



Briefing Transcript

Resilience along the West Coast

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Speakers:

Patrick Barnard, Research Geologist, Pacific Coastal and Marine Science Center, United States Geological Survey

Charles Lester, Director, Ocean & Coastal Policy Center, Marine Science Institute, UC Santa Barbara

Jessica Fain, Director of Planning, San Francisco Bay Conservation and Development Commission (BCDC)

Aimee Kinney, Coastal Law and Policy Research Scientist, Puget Sound Institute

Moderators:

Daniel Bresette, Executive Director, Environmental and Energy Study Institute

Bradley Watson, Executive Director, Coastal States Organization (CSO)

Daniel Bresette

All right everybody, I think we'll go ahead and get started. Good afternoon, and thanks very much for joining us today. I'm Dan Bresette with the Environmental and Energy Study Institute, and today we're going to be looking at issues of resilience along the West Coast. I'm going to start by giving our co-host today Bradley Watson an opportunity to welcome you and I'll get back up, but Bradley, this is the start of a beautiful friendship; thanks for being our co-host, would you like to welcome everybody here today?

Bradley Watson

I want to thank Dan; as he just noted, this is our first collaboration on a congressional briefing, and I'm really looking forward to a wonderful working relationship so thank you all for being here. I'm Bradley Watson, I'm the Executive Director of the Coastal States Organization. Our governor-appointed delegates represent a wonderful contingent of professionals and experts across the country working on resilience issues. We're thrilled to have one here today from the San Francisco Bay Conservation and Development Commission, Jessica Fain, and our governor-appointed delegates are often the coastal zone management entity from the state. Now, each state's coastline is different, and as such, so are the issues that they're facing, but one thread, one theme that we find across all the states is the need to address resilience. So we're thrilled that that's a focus area today, and thank you again for being here, and I'll turn it back over.

Bresette

In addition to our friends at Coastal States Alliance, I also want to take this opportunity to thank our host today, representative Jared Huffman from the great state of California. Thanks to him and his staff for helping us have this room in this setup today. Our briefing today is the latest in our series that looks at regional approaches to coastal resilience. Over the past few weeks, we've heard from experts, practitioners, and community leaders from the Northeast in New England and then from Louisiana. Our series will pick up again in the new year with a briefing, for example, on resilience issues facing Alaska, also the southeast U.S., Hawaii at some point maybe a little bit later in the first quarter, and we're also looking at territories and some other areas of the greater United States that have these issues. If you've missed any of our briefings, never fear, if you visit www.EESI.org you can access summaries and videos of all of our briefings and sign up for our *Climate Change Solutions* newsletter to stay informed about all manner of EESI goings-on, including our upcoming briefing schedule.

But today we turn west to the left coast, some say the best coast. Our panelists today are experts on West Coast resilience.. oh good thank you and this is Bradley's slide, so everyone can take a look at it, sorry the clicker wasn't working, I'll go back to EESI. Our panelists are experts on West Coast resilience and will tell you about how the communities stretching up and down California and the Pacific Northwest are trying to adapt to sea level rise and other negative impacts of climate change. In the few weeks since our coastal Louisiana briefing, we took the opportunity to submit an extensive set of responses to a set of questions posed by the House Select Committee on the Climate Crisis. If you've not already read our comments, you can visit www.EESI.org once again or talk with one of us on Team EESI staff. There are many of us here in the room, hands raised, there's more than that they're hiding; we're around anyway and please take an opportunity to meet us, we'd love to talk with you a little bit more and tell you a little bit more about EESI and our heritage going all the way back to 1984. Originally we were part of a congressional caucus, and then we were spun off in the early 90s and we're focused primarily on congressional education, but we also do some really interesting work in rural areas around the country with small utilities, municipal cooperatives, things like that. Happy to pass that along back to that Select Committee comments and set up a time for follow-up discussion.

I'm flagging our response for you today for two reasons: first, because in addition to specific sector-based suggestions, we also offered three high-level principles for the Select Committee to consider as it works towards it's important deadlines in 2020. Number one, we urge the committee to take near-term actions to reduce emissions while more comprehensive policy takes shape. Many of these policies are bipartisan, although somewhat limited in scope and scale, but we pay a cost of delay if we miss an opportunity to reduce emissions now. Number two, we urge the committee to think very carefully about the staging and sequencing of policy development. There's Annie with representative Huffman, thanks again for helping us be here today. The sequencing of this policy development and implementation, this is complicated stuff and we need to make sure that we take into account how to best set and follow-through on policies for the near, the medium, and long term gains. And number three, we urge the committee to allow states and local governments to continue to lead. Some policy options might be best handled at the sub-national level, and this is especially relevant today because some of those most some of the most ambitious states and local governments are those who live on the West Coast. And the second reason I mentioned our comments is because we also offered some very specific suggestions related to adaptation resilience and ensuring an equitable approach to resilience in general. I think there's a lot of focus on equity and conversations about mitigation policy which is a very good thing. But what I've heard in our past coastal resilience briefings, and I expect more of the same today, is how adaptation is best done with local input, community priorities in mind so those immediately affected by climate change, including those who might not be able to bear the full financial burden of the change, are included, brought along, and never left behind.

And now on to our panel. Our first panelist is Patrick Barnard, he's a research geologist with the USGS Pacific Coastal and Marine Science Center in Santa Cruz and the research director for the Coastal Climate Impacts Project. His research focuses on storm and climate-related challenges to the beaches and estuaries bordering the Pacific Ocean. His research has been published in over 100 peer-reviewed scientific papers and widely presented. He's advised members of Congress, executive branch officials, as well as state and local government representatives. Patrick, welcome.

Patrick Barnard

Thank you for having me. So I'm going to talk about some of the climate challenges facing the west coast states and particularly how USGS has developed some science and product lines to support how communities can

adapt to climate change. And then I'm going to talk about, which is the USGS mantra, is data-driven models, everything is peer-reviewed, everything is strenuously tested, and we talk about some of the highlights of this work we've done along California coast in particular, and then also highlight some of the research of others and how it can support adaptation planning. And I show a lot of pictures; we often think of climate change as this kind of dystopian future, and you're gonna see from all these pictures that we've taken across the California coast and in Puget Sound, that we're having these issues today. These hazards aren't issued today, they were issued several decades ago, and it's just getting worse, and these issues are becoming more frequent that we're having to deal with.

So the first really key lines of evidence that's how we know climate is changing is temperature. Now this is a map showing a simulation of over 6,000 weather stations that NASA has deployed across the world. It's showing how temperatures change based on a mid-century average and a five-year running mean here, and you're gonna see as we move through the decades how things are changing, they're not perfectly homogeneous across the world, but you're gonna see a very very clear trend, and I would argue this is probably one of the most robust scientific experiments that's ever been performed. Our understanding of how the climate is changing, how temperature is changing is extremely robust and solid and based deeply in the peer-reviewed literature. So you can see how the temperature is changing very rapidly especially in the last few decades. Why do we care about this along the coast? A couple reasons. Well one, the ocean absorbs much of the heat that hits the Earth's surface, and if it didn't, the average temperature on earth would be about 150 degrees, but thankfully the ocean absorbs much of that heat. But as it does absorb that heat, the ocean expands, this is called the steric effect, and this is responsible for about half of the observed sea level rise we've had in the last century which is about a foot or so. And the other major contributor to sea level rise is the melting of land-based ice, so ice sheets and glaciers, this is contributing the other half to the observed sea level rise over the last century. There's other things that are a bit in the noise in terms of local factors like how the land moves up and down from tectonics. For example, ocean circulation, how we store water behind dams actually has a noticeable effect on sea level rise a fairly minor [effect].. issues like that, but the big picture is that there's about 250 feet of sea level rise stored in our ice sheets and our mountain glaciers, and one of the biggest arguments for mitigation is to prevent any more contributions from those large bodies of ice to sea level.

