RESILIENT BY DESIGN

BAY AREA CHALLENGE

A blueprint for resilience that harnesses Bay Area innovation

Resilient by Design

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An Introductory Word

Sam Schuchat
Executive Officer
California State Coastal Conservancy

The Resilient by Design | Bay Area Challenge launched in 2017 at a turning point for the Bay Area. The region had recently come together to pass the Clean Water, Pollution Prevention and Habitat Restoration Measure (Measure AA), often considered the first climate adaptation measure in the nation to be passed by voters. This effort built on more than 20 years of investment in rebuilding our natural shoreline. Since 1999, a monumental, coordinated effort by local community leaders, elected officials and advocates across the region led to huge progress in restoring natural areas, rebuilding wetlands, creating more access to open spaces for our urban communities, more fish and wildlife habitat and a healthier San Francisco Bay.

Yet all of that is at risk. Stronger storms and rising seas could overwhelm the progress we have made in restoring wetlands as well as threaten homes, job centers and public infrastructure in all of our bayfront communities. In many of those bayfront communities, our region's most economically vulnerable residents are at the most risk for significant flood impacts as well.

Addressing climate-related flooding is going to require an unprecedented level of collaboration for which there are few existing models showing the path forward. While our need for investment is not new, the extent of our challenges is beyond what we have imagined. While our coastal cities grew over time to accommodate people and jobs, they were not designed with a significantly changing shoreline in mind. We face a rapidly changing climate that will require ever increasing levels of flexibility, collaboration, innovation, and investment to preserve all of the things we love about the San Francisco Bay Area.

The State Coastal Conservancy has played a critical role in shaping California's coastal landscape as we know it today. Since its creation, the Conservancy has built hundreds of miles of trails and preserved hundreds of thousands of acres of wildlife habitat, coastal farmland, and scenic open space. The Conservancy along with the Rockefeller Foundation provided crucial leadership and financial and technical support throughout the Resilient by Design | Bay Area Challenge and will continue to lead at the state, regional and local level for innovative, nature-based investments providing crucial benefits to our local communities now and in the future.

Bringing climate adaptation to the forefront of our regional infrastructure investment efforts helps us to face the reality we are already living in – that we must come together both to reduce our future impact on the planet and also to learn how to live with the impacts we have already caused. Public investment must be prioritized in a way that increases resilience – by design – and the Resilient by Design | Bay Area Challenge provides a blueprint for how to make that shift by collaborating more effectively; integrating natural systems, the built environment and social equity; and bringing innovative design thinking to the forefront to help us solve some of our region's – and our nation's – biggest challenges to build a resilient future for all.

Contents

A Rapidly Changing Climate

Climate change is rapidly altering conditions in our oceans and will continue to do so in the coming decades.

Current projections show that the Bay Area may see an increase in sea level that could reach nearly seven feet by 2100, with significant issues arising from storm surges, fluvial flooding, groundwater inundation, and changes in wave action well before even one foot of increase is met. At these levels, homes, job centers and major regional transportation infrastructure as well as other critical services will be severely at risk. Wastewater treatment and sanitation systems could be inundated or overwhelmed, and residential neighborhoods will see significant flooding.

This uncertainty and change in our natural world also comes at a time of great uneasiness about the economic and social future of the region. The rapidly accelerating displacement of low-income residents and communities of color is a defining crisis in the Bay Area. Each year, more people are pushed out of their homes due to rising rents, foreclosures, and other issues. While experts cannot predict exactly when and where natural disasters will occur, impacts on people in the disaster zone can be predicted based on pre-existing social indicators such as income, race, education level, mobility, and the depth of social networks. Creating solutions that protect the region from future sea level rise and respond to these current challenges is fundamental to building a more resilient region.

Today, humanity confronts unprecedented risk

Urban populations have never faced so many shocks and stressors. Without strategic investment, cities struggle to adapt, respond and recover from disaster.

Slower to Adapt | **Harder to Respond** | **Longer to Recover**

Investment limits disaster
Investment spurs new growth

Residents

- Lives saved
- Greater mobility and access
- More job opportunities

Businesses and Institutions

- Restore operations
- Lower operating risk
- New markets for innovation and technology.

Governments

- More effective disaster aid
- Increased private investment
- Greater protection for the vulnerable.

An Opportunity for Innovation

Streets and homes in Ortley Beach, New Jersey after Hurricane Sandy.

Rebuild by Design
The Hurricane Sandy Design Challenge

Hurricane Sandy destroyed over 650,000 homes and businesses on the northeastern coast the United States. In the aftermath, President Obama created a task force to rebuild damaged cities and communities and bolster them against future storms. Under the resulting guidance of the United States Housing and Urban Development Department, and in partnership with the Rockefeller Foundation and a number of other NGOs and funders, Rebuild by Design was born. Leading the new initiative was Henk Ovink, former Senior Advisor to the US Presidential Hurricane Sandy Rebuilding Task Force.

Rebuild by Design brought design experts from around the world together with local civic and community leaders in an unprecedented collaboration. They worked to create large-scale multipurpose infrastructure for the affected areas that addressed future climate uncertainties. The success of the Rebuild by Design Hurricane Sandy Design Challenge inspired other communities around the country and world to consider what this type of initiative could accomplish if completed before, not after, a disaster? Could the Rebuild by Design model be applied without the catalyst of a recovery effort? The San Francisco Bay Area seemed a natural place to start. The region was already implementing proactive resilience- building measures but lacked a regional plan to combat sea level rise. It was in this context that Bay Area leaders began discussing a potential design challenge modeled after Rebuild by Design with government agencies and potential collaborators in 2014.

Resilient by Design Bay Area Challenge

Challenge Objectives

Combine implementable and creative design-driven ideas with technical expertise;

Reflect rigorous research and a strong understanding of ecosystems, local community, and government challenges;

Inspire collaboration, connection, and coordination across the region; and

Prepare communities for the future by addressing ecological, economic, and social vulnerabilities that exist today.

The geography and hydrology of San Francisco Bay – so different from the Atlantic ocean coast – inspired a unique approach to this western design challenge. In such a large shallow bay with so much development right at the water's edge, changes such as new sea walls along one shore could easily increase sea levels and wave action along another. Only through collaboration on adaptation could each of the hundreds of jurisdictions and countless communities surrounding the Bay consider the impacts of their decisions on others sharing the shore. Indeed greater regional collaboration on climate adaptation had already been called for by San Francisco, Oakland and Berkeley as part of their participation in the Rockefeller Foundation's 100 Resilient Cities.

At the same time, the Bay Area passed a groundbreaking ballot initiative to generate hundreds of millions of dollars for wetland and habitat restoration, flood control and public access along the shoreline. Over 70% of Bay Area voters voted in favor of the Clean Water, Pollution Prevention and Habitat Restoration Measure (or Measure AA) to tax themselves in order to contribute to the health and preservation of San Francisco Bay. This demonstrated that communities in the Bay Area were willing to proactively invest to preserve our natural assets for future generations.

The commitment of regional leaders to an innovative pre-disaster climate adaptation design along with the willingness of Bay Area voters to proactively fund San Francisco Bay restoration inspired the Rockefeller Foundation to provide a foundational grant to launch the Resilient by Design | Bay Area Challenge in early 2017.

Regional leaders developed this challenge to initiate collaboration between communities, agencies, aca-demic institutions, local jurisdictions, and scientific organizations, and other stakeholders to plan for sea level rise in San Francisco Bay. Over twelve months, ten local and international design teams and dozens of regional experts took part in the effort. Through interdisciplinary research, collaboration with local stakeholders, and community outreach, teams arrived at innovative design solutions for nine Bay Area sites. Hundreds of organizations and thousands of individuals participated. The knowledge shared, relationships built, and ideas generated have inspired individuals and institutions throughout the region to take seriously the threat of climate change and plan concrete steps to address it.

Eden Landing, Alameda County

SEA LEVEL RISE IN THE BAY AREA

This map displays sea level rise of up to 9 feet across the San Francisco Bay Area. The extent of inundation is based on locally groundtruthed maps of elevation and hydrodynamic connectivity. For more information visit adaptingtorisingtides.org

Total Water Level (Inches) above Mean Higher High Water

12	66
24	77
36	84
48	96
52	108

BASEMAP AND DATA FROM BCDC'S *ADAPTING TO RISING TIDES*

The Grand Bayway
Common Ground

Elevate San Rafael
Bionic Team

ouR Home
The Home Team

The People's Plan
Permaculture and Social Equity

Islais Hyper Creek
BIG+ONE+Sherwood

Estuary Commons
All Bay Collective

Resilient South City
HASSELL+

Unlock Alameda Creek
Public Sediment

South Bay Sponge
Field Operations Team

0 5 10 20 Miles

The Process

LAUNCH

MAY 2017 JUNE JULY AUG

COLLABORATIVE RESEARCH

SEPT OCT NOV DEC

May 2017 → August 2017

51 Teams Applied

Resilient by Design was launched in May 2017. Over 50 teams responded to a Request for Qualifications and 10 of those teams were chosen by a Jury of national and international experts to participate in the Bay Area Challenge. Simultaneously, a call for potential vulnerable sites launched, where community members and city officials submitted over 74 potential sites vulnerable to sea level rise. **See page 14.**

74 Community-Submitted Site Ideas

37 Sites Visited

September 2017 → December 2017

During the Collaborative Research Phase, each Team spent four months conducting research, connecting with local communities through tours around the bay, and learning about the unique challenges and vulnerabilities of the diverse places around the region. Each Team presented three to five potential Design Opportunities to key stakeholders and the interested public. At the end of the Collaborative Research Phase, the Research Advisory Committee matched each Team with one of their Design Opportunities to move forward into the next phase. **See page 20.**

32 Design Opportunities Presented






COLLABORATIVE DESIGN

JAN 2018 FEB MAR APRIL

January 2018 → May 2018

122
Agencies Involved
(235 Individuals)

Varying in scope and scale, early design ideas imagined in the Collaborative Research Phase served as a springboard for the Collaborative Design Phase. Teams partnered with over twenty community organizations throughout the region to develop ideas for a more resilient Bay Area. At each site selected, initial design ideas addressed ongoing climate issues facing the Bay Area, such as sea level rise, severe flooding, and seismic risks, alongside other, sometimes more pressing challenges, including lack of housing, displacement, gentrification, limited access to public land and outdated transportation.
See page 36.

39
Public Events with Partners

375
Stakeholders Engaged

NEXT STEPS

AND BEYOND...

June 2018 → Beyond

In May 2018 each Team along with their local stakeholders presented their final design concepts and a roadmap toward implementation to the Resilient by Design community and members of the interested public at the Resilient Bay Summit. The projects now have networks of community organizations, city officials, local electeds, designers, engineers, scientists, and other experts that have been activated and inspired to work together to continue to move each project forward. The extraordinary collective effort over the course of the Bay Area Challenge serves as a call to action for the region to continue to work together to build a more resilient Bay Area. **See page 208.**

Launch

PHOTO BY BROOKE ANDERSON

The Launch

The premise of the Resilient by Design | Bay Area Challenge was to connect internationally-renowned experts with local communities to inspire innovation and catalyze designs, ideas and collaboration toward a more resilient future. To achieve that, the Challenge launched on May 31, 2017 with an open call for Design Teams to participate in the challenge and an open call for site ideas – which asked community members, government staff and regional experts to identify places around the Bay vulnerable to flood risk that could benefit from a collaborative, multi-benefit, multi-disciplinary design process.

PUBLIC CALL FOR VULNERABLE SITES

Over the next year, residents and local leaders partnered with local, national and international experts from the design community – architects, engineers, designers, planners and more – to develop innovative solutions that build our region's resilience to threats like sea level rise, severe storms, flooding and earthquakes while also addressing critical issues such as disparities in housing, income, access to open space, and environmental justice.

To make this initiative successful, we asked Bay Area residents to help us to identify the Bay Area's most vulnerable ecological systems and most vulnerable bayfront communities, as well as our outdated infrastructure at risk from a natural disaster. We looked for challenging areas with strong community engagement that could benefit from the creative, innovative energy from a multi-disciplinary design team partnering with local leaders to come up with implementable solutions.

DESIGN TEAM SELECTION

The Bay Area Challenge Design Brief issued a call to form teams up to the task of building multi-faceted solutions to flooding challenges in the Bay exacerbated by severe storms, groundwater inundation and sea level rise. Over 50 teams from across the region and the world applied to enter the challenge.

Design Teams were required to have a lead or co-lead architecture/design firm and to demonstrate professional expertise in several of the following fields:

Left: Otis Rolley of the Rockefeller Foundation addresses audience at the Research Phase Kickoff event in Richmond, CA in September 2017.

Above Right: The Permaculture and Social Equity design team posed for a photo at the Kickoff Celebration in Richmond, CA September 2017.

Building on Existing Knowledge

BRIEFING BOOK

The work of Resilient by Design built on the deep wealth of existing knowledge in the Bay Area. The Briefing Book compiled resources assembled with the help of our partners that served as a complement to the Collaborative Research Phase and a basis for further research. The book discusses relevant themes, tools, and organizations that helped orient teams to the regional resilience challenges in the Bay Area and set the stage for the depth and breadth of resilience challenges facing local communities.

Final Design Presentations at SFJAZZ Center, San Francisco

RESILIENT BY DESIGN JURY

A Bay Area Challenge Jury of some of the most highly accomplished designers and advocates in the field was assembled to select the cohort of Design Teams to participate in the Challenge. Their expertise in ecology, urbanism, community-based design, water access, public health, and sea level rise adaptation has helped set the bar for resilience internationally.

Lauren Alexander Augustine
National Academy of Sciences

Sarah Ichioka
Desire Lines

Roberto Moris
Research Centre for an Integrated Risk Management

Liz Ogbu
Studio O

Henk Ovink
International Water Affairs, Netherlands

Shelley Poticha
Natural Resources Defense Council

Denise Reed
Professor Gratis, University of New Orleans

Jerry Schubel
Aquarium of the Pacific

Cynthia Smith
Cooper Hewitt, Smithsonian Design Museum

Helle Soholt
Gehl Architects

David Waggonner
Waggonner and Ball

ADVISORS

The Resilient by Design | Bay Area Challenge was guided by specialized teams of advisors in a variety of related fields to provide ongoing support and advice to Design Teams throughout the Challenge in order to ensure that the innovative and creative design ideas were effectively grounded in reducing flood risk and had realistic potential funding sources for next steps.

EXECUTIVE BOARD

The Executive Board conceived the vision of Resilient by Design, secured funding and worked closely with Resilient by Design staff to guide the process throughout the Challenge.

Allison Brooks, Bay Area Regional Collaborative

Mayor Tom Butt, City of Richmond

Amy Chester, Rebuild by Design

Adrian Covert, Bay Area Council

Amy Hutzel, California Coastal Conservancy

Kiran Jain, City of Oakland/Neighborly

Ashwini Kantak, City of San Jose

Dwayne Marsh, Government Alliance on Race and Equity

John Rahaim, City of San Francisco

Laura Tam, SPUR

Francesca Vietor, San Francisco Foundation

SCIENCE ADVISORS

The Science Advisory Team was made up of experts from the San Francisco Estuary Institute. They helped develop the Briefing Book, met regularly with each Design Team and presented a science briefing at the start of the Research Phase. Through these activities, they helped incorporate local scientific knowledge and datasets, identified ecosystem restoration and adaptation opportunities, and maximized alignment with current environmental management efforts.

Julie Beagle

Scott Dusterhoff

Letitia Grenier

Robin Grossinger

Jeremy Lowe

Katie McKnight

April Robinson

Erica Spotswood

RESEARCH ADVISORS

A Research Advisory Committee made up of regional experts in a variety of fields was assembled to oversee the design of the Research Phase site tours and provide technical knowledge, relationships, and guidance for the Design Teamsthroughout the Challenge. The committee developed criteria for design solutions and oversaw the site matching process.

Ratna Amin, SPUR Transportation Policy

Kit Batten, PG&E

Josh Bradt, SF Estuary Partnership

Dana Brechwald, Association of Bay Area Governments

Ellie Cohen, Point Blue Conservation Science

Tian Feng, BART

Nahal Ghoghaie, Resilient Communities Initiative

John Gibbs, WRT

Letitia Grenier, San Francisco Estuary Institute

Jesus Hernandez, JCH Advisors

Jeffrey Koseff, Stanford Woods Institute for the Environment

David Lewis, Save the Bay

Roger Lin, Center for Race, Poverty and the Environment

Lindy Lowe, Bay Conservation and Development Commission

Bruce Riordan, Climate Readiness Institute (UCB)

Rupal Sanghvi, HealthxDesign

Parin Shah, Asian Pacific Environmental Network

Cathy Simon, AIA

Mark Stacey, UC Berkeley Department of Engineering

Rick Thomasser, Bay Area Flood Protection Agencies Association

Elizabeth Wampler, Great Communities Collaborative

Middle Harbor Shoreline Park, Oakland

Exploratorium, San Francisco

FINANCE ADVISORS

The Finance Advisory Team prepared a Finance Guide during the Research Phase for use by the Design Teams in preparation of their design alternatives. The Guide provided a strategic perspective and descriptive overview of funding and financing options to help orient design ideas towards more feasible, fundable projects. During the Design Phase, the Finance Advisory Team also developed specific project level guidance and reviewed each team's project finance plan.

Brian Benn, Environmental Risk & Financial Solutions

Mark Northcross, NHA Advisors

Michael Paparian, Climate Bonds Initiative

Kathy Schaefer, UC Davis Watershed Sciences Center

Robert Spencer, Urban Economics

Shalini Vajjhala, re:focus partners

Resilient by Design Kick Off

In September 2017, the Jury announced the 10 teams selected to a crowd of hundreds at a kickoff event overlooking San Francisco Bay along the Richmond shoreline. The Design Team members represented significant local talent as well as representatives from all over the US and around the world. Over 90 organizations and firms were represented on teams, bringing decades of experience creating innovative and effective nature based solutions to reduce flood risk, enhance local communities and address some of the biggest challenges facing our region. Each team brought their own unique set of experiences and technical expertise to the Challenge. Some teams came with a deep knowledge of the Bay Area while others drew primarily on national or international experience. Water managers and engineers from places as far as the Netherlands and Australia worked alongside designers and community organizers from across the region.

At the event, local elected officials, community organizations, planning agencies and others assembled to launch the Challenge and build connections with one another. Design Teams mingled and met with community leaders and began to get a sense of the cohort of experts they would work with in the months to come.

"Rising seas are already impacting our most vulnerable communities and threatening outdated and insufficient infrastructure around the country. This is more than a competition – this is personal for the Bay Area. It's not just about San Francisco, Oakland, San Jose, or any one city in the Bay. It's about all of us coming together and working collectively to figure this out."

– ED LEE, MAYOR OF SAN FRANCISCO

This page, clockwise from top right: Amanda Brown-Stevens, Managing Director of Resilient by Design, welcomes Design Team members, community partners and guests to the Research Phase Kickoff in Richmond, CA; Art created by CultureStrike pop up art studio drys on the wall; Former Mayor Ed Lee; Participants create posters at the CultureStrike pop up art studio.

Facing page, clockwise from top left: CA State Senator Bob Wieckowski poses for a photo with staff from the SF Consulate General of the Netherlands; Deborah McKoy, Executive Director of Y-PLAN speaks at the Kickoff event; Richmond Mayor Tom Butt; members of the Home Team pose for a photo; Resilient by Design staff at Kickoff event; Otis Rolley, Managing Director, 100 Resilient Cities.

"The Bay Area's commitment to protecting vulnerable communities through innovative design solutions that will drive lasting change is inspiring. When given the chance to collaborate, communities can not only learn from one another but also work together to develop a blueprint toward a more resilient future. And that's what this challenge is all about."

— OTIS ROLLEY, MANAGING DIRECTOR, 100 RESILIENT CITIES

"The Bay Area has always been on the forefront of leading change and now has the collective opportunity to take a true next step. Not only will the Challenge bring about 10 new approaches to serve as blueprints for the region, but it can also connect the community long-term to the idea of resilience. We are proud to stand with the other Bay Area communities who join Richmond in making this a priority."

— TOM BUTT, MAYOR OF RICHMOND

Collaborative Research

Left: Design Team members trek down a path in San Mateo County.

Right: Design Team member gazes at SF in the distance at Alameda Point.

Building resilience requires a different kind of thinking. Often, the goal in addressing big challenges is to narrow the scope of an issue enough to find a discrete solution. In this Challenge, however, Design Teams were asked to expand the scope of sea level rise beyond flood mitigation. The Collaborative Research Phase allowed Design Teams to learn about the unique assets and challenges in the Bay before making assumptions about the problems they should be solving for. The four month program familiarized Design Teams with the Bay Area's unique regional context and built a shared understanding of communities and ecosystems in the bay. New connections were forged between practitioners and experts across fields as teams engaged in tours, discussions, and talks led by Bay Area experts and community leaders. Teams grappled with issues from wetland loss and sediment flow to housing access and wastewater treatment.

The tour weeks were guided by the Resilient by Design guiding principles and planned in partnership with dozens of organizations and agencies. This phase gave the designers a stronger foundation to assess multi-dimensional problems as they moved into the Design Phase.

Guiding Principles

As a foundation for the Bay Area Challenge, Resilient by Design developed the following guiding principles. These principles were used to help shape the research tours and events in Fall 2017. In the Collaborative Design Phase, Design Teams utilized these guiding principles to assist in the development of their workplans and engagement tools with the goal of fostering an inclusive, equitable and collaborative design process.

1. **Address multifaceted, dynamic issues through collaboration, coordination and connection.**
2. **Prepare vulnerable communities for a resilient future by addressing our shared history, ecological, economic, and social vulnerabilities that still exist today.**
3. **Integrate social and ecological systems through rigorous research and a strong understanding of ecosystems, local community, and government challenges.**
4. **Integrate principles to sustain biodiversity and ecological functions.**
5. **Merge local, regional, and international knowledge with technical expertise toward implementable and creative design-driven ideas.**
6. **Acknowledge place and the First Nations of the Bay Area.**
7. **Develop equitable planning and development practices where community members are true collaborators and participate as equal partners at every level of design formation.**
8. **Leverage community knowledge and integrate in design to improve and not displace community members.**


Martinez

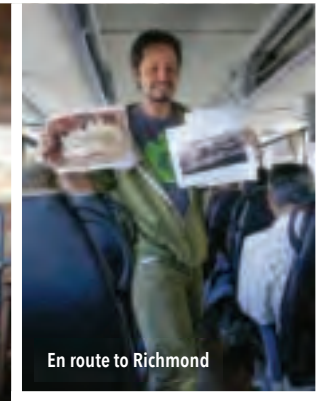

Pittsburg


Pt Molate, Richmond


San Leandro Bay


Bay Farm Island, Alameda


Jack London Square, Oakland


En route to Richmond

WEEK 1: EAST BAY


Pittsburg


Pittsburg


Gateway Park, Oakland


San Francisco


Alameda


Martinez


Vallejo


Marin City


Napa


Port Costa


Sonoma


Headed towards Marin City

WEEK 2: NORTH BAY


Sonoma Raceway


San Rafael


Marin City


San Rafael


Mare Island


San Pablo Bay


Suisun City


Oro Loma Horizontal Levee, Hayward


Alviso, San Jose


Alviso, San Jose


East Palo Alto

WEEK 3: SOUTH BAY


Eden Landing, Union City


Eden Landing, Union City


San Mateo


Eden Landing, Hayward


San Jose


Alviso, San Jose

Pier 80, San Francisco

Heron's Head Park, San Francisco

Pier 94, San Francisco

Heron's Head Park, San Francisco

Islais Creek,
San Francisco

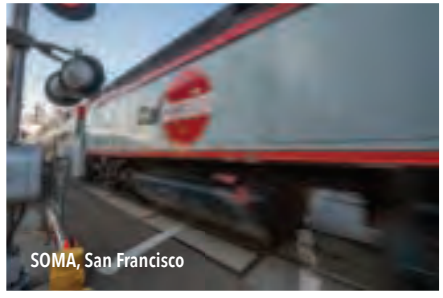
WEEK 4: SAN FRANCISCO

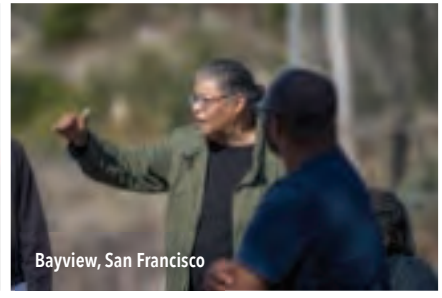

Heron's Head Park, San Francisco

California College of the Arts, San Francisco


Islais Creek, San Francisco

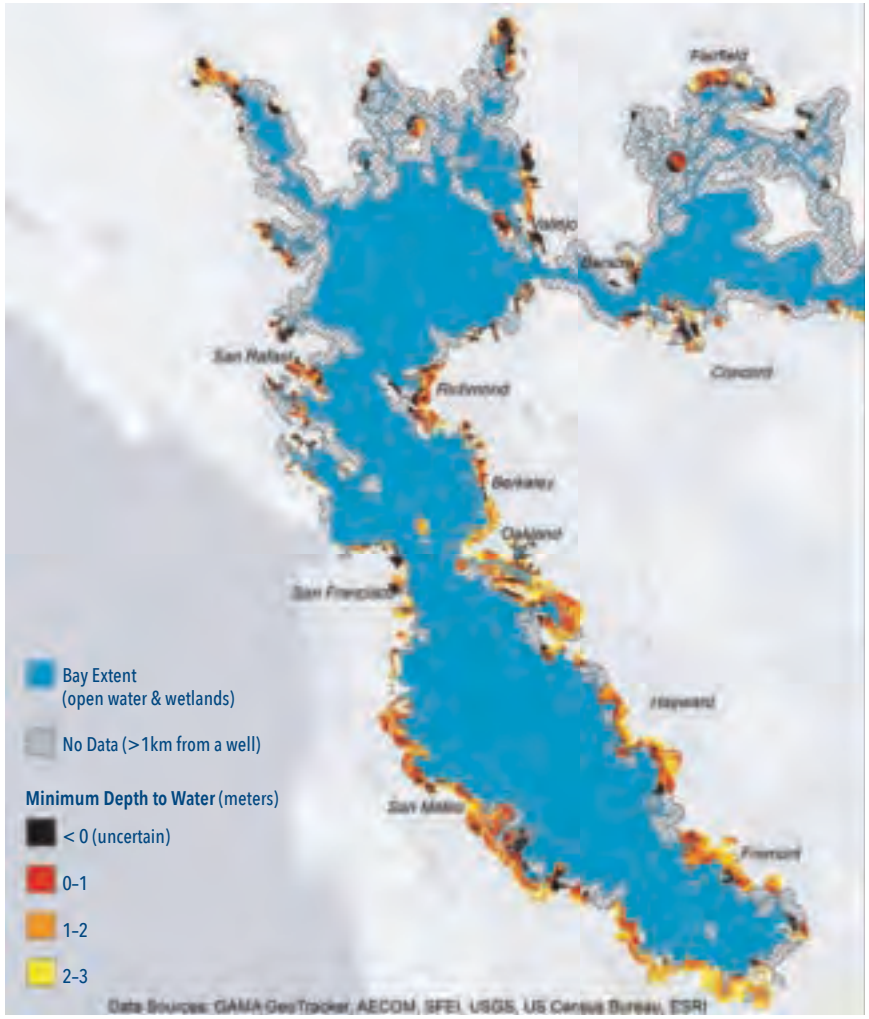

Mission Bay, San Francisco


SOMA, San Francisco


Bayview, San Francisco

Research

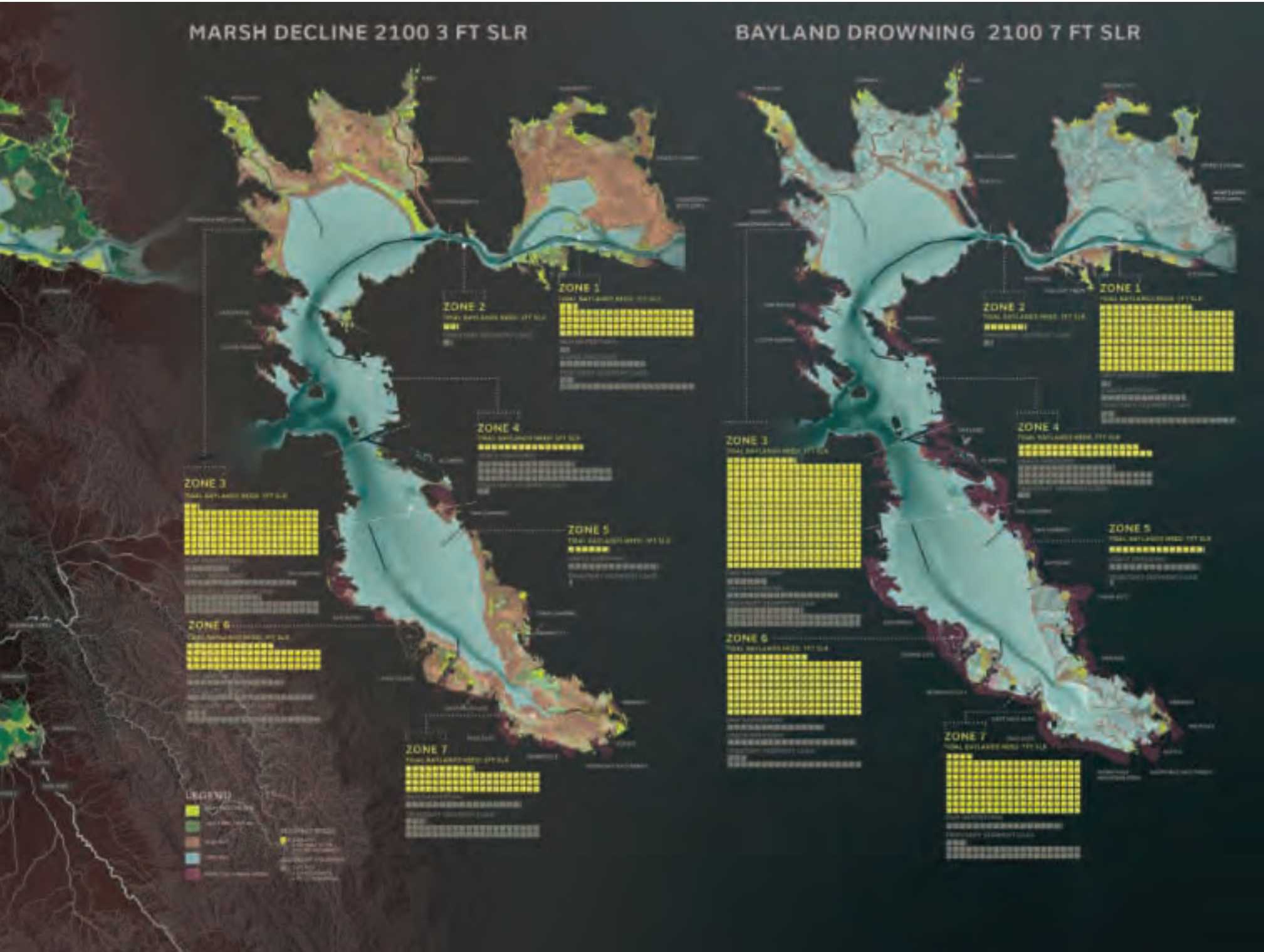
During the Collaborative Research Phase, Design Teams delved into existing data to understand site-level implications for sea level rise and flood risks. Determining future sea level rise is not as simple as finding a static number of feet to plan for, and Design Teams used research and images to create compelling visual tools to convey the urgency of increasing flood risk around the region.



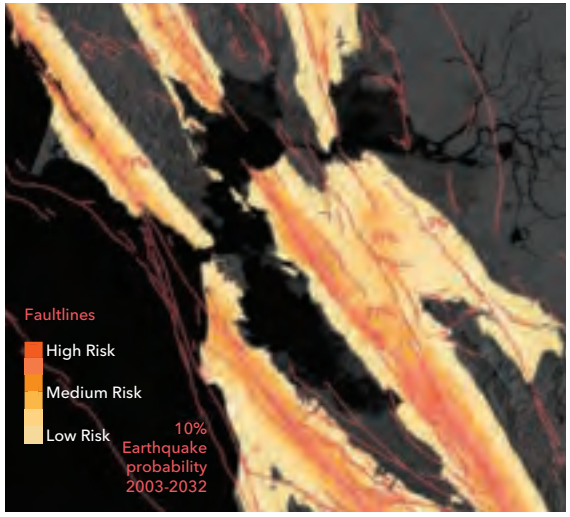
BAY AREA LOCATIONS THAT WILL FLOOD BY GROUNDWATER AS SEA LEVELS RISE

Left: The All Bay Collective examined numerous sites around the region that store contaminated material and may be subject to inundation from a rising groundwater lens. They learned that surface tributaries and waterways may also interact with these dynamics and further complicate the public health imperative of managing these sites and their changing landscape dynamics. Map from, "Minimum Depth to Groundwater for the Coastal San Francisco Bay Area" by Plane, Hill and May, 2018. dash.berkeley.edu/stash/dataset/doi:10.6078/D1W01Q

Right: Public Sediment used a spatial elevation analysis of the most recent lidar topographic data from BCDC's Adapting to Rising Tides research to identify sediment needs over time.


