THE GOVERNANCE GAP:

CLIMATE ADAPTATION AND SEA-LEVEL RISE IN THE SAN FRANCISCO BAY AREA

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UCDAVIS

predicted shoreline flooding with 100cm of Sea Level Rise, with a 100-year storm

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EXECUTIVE SUMMARY

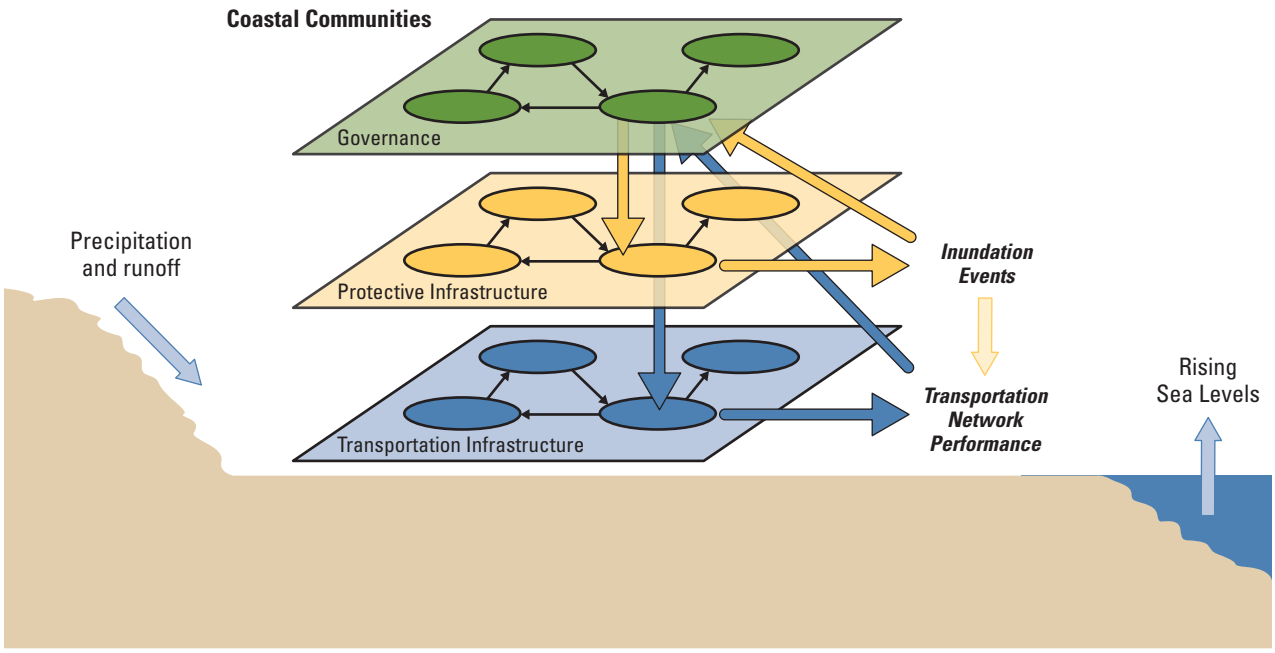
This report summarizes the results of an extensive study of governance for climate adaptation and sea-level rise in the San Francisco Bay Area (SF Bay Area), where the concept of sea-level rise adaptation also includes coastal flooding from high tides and extreme storm events. We focus on the "governance gap" that exists between the problem of sea-level rise and the implementation of adaptation solutions that increase resilience. We take a broad view on governance as the set of institutional arrangements, governmental authorities, and public stakeholders who collectively plan and implement adaptation activities, including identifying funding strategies and the agreeing on the information basis for decision making.

While most stakeholders recognize the risk of sea-level rise and other climate impacts, and have good ideas about potential on-the-ground solutions, realizing these solutions requires overcoming a series of governance challenges. All of these governance challenges are barriers to stakeholder cooperation at multiple geographic levels—local, regional, state, and federal. There are many different governmental and non-governmental actors facing the same sea-level rise problem (in "the same boat"), and coordination is required to have them "row in the same direction." The imperative for multi-level cooperation becomes more poignant as the science on sea-level rise continues to advance, and considers the possibilities of higher average levels of sea-level rise and rapid and extreme sea-level rise due to accelerated melting of the Antarctic ice sheet. This report summarizes the major challenges, identifies the menu of possible solutions, and develops some specific recommendations on the next steps needed to remedy the governance gap and enhance the adaptive capacity of the SF Bay Area.

The governance analysis is a component of the larger UC Davis/Berkeley research project called Resilience of Infrastructure as Seas Rise (RISeR), See Figure 1, which is funded by National Science Foundation to analyze the interactions between sea-level rise adaptation, transportation infrastructure, and governance in the SF Bay Area. The governance analysis was conducted in Fall 2016-Winter 2017, and is based on a qualitative case study that combines in-person interviews, focus groups, document analysis, and content analysis of interview responses. The draft report was made available to study participants in Spring 2017, along with two webinars for receiving feedback. Participants included leaders of governmental and non-governmental organizations across the SF Bay Area region. The research focused mainly on sea-level rise and coastal flooding, but also linked to broader issues of climate adaptation when appropriate. Focus groups deliberated on the best possible solutions to solving the identified governance challenges.

Respondents identified the overarching governance challenge as the imperative for multi-level cooperation among all sea-level rise adaptation stakeholders. Sea-level rise adaptation entails interdependencies, where the vulnerabilities and adaptation decisions of local actors impose regional costs and benefits. While regional cooperation is beginning to emerge, most stakeholders see a critical need for shared learning, coordination and planning. The recommendations provided in this report are intended to accelerate the processes of learning and cooperation needed to address the increasingly urgent problem of sea-level rise and coastal flooding.

Figure 1: RISeR Project Overview



NSF-funded project under their CRISP Program: Critical Resilient Interdependent Infrastructure Systems and Processes, RISeR seeks to analyze the interactions among governance, protective infrastructure, and transportation infrastructure in the context of sea-level rise adaptation.

The analysis of governance problems and solutions draws on important research from public administration and public policy, including environmental governance, network governance, collaborative governance, and adaptive governance. These literatures suggest important evaluative criteria for governance solutions as enhancing resilience, building social capital, equity (procedural and distributive fairness), economic feasibility, and political feasibility. These criteria include considering the vulnerabilities and adaptive capacity of disadvantaged communities that are disproportionately at risk from sea-level rise in the SF Bay Area.

The remainder of this executive summary outlines the key governance challenges and proposed solutions, as culled from the broader menu of solutions reported in Table 1. These overall challenges and solutions were identified via the case study research process. Evaluating the different solutions using some type of quantitative metric is beyond the scope of this analysis, although it could be attempted using expert elicitation techniques like multi-criteria decision analysis. Our more modest goal, based on the information provided by stakeholders as well as our own best-professional judgement and experience, is to provide a set of solutions that can start "pushing the ball forward" towards regional cooperation. It is important to recognize that sea-level rise governance is a fast-moving target, with many new developments ongoing at the time of this writing. Hence, these findings and recommendations should always be considered in light of the most recent information available to stakeholders. The main body of the report provides a more detailed discussion, with links and references available for interested stakeholders to learn more and develop their own opinions.

KEY GOVERNANCE CHALLENGES

CHALLENGE 1: Institutions for Multi-Level Cooperation

New institutional arrangements are needed to provide incentives and processes for multi-level cooperation. Lack of cooperation can slow or block progress towards increasing resilience, which in some cases will reduce the value of on-the-ground adaptation actions. The SF Bay Area encompasses many agencies at different levels of government: federal, state, regional, county, city, and special district. Many different non-governmental stakeholders also participate in sea-level rise governance. However, there is currently not a single central agency or institutional arrangement with comprehensive responsibility for sea-level rise and climate adaptation planning. Instead, local governments, regional infrastructure operators, private companies and others are creating their own forums and planning processes at different levels, creating the potential for fragmented decision-making, lack of regional coordination, and failure to account for interdependence. However, there is generally no consensus on exactly what types of institutional arrangements will be effective in the long-run.

CHALLENGE 2: Regional Adaptation Planning for Sea-Level Rise

At present, there is no single plan for climate adaptation and sea-level rise in the SF Bay Area, although a number of relevant plans—e.g., Plan Bay Area 2040, BCDC's San Francisco Bay Plan and associated sea-level rise adaptation planning, and others—are created by regional agencies under different legal mandates. How sea-level rise planning will occur depends heavily on the type of institutional arrangements that are created to manage the multi-level cooperation problem. The possibilities range from a comprehensive and integrated regional climate change or sea-level rise adaptation plan, to allowing individual organizations to develop their own local or sub-regional plans based on communication with other actors. An important debate within this challenge is whether a regional adaptation plan should focus narrowly on sea-level rise, or more broadly on climate adaptation inclusive of sea-level rise and other climate impacts related to temperature, precipitation, and extreme events.

CHALLENGE 3: Funding Portfolio

Fully implementing all gray and green infrastructure needed to enhance adaptive capacity will require substantial funding for which there is currently a shortage of identified sources. All stakeholders agreed that a "funding portfolio" including federal, state, local, and private sources will be needed to achieve all of the goals, but this may be unrealistic given the current political and fiscal climate at the federal level, and even new state funding such as Senate Bill 1 (2017) only provides partial "starter" funding for adaptation planning. The exact overall price tag is unknown although it will be in the billions of dollars; nobody has done a systematic analysis of all expected costs, and like most large infrastructure investments any current estimates are likely to experience inflation when actually implemented.

CHALLENGE 4: Integrated Permitting

Fragmented permitting and administrative procedures require substantial time to understand and complete, which may delay or block project implementation, increase costs, or produce conflicting recommendations. Implementing on-the-ground adaptation projects in the form of green or gray infrastructure requires obtaining permits from multiple levels of government. Needed permits might include local government, the Bay Conservation and Development

Commission, the Army Corps of Engineers, the Regional Water Quality Control Board, the California Department of Fish and Wildlife, the US Fish and Wildlife Service, and the National Marine Fisheries Service. Many projects will also require a full EIS/EIR under CEQA/NEPA. From a purely procedural standpoint, there is currently no overarching strategy for coordinating the permitting decisions of these multiple authorities. Furthermore, there may be a need to update many permitting requirements to recognize the dynamic nature of sea-level rise and climate adaptation, where decisions must consider uncertain future conditions.

CHALLENGE 5: The Climate Science Enterprise

Effective climate change adaptation requires identifying, agreeing on, and making accessible the "best available science" about expected levels of climate change impacts, and how those impacts will manifest at the local level. In the context of sea-level rise, the concept of "best available science" is complicated by uncertainty about how future emissions pathways will translate into global and regional climate changes and different amounts of local sea-level rise. Furthermore, the science on sea-level rise continues to advance, with recent hypotheses about higher levels of sea-level rise and sudden threshold events. Most importantly, stakeholders need professional assistance to translate the best available science into their local planning contexts and legally-defensible regulations, especially when the scientific knowledge is advancing faster than policy decisions. Providing a data clearinghouse and online database portals is not sufficient. There are opportunities to increase the co-production of scientific knowledge, and better link science supply and demand.

CHALLENGE 6: Civic Engagement

Sea-level rise is a challenge to civic engagement because it is currently perceived as a "slow moving natural disaster" that is not immediately visible, where the costs of adaptation are short-term and more certain while the benefits are long-term and uncertain. The "psychological distance" of sea-level rise also increases when people perceive it to affect others who are not like themselves or in geographically distant places. As a result, there is a general lack of public urgency with respect to sea-level rise especially in comparison to other policy issues with short-term and visible impacts. Public awareness, education, and civic engagement around sea-level rise are foundations for adaptation in a democratic country. Lack of engagement reduces political support for proposed solutions and creates resistance to any policies that may impose costs on individual citizens. Civic engagement by disadvantaged communities is further constrained by lack of capacity to effectively participate in planning, attention to other short-term priorities, and history of distrust with political actors.

CHALLENGE 7: Political Leadership

A more consistent and visible amount of political leadership is needed to make more than incremental progress. Advancing planning and implementation of sea-level rise adaptation requires leadership from elected officials and high-level administrative officials in government agencies and other relevant organizations. Elected officials include all levels of government—local, state, and federal. Elected officials play a key role in passing policies (legislation, ordinances etc.) that authorize and fund adaptation projects. Political leadership around sea-level rise has been uneven to-date, especially among elected legislators at the state and federal levels. Many climate change and water policy stakeholders are paying more attention to mitigation, or water scarcity/supply due to drought and the long history of conflict over California water management. SF Bay Area regional agency and NGO leaders over the last few years have been moving to take the lead on sea-level rise, in partnership with some innovative local governments and SF Bay Area legislators.

ACTION ITEM RECOMMENDATIONS

Our synthesis of the interview and focus group processes suggests the following high priority actions that could improve adaptive capacity in the near-term. The goal of this report is not to outline some type of final governance solution, but rather to accelerate the evolutionary process of deliberation, learning and cooperation that is needed to ultimately discover and agree-upon a more permanent set of governance arrangements. The recommendations can be thought of as waypoints along the pathway to governance solutions—a set of "preferred alternatives" for accelerating cooperation. Furthermore, many of the focus groups responded to the discussion of potential governance solutions by saying "all of it". This means that the governance solutions matrix should continue to be used as a source of additional ideas, and that in many cases the solutions are not mutually exclusive but rather complementary. We do not expect all stakeholders to agree with our prioritization, and providing a more quantitative analysis is beyond the source of this study but could be a useful future exercise. Stakeholders who do not agree with the specific action-item recommendations below can read the full report for information about different alternatives.

1. Sea-Level Rise "Adaptation Vision" Task Force

A regional "Bay Area Adaptation Vision" task force should be appointed by the California governor or legislature to produce a short-term vision plan that establishes goals, principles, and a timeline for guiding the development and update of other regional and local plans. The Adaptation Vision task force should review existing laws, regulations and policies, and make any relevant recommendations for new legislation or administrative activities. The Adaptation Vision task force negotiates the current Catch-22 facing the discussion of new institutional arrangements, where stakeholders desire more central coordination while simultaneously wanting to avoid creating a new regional agency, and also with mixed opinions about whether an existing regional agency is a satisfactory leader. The visioning process could be more quickly implemented than creating a new agency. A sea-level rise visioning process can navigate this dilemma by establishing agreement on the goals, principles, and information basis for achieving resiliency without immediately establishing any new regulatory authority. The visioning process can include new and existing sub-regional analyses of vulnerability and adaption options, and participation opportunities for both community groups and political leaders. The visioning process must be inclusive of all stakeholders with appropriate subcommittee structures, in order facilitate learning about diverse perspectives and values. An important question is whether or not ongoing sea-level rise planning efforts by regional agencies like BCDC can fill the same functional role of a broader visioning process. For example, MTC/BCDC/BARC are in the process of forming a regional working group to establish the foundation for a climate adaptation plan (BARC personal communication, 2017).

2. Update Existing Regional and Local Plans According to Adaptation Vision Document

The Adaptation Vision plan should establish an accelerated timetable to update existing regional and local plans according to the principles and goals. The initial Adaptation Vision is not a formal regional climate adaptation plan that mandates actions or funding, but will establish goals and principles that guide the updating of existing regional and local plans and promote collaboration among key parties. There are existing regional plans with legislatively-established

funding or regulatory mechanisms as well as local general plans and hazard mitigation plans that should be updated to reflect the goals, evidence, and principles developed by the Adaptation Vision task force. These plans should not be considered sufficient unless they integrate the Adaptation Vision information—the regional plans must take a "hard look" at the Adaptation Vision and incorporate the "best available science" as identified by the Adaptation Vision and Climate Science Service Center. By establishing a widely recognized basis for decision-making, the Adaptation Vision document can help underpin the evidentiary and legal basis for updating other plans according to CEQA, NEPA, and other existing laws. This may include prioritizing funding decisions for adaptation projects, and providing the scientific and political basis for permit decisions. The Adaptation Vision plan could be a prologue to a more comprehensive and long-term climate adaptation or sea-level rise adaptation plan.