So why do we care about all this in the sense of coastal communities and how temperature relates to sea level rise? So global temperature is projected to hit one and a half degrees by 2030, so we're on this trajectory, as you can see here in this plot, to go right through this Paris target within about a decade. There's no sign of that slowing down, the whole concept of the Paris Agreement was to stabilize global temperatures at about one and a half degrees above pre-industrial and keep them below two degrees Celsius, that's the goal. And one of the reasons for this from a hazards perspective that we know from the recent geologic past, 125,000 years ago the last major interglacial surface temperatures were about 2 degrees warmer but sea level was about 26 feet higher. So we take from that is that once the whole system equilibrates to two degrees Celsius, we'll eventually have about 26 feet of sea level rise. It may take several centuries, but eventually, we will get there. Currently, we have about six to seven feet baked into the system, [if] we've stopped emitting greenhouse gases today we're still going to get about six feet of sea level rise, and that would displace on the order of about 100 to 200 million people. So this is a target we really want to keep as we move forward, and there's also questions, "Well how quickly can this happen?" We know also from the recent geologic past, during the retreat of the last ice sheets that sea level rose as much as 16 feet for four consecutive centuries, so we can get multi foot sea level rise in a very short amount of time even with much less warming. So there's potential, however, if you look throughout the peer-reviewed literature, the leading projections are to expect about three feet of sea-level rise over the next century, that's about the average, if you look through the whole swath of what's out there in terms of the data-driven peer-reviewed literature, but the upper limit is about ten feet or so over the next century so.

And we're seeing these kinds of impacts all over the country, and the West Coast is no exception. We see this sunny day flooding more and more frequently in places like Newport Beach, we have a beautiful day but we have higher water levels and we have a large wave event and these waves are coming over these berms and flooding communities. We see this on high tides, king tides, especially in San Francisco some of the highest tides the year flood parts of the city already. And in addition, we've also seen the impacts of storms across the California coast and across the West Coast in general over the last few decades. This is nothing new, we have El Ninos, we have large events, we've seen these kinds of hazards and damages across the state for many many

years, and they're just becoming more and more frequent. This is right in my backyard in Capitola and Santa Cruz, you know we used to hardly ever see water coming over this wall, now it's coming over the wall every couple of years, roads like this the same thing- maybe it happened once every twenty years- now we're seeing these kinds of things happen almost every single year. I took this picture three days ago on East Cliff Drive in Santa Cruz, we're seeing this happen every single year now with rising sea levels, and our infrastructure just may not be quite enough in its current state to withstand these kinds of impacts. We're sort of built right at this very very narrow margin between the ocean and the upland areas and we're seeing these kinds of impacts happen more and more frequently and there's definitely a need to beef up this infrastructure if we're going to protect ourselves from climate change. It's just this knife-edge, very vulnerable area with very little freeboard, you know the West Coast is a very high relief coast for the most part but most people are built right at sea level. You think about San Francisco Bay and Puget Sound, there's about 13 million people just between those two areas built right at sea level, so very very little room for error.

So on the big picture, climate change including sea level rise and changing storm patterns is going to put additional stresses on communities worldwide, we're on track to have about a billion people living in the coastal zone over just the next several decades, there's currently about 700 million people living in the coastal zone, on the West Coast there's over 30 million people living in coastal counties, and of those 30 million people on the order of about 1 million will be subjected to daily flooding by the end of the century, just from median sea level rise projections, not a worse case just sort of the median range. But sea level rise as we just showed isn't the only thing to concern ourselves with, it's when you have sea level rise plus storms is when you really have to identify the total scope of the hazard along the coast, and we've seen in our research that about three times more people could be at risk when you consider storms.

And if you look at annual property risk, so just your average annual winter storm that happens every single year, we're talking on the order of about \$50-180 billion of property at risk over the next century. So sea level is not a bathtub, but there's some preliminary approaches, static approaches that to get this problem which look at sort of bathtub style flooding we consider just sea level rise and high tides. On the West Coast, this accounts for about 3 feet of sea level rise, and high of highest tides are about 6 feet or so depending on where you are, but the ocean is not a bathtub it's dynamic, and we're gonna under-predict our flooding hazards our community risk if this is all that we look at. And here's an example from Foster City looking at just very little sea level rise over the next few decades showing areas that are protected by levees in green, they're not connected to the bay with not considering a storm at all, and when you consider an extreme storm this is the flooding situation.

And this is the science that USGS has tried to bring to the table to include all the different physics that drive coastal water levels that result in flooding, use the latest global climate models to assess how storm patterns will change, and include all these relevant factors and when you consider communities at risk, that is seasonal effects, so water levels go up and down seasonally especially during El Nino we have warmer water levels go up, we have storm surges, if you're near river mouths water levels are higher, and the big driver on the West Coast is waves. Wave setup and run-up can elevate water levels another six or seven feet so we have to consider all these different factors when we're looking at the impacts along a California coast, and so we've done this for the urbanized part of the California coast and as you can see here in Newport Beach, it's one of the most vulnerable areas. When you sum up everything that's at risk along the California coast we're talking on the order of about 200 to 600 thousand people that could be exposed to flooding over the next century, in addition about \$40-150 billion in property. I think the key number here is really this percentage of GDP, so this is a really big number, about 2 to 6 percent of GDP is potentially at risk. And we talk about these, you know, 150 billion dollar number, that's about an order of magnitude greater than the wildfire seasons we've had to endure the last couple of years so this is a really big number. In addition to that as many as half a million employees at risk, you know several hundred schools and several hundred critical facilities like fire and police stations hospitals etc.

So we have this visualization tool, it's called Our Coast Our Future, this is a way that anyone can go in look at the data, zoom in and out, it's like a Google Earth interface and see if your community is at risk, your district is at risk. I'll just talk about this simply here but basically, you can choose whatever sea level rise and storm scenario you want, we have about 40 of them, go to your area of interest, here's just a look at Santa Barbara, you start clicking through different sea level rise scenarios, different storm scenarios, looking for tipping points, looking to see where infrastructure is at risk, and really where things start to go south and which areas need to shore up or not. It's not just these sort of urban cityscapes at risk, we have lots of key components of our energy infrastructure

right along the coast, like the San Onofre Nuclear Generating Station which is now being decommissioned, we have oil and gas refineries all along San Francisco Bay for example, like in Martinez here, and you see as you kind of go through different scenarios when things become particularly vulnerable. Sewage treatment plants are probably the number one piece of infrastructure that's at risk across the whole of the West Coast. Everything is built right at sea level and there's dozens of these facilities throughout the West Coast. We have at least three major international airports at risk, San Francisco, Oakland, and San Diego, and this is a visualization look at the San Diego Airport looking through the decades here as sea level goes up and we see extreme storms and what that vulnerability looks like. There's also thousands of miles of roads in Puget Sound, in the Bay Area, throughout the Central Coast and Southern California, and these are all pictures we've taken recently, so we know where a lot of these issues are going to be, they're just going to get worse and they're gonna happen more and more frequently. Also, two of the three largest port complexes in the United States are along the West Coast and that's Port of Seattle and Tacoma and also the ports of LA and Long Beach, this is really the sort of lifeblood of the entire economy runs through these two ports for the West Coast, these are all very low line by nature. There's also a number of DoD facilities at risk such as where the SEALs train in Coronado, Point Mugu Naval Air Station which is more up in the Santa Barbara/ Ventura area, and then up in Puget Sound Naval Base Kitsap where the nuclear submarine fleet for the Pacific is based. In addition to that there's also lots of private sector property at risk, you can talk about the tech sector, Silicon Valley you name it, they're built basically on fill along San Francisco Bay if it's Oracle, if it's Facebook, if it's Google, these are all very important pieces of our private sector and basically our whole network that are right at sea level.

So with rising seas, there's also another issue that we have to consider, and that is as sea level rises, shorelines and beaches naturally migrate vertically upward and landward. However, we've built up our infrastructure so much there's really nowhere for these beaches to migrate. We're basically pinning the beaches in, stuck between a rising sea and these upland areas and we're losing our beaches. And we've done some work in Southern California which suggests that we could lose about half of these beaches, they're basically going to be drowned. This is called coastal squeeze. We have upland development that's not going anywhere or infrastructure, and a rising ocean and these beaches get caught in the middle. And this is not only an issue for the beaches themselves but also for the ecosystems within these beaches, whether it's sort of micro fauna like this or macro fauna, and what we're seeing in a study we did in Santa Barbara with California Sea Grant and UC Santa Barbara is that we could lose on the order of 70 to 90 percent of these ecosystems on these beaches in this particular region, including the endangered Western snowy plover. So cliffs are another issue, as sea level goes up, waves hammer the base of these cliffs more and more frequently, and so we can see cliff rates double, and again these are all things that we're observing today in terms of these impacts, this is in Isla Vista, very well-documented issues in Pacifica up in Northern California, we've lost quite a number of properties to more rapid cliff retreat. And our models show there's just hundreds and thousands of communities that are built of houses built on tops of these cliffs that are vulnerable to retreat over the coming decades.

