

2ND NATIONAL LIVING SHORELINES TECHNOLOGY TRANSFER WORKSHOP

February 21-22, 2018 | Oakland, CA



ACKNOWLEDGEMENTS

We are indebted to the many people it took to convene this event. To our partners, Save The Bay – San Francisco and the California Coastal Conservancy, we thank you for your dedicated support and enthusiasm throughout this entire process and particularly are grateful to Donna Ball and Marilyn Latta for their guidance, hard work, and good-spirited contributions. We appreciate the steering committee for their input and recommendations: Donna Ball, Save The Bay - San Francisco; Kathy Boyer, San Francisco State University; Janine Harris, National Oceanic and Atmospheric Administration; Marilyn Latta, California Coastal Conservancy; Rebecca Lesberg, San Diego Audubon Society; Melody Ray-Culp, U.S. Fish & Wildlife Service; Tom Ries, ESA Sceda; Hugh Shipman, Washington State Department of Ecology; Tracy Skrabal, North Carolina Coastal Federation; Lee Weishar, Woods Hole Group; and Todd Woodard, Samish Indian Nation. Our note takers were a key to the success of pulling together this document and we thank them for their time and efforts: Geana Ayala; Margot Buchbinder; Lauren Garske; Julie Gonzalez; James Han; Ian Kelmartin; Erik Martinez; Melissa Patten; Gwen Santos; Kelly Santos; and Nikki Young. We are grateful to Nate Seltenrich for his work in developing the summary text.

CONTENTS

	EXECUTIVE SUMMARY	4
	WELCOME AND KEYNOTE ADDRESS	6
DAY 1	PLENARY SESSIONS	
	Latest Findings on Science, Efficacy, and Ecosystem Services	8
	Outreach, Engagement, and Social Science Aspects Related to Living Shorelines and Nature-based Projects and Programs	9
	BREAKOUT SESSIONS	
	Determining and Documenting Efficacy (or Lack of) for Living Shorelines and Nature-based Approaches	11
	Meaningfully Engaging Typically Underserved Communities	12
	Challenges Working with Materials in Living Shorelines and Nature-based Approaches	13
	Envisioning the Future of Living Shorelines and Nature-based Approaches	14
DAY 2	PLENARY SESSIONS	
	Design and On-the-Ground Implementation	16
	Policy, Permitting, and Regulation	17
	Valuing Ecosystem Services, Finance, Investment	18
	BREAKOUT SESSIONS	
	State and Regional-level Permitting and Laws	19
	Design and Implementation	20
	Valuing Restoration Projects to Increase Financial Investment	21
Incentivizing Adoption of Living Shorelines and Nature-based Approaches	21	
	CLOSING COMMENTS	22
	POSTERS	23

EXECUTIVE SUMMARY

Living shorelines came at different times to the East, Gulf, Great Lakes, and West Coasts, and in different ways. This makes sense, as the East Coast has thousands more miles of estuarine and/or sheltered shoreline, much of which is more densely developed coastal communities. As early as the 1970s, living shorelines began appearing along the Eastern Seaboard, particularly in Maryland, Virginia, and North Carolina. As their use evolved, programs were created that promoted, even required, a more ecological alternative to hard or grey infrastructure for erosion and flood control—one that was often also more effective and economical.

Rather than delineate the shoreline with a vertical concrete seawall or jumble of bulky riprap that displaces habitat and offers a rigid, minimally resilient bulwark against sea-level rise and storm surges, landowners and contractors could turn to so-called green or nature-based infrastructure to protect inland development. This approach employs natural slopes and materials, maintains tidal habitats from top to bottom, supports beneficial physical processes like sedimentation, and adapts and responds to a changing environment.

The distinction is clear, yet execution in the real world is loosely defined and can take myriad forms. Names for this alternative approach vary considerably depending on locality and context, including not only “green infrastructure” and “nature-based solutions” but also “soft shorelines” and, of course, “living shorelines.” In essence, they all refer to the same thing: managing shorelines to protect or restore natural shoreline ecosystems while buffering against erosion or flooding through the use of naturally sourced or inspired elements.

As these ideas continued to gather momentum along the East and Gulf Coasts, they also coalesced independently out West. Living shorelines concepts surfaced in isolated restoration projects in Southern California and the San Francisco Bay Area, and in a more cohesive manner—albeit with different terminology and technical details—in Washington, particularly around the Puget Sound.

Rules that applied to Atlantic shorelines did not necessarily apply to those of Washington, Oregon, and California: different storms, different geographies, different tides and waves, different species and materials. For years the exchange of ideas and new solutions from one coast to the other was limited.

The inaugural Living Shorelines National Technology Transfer, held in Hartford, Connecticut, in December 2015, was the first of its kind in the United States. It offered an opportunity for agency staffers, researchers, and other parties from across the nation to gather and exchange ideas. While the conference did include region-specific breakout sessions, including the West Coast, participation from that region was sparse. To encourage broader participation from the West Coast, Workshop organizers decided to hold the Second Living Shorelines National Technology Transfer Workshop in Oakland, California, in February 2018. The conference’s location was no accident. Beyond being in a coastal state with a rich history of environmental advocacy and scientific innovation yet limited institutional and political experience with living shorelines, the workshop took place adjacent to the San Francisco Bay, widely considered one of the planet’s most altered estuaries. And in a hotel built on a former mudflat, at an elevation of about three feet—near an international airport surrounded by riprap and at significant risk of flooding due to sea-level rise within the century.

The goal was to bring together local players and national experts, to introduce leaders from the Bay Area and across California and the Pacific Northwest to their counterparts on the other coasts. West Coast cities and states can come together and collectively get up to speed by learning from those that have already implemented living shorelines programs. This could help them begin defining how their own programs will look or work, recognizing that every state and region has unique requirements, both physical and regulatory.

On a federal level the movement is gaining steam as well, particularly with the adoption of the United States Army Corps of Engineers—Nationwide Permit 54 in late 2016. Federal agencies including the National Oceanic and Atmospheric Administration (NOAA) and the United States Army Corps of Engineers have recently expanded their efforts and

involvement as well.

The workshop agenda included discussions of a wide range of subjects with universal applicability, no matter which state or coast is in question: latest findings on science, efficacy, and ecosystem services; social-science aspects of living shorelines and nature-based projects; policy, permitting, and regulation; and financing and incentivizing living shorelines projects.

More than 240 people from 14 states and 3 Canadian provinces participated in the workshop. Jeff Benoit, president and CEO of Restore America's Estuaries, delivered the closing remarks, a fitting encapsulation of the living-shorelines ethos: "Our end goal is to build habitat, not walls."

Following is a more detailed summary of the workshop's proceedings that synthesizes its key themes and captures this important milestone for the living shorelines movement. For reference, full presentations are available online via the event **website**.

DAY 1

Welcome and Keynote Address

Speakers: Suzanne Simon, Restore America's Estuaries; David Lewis, Save The Bay; Sam Schuchat, California Coastal Conservancy

Suzanne Simon welcomed the audience and introduced Restore America's Estuaries, a national nonprofit dedicated to the protection and restoration of bays and estuaries as essential resources for our country. Its ten community-based member organizations, including Oakland-based workshop co-sponsor Save The Bay, undertake innovative and transformative restoration projects throughout the country. The alliance presents a united voice for conservation in the nation's capital, and advances the science and practice of protecting and restoring our estuaries. Simon noted she was impressed by the scope of living shorelines work happening across the country—a perspective local practitioners do not always take time to appreciate. Restore America's Estuaries crafted the workshop to harness this extensive, yet sometimes siloed experience, wisdom, and expertise so that the entire community can benefit, and thus increase the scope and momentum of living shorelines projects and programs from coast to coast.