3. "Local First" Innovative Funding Strategy

An innovative "local first" funding strategy should be created to identify all existing and potential local funding sources, and assess the best options for different jurisdictions. Financing coastal infrastructure will require a portfolio of funding strategies including local, state, and federal government sources along with public-private partnerships and foundations. However, state and federal funding is unlikely to be sufficient given current fiscal constraints and the political climate. Local governments and special districts can implement a variety of funding mechanisms to provide a revenue stream for coastal infrastructure development. A recent and very important example is Measure AA, a 9-county regional parcel tax of $12 per year to fund wetlands restoration. Additional parcel taxes are one possible funding mechanism for the future. The region should study and implement a wide range of funding mechanisms including new special tax assessment and other districts, development impact-fees for development in flood risk zones, integrating sea-level rise into special district funding reauthorization, local sales tax measures, increases in fees for water or other services, and special tolls on bridges or public transportation. Public-private partnerships should be a part of this strategy. However, this strategy should not preclude taking advantage of current and future state and federal funding opportunities as they become available.

4. Integrated Permitting Team for Coastal Adaptation Infrastructure

Regional, state and federal permitting agencies should create a new integrated permitting strategy and associated implementation team, modeled after the Long-Term Management Strategy for dredging in the SF Bay Area. An integrated permitting team establishes a formal agreement for coordinating their existing permitting authorities and administrative procedures; it does not create any new permitting authorities. The scope of the adaptation permitting team would need to be defined in terms of applying to gray or green infrastructure, and whether sea-level rise and flooding would be the narrow target versus climate adaptation broadly speaking. Finding a permanent source of funding to pay for involved staff will be a necessary step.

5. Climate Science Services Center

A Climate Sciences Services Center should be created to build the infrastructure for a data clearing house and provide boundary-spanning and translational experts to directly interact with stakeholders. These experts would assist stakeholders in identifying, translating, and analyzing relevant scientific data and information for appropriate integration into planning and decision-making. The center would work with stakeholders on an on-going basis to identify research gaps and studies to address those gaps. The translational experts would need a strong interdisciplinary background in the relevant biophysical and social sciences, as well

as science communication and policy. However, the Climate Science Services Center would probably not be the leader for developing new climate science models or data, but instead would serve as a boundary-organization that seeks to coordinate and integrate basic research efforts underway in other organizations. A Climate Science Services Center could be housed at a relevant non-governmental organization like San Francisco Estuary Institute, a university organization such as the Climate Readiness Institute at UC Berkeley, or a consortium of governmental and non-governmental organizations that divert the time of current staff into a sustained collaborative effort.

6. Comprehensive Civic Engagement Strategy

Develop a comprehensive and coordinated civic engagement strategy, which delivers an integrated portfolio of communication activities with consistent messages and visualizations about the likely vulnerabilities and economic/social impacts of sea-level rise, the range of adaptation options (including cost estimates), the sea-level rise impacts already being experienced by communities, and opportunities for public participation. The effectiveness of sea-level rise adaptation planning and implementation depends on increased demand for action from the SF Bay Area public. Organize the civic engagement strategy using the concept of "psychological distance"—sea-level rise and coastal flooding is something that is happening now, with relatively certain impacts, to local areas in the SF Bay Area, and to people like you. Deliver these materials in appropriate format on web-based and social media platforms, community meetings in all nine counties and as many cities as possible, and through partnerships with key civic organizations such as environmental and community NGOs, and cultural institutions like the Exploratorium, Cal Academy of Sciences, airports, public transportation systems, and others. The civic engagement strategy must consider the needs and capacities of disadvantaged communities that are disproportionally vulnerable to sea-level rise in the SF Bay Area, including established environmental justice organizations and leaders.

7. State and Federal Legislative Member Organizations Focused on Sea-Level Rise and Climate Adaptation

A coalition and network of political leaders is needed to repeatedly deliberate to better understand sea-level rise, and identify legislative and administrative actions that could be taken to address the problem. Such a coalition could be anchored by legislative member organizations, which are formal or informal networks of legislators who form groups outside of the existing standing committee structure. The Select Committee chaired by Richard Gordon provides an example that should be revived and expanded in coordination with the SF Bay Area Caucus. In order to form a broader political coalition and demonstrate political leadership, any legislative member organization should invite participation from the governor and federal legislators. The activities of this political leadership coalition would need to be clearly communicated to the public and other stakeholders.

Table 1: Governance Challenge and Solution Concept Matrix	
Bay Area Sea-Level Rise Governance Challenges	Proposed Solution Concepts (Preferred Alternatives Listed First)
Institutions for Multi-Level Cooperation	1. Climate Adaptation Vision or Commission (e.g. Delta Vision, Governor's Commission for a Sustainable South Florida, Western Water Commission) 2. Shared governance ("stay in your own lane") 3. Lead agency (BCDC or other existing agency) 4. New "network" administrative agency (e.g.; Delta Stewardship Council) 5. Institutional consolidation: special districts, regional governing boards
Climate Adaptation Planning	1. Vision Plan and next step recommendations 2. Update existing regional (SB375, Plan Bay Area, SF Bay Plan, other) and local plans (general plans, congestion management plans, local climate adaptation plans) 3. Overall regional climate adaptation or sea-level rise adaptation plan 4. Separate but linked new plans for specific issues—sea level rise, temperature, drought
Funding Portfolio	1. Regional/Local: parcel taxes, increases in fees, special taxation districts 2. State: Transportation and bond money, special legislation 3. Federal: special legislation, WRDA, transportation funding 4. Public-private partnerships
Integrated Permitting	1. Create new integrated permitting strategy for green infrastructure 2. Expand scope of Long Term Management Strategy for Dredging and associated Dredged Materials Management Office 3. Informal Communication Networks 4. Regional Advanced Mitigation Planning 5. Habitat Conservation/Natural Communities Conservation Plan 6. Expand permitting authority of existing regional agencies like BCDC
Climate Science Enterprise	1. Climate science services center (data and assistance/guidance) hosted at agency, university, NGO, or consortium 2. Create centralized web portal for all climate science information 3. Internal independent science review board 4. External National Academy of Science review panel (e.g. Committee on Independent Scientific Review of Everglades Restoration Progress)
Civic Engagement	1. Community-based adaptation meetings (e.g. Southern Marin Pilot Project) 2. Partnerships with established institutions (schools, museums, non-profits, utilities, airports) 3. Developing marketing and communication campaign with digital, traditional, alternative media 4. Citizen science and *in situ* visualizations 5. Educational venues 6. Climate leadership training programs (outreach staff, community leaders, consultants) 7. Partnerships with non-profits that have links to citizens
Political Leadership	1. Create state and federal legislative caucus groups focused on climate adaptation 2. Governor-sponsored regional climate adaptation dialog sessions 3. Legislative staff outreach task force 4. Climate leadership network for elected officials

INTRODUCTION: THE GOVERNANCE GAP FOR ADAPTING TO SEA-LEVEL RISE AND COASTAL FLOODING IN THE SAN FRANCISCO BAY AREA.

This report summarizes the results of an extensive study of governance for climate adaptation and sea-level rise and coastal flooding during extreme events in the San Francisco Bay Area. We focus on the "governance gap" that exists between the problems of sea-level rise and coastal flooding and the implementation of solutions. While most stakeholders recognize the risk from sea-level rise and coastal flooding, and have good ideas about potential on-the-ground solutions, realizing these solutions requires overcoming a series of governance challenges. All of these governance challenges are linked to the overarching issue of how to encourage stakeholder cooperation at multiple geographic levels—local, regional, state. This report will summarize the major challenges, identify the menu of possible solutions, and move towards some specific recommendations on the next steps needed to remedy the governance gap and enhance the adaptive capacity of the SF Bay Area.

In the SF Bay Area and other coastal regions around the world, sea-level rise associated with climate change is already being experienced in the form of coastal flooding especially during high tide and storm events, and regional climate anomalies like El Nino (Griggs et al. 2017). The projected increase in extreme weather events will exacerbate the problem of sea-level rise, primarily because high levels of precipitation in upland watersheds creates downstream coastal flooding, which is more damaging during high tides . The threat of sea-level rise will continue to increase in the future even if all global climate mitigation policies reduce carbon emissions to zero. The series of "atmospheric river" storms in winter 2017 highlighted these issues, with extensive flooding and landslides throughout the SF Bay Area including the closing of major transportation corridors like Highway 37 and Highway 84.

Coastal areas have the highest levels of human development, and sea level rise is likely to impose high economic, social, and environmental costs in urban regions like the SF Bay Area. The SF Bay Area is a massive hub of commercial activity supported by transportation, energy, communication, flood management, waste management and other types of critical infrastructure that are vulnerable to flooding exacerbated by sea-level rise. Commercial and residential development in low-lying areas is also vulnerable, and is particularly acute in economically and racially diverse disadvantaged communities. Rare and sensitive coastal wetlands, along with their associated species of concern, are already constrained by existing coastal development but may also be inundated by rising seas. Although many of the social and environmental costs are hard to quantify, just the economic costs alone highlights the importance of developing strategies for adapting to these issues. For example, the 2015 "Surviving the Storm" report estimates that a cost of an extreme storm in the SF Bay Area could be as much as $10.4 billion.

Sea-level rise is far along in what policy analysts refer to as the "problem definition" stage of public policy. Unlike many environmental problems, at least among SF Bay Area stakeholders in the last 10 years, a fairly widespread agreement has emerged that sea-level rise is a high priority issue that should be addressed in the near future in order to reduce vulnerability in the long-term. There remains some uncertainty about how much and how fast sea-level rise might occur, with some stakeholders worried that the current scientific estimates are too

conservative. There are also well-developed biophysical models of sea-level rise that can identify vulnerable areas with a fairly high level of precision, and local climate adaptation plans and policy forums are incorporating this information at varying rates. Another challenge from the problem definition perspective is that sea-level rise is a "slow moving natural disaster." In the absence of agenda-setting, dramatic events like Superstorm Sandy or Hurricane Katrina, sea-level rise has not yet attracted the sustained attention of policy makers and citizens. Political support for climate adaptation is also difficult when the benefits of climate adaptation occur in the future, but the costs of coastal protection are incurred in the near-term. Nevertheless, climate adaptation efforts in the SF Bay Area are facilitated by a level of agreement on the problem definition that is probably higher than in most other coastal regions in the US, or other types of environmental problems. This agreement is especially high among the network (sometimes called the "epistemic community"; Haas 1989) of environmental and infrastructure professionals who are involved with environmental management in the region.

Similarly, there is a relatively high level of agreement that a portfolio of "green" (sometimes called "living shorelines") and "gray" infrastructure investments is needed, depending on the nature of local vulnerabilities and existing configuration of coastal protection (see Figure 2 for examples from the South Bay). Major infrastructure facilities like the San Francisco International Airport and Port of Oakland already have major investments in flood control structures, and are developing strategies to elevate those structures in anticipation of future sea-level rise. A range of other so-called "gray infrastructure" investments are also needed throughout the SF Bay Area, either upgrading existing structures like the Embarcadero sea-wall in San Francisco or building new levees, dikes, and sea-walls where more hardened infrastructure makes sense. Given recent coastal flooding events and changing predictions regarding sea-level rise, there is a growing urgency to implement these adaptation projects as

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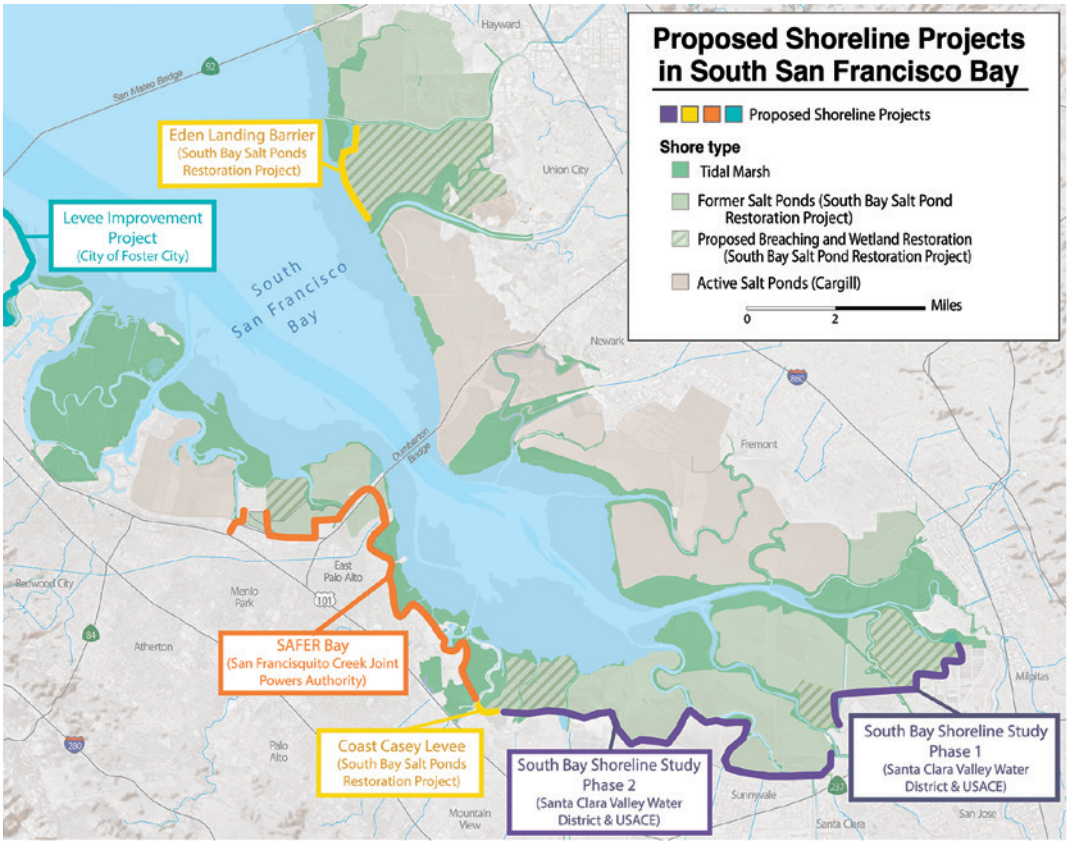
Photo, left: View of Horizontal Levee Demonstration Project at the completion of construction. The 400' by 150' demonstration is divided into twelve experimental cells with four different designs. Each design is built in triplicate to support research on the water quality, habitat, and hydraulic capacity of each Horizontal Levee cross section.

Photo, right: Volunteers led by Save the Bay transfer some of the 70,000 plants used to vegetate the completed face of the Horizontal Levee Demonstration.

FIGURE 2: Map depicting shoreline projects proposed in South San Francisco Bay, illustrating the emerging regional strategy for addressing sea level rise in the South Bay. Created as an exercise for the Bay Area Ecosystem Climate Change Consortium's South Bay workshop to help future modeling of the impact of different planned projects on regional and local tidal heights.



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quickly as possible, with the hope that the costs of protective infrastructure are lower than damage costs from extreme flooding.

"Green infrastructure", "nature-based", or "living shoreline" solutions such as wetland restoration and horizontal levees are considered "win-win-win" strategies because they absorb wave energy from high tides and storm surge, while also providing habitat for sensitive species and water quality benefits for point and non-point source pollution. SF Bay is already a major focus of wetlands restoration, given the historical loss of wetlands due to urban development during the late 19th and early 20th centuries. Sea-level rise has accelerated the urgency of these existing efforts in order to establish elevated wetland habitats before they are inundated by sea-level rise. There are important pilot studies of horizontal levees, such as the Oro Loma/Castro Valley Project. While there is some scientific uncertainty about the long-term effectiveness of green infrastructure in the face of a significant sea level rise, there are few stakeholders who are entirely opposed to the idea.

