the late 1800s, and these blue lines are monthly average sea levels recorded at both locations. The key thing to note here is the trend in sea level, what we refer to as relative sea level, at these two locations. In Neah Bay, sea level is dropping, whereas in Seattle sea level is rising. The ocean is doing the same thing in these two locations. Again, they're quite near to each other. What's different here is what the land is doing.

Land movement is a critical element of understanding sea level rise projections, as well as observations at the community scale. As a consequence, for that 2018 assessment we invested quite a bit of our energy not in what sea level in the ocean was doing, but what the land was doing, how the land was moving vertically. This is our summary figure. This is the shoreline of Washington state in outline. On the left-hand side, the colored figure is our estimate of vertical land movement, with hot colors being uplift and cool colors being subsidence, and these are expressed in feet per century to align us with the same time frame and units that we used for projecting sea level. And then on the right in the bluish tones is an estimate of uncertainty for each of those sections of coastline.

What this allowed us to do was take our Washington state probabilistic projections, couple those with these vertical land movement estimates at every location along the Washington coast, and essentially come up with what we call a relative sea-level projection, a localized projection that was applicable for every community. What we developed as a consequence of that was an interactive map, you're seeing a version of it here, that allowed a community planner, a person at a particular location or interested in a particular location in Washington state, to go in, click on their location, and then download a set of sea level rise projections for their particular location on the Washington coast.

Originally, and at their core, those projections are served essentially as a matrix. This looks onerous when you take your first look at it, but it includes some pretty useful information that allows you to get some pretty interesting insights about sea level change in your particular community that I want to highlight before ending by showing you what we've switched to to get away from sort of the immediate reaction to a table like this. There's really three ways that you can use this matrix approach to provide insights about sea level rise at your particular location.

The first is obviously you can focus on a particular time frame of interest and get a sense for the full range of uncertainty across that time frame. I'm showing you here 2100, and embedded in the table are feet of change in sea level. Here we can see by that time we've got a pretty significant range of uncertainty, 0.3 to 8.6 feet. But we can also focus on our best estimate or a narrow range in the likely zone. If we want to tie our decision-making to a particular risk tolerance, we can focus on a particular likelihood set. For example, I've highlighted here the 50th percentile, what we might assess as being our current assessment of the most likely sea level scenario for the future. Finally, if we have a particular decision or particular use that we know has a threshold associated with it, so if sea level changes by X amount we will start seeing impacts, we can trace that threshold through the table to get a sense for when and how likely those impacts are. The idea here is that you get some insights from this approach that you don't necessarily get from what came before.

However, acknowledging that that those tables are hard to digest in many cases, our colleagues at the Climate Impacts Group, and I'll use this as an opportunity to also point out that Dr. Amy Snover, who's the director of the Climate Impacts Group, and they were a partner on the regional resilience grant project will be presenting in this series on Wednesday about this and some other climate-related work that the Climate Impacts Group does. They developed this Tableau-based interactive sea level rise projections tool based on those tables to allow users to more easily navigate the information that was embedded in those tables in a user-friendly and visually appealing way. This tool is also available at WACoastalNetwork.com.

So with that I want to pass it off to Nicole Faghin to highlight the more important step, which is how do you take these tools that we built as part of this assessment and then translate them into use at community scales? Thank you.

Nicole Faghin

I would like all of you to imagine being in a rowboat on the sea. And then you imagine a huge storm is approaching, and now imagine you don't have any oars for that boat. That's really what's happening to our

planners and resource managers who need to address coastal flooding and sea level rise. My name is Nicole Faghin as Ian told you, and I'm a Coastal Management Specialist with Washington Sea Grant based at the University of Washington's College of Environment where I help coastal planners and resource managers find solutions for complex coastal management issues such as coastal flooding and sea level rise. As Ian mentioned, Washington Sea Grant funds and conducts marine research, outreach, and education throughout Washington State, and we support the health and sustainable use of our marine resources to improve the lives of people in Washington. While I work with coastal planners and resource managers, we also work directly with a host of other constituents that range from fishermen to legislators to tribal communities and educators.

How do we get to implementation? As Ian talked about, we engaged in this four-year effort, the Coastal Resilience Project, with four different tasks: sea level rise data, developing more specific for Washington State; then working with state agencies to develop better planning and project funding for those purposes; working with local experience to help communities in the region identify their sea level rise need for planning and implementation; and then ultimately finding ways to share it with a goal of rapidly increasing the capacity in Washington state to address sea level rise.