The last issue I'm gonna end on here and then hopefully we're going to have some solutions that are going to talk about some of these challenges that we face so it's not just a doomsday scenario here. The other issue is groundwater. And basically, the water table is very very close to the surface near the ocean, and so as the ocean surface goes up from sea level rise the groundwater table goes up as well. And so you've probably seen stories in the New York Times or Scientific American where Miami is dealing with this on a daily basis—at high tides water is coming up through the groundwater system and flooding streets every single day in certain communities. And so what we're doing at USGS is developing a state-wide and the soon-to-be national assessment of these groundwater hazards along the coast to complement the storm related hazards. And so this just kind of outlines the basic concept, as sea level goes up, the water table goes up, if you have communities that are protected by walls or by berms they're not protected from water coming up from underneath and so that's another issue that we're going to have to figure how to tackle. And just one example here from Pacific, this shows overland flooding from sea level about by the end of the century or so, coupled with an extreme storm, but we look at the groundwater issue and the warm colors here, the red is when water actually intercepts the surface, we're seeing about the same timeframe without even considering an extreme storm, water is starting to bubble up through the subsurface and basically turning some land into a swamp unless you pump or some other kind of barrier to keep water out of there. That's another issue that we have to think about when we're trying to adapt to climate change along the coast.

So we've done this work for California, we're building out right now for Puget Sound and Pacific Northwest, and we've also got some work now for the southeast Atlantic to build out these kinds of hazards models from Chesapeake Bay down to Florida, and the Gulf of Mexico, as well as on the docket, and we've often really tried to do a very deliberate outreach to engage communities to figure out how our science can directly feed into the climate policy and adaptation world, and we're looking for more innovative ways to do that into link our models directly with the policy and adaptation community to make the data as useful as possible. So just one thing I wanted to note before I close is that everything I showed today is if we do nothing. These are vulnerabilities with our existing infrastructure, just considering what the coast looks like today, so we're going to now hear from some solutions of how we can deal with some of these challenges along the coast. Happy to chat with folks afterward, or you can send me an email and talk more, I love talking about science and how we can help inform policy. Thank you very much for your time.

Bresette

Thank you very much Patrick, it's fun to talk about science when you're really good at talking about science. The visualizations you shared are really really powerful, it really makes this stuff hit home and understand it. I just want to make sure that everyone understands what's available nationwide as far as USGS resources to help understand these issues, a lot of what you presented is being built out for California in the Pacific Northwest but what's coming specifically what did you show that's coming for the southeast, and then what do you already have on a sort of a nationwide basis for staff people who might be from other parts of the country?

Barnard

Right, well the USGS has a National Coastal Hazards Program and so we have products like this in a lot of areas but we're now moving toward making a consistent product line that will cover all of the continental U.S., and working also on the Pacific Islands and Alaska so hopefully down the road five or ten years you'll be able to go to one stop and see these kinds of projections everywhere.

Bresette

Great thanks very much for that. Our next speaker, our panelist I should say, is Charles Lester. Charles is the director of the Ocean and Coastal Policy Center in the Marine Science Institute at UC Santa Barbara, where he works on issues of sea level rise, coastal resilience, and coastal law policy and management. Charles was previously the Executive Director of the California Coastal Commission, and in 2015 he led the completion of the state's first comprehensive land-use guidance for addressing sea level rise and coastal protection on the outer coast. And before that Charles was an Assistant Professor of Political Science at the University of Colorado Boulder where he taught environmental law and policy with a focus on public lands and coastal zone management. Charles, welcome.

Charles Lester

Alright, thank you very much, I'm really happy to be here today and I'm gonna move quickly cause Patrick has some slides at the end. Okay, here we go, I'm just gonna launch right into it. I think you did a really great job of setting up the challenge that we have. I'm gonna speak mostly to my experience with the California Coastal Commission as one of three state coastal management agencies we have in California, as you can see there. But the problem is great because essentially what we're dealing with, there are land-use patterns that we inherited and they were all set before we even started actively managing our coasts and this is just one example from Santa Cruz County where the development pattern was set by 1967, before we had any concern for this. We've also decided to build in a lot of really, what might be called dumb places, like on sand spits on beach level at the mouths of estuaries, lagoons, rivers, places that are inherently hazardous, and so as Patrick said the coastal squeeze is real and we're starting to see places like this iconic Surfrider beach in Malibu, which is going to be squeezed between the ocean and Highway 1 there in the background. This is a surf contest earlier this summer where there was not much space on the beach. Just to put it in historical context, this is a view of Pacifica in the 1940s and you can see an undeveloped beach and back dune environment, development starting to be put there, this is what it looks like today, and you can see from that development pattern and the protection that we placed in order to protect it from the waves, we've lost the beach in the immediate location and we've intercepted the

beach in the front, so if you could imagine what it would be like without that development, that's essentially an approximation of where the beach would be if we hadn't developed in that way.

So in terms of coastal management and hazards and solutions, I will see if there are solutions, we have two basic policies in California that we've had in place for almost 50 years now. One is for new development, and the idea is simple: you should do new development in places, locations, and designs that are going to be safe for their economic life, so minimize risks and so as to never need shoreline protection. On the other hand, we've grandfathered in all of the existing development that was in place when we adopted the law in the 1970s, so, and I'll get to that challenge in a minute, the other critical piece as was alluded to is the law is set up to use local governments' local land use planning abilities to implement the law, so there's a requirement that every local community, seventy-six local governments on California's coast, adopt plans to implement the statewide policies, including these two hazard policies.

So you heard about change is incremental but it's also sudden and episodic and depends on conditions like storms and El Nino years, and this is a sequence just for dramatic effect of what can happen in the space of a week in Pacifica. We lost up to 90 feet of bluff in this one sequence, and you can see that the dunes on the edge did not make out, so this is a it's a difficult challenging question but the basic approach that we've taken for more than 40 years is not rocket science, it's maybe we should develop a little further back from the hazardous edge, and so we've done required setbacks for many years in California, there's an example in Pismo Beach. But on the other hand, given all of the existing development that we already had and the grandfathering of that development in for potential shoreline protection, we've essentially seen most of our urban areas gradually develop out with sea walls, particularly in Southern California where more than a third of the coast is now armored. This is Solana Beach where you can see some pretty amazing cliff geology, in 1989 is now essentially a faux Disneyland kind of landscape with the fake wall there.

So given our need to approve these sea walls, we've focused a lot on mitigation of the impacts of sea walls, and this is just one example of a sea wall approved in the city of Monterey, where the Coastal Commission required as mitigation a \$5.2 million fee for the inevitable loss of that acre of beach in front of that wall. And so we've begun to take the impacts of sea walls and how to internalize those on the property owner more seriously, but it still hasn't addressed the fundamental problem that was mentioned of the loss of the beach. So in recent years, and this is what you mentioned the effort to start planning for and anticipating how to adapt to sea level rise, we've started to actually invest in updates to the local plans, those are the dollars invested over the last six years, the number of communities that have been funded or projects that have been funded, and there's the guidance that was mentioned that we offered in 2015 about things to take into account as you begin to think about how to adapt.

You've probably seen this in other briefings, the three core choices that people are focusing on, the solutions are to protect what we have there on the shoreline, to accommodate, perhaps by elevation, or to retreat, and I'll get into each of those in a little more detail. This is simply an illustration of what Patrick was talking about, this is some of that USGS data at Goleta Beach in Santa Barbara where I am, and you can see that depending on your assumptions, in this case, six feet of sea-level rise by 2100, the back of the beach, that blue line, is at the back of the shoreline so there is no beach in that projection. And surprise, all of the local vulnerability assessments that are taking place now are showing the same essential outcome, which is your beach goes to zero feet, depending on your assumption. So it's not a question of if, it's a question of when, based on our behavior in the future. This is a really good example of what the strategy of protection does for that situation, it aggravates and accelerates the loss of that beach environment, so you can see here where the two properties were protected on either side of that beach on the right-hand slide, there is no beach, in the middle where there's no protection you still have a beach, essentially in equilibrium with that eroding shoreline.

Accommodation, well we've been doing a lot of accommodation in California for many years, this is a string of development in Malibu where you can see all of it is elevated on caissons to accommodate the sea level, and that will be getting higher. But accommodating in this beach level environment merely raises the question of, "Is this the beach of the future, is this how we want to experience our beach, sitting underneath elevated homes?" And more fundamentally, as the sea level encroaches inland, the mean high tide moves inland, meaning in California and most other states the public trust lands move inland, so the question, the policy question is raised, "What are we going to do when these private developments start to encroach on public trust lands?" And that's going to be a huge issue going forward.