Actually implementing and installing these infrastructure solutions reveals the governance gap and associated challenges. At the very least, installing new infrastructure requires running a gauntlet of permits from government agencies, which slows down project development and features fragmented and sometimes conflicting decisions. At the same time, multiple stakeholders are required to share information, provide funding, and undertake other collaborative activities in order to effectively implement on-the-ground adaptation projects.

It is important to recognize that sea-level rise and extreme events are nested in the broader concept of climate adaptation. In many coastal areas, sea-level rise and coastal flooding is the priority problem due to potential damages to human health, property, and infrastructure. Sea-level rise is also linked to other important issues such as loss of biodiversity and critical habitat;

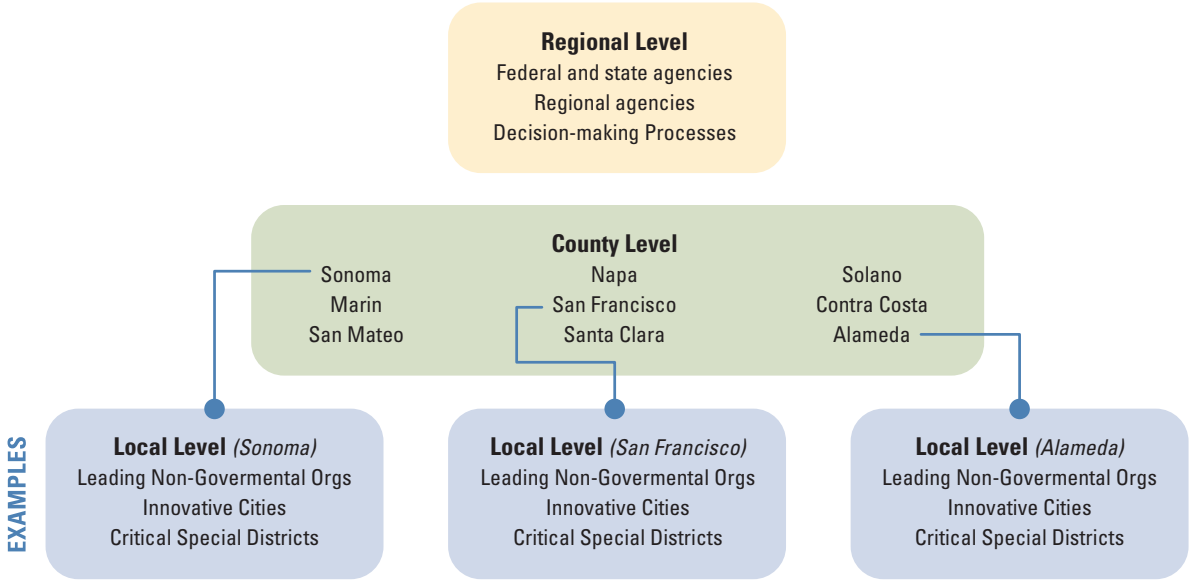
it is a "keystone issue". However, climate adaptation also requires attention to other aspects of climate change such as water availability, temperature stress, changes in snowmelt timing, *et cetera.* Many of the problems, challenges and solutions discussed below are extendable to the broader concept of climate adaptation. But in order to constrain the scope of this report, while also addressing the highest priority issue in SF Bay, we limit the discussion to sea-level rise and coastal flooding.

RESEARCH DESIGN: QUALITATIVE CASE STUDY

This study seeks to diagnose the governance challenges facing sea-level rise adaptation in the SF Bay Area, identify the possible solutions to those problems, and develop a set of recommendations around solutions that are likely to receive stakeholder support, be feasible to achieve and take forward steps on the path towards adaptive capacity. To do this, we implemented a qualitative case study approach in Fall 2016-Winter 2017 involving a combination of document review, stakeholder personal interviews, focus groups with expert stakeholders, and qualitative data coding. The qualitative approach provides a rich basis of information for developing these initial recommendations, along with a deeper understanding of the governance issues to inform more quantitative analyses that we are conducting in the future.

The personal interviews targeted stakeholders at multiple levels of the regional governance system, as depicted in Figure 3 including local governments, special districts, and non-governmental organizations within all 9 counties of the SF Bay Area. In total, we conducted in-person interviews with 43 individuals; most of the interviews were one-on-one and lasted approximately one hour. The interviews covered the following basic topics: professional background, perceptions of risk from sea-level rise, source of climate change information, current adaptation actions being implemented, funding needs, overall governance challenges, participation in climate adaptation policy venues, collaboration partners, and barriers to collaboration. The interviews were transcribed, and the report contains call-out boxes with anonymous quotes from stakeholders to illustrate some of our key findings.

FIGURE 3: Case Study Conceptual Model



The personal interviews were followed-up by three regional focus groups in the North Bay (15 participants), Central/South Bay (18 participants), and South Bay (12 participants). The goal of the regional focus groups was to deliberate about possible solutions to the seven governance challenges. The focus group participants were first asked to choose the highest priority governance challenge, and then discuss the possible solutions from the perspective of resiliency, cooperation, social capital, equity, economic feasibility, and political feasibility.

We also reviewed the various reports, plans, and websites of the interview participants and other involved stakeholders. This included a high-level review of over 100 climate adaptation projects identified by the UC Berkeley Climate Readiness Institute, which allowed us to identify the network of policy stakeholders who are involved in the overall ecosystem of climate adaptation governance in SF Bay. A later section of this report displays a "network diagram" that depicts over 500 organizations as "nodes" linked to over 100 planning venues. This illustrates the complex and fragmented nature of climate adaptation governance in the SF Bay Area.

THE OVERARCHING PROBLEM: REGIONAL INTERDEPENDENCE AND THE IMPERATIVE FOR MULTI-LEVEL COOPERATION

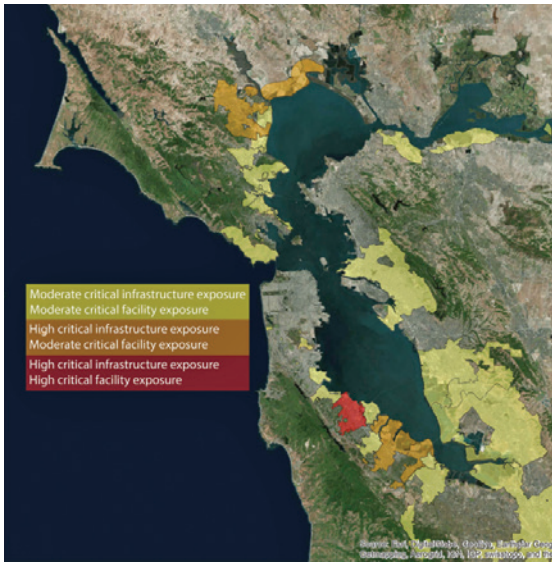
Most individuals and stakeholders recognize that climate mitigation—reducing carbon emissions—entails a multi-level, global cooperation problem (Ostrom 2010). The problem emerges because the benefits and costs that individuals experience from climate mitigation depend on the decisions of other individuals. If one person, organization, country, or other type of stakeholder decides to incur the costs of climate mitigation (e.g.; reducing behaviors linked to carbon emissions), then other actors will also benefit. This creates an incentive for actors to free-ride on the climate mitigation efforts of others—why should I pay the costs if I can enjoy the benefits provided by others? However, if all actors follow these incentives, then the overall level of climate mitigation behaviors will be sub-optimal. At the global level, some people consider this cooperation problem as a global "Tragedy of the Commons". The long-standing difficulty of negotiating climate mitigation policies among countries in the context of the Paris Agreement illustrates these issues.

Interdependence is at the heart of cooperation problems—the benefits and costs experienced by one actor depend on the actions of others. The role of interdependence and cooperation is less recognized in the context of climate adaptation. Climate adaptation is often considered in terms of private benefits and costs—for example, what a particular city undertakes to protect itself from sea-level rise will benefit only that city, and will not be affected by the decisions of other local jurisdictions. However, this study makes clear that interdependence is a fundamental aspect of climate adaptation in four main ways, which creates an imperative for multi-level cooperation.

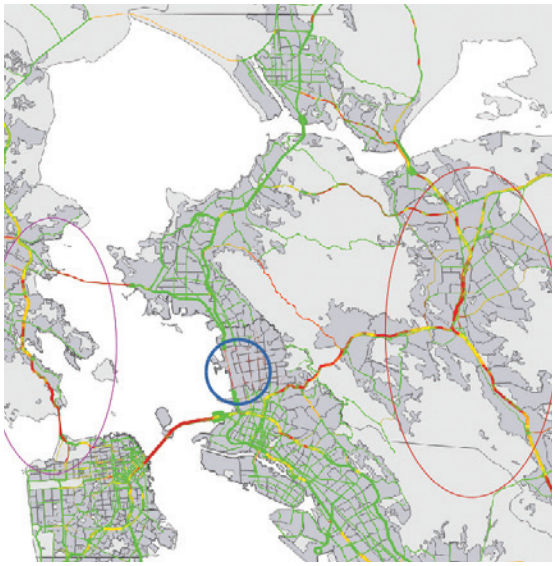
First, "shared experience interdependencies" emerge from the fact that many stakeholders are facing the same types of vulnerabilities and related climate adaptation parameters. This creates an opportunity for stakeholders to learn from each other, and share innovative strategies that have been analyzed or experimented by some particular actor. For example, many cities in the SF Bay Area are facing a similar level of expected sea-level rise, which may affect different economic sectors and populations in similar ways. Learning is facilitated by communication among cities that are facing similar vulnerabilities.

Second, "vulnerability interdependencies" exist when there are potential spill-overs in risk from one actor to another. In the context of sea-level rise and flooding, this usually occurs

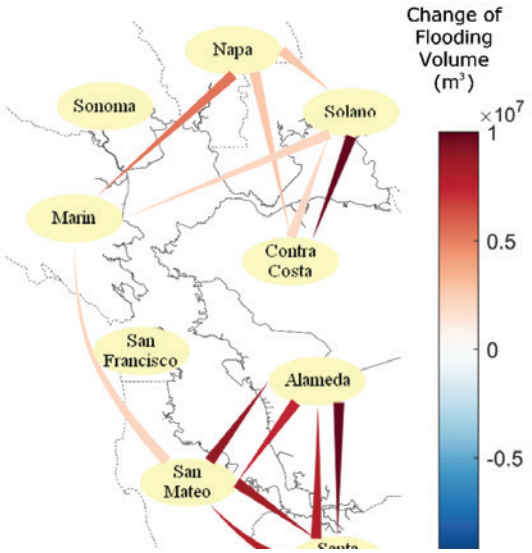
FIGURE 4: Regional interdependence for 1 meter of sea level rise.



Panel 1: Shared Experience via Community Clustering
projections of community clustering based on similarities in vulnerable infrastructure with threat based on existing shorelines only.



Panel 2: Vulnerability Interdependency via Regional Traffic Response
projections of changes in traffic flow using demand-based model for shoreline scenario in which entire area is protected except the City of Berkeley (inundated region highlighted by blue circle). Yellow segments have travel times that increase by 0-50% due to Berkeley inundation; Red segments increase travel time by more than 50%.



Panel 3: Adaptation Interdependency via Physical Interactions in Water Flows
projections of direct influence of action in one jurisdiction (county) on other jurisdictions in the region. Shoreline scenarios here assume that each county acts individually to construct a sea wall to provide complete protection against 1 meter of sea level rise. Colors show the change in volume of water that enters other counties' jurisdictions due to a county's action; the arrows are pointing in the direction of influence.

STAKEHOLDER PERSPECTIVES: Multi-Level Cooperation

"The shoreline of the coast and the bay is the Beirut, Benghazi, Baghdad of land-use politics. There are more laws, more interest groups, more lawyers, more agencies, wanting to ensure that multiple laws that protect the environment are followed."

"Well, each local government, acting on its own would have been nuts to stop filling the Bay if their neighbors were continuing to do it. But in the process of doing it, they were destroying an international treasure. So it's a classic regional example of the tragedy of the commons, each of the farmers with his sheep or his cow in the field was consuming so much of the pastureland that it was destroying it. But each of them was acting in their own self-interest. So BCDC was created to provide that regional oversight."

"There are multiple counties and multiple cities…and other stakeholders like us, and we tend to…really operate in a vacuum for as much as we try to have efforts to coordinate. It's easy to become, just start to, that focus starts narrowing just to your right away or your property, just to your property boundaries or just to your mission and goals."

geographically when a lack of action by one local jurisdiction creates a "weak link" where flood waters can spread to other jurisdictions, even if those other jurisdictions have invested in adaptation strategies. Another example is regional increases in traffic congestion, which would occur if one local jurisdiction experiences coastal flooding. Hence jurisdictions must work together in order avoid weak-link vulnerabilities.

Third, "solution interdependencies" occur when adaptation actions taken by one actor increase or decrease the vulnerabilities of other actors. Given the complex hydrodynamics of the SF Bay, increasing shoreline protections in one part of the SF Bay Area can change water levels and tidal dynamics in other parts of the region. When adaptation actions in one local area may have regional benefits, it makes sense to jointly invest in that particular area. Conversely, adaptation actions with local benefits that increase vulnerabilities regionally should be avoided. However, most local government jurisdictions and other types of actors only consider their private costs/benefits instead of the external costs/benefits. There is only an emerging awareness about these interdependencies among SF Bay Area stakeholders, and precise scientific characterization requires additional modeling efforts. Such modeling efforts are ongoing within the RISER project, and Figure 4 provides some initial results.

Fourth, there are "policy interdependencies" where implementing adaption actions requires authoritative decisions from multiple actors. Policy interdependencies are especially apparent in the context of permitting and funding, where implementing a specific adaptation project requires permits from multiple agencies and assembling a funding portfolio possibly from a combination of local, state, federal, and private sources. For example, the Oro Loma Horizontal Levee project, an important experiment in the implementation of green infrastructure, required an Environmental Impact Review/Statement, permits from the State Water Resources Control Board (Section 401 of Clean Water Act), the Army Corps of Engineers (Section 404 of Clean Water Act), and a development permit from BCDC. The South Bay Salt Bond Restoration project wetlands restoration faces a similar gauntlet of permits. At the very least, coordinating these permit agencies requires project developers to facilitate a sustained communication strategy among the agencies, applicants, and other stakeholders.