David Lewis said that Save The Bay has been working with Restore America's Estuaries for more than 20 years, and is locally more powerful because the San Francisco Bay is perhaps the most altered estuary in the world, with Bay's active tidal reach reduced by a third through development, diking, and filling over a very short period beginning in the mid-19th century. But the Bay is also home to the largest estuarine restoration effort in world, near San Jose, and local leaders, with significant voter support, are moving at a breakneck pace to respond to sea-level rise while restoring transition-zone habitats at the edge of the remaining tidal marsh. They are innovating and experimenting with new techniques, and taking advantage of the region's wealth and favorable political climate to protect and restore its natural beauty. They have an obligation to accomplish what they can for the environment,



Lewis said, as well as a duty to model that perspective for other parts of the country -- while simultaneously learning from others' real-world successes and failures. Workshops like this are not only about sharing technology, but also knowledge, energy, and enthusiasm.

Sam Schuchat noted that the California State Coastal Conservancy, another workshop co-sponsor, first began working on living shorelines in the San Francisco Bay in 2012. This was largely through the work of project manager Marilyn Latta, who continues to lead the region's largest living shorelines project. The concept later spread through the Conservancy to southern California, and in particular San Diego Bay. California and Oregon, and to a lesser extent Washington, still have plenty to learn from their East Coast counterparts, but it is worth remembering that the West Coast is geologically younger and, with some notable exceptions, far less developed along the immediate coast than is much of the Eastern Seaboard. West Coast states have already embraced climate mitigation and adaptation, and California in particular, whether in the San Francisco Bay or farther south in Santa Monica Bay, is working to protect its coastal cities and infrastructure from sea-level rise in an ecologically responsible way.

Keynote Panel: Where We Were, Where We Are, Where We' Are Going

Speakers: Tracy Skrabal, North Carolina Coastal Federation; Kathy Boyer, San Francisco State University; Letitia Grenier, San Francisco Estuary Institute

Moderator: Sam Schuchat, California Coastal Conservancy

These presentations set the tone for the workshop by illuminating the past, present, and future of living shorelines. Speakers representing diverse backgrounds and areas of expertise developed a common, simple definition of living shorelines, no matter what name they are given or what they look like, which can vary significantly by project and by region: shoreline-protection solutions that bolster the habitat values of coastal ecosystems.

Tracy Skrabal discussed the history of the living shorelines movement and its roots in the Chesapeake area in the 1970s. As a community we

have come an incredible distance on this issue since then, she said, but we have not yet reached a critical tipping point: when these techniques are considered the norm and not the exception. But that is where we should set our sights. We must do a better job providing successful alternatives to the hardening approaches with which we are all familiar. These alternatives must:

- be cost effective;
- be superior or at least equal in terms of effectiveness at providing erosion control
- provide superior habitat;
- protect water quality;
- provide storm and flood protection;
- hold up during hurricanes; and
- keep pace during climate change and the effects of increased storm intensity and frequency.

Living shorelines can do all of these things. Yet because appropriate designs vary by region and according to wave energy, ecosystem type, and other variables, one size does not fit all. For example, efforts in North Carolina (a state that continues to permit 30 miles of bulkheads a year) to import ideas from Chesapeake Bay—and specifically the Virginia Institute of Marine Science and the State of Maryland—were at first poorly received. We can all learn from others' experience and the many living shorelines resources now available, and we should not "reinvent the wheel," but we also need region-specific experience and buy-in to be effective. With continued progress in policy, science, and practice nationwide, the movement may soon reach that critical tipping point.

Kathy Boyer, meanwhile, provided lessons learned more locally from the Coastal Conservancy's San Francisco Bay Living Shorelines Project. Launched in 2012, this two-site pilot project is designed to demonstrate the potential of establishing native eelgrass and oyster beds to protect the Bay shoreline while creating biologically rich and diverse habitat that is resilient to changing environmental conditions. Her six tips include:

1) *Utilize knowledge from elsewhere, but consider unique species, constraints, and opportunities.* Compared to the East Coast, the San Francisco Bay has its own cordgrass and oyster species. Local eelgrass is the same species, but it grows quite differently. Distinct regions should develop their own guidance documents.

2) *Understand and incorporate biota and feedback.* If we are interested in the cascading effects of habitat, including what eelgrass can do for fish and bird species—or what invertebrates can do for eelgrass, or what cordgrass can do to stabilize mounds and jumpstart habitat development -- understanding these species well can help us do a better job of restoring them.

3) *Maximize synergies between habitat types.* By strategically grouping habitat types and promoting foundational habitats, you can maximize productivity. There is an additive effect.

4) *Include multiple climate change adaptation angles, and not just sea-level rise.* Other angles may include blue carbon storage, in which plants store carbon biomass. Aquatic plants like eelgrass can buffer water pH and help oxygenate water and soil.

5) *Use scientific rigor to understand and inform projects.* For instance, in the Bay, scientists are testing different oyster substrates to determine which works best. Get good data, and involve students in the work if possible. Replicate experiments to inform future restoration work.

6) *Expect setbacks, but sustain your efforts.* For example, Canada geese may remove eelgrass beds. High rainfall may lead to the decline of oysters and eelgrass. But sustain your efforts; do not just put in projects and walk away.

Letitia Grenier spoke about the importance of designing and evaluating projects within the context of complete systems, and all of their moving parts. One example is the San Francisco Bay Area's Baylands Ecosystem Habitat Goals report, first published in 1999 and later updated in 2016. The result of a collaborative effort among dozens of local agencies, with input in from both managers and scientists, the Baylands Goals project represents an attempt to guide shoreline restoration on a large scale.

The initial report's goal of restoring 100,000 acres of marsh stirred a wave of new acquisition and restoration throughout the estuary. But it was the recent update that explicitly recommended thinking in terms of restoring complete shoreline systems, not simply stretches of tidal marsh. A marsh is part of a system, Grenier stressed, and for that system to be resilient (meaning it can accrete vertically and

move horizontally as conditions change), to offer wildlife corridors and habitat, and to protect inland areas, it must be complete, with subtidal, low marsh, marsh plain, and transition-zone areas.

Systems thinking also accounts for processes that create and maintain shorelines, like the sediment flow that will be necessary to keep the Bay's marshes above water in the coming decades. It even takes into account something restoration practitioners rarely consider: simply making people happy, and giving them hope. Everything we do affects larger systems, Grenier said, and we may be able to squeeze more benefits from projects by keeping that in mind. Ask not what your estuary can do for your project, but what your project can do for your estuary.

Latest Findings on Science, Efficacy, and Ecosystem Services

Panelists: Hugh Shipman, Washington State Department of Ecology; Carolyn Currin, NOAA

Moderator: Lee Weishar, Woods Hole Group

Living shorelines practitioners all share the same broad objectives, but how they approach them can differ widely from one state to the next. In this session, speakers from two leading states with two very different perspectives reported on lessons learned, projects completed, and research performed in recent years. While much of their work is indeed region-specific, their most fundamental findings and insights are applicable around the country.