Another strategy that is not in that trio of outcomes is unplanned retreat, and we've seen that a lot also, and so this is Gleason's beach in Sonoma County where residents had to have their homes demolished and removed, we've been unable to stop the physical dynamics there no matter the effort and they're now looking at ways to relocate the highway in that spot, and Patrick mentioned Pacifica, where a lot of development has had to be removed and essentially demolished because of our inability to save it, and so another example of what we would call unplanned retreat. We're retreating, but it's not in any systematic planned fashion. On the other hand, when we've been starting to talk about planned retreat and or managed retreat, we're getting a lot of pushback now at the local level, from both property interests, real estate interests, development interests, but also the local communities generally, and it's not a very popular term right now at the local level. This is a sign in Pacifica 'no managed retreat, not for homes, not for businesses, not for Pacifica,' so there's been a really strong reaction to the idea that we might want to gradually pull back away from these hazardous situations. Another challenge with retreating is simply the cost of development in California, some of the most lucrative and valuable real estate in the world, and this is one example from Broad Beach in Malibu, where the average home price was about \$10 million last year, that would get you about 300 properties acquired in Staten Island with \$120 million but only 10 properties in Malibu, so you can see there's a big challenge if you're talking about planned acquisition of development along shoreline.

So beach replenishment has become more of a preferred strategy right now, and a lot of communities in California are starting to look to that as the way to save their beach and protect their shoreline. You have a lot of experience on the East Coast with this and California has done some but not nearly as much, but I'm sure we have a lot to learn from what has not been able to stop this inexorable rise of the seas so far. This is another example from Malibu Broad Beach, where the proposal is to cover this emergency revetment that you see in the upper right with a dune environment, and also replenish the beach. And so to their credit the homeowners formed a coalition to fund this strategy to build the beach

back, both for themselves and for the public, the problem is they haven't been able to do it. That was ten years ago when they put in the emergency revetment, this is what it looks like today, there is no beach yet for a variety of reasons including infighting among the homeowners about how much it's going to cost and how to actually get it done, where to get the sand.

And a fundamental problem with this challenge from a policy perspective, what are the environmental justice impacts of this rising sea and the loss of beach, and so it's not just about the impacts to communities, it's about impacts to the people who use those resources. This is that same location where I witnessed these kids come up to use the beach, they went up to the access way, they look down, they saw water, they went home, so it's a real environmental justice issue.

We have on the positive side started to recognize that we need to invest in solutions and so we've seen legislation and a bond measure that actually allocates, in this case over \$400 million to adaptation to climate change issues, and so we've started to proactively identify projects that we can implement, and I'm just going to run through a few examples now. This is Surfer's Point in Ventura, where the project was fairly straightforward, remove some parking on the edge, restored as a dune environment with public access in order to soften and pull back from the erosion impacts, obviously no development except for the parking resource had to be removed. This is a before-and-after of that location, you can see how the dune environment has been built back out in front of the eroding roadway at the time.

This is another example, more recent I'm going to skip through that one, and then on the regulatory side, I would argue that in California we actually have been doing a program of what are called rolling easements for at least a couple decades, and that's the idea that you're not just going to require a setback, like in this case, but you're also going to require restrictions on that property at the time of development. Let's say you assume the risk of developing there, you agree that you will never build a seawall at that location, you agree that you will remove the development when it becomes necessary, etc and so by internalizing those leave requirements on the property, assuming that no seawall will be built, that property will roll back at some point as the shoreline erodes, it will have to.

We've also seen active cases of management in places like Isla Vista, which Patrick showed a slide of also, this is a sequence of 40 years there, where if you look carefully you see the coast eroding back, but by 2013 you can see that the properties, the property in the middle, in particular, has been cut in half, the ones on the right have been cut back, there are over 30 properties in Isla Vista that have had this incremental cutting back or

removal, so we have been retreating and it's been through a regulated process of building inspection over time. It's, you know, it happens, we've been doing it, we just don't recognize it.

This is a case of Stillwell Hall in Monterey County, where the Army decided they needed to demolish that old officer's club there, you can see they'd spent a lot of effort over the years trying to protect it with rocks, when they removed that building, the Coastal Commission asked them to please take the rocks with you when you go, and the Army is really good at doing things when they get told to do something and they did it, and you can see how the beach in this location has restored itself to basically a sand environment, it's now a state park so with the commitment you can retreat. The urban infrastructure was mentioned in this case, the wastewater treatment plant in Morro Bay was proposed for an upgrade redevelopment, the Coastal Commission said no, you can't do that at your coastal location, look for another place they've now been pursuing this inland location, and they've also revised the project from just a wastewater treatment plant to a reclamation facility so a much more holistic water project at a safe inland location.

And this is one of my favorite projects that I had the chance to work on, it was working with the transportation agency in California to relocate about three miles of Highway 1 in San Luis Obispo County. We gave them an emergency permit in 1997, by 2014 we had approved the realignment to be safe for another hundred years, and the shoreline is restored, the old highway alignment becomes a coastal trail, so a success story in terms of how to manage retreat. They only had to acquire two private properties in order to accomplish this, so not a challenging urban situation. City of Monterey committed over a series of decades to redevelop this commercial area on the coast to make it a coastal park, and they did so without ever taking any private property, it was all through willing sellers gradually working the market, and so we know how to do this, we just have to commit to certain policy outcomes in places.

So, I want to finish with the slide of the Half Moon Bay Ritz Hotel which was grandfathered in with a vested right when the *Coastal Act* was first approved, you can see the old original foundation that they were going to use, but when they developed the hotel they didn't actually use that location, they set it back a little bit, but when it was approved by the Coastal Commission it was given a condition that they needed to again remove any development or move back from the hazardous shoreline if and when that becomes necessary. So just in the last two years we saw the removal of that old foundation because it had actually started to become a hazard to beachgoers, it was falling onto the beach, the City of Half Moon Bay said you got to remove it, they've removed it, and so planned retreat has begun, and there are literally dozens if not hundreds of properties in California that have similar regulatory restrictions on them, so I think there's a coming adaptation, we'll see what the outcome is because it's going to be a much more different story when the hotel itself becomes endangered, we'll see how that goes.

So just some concluding observations about the broader topic, in my experience, you know the context really matters, there is no silver bullet here it really depends on your circumstances, your physical circumstances, geographic development patterns, etc. Planning takes time and investment, and meaningful engagement, and that's been one of the challenges with managed retreat of late is that there's not enough understanding and connection at the local level where these things are going to happen. Phased implementation with monitoring and triggers, thresholds for action are important to think about, combining different strategies, not just thinking about one way to do things, partnerships obviously, looking at a broad social cost-benefit assessment of what are the costs and benefits of different strategies over what period of time and how do they match up with our values. And so I'll wrap up just by saying that in my view, you know, it's not easy but resilience is finding that sweet spot, the balance between cost-effective risk reduction, environmental protection and stewardship, and social equity, and those all three of those things need to be taken into account considering any option going forward, any solution. I'm not sure I solved it, Patrick, but that's what you need to do in order to solve it, thank you.

Bresette

Thanks Charles that was great. That dog was okay though on the edge of the golf course, did we know that for sure? Okay, good. So, the land use guidance document from 2015, what's the lifespan of that document, what's the next step in that? Is that an ongoing document, does it get updated sometime, what should we be looking out for in terms of how that evolves?

Lester

Yes, in theory they should be updating it on a regular basis but the Commission has been working on the next iteration of some guidance, specifically focusing on residential development areas, that's sort of what upped the ante on the managed retreat discussion and became much more of a political focus. That has been released in draft form, you can go to their website and find that, but has not been adopted yet.

Bresette

Okay, do you know when it would be, is it adopted next year or two years something like that?

Lester

If you asked me that last year, I would have said yes so I don't know.

Bresette

Sometime in the future it'll be adopted. Okay, our next panelist is Jessica Fain, she's the planning director at the San Francisco Bay Conservation and Development Commission where she works on issues related to sea level rise adaptation, environmental justice, ecosystems and working waterfronts. Prior to joining BCDC in 2018, Jessica worked in planning and resilience in New York City as a waterfront planner at the New York City Department of City Planning, and then as the Program Director at the Science and Resilience Institute at Jamaica Bay. Jessica holds degrees from the University of Pennsylvania and the Massachusetts Institute of Technology. Jessica, welcome.