These interdependencies play out both within and between geographic levels within the SF Bay, from the local to regional. All regional governance arrangements are nested, multi-level systems. Individuals are nested in neighborhoods, which in turn are nested in special districts, then cities, counties, regional government, state government, and ultimately Federal and global levels. At the local level, stakeholder cooperation is needed within cities and counties where multiple special districts, non-governmental organizations, and individual citizens must

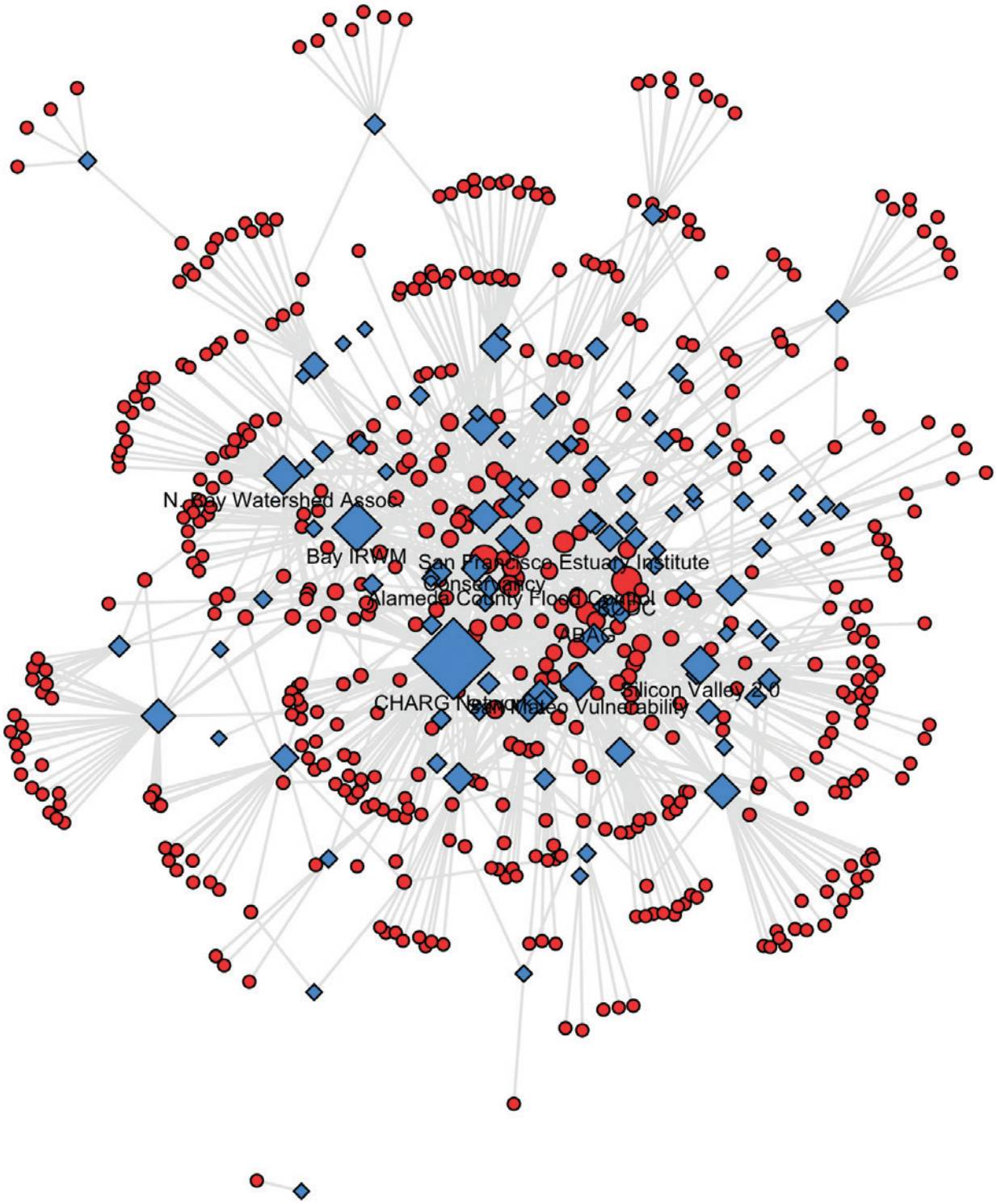


FIGURE 5: Climate Adaptation Policy Network in San Francisco Bay Area

The red circles represent actors, the blue squares are specific climate adaptation projects, and the links represents actors participating in projects.

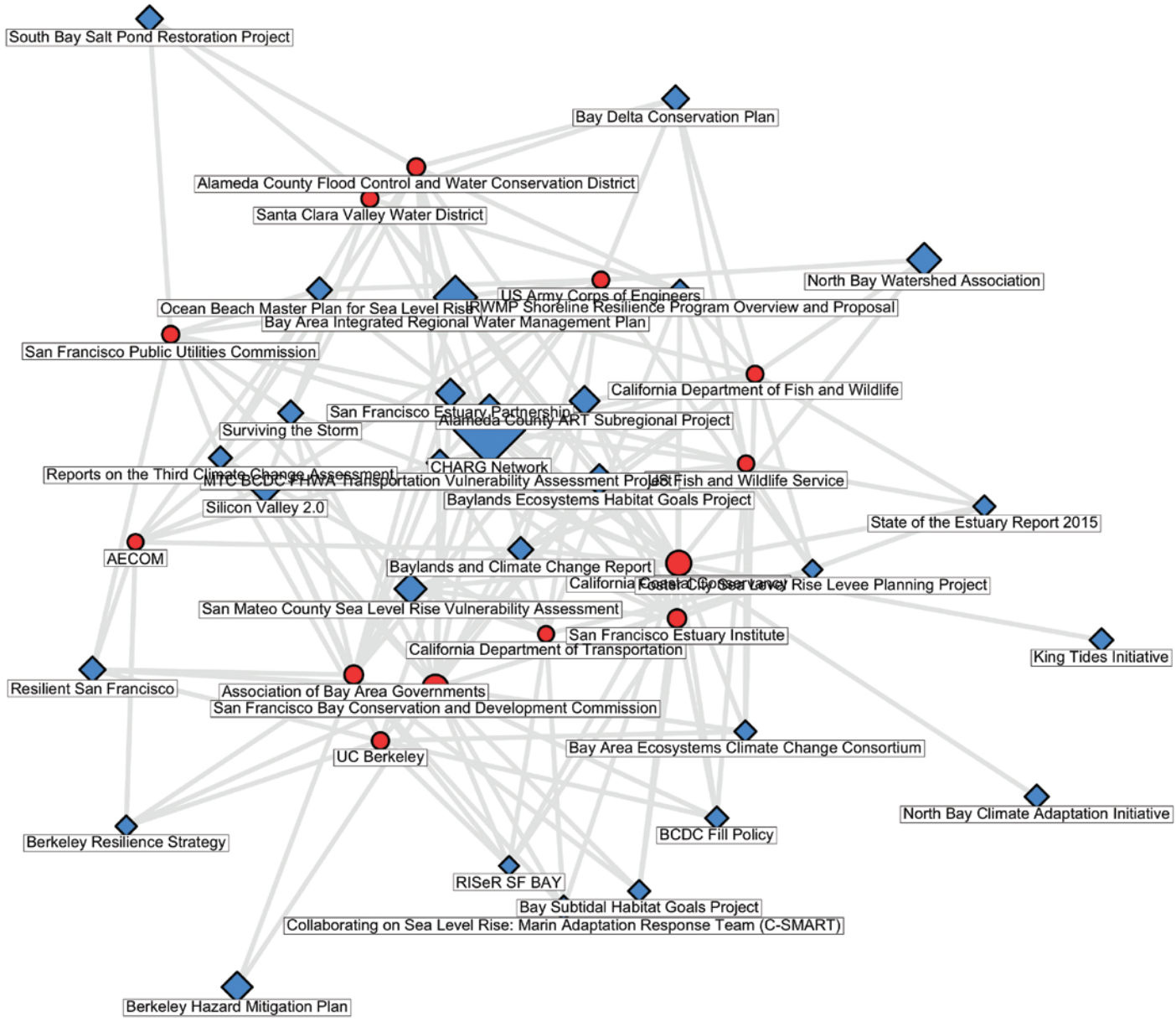


FIGURE 6: Core Actors and Projects in San Francisco Bay Area Climate Adaptation Policy Network

Zooms in on actors with 12 or more connections, and associated projects. Most central actors and projects have a regional scope.

engage in climate adaptation decisions and behaviors. At the same time, cooperation among local jurisdictions is required to manage interdependences that cross local boundaries. Cooperation is also needed among regional governance actors that have jurisdiction or influence over lower level units, but also have authority over different aspects of the problem (e.g.; water quality, wetlands, species protection). Achieving cooperation also requires cross-level relationships—regional actors "downscaling" information, resources and authority to local actors, and local actors "upscaling" information to regional actors.

Most SF Bay Area stakeholders recognize the resulting fragmentation within governance systems, expressing a feeling of "everybody's involved but nobody is in charge". To illustrate, Figures 5 and 6 use a network analysis diagram to visualize the policy network of 103 projects (see Appendix for full list of projects) and 512 unique actors involved with sea-level rise and climate adaptation in the SF Bay Area. The red circles in the diagram represent actors, the blue squares are specific climate adaptation projects, and the links represents actors participating in projects as observed in online documentation for each project. Figure 5 shows the whole network, and Figure 6 zooms in on the core central set of actors and projects (actors with over 12 links).

The network diagram clearly shows the fragmented and multi-level nature of the SF Bay governance system, with actors and projects at both regional and local levels. However, it also reveals a central core of actors and projects, which have a larger influence on steering the overall direction of the system. Many of these actors and projects, such as the Bay Conservation and Development Commission, the CHARG network, and the SF Bay Area IRWM have the mission of coordinating water management and land-use at the regional level. However, it is important to recognize that the participation links in these networks are gleaned from online records of membership and participation. Projects and policy venues, along with intensity of participation, can wax and wane over time so it is essential to couple the quantitative data in the diagrams with more in-depth qualitative information provided throughout this case study. For example, even though the CHARG network appears prominent in the diagram because of strong initial recruitment, some stakeholders expressed the perspective that CHARG is experiencing a decrease in participation and may even be abandoned as a viable process. Previous research has demonstrated that the survival of projects and policy venues depends heavily on political support from involved actors who believe the project is providing benefits in a manner perceived as equitable.

Not surprisingly given the overlap in agencies and close geographical proximity, this network is very similar to the network in the California Delta as included in Luoma et al.(2015), "Challenges Facing the Sacramento–San Joaquin Delta: Complex, Chaotic, or Simply Cantankerous?" However, such complex and polycentric systems are not necessarily chaotic, without coordination or guidance from more central actors and policy decisions. The key governance question is how to achieve cooperation for sea-level rise within this complex, multi-level system. Most stakeholders expressed a desire for increased centralization, but this general idea immediately raises the question of how much centralization, and through what types of institutional arrangements. Attempts to centralize cooperation at the regional level creates an enduring tension with the need to recognize the autonomy of local jurisdictions and the administrative scope and responsibilities of existing regional agencies and other types of stakeholders. Centralized approaches that push towards uniformity and one-size-fits-all solutions also have difficulty in adapting to heterogeneous local contexts and discovering innovative strategies. The recommendations developed in this report seek to navigate these tensions while still building the capacity for regional cooperation.

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Hayward Regional Shoreline Bay Trail Overtopping, December 31, 2005

PERSPECTIVES ON ENVIRONMENTAL GOVERNANCE

Academics and policy-makers often use the term governance very loosely without any clear definition of its meaning. A number of different governance concepts are useful to consider in the context of climate adaptation. These governance concepts suggest important criteria for evaluating any proposed solutions to the sea-level rise governance challenges. The brief discussion below parallels the academic fields of public policy and public administration in going from "government to governance"(Rhodes 1996). The basic idea is that policy analysis should not focus just on government agencies and authoritative decisions by bureaucracies and legislatures, but rather the entire network of government, non-governmental, and private actors and the associated processes of collective decision-making.

Governance as Rules

In an important overview of environmental governance, Lemos and Agrawal (2006) define governance as "the set of regulatory processes, mechanisms and organizations through which political actors influence environmental actions and outcomes." This definition retains some emphasis on the authoritative rules aspects of governance, which is important in the SF Bay Area because many of the policies around sea-level rise are associated with legislatively-mandated regulatory or funding processes that are governed by specific administrative procedures and requirements. These include the BCDC Bay Plan that contains specific permitting requirements for Bay-side development, the Basin Plan of the Regional Water Quality Control Board, the requirements for transportation funding through CalTrans and MTC and the Sustainable Communities Strategy, the Army Corps of Engineers rules for evaluating the costs/benefits of different projects, local government land-use and zoning, among others. At a minimum, solving the governance challenges will require many of these actors to adjust their administrative requirements to better synchronize with other actors. Furthermore, many of the proposed governance solutions suggest a greater centralization of

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Bay Trail, Sausalito, January 14, 2014

authority in some fashion, which entails modifying the administrative powers of existing agencies or creating new agencies with new authority.

Network Governance

Theories of network governance focus on mechanisms for coordinating the activities of the network of actors involved in a particular policy issue. As Provan and Kenis (2005; p.231) state "Although all networks comprise a range of interactions among participants, a focus on governance involves the use of institutions and structures of authority and collaboration to allocate resources and to coordinate and control joint action across the network as a whole." Network governance clearly encompasses the situation in the SF Bay Area, where multiple government agencies and policy stakeholders must coordinate across policy venues at the local and regional levels.

Provan and Kenis (2005) introduce a useful framework for analyzing the effectiveness of different forms of network governance, which range from "shared governance" where coordination is mainly informal, to "lead organization" where an existing agency becomes the central broker, to the creation of a new "network administrative organization" where a brand new agency is created with enough authority and funding incentives to coordinate the relevant actors. They also suggest that in contexts with many actors who bring different specialized competencies to the table, the most effective form of network governance involves some form of centralization to clearly identify "who is in charge". These themes are very relevant to the SF Bay Area, because a large portion of the debate resolves on defining who is in charge, whether it is an existing organization like BCDC or some type of new government authority.

Collaborative Governance

Emerson et al (2012; p.2) define collaborative governance as "the processes and structures of public policy decision making and management that engage people constructively across the boundaries of public agencies, levels of government, and/or the public, private and civic spheres

in order to carry out a public purpose that could not otherwise be accomplished." Collaborative governance is a bottom-up alternative to more top down, command-and-control approaches that rely on compliance and enforcement to shape the behavior of target groups (e.g.; local government development decisions). Emerson et al. (2012) identify three core "dynamics" of collaboration: principled engagement, shared motivation, and capacity for joint action. Principled engagement entails sustained deliberation in order to discover the interests of other actors and develop a mutual understanding of policy problems and drivers. Shared motivation involves the development of trust, belief in the legitimacy of the perspectives of other actors, and a commitment to the collective endeavor. Developing a capacity for joint action requires leadership, knowledge, and the development of new institutional arrangements. These same collaborative dynamics are clearly recognizable as SF Bay Area stakeholders grapple with the regional implications of sea-level rise vulnerability, and attempt to develop collective solutions.

Adaptive Governance and Resilience

A broader literature in public policy and environmental governance focuses on the role of governance in enhancing the resilience of social-ecological systems (Folke et al 2005). Folke et al. (2005) define resilience as "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks." This is clearly a relevant concept in the face of both the slow change of sea-level rise and potentially fast changes that come from coastal flooding.

Achieving resilience requires explicitly analyzing the SF Bay Area as a social-ecological system, which recognizes the linkages and feedbacks between social, ecological, and biophysical processes. Resilience also requires adaptive governance, where decision-makers must be able to adjust over time in the face of uncertainty and treat policy decisions as experiments that provide learning opportunities. In turn, adaptive governance requires a dynamic integration of scientific and local knowledge, shared management responsibility at multi-levels, building social capital in the form of trust-based policy networks, and leadership from key stakeholders. Adaptive governance emphasizes the co-production nature of scientific knowledge, where decision-makers and scientists develop relationships in the early stages of research in order to better connect science supply and demand. This is in contrast to the so-called "loading dock" model of science, which is a top down perspective where scientists develop their findings in relative isolation and attempt to launch new ideas at decision-makers. Many of the governance challenges in the SF Bay Area revolve around establishing these key ingredients for resiliency and adaptive capacity.

EVALUATIVE CRITERIA FOR ENVIRONMENTAL GOVERNANCE SOLUTIONS

Based on the above governance perspectives, we developed the following evaluative criteria in considering the governance challenges and overall solutions. As emphasized in one of the focus groups, it is important to think about linking form and function. In other words, the evaluation of any potential governance solutions must consider how the institutional arrangements enhance or become detrimental to the evaluative criteria.

Resiliency and Adaptive Capacity

The overarching criteria for governance solutions is to enhance the resilience and adaptive capacity of the SF Bay Area to prepare for and respond to sea-level rise and associated extreme events and flooding. In this context, this means minimizing the economic, social, and

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South Beach, San Francisco, January 22, 2012

environmental costs associated with coastal flooding, along with recovering the functionality of the SF Bay Area social-ecological system as quickly as possible. As emphasized by the resilience literature, this does not mean just recreating the SF Bay Area social-ecological systems exactly as they were before sea-level rise or an episode of flooding, but enabling a capacity for re-organization that preserves the flow of social, economic, and environmental benefits. It also means increasing the capacity of decision-makers at all geographic levels to respond to both real-time events such as a levee breach, and make decisions in the face of uncertainty where there are low probability events far in the future (e.g.; the 1-in-300 year storm that occurs 50 years from present after a slow but uncertain amount of sea-level rise). Resilience requires policy processes that ultimately lead to on-the-ground implementation of coastal infrastructure that reduces regional vulnerability.