Hugh Shipman represented the Northwest, and specifically Washington State's Puget Sound. About 30 percent of the region's 2,500 miles of shoreline is hardened. Yet soft shorelines, as they are known locally, are now well established as the preferred alternative—both for new projects and for retrofits, where existing bulkheads, groins, and intertidal fill are removed and replaced with a natural slope, backshore plantings, and materials including coarse sediment and large woody debris. Helping to steer planners and landowners toward soft shorelines are the widely acknowledged shortcomings of traditional armoring or so-called "hard" infrastructure. These include:

- loss of the upper beach

- isolation of terrestrial and aquatic ecosystems
- reduction in wrack and terrestrial detritus
- reduction of sediment supply
- wave reflection and scour
- passive (chronic) erosion

Concern about the performance of traditional erosion-control structures has led the state and region to explore other options. Soft shorelines, which maintain ecological function while both reducing unwanted erosion and supporting more natural or desirable sedimentation processes, are emphasized in state and local regulations. They are increasingly encouraged and used, and constantly being improved in terms of design and construction. While many projects have been successful, some have not, due to compromises imposed by site constraints; lack of designer or contractor experience; and failure to address underlying causes of erosion. With additional experience over time and knowledge gained from short and long-term monitoring, project performance, and landowner confidence in soft shorelines should continue to improve regionwide.

Carolyn Currin shared the latest science on living shorelines from the opposite coast, in North Carolina. Among her findings was that a five-meter-wide marsh of the cordgrass *Spartina alterniflora*—a species with woody, hollow stems that absorb wave energy—can reduce wave energy by 50 percent. And a 25-meter marsh can attenuate energy by more than 90 percent. Currin stressed, however, that all marshes are best at reducing wave energy when plant-canopy height and water-column height are about the same. Attenuation ability decreases steadily as canopy inundation increases.

Another study of North Carolina's New River Estuary identified a threshold of wave energy—300 RWE (Representative Wave Energy)—above which researchers observed a marked decrease in the width of natural fringing marshes. By the same token, at low-energy sites, marshes are far narrower when exposed to boat wakes. Together, these findings confirm that in some cases it may take more than a marsh to sustain a shoreline, and that design parameters should be site-specific.

Currin also shared data showing that across a 10 year monitoring period, four sill marsh sites along the North Carolina coast were able to increase their elevation at a rate exceeding sea-level rise, while four comparable natural marshes lost considerable

ground. More than half of salt marshes worldwide are adding elevation at a rate greater than sea-level rise, according to a 2015 study. And a 2014 paper showed that North Carolina oyster reefs grow more than 1 centimeter per year (compared to 3.2 millimeters for sea-level rise). As living shorelines accrete sediment and move landward, they help protect property and infrastructure by delaying the impacts of coastal squeeze.

Outreach, Engagement, and Social Science Aspects Related to Living Shorelines and Nature-based Projects and Programs

Panelists: Todd Woodard, Samish Indian Nation; Nicole Faghin, Washington Sea Grant

Moderator: Suzanne Simon, Restore America's Estuaries

Outreach is a critical component of living shorelines projects and of the movement as a whole. Here two speakers from the Puget Sound region of Washington offered valuable perspectives on outreach, engagement, and the social science of living shorelines. In the end, they said, the key to successful outreach is knowing what you want to achieve, knowing your audience and its motivations and challenges, and targeting your message accordingly.

Nicole Faghin steered the discussion toward social science. Her presentation addressed ways of creating targeted programs to help people change their behavior, leading to shoreline improvements. In general when we talk about changing behavior, there are three categories of people to consider: the show-me group, also known as early adopters; the make-me group, who act only when forced through laws or regulations; and, in between, the help-me group. This third group is the one that project managers should target through "social marketing," or marketing for social good, to encourage the adoption of living shorelines.

Within this group are three subcategories or audiences. The first is homeowners, who in the Puget Sound region own more than 50 percent of the shoreline. The second is so-called influencers, namely real estate agents and contractors, who do not own the land but can influence those who do. The third is local government staff, who play a

regulatory role and can impact projects through permits and other guidelines. All three audiences can be targeted to impact waterfront landowners' behavior, how they approach their shoreline, and whether or not they are going to armor. But homeowners, contractors, and real estate agents have unique concerns and motivations that need to be understood and addressed. Extensive surveys and focus groups in Washington have identified relevant needs and challenges for each audience.

Puget Sound homeowners, for example, seem to be primarily concerned with reducing erosion, cost, and the burden of permits. Real estate agents are motivated by maintaining a competitive edge and being viewed as a knowledgeable resource and expert. Contractors are concerned about cost, liability, and the proper design of living shorelines projects. Examples of programs to address these concerns include LEED-like rating and education programs for homeowners (such as the Puget Sound area's Green Shores for Homes and Shore Friendly programs); training and certification programs for professionals; and streamlined permitting processes and targeted loans, grants, tax breaks, and other financial incentives.

Todd Woodard, who serves as Natural Resources Director for the Samish Indian Nation, expanded the conversation to include the perspective of tribes located throughout the greater Salish Sea region. He noted that when working with tribes, surveys often do not work well, and that the exchange of information—and the success of projects—often depends upon personal ties and relationships. Samish concerns and priorities are often similarly holistic, as it is virtually impossible to distinguish the culture from the natural resources they have

depended upon for centuries. Anyone working with them or other Coast Salish communities should recognize these are place-based cultures that have depended upon the sea for hundreds of generations, that possess traditional ecological knowledge and can offer insight into historical conditions, and operate on a longer time frame than most of us are used to.

To illustrate the importance of audience-appropriate outreach, Woodard discussed a three-phase beach-restoration project he led with the Samish Indian Nation in Anacortes, Washington, that concluded after nearly a decade of work in the summer of 2017.

The project required convincing adjacent condominium owners that a soft shoreline, not a seawall, would be most effective at reducing erosion and flooding. It also involved designing living shorelines to address Samish cultural uses and concerns by providing habitat for clams, forage fish, and other resources while making the new beach accessible to canoes and useful for camping during annual events. The project has held up well during subsequent winters and storm events, and now provides an accessible outreach site for coastal landowners and the greater community to see a successful living shoreline in action, Woodard said. It also illustrates four key outreach goals:

- Understand who you are talking to, and tailor to them.
- Get every stakeholder to the table.
- Enlist local champions, leaders, and trusted individuals to help get your message across.
- Discuss and document your project so it can serve as a case study to assist future outreach in your region and across the country through a blend of social and hard science.



Breakout Sessions

Determining and Documenting Efficacy (or Lack of) for Living Shorelines and Nature-based Approaches

Speakers: Ryan Fikes, National Wildlife Federation; Chela Zabin, Smithsonian Environmental Research Center, UC Davis

Facilitator: Megan Cooper, California Coastal Conservancy

After the four breakout sessions concluded, representatives of each reported back about key takeaways. This group concluded that monitoring should be an integral component of living shorelines projects, particularly in regions where nature-based solutions are novel, and ideally for three to five years. Data generated during monitoring can be shared with decision-makers to support the overall case for living shorelines, as well as to refine approaches and improve future projects. Key metrics to assess alongside physical benefits include cultural preservation, economic and recreational outcomes, and the protection of vulnerable human communities.

Megan Cooper noted that the Coastal Conservancy has become increasingly active in funding, planning, and implementing living shorelines projects throughout California. One of the lessons the agency has learned throughout this process is the importance of documenting efficacy. This can be critical for making a case to regulators, funders, decision makers, and lawmakers -- for getting things done on a practical level, and for providing inspiration on an emotional level. Monitoring is not a separate effort, but integral to the project, especially in areas where techniques are new or novel. Compared to the East Coast, California still has very few living shorelines projects, so it is important to continue sharing information about efficacy not just within regions but across the country. At the same time, remember that efficacy can be evaluated in different ways, and its specific definition can depend on project goals, whether they pertain to physical processes, biological processes, or social/emotional outcomes.