MARSH DECLINE 2100 3 FT SLR
BAYLAND DROWNING 2100 7 FT SLR
ZONE 1
ZONE 2
ZONE 3
ZONE 4
ZONE 5
ZONE 6
ZONE 7
LEGEND

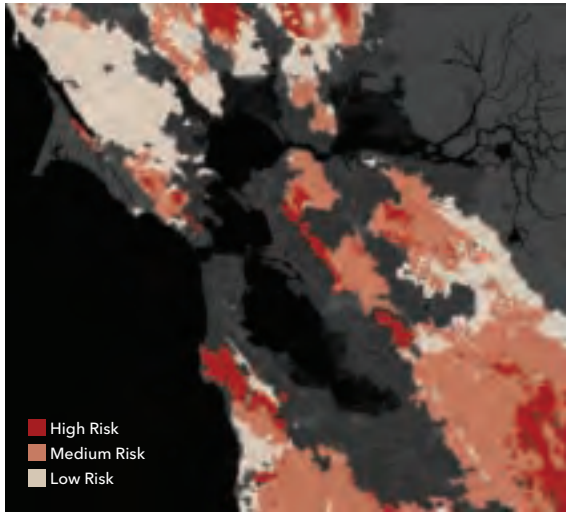
EARTHQUAKES



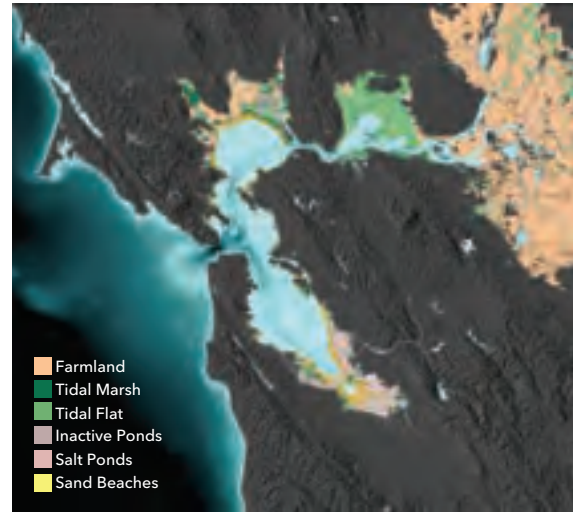
REGIONAL LANDSCAPE HABITATS

HISTORIC COASTAL HABITATS

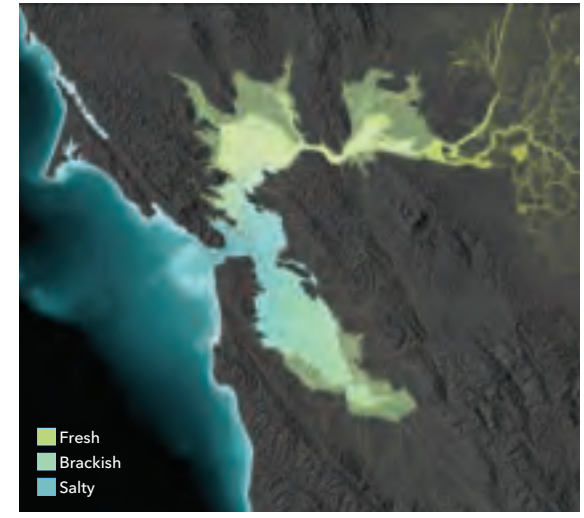
WILDFIRES



TODAY'S COASTAL HABITATS



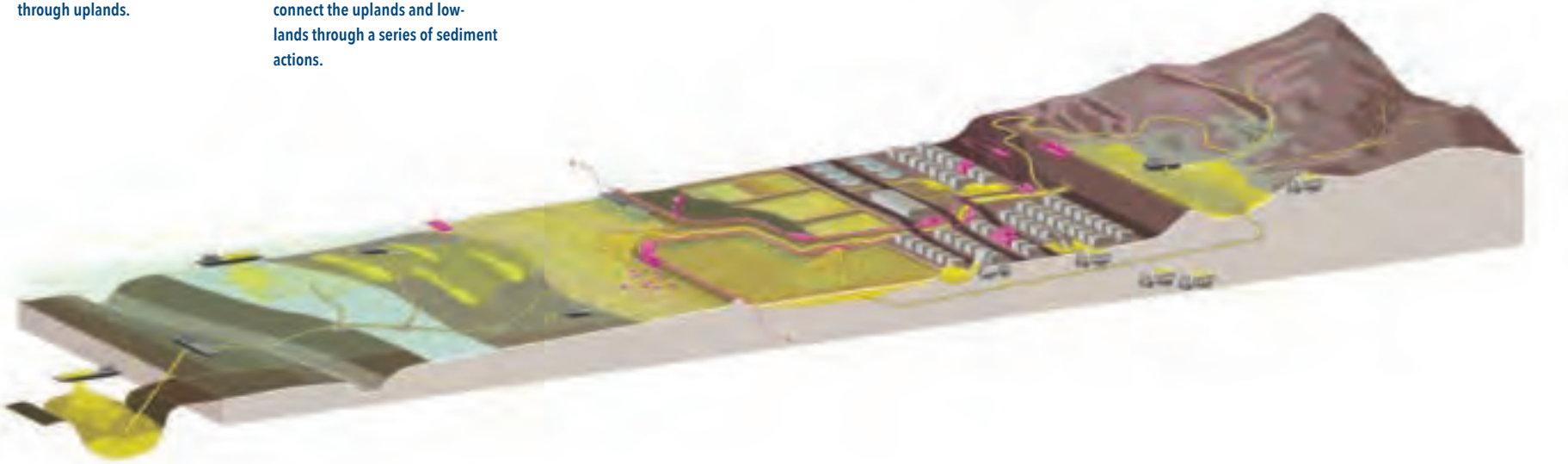
SALINITY & CONVEYANCE



In researching potential locations, BIG+ONE+Sherwood examined the earthquake and wildfire vulnerability. They also mapped regional landscape, coastal habitats, and salinity.

Above: Common Ground examined the ecosystem of the San Pablo Baylands in zones from sub tidal through uplands.

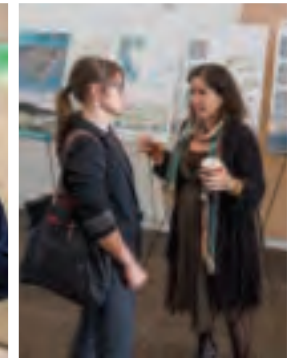
Below: Public Sediment examined Alameda Creek through the sediment flow and proposed to connect the uplands and low-lands through a series of sediment actions.



Presenting Design Opportunities

At the close of the Collaborative Research Phase, Design Teams presented their initial ideas to the Research Advisory Committee and stakeholders at a public reception at the Contemporary Jewish Museum in downtown San Francisco. The ideas generated ranged from more traditional restoration efforts integrated into a larger regional context to novel and ambitious plans for floating housing stock and transformative regional initiatives.

After the presentations, the Research Advisory Committee evaluated the research and designs produced by each of the teams. Committee members also reviewed and weighed stakeholder and public input on each of the potential project ideas. The Research Advisory Committee then matched each team with one potential project location to develop alongside community stakeholders in the Collaborative Design Phase.



Online Digital Engagement Tool

NEIGHBORLAND

In order to get public feedback on the Design Opportunities and ground truth the ideas as part of the matching process, Resilient by Design partnered with Neighborland to create an online communication platform. This online tool was a great way to increase accessibility and provide greater opportunities for local Bay Area residents to give feedback on the Design Opportunities. Local residents were able to log online and comment directly on the renderings, sketches and text about each Design Opportunity. This information was used by the Research Advisors in selecting one of the Design Opportunities for each team.

Collaborative Design

San Pablo Baylands Discovery Tour


Alameda Creek Crawl


Walking tour of Alameda Creek

"We came to this challenge as a team of technical and academic experts. We leave as committed allies in community-driven planning, enriched by our collaboration with neighborhood and agency representatives. We see the San Leandro Bay Estuary representing the dawn of a new era in city-making – an era when community priorities are at the heart of important decisions and residents prosper in harmony with rising water levels."

– ABC PROJECT DIRECTOR STEPHEN ENGBLOM, SENIOR VICE PRESIDENT, CITIES, AECOM


San Rafael Flood Fair

The Collaborative Design Phase kicked off in January 2018 with community meetings and the formation of local advisory groups in each project area. This phase was an opportunity for designers to dive deeper into site-specific challenges and co-create solutions with local jurisdictions and communities. Through outreach events, community meetings, and creative engagement tactics, Design Teams learned from communities and shared their own expertise. Advisory groups in each county included relevant stakeholders such as local elected officials and city staff, regional park and open space districts, environmental justice leaders, flood managers, ecologists, community members, and advocacy organizations.


People's Plan Graduation, Marin City

Walking tour of San Pablo Bay


Estuary Commons working group


Sea-level rise art installation.


Kayak tour, San Rafael


Regulatory Speed Dating,
San Francisco


Sponge Hub, South Bay

Pop up Storefront, South San Francisco

People's Plan graduation, Marin City

Pop up Storefront, South San Francisco

Flood Mobile (#FloMo), San Rafael

Y-PLAN Resilient by Design Youth Challenge

Student proposals addressed affordable housing, sea level rise, healthy food and inclusive transportation.

Over eight hundred Bay Area students, ages 8 to 18, brought big ideas and unbounded energy to the Bay Area's first-ever Y-PLAN Resilient by Design Youth Challenge. Y-PLAN is an award-winning civic learning and engagement strategy based at the University of California Berkeley Center for Cities + Schools. The Y-PLAN Resilient by Design Youth Challenge was a unique opportunity to engage over 1000 young people, community members, civic leaders, parents and local schools in reimagining and redesigning communities most vulnerable to climate change and sea level rise. The Challenge also prepared elementary and high school teachers that engaged students in these issues in partnership with local leaders and RbD Design Teams.

The young participants demonstrated the important role they play in their communities' efforts to effectively respond to inevitable challenges like rising seas, flooding, earthquakes and man-made disasters while confronting daily stresses like food insecurity and homelessness. In all, students from 32 schools in low income communities of color in Oakland, San Rafael, San Francisco, Richmond, and East Palo Alto were involved in planning for a climate resilient future for themselves and their communities.

During the Youth Challenge, Y-PLAN Student Scholars pushed the envelope within the field of climate resilience, arguing that their lived experience and existing resilience within their communities must be an essential starting point for adapting to climate change.

In Richmond, three high schools addressed issues ranging from sea level rise to accessing healthy food, affordable housing, and open space, highlighting the intersecting needs of residents in the city. In San Rafael, elementary students tackled flooding, developing models and plans for their community to adapt to sea level rise. They presented their work and interviewed attendees at the Flood Fair, a Resilient by Design Bionic Team community event. In East Palo Alto, high school students grappled with the relationship between rising sea levels, housing costs and the closure of their school, developing proposals that fostered community resilience and centered cultural identities. In Oakland and San Francisco, as in other cities, students considered issues from food insecurity and floating houses to bus routes and school quality in proposing recommendations for equitable community resilience in the face of rising sea levels.

The Youth Challenge culminated in a regional summit at UC Berkeley where over 100 student representatives shared their proposals for a resilient Bay Area with their peers around the region and an equal number of regional civic leaders. Proposals included floating homes; electric buses rerouted to reach all communities; educational boardwalks installed above newly appearing marshes; exercise bikes powering a gym; and a college-bound culture with food, housing and educational opportunities available to everyone. In each case, Y-PLAN Student Scholars described how their lived experience contributed to the development of their final proposals, highlighting the important relationship between lived experience and professional practice when planning a resilient and inclusive region for and with young people.


RESILIENT
OAKLAND

Final Designs

Compost Pile

Rain Garden

Brush Layer Erosion Control

Loose Stone Check Dam

Keyline (Ploughing)

Live Pole Drainage

Cut & Fill Grading

Green Roofs

Brush Layer Fill

Food Security Garden

Detention Basin

Wild Habitat

Infiltration Zones

Brush / Earth Plugs

Rainwater Cistern

Diversion Drain

Agroforestry

Sand Dunes

Curb Cuts

Mound

Piles

Reinforced Earth Walls

Live Smiles

Roof Water Drainage

Brush Wattles (Fencing)

The People's Plan

The Permaculture + Social Equity Team

Pandora Thomas

Urban Permaculture Institute

Ross Martin Design

Urban Ecology and Design Lab, Yale University: Alexander Felson (project director), Samantha Monge Kaser (project manager), Jen Shin, Tayyaba Anwar, and Varoon Kelekar. With Ivy Li and Connor Duwan

SUMMARY:

The Permaculture + Social Equity Team (P+SET) approached Resilient by Design (RbD) with the goal of building community capacity and local eco-literacy to address the challenges of coastal adaptation and resiliency planning. Rather than generating a professional design solution, P+SET pursued an unconventional approach – a social **design process** – to create a planning process building on local knowledge and community priorities. The approach caters to vulnerable communities experiencing generations of marginalization and exclusion.

The Marin City residents invited P+SET to join with Shore Up Marin (SUM) and pilot a capacity building program to generate the People's Plan: a self-determined watershed-scale proposal, reflecting the aspirations and intentions of the community's residents. An intergenerational cohort brought their experiences and knowledge together to assess, expand, and address risks and opportunities to develop near-to-long term projects through phased implementation.

Additionally, the community expanded their advocacy practices and literacy to engage with municipal, regulatory, and regional stakeholders. P+SET firmly believes communities can solve the local and regional problems they face most effectively building on their own skills, experiences, and strategies. To demonstrate this, P+SET listened first and sought to empower residents and connect community with relevant partners.

P+SET transformed the engagement process into an authentic partnership and a reparative capacity building approach. Educational hands-on workshops and activities helped to deconstruct institutional inequities and create a comprehensive, living, People's Plan to represent the community's interests and visions. The People's Plan is a starting point for complex negotiations for collective participation to adapt to an uncertain climate.

APPROACH:

The People's Plan: A Community-Led Design Process

The P+SET design approach utilizes a Community Partnership Process (CPP) that goes beyond community engagement to position residents as leaders working through an inclusive and transparent partnership with facilitators. We encourage and support intergenerational local leaders guiding and planning the future of their community through the social design process.

The CPP specifically designs programs for local communities based on their unique assets, needs, and interests. P+SET uses a community's strengths as a starting point for building local solutions with a community-based asset-mapping methodology. In this process, community members are lead actors and agents of change. Local residents including individuals, groups and associations, and institutions bring knowledge, skills, and passions to the process to influence their physical space, foster exchanges, and foreground culture, history, and community vision. For this process, P+SET/SUM designed a permaculture-based workshop curriculum. Permaculture, a conflation of permanent and culture, is defined as agricultural or urban systems or methods that seek to integrate human activity with natural surroundings so as to create highly efficient self-sustaining ecosystems informed by ancient techniques and incorporating new technologies for stacked functions.

P+SET compliments this asset mapping and resident learning, providing technical expertise and education to build skills for interpreting pressing challenges (such as flooding in a particular location) and linking risks to community actions.

The CPP is grounded in a whole systems perspective. Multifunctional, distributed, and ecologically-based solutions are co-generated with the community through a process of ideation and rationalization. Training and capacity building approaches are used to develop stacked benefits, and to contribute to solution options.

A successful CPP would generate a community culture of place-based stewardship. Near-term small-scale projects could be pursued and implemented to establish a process of engagement and co-learning and lead to larger more elaborate collaborative designs. As participants become agents of change working through these early projects, through additional technical support and dialogue, the program would support building the community's capacity to assess risk, address challenges, and communicate in ways that enable equitable outcomes. Establishing knowledge and taking action would help to avoid local challenges that may obstruct this process of change.

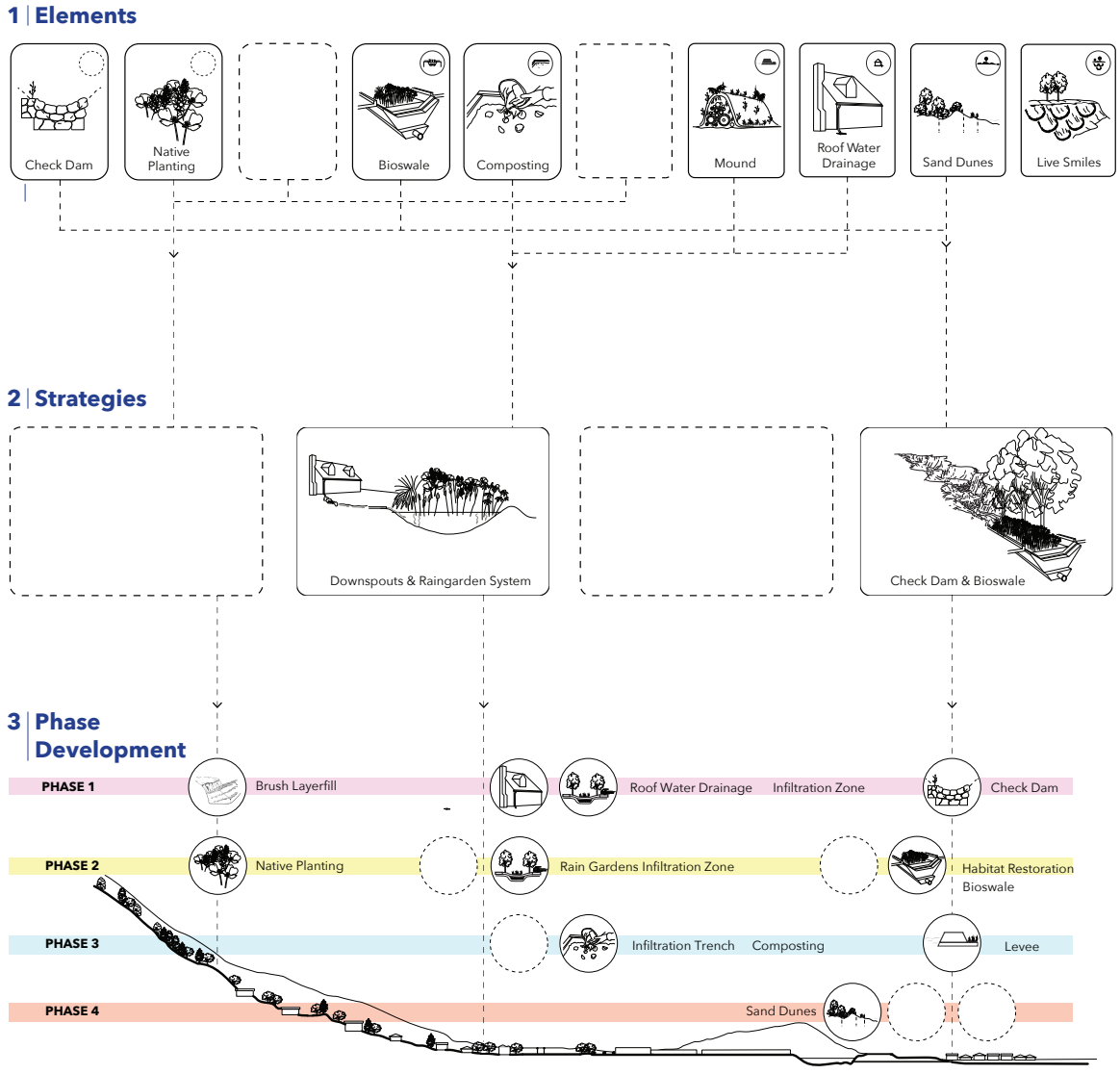
P+SET piloted a core component of the CPP in Marin City, building community capacity on top of existing assets (skills, resources, and knowledge). This typically looks like skills and literacy transfer. The culture of the design community has *professionalized* design thinking such that communities often feel intimidated and therefore cautious and guarded in their participation with anything ostensibly collaborative. The CPP aims to *de-professionalize* core aspects of design thinking grounded in a whole systems perspective. The CPP enhances existing initiatives of self-determination and seeks strategies that increase community ownership of both solutions and problems. P+SET designed the CPP as a tool and process to create a living document that captures near and long term solutions generated by the community – the People's Plan. The goal of a People's Plan is to create a more equitable arena of discussion with planners, designers, and other stakeholders, where the community has engaged in conceptual designs to address present and emergent risks and opportunities.

PROCESS:

People's Plan Community Design Tool

Working with the community, the team generated a collaborative design tool with a map and solution forms where community members could learn about and place selected practices in targeted locations with specific configurations. The tool builds on the permaculture design system based on indigenous knowledge and wisdom that elevates ecosystem health while meeting human needs. The simplified basemap represents the context of the land and community that lives there. It is an easily readable and understandable map and includes existing built elements such as streets, homes, parking lots, buildings, etc. It also incorporates watershed features, contour and any major above ground civic water infrastructure. Given the location of Marin City at the base of the San Rafael and Sausalito mountains, the cross section includes a range of conditions. Deeply eroded gullies and chronic flooding overwhelm the undersized pipes with sediment and debris. Low-lying areas that flood, isolated communities and limited egress create challenges. Based on the Marin City configuration, we developed a hierarchy of solution forms to address distinct conditions across the watershed that can function as a combined system. Effective erosion control addresses surface runoff and are important techniques for preventing water pollution, soil loss, wildlife habitat loss and human property loss.

The People's Plan is not static but much like natural cycles, will grow and change as needed over time, with the guidance of local community designers and the wisdom of natural systems.




Richardson Bay
US 101
Donahue St
Buckelew St
Park Cir
Drake Ave
Donahue St
Drake Ave
Drake Ave
US 101
WALDO
Golden Gate National Recreation Area
NATIONAL PARK BOUNDARY
LEVEE
DRAINAGE PIPES
SUB BASINS
LIQUEFACTION RISK
3 FT WATER LEVEL RISE
RAINFALL INDUCED LANDSLIDE
RETENTION BASIN
INFRASTRUCTURE
WATER
500 FT
1000 FT

The design of the Marin City's People's Plan was an adaptive process. It began with the assessment of risks by community members while also learning about and applying strategies appropriate for different contexts and sites.

Through this process, the community identified six projects representing a series of adaptation strategies spread across Marin City's watershed. These project descriptions include community-developed composite assessment sketches and solution concept renderings developed at the direction of the community. The P+SET/SUM goal is to implement one or more of the projects during the summer and fall of 2019. Over the next two to three years each of the priority designs, in whole or in part, could be pursued further and then implemented to create a showcase of demonstration projects which can be replicated and modified over time. The collective impact of these small repeated works would serve to mitigate one and ten-year storm events, increase food and water security, and, when applicable, create jobs or vocational pathways for residents of Marin City.

While the community organizing efforts focused on the six priority projects, the repeating themes or patterns of replicable decentralized solutions across Marin City will support more collective community engagement in larger, cross-jurisdictional projects of significant magnitude over 50 to 100 years. These large-scale projects include the modification of the grading and raising of the 101 Freeway corridor; dredging, modification, and enhancement of the detention basin on private property at the shopping center; and retrofitting and redevelopment of Golden Gate Village. Efforts were made to frame the pilot projects to inform these larger initiatives to be consistent with the People's Plan for no displacement, appropriate mixed income new development, and historical preservation. Community members' active engagement in their watershed through permaculture and the creation of local pilot projects led to increased knowledge and capacity. To advocate for their self-determined plan county planning and stakeholder meetings with large asset owners (Caltrans, Marin County Public Housing Authority, etc.) with the potential to inform large infrastructure projects to address local flood concerns including addressing the 100 year storm events, potential right of way flooding, and salt water intrusion from sea level rise.

Finally, as the Marin City People's Plan becomes more robust and layered with multi-benefit strategies to mitigate climate change impacts and risks, the community could become a model for distributed systems and decentralized strategies which address multi-factorial resilience stressors for other front-line communities in the region and throughout the country.

Above: Community members during the P+SET curriculum identifying problem areas on a map.

Right: The team developed a Marin City plan that incorporated the individual community generated site plans. The overall plan illustrates the connections across each distinct zone emphasizing the road network connections, trails and green spaces.


MARIN CITY
PEOPLES PLAN
MAY 20, 2016 RESILIENT BY DESIGN
0' 500' 1000' 2000' 4000'
School
Public Parkland

Six Priority Projects of The People's Plan

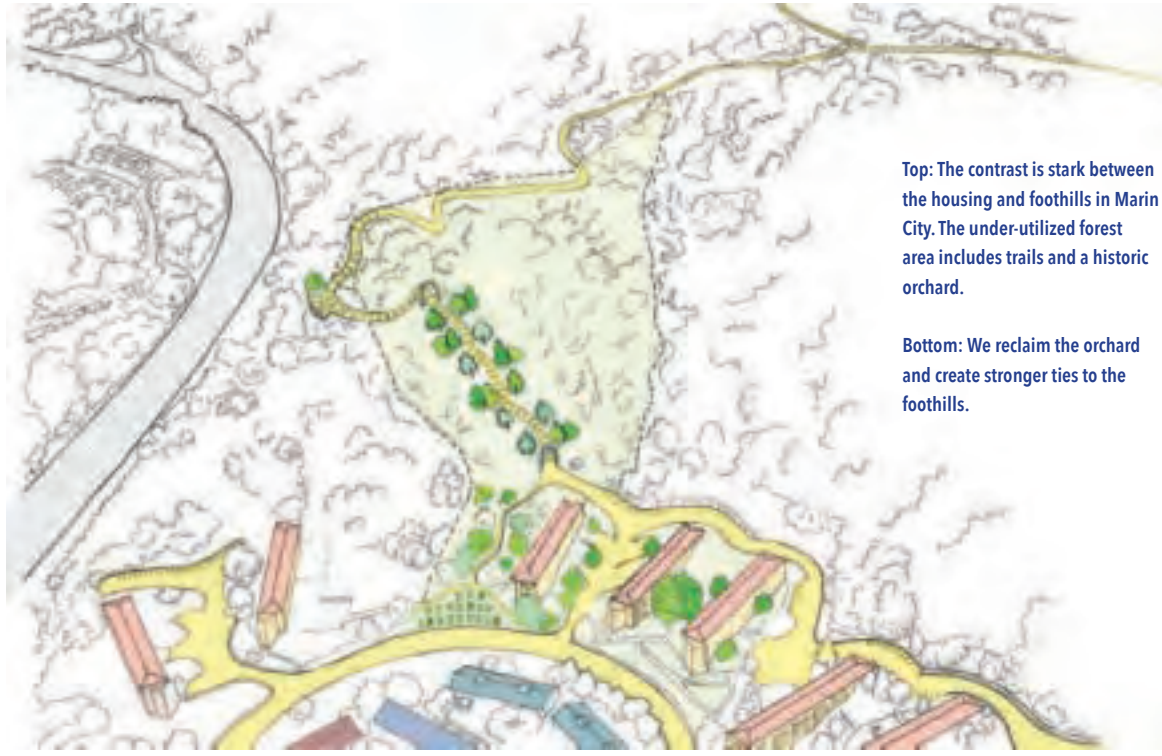
1 | Marin City Community Center and Intergenerational Garden

Assessment: The Manzanita Recreation Center sits at the heart of Marin City and houses a wide variety of programs for the local community as well as the larger surrounding population. The buildings and surrounding spaces are underutilized and not adequately maintained.

Strategies: This site is ideally suited to serve as a resiliency hub for all of Marin City to access disaster preparedness services including food, water, medical and other safety needs. In addition, the entire block could serve as a showcase for best practices including water security cisterns, rain gardens, food security gardens, erosion control measures, and other landscape strategies that can be built across Marin City to increase resiliency. A critical step to making this resilience hub work for the people of Marin City is to establish buy in and create a participatory framework. The first phase of this engagement program, the inter-generational garden—identified as being of key importance towards catalyzing the community and future projects—has already received funding.

Top: Phillips Dr. already serves as a public community corridor including the community center, school and public park. The road currently floods.

Bottom: Phillips Dr. provides an opportunity for a community resilience corridor designed with a raised road for dry egress, urban food gardens and enhanced storm water management strategies.



Top: The contrast is stark between the housing and foothills in Marin City. The under-utilized forest area includes trails and a historic orchard.

Bottom: We reclaim the orchard and create stronger ties to the foothills.

2 | Creek bed and cultural landscape restoration and management above Golden Gate Village Building 69

Assessment: The steep slopes of Marin City create flooding and erosion issues. The area behind Golden Gate Village Building 69 is just one example of erosion gullies across the watershed that create sediment build up, flooding, and erosion. In addition, there is a historic cultural landscape – an orchard – that exists in the upland area adjacent to the creek bed. Halfway up the hillside to the ridge, the land is part of the Golden Gate National Recreation Area (GGNRA), an ideal opportunity to partnership to co-manage the watershed.

Strategies: A combination of habitat restoration, creek cleanup, and implementation of erosion gully brush plugs and small check dams would slow stormwater and reduce silt. An adjacent heritage orchard and trail could be restored and replanted to serve as a community building feature and food producing opportunity.

3 | Baptist Church resiliency hub, rain garden, and cistern retrofit to showcase key strategies

Assessment: The First Missionary Baptist Church floods repetitively with large rainfall events due to the steep upland slopes and inadequate storm drains. The church is indicative of other steep areas across Marin City. Without watershed scale interventions, these areas will continue to flood. Interventions require collective efforts to slow down the water and consider the block development pattern and watersheds. Working with homeowners to understand the challenges and pursue shared solutions is necessary.

Strategies: Working with the Baptist church community, we propose to showcase one adjacent upland home owned by the church area to illustrate permaculture strategies that divert and slow the water, capturing and infiltrating it in place, and managing for erosion. The adjacent home could feature rainwater cisterns, rain gardens, a food security garden, and other showcases of best practices. We propose to negotiate access across properties that will allow for ongoing management of debris. Coupled with a storm drain retrofit, we seek to split the water and redirect overflows around the church and into the street as a key intervention, complete with diversion ditch and infiltration bioswale.

A sketch of the community feedback.

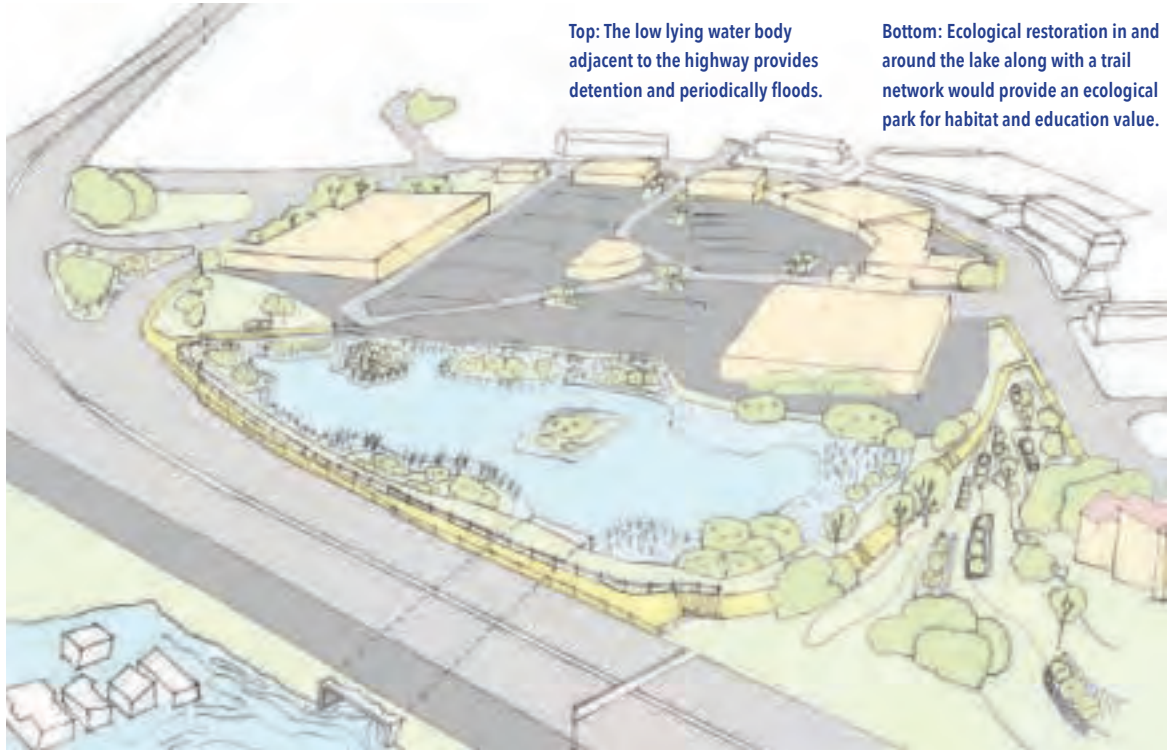
Top: Steep slopes behind the Baptist Church create erosion and flooding issues.

Bottom: Diversion channels and in stream brush plugs improve erosion issues and habitat functions.

4 | Shopping Area and Detention Basin and adjacent parking lot retrofit

Assessment: The detention basin floods periodically and it continues to silt up with debris and sediment coming from the surrounding watershed. As a result, the holding capacity is greatly diminished. Over time, it has developed an ecology and habitat as a tidal marsh with a diverse species. The location is visible from the highway and from several vantage points around the neighborhood. The pond embodies the dynamic relationship between the coastal ecology and upland watershed. Runoff from the parking area drains directly into the pond. It is currently designated as a habitat area.

Strategies: The community is interested in reinvigorating this area as a prime ecological and recreational feature with accessible parkland, pathways and seating, and informational signage on the ecology and watershed role of the pond. To do so, we propose dredging and expanding the detention basin and developing habitat restoration enhancements. Since the site is a tidal marsh, we could integrate hydrologic management as part of the redevelopment of the box culvert.



Top: The low lying water body adjacent to the highway provides detention and periodically floods.

Bottom: Ecological restoration in and around the lake along with a trail network would provide an ecological park for habitat and education value.

A sketch of the community feedback.

5 | Donohue Street neighborhood Bioswale network

Assessment: This neighborhood is the site of some of the most common flooding issues as well as one of the prime roads through town and the on ramp onto Highway 101. Donohue Street has opportunities for demonstrating strategies for capturing, directing, and managing water. These methods can be replicated in various locations around Marin City.