What I'm going to focus on is the local experience and those aspects of our work. Our goal with that aspect was to enhance the resilience of at least three Washington coastal communities through pilot projects. We selected two communities to work with on this effort. One was Tacoma, which is a very urban community with a port and a very significant linear coastal park. The other was Island County, which is more of a rural community. There the focus was really concerning how to address issues of shoreline homeowners. Our third community partner in this was a state program called the Estuary and Salmon Restoration Program (ESRP), which is at the Washington Department of Fish & Wildlife. ESRP provides funding and technical assistance to organizations who work to restore shoreline and near-shore habitats critical to salmon and other species in Puget Sound.

We worked with ESRP along with our other two partners Tacoma and Island County to develop guidance on how to use the sea level rise data we've been talking about to determine how you site and design, construct, and maintain marine shore restoration projects in the region. We use case studies to develop the guidance for local governments and others who are working in the field of restoration. This example of a case study, here is the Leque Island and Zis-a-ba project that's in Snohomish County.

Working with Tacoma, we worked with several of their departments: the Planning Department, the Public Works Department, and Metro Parks Tacoma. I'm going to give two examples of working with Metro Parks. The city had a beach park, Owen Beach, and it was really struggling. It was getting flooded, the infrastructure was crumbling, there was a need to do something and to make changes. Metro Parks had taken on the improvement of the facility, but early on they heard about the work we were doing with our resilience project and they approached us and they said, "We think we really want to try to figure out how to address sea level rise as part of this project." They invited us to sit down with Metro Parks and with their designer, Site Works, to determine what are the sea level rise issues and how can that be incorporated into designing this park?

Ian gave a presentation very much like what you heard from him already and talked about what the sea level rise projections would be, and we talked through then what the different aspects of the park would be, what are the different infrastructure, what were the implications. These lines you see drawn here are showing the different sea level rise impacts at different times in the future, and we extended these drawings out so that then they could start thinking about what they are actually designing. Then, as a result of that, they were able to come up with a complete rework of the project. Now it's designed and it clearly indicates where sea level rise projections might be, and the facilities that might be potentially impacted were pushed way upland outside of what projections might be ranging up until the year 2019 for beyond.

Another project we worked with Tacoma on was to evaluate sea level rise and impact along this master planning project that takes into consideration sea level rise, storm surge, and wave events. It was supposed to just be a visioning of this linear park, but again Metro Park said, "We want to take into consideration sea level rise." As a part of all of this, this area that is circled is what we were looking at as part of their visioning. First we met with the city, with their design team Mithoon, and with Metro Parks to impart the details of sea level rise to get them to understand what are all of the projections, how to use them, how to use them for different timeframes. We also engaged in an exercise on modeling the wave impacts for the site, which is an effort that is going to be conducted throughout the region to give us all better ideas of how storm and wave intersect with sea level rise impacts.

Then Metroparks engaged the community, and this is an exercise of a visioning project where they brought the all the community together in a series of meetings. What was incredible is that usual visioning projects just look at the transportation or the access or recreational use of a site, but in this case they had the whole overlay of sea level rise and brought the community along to understand that for everything that they were interested in they also had to be thinking about what the sea level rise would be. Ultimately with the input from the public, [inaudible] have a new vision for this linear park, and it will be taking into consideration sea level rise.

Next was with Island County, and there we engaged with a series of different types of exercises. One in particular involved the Planning Department and issues related to implementation of the Shoreline Master Program and the need for homeowners to have better guidance about what their options are. The first thing we did was we sat down with the Planning Department, Public Works, and even a member of their Board of Commissioners. We walked through all these sea level rises. You see, there's Ian explaining how to use these projections, and to understand so that everybody was on the same page and really having the same language to talk about. Then we used NOAA's Sea Level Rise Viewer. It's a great way to get people to immediately visualize impacts. The slider on the left of your screen showing feet can be changed, and you can use that to simulate what the different elevation gate might be of sea level, and then that can relate to different time frames, and with that starting to notice, what are the flooding impacts in different parts of your community? The blue areas show those areas of flooding. We had folks working in the room looking at what the impacts were to their community specifically to start to then target what they wanted to address.