Social Capital

Social capital consists of the norms of reciprocity, levels of trust, reputation, and networks of relationships that are the foundation of cooperation over time. Building social capital is difficult; it requires a lot of repeated communication and observed cooperation in terms of fulfilling policy commitments. Conversely, it is easy to destroy through non-cooperative behavior that erodes trust and reputation. For example, some SF Bay Area stakeholders noted that conflict over past decisions made it harder for some actors to contribute to the development of collaborative solutions in the context of the new problem of sea-level rise. Social capital is also built in terms of human relationships, and thus turnover in organizational roles can be challenging. Many of the collaborative venues currently underway in the SF Bay Area are in the business of building social capital.

Equity

The equity of governance solutions requires examining both procedural and distributive fairness. Procedurally fair solutions are inclusive and provide opportunities for all types of stakeholders to participate in decision-making, with the belief that their voices will be

heard and any final decisions will put some weight on their preferences (sometimes called external political efficacy). On the distributive dimension, governance solutions should avoid concentrating all the benefits or costs on a particular set of actors or geography. Governance solutions should strive to deliver benefits broadly across SF Bay Area stakeholders, and no single actors should bear all the costs. This is not to say that the costs and benefits of governance should be spread exactly evenly across all actors; for example there some actors with a greater capacity (e.g; government agencies) and others who may need additional benefits from risk mitigation (e.g; disadvantaged communities). Even the theoretical literature on equity does not agree on some single scheme for an "equitable" distribution, but stakeholders still need to pay attention to distributive fairness. There is an important link between procedural and distributive fairness because stakeholders who can effectively engage in the decision process are more likely to experience a distribution of benefits/costs that they can accept. Equity is an important concept in the context of environmental/climate justice, where disadvantaged communities face significant challenges for participation, representation and procedural fairness and thus often bear a disproportionate amount of environmental harms. For example, many of the disadvantaged communities are also disproportionately vulnerable to sea-level rise.

Economic Feasibility

Increased resilience to sea-level rise requires a strategic portfolio of grey and green infrastructure, investment in science/monitoring, and other administrative costs. As described later, these costs will easily be in the hundreds of millions of dollars range. There is no identified funding sources for paying all of these costs. Thus in the discussion of governance solutions, it is crucial to consider the most cost-effective pathways for achieving resilience.

Political Feasibility

Political feasibility means that enough political support exists from key actors who are required to establish new governance arrangements and provide funding and other political resources. Key political actors include local, state, and federal legislators, the governor, agency leaders, and leaders within non-governmental organizations and communities. Political feasibility also requires fairly widespread support among the general public, which sets and constrains the policy agenda for elected officials. Public support involves recognizing the seriousness of sea-level rise as a problem, supporting specific policy strategies such as Measure AA, and possibly taking individual-level action to protect businesses and households from coastal flooding. Without sufficient support from political leadership and the general public, many potential adaptation strategies will fail to materialize due to their economic costs and potential for reducing decision-making autonomy at the individual and organizational level.

THE GOVERNANCE CHALLENGES AND SOLUTION CONCEPTS

This section provides a more detailed description of the seven governance challenges and solution concepts. These challenges were identified directly from the stakeholders, and most of the solutions are also part of the overall policy dialog. In order to illustrate stakeholder perspectives, the description of each governance challenge is accompanied by a dialog box containing direct quotes from stakeholder interviews. Table 1 provides a quick summary, which can be thought of as a type of "restaurant menu" for choosing a set of solutions that might best solve the associated challenges. It is not necessarily the case that all solutions can be mixed and matched; for example, the type of planning that occurs may depend heavily on the types of institutions that are developed. However, we expect that many stakeholders may creatively combine these different solution concepts into their own preferred "meal". We also recognize that some readers may have different ideas that are not currently on the menu.

Importantly, we do not engage in the exercise of creating some type of quantitative evaluation or index system that rank orders the various solutions according to the evaluative criteria. The evaluative criteria are difficult to quantify, and stakeholders may have many different opinions. Nevertheless, on the basis of governance theory, our own experience from observing and participating in these types of governance challenges in different contexts, and the deliberations of the focus groups, we do offer some initial recommendations about which solution concepts may provide a way forward at least as the next steps for bridging the governance gap.

CHALLENGE 1: Developing Institutions for Multi-Level Cooperation

The SF Bay Area encompasses many agencies at different levels of government: federal, state, regional, county, city, and special district. Each of these government agencies has different geographic jurisdictions, regulatory authority, funding, and capacity. In addition, there are many different types of non-governmental stakeholders also involved in sea-level rise planning. However, there is currently not a single central agency or institutional arrangement with comprehensive responsibility for sea-level rise and climate adaptation planning. Instead, many agencies are creating their own forums and planning processes at different levels, creating the potential for fragmented decision-making and lack of coordination at the regional level. This is the classic problem described in network and collaborative governance literature, and the question is what types of institutional arrangements could be created in order to increase regional cooperation. The solutions range from shared governance, which is closest to the status quo, to a new agency with a broad range of authority to implement on-the-ground solutions and shape local development decisions both at the water's edge and in upstream watersheds. Almost all stakeholders suggested a strong need for more central coordination, but disagreed on exactly what types of institutional arrangements would be ideal. This creates a governance Catch-22, because while there is a desire for coordination and integrated planning, there is also simultaneously a distaste for creating a new agency or increasing the authority of an existing agency in ways that would limit local autonomy, encroach on the bureaucratic "turf' of existing agencies, or create additional administrative procedures. The solutions concepts outlined below are drawn mainly from the Kenis and Provan framework, but we also add the idea of a visioning process as an initial step towards identifying longer-term institutional arrangements.

STAKEHOLDER PERSPECTIVES: Institutions

"I think MTC does a very good job as a regional agency…I think they have the planning chops and the funding chops to do a variety of things including that sort of planning, especially if we're talking about infrastructure. BCDC's an interesting place for it to land too potentially…I just don't know if it's their bread and butter. So some blend of those two, probably."

"Within the last six months we're seeing more of a coalescing of an organized structure. No agency or group has been designated as taking the lead as sort of having full jurisdiction, which is probably okay, but we're seeing much more cooperation, we're seeing more of an understanding…"

"I think BCDC is really interesting because it has the right jurisdiction, it covers the Bay and all 9 counties, has the right geography…one option for the SF Bay Area is to give BCDC more authority and more tools to deal with climate adaptation."

"You could have a whole new agency that's in charge of this and give them everything. You could expand the jurisdiction both geographic and authority of an existing agency. I think you need authority or you could somehow all agree you all don't need authority and you could work together under this umbrella-like Plan Bay Area, but that's not working so well. We're already seeing that it's very challenging to do that without any teeth."

Solution Concepts

Sea-level Rise/Climate Adaptation Visioning Process *(Preferred Alternative)*

Many regions across the country have created high-level visioning processes as preludes to the development of more comprehensive plans and institutional arrangements for regional cooperation. The resulting visioning documents do not compel action by any actor or impose new authority. Rather, they establish a set of principles and goals, the information basis, and the policy networks needed to facilitate an initial set of coordinated actions. These principles and goals can be used as guideposts for planning and policy decisions of other actors, and perhaps provide a definition of "best available science" for evaluating the sufficiency of documents such as Environmental Impact Statements. They also provide an opportunity for elected officials and other political leaders to become visibly involved in the policy process. The visioning process allows stakeholders to deliberate about longer-term institutional solutions, including the possibility of legislative proposals.

The visioning process should be inclusive of multiple stakeholders and feature an appropriate subcommittee structure to specialize on critical issues. This allows stakeholders adequate opportunity to learn about the values and policy preferences of other actors. Subcommittees can develop more detailed components such as specific recommendations for new legislation, changes to existing policies, design principles for new construction that could be implemented region-wide, inventories of existing local projects and financing opportunities, or other specific issues.

Other examples of visioning processes have been created by either executive branch or legislative actions. For example, the Delta Vision Process and Blue Ribbon Task Force was created in 2006 by the Executive Order of Governor Arnold Schwarzenegger, and was instrumental in shaping the post-CALFED management of the California Delta and the establishment of the Delta Stewardship Council. In Florida, the Governor's Commission for a Sustainable South Florida, established by executive order, paved the way for the Comprehensive Everglades Restoration Plan, one of the largest ecosystem management programs in the United States (Harwell 1998). Before BCDC became a permanent agency with regulatory authority, it was first established as a temporary agency that would provide recommendations about future institutional arrangements (Smith and Pendleton 1998).

Legislatively-mandated commissions have played crucial roles in the development of western public lands and water policy. The Public Land Law Review Commission was established by the US Congress in 1964, and developed a series of reports and recommendations that ultimately coalesced into the Federal Land and Policy Management

Act of 1976 and the National Forest Management Act of 1976, which are the foundations of federal law for the Bureau of Land Management and US Forest Service. The Western Water Policy Review Advisory Commission was established by Congress to advise the President and Secretary of the Interior on western water policy, leading to the influential report "Water in the West: A Challenge for the Next Century."

Shared Governance

Policy practitioners often refer to the shared governance solution as the "stay in your own lane" approach, which remains close to the status quo and does not involve any new organizations, expansions of authority or planning processes. Rather, all individual actors make decisions according to their established organizational and planning routines, with voluntary integration of climate science and regional priorities. Regional coordination is achieved mainly by informal communication among policy stakeholders at the regional level, driven by boundary-spanning professionals capable of working across jurisdictional, geographic, ideological, and organizational boundaries.

Bay Conservation Development Commission as Lead Agency

Designates an existing regional agency as the lead agency in charge of sea-level rise planning and vulnerability analysis. To date, the BCDC has been the most active regional agency for sea-level rise planning, specifically through their Adapting-to-Rising Tides (ART) program and an ongoing series of regional workshops initiated 2016-17. On October 6, 2016, BCDC adopted a resolution to initiate an overall sea-level rise adaptation planning process, with the goal of creating a regional sea-level rise adaptation plan that knits together many of the local efforts undertaken by the ART program. Many stakeholders have a favorable view of the ART program, and nominated BCDC as the current best candidate for a lead agency. However, it was noted that BCDC is hampered by its limited geographic jurisdiction, potential conflict between regulatory and technical assistance functions, lack of permitting authority to regulate developments in upstream watersheds, and history of political conflict from past decisions. Other regional agencies or organizations that were also mentioned as possibilities include Association of Bay Area Governments (ABAG), San Francisco Bay Restoration Authority, and Bay Area Regional Collaborative (BARC). Hence, an important question going forward is whether the ongoing sea-level rise planning efforts of BCDC will produce a regional plan that provides the same coordination capacity as a broader visioning process.

New Climate Adaptation Agency

Create a new agency with extensive authority over sea-level rise adaptation issues, which could include development of a regional sea-level rise and climate adaptation plan, permitting authority for local land-use decisions at the water's edge and upstream watersheds, coordinating permitting for both gray and green coastal infrastructure, oversight over state agency decisions, and funding for coastal infrastructure. The most relevant model for this type of agency is the Delta Stewardship Council, which has responsibility for developing the Delta Plan and authority to review state agency decisions that fall within the definition of "covered actions" to be consistent with the plan.

Institutional Consolidation

Institutional fragmentation is a ubiquitous problem in the context of water management, and is especially severe for the case of single-purpose special districts like flood control and wastewater agencies. The infrastructure of many of these agencies is vulnerable to sea-level rise, but many

STAKEHOLDER PERSPECTIVES: Planning

"There are no voices for the SF Bay Area. And that's one of our challenges…is to bring all of the land managers in the SF Bay Area, the different jurisdictions over vulnerable lands in the SF Bay Area, together to co-plan and to plan together. And that's because there really is that kind of gap. Question is who's going to fill that gap and how's it going to get filled."

"Encouraging each of the nine counties to actually have an adaptation plan may be more valuable, and then kind of shuffling those together into the larger plan because some of this is really locally specific, and there's a regional lens for it, and I can appreciate that, but it can be pretty granular, you know, if you're talking about, 'Oh, well that street's going to flood but maybe not that one.' But I think an adaptation plan needs to be more than just infrastructure."

"You need the basic information to build a regional plan, but there's no amount of assessing that's going to build you a regional plan because the kind of planning we do is so scalar, right. So this idea of a regional assessment is never going to be satisfying to anybody, because it's going to be regional. And then even the county assessments sometimes aren't as specific as they need to be, because some of that planning needs to be local. But every step of the assessing, whether it's local, regional, state, or federal, plays a role. But it's that idea of the scale on which you're assessing is that scale on which you find information. Somehow we all forget that."

of them are very small with limited financial and technical capacity to upgrade infrastructure. The sheer number of districts makes it challenging to coordinate effort. For example, the Bay Area Flood Protection Agencies Association (BAFPAA) represents the flood management agencies in each county of the SF Bay Area, the Bay Area Stormwater Management Agencies Association (BASMAA) coordinates the nine municipal stormwater programs at the county level, and Bay Area Clean Water Agencies (BACWA)represents 65 special district or municipal wastewater treatment agencies in the Bay. In some cases, such as Sonoma County Water Agency, entities consolidate these public service functions under a single organizational structure, which facilitates integrated management. A number of stakeholders expressed frustration and confusion about the diversity of agencies in the SF Bay Area, and recommended institutional consolidation of some type. This could include forming multi-purpose county water agencies, Joint Powers Authorities, Memorandums of Understanding, or other mechanisms. A more unconventional suggestion for institutional consolidation was merging the advisory boards of all the regional environmental agencies into a single entity.

CHALLENGE 2: Regional Adaptation Planning for Sea-Level Rise

There is no single plan for climate adaptation and sea level rise in the SF Bay Area, although many regional plans do exist at the individual agency or multi-agency level. How sea-level rise planning will occur depends heavily on the types of institutional arrangements that are created to manage the multi-level cooperation problem. For example, if the "new agency" or "lead agency" model is chosen, then it would likely produce a single climate adaptation or sea-level rise plan while a "Visioning Process" would produce a more limited document with goals and principles along with any other relevant scientific or policy reviews.

Solution Concepts

"Sea the Future" Visioning Plan *(Preferred Alternative)*

A sea-level rise visioning process would establish the information basis for sea-level rise adaptation planning, as well as a set of goals and principles for achieving resiliency. The visioning plan would include a scenario-based vulnerability analysis, addressing multiple possible levels of sea-level rise, any new science regarding threshold effects from rapid ice melt, and different combinations of high tides and coastal flooding from extreme storms. The visioning plan should include an analysis of different adaptation options including an inventory of possible green and gray infrastructure development and analysis of how different coastal adaptation options provide regional and local benefits/costs. The regional analyses in the visioning plan should become the standard for guiding the development and update of other regional and local plans. This could provide a basis for

permitting decisions or defining what types of projects should be considered by an integrated permitting team, or identifying the sets of projects that may be prioritized for funding. It should also review existing laws and policies, and make any relevant recommendations for new legislation, changes in permit requirements, or administrative activities.