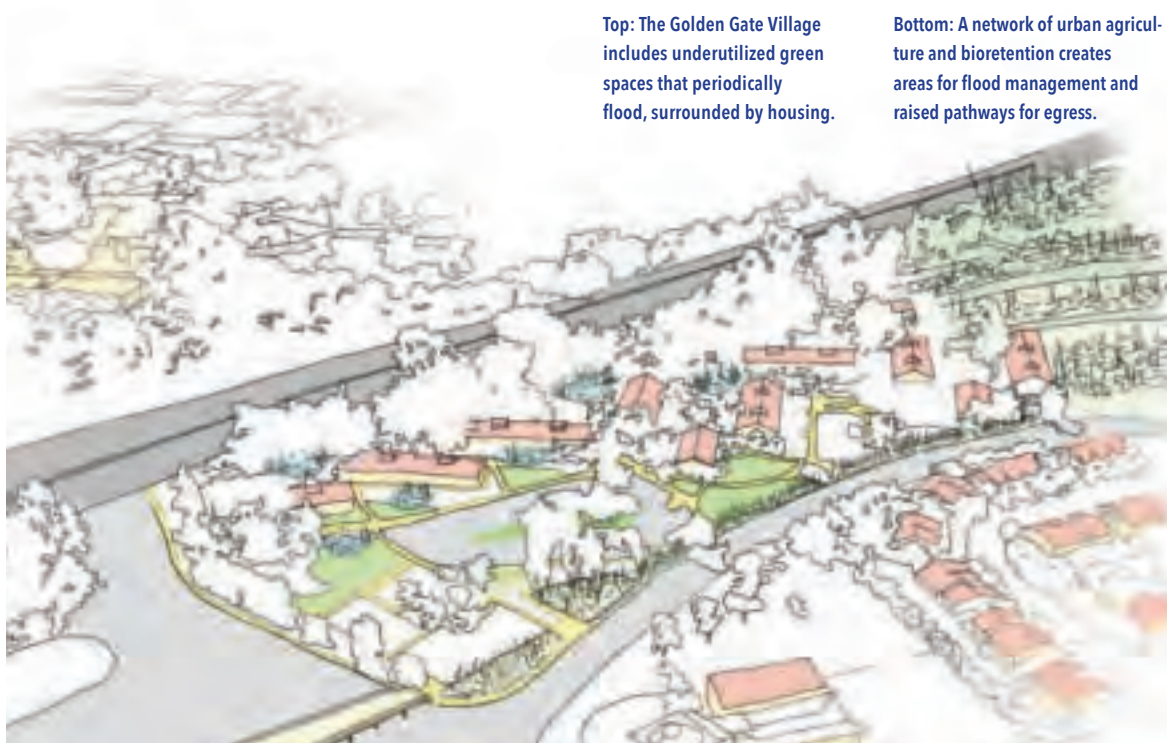
Strategies: There are many opportunities to create a bioswale network in Marin City. Between Donohue and the baseball field, there is an open space of approximately 30,000 square feet. This could be connected to receive runoff from the field as well as the school and other hard surfaces. This strategy could be paired with a series of interconnected bioswales along Donohue that include the median strip and other small spaces bordering the road.

Top: The Bayside Martin Luther King Jr. Academy and the baseball field have flooding issues and include underutilized areas.

Bottom: Introducing bioswales and retention basins create areas for managing water during flood events alongside habitat function.

Top: The Golden Gate Village includes underutilized green spaces that periodically flood, surrounded by housing.

Bottom: A network of urban agriculture and bioretention creates areas for flood management and raised pathways for egress.



A sketch of the community feedback.

6 General resilience retrofit for housing development near the entrance to Marin City

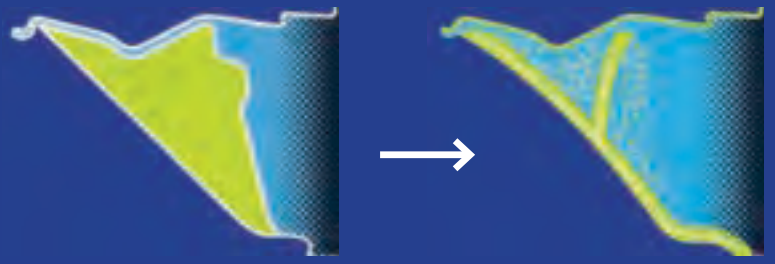
Assessment: The intersection of Drake and Donohue Streets is the location of some of the most common flooding in Marin City and access is restricted here in and out of town. The Golden Gate Village sits at the corner of the intersection and features substantial open space that could be retrofitted.

Strategies: Utilizing the various open spaces and reconfiguring the pathways and parking lots into catchment and detention basins, this site could hold a substantial amount of water and thereby play an important role in mitigating road closures. It is easily visible from the street when entering Marin City and would also serve well as a showcase to be replicated across the rest of Golden Gate Village as well as into other areas.

Forces & Flows of the
Bay Area Metropolis

Elevate San Rafael

MARIN COUNTY



TODAY
Life versus Bay

TOMORROW
Life with Bay

The Bionic Team

Bionic

Penn Design

WXY Architecture + Urban Design

Studio for Urban Projects

Enterprise Partners

Michael Yarne

SF State University

Keyser Marston Associates

WRA Environmental

RAD Urban

Moffatt & Nichol

SUMMARY:

"Elevate San Rafael" is a new paradigm for responding to complex environmental change. To "elevate" in this case simply describes what needs to be done: occupy higher elevations and raise the quality of life for everyone. Over time this paradigm changes the city by combining time-tested approaches for coastal adaptation with a moral, financial, and infrastructural agenda for large-scale adaptation. Redefining the relationship of life to the bay leverages this singular opportunity to elevate all aspects of life, from community bonds and dignity to socioeconomic standing and urban policy. It aspires to lift infrastructure to new elevations and purposes and allows for ecology to expand and persist.

Elevate San Rafael is a two-part proposal addressing near-term needs directly as well as a long-term strategy for large scale resilience. The proposal frames necessary policy and finance mechanisms to equitably stimulate and guide change. In the near term, pilot and catalyst projects protect San Rafael now, enhance community resilience, test new ecological technologies, and buy time to prepare for the future. The long-term strategy engages the forces of development, economy, and the environment to reposition the urban form of San Rafael. In time, the city will be able to anticipate change, enhance mobility, reinvent infrastructure, and enable ecology with a goal of providing enduring protection for another century or more.

APPROACH:

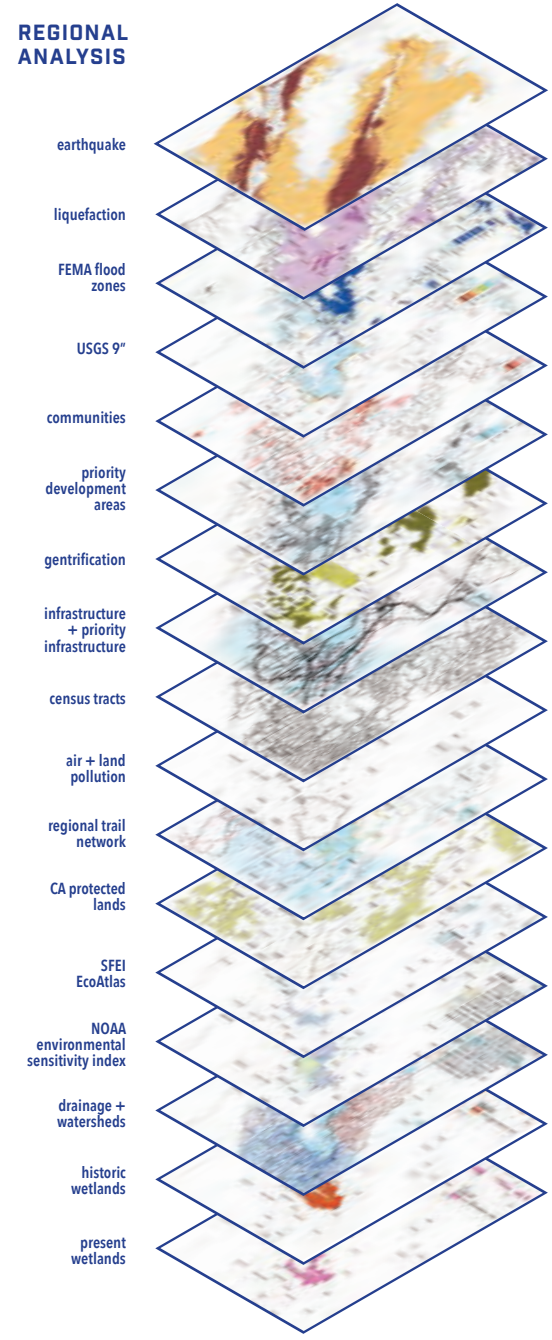
Finding the Areas in Greatest Need

The Bionic Team was organized around the cause of finding the area that needs help first in the face of sea level rise. The Team designed a comprehensive research and analysis process to identify the low-lying places where rising tides of just 6" – 12" will radiate for miles, affecting vital economic clusters, major infrastructure, and countless vulnerable people. The Team overlaid existing datasets never-before analyzed together to generate a composite vulnerability assessment.

Through this process, the Bionic Team identified the areas that are most at risk and have the greatest urgency. These low-lying areas are the places most vulnerable to inland flooding as well as liquefaction potential from earthquakes. These areas are dense, they have constrained waterways abutting valuable property, and they are often home to underserved communities.

The Team's macro-scale spatial analysis identified five territories in need of immediate attention due to both high physical risk and extremely vulnerable populations who do not have the means to address the risks. These include San Rafael, Richmond, East Palo Alto, Redwood City, and San Leandro. This is new knowledge that offers the Bay Area a way to focus on these areas and prioritize investments.

But data has its limits. So, the Bionic Team asked: "What is missing from the data? What is the data not saying?" To answer this, the Team conducted a more nuanced, fine-grain assessment of these places through



3 SCALES OF ANALYSIS

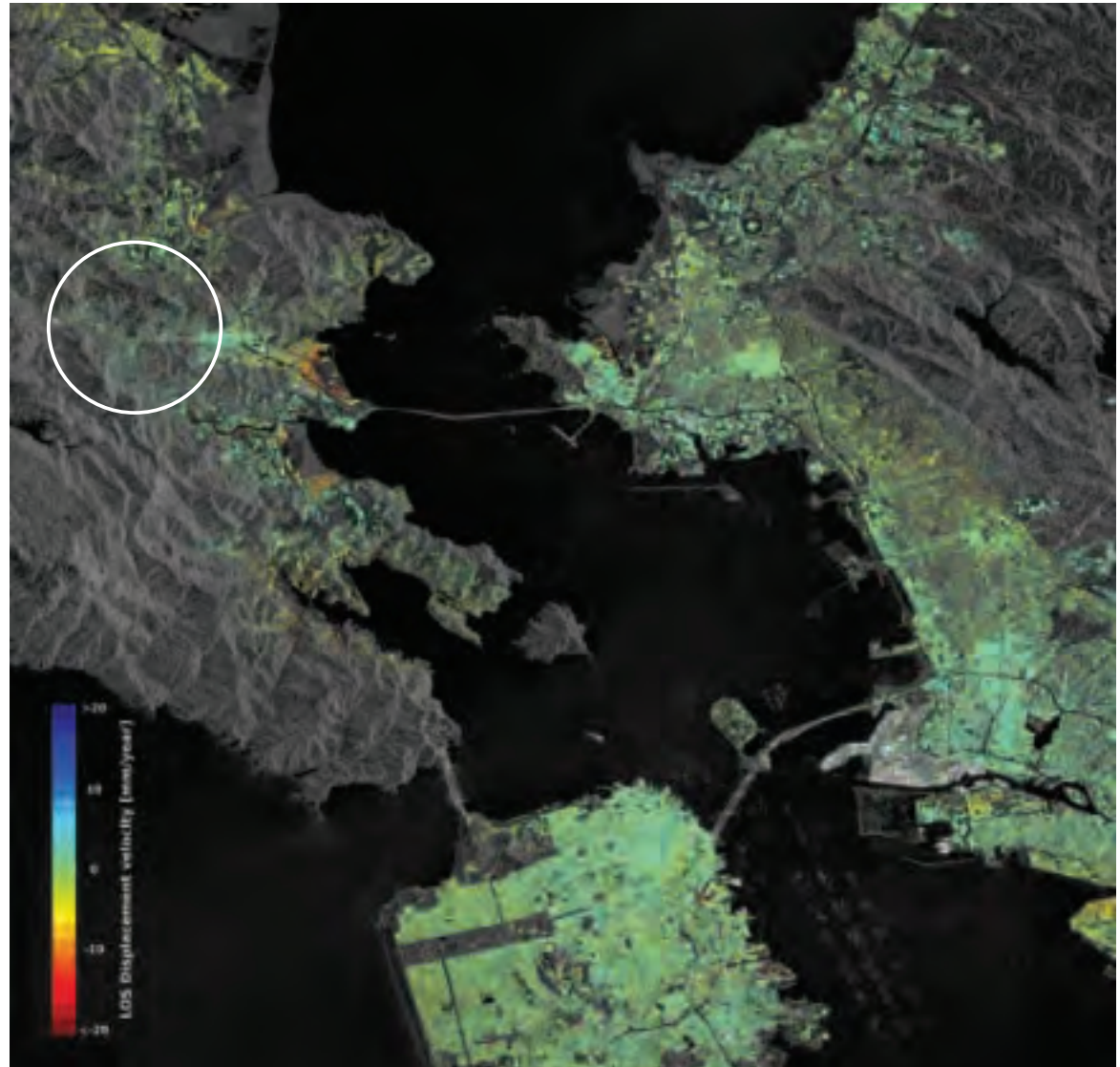
Bay >> 5 Territories >> San Rafael

site-scale analyses of existing conditions, communities, and ecologies, a review of previous and existing initiatives, and on-the-ground field visits, interviews, and videography.

Each of these places is unique and complex. The watersheds are commingled with old infrastructure, communities are tightly knit, and outdated structures are pervasive in the lowest areas. Some areas have active stakeholders. Some areas have initiatives already in motion, while others do not.

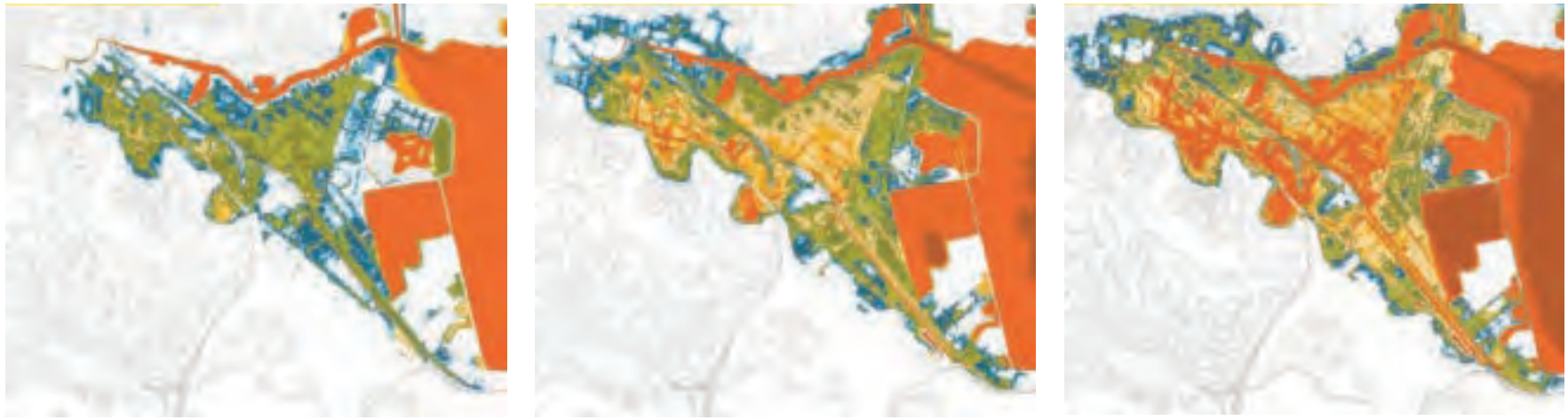
Through a site selection rating system based on the Team's macro- and micro-scale analyses, the Bionic Team identified San Rafael in Marin County as the area demonstrating the greatest need.

While San Rafael is a small town, it is one of the region's vital infrastructural, logistical, and workforce centers. Yet San Rafael is subsiding at alarming rates. As one of the lowest-lying areas in the Bay Area, San Rafael will feel the effects of sea level rise first.



SUBSIDENCE MAP

San Francisco Bay subsidence showing San Rafael in comparison to other logistical and infrastructural centers. Source: http://www.esa.int/spaceinimages/Images/2016/11/Bay_Area_displacement



(7.87 ft, 2017)
Equivalent to MHHW in 2040

100-year event
(10.06 ft, ~2040)
Equivalent to a 25-year storm or 10-year storm w/ 9" of SLR in 2040 or 10-yr storm w/ 20" of SLR in 2060

500-year event
(10.06 ft, ~2040)
Equivalent to a 25-year storm or 10-year storm w/ 9" of SLR in 2040 or 10-yr storm w/ 20" of SLR in 2060

Data Source: "San Francisco Bay Tidal Datums & Extreme Tides Study," February 2016

At Risk

San Rafael is a small city of 59,000 that exhibits all the stresses of the Bay Area Metropolis because it is one of its vital infrastructural, logistical, and workforce centers. It is home to vibrant communities and industry all located in low-lying areas. It is built on what was formerly salt marsh and mud flats. San Rafael Creek flows through the area. A portion of the community lives and works on the water. Yet the infrastructure, roads, housing stock, and natural environment are all showing signs of urban stress and environmental change. A large portion of the tax base is light industrial and auto retailers. Downtown is located along the creek. And there are existing neighborhoods and community facilities, all in low lying areas.

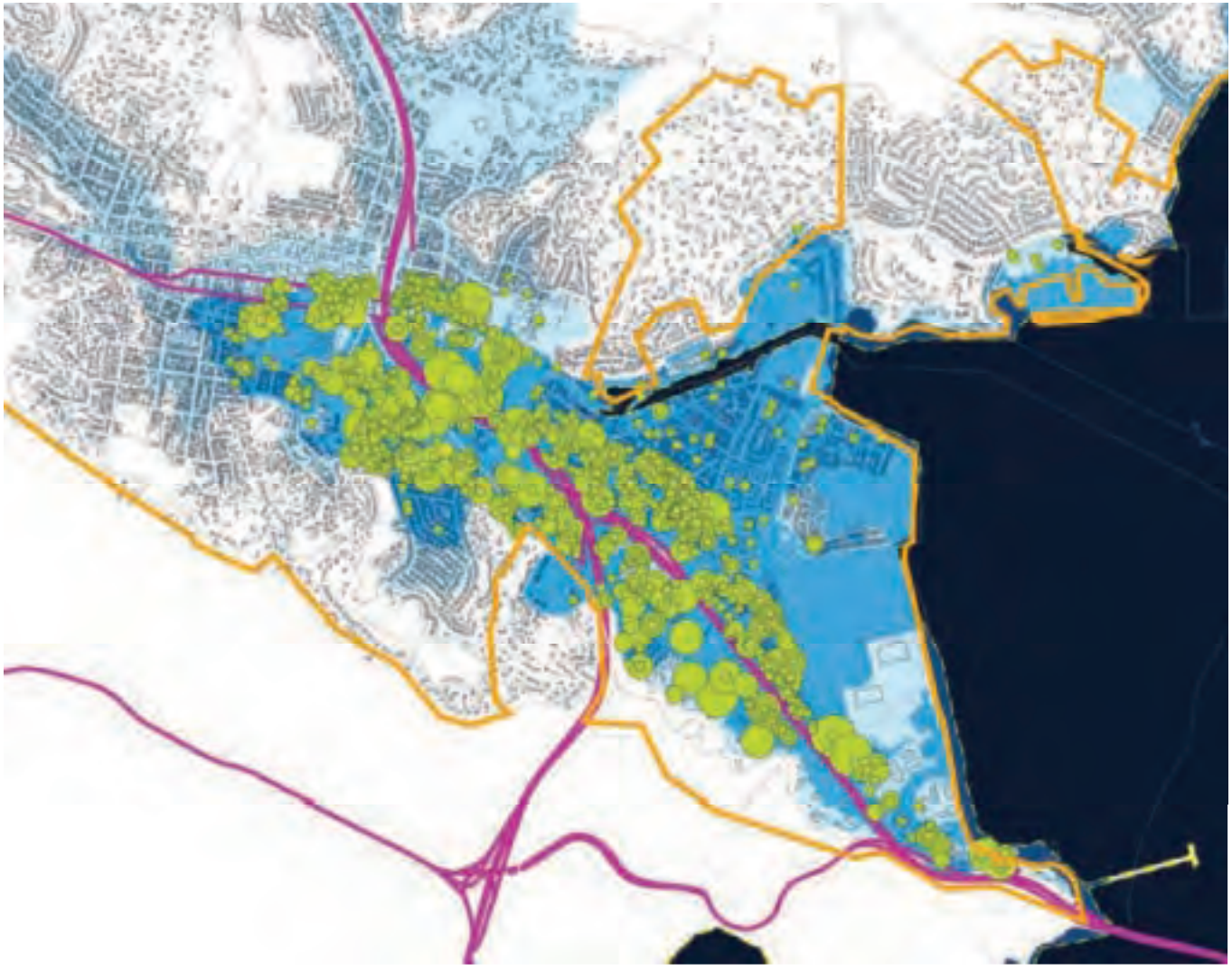
Today, all of this is threatened by flooding. San Rafael has assets and risks at all scales from the size of an individual property to the scale of the regional infrastructure. The combination of climate events, subsidence, and tides could create flooding now. This will only get worse with sea level rise. The Bionic Team quantified and measured these risks to help educate stakeholders and to ground the design in data and facts.

This analysis produced 6 major vulnerabilities:

- San Rafael is critical to the regional economy and workforce.
- The tax base of the city is at risk because much of its business taxpayers are in the flood plain.
- Business owners are at risk because the lowest areas have old failing infrastructure.
- The pump system is a major vulnerability, and human or technical failure could devastate the local economy.
- The housing stock in the Canal District is at risk of condemnation if there were a flood event.
- Human life is at risk due to the number of ground floor units, lack of emergency preparedness, and few escape routes.

These risks exist due to a range of existing conditions and outdated infrastructure. Downtown and East San Rafael are located within a singular watershed. All rain eventually flows to and under the Canal District which is the lowest lying area of San Rafael and thus will be the most severely impacted by storms and sea-level rise. The area usually stays dry now because it is pumped. However, there are many corroded and undersized pipes. This system is a major vulnerability: any human or technical failure could devastate the residents and local economy at any time. The further out in time, the greater

Data Source: Marin County Accessors Office



ASSETS AT RISK

100-year event

Residential Units	5,019
Jobs	10,852
Land Value	$1.95 Billion
Business Revenue	$2.68 Billion

500-year event

Residential Units	5,423
Jobs	12,826
Land Value	$3.95 Billion
Business Revenue	$2.95 Billion

- Business sales volume, businesses located in the 500-year floodplain
- Highway
- Bay outline
- San Rafael city boundary
- 100-year flood zone
- 500-year flood zone

the potential of human suffering and loss of life.

The challenge for San Rafael is threatened by the old paradigm of monofunctional infrastructure. For good, practical, and humane reasons, the easiest solution for the complex pattern of urbanism and coastal dynamics in San Rafael would be to gate off the creek, raise the levees, and proceed with life as it is known today. But to continue with this paradigm would compound risk. It would increase the separation that the city has with its waterfront. It would perpetuate the deep issues of urban stress placed on businesses and the community, all located below sea level. It would further eradicate coastal habitats and interrupt coastal processes. If there were a failure it would be a humanitarian crisis. As sea levels rise it would ultimately become obsolete, and a legacy offering danger with even fewer options remaining for future generations.

The old paradigm is disaster, which would define us. Through the course of the analysis phase, the big questions became clear. Is the cost, effort, and ecological impact of the conventional solution worth it, and for whom? Is there another way? Or can San Rafael initiate a process of strategic change? Finding a new paradigm is the challenge for San Rafael.

Flood mobile

Design as Agency for a New Paradigm

The Bionic Team designed the engagement strategy to reach the greatest number of residents and constituents in a short period of time. Working with community partners and employing the team's resources, the Team created a broad presence to the community at large and to groups with special interests to learn about their needs. In a short amount of time, the Bionic Team wanted to understand the details of life in San Rafael, and the everyday issues that matter for people, their families and businesses now. The Team also wanted to reach a deeper level of conversation with the people that live there about the threat of flooding and sea level rise. From these interactions, common themes and patterns emerged to inform short and long-term design thinking.

The people of San Rafael share the desire for essentials that allow them to thrive - safety, secure housing, a livelihood, equal access to resources, and a community to rely on. The Bionic Team also gained an appreciation for the community members themselves and their social cohesion, which is complex, interwoven, and highly resilient.

A new paradigm for adaptation requires new methods, tools, and techniques. At every stage of the challenge, the Bionic Team asked "how can design be used to find another way".

Community Engagement: Flood Fair, stickers, school visits, and tours

FLOOD KIT

The Team used drones, underwater cameras, time lapse video, simulation software and sensor data in the analysis and visualization. To communicate with the community and stakeholders, the Team designed logos, stickers, books, posters, digital graphics, and surveys. To engage and educate people who have differences in learning, the Team designed a 3-D printed flood kit. To increase the visibility of the issue and the cause, the Team designed a van, the Flood Mobile / The Flo-Mo and left it as a gift and tool for community partners to continue their work. The Team designed multiple tours and curated events that offered access to experts and opportunities to discuss ideas. Through these techniques, the Bionic Team was able to speed up time, get more people's attention, move faster, provoke deeper questions and answers, and transcend educational, language, and age barriers to engaging people. The agency of design in all forms created access to the information necessary to elevate the dialogue and the process.

FINAL PROPOSAL:

Elevating San Rafael

East San Rafael is home to a vibrant community that would like to stay in San Rafael - it is their home, their livelihood, and their community. Leaving San Rafael is not an option. To remain in place, elevating is the answer.

To "elevate" is the simplest way to describe what needs to be done: to occupy higher elevations and raise the quality of life and social connection for everyone. The project proposes that the city should not merely adapt, retreat, or resist, but instead should evolve with intention.

To elevate is to physically elevate habitation and the bonds of community and dignity; to elevate one's social and financial position in life, and develop policy for urban change; to lift infrastructure to a new level and allow for ecology to expand. Elevating is an opportunity to improve both housing and bay ecology. Elevating is expansive and inclusive, simple and synthetic, multi-generational, urgent and patient, real and futuristic, sensitive and bold, policy and practice. It must be done by design, not by disaster. It must done for the benefit of all, not the few. It must begin now, not later, and it will require changing policy and financing mechanisms to make it possible and equitable.

Elevate San Rafael is a two-part proposal addressing near-term needs directly as well as a long-term strategy for large scale resilience.

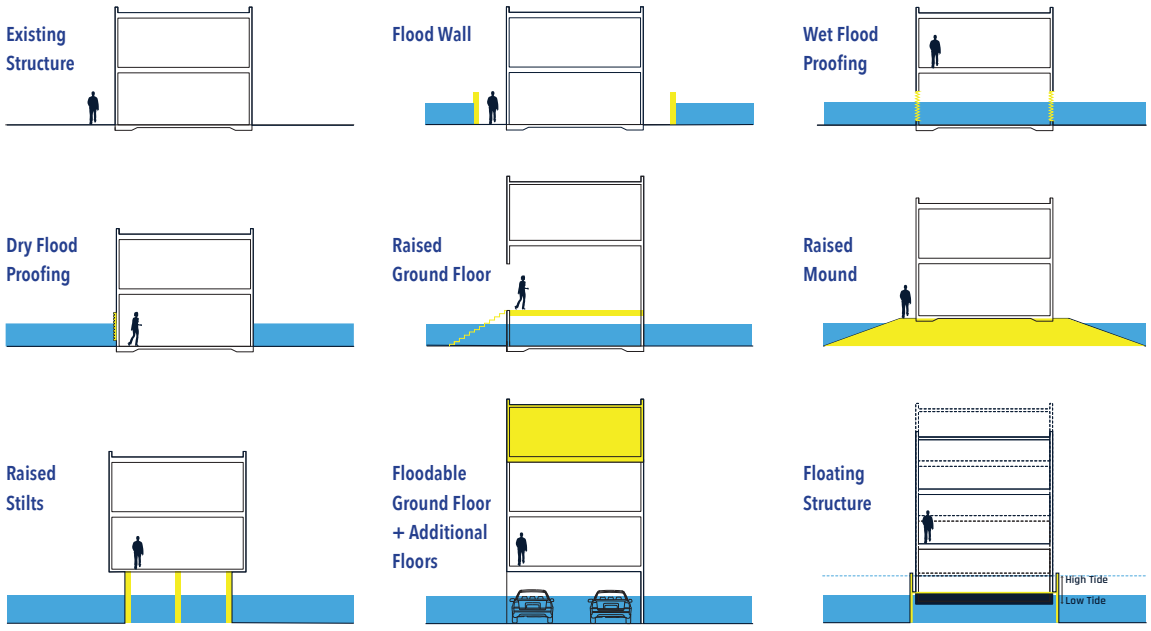
Elevating in the Short Term: 5 Catalyst Projects

Pilot and catalyst projects protect San Rafael now and allow the existing community to remain in place. The projects enhance community resilience, test new ecological technologies, and buy time to prepare for the future. Through this framework, future generations will have options, space, and resources for how they continue to build resilience.

CATALYST PROJECTS

1. Buy Time
2. Protect Pickleweed Park
3. New Forms of Living
4. Canal Ecology
5. The Reef

ADAPTATION STRATEGIES + TYPOLOGIES



Catalyst Project 1: Buy Time

The Bay Trail currently runs along the San Rafael shoreline but does not connect the shoreline to the neighborhoods, to downtown, or the creek. A new bike lane levee on Canal Street (City-owned land) would complete the Bay Trail with a Class-I multi-use path that doubles as flood protection for the majority of at-risk housing and businesses. Equally important, the new facility would future-proof essential utility services. The Class-I multi-use path solution also activates new priorities and requirements for upgrading buildings. Similar to the seismic upgrade programs in San Rafael, this approach requires safety upgrades for flooding and offers owners choices on how to adapt.

Catalyst Project 2: Protect Pickleweed Park

The Park is the community's most important resilience infrastructure. This catalyst project proposes to upgrade flood infrastructure and a pump station with a multi-benefit project that would also create an event space, a new playground, sports facilities, and a water sports access. In the case of emergency, this project would be stout enough to withstand flooding and provide a safe haven for the community in a time of crisis.

Upgraded sports facilities

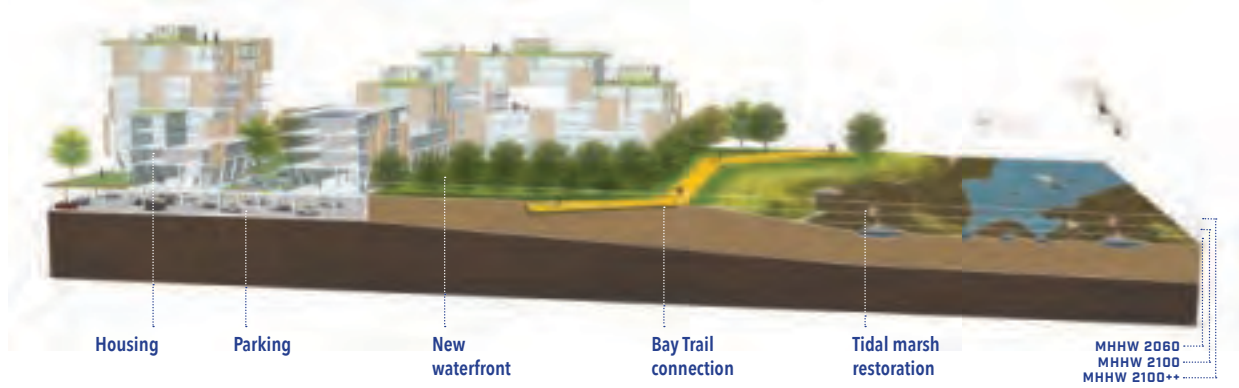
Multi-purpose shed and pump station at Pickleweed Park


1 Bike path flood wall
2 Shared playground
3 Community shed
4 Pump station
5 Boat storage
6 Boat launch + deep water access
7 Levee trail
8 New athletic fields
9 Wetland observation deck
10 Wetland restoration
DISASTER RESPONSE CENTER
PICKLEWEED PARK COMMUNITY CENTER


EXISTING HIGH GROUND
NEW HIGH GROUND + HOUSING
EXISTING HIGH GROUND
New forms of living at the water's edge

Catalyst Project 3: New Forms of Living

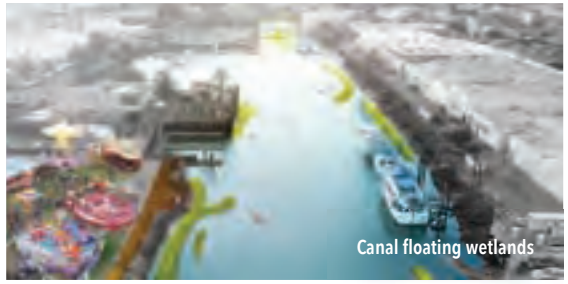
To accompany new policy for community values, resilience planning, and adaptation incentives, an upgrade to the housing stock would be created on a large underutilized site adjacent to the existing community. This project would establish a new datum for flood protection through the creation of a large parking podium to accommodate the many Canal residents who make a living using their vehicle. This seemingly common construction would solve a basic need for housing, flood protection, and parking in the near term, and create long-term flood protection for the city. The new datum would also sponsor the creation of a large restored marsh and recreation area.



Moon rise over created tidal marsh

Catalyst Project 4: Canal Ecology

The pattern of parcelization, ownership, and maritime uses along the canal is the source of its charm and its greatest weakness. To add to San Rafael's resilience, the canal requires incremental transformation. To prime its potential as a waterfront and a destination, a program of floating wetlands would be installed along underutilized portions of the creek to provide a range of ecological services. The wetlands would stimulate activity, test their viability, create habitat, reduce erosion, and build stewardship.