Ryan Fikes works for the National Wildlife Foundation in the five states bordering the Gulf of Mexico, where living shorelines have a long history

yet continue not to be prioritized over traditional shoreline protection methods. His talk on the tracking and monitoring of living shorelines projects included examples from past projects in Florida, Texas, and Alabama. He began by laying out some key points and questions about metrics for living shorelines projects:

- It is critical to determine specific metrics in advance of project implementation. (Ask: What are we trying to fix in the system and how will we measure it?)
- Metric selection is often dependent upon baseline information available at the time of implementation. (Ask: Do we have the baseline data needed to be able to show that the project "moved the needle"?)
- There is a need for consistency in monitoring across projects and geographies in order to gauge success. (Ask: Are we measuring things in a way that shows key stressors in the system are being addressed, and restoration needs met?)

Core project parameters that are easy to evaluate include area, elevation, vegetation survival, and vegetation percent cover and composition. Parameters for consideration as appropriate include water level, vegetation height and density, salinity, subsidence and accretion, and sediment texture. But the field also needs to move toward objective-specific parameters such as shoreline position, bird abundance, or fish use. The National Wildlife Federation also tracks metrics such as acres restored/protected, value of fisheries production, and value of infrastructure protected. Until proponents can do a better job of measuring and communicating the co-benefits of living shorelines projects, they will struggle to break the momentum toward more traditional structural approaches.

Chela Zabin spoke about the importance of long-term monitoring to the San Francisco Bay Living Shorelines Project. This ongoing multi-habitat, multi-objective restoration and research project includes provisions to measure use by various native species; determine physical benefits to the shoreline; and assess the behavior and success of two native species employed in the project design, Olympia oysters and *Zostera marina* eelgrass. The project includes a robust monitoring plan and funding for five years of study.

As examples, some specific research questions for the project include learning whether to restore the

two species in tandem or separately, identifying the best oyster substrate and elevation, and comparing the use of eelgrass transplants versus seeds. Initial findings from November 2012 through July 2015 indicated that oyster establishment did not benefit from eelgrass presence, contrary to initial expectations. Data also indicate that oyster shell bags significantly outperform reef balls and reef ball stacks, oyster blocks, and so-called “layer cake” structures. And quarterly eelgrass monitoring throughout 2014 and 2015, which involved counting shoots and measuring the longest shoots, revealed that eelgrass performed better in plots without oysters in terms of both density and height. Zabin also shared methods and findings related to use by invertebrates, fish, and birds and effects on wave attenuation, sedimentation, and subsidence of structures.

Meaningfully Engaging Typically Underserved Communities

Speakers: Nahal Ghoghaie, Environmental Justice Coalition for Water; Heidi Nutters, San Francisco Estuary Partnership; Todd Woodard, Samish Indian Nation

Facilitator: Donna Ball, Save The Bay

Engaging with underserved communities in a meaningful way around living shorelines projects means asking for input instead of simply conveying information. It means connecting from the outset and encouraging residents to help develop a plan based on their resources and needs. It means building partnerships in advance of projects whenever possible, as opposed to in the middle of the process. Do not go in as if you know everything, and do think of part of your work as connecting hearts and minds.

Donna Ball began the session by acknowledging that restoration ecologists tend to focus on wildlife when planning and discussing their projects, without consideration for direct impacts on humans. She encouraged paying more attention to people, and considering them a part of the larger ecosystem along with plants and animals. This is particularly important in the context of living shorelines, Ball said, as on a global scale low-income and underserved/underrepresented communities will be disproportionately affected by climate change, sea-

level rise, and coastal flooding. That means they are also among those most immediately and most profoundly affected by mitigation and restoration efforts.

To further set the stage for the discussion, Ball offered definitions of relevant terms. Environmental justice essentially means ensuring no group or community bears a disproportionate share of the harmful effects of pollution or environmental hazards, while equity, a somewhat broader term, can mean in the context of shoreline restoration projects that all potentially impacted people, regardless of race, social class, gender, age, or political leanings, have opportunities for meaningful involvement as well as access to decision makers. Exploring these themes dominated the remainder of the session.

Nahal Ghoghaie discussed her work supporting environmental justice in disadvantaged communities across the San Francisco Bay Area. Through the statewide nonprofit Environmental Justice Coalition for Water, for which she serves as Bay Area Program Coordinator, Ghoghaie helps administer the Disadvantaged Community Involvement Program included in California Proposition 1. The \$7.12 billion water bond approved by California voters in 2014 includes funds for flood management and watershed and ecosystem protection and restoration. Ghoghaie also serves as an environmental justice representative on the advisory committee for Measure AA, a parcel tax passed by Bay Area voters in 2016 that will raise approximately \$500 million for wetland restoration.

Beyond being a potential source of funding for living shorelines projects, Proposition 1 and Measure AA also offer opportunities to be proactive about environmental justice. Prop. 1’s Disadvantaged Community Involvement Program, for example, specifically seeks to educate local community members, learn from them about existing conditions, build capacity for engagement, redistribute resources to grassroots groups, and foster local alliances for greater community resilience.

Heidi Nutters said that given growing inequality in the San Francisco Bay Area, equity should be at the center of the work of all resource protection organizations and agencies here. She illustrated the point by explaining how the San Francisco Estuary Partnership approached equity and environmental

justice in a U.S. EPA-funded project about 25 miles north of the workshop site in the town of North Richmond. The goal of this work was to link transition-zone planning, shoreline resilience, and environmental justice in a disadvantaged and pollutant-burdened community that is rich in natural resources and possesses significant built-in capacity for activism and engagement. North Richmond also is highly vulnerable to sea-level rise and coastal flooding that will further squeeze its embattled shoreline and create new challenges. As part of their project, Nutters and her team conducted a survey to learn more about what local residents want to see on their shoreline. Findings could inform future work including a horizontal levee, new trails, other public-access improvements, and living shorelines projects. Nutters closed by sharing lessons learned: meet people where they are at, build relationships with local residents, do not come with all the answers, and acknowledge community history and resilience.

Todd Woodard offered additional insights from his sixteen years of experience leading stream and beach restoration projects and addressing other natural-resource issues with Tribes in northwest Washington. Many of these tribes, with dozens or hundreds of generations of local history, are still operating in survival mode decades after losing some or all access to ancestral lands and associated plants and animals, Woodard says. Tribes are also among those disproportionately affected by sea-level rise. Outsiders conducting restoration work on tribal lands, who may initially be viewed with suspicion, should approach tribes with a genuine desire to learn what they know and what they want out of the project. Recognizing tribes' deep ties to the land, project leaders should learn from traditional ecological knowledge that has been passed down through the generations, as this can provide a benchmark for restoration while helping develop a strong partnership. Finally, Woodard says, project leaders should engage early, engage often, and make the tribe an equal partner, as this will help work proceed more smoothly and lead to a better outcome.

Challenges Working with Materials in Living Shorelines and Nature-based Approaches

Facilitators: Janine Harris, NOAA; Natalie Cosentino-Manning, NOAA

Living shorelines practitioners have a myriad of

materials at their disposal, from plastics and precast concrete to rocks and woody debris or hybrid alternatives like coir products and locally sourced "baycrete". Each has advantages and disadvantages that can vary in significance from one region or project to the next. Important considerations across the board include longevity, availability, weight, cost, maintenance requirements, ability to meet specific project goals, and potential negative environmental impacts. In some cases, more research and development is needed to develop and identify ideal materials.