Jessica Fain

Thank you, and it's a pleasure to be here today and with such esteemed colleagues. As was mentioned I only recently relocated to California from New York and so it's fun to be on a West Coast panel for a change and not talking about the East Coast. And so I'm the planning director at BCDC, and just a bit about BCDC, as Charles mentioned, California has three coastal management programs. The California Coastal Commission is responsible for the regulatory program and the outer coast, BCDC is responsible for the program within San Francisco Bay specifically. And BCDC was established in 1965, actually predating the *Coastal Zone Management Act*. At that time it was a different time, excess unregulated fill was threatening the bay, and so our policies were initially written to safeguard against that type of development. So 70 years ago it was a lot easier to build in the bay, all you needed was a local permit, a truck, some dirt, and voila you have some new land to build your development on. There was very little over environmental oversight for the purpose of the filling, and that was really where BCDC came in. And so here is this photo from 1969, you might recognize a young governor Reagan signing the BCDC into state law, but I think almost more importantly are the three women who are standing behind him, three faculty wives from UC Berkeley who were really responsible for the Save The Bay movement and the creation of BCDC and to stop the filling of the Bay.

But now here we are, almost 2020, and as I mentioned 1965 was a different time. Climate change and sea level rise are game-changers and so BCDC has really been in this process of pivoting from an agency that was meant to stop the filling of the Bay to one that now has to reckon with an increasingly growing bay, and what that means in terms of our coastal management. So, as part of this pivoting, we've been updating and thinking and giving a hard look at a lot of our policies, planning, and regulatory practices in light of rising seas. In 2011, BCDC adopted climate change policies into the San Francisco Bay Plan, which is our coastal management policies for the bay, and those policies have been in effect since then, and they basically require that any project shows that they're resilient to mid-century and adaptable to end of century. But we've also been doing some other stuff since then, we started around the same time, the Adapting to Rising Tides Program, which is our voluntary, stakeholder-driven sea level rise adaptation planning effort. So on the one hand we have our regulatory function, but our ART program, which is what we call it for short, really tries to work with counties with cities to work through adaptation planning, and we have a step-by-step process that we have laid out and have used in multiple places around the Bay. We also received in 2015 a NOAA project first of special merit, where we did a report called Policies for a Rising Bay that tried to really identify those additional policy issues that really could help us move forward with addressing some of the threats of rising seas and kind of continue on that pivoting.

And so what I'm going to talk about for my time today are really these four different projects that we've been focusing on in the near term, one called ART Bay Area which is our first regional ART project. Two updates to

our Bay Plan policies, one on environmental justice and one called Fill for Habitats, and one at something called the BRRIT, which I will define for you in a minute. And moving forward a key takeaway from this and what we're really hoping to move towards is more of a regional approach, an integrated regional approach to how to think about this work. And it's just worth mentioning too that BCDC is one of many actors in San Francisco Bay who are thinking about this, it is a crowded field there is a lot going on in the Bay Area on this topic and so we have a great foundation to be working on. I feel very fortunate to be working and in a place that is rich with this kind of science data and information, and so now it's a lot about how do we weave it all together into something meaningful. One of the stories that I heard when I first came out to the Bay Area that really just blew my mind was this one about Measure AA, for those who don't know this story, this is a regional nine county parcel tax that the Bay Area voters decided to tax themselves several years ago. It's \$12 per parcel per year for the next 20 years, and all of the funding goes to wetland restoration, and besides the fact that the voters decided to tax themselves for this purpose, the other thing that really astounded me was that this effort was really led in close partnership between the environmental community and the business community, so it just kind of goes to show what kind of place the Bay Area is. So with this new source of revenue coming into the Bay we're gonna see lots of great wetland projects moving forward, and all this work needs to get permitted, and so one of the things that the BCDC has been working on has been partnering with our seven different federal and state agencies to create the BRRIT which stands for, I know you're waiting for it, the Bay Restoration Regulatory Integration Team and it just kicked off this fall and it's specifically meant to be a team of regulatory staff to work together, sit around a table to help permit these wetlands restoration projects. What it looks like in practice is that there's a staff person from each of these agencies, that's their sole job is to be on the BRRIT, they meet in person and they're accepting projects right now, so the first projects are really going through, so it's too early to say whether it's been a success or not but I think it's a really great start and hopefully we'll hear more about it and then in the next few years about how it works out.

Then pivoting a little bit here I want to switch gears to discuss our two recent Bay Plan amendments, and these I think are both things that also get at this idea of how do we accelerate our approach to resilience. So this photo here is a marsh in San Mateo that just on a regular king tide you can see how the marsh looks like at that different sea level, so as I mentioned BCDC was created to control bay fill but with sea level rise and reduced sediment supply in the bay, ecosystems such as this one could experience major shifts in habitat and habitat loss as well, and so we know that in order to adapt to these changing conditions, habitats might require more fill in the bay. So for example thin-layer placement of dredge sediment on the left, or construction of, another term that I only learned when I moved to California but a horizontal levee, a very gradually sloped levee that's planted to kind of mimic the natural slope of a shoreline are the types of strategies that we might need moving forward. And so thankfully our commission in early October adopted this amendment and in summary, it will do the following things: it will recognize the positive effects of fill for the first time, it will allow for more fill for habitat specifically in the Bay, it will scale the amount of monitoring with the project's goal and the level of risk, it will incorporate principles of regional ecosystem goals into project consideration, it will encourage pilot projects, it will require the consideration of natural and nature-based infrastructure, and it will allow for more beneficial reuse of dredged sediment for most habitat projects in the Bay, so that was a real achievement.

The second, concurrently, BCDC has been tackling a rather different but equally important issue, that of environmental justice. Like many other coastal programs, including the Coastal Commission, BCDC is taking a hard look at what it can do better to serve all people in coastal communities. So one of the main outcomes of that NOAA the project of special merit that I mentioned before, the Policies for the Rising Bay report was this recognition that in order for BCDC to carry out its mission equitably and fairly, the Commission must examine how its policies and practices may be contributing to or exacerbating environmental injustice and social inequity and identify those opportunities for change. We say the Bay is meant to be a resource that's shared for all, but in some cases, shoreline development may place burdens upon certain communities, such as increased pollution or displacement of residents. Likewise, certain climate change impacts will impact different areas differently, and Adaptation to Rising Seas proposed additional challenges to those with fewer resources. So I'm pleased to say that our commission also adopted in late October another Bay Plan amendment on environmental justice and social equity, and this Bay Plan amendment will recognize the agency's role in environmental injustice and social inequities, it adds definitions and guiding principles to help shape the Commission's work, it requires meaningful community involvement for specific projects, it asked folks to identify and address disproportionate impacts of

projects, and use inclusive design principles in evaluating public access projects, as well as addressing issues about adverse impacts on adjacent shoreline protection. And so we're really excited for this to be added to the Bay Plan and hopefully will be in effect starting in 2020.

And so finally I just want to touch on our voluntary stakeholder program we have in Adapting the Rising Tides, it's a great program I'd recommend you check out our website, there's tons of information—how-to guides, all the examples of past projects, as well as data and maps, we have our own Bay Shoreline Flood Explorer and other tools that we have that are really meant for this to be not a one-off, we'll do an adaptation study for you, but really here is the materials to empower communities to be able to then take it and do it themselves.

The most recent ART project is ART Bay Area and this will be released in early 2020, so I'm just going to give you a quick sneak peek of what this work does, and stay tuned you can read either the 300 page version report or hopefully the short report which will accompany it in early next year. But this is a Caltrans funded project in partnership with other regional agencies and has been a real collaborative effort. So ART Bay Area is the first time that we're kind of looking at the Bay Area as a system, as a region, as a whole in a series of systems that are interconnected, and it sort of started with a hypothesis that within a closed bay system what happens in one corner of the bay might actually matter and have cascading impacts to other corners of the bay. We all kind of intuitively would think that's true but what this project went and did was try to systematically think about well what does that really mean in practice. And so it looks specifically at four different systems, our transportation systems, our vulnerable communities, our potential future growth areas, which are called priority development areas, as well as our conservation and natural areas, and it looks regionally at what each of these on their own, it zooms in locally what these mean at a kind of sub-regional specific area and then it looks across them what happens when you layer these on top of each other.