Canal floating wetlands

Enhanced biodiversity shoreline

The Reef: research platform and recreation destination

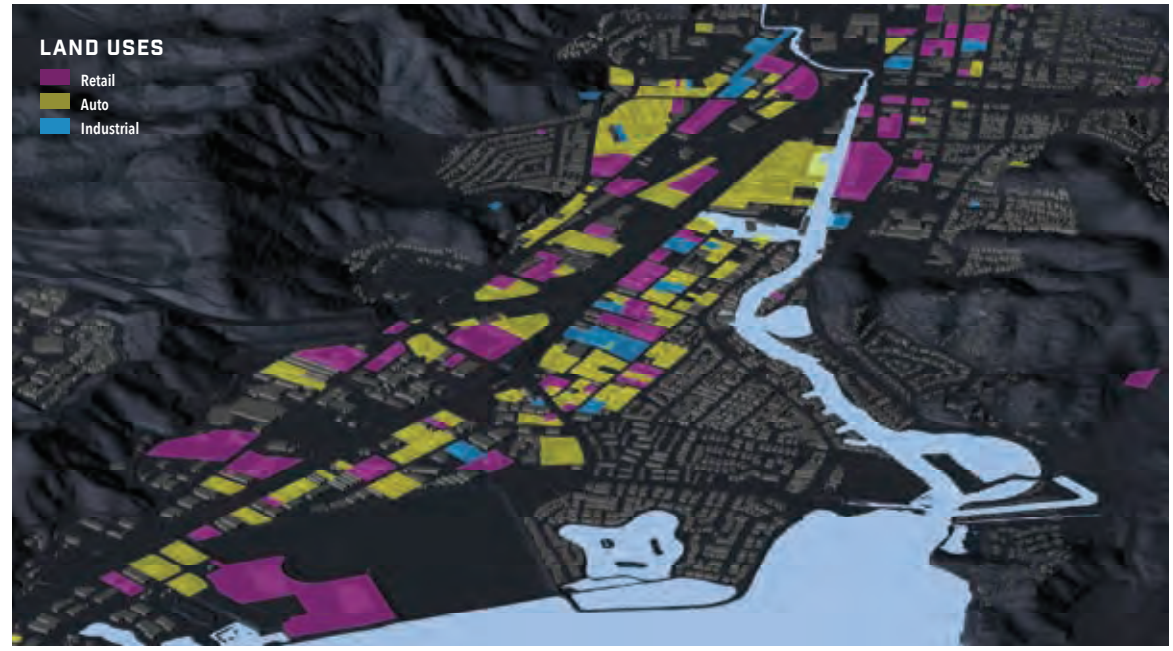
The Reef integrating habitats and coastal processes.

Catalyst Project 5: The Reef

The ecology of the water's edge in San Rafael is a series of disconnected habitat projects and resources. In the center of the shoreline there is an existing pilot project testing constructed oyster habitats and how they react to coastal processes. A more resilient and diverse edge would be interconnected, related, culturally valued more broadly, and equipped to adapt to more environmental change and less sediment supply. The existing living shoreline program could be expanded to test the ability of this technology to influence coastal processes, habitat creation in a greater range of bathymetric conditions, sedimentation, and wave energy dissipation in the long term. The tidal zone could grow into a nursery for a diversity of marine species, a wave attenuator, and sediment surging device for marshes, and a gradient of integrated ecological niches.

Invisible Forces

The business tax base of San Rafael in the 100-year floodplain is largely comprised of uses that are undergoing industry transformation. Incremental change is happening in automobiles, retail, logistics and supply chains, labor, and building trades. These changes are occurring over the San Rafael terrain at a steady but difficult to perceive pace. In addition, the economics of the insurance market for flood-prone areas like East San Rafael is rapidly changing the value of property and patterns of urbanization. These invisible forces will shift the ownership of large parcels of land throughout the East San Rafael floodplain in the coming decades. The combined effect of the invisible forces shaping San Rafael could be understood and engaged as an opportunity to gradually reposition the urbanization pattern of today to an urban form that can sustain life in the uncertain future of rising sea levels.

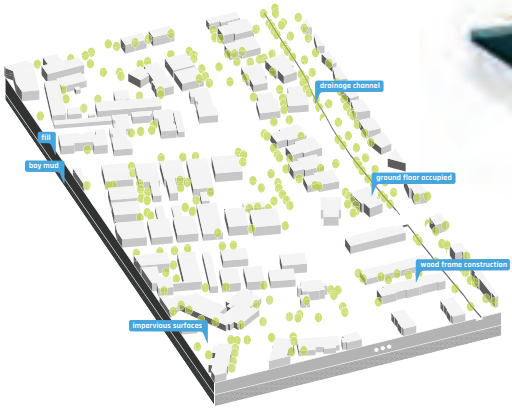


Elevating in the Long Term

The long-term strategy engages the invisible forces to enhance mobility, reinvent infrastructure, enable ecology, and provide enduring protection. The city will need to use incentives to shift the pattern of urbanization from diffuse and auto centric to a more equitable and resilient urban form. Using enhanced zoning, density bonuses, housing subsidies, and community land trusts, property owners could be motivated to face the creek, add housing and business space, provide continuous water access, and nature-based solutions to define the edges.

The 101 and 580 freeways run through San Rafael. They are critical infrastructure for the region and need to be protected. Kerner Boulevard connects the high ground to the south with Pickleweed Park. Francisco Boulevard parallels the transportation corridor

TRANSFORM



AFTER

KERNER BLVD.

1. New Fill
2. Bay Mud
3. Existing Ground
4. Existing Fill
5. Linear Cistern
6. Drainage Channel

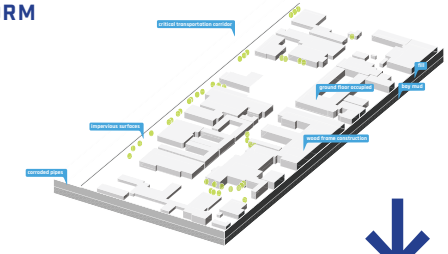
and leads to the down town area. These two corridors should be the future spines of development, services, infrastructure, and movement. Along these city-owned streets, acquired properties could be raised to higher elevations and connect higher ground. Infrastructure in these elevated alignments could be buffered from destructive forces of water and seismicity by new edges that host ecologies, culture, and maritime activities. Infrastructure could also influence the pattern of development away from the most hazard prone and subsided areas. Pickleweed Park would remain connected to the community and a center for maintaining social resilience.

Along these two critical spines, owners could choose to protect in place, raise, or sell, and parcels could be acquired for the creation of green infrastructure. Over time properties could reorient their position to the environment and the infrastructure that support them.

Building on the catalyst and pilot projects of the near term, San Rafael could gradually shift resources away from the current pump and levy system and reduce the perimeter extent the City maintains for risk reduction.

Paired with programs for upgrading to floodable buildings, acquisition of property for infrastructure protection, and equitable housing, this strategy proposes to build a city scale apparatus of green infrastructure that would elevate life in San Rafael and all of the systems that support it.

TRANSFORM



AFTER

FRANCISCO BLVD

1. New Fill
2. Bay Mud
3. Existing Ground
4. Existing Fill
5. Linear Cistern

Future central spine of development, services, infrastructure, movement and long-term protection

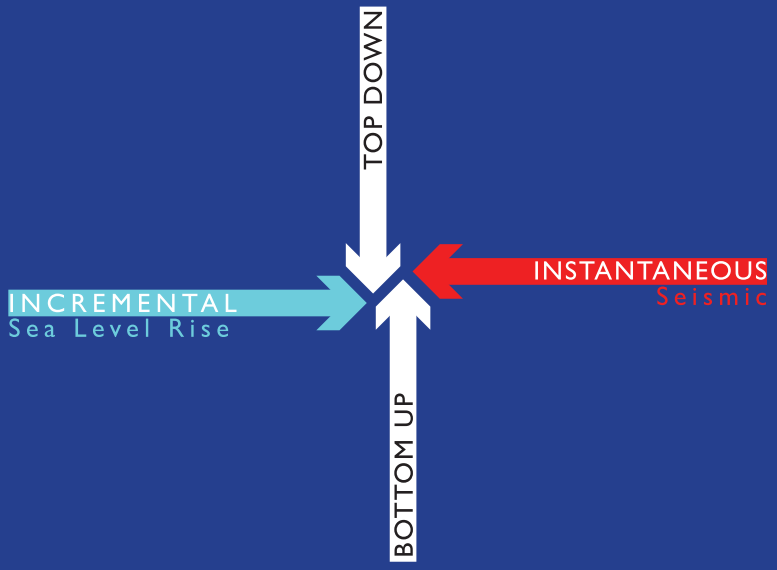
A Nexus of the Region

San Rafael is a nexus of the region. It is one of the four cities that conduct the flow of goods, materials, energy, and logistics that support the Bay Area Metropolis and its economy. Unlike the other three cities it does not receive the same level of investment in the infrastructure that it hosts on behalf of the region. To sustain life in the small city and fund large scale changes, San Rafael needs to reframe its significance to the regional, state, and federal agencies.

"Elevate San Rafael" is a strategy for local incremen-tal change that would accumulate into large-scale resilience for the region over time. San Rafael itself is infrastructure. Like any other regional infrastructure, it will take generations to plan, fund, and build resilience for this nexus of the region. Yet through this framework, future generations would have options, space, time, and resources for how they continue to build resilience and could choose to persist in this place for another hundred years or more.

The Grand Bayway

SOLANO, SONOMA, NAPA, AND MARIN COUNTIES



Common Ground

TLS Landscape Architecture

Exploratorium

Michael Maltzan Architecture

Sitelab Urban Studio

Rana Creek Design

Richard Hindle, UC Berkeley

HR&A Advisors

Guy Nordenson & Associates

Lotus Water

Fehr & Peers Transportation Consultants

Dr. John Oliver, Moss Landing Marine Laboratories

SUMMARY:

State Route 37, a low-lying commute route that skirts the northern edge of San Pablo Bay, is both traffic-choked and increasingly flooded due to sea level rise. Sitting atop a precarious levee that confines an immense but compromised marsh complex, Dr. Fraser Shilling of the UC Davis Road Ecology Center has observed, "The highway has the dubious distinction of constricting both traffic and tidal flows." The project considers a new future for this highway as an elevated scenic byway, creating an iconic "front door" to a vast ecological open space previously known to few. Accessible to cyclists, runners, kayakers, campers, and fishermen, the Grand Bayway would become an ecological Central Park with more 21st century sensibilities for rapidly expanding North Bay communities.

APPROACH:

Finding a Place for a New Bayway

Typical of San Francisco Bay in general, San Pablo Bay is structured by parallel rocky, fault-generated ridges and soft alluvial lands between them where water collects and flows. Flat and compliant, shoreline marshes and mudflats have been an easy place to construct infrastructure – highways, railroads, airports, and refineries. This project is about adapting our lives and our infrastructure within these fertile and biologically diverse lands frequently degraded by marginal human uses and unstable fill. These lands are often home to shoreline communities at the frontlines of sea level rise, including some of the most disadvantaged neighborhoods in the Bay Area. City and regional leaders need a plan, not just for how to patch flooding problems, but for how to safely and sustainably grow their cities with a focus on people, habitat, and healthy connections with the Bay.

As the team immersed itself in the regional issues, Common Ground focused on 'Segment B' of SR 37 that spans from northern Mare Island to Sears Point. This

SR 37 corridor and the San Pablo Baylands on the northern periphery of San Pablo Bay

Low-lying SR 37 corridor as seen from Vallejo with the baylands on its right and San Pablo Bay on its left.

site focus was prompted by both stakeholder priorities and an assessment of which section of the highway would yield the richest array of opportunities for resilience problem-solving on behalf of the San Pablo Bay community. Because the baylands to the north of this segment are inextricably linked to whatever solutions are proposed for the highway itself, the team viewed the entire zone, replete with overlapping natural, infrastructural, and cultural systems, as a single logical planning unit, not only a highway study.

Of the >30,000 acres of baylands north of SR 37, almost all are designated as National or State Wildlife Refuge and represent the largest remaining marsh complex in San Francisco Bay. The estuaries, littoral mudflats, and open shallows support a huge diversity of resident and migratory bird species and the baylands are crucial nurseries for fish species such as Steelhead trout and Chinook salmon. Bay Area taxpayers and NGOs have invested >$600,000,000 in wildlife conservation, baylands restoration, and protection from inundation by the Bay, which is the default outcome without any intervention.

Despite restoration efforts in recent decades, the San Pablo baylands still bear the signs of 150 years of human use, first leveed and "reclaimed" for agriculture and later for salt ponds. Cut off from tidal exchange and watershed runoff, they gradually subsided up to 8 feet due to peat depletion from farming and lack of natural sediment deposits. The entire area is at risk of becoming open water and losing much of the ecological function and recreational value it offers today. Restoring these voids of subsided lands by conventional means would consume more resources than would be feasible, both in imported sediment as well as money. Skaggs Island provides a clarifying example. It would require 40-60 million cubic yards of fill to restore Skaggs, but the Army Corps of Engineers only allots 1 million cubic yards of dredge for beneficial reuse for the whole bay each year.

This land use legacy has far-reaching implications for both the resiliency of these ecosystems and the potential adaptation of SR 37. As sea level rises and more ocean water fills the bay, tributary wetlands and shallow channel systems will cut deeper and tideheads will move inland. Sea level rise will also likely cause levee failures, and with these breaches come an increase in tidal prism that will require the creek mouths to widen considerably to allow for these increased flows. If the new SR 37 spans Tolay Creek and Sonoma Creek, longer spans will be needed to traverse these widened channels.

Coinciding with sea level rise is a projected decrease in sediment supply. While the natural berm on which SR 37 is built is formed by wave-deposited sediment,

Right : Engagement exercises and events in multiple cities around San Pablo Bay helped the team understand the array of community aspirations and concerns for SR 37 and the baylands .

much of this berm and "strip marsh" we see today is comprised of sediment and fine gravel flushed through the delta by hydraulic mining in the mid and late 19th century which grew the berm further into San Pablo Bay. As less sediment enters the bay, the southernmost marsh edge will begin to recede northward, back toward the highway and will likely migrate north of the current SR 37 alignment. Any new highway solution should account for this by allowing this transition to proceed unimpeded.

This region is the locus of palpable urgency for both conservationists and transportation planners. There is a will to address these issues, but the way forward remains unclear and at times contentious. The challenge of this site is not only that it is a swath of subsided land larger than the city of San Francisco that is at immediate risk from sea level rise and storm surge. The challenge that Common Ground faced was also to find ways to simultaneously address the goals of conservationists, transportation planners, and North Bay communities by reconciling these interests and, where possible, finding ways that their efforts could reinforce each other.

Foundational to Common Ground's approach was incorporating key messages the team heard from the residents and commuters of the region, including feedback on past planning work in the area to address transportation and environmental issues. Since so few people live in the San Pablo Baylands, the team went to communities throughout the four North Bay counties that border the baylands and depend on SR 37. The team held and attended events to solicit input at local farmers markets, the annual San Francisco Bay Flyway Festival, local schools and other Bay Area learning institutions, and in the baylands themselves. These events, along with online surveys, served as a forum for communities to voice their desires and vision for the baylands and future SR 37 redesign. This data was paramount in grasping a full picture of opportunities and constraints in the area.

Some of the main themes that appeared in these conversations and online feedback centered around traffic, resiliency, and the recreational and ecological resources the baylands offer. Participants noted the highway flooding in early 2017 that closed SR 37 for 28 days and highlighted its vulnerability to sea level rise. They also expressed their appreciation of the wetlands and sloughs, though not all had ventured within the baylands due to lack of access, signage, directions, or parking. Others noted the terrible traffic along Highway 37, but also how wonderful the views are. Many visitors to the baylands travel there to birdwatch, hike, bike, taste wine, attend raceway events, and kayak. These contributors shared that they were most excited about future guided tours and educational opportunities, improved pedestrian and bike trails, more water access and bird watching options, and new picnic and camping areas.

Throughout the design process, the team sought input from a stakeholder working group comprised of transportation planners, ecologists, public access advocates, landholders, and other advisers. These conversations, along with the feedback from North Bay communities, provided clear mandates and standards by which we could measure our design proposal in four key areas:

Identity

Strengthen the identity of the San Pablo Bay region to encourage better understanding of the baylands as a major ecological and educational resource.

Adaptation

Provide new strategies for adaptation of the San Pablo Baylands in response to sea level rise.

Mobility

Deliver long-term intermodal connections around and across the San Pablo Baylands.

Access

Provide more equitable access to the communities of San Pablo Bay, with particular attention given to programs for disadvantaged communities to broaden the constituency for the baylands.

To capture and hold the attention of policymakers and communities, solutions to sea level rise have to be about more than just mitigating threats. Design solutions must demonstrate near and long-term value by creating opportunities for shoreline cities to grow and improve along the Bay, fostering new, more complex relationships between land and water.

FINAL PROPOSAL:

S(cenic) R(oute) 37

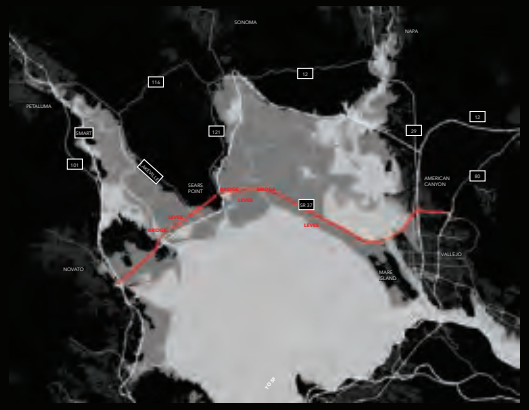
Building from engagement with local communities, stakeholders, and experts, Common Ground approached the Design Phase as an opportunity to envision ways that life in the North Bay could grow in a more holistic way and foster a lifestyle not only on dry land but interwoven with the complexities and opportunities of the bay. As part of this work, the team reimagined how the SR 37 corridor could benefit the restoration and adaptation of the Bay Area's largest continuous bayland marsh system and equitably connect communities around San Pablo Bay through a resilient and diverse transportation network.

The design proposes an adaptation strategy for SR 37 that incorporates the objectives of conservationists and transportation planners while also advocating for a larger constituency of North Bay communities seeking increased equitable public access to the baylands adjacent to SR 37. To this end, Common Ground proposed two strategies for the highway that were both consistent with these goals for mobility, conservation, regional identity, access, and adaptation: 1) elevate the highway as a scenic causeway adjacent to the existing highway alignment or 2) move the highway northward and inland to higher ground that is unlikely to flood under even extreme projections for sea level rise or storm surge. Both options would reduce flood risk, expand vehicle capacity, offer additional opportunities for public access to the baylands, and provide unconstrained ecological and hydrological connectivity. While each option comes with its own set of costs and opportunities, the Common Ground proposal remains "alignment agnostic" – the highway alignment will ultimately be determined by thorough studies of travel origins and destinations, costs, and environmental impact, all of which are already underway by other agencies.

Regardless of the alignment that is ultimately selected, the Common Ground proposal advocates approaching design alternatives as more than just instrumental solutions to a highway project that risk replicating the auto-sprawl of the past. Taking cues from the USFWS Roadway Design Guidelines and an array of international precedents, the project proposes a new SR 37 that would be more responsive to landscape features and ecological processes. This "Grand Bayway" is designed with the same ambition and flair as other iconic bay crossings but based on 21st century sensibilities for the natural environment and diverse transit types. Rather than broad concrete platforms atop a forest of columns, this design is based on the principles of scenic byway design, curving to open views over the bay and marshes and oriented to natural landmarks like Mt. Tamalpais, Mt. Diablo, and Cougar Mountain. Two carefully sited observation towers designed in the same architectural language as the causeway serve as additional follies. The sinuous and meandering profile of the causeway not only curates viewsheds of distant features, the elevated vantage also affords an entirely different reading of t he landscape textures than from the ground. Conceived as a rhythmically delaminating roadway, lane directions as well as the Bay Trail are "unspooled" and flow independently like the sloughs they traverse. The causeway "touches down" at a series of strategically placed amenities, offering more intimate and immersive opportunities to interact with the bayland terrain.

Whether in a northern or southern alignment, the scenic highway would be an iconic symbol of regional

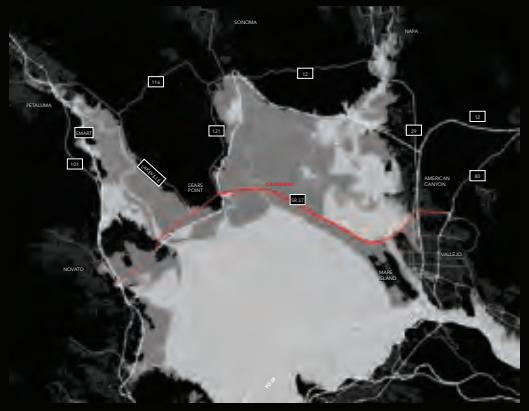
Proposed SR 37 elevated causeway as seen from Sears Point. Sonoma Creek winds under the causeway between wider banks along a gentle course.



BERM IN PLACE

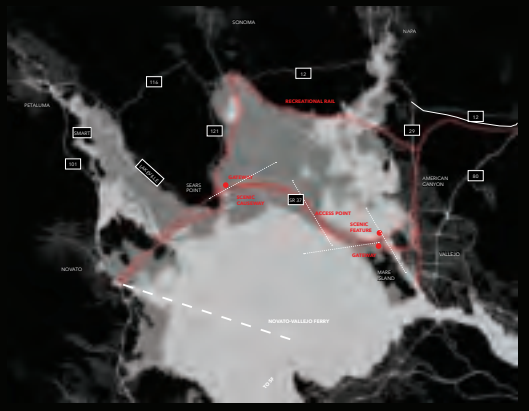
SAN PABLO BAY BRIDGE/TUNNEL

SR12 ALIGNMENT



CAUSEWAY IN PLACE

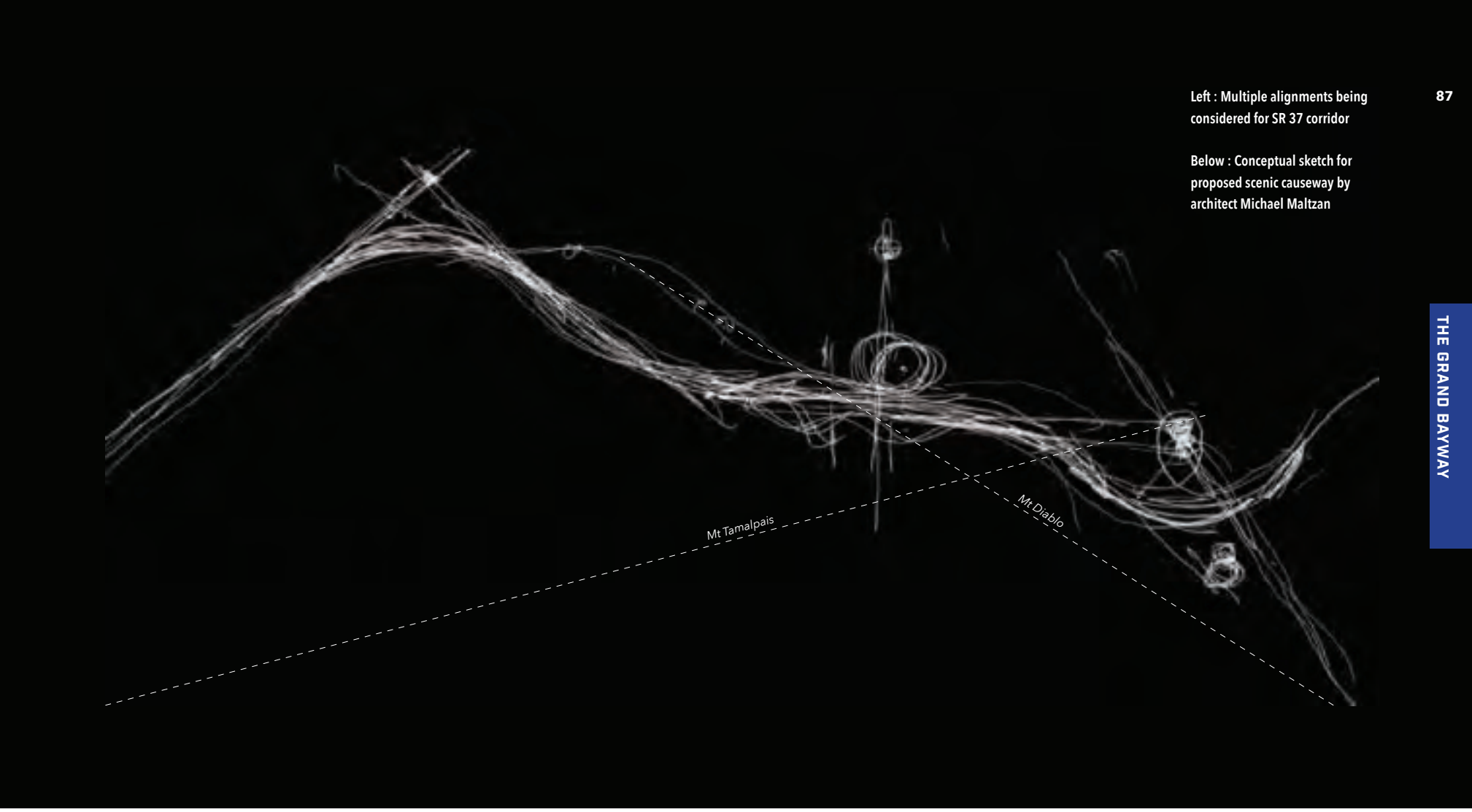
NORTHERN ALIGNMENT



SCENIC BAYWAY+RAIL

identity; provide for unimpeded hydrological exchange, marsh migration, and species movement; be adaptive to changing and multimodal transportation technologies; and offer options for equitable public access for the diverse communities of the North Bay. Serving as a "front door" to a vast ecological commons, the highway would provide access to additional programming and facilities for cyclists, runners, kayakers, campers, and fishermen. These access points would be situated along a multimodal mobility loop on the periphery of the baylands that includes expanded Bay Trail and other bike and pedestrian routes collocated with the existing SMART-owned track and right of way from Novato to Napa Junction that is currently used for freight. This rail line could be modified to offer modern passenger rail service and weekend excursions that would bring visitors to a variety of historic train stop ghost towns such as Buchli and Wingo.

Through community engagement, the team learned that people are intrigued by this landscape but aren't quite sure where to go or what they would do there. Although considerable human effort has gone into transforming these lands from marsh to agricultural fields, to settlements, to salt ponds, and back again to baylands, few people have really lived here. To expand the constituency around a place that is unfamiliar to many, the project proposes multiple gateways and



Left : Multiple alignments being considered for SR 37 corridor

Below : Conceptual sketch for proposed scenic causeway by architect Michael Maltzan

nodes around the perimeter of the baylands at Cullinan, Tolay/Sears Point, Wingo, Buchli, Napa Junction, and the Mare Island Interchange. These nodes would bridge between the urban environment and the interior, invite people to the marshes, and provide opportunities to learn about the ecological and cultural timelines of this place.

While the scale and intensity of these access nodes would vary, they would generally take the form of trailheads, train stops, and roadside facilities. A series of public field stations comprised of repurposed and renovated existing structures such as pump houses, landings, or barns could serve as bird blinds, kayak launches, wetland monitoring stations, or small interpretive centers. These field stations begin to frame an itinerary for exploration and public education. By providing ways for the public to observe and participate in these dynamic landscape processes, the place becomes legible – the San Pablo Baylands could serve as an ecological "Central Park" of the Bay Area.

Research in environmental psychology confirms that when we make connections to place, we develop a sense of agency and meaning that prompts us to become stewards actively involved in future placemaking. In this way, simply providing the public with a presence in the landscape is a resilience strategy. Place-based education engages people in their local

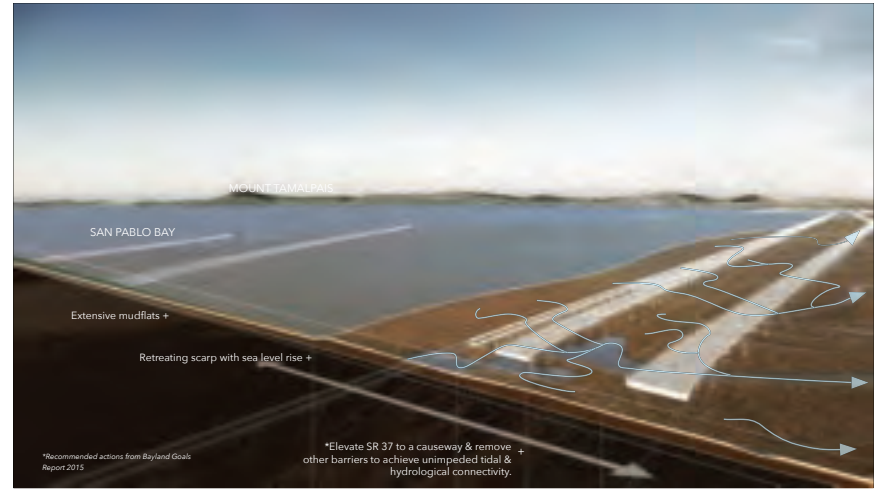
environment from the combined perspectives of ecology and history – an informal educational strategy that mixes experiences, tools, exhibits, tours, stories, and maps to highlight current landscape features, projected changes, and the rich anthropological history and narratives of those who have lived with these lands in the past. Because place and human identity are deeply linked, public access, recreation, and education inculcate a sense of value for the landscape and identification with its fate.

The proposed strategy for public engagement, access, and education would be closely associated with approaches to adapting the baylands; landscape processes and ecological restoration efforts are precisely the subjects that public field stations and access nodes seek to highlight.

Mare Island pedestrian/bike loop bridge with observation tower and city of American Canyon in the background

Offramp leading to Cullinan fishing camp with SR 37 seen in the background

To keep pace with sea level rise, the baylands need to accrete sediment quickly and, due to the legacy of human impact, most are already subsided several feet below their elevations a century ago. While the Napa River and Sonoma Creek provide roughly a third of all sediment entering the Bay today, these rich sediment resources are currently trapped by leveed sloughs and bypass the subsided former farmlands that need sediment the most. With the challenge of a sediment deficit and a dearth of time to prepare land for sea level rise, the team focused research on finding more innovative ways to budget existing sediment resources to greatest effect, design ways to take advantage of flood events to redirect sediment, and deliver sediment through both natural and artificial processes to existing marshes and future areas for transition and retreat.



Above : Proposed plan to improve multimodal public access to the baylands and diagram illustrating the benefits of ecological connectivity.

Below : Improved travel experience with split lane directions and a fully separated bike path.

Bayland Adaptation

To address a wide range of circumstances with varying topography, sediment sources, subsidence, and development, the project proposes an ecological laboratory that introduces strategies calibrated for these diverse conditions. Through limited topographical manipulation, revegetation, and innovative prototypes, restoration efforts could incrementally re-engage this varied landscape to further cultivate biodiversity and heterogeneity in a mosaic of habitats from open water to marsh, to uplands:

1. Adapt from the edges of sloughs where sediment deposits and key habitats exist today.

2. Restore smaller landscape cells that aggregate to form a larger connected network from the bay to its watersheds.

3. Harvest limited sediment by taking advantage of natural sediment pulses (e.g. storm events).

4. Pursue a heterogeneous strategy which adapts to dynamics over time while maintaining biodiversity.

Taken together, these principles establish the framework for a mosaic of dynamic approaches. To illustrate how these might function, Common Ground developed four approaches in greater detail.

Conceptual diagram of an ecological "Central Park" for the North Bay. Historical evolution and projection for the baylands from 1900–2050.

Hyper-Accretion Gardens

This strategy leverages increased hydrological exchange to trap sediment. By constructing a short "chamfer levee" that would cut across the shortest distance between two sloughs in an oxbow, a large subsided parcel could be segmented into a smaller, more manageable unit. Within this smaller unit, terraforming and planting would take place in advance of modular levee breaches that would open this smaller landscape unit to the sloughs. Analogous to the "marsh mounds" at the Sears Point restoration, wattle walls and lattice berms would form the elevated armature for vegetation. Like the inundated coyote bush at Cullinan Ranch, some of this vegetation would be sacrificial when the levees are breached and salinity changes. These wattle walls, in conjunction with live and dead vegetation, provide surface roughness and structure to slow currents, decrease turbidity, and settle suspended sediment. Adopting the mentality and ingenuity of cultivation, these "hyper-accretion gardens" offer diverse ways to accelerate natural sedimentation from both the tides and upland watersheds.

Benthic Lab

While sediment capture can help rebuild baylands, an increase in areas of shallow open water is inevitable and is already seen in the breached former salt ponds along the west bank of the Napa River. In these zones of shallow marine and brackish open water, artificial islands, reefs, and breakwaters could form a network of linked experimental strategies to attenuate wave suspension of mud, reduce marsh erosion, and potentially increase water clarity enough to establish an eel grass fringe in the muddy bay. These artificial technologies are typically constructed from fiberglass reinforced plastics which are light, durable, nontoxic, and thus easy to install, remove, and reinstall up the shore as water levels rise. Floating, shallow-draft breakwaters just below the intertidal marsh could be used to increase sediment deposition and grow the shoreline as sea level rises. With increasing water depth, the breakwaters would harbor a more diverse and productive marine ecosystem dominated by invertebrates with macroalgae establishing a larger presence as water clarity increases. San Pablo Bay is an outstanding natural laboratory for developing ecological bands for marine habitat protection that optimize for food web complexity, aquaculture, and erosion control.

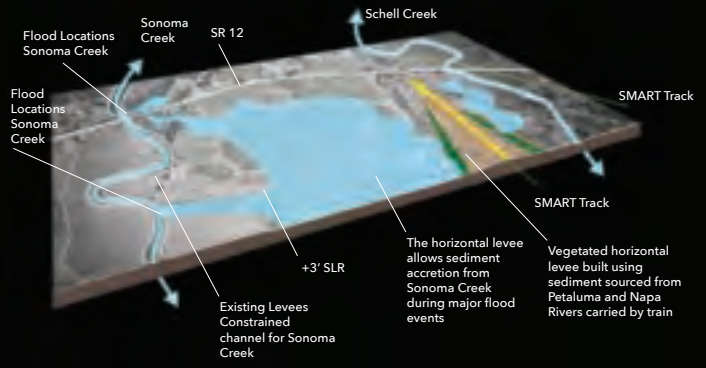
Above: Travel nodes and field stations proposed in the baylands using repurposed structures. L-R : Buchli, Tolay, Cullinan Landing, and Wingo.