Update Existing Regional Plans and Local Plans

The SF Bay Area institutional ecosystem already contains a number of regional plans, which either guide the decisions of specific agencies or have been created in an attempt to pursue ecosystem management or integrated water management at the regional level. Some of these plans have started to incorporate climate change mitigation and adaptation. For example, the San Francisco Regional Water Quality Control Board is in the early stages of deciding how to integrate sea-level rise into the basin plan for San Francisco Bay. This process will be accelerated by executive orders from the California Governor or resolutions from state-level agencies like the State Water Resources Control Board. The "shared governance" model would emphasize allowing parallel planning efforts to unfold without any additional centralized planning. The "Visioning Process" model would provide principles, guidelines and information to help coordinate these regional planning efforts. A "lead agency" or "new" agency model might create a single climate adaptation plan, but would still also require action from individual regional agencies with oversight from climate adaption plan. Regional agencies that would need to update their plans include the MTC/ABAG Plan Bay Area 2040 (jointly fulfills requirements of regional transportation plan and Sustainable Communities Strategy under S.B. 375), the BCDC Bay Plan, and the Regional Water Quality Control Board's Basin Plan for SF Bay. Collaborative plans that would need further integration of sea-level rise include the Integrated Regional Water Management Plan, the Comprehensive Conservation Management Plan of the San Francisco Estuary Partnership, and the SF Bay Joint Venture.

At the local level, existing General Plans and Local Hazard Mitigation Plans would need to be updated to align with the principles and goals of the visioning process. SB 379 has started this process by requiring local general plans to include sea level rise and other climate impacts as they are updated over the next few years.

Comprehensive Regional Climate Adaptation Plan

A single comprehensive climate adaptation plan could be created by an existing lead agency or new climate change adaptation agency. Beyond identifying the organization that would be responsible for leading the comprehensive adaptation planning process, key questions include the level of detail needed to direct on-the-ground infrastructure investments, desired land-use goals, development criteria, and other specific implementation projects. In addition, the climate adaptation plan must be able to secure cooperation from relevant agencies. Cooperation incentives could include regulatory "sticks" such as permit requirements for particular types of land-uses, or "carrots" that channel funding to projects that demonstrate a benefit to resilience. For example, IWRM planning and implementation grants from the Department of Water Resources provide funding incentives for water management actors to work together at the regional level. Funding incentives are usually more politically feasible than creating new regulatory authority. A comprehensive plan would cover sea-level rise and coastal flooding, but might also consider other climate change issues such as water supply, water quality, and temperature. A comprehensive planning process would involve a collaborative approach with extensive stakeholder input and appropriate subcommittee structures. The visioning process could be a prologue to the development of a more formal climate adaptation plan. As with the visioning process, a formal climate adaptation plan could guide decision making for permitting, funding, and other climate adaptation decisions.

Regional Sea-Level Rise Adaptation Plan

A regional sea-level rise adaptation plan would be a narrower version of a comprehensive plan, focusing specifically on the issue of sea-level rise and coastal flooding. The planning process would need to consider all the same components described above for a comprehensive plan, but with a narrower issue scope. Many stakeholders expressed the idea that sea-level rise should be considered as a separate issue, in order to simplify the number of stakeholders and decisions and make near-term progress on the bigger picture of climate adaptation. This argument recognizes the fact that sea-level rise is probably the highest priority issue in the SF Bay Area. However, from a scientific standpoint these climate adaptation issues are linked via global and local biophysical processes. For both the broad climate adaptation plan and the narrower sea-level rise adaptation plan, a key question is whether the existing planning efforts of regional agencies like BCDC are sufficient, versus creating a broader regional visioning process.

CHALLENGE 3: Funding Portfolio

Fully implementing all of the needed gray and green infrastructure will require a very substantial investment, and there is currently a major shortage of identified funding sources. The exact overall price tag is unknown; nobody has done a systematic analysis of all expected costs, and like most large infrastructure investments any current cost estimates are likely to experience inflation when actually implemented. However, there are some indicative numbers. The "Greening the Bay" report (Save the Bay, 2007) estimated that reaching the goal of 100,000 acres of restored wetlands would cost $1.43 billion, and the recently passed Measure AA is expected to contribute $500 million (approximately 1/3 of costs) to that goal. Another prominent example is San Francisco's sea-wall resiliency project, which is expected to cost up to $500 million for the first phase and $5 billion for all needed infrastructure improvements. These basic numbers are only illustrative of the huge price tag for sea-level rise adaptation; for example, we do not include the costs of upgrading and maintaining major transportation infrastructure. The solution concepts described below consider a number of separate funding sources, but all stakeholders agreed that a "funding portfolio" including federal, state, local, and private sources will be needed to achieve all of the goals.

Liscom Slough, Arcata, December 31, 2013

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Solution Concepts

Local Sources *(Preferred Alternative)*

Local governments and special districts can implement a variety of funding mechanisms to provide a revenue stream for coastal infrastructure development. A recent and very important example is Measure AA in 2016, which was a regional, 9-county parcel tax of $12 per year to fund wetlands restoration. Stakeholders viewed the passage of Measure AA as major victory that signaled the willingness of SF Bay Area citizens to invest in environmental public goods. However, Measure AA provides only approximately one-third of the funding needed just for the wetlands restoration, and, by design, does not consider gray or hard infrastructure. Additional parcel taxes are one possible funding mechanism for the future.

Other funding mechanisms include creating special tax assessment and other districts (this UCLA report provides a good overview), development impact-fees for development in flood risk zones, local sales tax measures, and increases in fees for water or other services. Many stakeholders suggest that special tolls on bridges or public transportation could be an important source of funding for coastal infrastructure development that would protect the transportation networks. It is important to note that many of these local revenue options will be subject to voter approval under Proposition 218, which highlights the importance of the civic engagement challenge discussed later.

California State Sources

California has traditionally been a national leader on climate mitigation and adaptation policy, and has provided a diverse set of funding opportunities. California normally funds it water infrastructure programs through stand bond acts like Proposition 84 (Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006; $5.39 billion), Proposition 1E (Disaster Preparedness and Flood Protection Bond Act of 2006; $4.09 billion), and Proposition 1 (Water Quality, Supply, and Infrastructure Improvement Act of 2014; $7.54 billion). The California Natural Resources Agency provides a very transparent and useful "Bond Accountability" website to track spending on these propositions. Although the SF Bay Area has received funding through these propositions, the monies are distributed statewide and Propositions 84 and 1E are nearly spent down. The flood control allocation in Proposition 1 remains unallocated, but in response to the record precipitation and flooding of Winter 2017, Governor Brown announced the intention to spend $437 million on flood control infrastructure ($387 million from Proposition 1, $50 million from general fund). Given the statewide distribution of funding, it is clear that currently identified state money is not enough to pay the full costs of even the wetlands restoration goals, let alone the costs of hard infrastructure upgrades. The recently passed Senate Bill 1 also includes funding for adaptation planning.

STAKEHOLDER PERSPECTIVES: Funding

"And unfortunately it's going to be very expensive, and these are small counties with small populations, and a lot of our funding comes out by population or road miles, and compared to big counties like Alameda, Santa Clara, or San Francisco, San Mateo, we don't get a huge amount of money; so for four little counties to come up with funds to rebuild a Highway 37 is going to be tough."

"The interesting thing is can you take transportation money and spend it on flood mitigation as a project. I think you can build a Highway 37 and scope the project to address sea level rise, but MTC is already struggling with how to take transportation money and build housing. They're toying with how to do that. Now the question's going to be how do we take transportation money, which again comes through these very well established policy and authority funnels, and do sea level rise adaptation?"

"No there won't be enough money, I mean that's clear, we're trying through other avenues, we're actually, just on the dredging side, we're trying to get dredging funding put into the state budget, and we're also trying to get I would say, claw back money from Washington."

"Federal money, local money, and private money, all of it. My guess is that will also be true for the Restoration Authority, that for every dollar of locally generated money they put out, they'll probably be able to attract another buck fifty or two bucks of state and federal and other kinds of local and private money."

Federal and state transportation funding also pass through the designated regional transportation agencies like the Metropolitan Transportation Commission, which must develop a regional transportation plan to prioritize projects. However, sea-level rise and adaptation issues are only beginning to be considered as a regular part of regional transportation planning, for example the CALTRANS "Guidance on Incorporating Sea Level Rise" issued in 2011. There are many basic maintenance needs that receive short-term priority over infrastructure investments that may have longer-term benefits for resilience against sea-level rise and flooding. Furthermore, there are some policy constraints on funding projects that may benefit transportation, such as coastal wetlands, but do not have a direct physical nexus with transportation infrastructure (e.g.; elevating a roadway). The recently passed Senate Bill 1 also includes funding for climate adaptation planning in the context of transportation. While transportation planning and funding may incrementally start to consider sea-level rise, state funding for adaptation projects will be limited in the short-term.

Federal Sources

Many stakeholders expressed a desire for an ear-marked federal program similar to the Chesapeake Bay Program or Great Lakes Restoration Fund, both of which received explicit statutory authority under the Clean Water Act. The Comprehensive Everglades Restoration Plan receives its primary funding through the Water Resources and Development Act, which supports the Army Corps of Engineers. Part of the funding for the Chesapeake Bay Program is specifically authorized by Section 117 of the Clean Water Act. However, the recent election of President Trump has ushered in a new policy agenda that has already proposed reduced funding for federal environmental programs. Furthermore, many stakeholders feel that California faces an uphill political battle for environmental funding in the US Congress, due to political factors such as San Francisco Bay being represented by only two Senators and a handful of members in the House of Representatives, while Chesapeake Bay and other large watersheds span multiple states. In addition, California is one of the largest economies in the world and is actually a donor state to the US treasury, which is a challenge to political bargaining especially in the SF Bay Area where average per capita income is high relative to many other areas of the United States. The struggle for Federal funding is evidenced by recent high-profile political clashes over the Water Resources and Development Act of 2016. Hence, the current likelihood is low for sustained federal funding for sea-level rise and climate adaptation.

Public-Private Partnerships

Private corporations and foundations have made limited investments (more by foundations than businesses) in local adaptation planning to this point, despite the SF Bay Area being home to some of the most profitable technology and financial businesses in the world. Some of these companies have facilities that are directly threatened by sea-level rise and flooding, and any regional disruption in transportation would impose significant economic costs due to travel interruptions for employees. Some stakeholders expressed the opinion that private corporations view infrastructure as the "government's job", although it is obvious that especially in the case of local governments their budgets are severely constrained relative to profitable private companies. Public-private partnerships that were capable of identifying and funding infrastructure developments with regional benefits could be a valuable strategy. Foundations will probably continue to invest in sea-level rise issues.

One possibility is to form a multi-stakeholder network (public, private, NGO and academic institutions) to work together in engaging private corporate and foundation funding sources.

Such a joint fundraising effort, perhaps formally recognized under the umbrella of some type of project or organization, could be more effective than many individual agencies, organizations or researchers independently pursuing private funding.

CHALLENGE 4: Integrated Permitting for Adaptation Infrastructure

Implementing on-the-ground adaptation projects in the form of green or gray infrastructure requires obtaining permits from multiple levels of government. As discussed earlier in the definition of "policy interdependence", permits for different projects might include local government, the Bay Conservation and Development Commission, the Army Corps of Engineers, the Regional Water Quality Control Board, the California Department of Fish and Wildlife, the US Fish and Wildlife Service, and the National Marine Fisheries Service. Many projects will also require a full EIS/EIR under CEQA/NEPA. At best, these fragmented permitting and administrative procedures require understanding many different legal and procedural requirements and taking the time and effort needed to navigate the administrative processes. At worst, the different agencies may come to conflicting conclusions about the permissibility or requirements of a particular project or even prevent the implementation of a beneficial project.

Some form of "integrated permitting" is the usual solution to this type of problem in the applied public policy and public administration literature (Rabe 1995). The basic idea of integrated permitting is to consolidate the process for obtaining multiple permits into a single application. Creating an integrated permitting process requires substantial communication and usually the creation of some type of governance arrangement, such as a Memorandum of Understanding, among the relevant agencies. Setting up an integrated permitting process should also involve substantial stakeholder and permittee input in order to target the high priority problems associated with the status quo fragmented process.

The SF Bay Region already has a well-known example of integrated permitting in the San Francisco Bay Long Term Management Strategy (LTMS) for Dredging, which is implemented by the Dredged Materials Management Office(DMMO). Established by an MOU, the DMMO provides applicants a single application form for acquiring a consolidated permit for the disposal of dredged materials. The LTMS is accompanied by a programmatic Biological Opinion under the Endangered Species Act, in order to speed up the permits for endangered and threatened species. The DMMO has a standing multi-agency team that continuously reviews projects. Individual leaders of other projects have taken steps towards this type of model. For example, the project director for the South Bay Salt Pond Restoration projects organizes at least annual meetings to facilitate communication among all the involved permitting agencies. Such

STAKEHOLDER PERSPECTIVES: Permitting

"Yes, most permits now tend to occur on a site specific and sequential basis. And the dialogue that has to occur among all the stakeholders, the environmentalists, the regulators…is there a way…to increase the geographic scope, the collaborative approval, and accelerated approval of larger scale resource protection strategies?"

"So what are the constraints otherwise to getting this done and the answer a lot of times comes back to the slow expensive and burdensome regulatory process. So there are several people independently kind of circling around how do we deal with maybe some sort of expedited permits or restoration projects. Because right now, I mean, we basically, we get treated the same as someone putting up a Wal-Mart. We got to jump through the same hoops and it takes years and hundreds and hundreds of thousands of dollars to get permits."

"Well, you can't not hear that the disjointed permitting and regulatory framework for shoreline projects, flood control projects, anything about water, is really a huge challenge. The time it takes to get a permit to do any kind of maintenance is problematic. So those are real, those barriers are real and they make people avoid trying to improve and maintain infrastructure. It's far easier to just have deferred maintenance than to go through a gnarly process of getting permitting and funding to do some sort of maintenance project."

communication is a necessary precursor to the development of more formal arrangements like the LTMS. The Habitat Restoration and Enhancement Act of 2014 provides another model of expedited permitting, focused on small-scale habitat restoration projects on private land.

Integrated permitting can be considered from a purely procedural perspective, where agencies coordinate their decision-making without changing the overarching permitting requirements anchored in administrative rules or legislation. However, in some cases there may be a need to change the permitting requirements to deal with the dynamic and uncertain future of climate change and sea-level rise. For example, there are already documented cases in the SF Bay Area where marsh restoration projects that could potentially provide future biodiversity benefits were constrained to protect species habitat in the short-term. Of course it is possible that the portfolio of wetlands restoration projects across the bay could disrupt enough habitat in the short-term to create a population bottle-neck for a particular species. However, if all of the existing habitats will be inundated in 50-100 years, action is needed now to create future habitats. Such temporal conflicts need to be identified, and linked to possible solutions that are available within existing law or policy, or recommend how laws and policies need to be updated for a dynamic future.

Solution Concepts

Integrated Permitting Team for Coastal Adaptation Infrastructure *(Preferred Alternative)*

Regional permitting agencies could create a new integrated permitting strategy and associated implementation team, using the same model as the LTMS. The scope of the adaptation infrastructure team would need to be clarified—should it apply to only green infrastructure or also include gray infrastructure? Should it apply exclusively to adaptation infrastructure for sea-level rise, or also for other types of climate adaptations? Finding a permanent source of funding to pay for involved staff will be a necessary goal. Region 9 of the Environmental Protection Agency has already started some dialog about establishing a new integrated permitting process. The integrated permitting team at the very least should have procedural benefits by reducing the time, financial costs, and conflicting nature of permitting processes. The integrated permitting team should also be able to identify any needed changes in policies or laws that may enable more adaptive decision-making in the face of uncertain future climate conditions.

Expand Scope of LTMS to address Coastal Adaptation Infrastructure

The LTMS has an established governance structure and set of relationships that could be expanded to encompass climate adaptation projects in addition to the disposal of dredged materials. The LTMS is already oriented towards "beneficial re-use" of dredged materials, hence there are likely to be complementarities between dredging permits and wetlands restoration projects that require clean fill material. However, many stakeholders suggested that expanding the scope of the LTMS risks damaging what is currently a functioning institutional arrangement.