And so I'm just going to talk you through one of the examples about how this layering sort of works. So here for example we've mapped out the 11 transportation indicators impacted at 36 inches of sea level rise, things like those highway segments that are going to be most impacted on average annual daily trips, the top five passenger rail segments, the high quality bus routes, and using data—not just here's a highway, but here's actually how many people are going to use that highway and here's what it means. And so we started to layer that with things like our conservation areas, our planned development areas where housing and job growth is expected to occur, as well as our vulnerable communities, we didn't really rank them and we just kind of mapped that on top. And so what we start to see is some clusters emerging and why this is interesting I think is that these really point to some areas where there's opportunities for these types of multi-benefit solutions where you can start to see okay, there's a growth area that's proposed here, there's a vulnerable community, there's a transportation asset that needs upgrading, how can we start to plan holistically for these different solutions together. And what you also start to see is as you look at different water levels, TWL stands for a total water level, it might not be an acronym familiar to everyone but it's an approach that we use to say water levels, and we don't know exactly when 108 inches of total water level will happen, but it could be a combination of sea level rise and storms or future storms and it's a way to kind of use one map to just say many things, but we see 108 inches of sea level rise is that how many of these clusters actually stay the same, and you see a few different ones but that these really do start to point to some of those areas where as a region we can start to prioritize and think about how we want to direct our resources.

All of this work kind of gets summed up into eight key planning issues where we've looked across the region and kind of boiled it up and written up what some of these key cross-cutting concerns are, and they're things like number four that contamination complicates and exacerbates flooding issues, or five that sea level rise will amplify existing housing displacement concerns, and if you've tried to rent or buy a house in the Bay Area recently you will know that this is a really important issue. And from our key planning issues that then leads to a set of 80 over 80 adaptation responses, so it's a really rich report and it really sets us up well to start to make some key decisions as speaking as a region about how we can move the needle.

So in conclusion, where do we go from here? The first I would say is it's important to remember that sea level rise is a huge crisis, it's one that is impacting people now, not at some big point in the future, but if you spend any time in the Bay Area lately you've realized that between the the housing crisis as well as recent wildfires that if we wait to fix problems until they reach that tipping point, it'll be too late. We knew that our housing situation wasn't up to snuff but we didn't build more, we knew that our infrastructure was old and that our forest management wasn't in tip-top condition but we didn't act. We have the chance with this problem to be proactive,

not reactive and so what will really push us into high-speed action is, and really thinking about what the cost of inaction is. The second is that we need to be able to solve crises together, we need to be able to talk and chew gum at the same time. Housing doesn't need to come at the cost of adaptation or vice versa, and as well as many other issues, but they need to be in conversation with each other. And then finally the last point which is that adaptation in the Bay at least is still very much occurring on a project-by-project basis, or a city-by-city basis, and our next challenge is really how to get to the point of agreement around the region about the values and priorities for adaptation so we can make some more definitive decisions about action holistically and equitably. Much of the work of adaptation falls on local governments and so how can we ensure that they have the tools and capacities that they need in order to do their job within a framework that makes sense for the region. So in short, resilience to me is not a one department issue, it really requires coordination across the range of program areas that touch the coast, from transportation to housing to emergency management to public health to natural resources to education and beyond, so I will just leave with that thought, thank you

Bresette

I'm glad that you touched on sort of that regional coordination approach. You said that BRRIT hasn't been around long enough to know whether or not it's successful, but how will it know? Like what will sort of an early sign of success of that of the BRRIT initiative be that you think would indicate to you that this is on the right track?

Fain

I would say that it's the permits that don't get caught in the gears like they sometimes do, so we'll see permits that are able to be ironed out faster. I mean part of the challenge with coastal management work in general is that you don't see what doesn't get built right, you don't see how sometimes the regulatory process works, but I think we have some internal metrics that will be able to measure how quickly these projects move along and whether we're meeting those milestones or not.

Bresette

Thanks. Our final panelist is Aimee Kinney, she's a research scientist who focuses on environmental governance, she provides analysis of existing programs and policies to support implementation of Puget Sound National Estuary Program Recovery Plans and Strategy, so we're moving north from California. Aimee's particularly interested in optimization of regulatory and incentive approaches for ecosystem-based management. Aimee previously worked for the U.S. Army Corps of Engineers, you saw their logo on one of Jessica's slides, the little red and white castle thing, in the Seattle District, and helped plan coastal habitat restoration projects, supported maintenance of water resources infrastructure, and ensured compliance with environmental laws and regulations. So welcome Aimee, thank you.

Aimee Kinney

Hi, good afternoon. Before I get started I just want to say thank you to EESI, especially Amber and the Coastal States Organization for inviting us all here to share some of the work we're doing. This has been a great panel, thank you. So today I'm going to talk about the Shore Friendly program developed by National Estuary Program Partners in Puget Sound and this is hopefully a solution and we're gonna pivot a little bit, it's different from the regulatory programs that we've been starting with, it's a voluntary program that's using incentives to encourage homeowners to either remove damaging shoreline armor that has been really detrimental to fish habitat in Puget Sound, and also to use nature-based alternatives that protect property without some of those negative impacts. This was a program that was developed really primarily for ecological resilience at first. We have beach-spawning forage fish in Puget Sound that are a really key element of our food web, and so salmon eat them, birds eat them, marine mammals eat them, and so as our beaches get damaged with hard armor it has pretty drastic impacts on the food web. So I'm also going to discuss plans we have to grow this program by developing a revolving loan fund to finance Shore Friendly projects and plans to add sea level rise adaptation measures to program offerings so that we can look at bringing community resilience into this program as well.

First I'm going to tell you a little bit about Puget Sound and the nature-based shore protection technique most commonly used there. So Washington State has a little over 3,000 miles of marine shorelines and 2,500 or so of those are inland waters, so everything east of that purple arrow, and our wave conditions are very different

than the outer coast, and so the impacts we've been seeing haven't been quite as dramatic as some of those California impacts. We have a range of habitats—we have high bluff habitats, we have low bank habitats, we've got really highly developed, highly modified shorelines, and relatively pristine shorelines. You can see from the photographs this is a system where there's a lot of wood on the beach, so a trees fall in, they stay in the system when they are on an unarmed ridged beach, they really accumulate there, I mean that picture on the lower right-hand corner is to demonstrate the tidal range, so you can see the the arrow there is about twice the height of two men in the pictures. So in Seattle, the tidal range is about 15 vertical feet and that really affects the types of projects we can build.

So in Puget Sound the primary alternative shore protection technique we use is called soft shore stabilization, these are engineered projects that utilize beach nourishment and that could be either sand, it could be cobbles, it can be gravels, depending on conditions, logs and plants to slow erosion and so this is a project at Seahorse Park just south of Seattle, that was the first phase, it was conducted in 2005, the second in 2014, and a large bulkhead structure was removed and on the right that is actually a soft shore protection project that was designed to protect infrastructure behind the wall, that's been performing very well. And large restoration projects like this one are a big component of the regional strategy to restore beaches. But we've really realized recently that they're not sufficient, and this is because about 60% of Puget Sound shoreline is zoned for single-family residential use, and we recognize that planning and executing a large restoration project on public property is fundamentally different from executing a lot of small projects on private property, and so we realized we needed to develop some tools in our toolbox to help encourage those types of projects.

And one of the first things we did in implementing that strategy is, which is a unique resource we have, is development of regional standardized engineering guidelines for different erosion control techniques, ranging from beach nourishment to hard armor where necessary. These marine shoreline design guidelines were released in 2014, and in addition to providing your engineering specifications, they provide a comprehensive framework for site assessment and alternative analysis. So this is really a tool that both regulators and others can use to help determine when removal of hard armor, where that's appropriate and where soft shore alternatives would be a feasible option as well. And when you look at the risk model provided in these guidelines, they really show that much of the shoreline armor along Puget Sound is really overbuilt from an engineering perspective. It's not really necessarily needed to protect infrastructure, in many cases, it's more of a landscaping feature, people put these retaining walls in so they could have a nice flat yard, combined with the fact that a lot of the existing armor was installed in the 1950s and 60s and is really getting to be at the end of its serviceable life, we're left with an enormous opportunity to restore beach habitat in Puget Sound. This Your Marine Waterfront brochure is one other tool we added to help with that, it's a user-friendly summary of the marine shoreline design guidelines, meant to really teach homeowners about what's on their beaches, that there are fish that spawn on their beaches, the eggs are tiny you can't see them, people don't know they're there, what the impacts armor has and what their alternatives are.