Janine Harris and Natalie Cosentino-Manning led a discussion on challenges related to working in subtidal and intertidal environments in the San Francisco Bay and other areas. The group began by compiling a list of types of materials that are used in living shorelines projects. These include: vegetation/plantings, wood, sand/gravel and larger rocks, oyster/clam/mussel shells, reef balls and related structures, coir materials, and plastic shell bags. The group then identified specific challenges and limitations related to each. For example: vegetation may be consumed by native species; wood can break down and move around; reef structures can be very heavy and difficult to install; and plastics including shell bags may have poor public perception and could become a source of contamination and litter in the marine environment. Lightweight and biodegradable materials are generally preferred where appropriate, and costs and benefits of various options may be balanced by beginning with heavy materials to stabilize a site, then going in with lighter and, often, more natural materials.

The discussion shifted toward challenges related to permitting. Locally, the San Francisco Bay Conservation and Development Commission (BCDC) controls coastal permitting, and as of 2012 all permits must consider sea-level rise in addition to 100-year flood scenarios. One area of uncertainty is how to deal with areas that are not currently within BCDC's jurisdiction, but will be in the coming decades due to sea-level rise. Other permitting challenges include weighing the needs of various species and short- versus long-term outcomes. Beneficial reuse of dredged sediment can be an asset for some projects, but timing is often an issue, and testing sediment for contaminants can be cost-prohibitive. These will become larger concerns as the size and scope of restoration projects and thus the need for fill increases in the coming years.

Some permitting hurdles can lead to innovations in living shorelines techniques. In the San Francisco Bay Living Shorelines Project, reef balls were constructed with locally sourced “baycrete” due to no-fill policies. Baycrete includes 20 percent concrete and 80 percent native sand and shell, making it a more acceptable fill material. The creation of Nationwide Permit 54 can be helpful in some regions, as will a broader push toward developing other general or regional permits for living shorelines projects. Finally, scale issues exist in permitting: permitting smaller pilot projects is not necessarily faster than permitting large projects, in part because these projects are in a research and development phase.

Envisioning the Future of Living Shorelines and Nature-based Approaches

Speakers: Lee Anne Wilde, Galveston Bay Foundation; Melody Ray-Culp, U.S. Fish & Wildlife Service; Matt Gerhart, California Coastal Conservancy; Amanda Brown Stevens, Resilient by Design Bay Area

Facilitator: Anne Morkill, USFWS

Finally, representatives of the fourth breakout session noted that a number of common challenges face living shorelines practitioners looking to advance the field. These include a regulatory process that is sometimes at odds with restoration goals and can delay living shorelines projects to the point that they become unfeasible or undesirable, particularly when private homeowners are involved. In addition, policy makers and funders do not always have the scientific and economic knowledge or information available to properly assess the benefits of nature-based solutions relative to hard infrastructure. To overcome these challenges, proper branding, targeted language, and public outreach are valuable tools.

Anne Morkill began by outlining the goal of the session: to envision the future of living shorelines and nature-based approaches as solutions for protecting coastal properties and conserving the natural heritage of our diverse shoreline habitats. She noted that despite mounting evidence showing that hardened shorelines do not function well over time in many settings, and that they do real and widespread harm to estuarine ecosystems, persistent barriers hinder the broader use of living shorelines. These include:

- Institutional inertia;
- Lack of a broader context for shoreline management decisions (including both ecological and economic considerations); and
- Lack of an effective advocacy force.

To help overcome these challenges and develop solutions, the session featured presentations from four panelists representing the Gulf and West Coasts who shared their own ideas and solutions for the future. This was followed by a group discussion around ways of moving forward.

Melody Ray-Culp of the U.S. Fish and Wildlife Service’s Florida Panhandle Coastal Program in Panama City, Florida, called upon participants to envision future headlines for living shorelines. She offered dozens of her own, some serious and some whimsical, but all designed to promote clear and even visionary thinking about what our future shorelines could or should look like. Ray Culp’s examples included “Birds boycott bulkheads,” “FloridaLivingShorelines.com goes live,” “Seawalls out, tide comes back in once again,” and “State and federal regulators cut through red tape to adopt green-tape rules—make it easier for coastal property owners to work with nature.” But it was not purely an exercise in creativity; living shorelines do make the news nationwide, and with even schoolchildren getting involved, they should receive ever more attention as years go by.

Lee Anne Wilde of Texas’ Galveston Bay Foundation presented on the Living Shorelines Suitability Model (LSSM), a GIS- and remote-sensing-based approach to site assessment and suitability around the Gulf of Mexico. This geospatial model, which runs in ArcGIS and uses available GIS datasets, was developed through NOAA funding by team members at Alabama’s Troy University, the Virginia Institute of Marine Science (VIMS), and the Geological Survey of Alabama. Additional partners included Tampa Bay Watch, Florida Fish and Wildlife Conservation Commission, Louisiana Sea Grant and Policy Program, and Gulf of Mexico Alliance. Its purpose is to model tidal shoreline erosion, delineate shoreline best management practices, and identify where nature-based solutions are possible. Potential end-users include regulatory boards and agencies, local planners, stormwater managers, contractors, engineers, and private citizens. Related models include the Mobile Bay LSSM and the Tampa Bay LSSM.

Matt Gerhart pivoted to the West Coast and the San Francisco Bay Area through the State Coastal Conservancy's 2015 report *The Baylands and Climate Change: What We Can Do*, a collaborative document outlining a regional approach toward sustaining wetlands in the face of sea-level rise. The Coastal Conservancy program manager said shoreline planners must look to the future and its changing conditions rather than restore to a specific point in the past. This means:

- *Restore complete systems, including processes—not just places.* The future of marshes depends on sediment supply. In the San Francisco Bay, sedimentation processes include alluvial fan deposition, stream delta deposition, and tidal overbank deposition in addition to wave erosion of marsh scarp and wave deposition of barrier beach on the immediate coast. Sediment is a precious resource locally, yet incredibly expensive to move around, so planners should work with these systems and processes, not against them.
- *Restore soon in areas where marshes are likely to persist—ideally by 2030.* The build-up of sediment and vegetation takes time. A higher starting elevation means marshes survive accelerating sea-level rise for longer. Managers could support vertical accretion and increase marshes' ability to keep pace by augmenting their sediment supply through freshwater flows, artificial placement, or increased channel density. Communities should also restore lost watershed-estuary connections that nourish the baylands. Finally, to buffer wave erosion and preserve wide marsh, coarse beaches, which occur naturally in some parts of the bay, could be constructed along the marsh edge.
- *Plan for the baylands to migrate.* Key strategies include acquiring and conserving future migration space now, constructing horizontal levees, and planning for managed retreat.

Amanda Brown Stevens discussed Resilient by Design, another Bay Area effort to address sea-level rise. Resilient by Design is a ten-team design competition whose goals are based in part on the Baylands and Climate Change report. The competition launched last year and concludes this May, when each team will unveil its sea-level rise adaptation plan for its chosen site. Loosely modeled on a similar competition held in New York City after Hurricane Sandy, Resilient by Design launched in May 2017 with an open call for site ideas. From there it moved to a collaborative research phase that included visits by ten newly formed teams to ten

vulnerable shoreline sites. Each team was then paired with a site to begin its collaborative design phase, which entails working with community members and organizations to learn more about local challenges and potential solutions. This phase involves considerable outreach including public events like guided hikes and community fairs. Once the teams have integrated their research and outreach into a final design, they will help guide communities toward implementation (which is beyond the scope of the competition) by identifying next steps, policy objectives, key advocates, and funding opportunities.