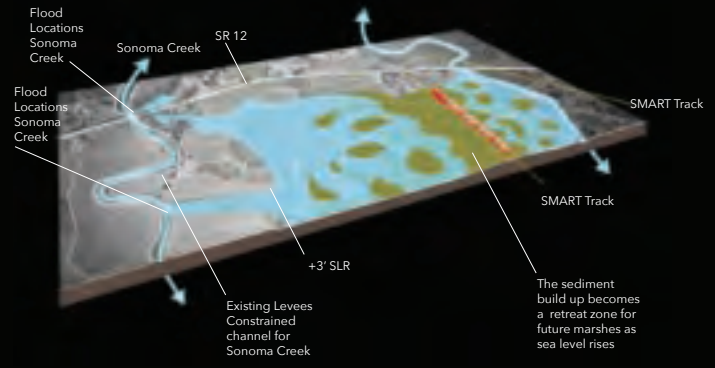
Elevation Capital

This strategy would enhance the natural sediment delivery mechanisms of the alluvial fans bordering the marsh. Many surrounding landowners are vintners and farmers who have been maintaining private levees that fail during large winter storms, flooding their properties. There are opportunities to work with these motivated landowners to move back from creek and slough edges and allow these waterways to reestablish their shifting fluvial courses. While most of the coarse sediment delivered in large events would deposit on the margins, finer sediment would work its way further down into the baylands. This sediment currently deposits in the sloughs and leveed channels, making them narrower and more flood-prone. Opening the system by breaching levees in key places would allow the sediment-laden waters to empty into low-lying areas. Allowing major floods to deposit large woody debris in the channels and marsh plains promotes channel complexity and hydrological dynamism while also providing important high-tide refugia for wildlife.

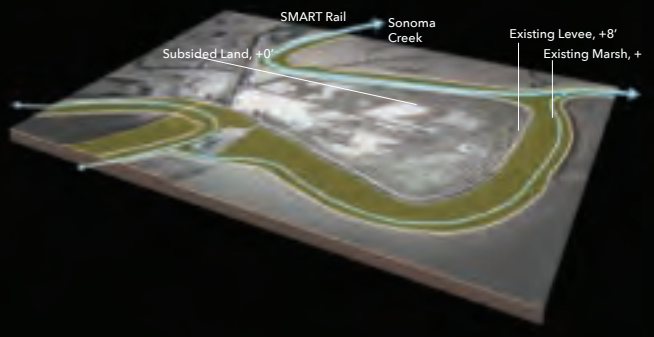
Sediment Train

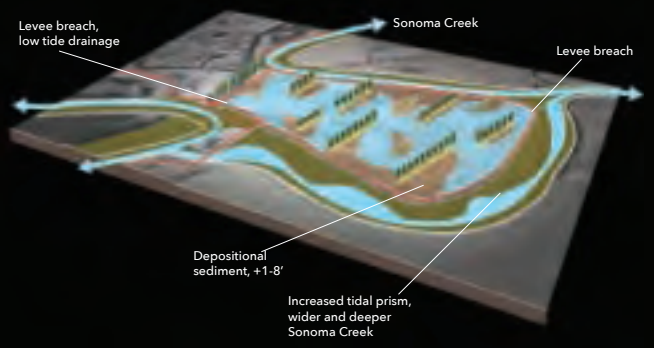
The greatest impediment to using dredge spoils to help build subsided lands and nourish imperiled and eroding marshlands is the cost of transport and placement. Often the locations in need of sediment are not easily accessed, and in many places vehicular access would damage the ecosystems we are trying to enhance. In the San Pablo Baylands, the existing and underutilized rail corridor circumnavigates the marshlands at an elevation that roughly corresponds to end of century projections for sea level rise and is therefore appropriate for future marsh and upland transition zones. Current rail levees are sloped at ~6:1, but horizontal levees with shallower gradients (~40:1) comprised of finer sediments allow for much better marsh and upland species recruitment. Capitalizing on the intersection of the rail and navigable channel at the mouth of the Petaluma River, open-topped dump train cars would be filled with dredge spoils via barge and delivered anywhere along the rail corridor. Currently, most places adjacent to the train tracks are not considered critical habitat for native species and horizontal levee-building could happen rapidly. In places where the rail is near marsh habitats, sediment deposition would need to occur in relatively small increments or "lifts." Pairing this nourishment approach with an upland transition plant restoration would provide future high water refugia for wildlife and supply the biomass critical for trapping suspended tidal sediments that will eventually lap against this horizontal levee.

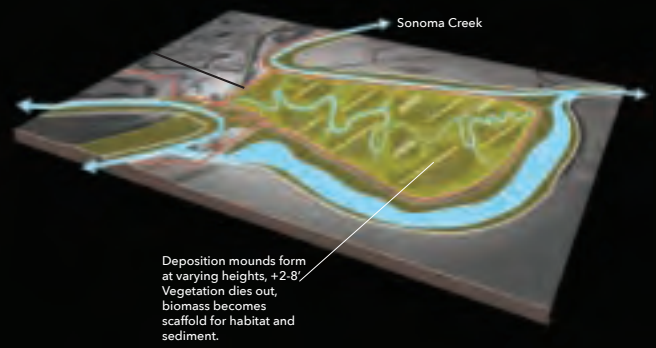




Sediment-building strategies using Sediment Train and Hyper-Accretion Gardens







OPPORTUNITY:

Highway adaptation could reinforce protections for the Bay Area's greatest ecological resource.

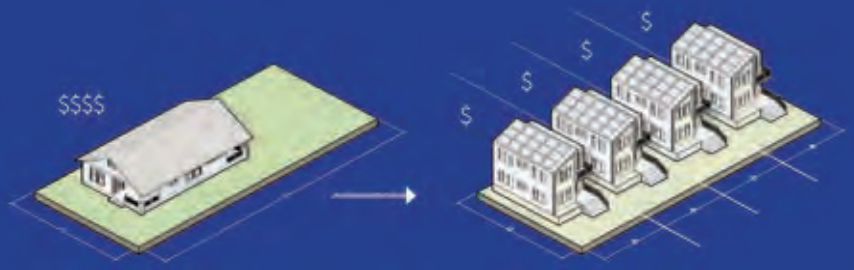
Common Ground believes that linking these adaptation strategies with public access improvements, a multi-modal transportation network, and the highway itself would create a new cohesive identity for the region that is currently a diverse collection of parcels, jurisdictions, and agendas. To facilitate this coordination of integrated planning, policy, programming, and funding, the team researched models of cross-sectoral entities that could oversee economic development, capital improvements, conservation, mitigation, and identity creation. Linking multiple stakeholders through multidimensional solutions that go beyond single-focus agendas yields opportunities for shared funding sources, including the creation of a regional mitigation bank and the use of cap and trade funds. This potentially robust, albeit multi-layered, capital and operating funding "stack" could justify and defray costs for this ambitious shared vision for the region. By linking the fate of the highway to the landscape, both could become more adaptive by coordinating planning efforts, sharing funding sources, and fostering a cohesive regional identity that could garner greater public interest and support.

While the North Bay is home to some of the Bay Area's most economically vulnerable populations, San Pablo Bay is a shared source of resiliency and opportunity. Resilience cannot be achieved by design and restoration strategies alone – it must be fostered with the help of human connection to this place that the public will increasingly consider as part of their home and lives. This project invites North Bay communities to imagine a lifestyle that includes a closer relationship with the baylands and the Bay and ways that they could share and steward environmental resources while having more diverse means to connect with each other for work, recreation, food, health, and cultural ties. Contextualizing highway adaptation as part of a larger strategy for multimodal transportation, ecosystem resiliency, and community access allows the project to move beyond just mitigating the threat of sea level rise – the project is an opportunity to foster more nuanced and resilient relationships between shoreline communities and infrastructure and the changing landscapes in which they're situated.

Proposed field station and hyper-accretion garden at Wingo

ouR-HOME

CONTRA COSTA COUNTY



The Home Team

Mithun

Alta Planning + Design

Biohabitats

Chinatown Community Development Center

HR&A Advisors

Integral Group

ISEEED/Streetwyze

Moffatt & Nichol

Resilient Design Institute

Urban Biofilter/Marisha Farnsworth

SUMMARY:

The Home Team started by asking questions. What is Home? What are the boundaries of Home? What are the places we love? What will our Home look like in the future? Central to all questions was – What is the racial history here and what would structural equity look like?

Many of the Bay Area's most vulnerable communities, those enduring poverty and structural racism, also live in areas that are highly susceptible to sea level rise and flooding. Through the lens of "home," the team explored solutions that allow neighborhoods to remain in place and thrive. The Home Team pursued a "both, and" approach, combining strategies to address both structural inequity in the Bay Area by meeting the immediate needs of housing and health and strategies to nurture living shorelines that protect residents, regional infrastructure and species. Inspired by the belief that sea level rise strategies can be a powerful social justice tool when investment dollars are leveraged for multiple-benefit solutions, the team engaged in a deep community and stakeholder process, seeking to find maximum social impact for every proposed dollar spent on climate disaster response.

The suite of sea level rise projects in North Richmond, ouR-HOME, emerged from the community's ideas for building health, wealth, and home ownership for over 5,000 North Richmond residents – turning investments in sea level rise adaptations and aging infrastructure into opportunities for all. Sea level rise and inland flooding mitigation (GROW), affordability and wealth building opportunities (THRIVE), air quality and health strategies (FILTER), and multi-modal connections (RELATE) combine to create a holistic and equitable approach towards climate resilience.

APPROACH:

A community-driven multi-benefit approach

Community Advisory Board and the Home Team

To be truly resilient to sea level rise and climate change, communities must have the agency to adapt. The Home Team used job creation, education and pathways to home ownership as primary drivers for design. Neighborhood stabilization needs identified by the community are the first-order sea level rise response strategy in disinvested communities. Designing to meet immediate housing and health needs increases the neighborhood's ability to execute long-term ecological and infrastructural strategies that protect residents from sea level rise while bolstering regional habitats. By using the lens of home and rethinking 'return on investment' as a 'return to community', the Home Team's design strategies adapted the traditional market-driven approach to respond to the profound economic and social impacts posed by climate change.

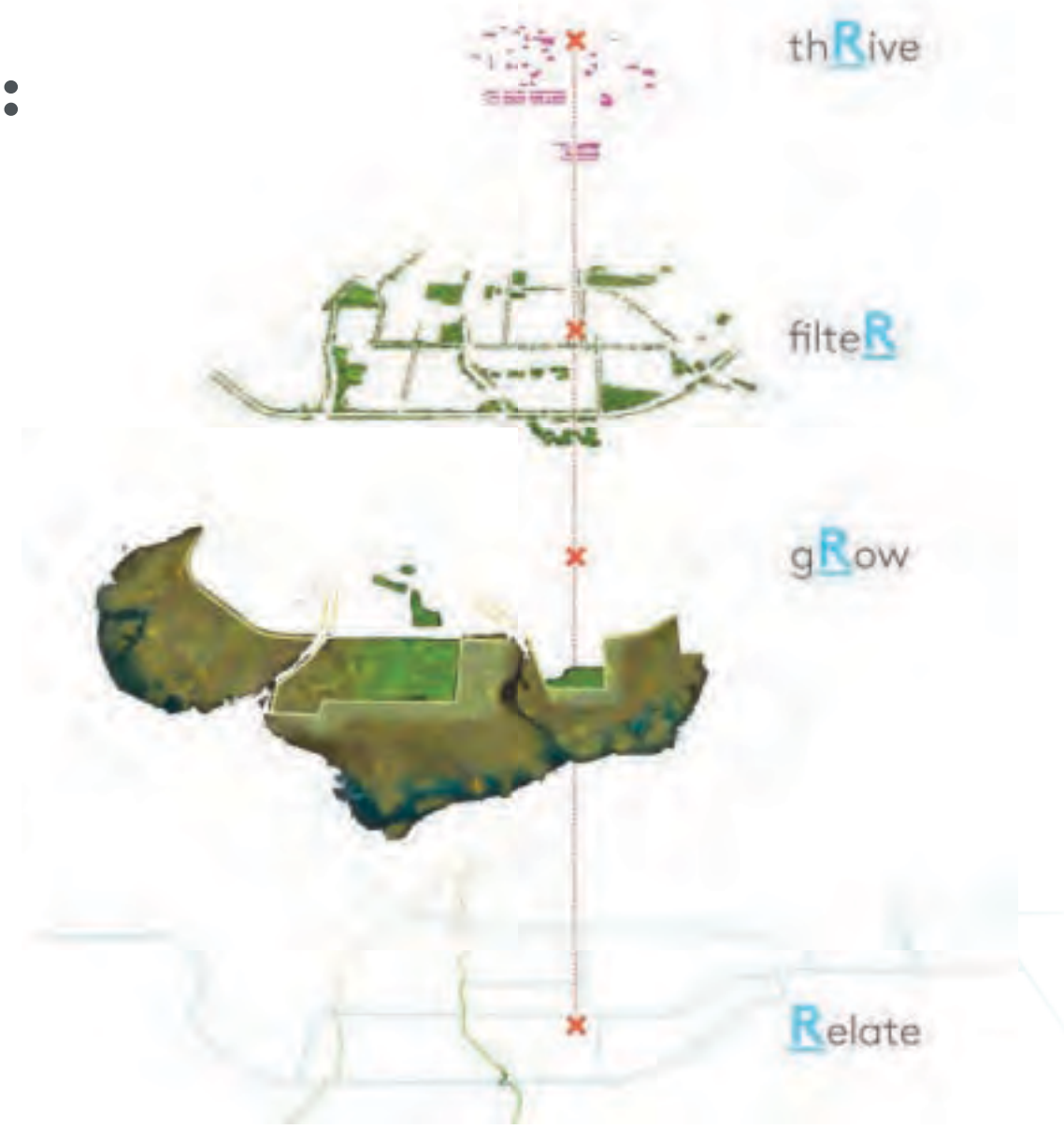
Throughout the design process, community and local stakeholder expertise was front and center. A Community Advisory Board, comprised of 20 North Richmond residents, elected officials, local non-profits, and agency stakeholders shaped the design and helped capture maximum community benefits through meetings and workshops. Countless individual stakeholder conversations, app-based mapping via Streetwyze, community leader training, a public art exercise, high school workshop, and a public Earth Day event further informed the Home Team design approach in North Richmond and helped raise awareness of the climate change impacts to this community.

FINAL PROPOSAL:

North Richmond: ouR-HOME

Driven by a legacy of activism, a strong sense of self-determination, and a history of systematic environmental and social injustice, the North Richmond neighborhood stands as a potential model for future Bay Area resilience. Many bay communities have similar challenges to North Richmond – enduring structural racism, chronic flooding, industrial pollution and poverty. The conditions in North Richmond are a particularly vivid example, and the community has already proven to be adaptable and resilient. For the final design proposal, the Home Team worked closely with North Richmond residents and stakeholders to identify needs and desires and to amplify existing initiatives and goals. Building on potent community-led legacy work, a suite of four actions emerged—GROW, THRIVE, FILTER, and RELATE. Collectively, these form the North Richmond ouR-HOME proposal.

ouR-HOME's holistic design approach focuses on a regional issue: using infrastructure dollars to leverage health and wealth benefits for disinvested communities. Following the Home Team's design philosophy that neighborhood stabilization, anti-displacement strategies, and wealth-building are key sea level rise strategies, ouR-HOME expands long-term resilience through four approaches. THRIVE champions strategies for paths to home ownership and job training as the foundation for community agency to adapt to climate change and includes: housing infill and the Las Deltas redevelopment, small lot housing splits, a community land trust, and neighborhood-scale wastewater treatment. FILTER creates a green "force field" around the community, combating air quality and stormwater impacts with multi-benefit green infrastructure and includes: an Urban Forestry Plan encompassing air quality parks, greenbelts, and nodes, a Heritage Walk, and the Fred Jackson Way Green Corridor. GROW utilizes green infrastructure as placemaking to protect North Richmond from the long-term impacts of sea level rise while creating new spaces for people and habitat and includes: a horizontal levee and trails system, wastewater treatment in the ecotone slope, muted marshes with trails, and wetland restoration integrated with commercial uses. RELATE connects the community to the Bay and to transit, building on existing street improvement projects and celebrating North Richmond's identity, and includes: a multi-use path overpass at Richmond



North Richmond design study areas

Parkway, creekside picnic areas along Wildcat Creek, and future floating trail connections to Point Molate. All four actions within ouR-HOME start from an integrated set of policies, including the development of a Green Benefits District and an Integrated Water Management Plan.

Site

The area of unincorporated west Contra Costa County known as North Richmond contains rich ecological and social history that shapes its current resilience challenge. A place of tremendous ecological diversity when Ohlone tribes first arrived there in the 6th century, the Bay coastline and marshlands of the Wildcat and San Pablo creek deltas provided critical resources for initial human settlers. The low-lying area with fertile soils provided good agricultural opportunities as populations migrated west. African Americans arrived in the Bay Area from across the country during the WWII labor surge and were forced to settle in the low-lying and flood-prone topographic bowl adjacent to the Chevron refinery through de facto segregation. Cut off physically from adjacent resources by railroads and other infrastructure, community members also had to endure a lack of public services and travel long distances to their seat of governmental representation. This community derives strength from a long history of cultural, environmental and social justice issues. Today, the demographics of North Richmond's 5,000 community members are changing, as Hispanic Americans find homes in the neighborhood. The spirit of advocacy and community organization continues to thrive, as evidenced through the work of neighborhood groups such as Urban Tilth, the Verde School, the Watershed Project and other organizations.

Even with an active and informed population, immediate housing and health challenges hinder the near-term ability of the community to adapt to long-term climate change and sea level rise. Housing in North Richmond is a challenge with widespread vacancy, a loss of 288 units of decommissioned federal public housing, and a lack of access to capital to renovate or develop. And yet, like the rest of the Bay Area, rental costs are rapidly increasing and driving displacement. Displacement compounds climate change impacts; people are separated from the support of familiar neighbors, friends and families while the high cost of living minimizes an individual's financial ability to respond to stressors and shocks. Air quality concerns from surrounding infrastructure and refineries, run-off contamination, aging stormwater pump infrastructure, and lack of physical activity options further burden the health of community. Through THRIVE, FILTER, RELATE and GROW, the Home Team's ouR-HOME proposal tackles the "both, and" by addressing immediate needs while protecting against long term impacts.

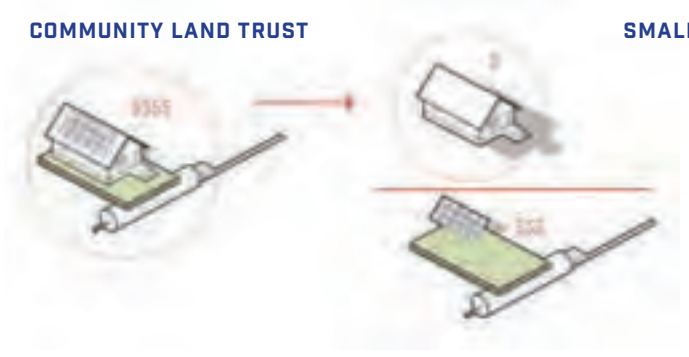
Thrive

Resilience in North Richmond requires attention to the challenges that limit residents' ability to thrive – the cost of housing, utilities and transportation, the limited access to good jobs that build careers, and the obstacles faced by resident entrepreneurs eager to start local businesses. The Home Team proposes strategic investment in affordable "net zero" ownership housing, electric vehicles, transit connections and community support services that can reduce the cost of living for residents, and catalyze local reinvestment and wealth building.

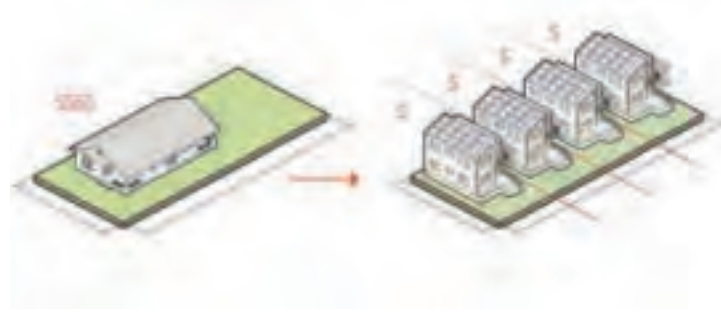
North Richmond contains a significant percentage of vacant parcels, many owned by the County, creating key opportunities for strategic long-range planning in the community. In addition to privately owned vacant parcels, 42 Contra Costa Housing Authority parcels formerly comprised of 288 units of housing are being vacated and are slated for near-term redevelopment. To lower barriers to home ownership, the THRIVE proposal builds on the history of do-it-yourself resourcefulness of North Richmond residents and proposes subdivision of vacant lots to create small lot housing in keeping with the scale of existing homes. Larger lot housing redevelopments can help stabilize affordable home ownership through exploration of a community land trust. Other affordable cost-of-living strategies for energy, water and wastewater create an opportunity for North Richmond to be a model community in the Bay Area.

There is tremendous history in North Richmond. Celebrating the people and places with medallions in the streetscape reinforces social cohesion and pride of place – creating a more resilient neighborhood. Small lot splits create affordable housing alternatives, lowering barriers to homeownership while creating a vibrant neighborhood.

COMMUNITY LAND TRUST



SMALL LOT SPLITS



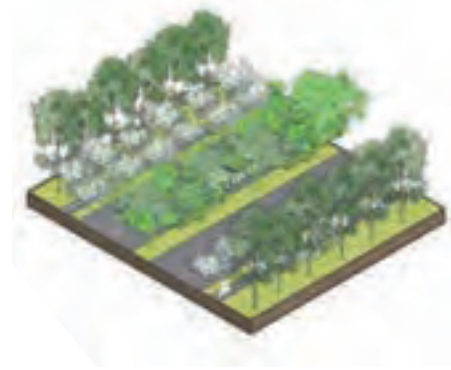
Air quality parks surrounding the neighborhood create a green 'force field' around the community.

The trees filter the particulates in the air generated by traffic and industry.

❶ Air Quality Park

❷ Tree Nodes

❸ Neighborhood Greenway



Filter

Heavy industrial uses, an adjacent refinery operation and heavily-trafficked transit corridors lead to poor air quality and high community health burdens in North Richmond, which has the highest CalEnviroscreen score for asthma in the state. In addition, areas of ground contamination can lead to problematic storm runoff into the Bay if water isn't adequately slowed or filtered, affecting both the health of the Bay and the residents.

What if 20,000 more trees were planted in North Richmond to combat the substantial asthma rates in the neighborhood? Forming a natural air filter, stormwater filter and habitat filter, trees planted in mass create a green "force field" against particulates and toxins. Three typologies of tree species, patterns and maintenance regimes capitalize on the science behind achieving greater health for people, flora and fauna. A greenbelt of planting along the largely diesel-based industrial corridor of the Richmond Parkway and larger scale neighborhood streets – Fred Jackson Way, Market and Chelsey – create ecological function and a more walkable neighborhood. Reinforcing a green-belt along Fred Jackson Way to the Urban Tilth farm less than a half mile to the north is a primary goal of the community – connecting to fresh food, community events and career paths offered by the farm. A Heritage Walk highlighting the history and community leaders of the neighborhood could be incorporated with these improvements. Air quality parks are groves of trees on larger residual lots not viable for housing that would provide new places to gather and for stormwater filtration. Nodes are landmark trees protected and/or strategically distributed throughout the neighborhood. These large trees would complement adjacent planting areas and add to the structural diversity and health of an urban forest canopy.

Grow

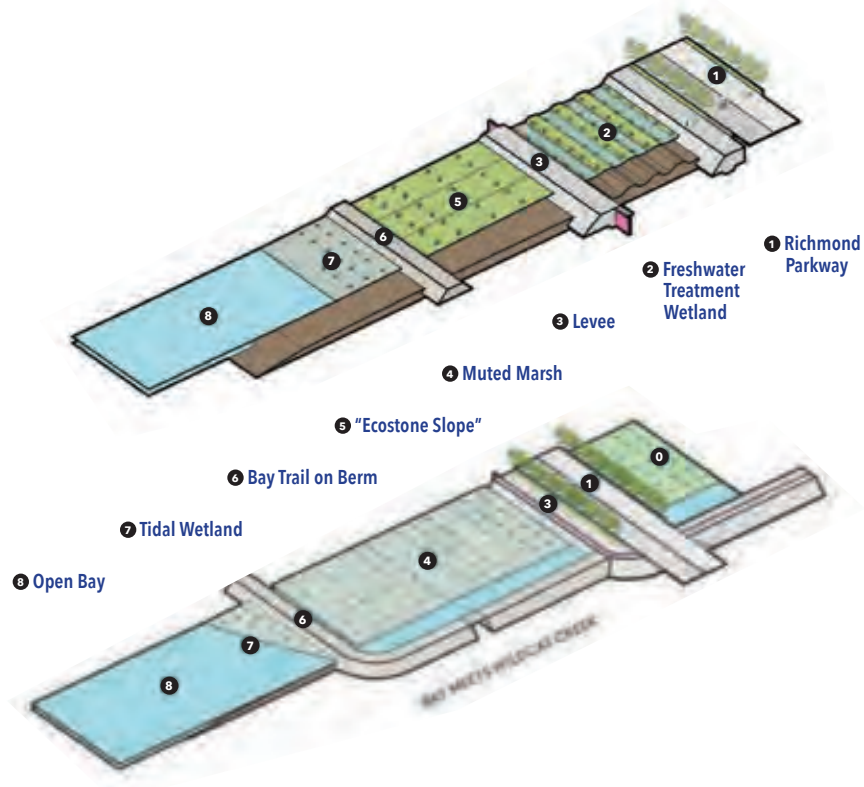
Sea level rise threatens both the North Richmond neighborhood and critical infrastructure that supports it. North Richmond lies in a topographic bowl and some of the lowest lying areas of the neighborhood are kept dry from stormwater flooding by a county-owned pump that deposits millions of gallons of urban runoff into the Bay, even during the dry season. This critical piece of infrastructure lies within the sea level rise zone, is reaching the end of its functional lifespan and currently serves as a stop-gap solution to inland flooding within the neighborhood. In addition, sea level rise threatens to drown valuable marsh habitat that provides habitat for endangered species like the clapper rail and salt harvest mouse.

The proposed horizontal levee would provide both sea level rise protection and more ways to enjoy the shore. Horizontal levees could be a placemaking tool. Building on the North Richmond Shoreline Vision Plan and concepts initiated by the West Contra Costa County Wastewater operations, the horizontal levee would minimize flooding into North Richmond, protect

Horizontal levees could be a placemaking tool. The proposed horizontal levee protects valuable infrastructure from flooding, allows marsh migration as sea levels rise, and provides educational and recreational opportunities for the community along the shore.

The horizontal levee incorporates wetlands restoration, tertiary wastewater treatment, expands habitat for endangered species as well as redundant recreation connections, providing more than one route and thereby fostering resilience in a system.

infrastructure assets and enable marsh growth in an ecologically rich part of the Bay. Wetlands restoration and tertiary wastewater treatment would be part of the levee strategy, supporting marsh replenishment as sea level rises over time and the current marsh drowns. Levee trails would provide redundant trail connections in the event of high tides and different types of walking experiences, including panoramic views. A pilot to test a decentralized wastewater facility, inspired by 8th and Hassalo in Portland, Oregon, would create additional reclaimed water located closer to local users such as the Urban Tilth Farm and new greenbelt plantings. The neighborhood-scale facility would also be a placemaking opportunity in a neighborhood that has identified gathering spaces as a much-needed amenity.



Relate

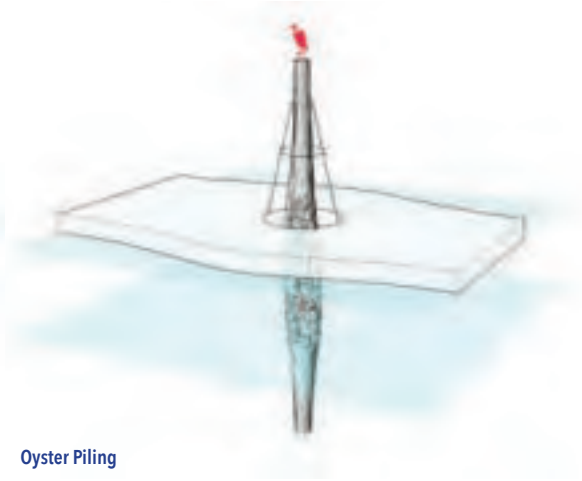
North Richmond has long been isolated from the Bay edge, cut off by roads and infrastructure to the water just a few hundred yards away. In addition to a lack of safe crossing to the environment, Community Advisory Board members noted the need for markers of community identity. A parkway overpass design for a multi-use trail connecting Wildcat Creek Trail to the Bay Trail would create a sense of identity specific to the history of North Richmond that can be developed through a community-driven design process. Proven to alleviate chronic stress, expanded nature experiences and active recreation via safe trail networks would provide health benefits to the residents while connecting sea level rise infrastructure. In addition, the proposed trail system would provide an important educational opportunity, as the overpass from the Bay to the Wildcat Creek Trail connects to the neighborhood's Verde Elementary School, which will include a middle school soon.

Green Benefits District

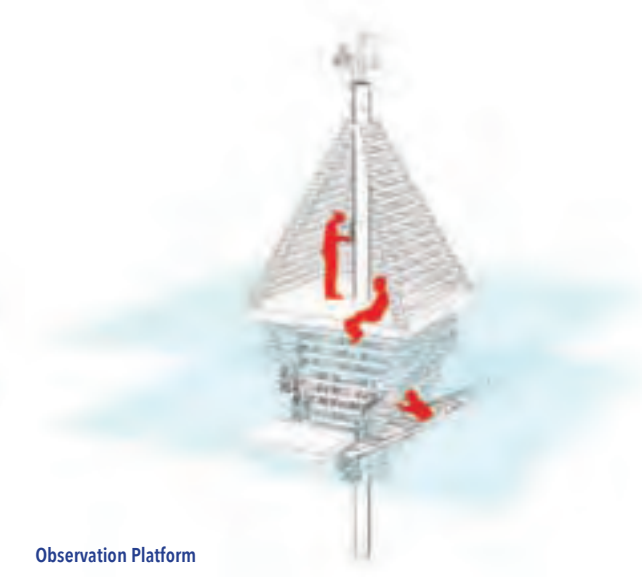
A new policy tool is envisioned to support local investment, hiring and project development. This tool, a "Green Benefits District," would collect funding from multiple sources, including county funds from streamlined waste and water programs, and impact fees from new commercial and industrial development. The Green Benefits District would form the primary tool in moving from a traditional "return to capital" model to a community wealth building "return to community" model, capturing the benefits of re-localizing labor, capital and resources such as water and biomass. This overarching district would economize funding and labor distribution between the ouR-HOME projects, ensuring maximum community benefit and multiple outcome investments.

A critical pedestrian overpass would create a direct community connection to shoreline, feed into the Bay Trail, and create an identity marker for the neighborhood.

Floating Wetlands



Oyster Piling



Observation Platform

Prototypes

Alongside the final design concepts, the Home Team developed prototypes alongside Laney College students to test components that constitute hybrid models of ecology and housing (Habitat + Habitation) in support of the proposals – THRIVE, RELATE, FILTER, GROW. The prototypes: 1) enhanced community engagement and excitement through building a tangible project; 2) provided a research platform to inform evidence-based design of resilient ecological infrastructure; 3) advanced job opportunity programs and employment. The California State Coastal Conservancy and the Contra Costa County Conservation Resources provided input on the development of ideas by the Home Team and Laney College students.

Observation Platform: Piling platforms could be built on and around structural pilings in aquatic and intertidal environments. Development in current Bay edge conditions and those that will be subject to inundation due to sea level rise will require structural pilings; the dimensions of these structures is an area that requires significant study. The piling platforms prototype is designed to explore implications for sub-tidal, tidal, and nonaqueous habitat for piling structures, while also integrating human use for Water Trail users.

Oyster Piling: Over 33,000 existing creosote pilings pollute the San Francisco Bay and, while various agencies are working to remove the pilings, there are challenges to removing them entirely. This prototype would encase the creosote piling for mitigation and improve the local ecological conditions and habitat through biomimetic materials and form. The creosote piling adaptation prototype could also become the structural member for recreation projects, placing people in contact with oyster establishment on the piling as the tides move.

Ridgway's Rail Wetlands: The constructed floating wetland system provide critical new marshland and intertidal zone habitat, improve water quality by making use of indigenous aquatic plants and natural processes to remove the contaminants from Bay waters, particularly industrial effluent and stormwater outfalls from urban streets.

North Richmond: ouR-HOME

The suite of sea level rise projects in North Richmond, **ouR-HOME**, emerged from the community's ideas for building health, wealth, and home ownership for over 5,000 North Richmond residents—turning investments in sea level rise adaptations and aging infrastructure into opportunities for all. Throughout the four action areas—THRIVE, GROW, FILTER, and RELATE – the Home Team pursued a "both, and" approach, combining strategies to address both structural inequity in the Bay Area by meeting the immediate needs of housing and health, and strategies to nurture living shorelines that protect residents and regional infrastructure.

Prototypes for aquatic habitat pair with regional recreation infrastructure to create a community culture around bay health, local adaptation, and critical restoration.

The Estuary Commons

ALAMEDA COUNTY

The All Bay Collective

AECOM

CMG Landscape Architecture

UC Berkeley

California College of the Arts

Silvestrum Climate Associates

SKEO

modem

David Baker Architects

SUMMARY:

The All Bay Collective (ABC) asked how designing for resilience might require us to think differently about the way resources and places are shared. Many coastal cities must address the urgency of social inequality alongside long-term environmental risks. This need is especially acute in the San Leandro Bay—known locally as the Oakland Estuary. Our work with stakeholders in East Oakland, Alameda, and San Leandro revealed how discriminatory planning practices have led to disinvestment, making it harder for residents to access jobs, housing, transportation, and open space. The combined threat of sea level rise and groundwater flooding threatens to compound these inequities.