Island County said they wanted to look at adaptation strategies to be made available to the property owners, and they picked three different community types they wanted to focus on. One is their historic beach communities, the second was what they call their canal communities, and the third are bluff communities. We helped them work through creating a set of recommendation, strategies, and tables by timeframe looking at short-term, mid-term, and long-term and considering what can you do to either protect, accommodate, or retreat, and thinking about all of these within what works within these different time frames. We relied first upon the sea level rise timetables that have been developed now for Island County so we can determine what would be most applicable for adaptation strategy within these different time frames.

Another thing that Island County wanted to do is develop a community-based coastal resilience planning guide. The big difference here is this is a planning guide that's by the community, for the community rather than it being imposed by the Planning Department or the county coming and saying "do it." Five steps go into this approach. This is very similar to approaches that you will see in many adaptation planning programs, except that this is designed to be totally accomplished at a local level by a neighborhood. Step one is you define what your planning issue is. Step two, you identify the community values and your vulnerable assets. Step three is you analyze the risk and your thresholds for when you want to take action. Step four is you develop and implement community resilience strategies. Finally, step five is you monitor the outcomes to inform your future plans. Both of these are ways in which Island County planners are setting themselves up to provide more resources for the shoreline homeowners based on all of the information we started with and the data to get them started.

A big question is how do you get these tools to these decision-makers? Once you have the science, like Ian talked about, it's really the foundation and it gets to where people can use it and be emissaries to the broader community. In order to do this we held over 20 workshops. We probably were able to touch at least 300 people with this information, and then afterwards we sent out a survey to all the participants in the workshops about six months afterwards and in response to "Are you using the tools and the information we provided at our workshop?" we had a 70 percent response rate of "Yes, we are using it," which tells us that we're getting the information out there. It's our priority to really focus on getting the right information so people can be using it. Through the collaborative efforts of Washington Sea Grant and our partner the Climate Impact Group, Department of Ecology, and others we are helping to put those oars back on the rowboats for the people of Washington state. Thank you.

Bresette

Thanks very much Ian and Nicole, that was great. That was a really excellent set of presentations. I love those photos of the community engagement, and to me that that's a great evidence that what you're doing is impactful and meaningful for all of the communities you're working with, so thanks very much.

One of our innovations with these shorter format briefings is this idea of co-moderating, and so I'm going to turn it over to my colleague, but before I do we still have an opportunity for you to submit questions. You can submit them by following us on Twitter @EESIOnline or by emailing us at EESI@eesi.org, but let me turn it over to my colleague Amber Todoroff. She's a policy associate with EESI coming up on her one-year anniversary with us, so I'm actually more junior than she is, I've only been around since October. Amber, why don't you take it away and let's get the Q&A started.

Amber Todoroff

Thank you, Dan, and thank you both Nicole and Ian so much. This was a really interesting presentation and really great work that you guys are doing, so thanks again. This first question's for Nicole: You started off with three project partners, community partners; have you seen a lot of interest from other communities? And if so, what are the biggest barriers to communities to start their own similar sea level rise adaptation plans?

Faghin

I'm going to start back with Ian's survey that he started with back in 2014. Not only did we find out there was the gap but another thing that the survey asked was who's doing anything about sea level rise, and very few people in the community were. As we've been working through this project, what we've noticed is because of our work, in part, but also because of a heightened awareness a lot more communities are taking on the work of addressing sea level rise in this region. It's a combination of there being a lot more awareness, so people are starting to be engaged, and because of us reaching out. When we held those workshops we had over 35-40 jurisdictions, including numerous tribes, attending those. Everybody who attends one of our workshops then becomes more of an adversary for them to go back and do that kind of work. For amount of interest, we sold out, our workshops were filled to capacity.

In terms of what's next, I think that what we've been doing and what Ian and his team identified as a barrier was really a starting point, which is having information and having the right information. People were going, "Is it one foot, is it two feet, should it be three feet?" That was the starting point of we needed better information. That barrier we're breaking down, and then making the information available. Then after that is a lot of work at the local level. Especially now, priorities are going to be shifting dramatically. I think we're going to be seeing even more need to make the information available, to make it possible for jurisdictions to be identifying what their priorities are, but recognizing that this is something we really don't have a lot of time to be holding off on.