DAY 2

Design and On-the-Ground Implementation

Panelists: Todd Bridges, U.S. Army Corps of Engineers (USACE); Jim Johannessen, Coastal Geologic Services; Marilyn Latta, California Coastal Conservancy

Moderator: Cameron Perry, HDR

The workshop's second day began with a living shorelines primer offering both breadth and depth. Speakers discussed past projects, lessons learned, and next steps. They addressed science and policy, infrastructure and ecosystems, public and private lands, even nomenclature. And they mentioned case studies in New Zealand and England, Louisiana and Florida, and the Puget Sound and San Francisco Bay. Clearly, no matter what they are called, living shorelines success stories and learning opportunities abound.

Todd Bridges began by recalling how the Great Galveston Hurricane of 1900, which flooded the Texas city and killed thousands of people, led to the construction of the Galveston Sea Wall, which is 17 feet high and 10 miles long. By contrast, 112 years later, Hurricane Sandy generated significant interest along the East Coast in the role of natural features in storm-risk management thanks to the success of healthy, natural beaches and shorelines in protecting those living behind them. During the storm, wetlands prevented some \$625 million in damages, according to insurance-industry projections.

This history informs the U.S. Army Corps of Engineers' (USACE) Engineering with Nature program, which began in 2010 and subsequently developed a technical report on the use of nature-based features to protect shorelines. Case studies in the report include a 1.5-kilometer shoreline restoration project near Auckland, New Zealand, that involved replacing 700 meters of rock revetment with a more natural shoreline to protect a critical transportation artery. Bridges also discussed USACE projects in the San Francisco Bay, including research on wave attenuation and other physical processes at the Hamilton and Sears Point wetland restoration sites. He noted the USACE is



interested in collaborating with other agencies, the private sector, and universities on its Engineering with Nature program. It is currently developing international guidelines on the use of nature-based features for sustainable coasts and fluvial systems, which should be published in 2020.

Jim Johannessen offered his perspective as a longtime consultant in the Puget Sound region. He recalled first using the term “soft shore protection” 18 years ago, after picking it up in the European literature, to describe what some now call soft or living shorelines. This was defined as working with natural materials, and sometimes augmenting the natural “robustness” (gravel size, vegetation, presence of woody debris), to mimic nature with a flexible design. Johannessen mentioned the peer-reviewed Marine Shoreline Design Guidelines guidance document he helped prepare for the State of Washington and a consortium of agencies. It describes how to evaluate a site, which coastal/landscape processes to look at, and what techniques to use, and includes 25 case studies. He then presented on some past projects he has designed, including a large number involving bulkhead removal, an increasingly common practice in the region. Lessons learned from this work include: recognize that sites are all different; seek out local or regional guidance documents; use complimentary techniques; and perform monitoring and synthesis to inform future work.

Marilyn Latta of the California State Coastal Conservancy noted that the state has a long history of wetland restoration projects that meet most or all criteria and objectives of living shorelines—even if it has only recently started using the term—including habitat creation, wave attenuation, and erosion and flood protection. Shoreline restoration efforts in the San Francisco Estuary have traditionally focused on marshes, but there is a growing focus on the subtidal area. The Coastal Conservancy has led a series of projects in this realm in the Bay, designed to support some of nature’s architects: native Olympia oysters and eelgrass that have limited ability to attenuate waves yet provide food resources and habitat structure and substrate. The first, a one-acre experimental pilot project constructed in the North Bay city of San Rafael in 2012, is designed to study the creation of biologically diverse subtidal and low intertidal habitats, including eelgrass and oyster reefs, as part of a self-sustaining estuary system that restores ecological function and is resilient to

changing environmental conditions. She said the Conservancy is expanding this work to additional locations with new designs and habitat types, and matching it with creosote piling removal, which could provide an important model for future shoreline restoration projects throughout the Bay. In the intertidal zone, the agency is investigating the role of Pacific cordgrass in wave attenuation and other physical processes for future living shoreline projects.

Policy, Permitting, and Regulation

Panelists: Niki Pace, Louisiana Sea Grant; Xavier Fernandez, San Francisco Bay Regional Water Quality Control Board

Moderator: Amy Hutzal, California Coastal Conservancy

In the San Francisco Bay Area, multi-benefit wetland restoration projects need three key things, noted moderator Amy Hutzal: funding, mud, and permits. Funding may come through Measure AA, a new regional parcel tax that will attract additional state and federal funds. Extra sediment can come from a dredge or construction site through beneficial reuse. And progress is happening on the permit front, too, from the national scale to the local scale, including regional efforts to revise bay fill policies for habitat restoration projects. The session continued with more detailed discussions of permits and policies that impact living shorelines projects.

Niki Pace, a legal expert with Louisiana Sea Grant, began with an overview of the permitting landscape. Living shorelines practitioners must comply with federal, state, and local permitting requirements, which vary widely from place to place. Nationwide permits apply only in specific situations with minimal impacts, and provide broad authority allowing projects to proceed more rapidly. Regional permits are similar but limited to a specific region. Projects that do not meet criteria for either must obtain an individual permit, which is the most time-consuming option.

Prior to March 2017, nationwide permits applying to living shorelines were NWP 27, which deals with restoration activities, and NWP 13, which deals with bank stabilization. Now NWP 54, which explicitly concerns living shorelines, is an option as well. It

defines living shorelines as “vegetation or other living, natural ‘soft’ elements alone or in combination with some type of harder shoreline structure (e.g. oyster reefs or rock sills) for added protection and stability.”

To qualify, the structure must be composed of mostly native materials, include a substantial biological component, and maintain or enhance shoreline ecological processes, including natural continuity of the land-water interface. Sites cannot exceed 500 feet in length or extend more than 30 feet into the water body, unless a waiver is granted. Materials must be anchored to stay in place during most wave action. Beach nourishment is prohibited, and sills and breakwaters must be of the minimum size necessary to protect the wetlands. NWP 54 also authorizes maintenance and repair after severe storms or erosion events. Pace noted the permit is administered differently in many states and regions, with significant variations in Louisiana, Alabama, Mississippi, Connecticut, Ohio, Maryland, and Virginia.

Xavier Fernandez set the stage with an “ode to regulations.” To implement a living shorelines project in the San Francisco Bay Area, practitioners must navigate a host of federal and state laws—roughly a dozen. Yet prior to these regulations, the Bay was being filled at an alarming rate. New laws came into effect to protect our natural resources, and as we move forward, these regulations will need to be adapted to face new challenges related to climate change. His agency, the San Francisco Regional Water Quality Control Board, follows two policies that are particularly relevant to living shorelines projects: the Wetlands Conservation Policy, which calls for no net loss and a long-term net gain in wetland acres and functions, and the Wetland Fill Policy, which calls for avoidance of impacts to aquatic resources to the maximum extent feasible, and for mitigation to offset any unavoidable impacts. Fernandez then illustrated how two local projects—the South Bay Salt Pond Restoration Project and the San Francisco Bay Living Shorelines Project—navigated the complex permitting process in different ways. He concluded with a few closing points. First, it is clear some policies could use clarification or revision to adequately account for benefits from all types of living shorelines projects. Second, while general permits can streamline the process, they must be carefully designed to encompass a sufficiently broad range of projects

while still protecting the environment. Finally, communication and collaboration within and between all agencies is essential, and facilitates the permitting process.

Valuing Ecosystem Services, Finance, Investment

Panelists: Tracy Rouleau, TBD Economics; Adam Davis, Ecosystem Investment Partners

Moderator: Chris Hilke, National Wildlife Federation

In addition to simply supporting biodiversity, living shorelines benefit humans in innumerable ways, like protecting homes, businesses, and infrastructure from floods or sea-level rise and preserving or restoring the cultural and natural resources we most value and depend upon. Simply put, coastal restoration is big business. During this session, speakers explored two different ways in which finances, economics, and shorelines intersect, from valuing ecosystem services to identifying the most efficient and effective ways of funding restoration work.