Our proposal for The Estuary Commons begins by addressing the everyday challenges facing residents. By putting local priorities at the center of the planning process, we were then able to design adaptation solutions that will protect regional infrastructure and produce social, economic, and environmental co-benefits. Instead of delivering a singular master plan, we focused on building alliances, design strategies, and decision-making tools that will long outlive the Resilient by Design Bay Area Challenge and help stakeholders collectively manage Oakland Estuary for the benefit of all. Together, these actions will catalyze equitable economic development, adapt shorelines and creeks into protective open spaces, stitch communities to local and regional opportunities through new transportation connections, and help all residents prosper in harmony with rising water levels.

APPROACH:

Putting local priorities at the center of the planning process

Existing Context

Physical Vulnerabilities

The infrastructure around Oakland Estuary is a product of the 20th century's binary model of city building, which more often divided places rather than unified social and ecological systems. Local creeks have been channelized and fenced off, making it harder to get around and reducing both habitat and historical flood protection functions. Transportation corridors like Interstate 880 connect the region but impose barriers to residents trying to access open space around Oakland Estuary. Sprawling, paved surfaces intensify flooding challenges while covering up the risks of contamination and seismic shaking on filled soils.

One of our major findings was that the impacts of sea level rise and groundwater flooding need to be considered cumulatively, not just independently. While sea level rise will already threaten large swaths of East Oakland, Alameda, and San Leandro, examining the combined threat of rising tides and rising groundwater revealed that 23 percent more land around Oakland Estuary will be susceptible to flooding. This means traditional shoreline protection measures like levees may be ineffective against the waters rising behind and underneath them.

Socioeconomic Vulnerabilities

The neighborhoods around Oakland Estuary tell a tale of two communities. Alameda residents earn median annual household incomes of $105,355 while their East Oakland neighbors earn $37,696. These differences are also reflected in environmental burdens. According to CalEnviroScreen, which measures communities' vulnerability to environmental pollutants, Alameda experiences below-average pollutant exposure when compared to other California cities while East Oakland bears more risk than 90 percent of these cities. Air pollution especially burdens East Oaklanders, with emissions from Interstate 880 and local industrial uses contributing to high asthma rates and other health issues.

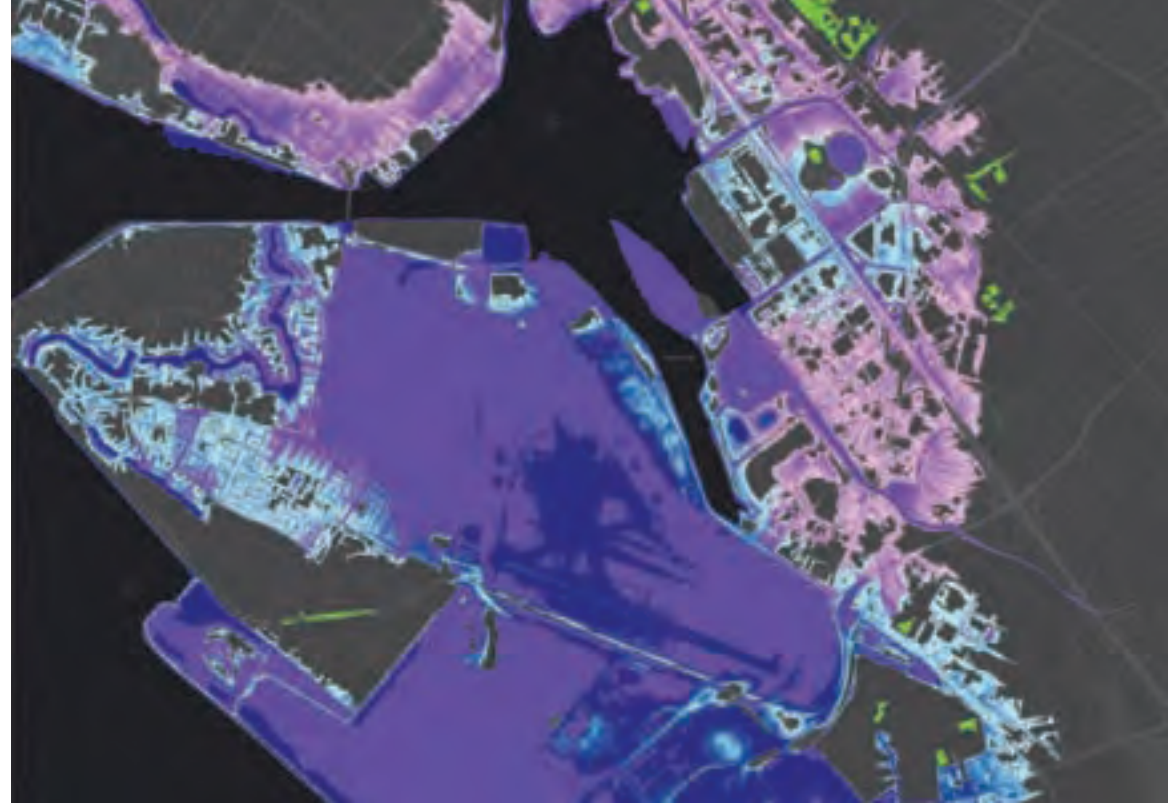
In addition to intensifying environmental burdens, discriminatory planning practices like historic redlining and predatory lending have also prevented residents from accumulating wealth. High housing prices, coupled with the lack of affordable housing, have put homeownership out of reach for many East Oaklanders and accelerated displacement. To generate community reinvestment, residents have expressed a need for more locally owned businesses that contribute to a green economy, like solar power installation and food production.

Below left: Community garden in East Oakland pressed against a concrete flood channel

Below right: Interstate highway brings regional connectivity but imposes barriers to local mobility

The combined threat of sea level rise and groundwater flooding means 23 percent more land is at risk of flooding.

The map to the right shows combined groundwater flooding and sea level rise inundation at 5.5 feet of sea level rise.



Combined Groundwater Sea Level Innundation (depth in feet)

- 0-1
- 1-2
- 2-3
- 3-4
- 4+

Sea Level Rise Innundation (depth in feet)

- 0-1
- 1-2
- 2-3
- 3-4
- 4+

Emergent Groundwater (depth in feet)

- 0-1
- 1-2
- 2-3
- 3-4
- 4+

Lowlying Area

East Oakland bears more environmental burdens than 90 percent of California communities.

The map to the right shows the CalEnviroScreen 3.0 analysis of environmental burdens (June 2018 Update).

Least Burdened

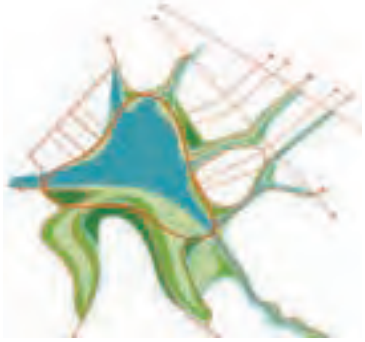
- 1-10%
- 11-20%
- 21-30%
- 31-40%
- 41-50%
- 51-60%
- 61-70%
- 71-80%
- 81-90%
- 91-100%

Most Burdened

FINAL PROPOSAL:

The Estuary Commons

Community Priorities



The Place

The Path Forward

The vision for The Estuary Commons was born out of a collaborative learning and co-design process. To put local priorities at the center of resilience planning, our team facilitated a two-tiered approach to community and agency collaboration – first at the Project Working Group (PWG) level and second at the community level. The PWG, which included various government agencies and community-based organizations, met during intensive sessions, exploring a wide range of stakeholder goals and adaptation strategies and spurring sustained partnerships between agency staff and local advocates. We also collaborated closely with eight local community-based organizations, working side-by-side during weekly design meetings, interviews with agency staff, and neighborhood events.

This approach encouraged us to lead with the urgent challenges facing residents today and prioritize local health, wealth, and housing stability. Building on these priorities and our knowledge of Oakland Estuary's past and present vulnerabilities, we co-designed The Estuary Commons – a park system along local waterways that protects neighborhoods from flooding and catalyzes innovations in mobility and community-led wealth creation. It provides a space for collaborative local governance, where residents and stakeholders work together to co-design a resilient

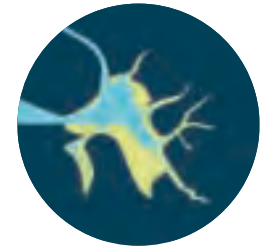
Top: Our model of San Leandro Bay made by students became our impromptu speaking circle.

Above: ABC's community and place led approach to develop the Estuary Commons.

Facing Page: The Estuary Commons– open space and waterways system overview plan

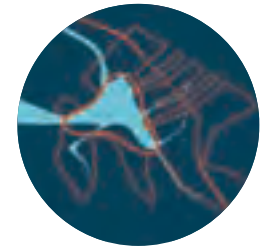
Housing

Catalyze sustained health, wealth, and stability by creating a Community Benefits District and enacting neighborhood-stabilizing housing policies



Parks

Adapt shorelines and creeks to protect against flooding, restore ecosystems, and provide gathering spaces



Mobility

Stitch neighborhoods to local and regional opportunities by creating green corridors, putting highways underground, and building a new transit hub

Collaborative planning tools

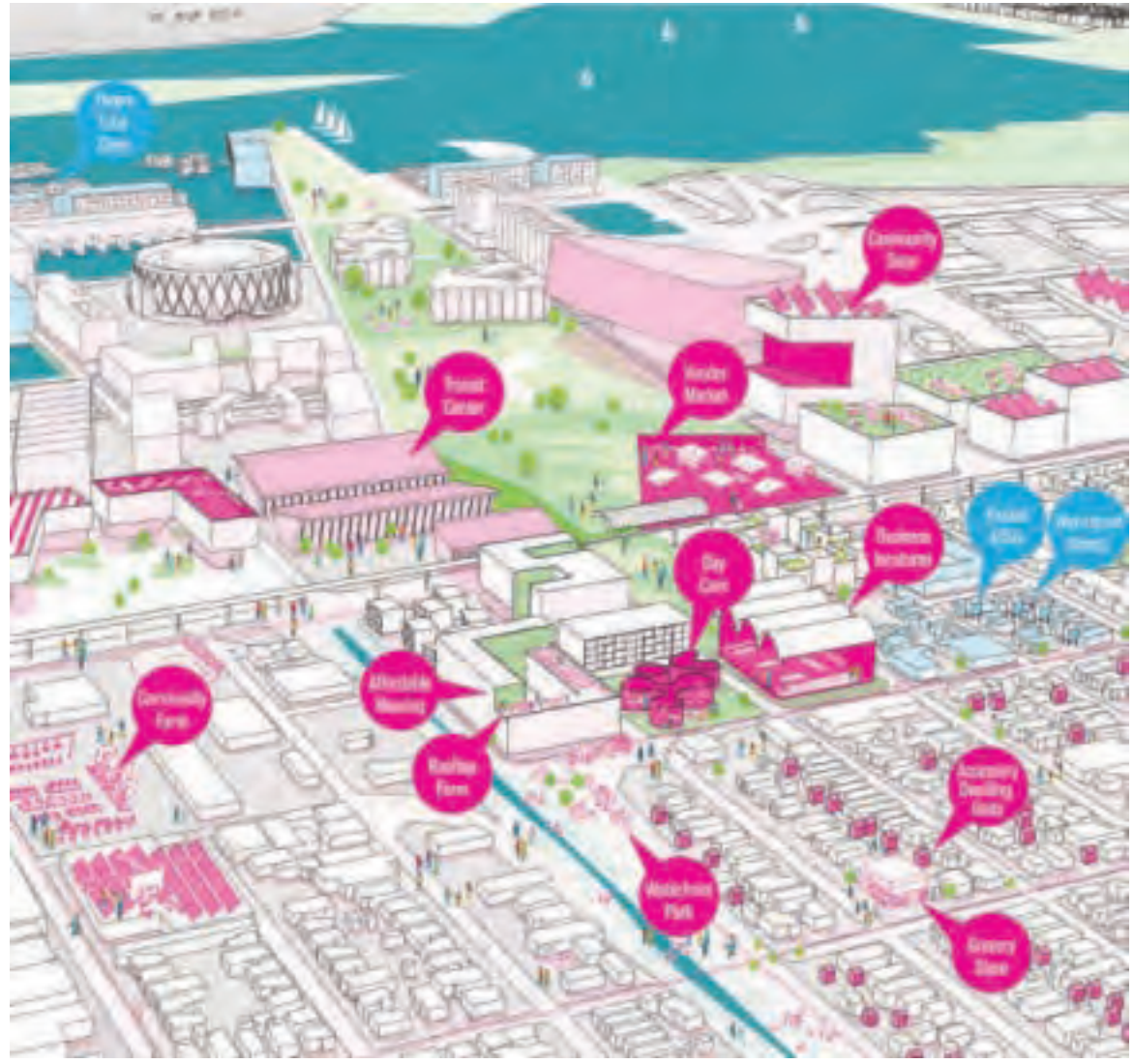
Develop learning games and project evaluation methods that support community-driven resilience planning processes

Housing: Catalyze sustained health, wealth and stability

High housing costs and displacement are two of the most pressing issues facing local communities. We propose several near- and long-term strategies to stabilize local housing prices while also protecting neighborhoods from environmental threats. Near-term measures include (1) streamlining and incentivizing the development of "Resilient Accessory Dwelling Units" (i.e. ADUs retrofitted against flood risks); (2) requiring 100 percent affordable housing on vacant parcels; (3) incentivizing new market-rate development to include below market-rate housing; and (4) establishing a community land trust to maintain an affordable stock of housing. Resilient Equity Hubs (see below) would support these housing proposals and build capacity for residents to adapt in place. In the long-term, new Tidal Cities (see right) would use the land trust model to maintain a mix of housing units that is both floodable and affordable.

Resilient Equity Hubs (REHBs)

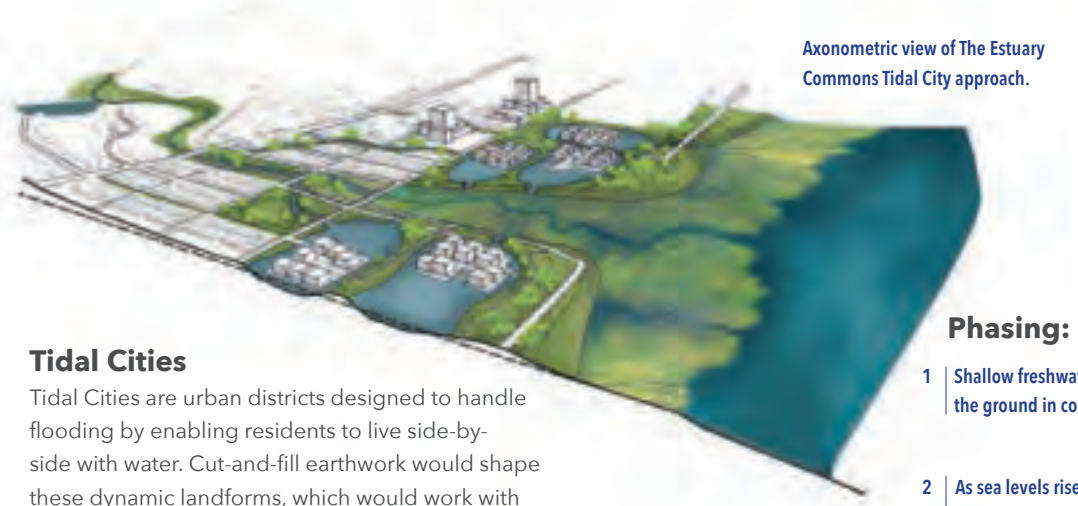
REHBs are layered districts with governmental and financial powers to produce community benefits and fund resilience-related initiatives like affordable housing. We propose establishing a Community Benefits District (CBD) that would give East Oakland residents a way to convene policy discussions with agencies and fund high-priority projects. This CBD could add future layers of capacity, like a Geologic Hazard Abatement District to streamline implementation, an Environmental Overlay Zone to restrict polluting land uses, a tax increment financing district to finance major improvements, or Community Land Trusts to promote long-term housing



A Community Benefits District in East Oakland that would support resilience-related initiatives, including long-term housing affordability for residents.

Tidal Cities enable residents to adapt in place using tidal ponds and floating structures that dynamically accommodate rising water tables and store excess flood waters. These communities would also be protected from seismic events.

Groundwater level



Axonometric view of The Estuary Commons Tidal City approach.

Tidal Cities

Tidal Cities are urban districts designed to handle flooding by enabling residents to live side-by-side with water. Cut-and-fill earthwork would shape these dynamic landforms, which would work with tidal flows, local creeks, and rising groundwater. This strategy could be phased by first building narrow canals along streets to protect existing buildings. As sea levels rise, these canals could expand into tidal ponds that support entire floating neighborhoods. Adjacent areas could also be built on terraces to avoid flooding. Tide gates would maintain stable water levels while still allowing tides to refresh the canals and ponds.

Pre-fabricated housing units could be stacked onto shared decking, supported by pontoons, to reach densities of 25-75 units per acre. A community land trust could own the land and some of the units to maintain long-term housing affordability.

Phasing:

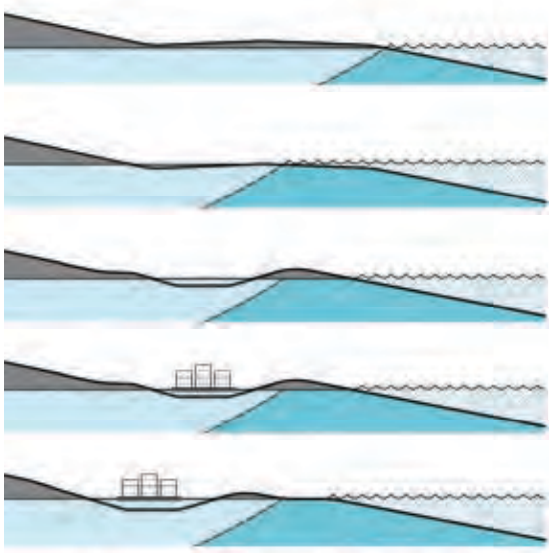
1 Shallow freshwater lies just below the ground in coastal areas.

2 As sea levels rise, this groundwater will also rise, causing flooding.

3 Levees and seawalls won't keep out this new groundwater flooding.

4 Instead, tidal ponds and floating structures can be built that let people live with rising water.

5 As sea levels continue to rise, "Tidal City" ponds can move inland; old ponds become new wetland edges.



Parks: Adapt shoreline and creek ecosystems

Widening and restoring creek corridors to store floodwaters while also providing mobility for people and wildlife is a tried-and-true strategy, going back to Frederick Law Olmsted and Boston's "Emerald Necklace." We propose reviving it by creating a landscape armature that supports adaptation to sea level rise and fluvial flooding. Our proposed creek parks and shoreline adaptations restore ecological functions to help dissipate flood waters, protect local neighborhoods, and enhance wildlife habitat. They turn concrete channels into new greenways that link schools and workplaces to an expanded MLK Shoreline Park. These linkages would flow over proposed highway tunnels and connect with existing regional trails to form a safe, accessible regional mobility network. A new promenade would wind around the Oakland Estuary, providing opportunities for residents to walk, run, bike, and gather. Integrating parks with ecological functions to mitigate flood risk and foster social resilience is an old idea with enormous new potential.

Residents and visitors enjoying the expanded–and protective–MLK shoreline park.

Wetland Area: From 100 existing acres to 300 proposed acres

Reshape creeks, sloughs and shorelines to expand riparian and wetland ecosystems, reduce fluvial flood risk, and provide protection from sea level rise.

Link

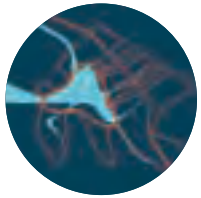
25 miles of neighborhood-shoreline connections, with a 4.5 mile loop around Oakland Estuary

Create a sinuous, Estuary-circling promenade and turn concrete channels into flourishing greenways to link neighborhoods, schools and work places to both the shoreline and regional mobility networks.

Gather

Three new recreational gathering spaces

Bring diverse communities together in thriving parks to foster social resilience, health, and access to nature.

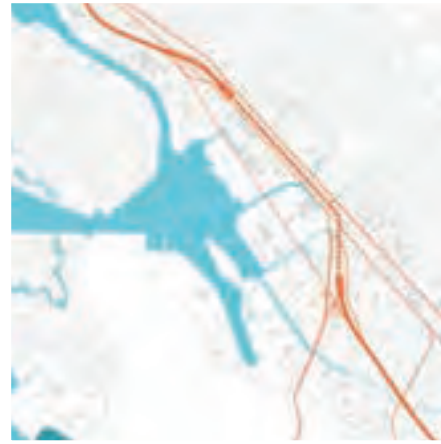


Mobility: Stitch neighborhoods to shoreline

As in many coastal cities, Oakland's shorezone is dominated by regional transportation highways and rail lines. Several corridors, including Interstate 880, the Capitol Corridor, and Bay Area Rapid Transit (BART), provide lifeline regional connections to local communities, but also sever these neighborhoods from Oakland Estuary. In addition, these corridors are susceptible to flooding, with sea levels already 12 inches from overtopping Interstate 880 during King Tides. The urgency and scale of the area's vulnerabilities required a bolder approach to this critical infrastructure – one that simultaneously protects against flooding threats and connects to new economic and recreational opportunities. Realigning Interstate 880 eastward and tunneling the corridor would free up land for development and create a green, civic spine running from East Oakland to Oakland Estuary. A multi-modal transit hub at Coliseum Station would unite regional transportation options under one roof while also generating new job opportunities and affordable, transit-oriented housing development.

Interstate 880 Corridor Realignment Option

As a potentially catalytic option, shifting Interstate 880 eastward along the existing Amtrak, Union Pacific, and BART corridors would protect this critical asset from the imminent threat of sea level rise. Tunneling the corridor would remove an imposing barrier separating East Oakland from the shoreline and free up land for community-centered economic development.



Above: Photographs taken from Oakland Estuary highlighting exposed and polluted groundwater (top) and infrastructure dividing communities (bottom).

Left: Realigning Interstate 880 eastward and tunneling the corridor could free up land for community use.

Top: A fully integrated, multi-modal station at the Coliseum site that stitches together transit connections: locally, regionally, and globally.

Left: Improved public realm resulting from I-880 tunneling and rezoning to enhance value capture opportunities and provide sea level rise protection.

Coliseum Multi-Modal Transit Hub

A fully integrated station at the Oakland Coliseum site would stitch together transit modes at all levels, enabling connections between BART, Amtrak, AC Transit, and Oakland International Airport. Transit-oriented development would bring opportunities for affordable housing and local jobs. Value captured from this development could help pay for local adaptation actions. The hub could serve as a key node for a second transbay crossing, helping expand the job shed to put more well-paying, regional jobs within reach for residents. As Oakland Airport contends with the threat of sea level rise, this hub could also serve as a connected, flood-safe space for off-site terminal development.

Collaborative planning tools: Prosper through community-centered design

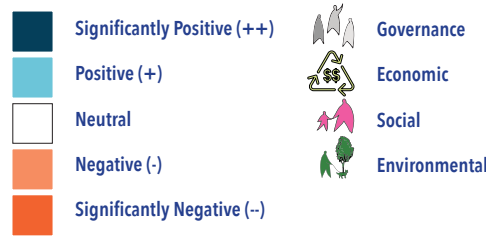
All cities that face flooding challenges need to build collaboration through community-centered conversations. We developed a three-part toolkit that includes the In It Together game, ABC Equity Checklist, and Quadruple Bottom Line (QBL) framework. In the game, players role-play diverse stakeholders and initiate adaptation actions such as living levees, Tidal Cities, and Community Land Trusts by placing corresponding pieces on a map of Oakland Estuary. Players can choose to work competitively or cooperatively as they weigh the benefits of collaborative and solo actions.

The ABC Equity Checklist helps communities document and advocate for their priorities in local investment decisions, focusing on factors related to socioeconomic equity, inclusion in decision-making, and public health. The QBL offers a framework for residents and project sponsors to evaluate adaptation actions, assessing each proposal based on criteria co-developed with community and agency representatives.

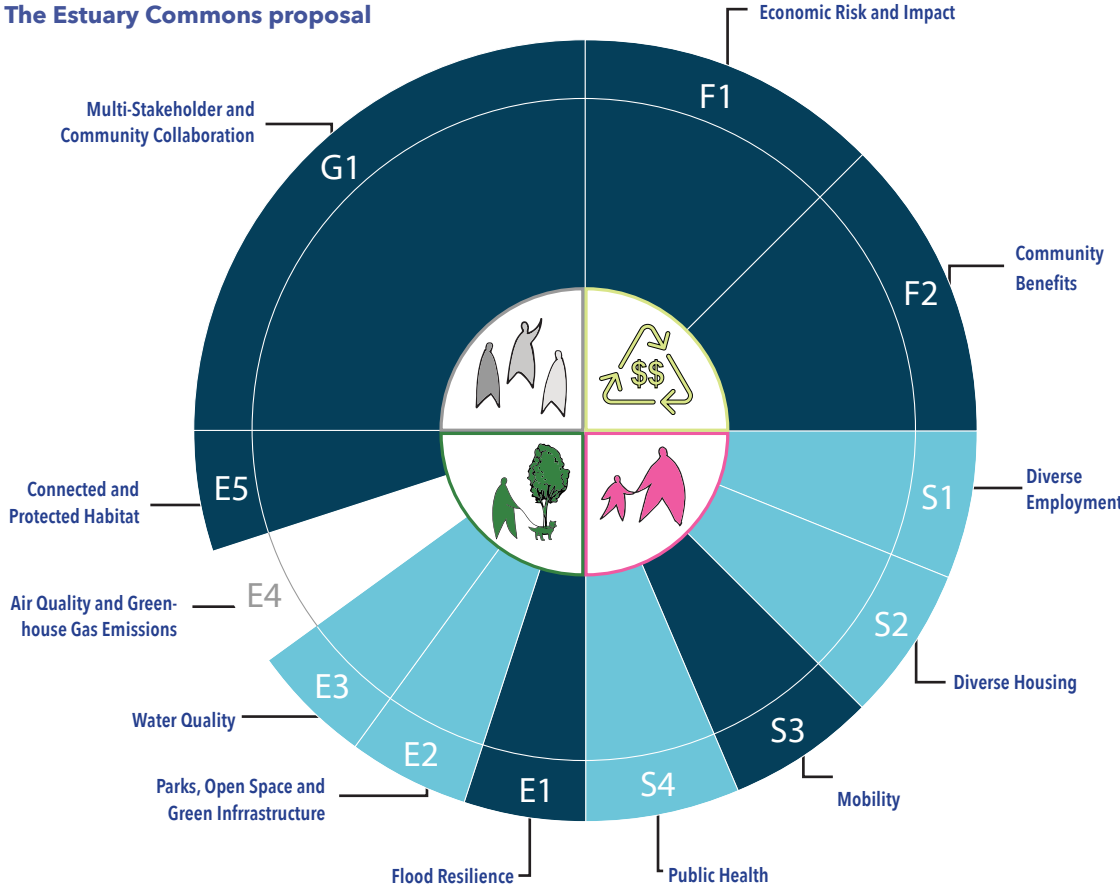
Playing In It Together Game with community members

Quadruple Bottom Line

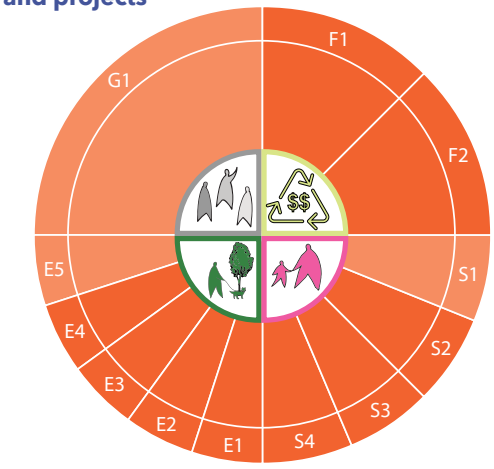
We developed an evaluation tool that scores adaptation proposals using a quadruple bottom line model, adding "governance" to the usual categories of economic, social, and environmental benefits. This recognizes the importance of local engagement and collaboration across agencies and scales of government. We developed the criteria and indicators in our QBL model with our community and agency partners, creating a custom approach that puts local priorities first.



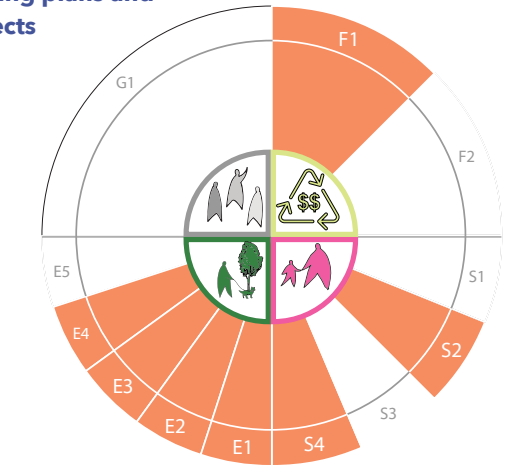
The Estuary Commons proposal



Current trends without existing plans and projects



Current trends with existing plans and projects



A Path Forward

For cities to adapt to sea level rise and thrive amid urgent environmental and socioeconomic threats, they must embrace the challenge of living in the edge and adapting in place, instead of retreating. Infrastructure investments must simultaneously protect shorelines, while also contributing to equitable, economically vibrant, and ecologically flourishing communities. Through our proposal for The Estuary Commons, the communities of East Oakland, Alameda, and San Leandro are poised to establish a model for coastal cities globally that embraces collaboration, inclusivity, and innovative design.

Many of our adaptation actions can begin today, building on the inspirational resilience work that local stakeholders and community-based organizations are already leading. A CBD in East Oakland would be an important first step to catalyze the health, wealth, and housing stability of local neighborhoods. Near-term shoreline and creek adaptation projects would have an immediate effect on controlling flooding, with the added benefits of increasing wildlife habitat and creating new, green pathways for residents. Conceptual studies could also be launched for longer-term actions like Tidal Cities and the Coliseum Multi-Modal Transit Hub, setting the stage for lasting resilience.

As members of the All Bay Collective team, we thank our community and agency partners for co-creating this proposal with us. We look forward to being part of the creative, community-centered adaptation initiatives around Oakland Estuary and sharing these lessons with the whole world.

Top and facing page: Community members, agency stakeholders, and students collaboratively designing a resilient and equitable Estuary.

Bottom: Student model demonstrating Tidal Cities concept.


Estuary
Commons

Unlock Alameda Creek

ALAMEDA COUNTY

Public Sediment

SCAPE Landscape Architecture

Dredge Research Collaborative

Arcadis

UC Davis Dept of Human Ecology

TS Studio

Architectural Ecologies Lab

Cy Keener and Justine Holtzman

SUMMARY:

Public Sediment for Alameda Creek is a proposal to address the challenge of sediment scarcity along the vulnerable urban edges of Fremont, Union City, and Newark. To bring sediment to the baylands, the team looked upstream to Alameda Creek, the largest local tributary that feeds the Bay. With the redesign of this waterbody, the team plans to create functional systems that sustainably transport sediment, engage people, and provide habitat for anadromous fish. The proposal moves beyond the tidal edge to span four geographies (uplands, creek, baylands, and bay) and resulted in three proposals:

Unlock Alameda Creek is an implementable project that links the creek with the baylands. It would provide a sustainable supply of sediment to baylands for sea level rise adaptation, reconnect migratory fish with their historic spawning grounds, and introduce a network of community spaces that reclaim the creek as a place for people, building an ethos and awareness around our public sediment resources.

Rethink the Sedimentshed is a long-term, multi-agency planning and visioning process for the sedimentshed of Alameda Creek that balances creek inputs with bayland needs over time. The planning process would develop strategies to rethink upland dam and reservoir infrastructure to harvest sediment and move it downstream. It would quantify and monitor the sediment needs of the changing baylands.

Plan + Pilot for a Future Bay proposes the formation of a design-science collaboration that explores new scenarios of sediment management for the Bay in order to plan now for the future of all the San Francisco baylands with low sediment supply and sea level rise.

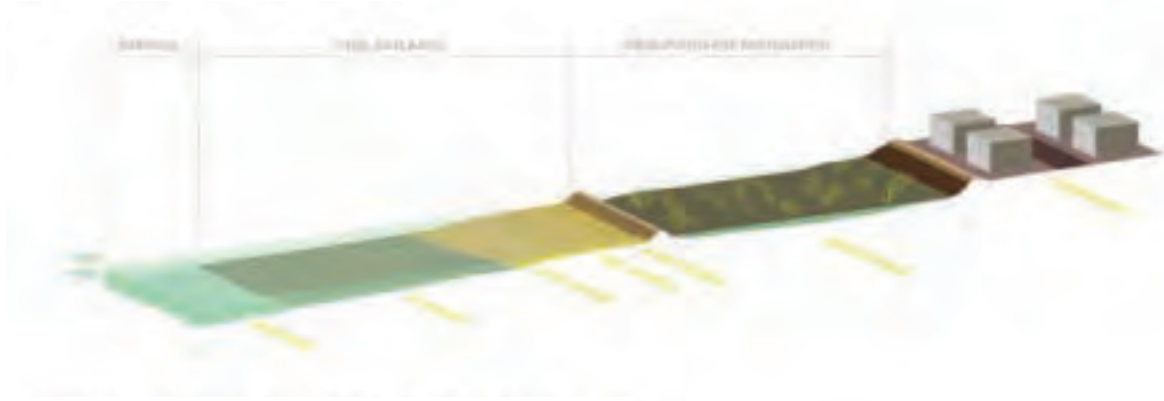
APPROACH:

Baylands as Living Infrastructure

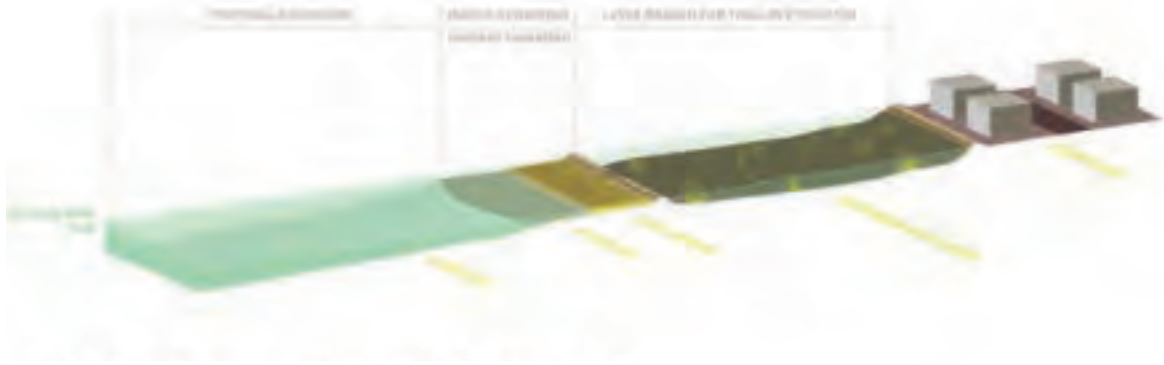
Public Sediment believed that tidal ecosystems are protective infrastructure that cushion the urban edges of the San Francisco Bay. Yet the Bay Area's tidal ecosystems – its marshes, mudflats – are at risk. These systems require sediment to grow vertically in response to sea level rise – without sediment, the baylands will drown. Low sediment supply and bayland drowning represents a slow but devastating scale of loss that threatens ecosystems, recreational landscapes, and places hundreds of thousands of residents and the region's critical drinking water, energy, and transportation systems at risk. To creatively adapt to this challenge, the team focused on sediment, the building block of resilience in the bay, and proposed to actively intervene in this ecological transformation by **designing with mud** and **making sediment public.**

Public Sediment for Alameda Creek represents a paradigm shift in how the Bay Area can plan for climate change. Rather than hardening the edge and ignore the long-term consequences, the design recalibrates our relationship with sediment and water resources and invest today in living systems that will grow over time to adapt to sea level rise. PUBLIC SEDIMENT is a methodology for unlocking and remaking broken systems and can be applied at multiple scales – to the necklace of tributaries that feeds the Bay, to the Delta and the larger Rivers of California. Many of the risks are invisible yet they increase dramatically over time – the team's proposal creates pathways to act now and set up functional ecosystems that sustain living bayland infrastructure for the future.