But social science tells us that more than education and outreach are needed to change behaviors and so we knew we needed a different approach for changing behavior. The Puget Sound Partnership, who's the lead state agency for the National Estuary Program in Puget Sound, works really hard to integrate social sciences into recovery planning, and they suggested that a technique called social marketing could be really useful here. And this has really turned out to be a very powerful tool for our toolbox that we're expanding to other things like green stormwater infrastructure as well. Social marketing applies traditional marketing principles to influence behavior for the good of society, and so it's an evidence-based approach that's been used for decades in public health to help people make better decisions. In our case, social marketing provided a really systematic framework to look at who our target audiences are, where are they, what are their characteristics, what are different target behaviors that we're seeking, what are barriers and motivators for those behaviors, and what sorts of strategies can we use to change those behaviors. So for example, our target behaviors are going to range from leaving a property unarmored, to using soft shore techniques instead of armor, or removing a bulkhead, and there were also some supporting behaviors as well. And then information about the barriers and motivators for those behaviors was obtained with one-on-one interviews with surveys with focus groups, and that identified really key things [about the] information that homeowners used to make decisions about the properties. And one of the interesting things that came to this, the research pointed that real estate agents are a really important influencer for harbor decisions because a lot of projects happen around the time of sale for a property, so we knew we needed to reach

real estate agents somehow. And we also noted that the complexity of shoreline projects, the number of experts you had to get involved, how long it takes, who do I call, what do I need to do, what are all these permits, that was another enormous barrier for projects and so we knew we needed to develop some technical assistance, permitting assistance, and also cost as an issue so financial assistance as well.

So the result of all this formative work was the Shore Friendly Program, and the program has a couple of key elements, a lot of education both for homeowners themselves and those influencers, so contractors, real estate agents, consultants, things like that. There's really an emphasis on in-person, face-to-face engagement with those audiences, but also we've got many electronic and paper resources as well. Really at the heart of Shore Friendly is technical assistance provided to homeowners during visits to a participant's property, these are free, homeowners can ask for help and qualified professionals will evaluate conditions on that specific property. We have a lot of variability in shoreline, so we can't say this is the one thing you have to do, that's really something that needs to be assessed on-site for that space. And then the professionals can make specific management recommendations for that property. Participants are encouraged to invite their neighbors, in some cases, we have neighborhood projects and neighborhood beach walks like you see in the photograph there, and a lot of times these visits are focused on things other than a discrete problem on the shoreline. The photo on the bottom there shows a landslide over a nice shiny new bulkhead and that's because upland management of bluff vegetation, drainage, can really affect bluff stability, so in many cases, someone may feel like they need to build a bulkhead, but really they need to have an arborist that's trained to do work on that property. When participants are interested in moving forward with an armor removal project or soft shore installation, the program can provide additional assistance, they can help with getting designs, getting all the permits for the projects, and financial assistance as well.

So Shore Friendly is a program, it's a regional strategy developed for Puget sound, but it's implemented at the local level. And so between 2012 and 2016 there were five pilot campaigns that were funded through the National Estuary Program, 2019 has been a really big year for Shore Friendly because of the success we've been able to expand it to all 12 Puget Sound counties. It found a permanent home at the Estuary and Salmon Restoration Program at the Washington Department of Fish and Wildlife, and we also got a state appropriation that is allowing the program to sort of wean off of that National Estuary Program seed funding and become self-sustaining. One of the things I want to point out here is you'll notice that conservation districts have been a really key element in the expansion, and what we found is

that this face-to-face technical assistance model is very very similar to agricultural conservation programs that have been implemented by conservation districts for decades. And so they've really moved into this role very well, they've got lots of experience executing cost-share agreements, that one-on-one assistance working with homeowners or landowners in a non-regulatory manner, and like I said they're starting to use social marketing as a technique in urban areas to work on green stormwater infrastructure projects as well. Also notable for 2019, the Swinomish tribe joined as our first tribal implementer for Shore Friendly. So the locals have really done a fantastic job implementing these programs, by having the programs delivered locally each was able to focus on the needs of their communities to adjust the different tools in accordance with factors in those communities. Demand for the assistance has consistently been very high and we've recognized that additional financial incentives are really needed to the program and get more armor removal projects completed. And to make our efforts really commensurate with the problem we're facing, we need to scale that up rapidly. So remember how I told you a lot of the armor was beginning to fail? Between 2011 and 2017, 14 miles of armor was replaced in Puget Sound and so yeah this was successful for the pilot programs, but we really need to scale that up to make a difference.

So looking to the future we're seeking to expand the Shore Friendly offerings in two ways, first by creating a revolving loan fund that would allow us to offer homeowners low-cost loans to finance Shore Friendly projects, and this would be modeled after a long-standing living shorelines loan program in Maryland as well as a recent septic repair program in Washington. Second, we're finding that many of the Shore Friendly participants are concerned about coastal flooding and sea level rise, they really want to talk about what do they do long term when they're having these discussions about their shoreline, and so what we would like to do is add elevation of homes or moving homes landward away from the water or bluffs edge as things that could be financed with our loan program, and this would really allow us to join that community resilience piece with the ecological resilience piece. Capitalizing a loan fund like this though is really tricky, funding any sort of multi-benefit project is challenging. Here we're looking at restoring habitats, so there's maybe salmon recovery and NEP money available,

there's a nexus with water quality as well, some of these structures are made of creosote which are leaching toxics, we've got flooding of septic systems is a concern of water quality concerned as well, so the state clean water revolving loan fund is potentially interested, and when we look at reducing coastal flooding risk we get into the emergency management world, so maybe FEMA programs are appropriate, HUD block grants, that sort of thing. But each of these programs is sort of in their own stovepipe and we're just getting started with this, and have concerns about whether all those puzzle pieces are going to fit together, or we're just never going to make them work. But the good news is we've got two bills introduced this session that do look at those ecological resilience piece and community resilience piece jointly, and would provide funding for this type of program. Both of them I think we would need to look a little more closely about whether this sort of local program focused on small residential projects would be eligible for those, in some ways, what's currently in the bill is really focused on those larger municipal projects and so a little more work needs to be done there. With that I will wrap up and hand it back to Daniel so we can start our question and answer portion, thanks!

Bresette

I'm gonna go back to the EESI slide, there's a survey link up here, hopefully you'll take an opportunity to do that. I'm gonna skip my follow up questions so we can dig right in. So for staff who are here in the audience, they're gonna go back to their offices and they're gonna talk about what they've heard today and a question they might get from their bosses is what do you mean by resilience exactly? so Aimee I'm gonna start with you and we'll move this direction in two sentences three sentences max, what would you recommend as far as a definition for resilience for the staff who are here with us today, when they get that question, what is resilience?

Kinney

So that's a really complicated question!

Bresette

Three sentences max.

Kinney

So I think you're looking with resilience or you're looking at being able to go after some sort of stressor, you're able to go back to a condition similar to the condition where you started. And it really differs whether you're thinking about ecological resilience, how the ecosystem responds to a stressor, like armoring, like a storm, that sort of thing, and the community resilience. But it's really important to think of both and not just one or the other.

Bresette

Okay I know you used a lot of semicolons to stretch that out.

Kinney

I actually have a colleague that wrote I think like a 60-page paper about what resilience is and what it means to different folks.

Bresette

Thanks very much. Charles, you're up next.

Lester

So bouncing off of that, that's not a sentence, you know, I would agree that I don't think it's really helpful to focus on the narrow of scientific definition of the ability of a system to bounce back to something, what's important is what is this something, and so I concluded with it's in my mind it's that target of what's the right mix of, in this case, risk reduction, a cost-effective risk reduction, environmental stewardship, or protection, and social equity, and all three of those things I think you just said need to be in the mix, but the important question at the community level is what are those things that we care about that we're trying to bounce back to, and so in the

adaptation literature there's a discussion of healthy and unhealthy adaptation or maladaptation, and for example, I wouldn't, at least myself, think that adapting to sea-level rise with sea walls up and down the coast is not a resilient bouncing back, it's an adaptation to a state of the system that we do not want to be in.

Bresette

Great, Jessica.

Fain

I would just add that sometimes you hear the phrase, not just bouncing back, but bouncing forward, so how can we play on these systems so that we're actually bouncing towards a goal that represents where we want to be going, not just necessarily where we have been before, and to me personally I think it's most powerful to communicate resilience, not just around ecological resilience but around all these multiple aspects of resilience and linking it with health, with communities' ability to thrive, with our economy, and kind of all those facets of resilience to me kind of make it most compelling as something that we need to be focusing on.

Bresette

And Patrick, USGS probably has a definition of resilience somewhere but in your words what are we really talking about?