Tracy Rouleau offered further insight into the value of coastal restoration. The ecological restoration economy is a \$25 billion industry that employs 126,100 people, placing it between motor vehicle manufacturing (175,000 jobs) and iron and steel mills (91,300 jobs), according to 2014 estimates. The value of an individual project can be defined in a number of ways, including cultural, social, and environmental benefits; reduced risk; and profit or return on investment. Quantifying ecosystem services, which are beneficial outcomes to humans that result from natural ecosystem functions, is a particularly important approach for many restoration projects. This involves measuring what is changing biologically in terms of functions, processes, biodiversity, habitat, and other metrics, then translating those changes into specific services that can be ascribed a monetary value. Ecosystem services for a living shorelines might include shoreline protection, recreational benefits, and food-resource benefits. Unlike with grey infrastructure, which loses value over time as it ages, living shorelines are likely to increase in ecosystem services and thus value as they mature. Finally, Rouleau concluded with a few key points:

- Project proponents should tie their value stories to benefits that are relevant to their audience.
- Bigger numbers are not always better; for ecosystem services values to be meaningful, they need to be at the same scale as the project.
- Monetize only if good data are available; otherwise, count what you can count. When all else fails, tell a really good story.
- Natural and social scientists can and should work together on these issues.

Adam Davis of Ecosystem Investment Partners (EIP) discussed the role of private investment in the restoration economy. Ecosystem Investment Partners is a private equity fund established in 2007 to take advantage of the need for private capital in mitigation banking. Over time, opportunities to do restoration projects at scale through private investment have expanded, with Section 404 of the Clean Water Act (which requires the offset of unavoidable adverse impacts to wetlands, streams, and other aquatic resources) as a primary driver. In the last five years the fund has raised more than \$500 million for ecological restoration from institutional investors like pension funds, university endowments, and ultra-high-net-worth individuals interested in making socially and environmentally responsible investments that also provide a good return. Essentially, EIP performs restoration work to obtain credits from the government, which it then sells to those with unavoidable impacts under Section 404. It recently used this approach to purchase and restore through dredge and fill hundreds of acres of coastal marsh outside New Orleans, to reverse the course of erosion and subsidence while providing flood protection and habitat. Davis suggested that public agencies should continue to support the role of the private sector in restoration work by issuing requests for proposals instead of grants, requiring full project delivery before payment is made. That way risk is placed on the private sector to handle permitting, entitlement, and completing the project to the government's standard. The private sector can take on this risk, Davis said, and is organized to do so efficiently.

Breakout Sessions

State and Regional-Level Permitting and Laws

Facilitator: Tracy Skrabal, North Carolina Coastal Federation

Four more breakout sessions took place on the second day. This group continued the discussion of policy and law from the morning plenary, narrowing in on a few central questions. How can living shorelines practitioners best navigate the permitting process? How well do existing regulatory and policy options work? On the state level, what are the impediments to developing successful programs, and who is doing it right? Attendees concluded that the field could benefit from a robust policy analysis evaluating how different states and regions interpret living shorelines differently; more science and a comprehensive literature review on the impacts of hardened shorelines; and a cost analysis framework to demonstrate how living shorelines can be cheaper than bulkheads. Across both permitting and policy, work should be done to put living shorelines on a more level playing field with hardened shorelines.

Tracy Skrabal led this discussion of permitting and laws: an exploration of what has worked at the state and regional levels, how state laws have been passed, and ways of overcoming hurdles to implementing regional and state permitting. Key questions addressed by the group included: If we have one Clean Water Act forming the basis for the federal regulatory program, then why do we see such wildly disparate implementation across the nation? How do we evolve state and/or regional programs into something that works for us? And moving forward, what is missing in each state or region as far as permitting or regulation? Key conclusions or points of agreement, meanwhile, included the following. First, we are seeing more scrutiny from regulators around living shorelines today than we have historically for other approaches, largely due to our heightened awareness. It is critical to get regulators in the field, on-site, and as a group so they can better understand what we are trying to achieve. This can enable more fruitful discussions, suggestions to guide through the process, and potential cohesion across agencies. The experience is completely different from simply reviewing something on paper. Similarly, we should train staff and offer to educate regulators. Appreciate that their workloads are often

enormous, so time is precious. Also, consider starting smaller and simpler as pilot projects to avoid overwhelming others or branding living shorelines as cumbersome or difficult. This will help breed familiarity and confidence with all aspects of the work. Finally, we must consider the cumulative effects of hardened shorelines as a means to leverage living shorelines.

Design and Implementation

Speakers: Tom Ries, ESA; Eyan Sloane, California Coastal Conservancy

Living shorelines can take a wide variety of forms depending on where they are located. In urban settings, which were the focus of this discussion, project demands include space—to allow for natural processes, a range of habitat types, and, in some cases, managed retreat—and sediment, which can be sourced from dredge projects through beneficial reuse if the material is clean and the timing is right. Also in urban areas, seawalls and rock revetments are sometimes required, but their habitat value can be enhanced by adding a littoral shelf or other structural elements.

Eyan Sloane began by noting that Southern California has lost much of its natural shoreline habitats. A recent study found that 14 percent of the U.S. shoreline is hardened, and Southern California is the most hardened region. Habitats have been impacted by the placement of structures such as seawalls, groins, levees, and rock revetments, which have cut off ecosystem processes and connectivity. Hard infrastructure can provide physical benefits and is necessary to protect inland areas in some locations, but provides minimal to no biological or societal benefits, typically begins degrading immediately after construction, is costly, and requires frequent maintenance. Living shorelines can be used to provide physical as well as ecological benefits. Habitat types that can be addressed in living shorelines projects include: on the inner coast, tidal wetlands, macroalgal beds, eelgrass beds, shellfish beds, and mudflats; and, on the outer coast, where there have been few living shorelines projects because of steep slopes and high wave energies, coastal dunes, kelp forest, seaweed beds, coastal scrub, and beaches. The Coastal Conservancy has learned through its pilot projects to date that the most resilient living shorelines integrate many

different habitat types along the elevation gradient, allowing estuarine processes space to function and habitats the ability to interact. Sloane then presented on a series of shoreline restoration projects throughout Southern California representing various approaches and points along the green-grey continuum for restoring shorelines and habitat and protecting the coast from flooding -- including, on the grey end of the spectrum, the idea of using a "living seawall" along rocky intertidal habitat, which is highly vulnerable to sea-level rise. She concluded by emphasizing that in order to catch up to progress made in other regions, California needs more pilot studies to demonstrate the effectiveness of various techniques.

Tom Ries expanded on the idea of enhancing sea walls to provide habitat. While we should always try for a nature-based solution, in some cases seawalls must be built, such as to protect a federal highway, or cannot be removed because of the infrastructure they protect, he said. These are not living shorelines, nor are they technically restoration projects. And while these walls will eventually fail or be overtopped, in the interim they can be enhanced. His firm is experimenting with ways of improving seawalls in Florida. One approach is simply placing rock in front of a seawall. This provides interstitial space, affects waves coming in, and protects the seawall, but offers limited ecological benefits. This design could be augmented to also provide habitat by including a littoral shelf that supports plants such as mangroves for additional wave energy dissipation capacity while creating habitat for birds and fish. In one example, a "living seawall" was created through the use of reef balls, which help create ledges and other interstitial spaces in front of the wall and can support both plants and animals.