Baylands Today

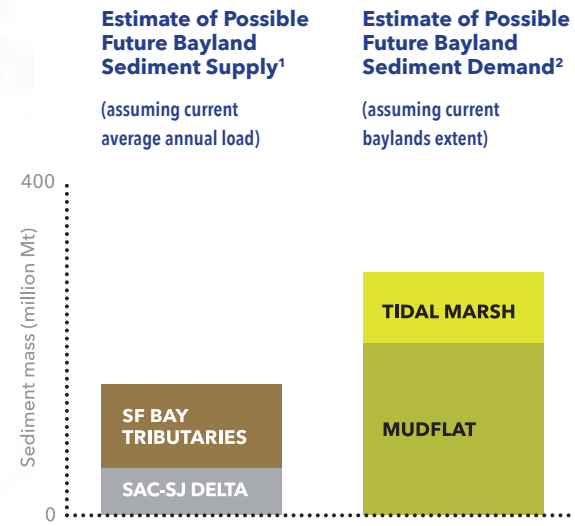


Baylands with 3ft of SLR



Baylands with 7ft of SLR

Bayland Need by 2100 with 3.5 ft SLR



Based on preliminary analysis by SFEI. A more detailed analysis is being conducted as part of the Healthy Watersheds Resilient Baylands project (hwrb.sfei.org)

[1]Sediment supply was estimated by multiplying the current average annual sediment load values from McKee et al. (in prep) by the number of years between 2017 and 2100.

[2]Sediment demand was estimated using a mudflat soil bulk density of 1.5 g sediment/cm^3 soil (Brew and Williams 2010), a tidal marsh soil bulk density of 0.4 g sediment/cm3 soil (Callaway et al. 2010), and baywide mudflat and marsh area circa 2009 (BAARI v1).

Today the Bay supports a mosaic of estuarine ecosystems, but sea level rise is projected to trigger bayland habitat shifts where protective marshes and mudflats become open water.

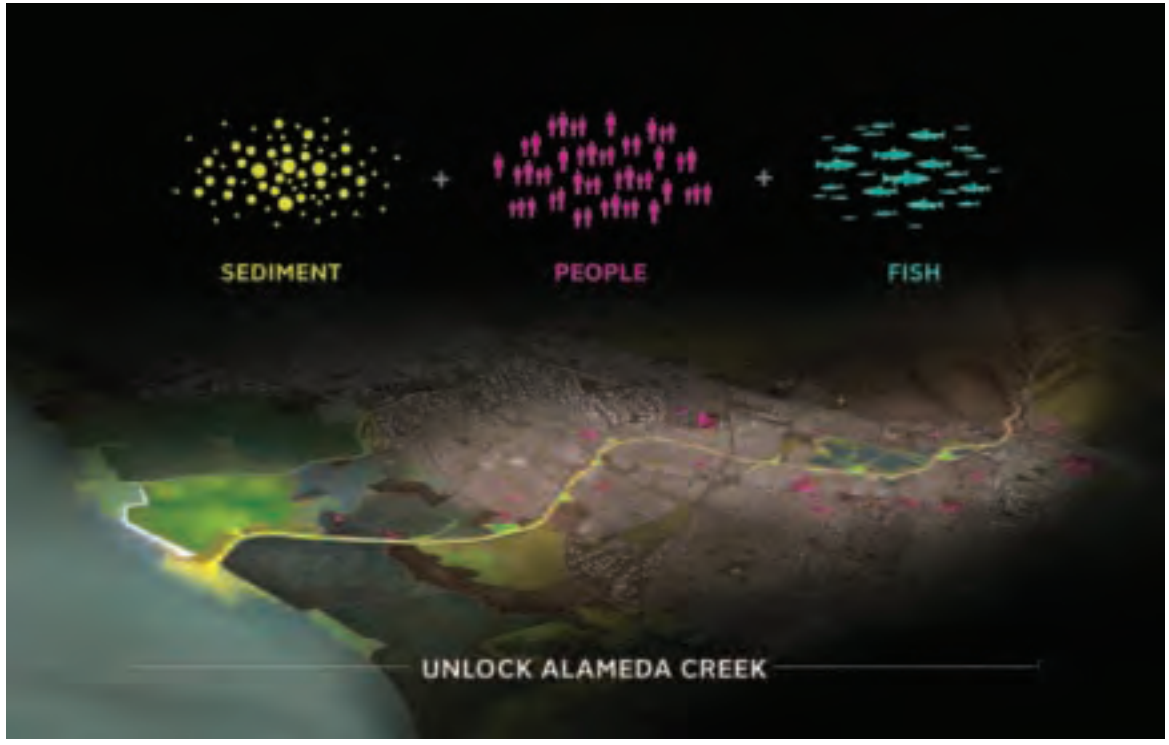
Unlock Alameda Creek

Today the Bay supports a mosaic of estuarine ecosystems, but sea level rise is projected to trigger bayland habitat shifts where protective marshes and mudflats become open water.

Unlock Alameda Creek is an implementable project that links the Creek and the Bay. It provides a sustainable supply of sediment to the bayands for sea level rise adaptation, reconnects steelhead with their historic spawning grounds, and introduces a network of community spaces that physically connect to the Creek and Bay.

Today, Alameda Creek is the largest local tributary that feeds the Bay, but sediment remains stuck in the flood control channel, trapped behind dams, and is unable to make it to the Baylands where it is needed for marsh and mudflat accretion. Unlock Alameda Creek is a buildable project that redesigns the creek to enable sediment flows and reconnects it to the Baylands, balancing the needs of people, fish, and sediment in the watershed. The creek levees would be selectively breached near the mouth to feed bay marshes with sediment and manage flood risk at the bay edge. The flood control channel would be redesigned to move sediment, support vegetative diversity, and enable fish passage through critical migration seasons. Public access would be expanded along the 12-mile flood control channel that links Fremont, Union City, and Newark, enhancing recreation, environmental education opportunities, and regional connectivity.

Alameda Creek connects communities that are diverse in race, ethnicity, age, and income, linking them with each other and the bay. For too long, Alameda Creek has been viewed solely as a flood control channel, and the Public Sediment Team worked hard to establish a vision for Alameda Creek as living system that is socially inclusive, ecologically functional, and adaptive to future sea level rise and climate change.

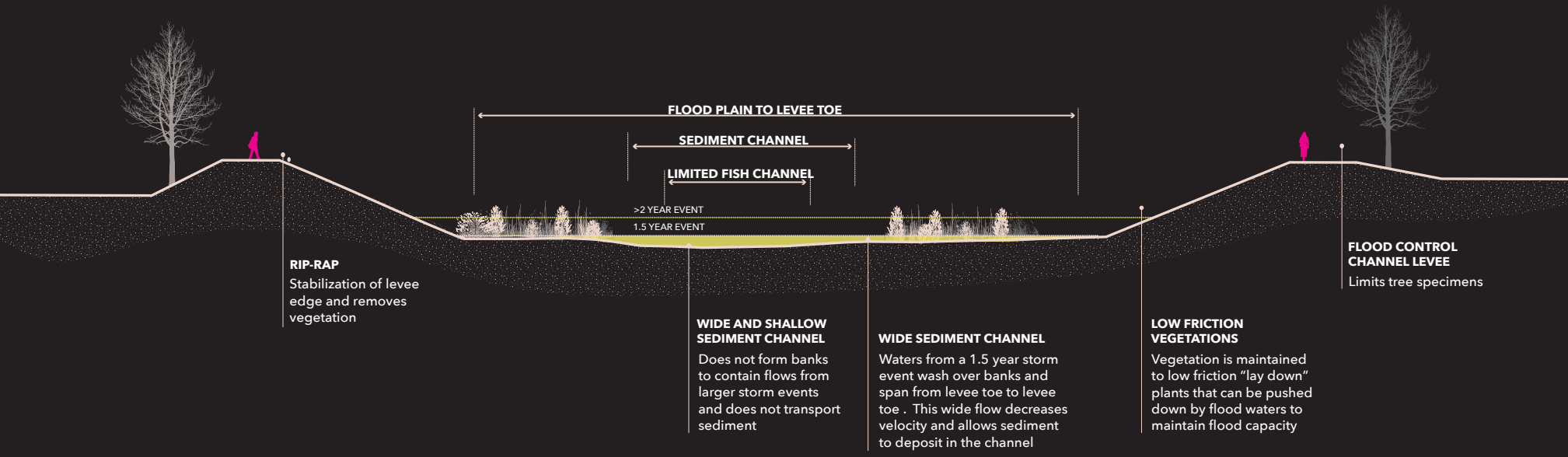


How to Move Sediment?

Today, coarse grain sediment builds up in the channel, reducing flood storage capacity and creating the continual need for dredging. Vegetation is removed to prevent friction that would impede floodwater flows and reduce channel capacity. Without stabilizing root systems, a deeper and narrower stream that moves sediment cannot form, and sediment is spread in thin sheets across the full width of the stream bed.

The Public Sediment team proposed to construct a bankfull sediment channel stabilized with diverse vegetation to move more sediment downstream during regularly occurring floods. The active sediment channel is deeper and more consistently sloped than today's channel, simultaneously moving sediment and relieving flood capacity concerns.

Current Alameda Creek Flood Control Channel



RIP-RAP
Stabilization of levee edge and removes vegetation

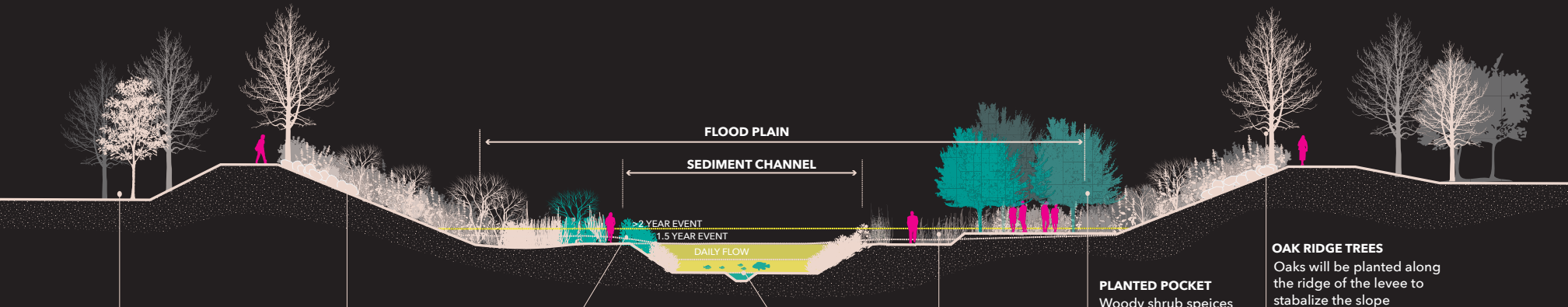
WIDE AND SHALLOW SEDIMENT CHANNEL
Does not form banks to contain flows from larger storm events and does not transport sediment

WIDE SEDIMENT CHANNEL
Waters from a 1.5 year storm event wash over banks and span from levee toe to levee toe . This wide flow decreases velocity and allows sediment to deposit in the channel

LOW FRICTION VEGETATIONS
Vegetation is maintained to low friction "lay down" plants that can be pushed down by flood waters to maintain flood capacity

FLOOD CONTROL CHANNEL LEVEE
Limits tree specimens

Proposed Alameda Creek Flood Control Channel



RIPARIAN FOREST LEVEE
Increased riparian trees- additional riparian species to be planted on levee edge

LIVING RIP-RAP
Allows for plant material to be integrated into the flood control channel edge to prevent erosion and increase biodiversity

SEDIMENT CHANNEL
Reduced width and increase depth creates banks that are capable of moving sediment down-stream within a 1.5 year storm event

FISH PASSAGE
Increased depth and deeper water flows facilitate fish passage. This channel can meander within the sediment channel

FLOOD PLAIN
Plant materials such as sedges, rushes, and large shrubs stabilize banks of the sediment channel

PLANTED POCKET
Woody shrub speices and small trees are clustered around mudrooms to increase biodiversity within the channel.

OAK RIDGE TREES
Oaks will be planted along the ridge of the levee to stabalize the slope

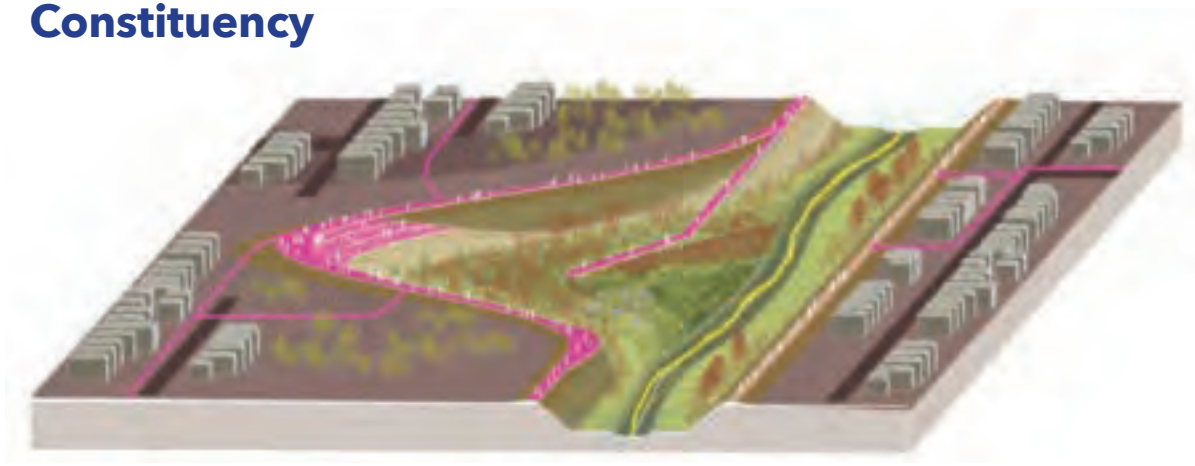
The terrace trail is a dry season trail for people to access the creek bed due to a strong desire for people to be close to the water.

Simple construction techniques are used to create the Terrace trail and transform the creek experience into one that is long, meandering, and immersive.

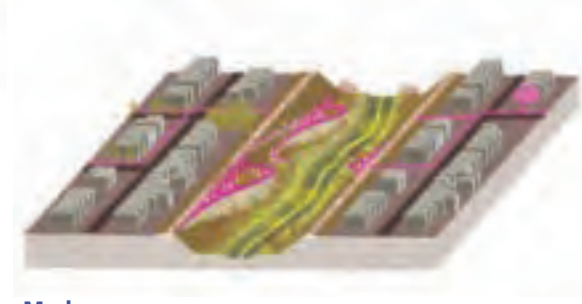
Building a Creek Constituency

The design proposes four types of public access in the newly formed creek: Mudrooms, Floodrooms, Terrace trails, and seasonal bridges.

Each of these establishes connectivity and exchange, unlocks new creek-side experiences, and enables new forms of environmental education and stewardship.



Floodrooms



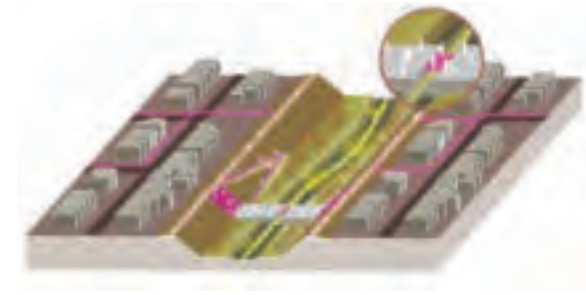
Mudrooms

How to Connect People?

Creek trails are well-used by local residents, but the channel and its levee infrastructure divide Fremont, Union City, and Newark–the Tri City Area. Historically the creek was a social space, a place for fishing, swimming, and enjoying the water's edge. Today, public access is limited and the creek bed itself has been erased from the public realm. This large suburb is extraordinarily diverse, hosting an Asian-majority population and the region's largest concentration of Afghan residents in Little Kabul. Yet many of these communities are isolated from one another – of the twelve bridges that do cross the 12-mile creek system, only six are accessible to pedestrians and bicyclists, leaving miles of isolated urban fabric between.

There were four techniques within the design used to expand the public realm within the Creek: Mudrooms, Floodrooms, Terrace Trails, and Seasonal Bridges. Each would be managed alongside seasonal flooding, with limited access during the rainy season. This network of public access infrastructure would enable people to reach the water, linger along its edge and to cross the creek – transforming a linear and fast experience to one that is slow and meandering. These interventions would bring Alameda Creek back into the public realm, unlock the powerful aesthetic environment of the creek, enable connectivity between neighborhoods, and create new space for public sediment education and creek stewardship. These new, immersive experiences would MAKE SEDIMENT PUBLIC and build a larger ethos and awareness around the system-scale goals of this work.

While public access improvements like mudrooms and seasonal bridges would connect people with the creek, a larger creek constituency is needed to value this resource and advocate for its adaptation to climate change. The team held events in the watershed to understand how people perceive this ecosystem and synthesized these stories into a CREEK ATLAS – a document that reflects changing perspectives and attitudes towards the creek. The Creek Atlas is a starting point for organizing this information into a larger campaign that engages students, youth, and residents in this changing environment, building awareness and activism around PUBLIC SEDIMENT resources for the future.



Seasonal Crossings

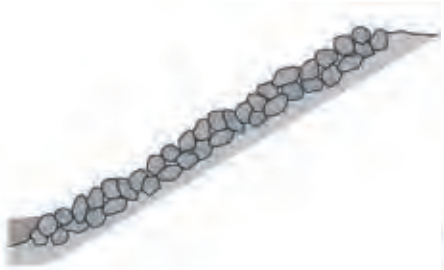
Terrace Trail

How to Design for Fish?

Many species depend on a healthy creek for survival, but the design focused on the needs of steelhead trout, as their lifecycle depends upon a series of connected ecosystems that link the bay with the uplands. Adults live in the open bay and then migrate up the creek in the winter to spawn in pools and reservoirs upstream. Steelhead born upstream migrate down the creek to the Bay as juveniles, where they seek refuge in tidal wetlands as they physiologically adapt to their new salt water environment. Alameda Creek likely supported one of the largest historic steelhead runs in the San Francisco estuary. Today, these runs are all but lost.

Plans are underway to remove barriers for fish passage, including the construction of a series of fish ladders and access-ways at the Bart Weir and the Rubber Dams. Even with these improvements, the wide and shallow cross section of Alameda Creek inhibits the successful migration of steelhead. We propose the design, excavation, and stabilization of a deeper fish channel, inset into the sediment

The team held events in Alameda Creek watershed to understand how people perceive this eco-system and synthesized these stories into a Creek Atlas. People want access to the creek, see the water, and experience this ecological system.

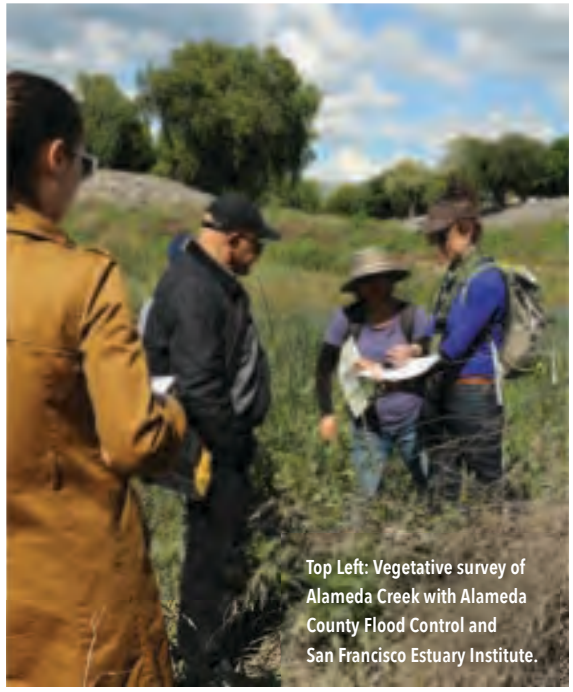


CONVENTIONAL RIPRAP
Provides minimal ecolgical value.

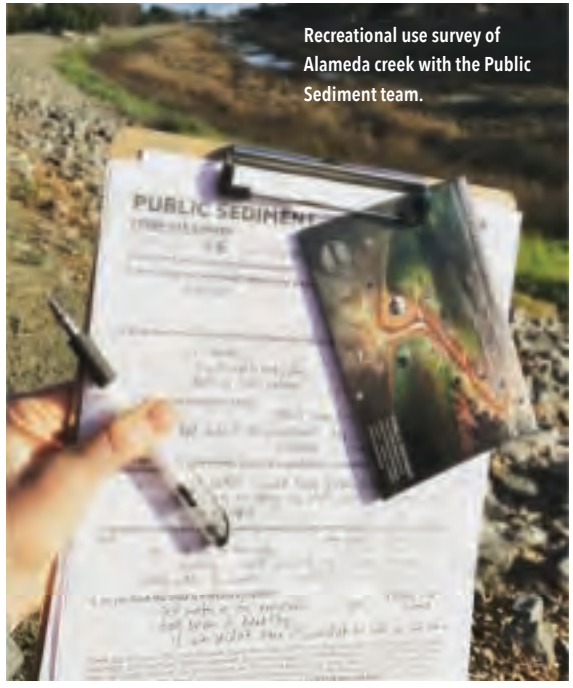
LIVING LEVEE
Provides ecological habitat for fish, plants, and people.

While the levees of Alameda Creek will remain in place throughout a majority of system, this condition can be improved. The Living Levee is applied on select levee banks to stabilize new mudroom edges, stabilize the meandering channel, and encourage the formation of a sediment channel below bridges and structures, where it is too shady for plant growth.

Bay interventions implemented such as the pebble dune and mid complex levee in order to breach the flood control channel of Alameda Creek.



Top Left: Vegetative survey of Alameda Creek with Alameda County Flood Control and San Francisco Estuary Institute.



Recreational use survey of Alameda creek with the Public Sediment team.

channel, that ensures consistent flows during the in-and out-migration seasons, increasing passage opportunities for fish. Today's migration gauntlet would be alleviated by vegetated banks that provide cover, deeper pools and riffles, and consistent streamflow conditions below bridges and overpasses. In the creek bed, FLOODROOMS and MUDROOMS would create expanded floodplain habitat for forage and refuge during major storm events that occur during migration

While the levees would remain in place throughout a majority of the system, this condition could be improved. Today's levees are sterile spaces that do not contribute to ecosystem function. The LIVING LEVEE is a blanket of concrete units that weave together to stabilize new edges, create space for people, and enable vegetative growth on the levee edge. Different surfaces and textures would accommodate the needs of different users – people can sit, fish can shelter, and macro invertebrates can settle. The Living Levee unit is shaped to embed itself in the levee with high water flows and weave together with other units to form a self-stabilizing bank.

Connecting to the Baylands and Breaching the Creek

Today's creek bypasses the Eden Landing Ponds, which host important habitats but are currently cut off from tidal inundation. Because of this disconnection, the ponds are subsiding at an extreme rate, and without action these areas are vulnerable to erosion and overtopping with sea level rise, exposing adjacent neighborhoods to flooding.

Public Sediment proposes a multi-part strategy to connect sediment with the Baylands. First, large volumes of sediment must be imported to lift the subsided lower ponds to marsh plain elevation before breaching. This would provide immediate flood protection benefit and gives marshes a head start on sea level rise. Up to seven million cubic yards of sediment are needed. Sourcing this volume of sediment is no easy task and depends upon an uncertain timeline – even if this volume can't be imported in time, the ponds should be breached as soon as permitting allows to stop subsidence through slower accretion by tidal means.

While breaching improves long term flood protection through the creation of sustainable tidal baylands, near-term fluvial and tidal flood risks must be addressed. In order to breach Alameda Creek a series of interventions must occur. These include modifications to the Old Alameda Creek levee to allow fluvial floodwater to leave the system, the construction of a mid-complex levee to separate managed ponds from tidal ponds, and the construction of a PEBBLE DUNE at the perimeter of the ponds, that would perform like a barrier island by reducing tidal forces and protecting the baylands from wave action and erosion.

With these interventions in place, the lower northern levee could retire, the creek could be breached, and a new delta could begin to form in the Bay.

How to Connect People to the Bay

There are very few places in the Bay Area to directly access the open water. Although the current Bay trail extends to the water's edge, the north side of the creek trail does not connect to southern paths, and the experience can be flat and monotonous to the average user. By creating a new series of new destinations in the Baylands, the design would unlock the larger ecological investments at Eden Landing to the wider public. A new segment of the Bay Trail could expand into the Baylands connecting to the Alameda Creek Levee trail. Turk Island, an exciting topographic destination in a horizontal landscape, would become a stopover point for travelers on the Bay Trail. At Alameda Creek, the Breach Bridge would jump the channel and move with the tides, linking the greater path network of Eden Landing and providing a clear overlook to the newly forming delta. A potential floodroom site is also possible to the south of the flood control channel level, providing additional recreational opportunities in Coyote Hills Park.

The Bayland Bridge enables access across the creek- directly linking the trails of Eden Landing and Coyote Hills. The Bridge also frames a moment where the creek and Bay mix, creating a space for people to watch this new tributary delta form over time.

How to Design for Fish and Other Species

Bayland species require estuarine environments, where fresh and salt water mixes. Juvenile steelhead require this transitional space to adapt to a salt water environment. Other threatened species, like the Salt Marsh Harvest Mouse and the Clapper Rail depend on these habitats for long-term survival. The channelization of the creek to the bay's edge has severely limited this estuarine zone, transforming what was historically a wide marsh plain of shallow meandering sloughs into a single linear channel.

Public Sediment links flood protection interventions with habitat creation potential. The PEBBLE DUNE is designed to create a shifting coarse grain beach over time. Secluded from people, the Pebble Dune would be ideal for nesting pairs of terns. Large mudflats, fed by Alameda Creek's sediment, would break waves while expanding pupping zones for harbor seals. The BREACH would be wide and strategically located for fish to find it on their migration routes, expanding into a new tributary delta at the Bay's edge.

Bay Sensor Installation

A phased strategy for monitoring the ecological system of the creek spans the scope of the project. In the short-term, sensing stations will be deployed throughout the tidal range where there are currently no permanent sensing installations to study tidal sediment flows and the potential breach location. In the long-term, a comprehensive monitoring strategy is deployed alongside the living infrastructure interventions to ask critical questions about creek and bay morphology as well as ecological health

Long Term Proposals

Sedimentshed Vision Plan

Alameda Creek is fed by a 633 square mile watershed, an area almost as large as the Bay itself. A large portion of the Alameda Creek Sedimentshed is impounded – limiting sediment flows and trapping sediment upstream. Recent development in the upper watershed has led to sedimentation in areas where it is damaging for local ecosystems. Channels, dams, and recharge ponds, decouple the flows of water with the flows of sediment, preventing movement downhill. Mining removes sediment from the system, exporting it to construction sites and yards for resale.

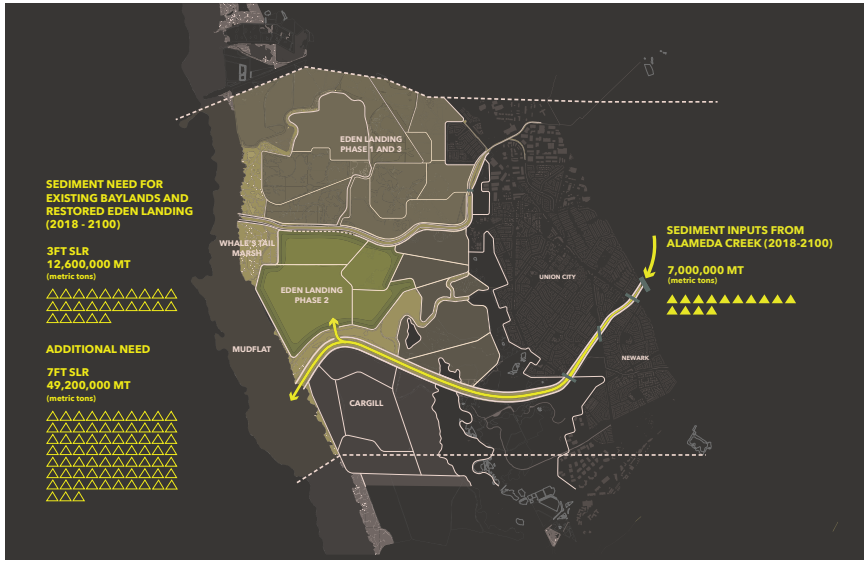
While the team's proposal UNLOCK ALAMEDA CREEK addresses some of the infrastructural barriers in the lower creek, the upland sedimentshed cannot be ignored. Dams cannot be removed overnight – reservoirs provide critical drinking water for residents of Alameda County and the City of San Francisco. Recharge ponds replenish the local aquifer and protect the water supply from saline intrusion from sea level rise. The team proposes a SEDIMENTSHED VISION PLAN, a long-term scientific study and multi-agency plan for the Alameda Creek sedimentshed.

This process would involve a long-term monitoring strategy, establish a sediment budget for Alameda Creek, and develop a vision for balancing the sediment needs of the Bay marshes and mudflats with upland sources of sediment over time. It would quantify sediment accretion rates and bayland adaptation needs, determining where living infrastructure along Niles Cone is most viable as sea levels rise and where it can benefit vulnerable communities the most. The collaboration would engage dam operators, water managers, regional watershed policy makers, and flood control districts to balance lowland needs with upland concerns. It would assess the potential to retrofit and operate dams for sediment transport, harvest sediment from upland reservoirs, and import and reuse sediment currently treated as a waste product.

Facing page, top: Drone footage looking from the Quarry Ponds and Rubber Dams to Niles Canyon and the Sunol Regional Wilderness area that compose 633 sq miles of watershed for Alameda Creek.

Facing page, bottom: Drone footage looking from Coyote Hills to the Bay's edge. Alameda Creek flood control channel extends to the furthest extents of bay lands.

This page: The Alameda Creek sediment- shed is extensive and contributes the largest amount of sediment to the south bay of any local tributary. Water management infrastructure like channels, dams, and recharge ponds decouple the flows of water and the flows of sediment.