Informal Communication Networks

Projects like the South Bay Salt Pond Restoration Project have addressed the integrated permitting challenge by establishing an informal network of communication among permitting agencies and permittees. Foster City has done something similar for their initial sea level rise work. Creating a regular meeting schedule for permitting agencies could be accomplished by a regional agency like BCDC or the Bay Restoration Authority. This would be a minimum requirement for improving the coordination around permits, and possibly a

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precursor to a more formal institutional arrangement. The informal communication network could also provide advice on funding priorities, for example around projects proposed for Measure AA monies.

Regional Advance Mitigation Plan for Climate Adaptation Projects

Most infrastructure projects require at least identifying mitigation options and CEQA requires mitigation to be implemented. California has recently developed statewide guidance and a Central Sacramento Valley pilot project on the idea of regional advance mitigation planning (RAMP). The basic idea of RAMP is to identify in advance the impacts of infrastructure projects and opportunity zones for mitigation. The opportunity zones link to broader conservation goals and programs, and form a regional strategy instead of piecemeal, uncoordinated mitigation that often occurs when projects are considered independently. A RAMP approach could be developed for dredging so that beneficial re-use for restoration is planned in a coordinated manner, or for wetlands restoration under Measure AA or the Baylands Goal report. A RAMP approach could also be complemented by a regional wetlands monitoring program in order to understand the landscape or ecosystem-scale implications of mitigation and permitting decisions. Stakeholders like SFEI are already engaged in discussion about linking monitoring, permitting, and mitigation at the scale of the entire SF Bay.

Habitat Conservation Plan/Natural Communities Conservation Plan

Protecting federal and state-listed threatened and endangered species is often a challenge for adaptation infrastructure that may disrupt coastal habitats in which these species are located. Endangered species law has strict prohibitions against "take" and infrastructure projects that require a permit from a federal agency will also need a biological opinion under Section 7 of the Endangered Species Act. Even if the project proposes to increase habitat in the long-run by restoring wetlands, it may be delayed or blocked if it possibly takes individuals of a listed species or degrades critical habitat in the short-run. Habitat Conservation Plans (federal ESA) and Natural Communities Conservation Plans (state ESA) provide a mechanism for acquiring incidental take permits (usually for development projects) in return for coordinated mitigation

to achieve regional conservation goals. HCP/NCCP plans are often integrated together, and California has been a pioneer in this approach to endangered species management. An HCP/NCCP plan could be developed for wetlands restoration or a broader set of climate adaptation infrastructure projects across the SF Bay region.

Expand BCDC's Permitting Authority

The current permitting authority of the BCDC has a limited geographic scope, which could be expanded to cover the upstream watersheds and provide stronger oversight of local government decisions. This is the model used by the California Coastal Commission, which certifies the Local Coastal Programs submitted by local governments. The Local Coastal Programs ensure the zoning ordinance and other development guidelines of local governments are consistent with the Coastal Zone Management Act. This mechanism integrates individual coastal development permitting decisions with broader statewide goals for the coastal zone.

However, expanding the scope of permitting authority for BCDC or any regional agency has been a significant source of conflict in the past, especially when it might constrain the autonomy of local land-use decisions. It is unlikely that BCDC's permitting authority could be expanded without amending their legislative authority; the legal principles of the Coastal Zone Management cannot simply be appropriated via administrative decision-making. In addition, some stakeholders suggested that any additional permitting authority, which usually increases procedural requirements, could actually work at cross-purposes for the efficient implementation of climate adaptation projects.

CHALLENGE 5: The Climate Science Enterprise

One of the most important issues in climate change adaptation is having accurate information about expected levels of climate change, and how those changes will manifest at the local level. In environmental policy, this issue often falls under the heading of having access to the "best available science." In the context of sea-level rise and climate change, the concept of "best available science" is complicated by uncertainty about how future emissions pathways will translate into global and regional climate changes and different amounts of sea-level rise. There is also the additional issue of "downscaling" global changes to understand specific local impacts. Modeling sea-level rise has some advantages in that given a certain amount of sea-level rise, the existing models have fairly fine-scale spatial resolution about where inundation and flooding is expected to occur based on existing topography, built environment, and location of critical infrastructure. However, sea-level rise science continues to quickly advance and California is in the midst of updating its statewide guidance in light of the most recent research.

Establishing an effective "climate science enterprise" at a minimum requires identifying the current best available science (e.g.; how much sea-level rise can we expect?), providing data access, and establishing a cadre of "translational" experts who can help local policy-makers integrate this science into decisions. The most frequently cited scientific resources by SF Bay Area stakeholders are the National Research Council's 2012 report "Sea-Level Rise for the Coasts of California, Oregon, and Washington" and the "State of California Sea-Level Rise Guidance Document"(2013) developed by the Coastal and Ocean Working Group of the California Climate Action Team with input from the California Ocean Science Trust. The California documents directly rely on the NRC 2012 report. However, these scientific guidance documents are currently being updated to reflect ongoing changes in basic research on sea-level rise, for example the possibility of threshold effects due to fast melting of Antarctic and

Greenland ice sheets. A number of modelling results have also been developed into websites that allow citizens and decision-makers to interactively visualize sea-level rise predictions. The Our Coast, Our Future platform, based on the USGS Coastal Storm Modeling System (CoSMoS) is a frequently cited example.

However, none of this information is consolidated in one single scientific clearinghouse, and more importantly, even if the science exists many stakeholders lack the technical, financial, or time capacity to effectively access the information and incorporate it into decision-making. During the interviews and focus groups, an oft-heard refrain was the undesirability of "yet another data portal." Instead, decision-makers really value direct interaction with translation experts who can help them integrate the science directly into local planning documents and other decisions. Ideally, these linkages between science and policy are built via co-production, where stakeholder needs and capacity are involved at an early stage.

Solution Concepts

Climate Science Services Center *(Preferred Alternative)*

A Climate Sciences Services Center would build on the infrastructure of a data clearing house and provide boundary-spanning and translational experts to directly interact with stakeholders. These experts would assist stakeholders in identifying, translating, and analyzing relevant scientific data and information for appropriate integration into planning and decision-making. The center would work with stakeholders on an on-going basis to identify research gaps and studies to address those gaps. The translational experts would need a strong interdisciplinary training in the relevant biophysical sciences, as well as science communication and policy. The center would seek to minimize duplication in the production of basic science around climate models and data, which are currently developed by a range of NGO, government agency, and university-based researchers. Rather, the center would seek to integrate and coordinate these existing basic research efforts and connect with decision-makers. These goals are consistent with the adaptive management perspective, which emphasizes the value of co-production and linking science supply and demand. A Climate Sciences Services Center could be housed at a relevant non-governmental organization like San Francisco Estuary Institute, a university organization such as the Climate Readiness Institute in Berkeley, or a consortium of organizations. A Climate Science Services Center would also need a dedicated revenue stream in order to support the translational science staff. State legislation could play

STAKEHOLDER PERSPECTIVES: Climate Science

"People don't need products and tools and data. They do, but that's not all they need. They need a collaborative approach—they need a sustained collaborative approach, which means scientists and boundary organization professionals who understand and care about the needs of decision makers, engage with those decision makers over time, in an iterative fashion, to go internalize what our needs are, and then customize products and processes that will help us meet our needs."

"One of the things that everyone recognizes…would be a tremendous asset, would be a central repository of information. The question has been who should take that on. There is a need to centralize this. I think we've benefitted… for a certain amount of time from a more diffuse approach, and now there's a sense that we know enough…now we'd all benefit by a more efficient centralized resource. So that we're all tapping into and feeding into the same pot."

"Yeah, I think our ideal would be that there would be sort of a lead science. It's something that, it needs to be able to be done in a way that it builds the credibility and also be accessible…moving forward to say what is it the flood control agencies could agree to use versus having competing data sets or dueling science or that sort of thing."

"I think there's a lot of buy-in on the idea that there is this role, what we call a data ambassador or a liaison, and it really is just as much about taking the science to the people, rather than taking the people to the science, understanding that the science that we're doing is not necessarily the most relevant to the actual tools that the people have at hand."

a role in establishing a Climate Science Services Center. The Ocean Science Trust provides a possible model, and was established by the California Ocean Resources Stewardship Act of 2000 as an independent non-profit organization and receives funding from private foundations and the state of California.

Data Clearinghouse

A data clearinghouse could be established as a repository for all climate and other environmental data, and model results relevant for sea-level rise and other climate adaptation issues. The data clearinghouse would need standardized meta-data information, data management, and data curation to enable scientists to integrate multiple databases for additional analysis. Funded climate adaptation projects could require data sharing in order to build the database over time. Public-facing data access and visualization portals would need to be created to integrate multiple data layers for use in planning and regulatory processes. Links to the "best available science" regarding climate change and sea-level rise would need to be included, so all stakeholders have a clear idea where to find the latest relevant scientific information. There are some similar examples already underway in the SF Bay Area, such as "Our Coast, Our Future" and the EcoAtlas maintained by San Francisco Estuary Institute. Cal-Adapt is California state's data portal for adaptation issues. However, as mentioned earlier, many stakeholders expressed frustration about the proliferation and lack of integration among data portals, along with the lack of capacity to effectively use the information.

Regional Independent Scientific Review Board

This solution would establish a regional scientific review board based in the SF Bay Area to review all pertinent research and establish standards for best available science on climate change and sea-level rise vulnerabilities and adaptation efforts. The Independent Science Board would focus specifically on the San Francisco Bay region. The Delta Independent Science Board provides a possible model. The Delta ISB was established by the Delta Reform Act of 2009, and the members are appointed by the Delta Stewardship Council. In the case of SF Bay, the organizations authorized to appoint an independent science board would depend on the structure of institutional arrangements and planning that emerges in response to previously identified governance challenges.

External National Research Council Committee on Scientific Review of Climate Adaptation in the San Francisco Bay Area

National Research Council reports provide an authoritative and independent scientific perspective, which is often sought by stakeholders in order to resolve key science-policy disputes that are stalling cooperation. These reports have been used in the past in the context of California environmental policy, for example an analysis of the effect of different hydrological regimes on the viability of fish populations in the Sacramento-San Joaquin Delta and the aforementioned NRC report on expected levels of sea-level rise on the West Coast. Another important example is the Committee on Independent Scientific Review of Everglades Restoration Progress, which was established in 2004 (building on a previous committee that started in 1999) to review the progress of the Comprehensive Everglades Restoration Plan. The Committee was mandated by the Water Resources Development Act of 2000, and is funded by the Army Corps of Engineers under that legislative authority. The Everglades committee produces biennial reviews of the relevant science and specific recommendations for restoration planning and implementation. For example, the 2014 report contains a chapter on the implications of sea-level rise for Everglades restoration, which concluded that climate change and sea-level rise were not adequately

considered in Everglades planning based on historical hydrology. The membership of the committee is interdisciplinary and includes a mix of people familiar with the local context and external scientists with more general knowledge and experience.

CHALLENGE 6: Civic Engagement

Public awareness and civic engagement around sea-level rise are foundations for adaptation in a democratic country where elected and administrative officials are responsive to public opinion, and there are many forums for public participation. Lack of engagement reduces political support for proposed solutions and creates resistance to any policies that may impose costs on individual citizens. When people are aware of sea-level rise risk, they are more likely to take individual action to increase community or household resilience. In the case of short-term responses to extreme events and flooding, social networks are one of the most important resources for helping people survive and recover from local flooding (Aldrich 2012; Aldrich and Meyer 2015). Discussion of sea-level rise within social networks is an important indicator of the extent to which it has become a high priority social issue.

The challenge of civic engagement is especially difficult for disadvantaged communities. Due to the history of industrial and economic development in the SF Bay area, many disadvantaged communities are in low-lying areas and more vulnerable to sea-level rise and flooding. These communities face many other short-term challenges such as lack of job opportunities, high housing costs, and crime, which displace concerns over long-term risks. The networks of social and environmental justice organizations and activists have limited capacity to engage in the many different policy forums addressing sea-level rise along with other issues. In the case of adaptive capacity and flood recovery, disadvantaged communities often lack the resources to effectively rebuild, participate in emergency response programs, or move to safer locations. Hence, the procedural and distributive fairness of any civic engagement program requires increasing the capacity of disadvantaged communities to effectively participate.

However, sea-level rise is difficult from the perspective of civic engagement because it is a "slow-moving natural disaster" that is hard to observe and features long-term risks that require short-term mitigation costs. From a behavioral decision-making perspective, human beings have a difficult time responding to any decision that features long-term benefits and short-term costs. Hence, many stakeholders expressed the opinion that there is a lack of awareness and engagement among the general public, although there was also acknowledgement of a more recent increase in awareness as exemplified by the strong public support for Measure AA.

The idea of "psychological distance" is useful concept for analyzing sea-level rise and other climate risks. People are more likely to act on the basis of concepts that are psychologically "closer" to them, and

STAKEHOLDER PERSPECTIVES: Civic Engagement

"There's a lot of understanding, wisdom, knowledge, that comes out of communities because people are dealing with the issues of environmental change and environmental impact on a daily basis. They see the conditions that often others are just talking about…People see what's happening in their creek sheds, they see what's happening on their shoreline, they see what's happening in their neighborhoods."

"So the challenge was…how can we assure the public, listen, we care, we know about this issue, there is a risk, we don't know the exact amount of risk, the sooner we start, the sooner we can work on it, and the better off you are, the cheaper it will cost the city, the less impact on the long run…assure them that this city is…concerned about resiliency…not only in San Francisco, but throughout the whole region because this is not an issue that affects San Francisco only."

"That's what starts to resonate with people, when they see that climate adaptation means money in my pocket, or protecting my nest egg, my investment. Or ensuring that my job isn't in jeopardy because the shipping industry is offline for a bit because of a storm, or whatever sea level rise impacts have recently occurred. And I think the more we can start to frame it in that realm, the better."

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Jack London Square, Oakland, January 12, 2017

sea-level rise is a more psychologically distant concept (Liberman and Trope 2008; Spence, Poortinga, and Pidgeon 2012). Reducing psychological distance requires communicating about a concept in a way that makes it more geographically proximate (e.g.; flooding happening in your neighborhood), closer in time (is already happening and may happen next year too), more likely to affect people like the individual (will affect your commute to work, not just low-lying neighborhoods), and with less uncertainty (all scientific models suggest sea-levels will rise to some extent over the next 100 years). Any civic engagement or communications strategy can capitalize on the idea of psychological distance to help increase awareness and action around sea-level rise.

Solution Concepts

Integrated Civic Engagement Portfolio *(Preferred Alternative)*

The solution concepts included here offer a number of specific strategies for civic engagement. However, as with the funding portfolio challenge, most stakeholders expressed a desire to use "all of it". A diverse and integrated portfolio of civic engagement strategies provides the capacity to reach many different audiences via different mediums. One approach is to hire a communications consulting firm to develop an integrated strategy, in partnership with key agencies and stakeholder organizations including disadvantaged communities. Another option is to devote a team of public outreach staff from regional agencies to collaboratively develop a program that is implemented at the regional and local level. The civic engagement strategy would include a traditional and social media messaging and information campaign, in combination with the various approaches listed next. The integrated civic engagement portfolio should receive input from a collaborative group of stakeholders, to insure key actors are aware of the existing efforts and minimize the number of duplicative or conflicting public outreach efforts.

Community-Based Adaptation Meetings

Community-based adaptation meetings are local events where citizens are given information about sea-level rise vulnerability, adaptation options, and opportunities for civic engagement. The materials developed for community-based adaptation meetings should be accessible to a general

audience not too technical. A key aspect of this strategy is that the outreach professionals travel to the local community, and conduct the event in a space that is familiar to community members. This is more effective than expecting community members to travel to some agency office or conference room, and demonstrates a willingness to take leadership and respect the capacity constraints facing local citizens. Some agencies and stakeholder agencies have already been conducting these types of meetings. The C-SMART project in Marin County is one example.