Ries' talk transitioned into a group discussion, which focused on the challenges of implementing living shorelines projects in urban environments, where they can be complicated by existing infrastructure, a more rigorous permitting environment, and increased public visibility. Solutions and opportunities presented by those challenges were discussed, such as how high-visibility visibility projects can serve to educate and cultivate support among the public, real estate agents, and contractors. This support is needed to advance policy that mandates use of living shorelines, which is the most effective way to get projects implemented. The importance of careful, site-

specific planning and oversight of projects was a theme throughout the session, particularly when working with contractors that do not have experience with living shorelines projects.

Valuing Restoration Projects to Increase Financial Investment

Facilitator: Tracy Rouleau, TBD Economics

Expanding on the morning plenary session, this breakout explored a number of communication-related themes including: how to tell a project's "value story"; how to attain stakeholder buy-in; and how to develop meaningful metrics. In all cases, living shorelines practitioners should consider what matters to their audience and then convey benefits accordingly, whether they be ecological, social, or economic. Messaging should be simple, clear, and targeted.

Tracy Rouleau led a deeper dive into how to talk about the value of restoration projects. One key concept revisited frequently during the session was storytelling. Behind the big numbers and the scientific data, the project's story—how it came to be, why it is important, etc.—is what truly engages peoples' emotions. But the story must benefit the stakeholder. In other words, it is critical to know your audience when discussing value. The group used the example of a busy mom and her concerns over a contaminated stream in her community. What are her main thoughts and worries with regard to the stream? Restoration ecologists could talk about species density and species richness, but the mother's main concern is the health of her children who are playing in the stream. The best way to determine the proper metric for project success, get buy-in, incentivize, and fund projects is to start by considering what will benefit specific stakeholders most. To learn about stakeholders and their priorities, collaboration is key: meet with stakeholders and the general public early on in the process to discover what is important to them. It is also critical not to overburden stakeholders with too much information; summarizing the key aspects of a project and presenting the information in a cohesive and comprehensible way is key when laying out incentives for stakeholders. When done correctly, targeted storytelling and stakeholder involvement are essential to securing the funding and support needed to succeed in restoration work.

Incentivizing Adoption of Living Shorelines and Nature-based Approaches

Facilitator: Rebecca Schwartz Lesberg, San Diego Audubon

A number of challenges can impede the adoption of nature-based approaches over more traditional hardening. These include missing ecological and geological baselines, institutional inertia, overlapping jurisdictions, and confusion over the definition or design of living shorelines. These concerns are fairly universal across the country, and their solutions may be as well.

Rebecca Schwartz Lesberg began by laying out three prompts for the discussion: examine which incentives will encourage adoption of living shorelines techniques; discuss differences in working with private versus public entities; and identify and share what has been successful elsewhere. With this framework in mind, attendees broke into small groups based on region to identify key local stakeholders, challenges, and solutions. One common concern was inconsistent or unclear definitions and terminology. Another was overlapping jurisdictions and the number of agencies involved in permitting and approving living shorelines projects. Attendees also were interested in increasing and expanding lines of communication, including among peers and across disciplines; developing positive, "carrot"-based incentives, not punitive, "stick"-based approaches; and prioritizing buy-in from stakeholders including the general public, government agencies, private businesses, and other experts. Attendees then shuffled into new groups and were asked to pick a specific audience or audience type, identify that audience's concerns and motivations, and think of messages and actions that audience would respond to. Again a common concern was attaining buy-in, particularly from private entities like homeowners and businesses. This work could be assisted by trusted community ambassadors. "Carrot" approaches were again favored over more punitive approaches, such as communicating the benefits of living shorelines to landowners, ensuring that living shorelines projects are easy to understand and have emotional appeal or resonance, and addressing community concerns head-on to diffuse resistance to living shorelines projects. Efforts to create shoreline resilience will not be successful in the long term unless the entire community feels included in the process.



CLOSING COMMENTS

A little over a year ago, when Restore America's Estuaries started thinking about where to hold this workshop, we thought, "Where do we need to be?" We kept hearing there are important stories to be told on the West Coast, and that is why we went to Oakland.

Each state and region is different: different geographies, ecosystems, politics. But over the course of the meeting, it became clear that those differences can connect us. They can help us realize that the work we are doing is meaningful not only to our specific setting and place, but to our nation.

This meeting represents an important milestone on the path of developing our community of practice for living shorelines. And as we continue to move forward, let us remember our end goal: to build habitat, not walls.

Jeff Benoit
Restore America's Estuaries

POSTERS

Natural Infrastructure for Sea-Level Rise Adaptation Along the California Coast

Maya Hayden, Point Blue Conservation Science, and Jenna Judge, NOAA Sentinel Site Cooperative.

Citizen Science and Oysters in San Francisco Bay

Helen Fitantes, The Watershed Project

Enhancing Tidal Marsh Habitat to Support California Ridgway's Rail

Jeanne Hammond, Olofson Environmental, Inc.

Forms and Uses of a Novel Biodegradable Composite for the Protection and Creation of Oyster and Salt Marsh Habitats

Niels Lindquist, Sandbar Oyster Company, Inc.

Why Living Shoreline Design and Implementation Differs for Southern California: A Regional Perspective

Emma Ross and Laura Engeman, San Diego Regional Climate Collaborative and the Middlebury Institute of International Studies

The Effect of Sedimentation on Oysters Adjacent to Eelgrass Meadows

Victoria R. Wood, California State University, Fullerton, Department of Biological Science

Finding Opportunities at the Estuary's Margin

David Thomson, SFBBO Habitats Program

Scaling Up Native Species Propagation Methods to Accommodate Large Scale Transition Zone/Ecotone Projects of the Future

Donna Ball, Save The Bay San Francisco

Understanding the Broader Consequences of Tidal Wetland Loss for Sea-Level Rise Adaptation Planning: San Mateo County Case Study

Kelly Malinowski, California State Coastal Conservancy

Reconstructing an Estuarine Beach at Aramburu Island—Shoreline Design Performance Five Years Post-Construction

Roger Leventhal, Marin County Flood Control District

Resilient Landscape Restoration on Lower Walnut Creek

Michelle Orr, ESA, and Paul Detjens, Contra Costa County Flood Control District

Designing High Tide Refuge Islands for the California Ridgway's Rail

Gavin Archbald, H. T. Harvey & Associates

A New Living Shorelines Project at Giant Marsh: Integrating Restoration Features Across an Elevational Gradient for Sea-Level Rise Adaptation

Katharyn Boyer, San Francisco State University

About Restore America's Estuaries

Established in 1995, Restore America's Estuaries (RAE) is dedicated to the protection and restoration of bays and estuaries as essential resources for our nation. RAE is a national leader in understanding the economic importance of estuaries, advancing blue carbon science, creating an imperative for living shorelines, and promoting strategies to enhance coastal resilience. We work with strategic partners to advance this mission regionally and as an advocate in the nation's capital. RAE and its alliance members create a powerful and unified voice for coastal habitat restoration and the well-being of coastal communities.

Photo Credits

Cover: Photo courtesy of the California State Coastal Conservancy | Page 6: Top & Bottom photos courtesy of the California State Coastal Conservancy, Middle photo courtesy of Galveston Bay Foundation | Page 10: Photo courtesy of the California State Coastal Conservancy | Page 16: Top & Bottom photos courtesy of the California State Coastal Conservancy, Middle photo courtesy of Tampa Bay Watch | Page 22: Photo courtesy of the California State Coastal Conservancy