Todoroff

Great, thanks so much for that. This next question is kind of for Ian, more on the data side. It's great to see another example of NOAA's Sea Level Rise Viewer in action. Our Southeast briefing we held last month had a speaker featuring that work as well, and it's got so many great capabilities and functions. Are there any layers or updates in the database that you would love to see that aren't already there, or that are perhaps in the works?

Miller

It's a great tool, something that we sort of take for granted now because it's been around for quite a while, but it's really ambitious in its scope and scale. It is part of our workflow, especially for communities that don't have GIS capacity. It's a great way to start interacting with sea level rise projections and get a first look at your exposure at various magnitudes of sea level change. In recent updates, I think maybe a year or two ago, NOAA started including links to projections within the viewer and even localized for some locations, so I'd like to see that built out a little bit. Some way that really anybody in a community in the coastal United States would be able to have localized projections.

The other thing that I think we've really struggled with is being able to use the viewer to understand your exposure to what we refer to as extreme water level events. Those events where people really notice coastal flooding, where water is pushed really high because of the confluence of high tides and storm surge, and then

what those events look like as sea level rises. That's something that takes a workaround to get there in the Sea Level Rise Viewer, but typically that's what you want to map because that's where we start to notice the impacts of sea level rise, on those extremes. We really have to figure out how to use the Sea Level Rise Viewer to be able to visualize those kind of events.

Bresette

Thank you, that's really interesting. We've gotten some questions and there are two that I think are kind of related, and so I'm going to try to combine them to close us out. A lot of what you discussed today, Ian and Nicole, involved communities, personal property, public property, shoreline property. What are the effects of your work on other essential infrastructure, things like shipping terminals? And what are the effects of your work on certain habitats, whether it's aquatic habitats or shoreline habitats for animals? Are you undertaking similar work for non-human interests as well?

Miller

The answer is yes. For example, I have a project that I'm currently just kicking off that is focused on habitat sensitivity in Puget Sound, in particular to sea level rise, so essentially trying to use our sea level rise projections to understand if and how habitats may respond to sea level rise. It's a little bit of a different translation, there's different information needs, but certainly our interest is in understanding Washington State's vulnerability to sea level rise writ large, not just impacts to homes, but also impacts to infrastructure and impacts to habitat.

Faghin

I'm going to add as to who are our constituents who came to the workshops and who we worked with. For a couple of our workshops we had Washington State Department of Transportation, who has been very engaged in this work even before we've been, and incorporating this. They've been doing work looking at the resilience of their local facilities. One of them that is major is their ferry system and where their ferries are located. Washington Department of Transportation is using now more specific information because we provided it to them with this data, and they're engaged in all sorts of planning and design.

Similarly, the ports. One of the presentations was the port of Tacoma, and they were engaged in all of our work in Tacoma. In fact, the industrial area called the Tide Flats in Tacoma was one of the areas we focused on because they're going to be looking at how they're going to deal with not just the specific facilities, but access in and out of the facilities and the whole range of them. Once you've developed this kind of information it's broad spread in terms of how it's used, and that was part of the beauty of what we were doing is working both with a very urban environment and a very rural to address that and that gets to our ports, that gets to our industry, that gets into our wastewater, gets to all of the infrastructure. Everything is affected, but you need the same kind of information as a starting point and then how you want to apply it is what you have the option to do, so that's the beauty of it all.

Bresette

Thanks so much thanks Ian, and thanks to those who are watching us on YouTube and submitting the questions, thanks for that. In fact, we're not going to be able to get to all of the questions that have come in unfortunately, so we'll try to save them and incorporate them in later presentations that we have this week. Thanks Amber for all your work this week. Thanks also to Amaury and Ellen and Anna and the other Dan at EESI, Dan O'Brien. It's a lot of work to put a whole Climate Adaptation Data Week together, but I couldn't think of a better way to get it started than to have great presentations from Ian and Nicole about the work that's being done out on the coast of Washington, so thank you very much.

A couple quick reminders as we close out here more or less on time. First, this is new for us. It's off to a great start, but we'd love to hear your feedback. Take a moment if you would to fill out our survey, visit us at EESI.org to sign up for our newsletter so you can stay in touch and keep up with everything that's coming up. Tomorrow at noon Eastern we have part two, titled *Assessing National Park Asset Flood Risk: Retreat, Adapt,*

Fortify. You can find the link and everything you need on the website. Thank you all, will go ahead and end there. Happy Monday the 13th to everyone, and hope to see you back here tomorrow.

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