Partner with Civic Organizations

Already operating in the SF Bay Area are variety of civic organizations with missions consistent with sea-level rise adaptation and built-in constituencies and networks. These include highly visible cultural institutions like the Exploratorium and the California Academy of Sciences. Non-governmental organizations including environmental groups, social justice/disadvantaged community groups, and business organizations are also effective partners who often hold regular meetings. Environmental and climate justice groups such as the Resilient Communities Initiative, Environmental Justice Coalition for Water, and Shore Up Marin are natural entry points and partners due to their efforts to form broad networks of community leaders throughout California and experience communicating with diverse constituencies. Facilities with heavy levels of public access can also be good locations for providing visualizations or other materials, for example airports, BART and Amtrak stations/cars. For example, the film "Chasing Ice", which visualizes glacier retreat, has developed a display for the Denver International Airport on screens located at the airport terminal transfer stations. Schools and universities are also excellent partners in these types of efforts, because part of their mission includes science education for future generations of policymakers.

Citizen Science and In-Situ Visualizations

Citizen science and in-situ (in-place) visualizations reduce the psychological distance of sea-level rise by providing citizens opportunities to directly engage with sea-level rise science in the context of their communities and neighborhoods. Citizen science efforts could be combined with social media, for example developing a smart phone application (app) linked to a geo-spatial database, which allows citizens to upload pictures or geospatial data about the location and timing of coastal infrastructure, flooding, wetlands, or other relevant features of coastal vulnerability and adaptive capacity. The resulting data could then be used by scientists to link with integrated models of climate impacts. The California King Tides Project is a good program that could be scaled-up to more systematically link to biophysical models of flooding and sea-level rise. In-situ visualizations can use various types of "virtual reality" to allow citizens to envision future sea-level rise and flooding scenarios in particular places. An excellent example of this type of visualization is the "Here, Now, Us" project in Marin county, which used "Owlized" virtual reality viewfinders to portray sea-level rise scenarios. In-situ visualizations can also be combined with social media analysis or social science research, to examine how such strategies change citizen perceptions of sea-level rise. For example, citizens could be asked to Tweet about their "Owlized" experience and then "big data" methods can be used to analyze the resulting online networks of tweets/retweets.

Climate Leadership Training Program

A climate/sea-level rise leadership training program could be used as a professional development program for outreach staff, community leaders, consultants or interested citizens. The program would be designed by a collaborative team of government, non-governmental, and scientific stakeholders. Completing the program would provide a "badge" or certificate that serves as a

STAKEHOLDER PERSPECTIVES: Political Leadership

"We're driven kind of these shorter midterm legislative programs. It's funny you were talking about urgency. We need the day after tomorrow to hit -- there are super storms all over North America, and the people are like we have to do something. I don't know, it's just not on people's agendas. It's not on legislators' agendas. They're interested in the housing and the disadvantaged communities."

"We've had…a select committee on Ports, which actually had a session, I think it was two years ago, on sea level rise. So there's interest at the state…legislature on this issue, but perhaps it hasn't yet gotten to the point of having crystalized into a state-wide focus on the question of sea level rise."

"Climate change is important. And that's helped get Caltrans to the table, because the Governor's office has said climate change is important. And the more that the Governor's office says it's important, the more we get state participation."

"I think the legislature is grappling with what adaptation is in some ways, or there's not really a champion. It seems like because adaptation, it covers so many sectors, what I've seen is certain members will pop up and advocate for a component of adaptation, but also missing the big picture or the opportunity to champion adapting to climate change."

"Rising sea level is creeping in, but if you talk about it, the legislative levels, California…but I'm sure there's less than half a dozen that are focusing on it. At the congressional level, the numbers may be a little higher but certainly not proportionally. The other piece is that if you go to the national level, then the areas that are getting the most attention about rising sea level are the areas where there have been major disasters, like Katrina and Sandy, and Florida…"

professional credential, to be associated with an individual resume or organizational services. The best scenario would allow such a climate leadership program to be counted as an official professional development activity within the human resources program of the relevant organization. The Extension programs associated with the University of California campuses is a possible home for a climate leadership program, and a similar example is UC San Diego's recently developed Specialized Certificate in Sustainability and Behavior Change. It would also be possible connect this climate leadership program with the political leadership academy described in the next section.

CHALLENGE 7: Political Leadership

Moving forward planning and implementation of sea-level rise adaptation requires leadership from elected officials and high-level administrative officials in government agencies and other relevant organizations. Elected officials include all levels of government—local, state, and federal. Elected officials play a key role in passing policies (legislation, ordinances etc.) that authorize and fund adaptation projects. Administrative leaders set organizational priorities and culture, and play a key role in implementing adaptation projects in a timely and efficient manner. At the current point in time, there are a number of administrative leaders especially in regional agencies like BCDC who are pushing forward sea-level rise adaptation as part of their organizational missions independent of any specific legislative directive.

Attention from elected officials has been more un-even. Some local elected officials are heavily involved as political entrepreneurs, and participate in different adaptation venues. Innovative local elected officials are often in vulnerable communities that have enough capacity to effectively participate. Many other local officials are uninvolved or taking a wait-and-see approach, due to either a lack of motivation or capacity. There has been some attention to the sea-level rise issue among members of the Bay Area Caucus of the California Legislature, for example the Select Committee on Sea Level Rise and California Economy chaired by Richard Gordon in 2014. There has been some attention from the California Governor's office and US Senators and Representatives, but many stakeholders expressed the belief that these higher level officials have paid more attention to climate mitigation and water supply issues around the drought, California Delta, and Central Valley.

Solution Concepts

Establish State and Federal Legislative Member Organizations Focused on Sea-Level Rise and Climate Adaptation *(Preferred Alternative)*

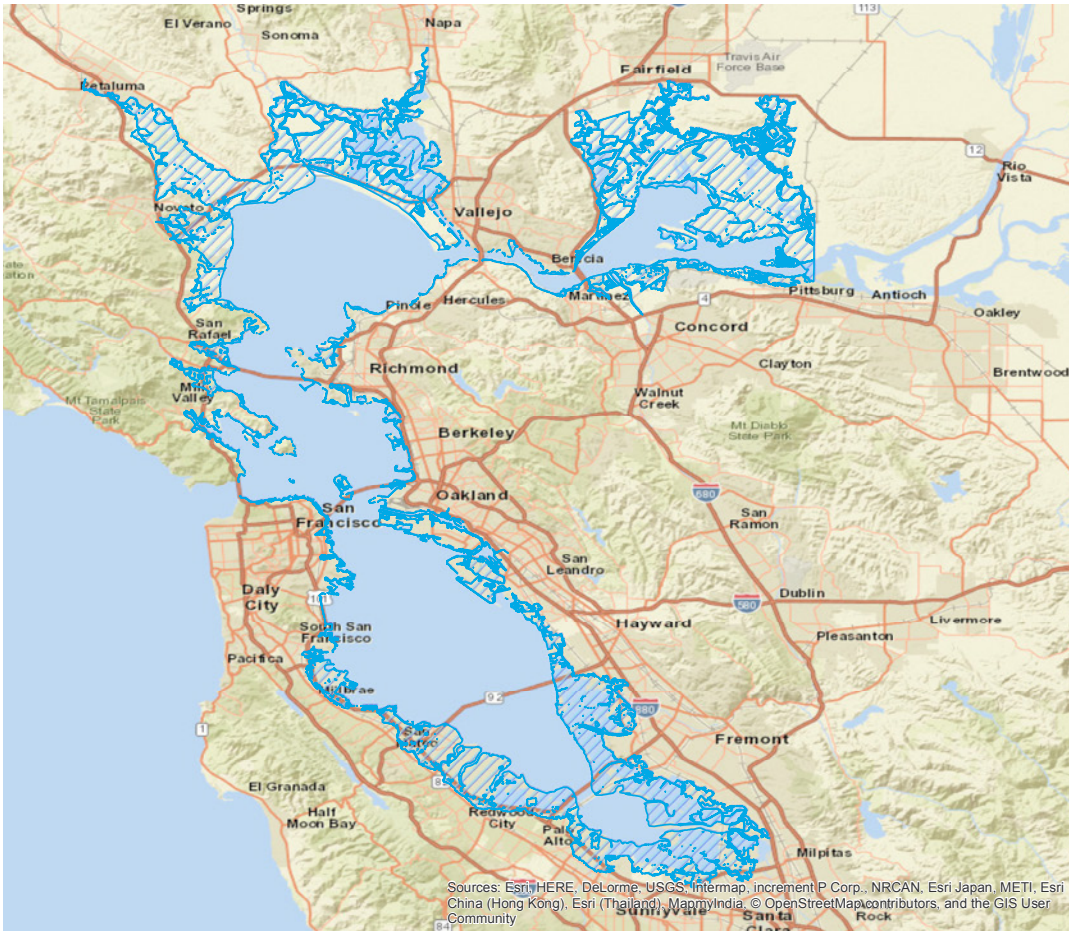
Legislative member organizations are formal or informal networks of legislators who form groups outside of the existing standing committee structure (Ringe et al. 2013). Legislative member organizations help legislators learn new information and form political coalitions to pursue common goals. The Select Committee chaired by Richard Gordon provides an example of a legislative member organization on sea-level rise that should be revived and expanded. A new select committee should be coordinated with the Bay Area Caucus in order to span the California Assembly and Senate. The Governor's office should also be invited to participate. Hearings could focus on what federal, state, and local government agencies are currently doing to address sea-level rise, and needed next steps from the standpoint of legislative decision-making. In the best case, a similar type of effort would be established in the US Congress featuring California Senators and Representatives along with legislators from other states facing sea-level rise issues. The overall goal is to establish a network of leaders within the legislature who repeatedly interact to form a coalition, better understand sea-level rise, and identify legislative actions that could be taken to address the problem.

Governor-Sponsored Regional Dialog Sessions

The California Governor could issue an executive order that establishes as series of political "dialog sessions" in the SF Bay Area, including relevant state agency leaders, and elected officials from state and federal levels. The dialog sessions would involve an inclusive list of stakeholders including disadvantaged communities. The dialog sessions would include a summary of the viewpoints and activities of elected officials, programs offered by government agencies, and stakeholder views on sea-level rise and climate adaptation. The dialog sessions would need to be open to the public and also receive extensive media coverage and public relations outreach. The goal is to increase awareness of sea-level rise and climate adaptation as an issue along with existing policy responses, and provide an opportunity for elected officials to demonstrate leadership, accountability, and transparency to their constituents. In order to establish a statewide coalition, similar listening sessions could be held in other regions of the state facing sea-level rise issues. The main risk of such dialog sessions is that they are symbolic gestures, without any actual policy follow-up that provides funding or policy incentives for on-the-ground projects.

Climate Leadership Network for Elected Officials

A climate leadership network for elected officials would provide an educational process and materials for educating elected officials at all levels of government about climate change and sea-level rise issues. They could be briefed on the biophysical science, including vulnerabilities, impacts, and adaptation options. The leadership program would also involve discussion of possible policy solutions. An important part of the program would be direct interaction with affected constituents and organizations, preferably in the field where sea-level rise and other impacts are clearly visible. The leadership program could be hosted by a regional NGO, university, or some type of consortium. The elected officials could earn some type of public recognition for completing the climate leadership program, with ongoing events and communication to maintain a network of communication and collaboration. The Water Leaders Program of the Water Education Foundation provides a similar model, although a program for elected officials may need to be less intensive and receive external funding. Another excellent model is the Climate Education Partners (CEP), a five-year education project in San Diego, funded by the National Science Foundation, where academic



institutions and foundations are working with a wide range of community leaders to increase their understanding of climate change in the region. Leadership training could also be provided to disadvantaged communities, for example by participating in programs such as Urban Habitat's Boards and Commissions Leadership Institute.

Legislative Staff Outreach Task Force

A climate leadership program could also be developed for legislative staff within committees or associated with specific officials (or other elected official staff), similar to the one described above. In addition, a legislative staff outreach task force could be created to deliver information about sea-level rise and climate change directly in staffer offices. The outreach task forces would need to develop effective and fast communication strategies for information about vulnerabilities, adaptation, and impacts. They would need to provide some type of "leave behinds" with links for staffers to track down relevant information, experts, and interested constituents to build the case for new legislation. Reaching staff is often an important step for building political leadership, because staff are often expert advisors to the more generalist elected officials and staff also often have a longer history of experience and relationships.

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APPENDIX: CATALOG OF CLIMATE ADAPTATION PROJECTS IN SAN FRANCISCO BAY AREA

CRI BAY AREA SEA LEVEL RISE PROJECT LIST 1.3

The projects and links below identify a number of relevant projects for sea level rise and extreme storms in the San Francisco Bay Area.

Regional

ART Portfolio — Findings, How-to and Help Desk

ART Portfolio — Bay Area Sea Level Rise Analysis and Mapping

ART Portfolio — Strong Housing, Safer Communities

Baylands and Climate Change Report

BCDC Policies for a Rising Bay Project (fill policies)

BCDC-MTC Transportation Network Vulnerability Study (Caltrans grant)

BCDC Commissioner Workshop Series on Rising Sea Levels – Final Recommendations Oct 2016

CHARG Network — Coastal Hazards Adaptation Resiliency Group

Impacts of Sea Level Rise/Extreme Events on Transp. Infrastructure (Biging, Radke)

IRWMP Shoreline Resilience Program Overview and Proposal

King Tides Initiative

MTC RFQ: A Resilient Transportation System for Safe and Sustainable Communities

Our Coast-Our Future

Resilient by Design — Bay Area Challenge

Rising Seas in California: OPC Update on Sea Level Rise Science (April 2017)

San Francisco Bay Restoration Authority

Save the Bay

SB 1 — $20M for Climate Adaptation Planning

SF Bay Transformability Study — Strategy Analysis

State of the Estuary 2015 Report

Surviving the Storm — Bay Area Council

North Bay — Marin, Sonoma, Napa, Solano

Aramburu Island Coarse Beach Restoration

Benicia Climate Change Vulnerability Assessment

Bothin Marsh Project

Collaborating on Sea Level Rise: Marin Adaptation Response Team (C-SMART)

Flood Control 2.0 (Novato Creek)

Game of Floods

Hamilton Field Restoration Project

Innovative Wetland Adaptation Tech. in Lower Corte Madera Creek Watershed

Marin BayWAVE — Marin Bay Waterfront Adaptation Vulnerability Evaluation

Napa River/Napa Creek Flood Protection Project

Owlized Marin Sea Level Rise Project

San Francisco Estuary Partnership Climate Ready Estuaries Pilot Project

SF Bay Living Shorelines Project

Shore-Up Marin

Southern Marin Pilot Project

State Route 37 Stewardship Study

Suisun Marsh Restoration Project

East Bay—Alameda, Contra Costa

Alameda County ART Subregional Project

Contra Costa County ART Project

Flood Control 2.0 (Walnut Creek)

Hayward Area Shorelines Planning Agency — Sea Level Rise Project

Hayward Shoreline Resilience Study

MTC BCDC FHWA Transportation Vulnerability Assessment Project

Northern Alameda County — San Francisco Bay Area Coastal Study

Oakland/Alameda Resilience Study

Oro Loma Ecotone Project

San Francisco

Guidance for Incorporating Sea Level Rise Into Capital Planning in San Francisco

San Francisco Sea Level Rise Action Plan

Ocean Beach Master Plan for Sea Level Rise

SF Mission Creek Sea Level Rise Adaptation Study

South Bay—Santa Clara, San Mateo

A Slow Rising Emergency — Sea Level Rise: 2014-2015 Santa Clara County Civil Grand Jury Final Report

Foster City Sea Level Rise/Levee Planning Project

Flood Control 2.0 (San Francisquito Creek)

San Francisquito Creek Joint Powers Authority

San Mateo County Sea Level Rise Vulnerability Assessment

Sea Change San Mateo County

SF Baylands Restoration and Flood Protection Project

SFO, San Bruno and Colma Creek Resilience Study

Silicon Valley 2.0 (sea level rise chapter)

South Bay Salt Pond Restoration Project

South San Francisco Bay Shoreline Study