Barnard

Yeah, I mean from a coastal hazards perspective, you know for us resilience is using data-driven projections to strategically plan for the potential impacts of climate change and thereby being very efficient how we're able to adapt and very malleable and how we can adapt to the range of conditions we can expect in the future.

Bresette

That's great, I'm glad you all had those great answers because I think a lot of times here resilience is thought of in terms of hardening things, you know the armor that we saw in a lot of those photos but I'm glad, I hope everyone takes that away that it's more than just that. It's sort of a concept as opposed to a set of things, so thanks for that. We can have questions from the audience, we have a couple minutes and we're happy to take a couple, we've got a roving microphone, please use it because that way your voice is captured for the webcast.

Audience

John Wetmore, pedestrians.org. As groundwater levels rise, what does that do to the risk of soil liquefaction in the event of an earthquake, you know all these things seem to interconnect.

Barnard

Yeah, that's an excellent question. I mean the Bay Area is certainly ground zero for both sea level rise impacts, in the state it actually accounts are about two-thirds of the projected impacts, and for earthquakes as well, and all the liquefaction maps are based on existing groundwater levels, and so those liquefaction maps are going to need to change, we're actually working with our earthquake hazards group now to update those maps based on these projections of where the water table will be in the future because it will certainly enhance the hazard of liquefaction during an earthquake in the coming decades.

Bresette

Do other panelists have comments on that? I just want to make sure we give everyone a chance to say something. Do we have any other questions from the audience? Oh, we have one over here.

Audience

I think Aimee mentioned the conservation districts, and could you just kind of explain what that is?

Kinney

So conservation districts are sometimes called soil conservation districts, but I think in most parts of the country there's one in every County and historically, they have delivered a lot of the Natural Resources Conservation Service and USDA agricultural assistance programs to farmers, and so a lot of the programs for planting riparian buffers and the wetlands reserve programs and these sorts of things are all administered and implemented by conservation districts. And so again it's a great model for the one-on-one help to a private landowner, and using public dollars to support conservation stewardship actions on private land, so it's been a great model to apply and like I said if they're conveniently located in every County it's really something we could build off to do these types of incentive programs.

Bresette

Any other comments on that? Charles?

Lester

I would just agree with that and say we've used them in California in a similar way, it's sort of a softer strategy and engagement of at the local level to get certain things implemented, so the Coastal Commission for example has approved at a programmatic level the ability to go out and do things that would ordinarily require an individual permit, but if the conservation outreach person has signed off, oh yeah you've met certain performance standards, it's able to happen under the auspices of a programmatic authorization, so you've eliminated the bureaucracy.

Bresette

Okay, that's interesting. Any other questions from the audience? We have a couple minutes.. you can have a second question, sure why not?

Audience

We've been looking at coastal impacts here, are there other people looking at other impacts such as snowpack in the mountains and how that's going to change and affect things?

Barnard

I can start, yeah I mean California's had their own climate assessments about every four to five years, so we've gone through our fourth Climate Assessment, so it kind of mirrors IPCC and so there's a range of climate-related issues that are being looked at, it's wildfires, it's snowpack, it's water resources that are looked [at] across the whole spectrum and how those affect infrastructure and just basically distribution of resources across the state, so a lot of work going on in all those different areas.

Fain

I'll just add that specifically in San Francisco Bay we're very connected to the Sacramento-San Joaquin Delta and so we partner very closely with the folks up there, the Delta Stewardship Council, it's another state agency who are looking at the Sierras and the snowpack impacts there, and we've been working with them about what that means as it kind of flows down and into the bay as water is coming down, and water is coming in where what are those dynamics and how do they kind of meet.

Lester

I just wanted to underline I think that's a really important point and you made it in your presentation, which is this more holistic framing of the problem, it's not just about sea-level rise and how to build right on the coast, but you have to consider the social systems more broadly, transportation, housing, economic redevelopment, all of that has to be considered at once if we're gonna deal with climate change, and these assessments that Patrick mentioned are an opportunity to really look across the board at what's happening to the state and society as a whole.

Bresette

We have time for one more, Amber?

Audience

This one's for Jessica. So you had previously worked in New York, is there any major overlaps or parallels between your work and the big issues and/or solutions in New York and California that you've seen?

Fain

There's a lot of overlap, there's also a lot of difference, and I would say some of the key differences are first in New York City, I was looking for the city specifically and it's built out to the edge and wetland restoration in New York means if you can get like a half acre, an acre wetland restoration project, it's like the jackpot. If you go to the Bay Area, it's not like that, they're doing... you know it's a massive scale [of] restoration projects, so just the ability to use and employ greener strategies in the Bay at least, just the opportunity there is huge. So that's one thing that's kind of different, another thing that's different and we were talking about this earlier is just the governance structure. Every coastal state is different, every state is different, but California has a lot of government, and a lot of layers of government, and so moving from a single city that had one mayor and one city council to now working in a region where there's you know several hundred, 100-plus coastal cities and many special districts and layer upon layer, it's a whole nother kind of ballgame I guess.

Bresette

So go ahead Charles cause I'm actually gonna expand on Amber's question, it's the last but why don't you go first.

Lester

I just wanna add as part of the observation that California also has a forty billion dollar a year coastal economy and so I used to talk about it as a win-win. The reason we have a huge coastal economy is because we decided to protect the coastal economy by doing things like protecting beaches and wetlands and natural resources, that's why people come to California, so it's a good example. Admittedly, we have some other crises we're now struggling with like housing, wildfire, you know just general land-use development generally, but it is an example of where regulation doesn't mean you kill the economy

Bresette

Mhmm, yeah, so Amber asked that good question, we had a briefing a couple of weeks ago now, and Kate Boicourt was one of our panelists, if you haven't checked out our Northeast coastal resilience briefing, please do, it was really good Kate in particular was a great panelist, but I think I'm just taking that up a step and then we're gonna end because we're a little over, but for the other panelists and Jessica can answer too of course, but are there others places around the country that you kind of look up to as doing the right things on coastal resilience that maybe does apply to the Pacific to the Pacific coast? Where else do you look and say oh, that's a great idea I'm gonna borrow that model or approach or funding mechanism, whatever it happens to be, and Aimee's nodding vigorously so I'll go with you first and then we'll come down.

Kinney

So we have looked to Maryland and Virginia and some of the things they're doing with innovative finance.

Bresette

Great thanks, Charles any other comment?

Lester

The one thing I've looked at is the Blue Acres Program in New Jersey which is, at least appears to me to be, a fairly successful robust buyout acquisition program to deal with housing in hazardous locations so I think California has some things to look to there.

Bresette

Jessica, anything else you'd like to add?

Fain

I'm always interested in what Louisiana is doing in terms of regional work around this issue and how they can really kind of focus at such a large scale.

Bresette

And we had a coastal Louisiana briefing a couple weeks ago also that had some great presenters, and yeah they're facing some very very stark challenges. Patrick, where are you seeing some of the best practices coming up?

Barnard

Yeah, Hurricane Sandy really sort of reimplanted coastal hazards on a map for a lot of people in California, reinvigorated the discussion for sure, and there's a lot of interest in seeing how the different states responded in New Jersey, and New York had very different responses, so that and also for sure the Gulf Coast, which is really one of the front lines of sea level rise impacts on the Mississippi Delta, there's a lot of interest in how they're dealing with relocating people. We also look globally, we have colleagues all over the world, and we've worked with the Dutch quite a bit to see how they've been living with the rising seas and just believe me they're right at sea level, below sea level for centuries, and so there's a lot of back-and-forth I think with colleagues all over the world, and really know how they've been responding to this issue.

Bresette

Great, thanks. I think we'll go ahead and end it there unless anyone else has any burning questions. Let me say thanks to our panelists, I think they deserve a nice round of applause. Let me also say thank you to our co-hosts the Coastal States Organization, thank you very much, yes for sure, representative Jared Huffman helped us get here today and host this briefing in this room, so thanks very much to him and his staff, and then last but not least the reason, I know her name is 'cause it's Amber, she was a big hand in pulling this off, thanks to Amber, Aumary, Savannah, Melody, Dan O, I don't know, the rest of team EESI I think that's everybody in the room, so thanks to team EESI, for our last briefing of 2019 unless there's something I don't know about, but thanks very much for joining us hopefully we'll see you back at whatever we are up to in January, remember to visit us online and sign up for that *Climate Change Solutions* newsletter. Thanks very much, have a great one.

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