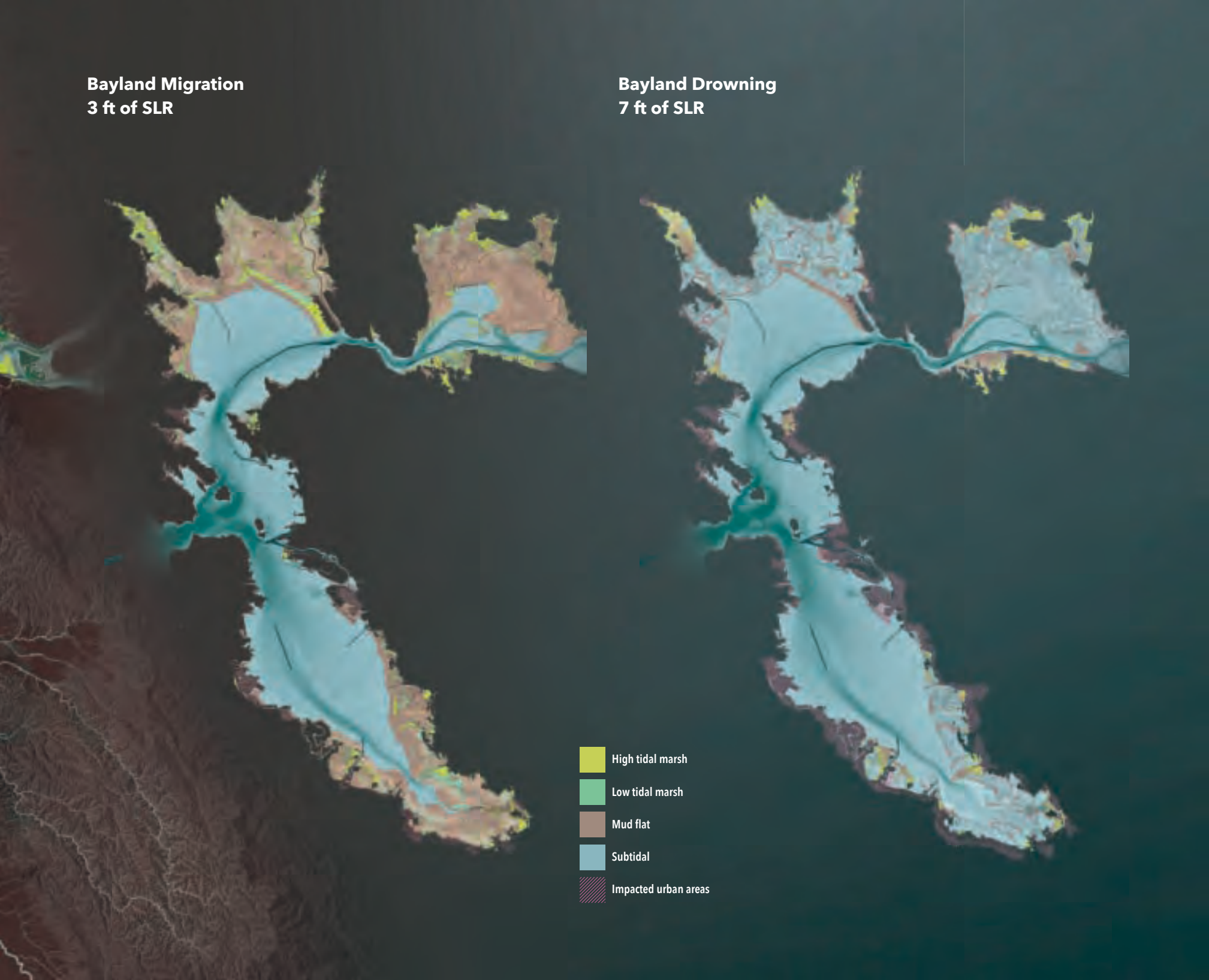
Pilot and Plan for a Future Bay

Unlocking Alameda Creek challenges the idea that Bayland investment should occur only at the edge. Measure AA, intended to restore Bay Area wetlands, passed as an example of a truly regional ballot measure. As these funds are spent, it is critical to consider future sediment supply and invest in new methods of bayland sustenance, including tributary unlocking and actively dispersing sediment.

PILOT AND PLAN FOR A FUTURE BAY is a design/science collaboration that would develop a plan for the future of the San Francisco baylands with low sediment supply and sea level rise. Investments in strong science are made – it is time to translate this science into clear alternatives for decision-making and debate that opens up this dialogue to a wider audience of policy-makers, agencies, and landowners. The Public Sediment team proposes a design/science partnership that explores new scenarios of sediment management for the Bay, articulating the physical realities, social dimensions, and long-term landscape implications of investing differently with mud. From this process, a series of pilots would be identified and constructed that prepare the region's living infrastructure for more extreme rates of sea level rise.

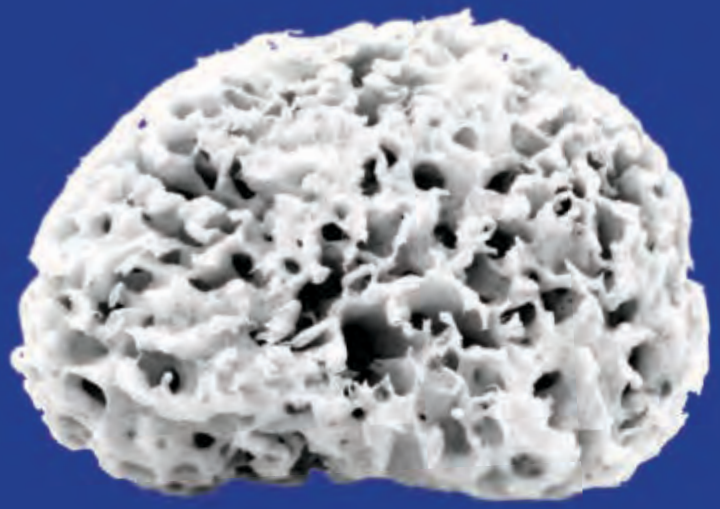
Bayland Migration
3 ft of SLR

Bayland Drowning
7 ft of SLR



South Bay Sponge

SANTA CLARA AND SAN MATEO COUNTIES



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SUMMARY:

The South Bay Sponge is a concept for using nature and natural systems as a primary tool for climate adaptation and resiliency in the South Bay, inspired by both the historic function of the region's inter-tidal marshlands as flood protection, as well as the remarkable, multi-jurisdictional efforts to restore the South Bay Salt Ponds. The potential of a massive assemblage of remnant marshlands, newly restored salt ponds and newly constructed wetlands as the core component of a regional flood protection strategy is at once radically innovative, but also resonant with the South Bay landscape today. In addition to addressing climate adaptation, the South Bay Sponge proposes great natural ecology (tidal marshes, subtidal zones, living shorelines), alongside urban revitalization (reconnection, reinvestment, densification, diversi-fication, transit) and vibrant ways for people to engage, experience and see the Bay as integral to their lifestyle and identity.

The South Bay Sponge project covers more than 20 miles of shoreline, stretching from Menlo Park to San Jose. The South Bay Sponge project is a multi-jurisdictional vision: the project encompasses two counties (San Mateo, Santa Clara), six cities (Menlo Park, East Palo Alto, Palo Alto, Mountain View, Sunnyvale, Santa Clara), and at least five federal agencies (National Marine Fisheries Service, U.S. Army Corps of Engineers, U.S. Fish & Wildlife Service, U.S. Natural Resources Conservation, NASA).

The South Bay Sponge is a framework for adaptation – for adapting the Bay shoreline and infrastructure and for advancing our methods of planning, design and communication to achieve new forms of settlement on the Bay.

APPROACH:

One Bay, Many Communities, Many Solutions

ONE BAY MANY COMMUNITIES MANY SOLUTIONS

Resiliency does not mean 100% protection and insulation from challenges, but more the capacity to recover from and adapt to ongoing and varied challenges over time. A "resilient community" is one that can quickly recover, creatively adapt and absorb stresses without too much loss of investment.

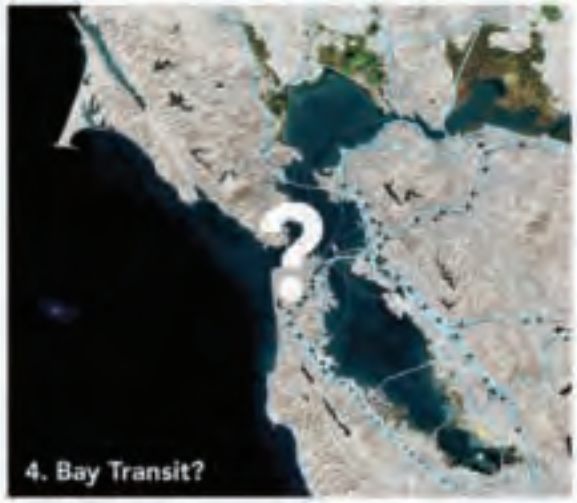
Thus, one cannot simply isolate "resiliency in the bay" to water's edge ecology and engineering alone; the effort must equally embrace broader issues of economic investment, community enhancement, primary infrastructures, and a variety of different solutions to different contexts, enabling more flexible and agile forms of "bouncing back."

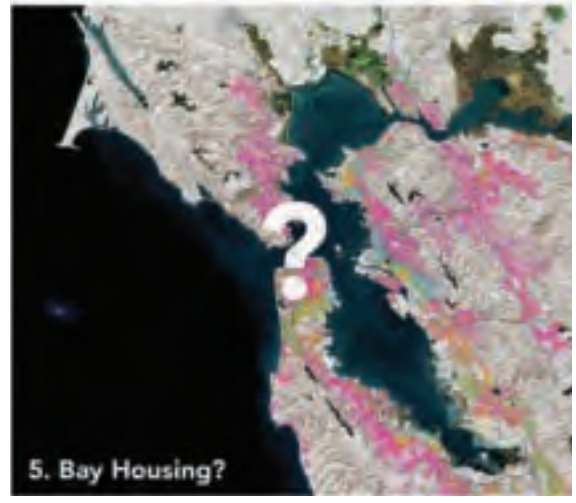
To frame the challenge of "resiliency in the bay", The Field Operations Team began with the notion of "One Bay, Many Communities, Many Solutions".

One Bay speaks to the bay as something shared and fundamental to a collective sense of place as well as environmental resiliency.

Many Communities speaks to the great number of settlements that surround the bay and to the diversity of cultures, priorities and points of view.

Many Solutions speaks to the diversity of conditions around the bay and therefore to the importance of multiple approaches that accommodate variation, difference and local circumstance.





Our approach is nature plus how people and communities relate to the Bay and grow. We need robust, living natural ecological systems around the Bay alongside thoughtfully planned urbanization — new housing and development, transit and infrastructure, and vibrant public spaces and waterfronts for people to engage with, experience and see the Bay as fundamental to their lifestyle and identity.

After touring the Bay and its various communities on the ground, it surprised us that many communities are in fact disconnected from and bear little actual relationship to the Bay. Many are cut off from the Bay by freeways or other infrastructures; others turn their back on marshland and other edge conditions as they see little value or connection.

How do we reconnect communities with the Bay in direct, visceral and experiential ways?

How might we engage with different Bay communities not only in terms of water's edge resiliency but also in terms of broader resilient systems: housing, infrastructure, economy, mobility and connectivity?

Reimagining Mission Creek as
social and ecological infrastructure

Proposal for a new ecological edge
for Oakland in Jack London Square

BAYTOWNS

The Field Operations Team's initial concepts for a more resilient Bay Area began with a proposal to establish and reinforce a diverse array of revitalized "BAYTOWNS". These are diverse communities surrounding and integral to the life of the Bay and to resilient forms of settlement.

The Field Operations Team developed concepts for four different communities where the many vulnerabilities and risks converge, communities with entirely different geographies and physical conditions around the Bay: one in the north, one in the south, one in the east and one in the west. The initial concepts aimed to leverage the vulnerabilities in these communities into opportunities for greater resiliency and to address how people and communities relate to the Bay as well as grow, adapt and realize more robust and resilient economies.

The Team proposed 4 physical typologies to help address the various environmental, urban and engineering issues of the Bay, differentiated by context and place, leading to the creation of more resilient BAYTOWNS.

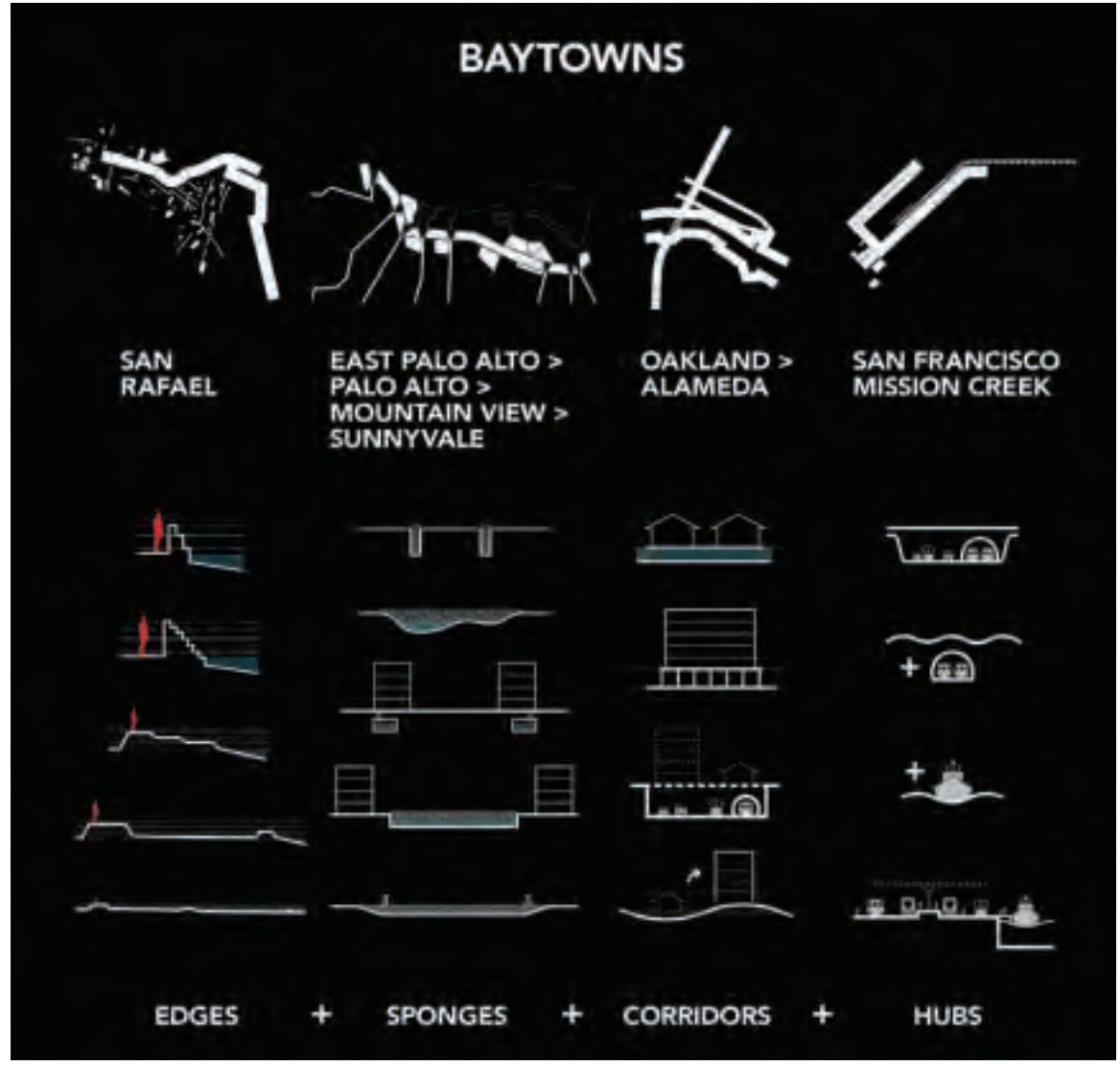
Edges: for sea level rise, ecology and public waterfronts;

Sponges: for stormwater absorption, habitat and parkland;

Corridors: for new investment, development, infrastructure and connection;

Hubs: multimodal transit nodes tied to investment in improved mobility and connectivity.

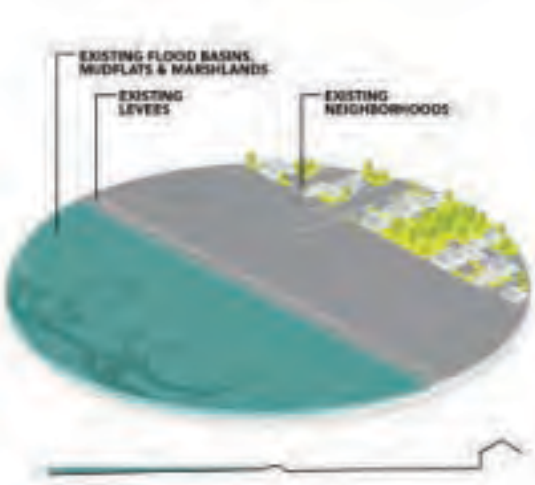
The Field Operations Team applied these fourfold framework to four communities around the Bay: San Rafael in the North Bay; East Palo Alto, Palo Alto, Mountain View and Sunnyvale in the South Bay; Oakland in the East Bay; and San Francisco in the West Bay.



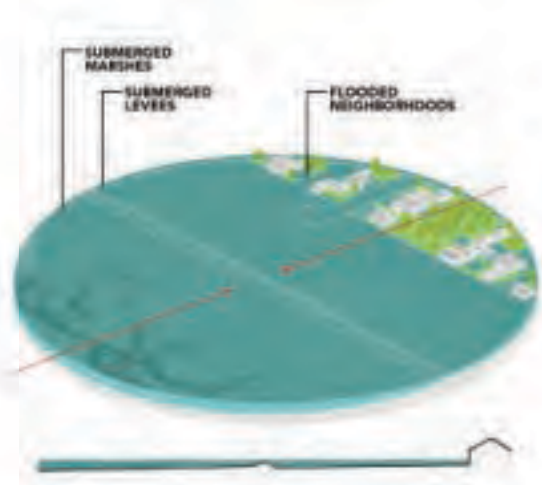
BAYTOWNS: Four case studies utilized four physical typologies for a more resilient Bay Area.

The four case studies each reinforced the notion of "living on the Bay" – living in revitalized "Bay Towns" that support resilient communities, resilient ecologies and resilient forms of economy. In this way, BAY TOWNS offers a holistic concept to address connectivity and resiliency across the Bay.

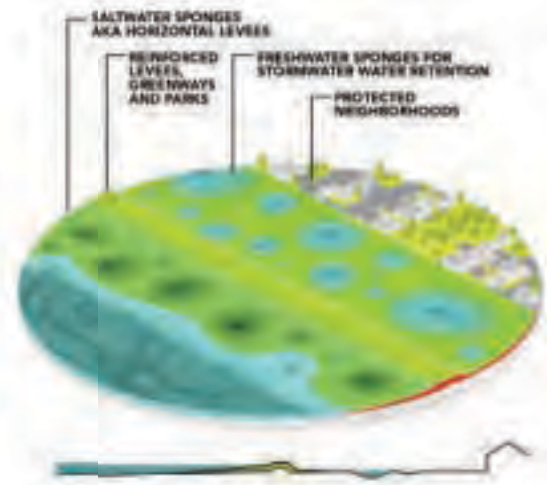
South Bay Projected Sea Level Rise 2100



The Bay Edge Today



Flooding



The Sponge

South Bay Sponge

In the Design Phase, The Field Operations Team worked closely with the communities in the South Bay and Silicon Valley to shape a vibrant and living framework for adaptation in the face of climate change and sea level rise.

The South Bay and Silicon Valley include some of the lowest-lying and most vulnerable communities to sea level rise in the Bay Area and at the same time are growing rapidly without big plans for increasing housing and transit connectivity. Any effort for resiliency in the South Bay must consider these vulnerabilities.

As sea level rises, low-lying communities in the South Bay will face flooding from two directions: 1) higher average elevations of the Bay compound the flooding potential of high and king tides, increasing the possibility of overtopping levees and 2) stormwater runoff draining towards the Bay from within the communities will be unable to drain into the Bay because of higher water levels. Without a plan to address both of these flood sources, the flood waters will have nowhere to go – resulting in the flooding of homes, businesses and infrastructure.

Using the concept of nature as a "sponge", Field Operations combined a new shoreline levee plus shallow marshland edges in the Bay ("horizontal levees" or "saltwater sponges") and new inland freshwater wetlands ("freshwater sponges") for stormwater to collect, filter and ultimately disperse. The result is an innovative redesign of the modern shoreline that employs natural systems or "sponges" to not only defend against sea level rise, but also sequester carbon, cleanse pollutants and revitalize fish and native wildlife.

As a means to spread the concept of "sponges" as a natural form of flood protection and to engage with as broad an audience as possible, Field Operations created a mobile hub of information on the South Bay Resilient by Design Effort, dubbed the "Sponge Hub".

Between February and May 2018, the Team toured the Sponge Hub around South Bay Communities, appearing at Farmers Markets, churches, high school sport events, parks and Bay Trail locations. At each appearance, our approach was four-fold: 1) to communicate the work of Resilient by Design, 2) to convey the specific relevance of sea level rise to each community and each place, 3) to listen, absorb and interact with the community, and 4) to be optimistic, forward thinking, memorable and fun (Field Operations served cotton-candy "edible sponges") – all with the aim of fostering greater curiosity, enthusiasm and optimism for participating in sea level rise planning.

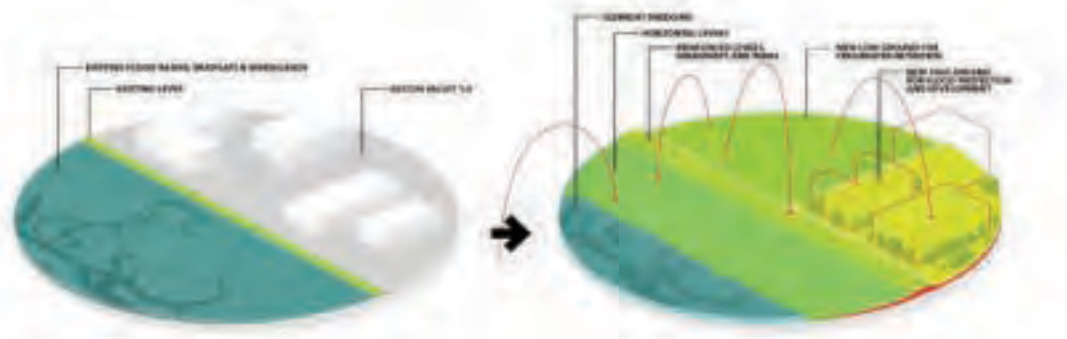
Five Strategies to Achieve the South Bay Sponge

The Sponges are diverse eco-tones, designed with topographic variation to support a range of ecological conditions.

1 | The Soil Swap

First, Field Operations proposes a "soil swap" – a coordinated, collaborative and regional approach to finding, sorting, moving, storing and utilizing soil for sea level rise improvements. Soil is a fundamental component of sea level rise adaptation projects: it is needed to build up the shoreline edges, restore levees, create new horizontal levee systems, and elevate building sites among other uses. The problem today: there is not enough soil that is either readily available or that meets the soil specification defined by the Regional Water Quality Control Board. One example: the USACE's EIA 11 shoreline project for Alviso is funded and permitted yet is unable to acquire adequate soil to achieve the design.

The aim of the "Soil Swap" is to create a coordinated and phased shoreline protection project for the entire South Bay. Phasing would begin with the lowest-lying and most vulnerable areas, would connect into existing high points (often landfills and local parks) and expand to create a continuous new shoreline. This new high ground is at once a sea level rise infrastructure, but also green space, parks, trails, and amenities for the whole region.



The Bay Edge Today

The Soil Swap

A softer, greener and denser Silicon Valley

Envisioning New Forms of Living on the Bay

2 | The Land-Use Swap

Next, Field Operations proposes a "land swap" – a strategic approach towards the de-densification in the lowest-lying areas of the shoreline and the densification of sites on higher ground. This strategy might appear radical and unrealistic on a large scale, however, Silicon Valley is evolving at an unprecedented rate. One example: Google has bought roughly four dozen properties in the Moffett Park district of Sunnyvale with a combined value of around $800 million. More than half of these properties are vulnerable to creek flooding today and sea level rise in the coming decades. This growth offers an unprecedented opportunity to reevaluate land use and potentially achieve a new and greener form of urbanism in Silicon Valley.

The concept of a "land-use swap" would necessitate changes to local general and specific plans as well as

A vision for Moffett Field and the NASA Ames Campus that combines nature and technological research.

zoning regulations for individual parcels. For example, zoning regulations Moffett Park are based on a car-dependent workforce and result in low density development, often with as much as 50% of the site dedicated to parking. If these zoning regulations were adjusted to promote higher density, transit-oriented development, significant portions of the Moffett Park district could be opened up for green infrastructure projects: stormwater detention "sponges" as well as parks and green amenities for the next generation of Silicon Valley's workforce.

While the entire Bay Area is struggling with a housing shortage, the South Bay has two unique development conditions: 1) Facebook and Google are both expanding their campus footprint at staggering speeds and 2) the Ravenswood Business District in East Palo Alto, the NASA Ames Campus and Moffett Field are all large scale underachieving sites that are poised for redevelopment. The opportunity is not only to unlock the potential of these sites, but to encourage multi-benefit outcomes for the local community and region.

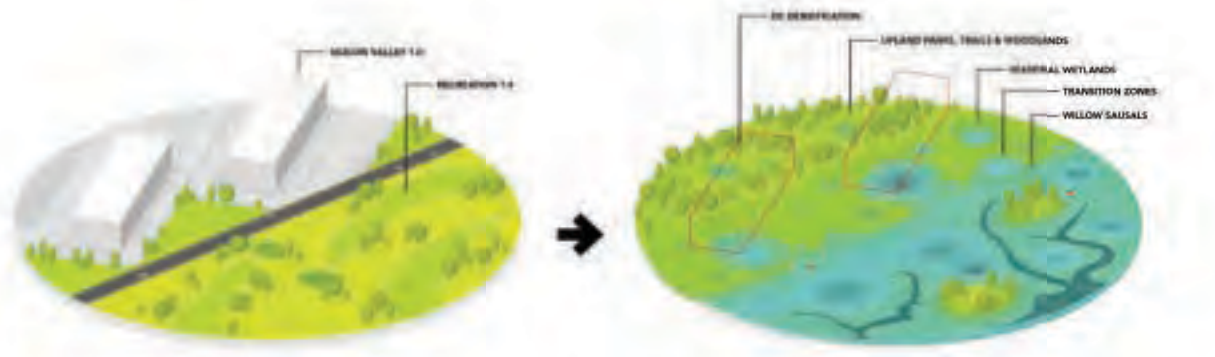
The goals of the "land-use swap" are two-fold: 1) to densify, to enable and encourage more dense and mixed forms of development in suitable sites and 2) to de-densify, to release the lowest-lying areas to provide space to support the region's flood management strategy.

Transfers of developments have the potential to generate significant funds to preserve and strengthen resiliency infrastructure while focusing uses in identified growth areas, supporting a built environment and land use planning strategy that enhances the quality of life and economic competitiveness of the region. As part of this tool, considerations could be made to guide resulting development and help to provide new parks, open spaces, schools, or other public assets or amenities.

The approach has precedent and there is reliable local appetite. In the region, City of Mountain View is proposing a transfer of development rights to help fund construction of a new community school. The deal proposes transferring 610,000 square feet of development rights from a 8.63 acre site through a TDR and estimates generating approximately $80 million through the process. Illustratively, Google currently has plans for a campus totaling 6 million to 8 million square feet in the area.

Any growth and resiliency planning at the Bay's edge must be tied in with improvements to connectivity, mobility and transit. Running trails, bikeways, BRT routes, Light rail and heavy rail trains all form part of a mobility network that would not only increase the prosperity of the region, but also the resilience of the communities and residents living, working and commuting along the Bay.

A new form of urbanism for Silicon Valley that is protective, porous, interactive and biodiverse.



The Valley Today

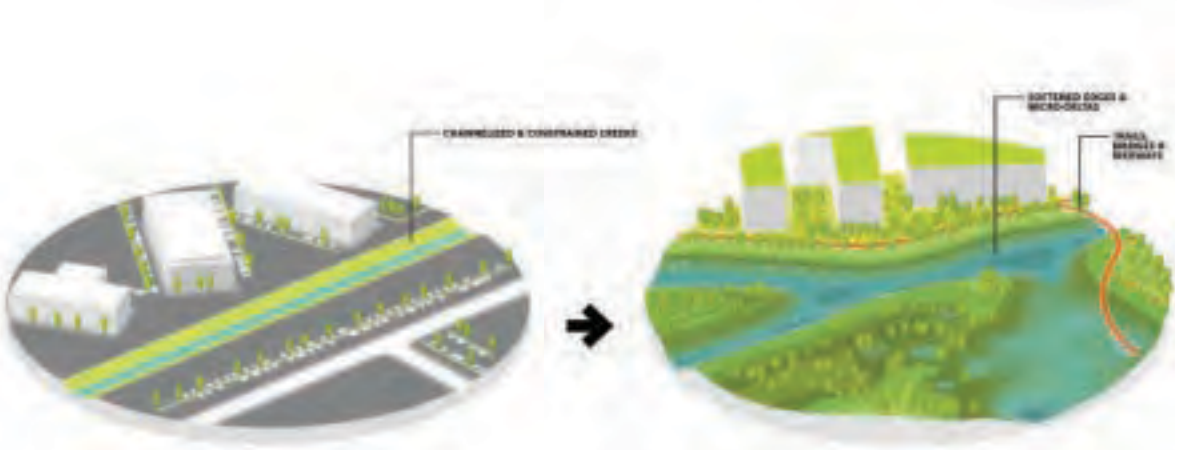
The Sponge

3 | The Sponge

Next, Field Operations proposes the Sponge. The "Sponge" is green infrastructure on a large scale: new absorptive landscapes for collecting, filtering and dispersing flood waters during storm events. The Sponges are also diverse ecotones, designed with topographic variation to support a range of ecological conditions from ponds, to marshlands, to transitional and seasonal wetlands, to floodable parks and green spaces at higher elevations alongside new and existing neighborhoods and development.

The "Soil Swap" and "Land-Use Swap" both enable the opportunity to create absorptive landscapes or "sponges". Low-lying sites supplying soil become stormwater infrastructure or "freshwater sponges". Sites receiving soil within the Bay become tide and wave cushions or "saltwater sponges". Together, the combination of natural, absorptive systems in the bay and within bayfront communities will ensure greater resiliency as bay waters rise.

The Sponge achieves many of the benefits and eligibility requirements of local and state grants and funding sources, including: flood protection; ecosystem and watershed protection; restoration, rehabilitation, and improvement of wildlife habitat; local parks and park improvements; restoration of wetlands and watersheds; reduction of polluted runoff; equitable access to clean water; parks and recreation for under-served low-income communities; waterway and natural resource protection; public access to natural resources; water conservation; healthy forests and urban greening; and climate adaptation and resiliency.



Channelized Creeks Today

More Absorptive Creeks

4 | The Creeks

Next, Field Operations proposes to widen and soften the creek corridors, thereby reducing speed of flood waters and providing space for water detention and absorption. The softer, wider and greener creeks would become linear parks and trails that connect South Bay Towns to the Bay.

The creeks of South Bay – there are eleven creeks between East Palo Alto and Santa Clara – are largely constrained and channelized as they meander from the hills and through neighborhoods and development on their way to the Bay. All of these creeks are at or near capacity for flood protection with few opportunities to adapt to higher bay levels and an increasing unpredictability of storm conditions.

By widening the creek corridors and softening creek edges, Field Operations would create the opportunity to both increase the storage and absorptive capacity of the creeks while also enabling and facilitating further adaptation over time.

As the creeks approach the lower elevations near the bay, they would merge with the "sponges" to create micro-deltas along the shoreline, resulting in a dynamic, adaptive and highly diverse ecological systems for flood protection. This widening and softening of the creeks is one of the most critical frameworks for flood protection for the entire Bay Area. Nearly every city on the bay is at risk to fluvial flooding from storm events today, a massive liability that only increases with higher bay levels. This concept for widened creeks, sponges and micro-deltas could be applied to creeks and watersheds around the Bay.

From channels to absorptive, green infrastructure, The Creeks provide space for diverse eco-tones, linear parks and trails that connect South Bay Towns to the Bay.

5 | The South Bay Multi-Benefit Resiliency District

Finally, Field Operations proposes a new framework for cooperation and coordination across jurisdictions in the South Bay.

The South Bay Towns project is the epitome of a multi-jurisdictional challenge. State and local government systems do not yet work for large scale, multi-benefit projects. Moreover, access to resources and ability to leverage funding varies significantly across the region. Individual jurisdictions, utilities, and private landowners are rightly concerned about meeting their own immediate resiliency needs. This individualized approach makes already extraordinarily expensive projects even more costly and puts under-resourced jurisdictions, communities or landowners at a significant disadvantage.

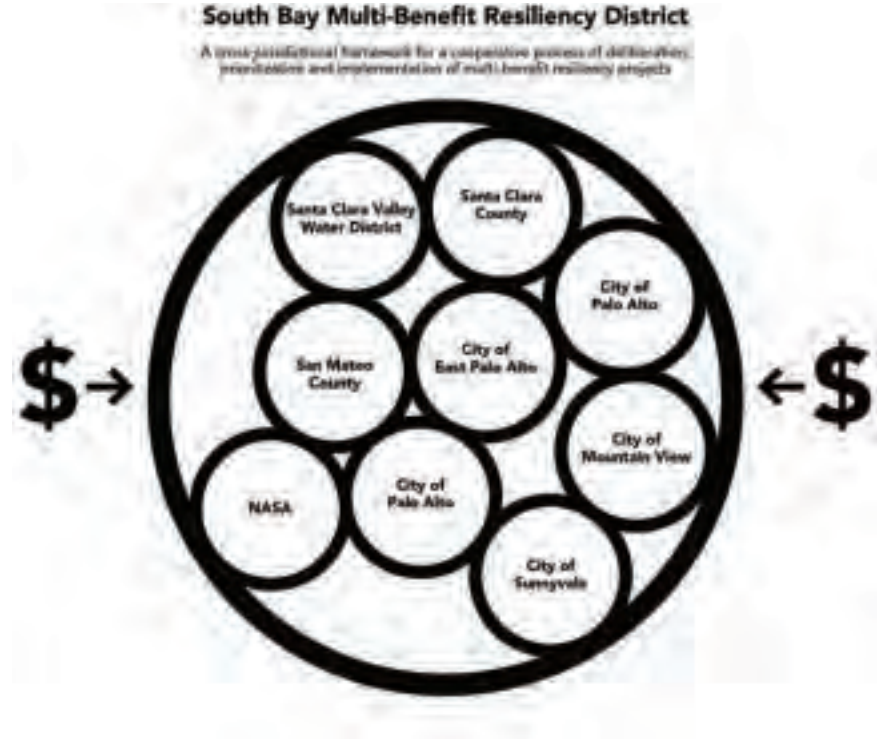
Field Operations proposes a more collaborative and cooperative model. Each municipality in the South Bay, plus the Water District and NASA, would enter into a collaborative agreement to define how the region messages, deliberates, prioritizes, acquires funds and implements multi-benefit resiliency projects. The framework may take the form of a Special District – The South Bay Multi-Benefit Resiliency District – whereby a host of funding mechanisms become feasible.

This cross-jurisdictional cooperation could all start with something as simple as an MOU between jurisdictions. It may be that the Santa Clara Valley Water District and San Mateo County Flood District already have the mechanisms in place to fund components of the South Bay Sponge, but it is clear that significant additional funds are required for continuous protection and significant coordination is required to make it all happen. The South Bay Sponge becomes the idea, the framework and the motivation for this new form of cooperative planning for a more resilient South Bay.

The South Bay Sponge is big, ambitious, complex and seemingly impossible to implement. The level of cooperation required across jurisdictions is unprecedented.

The South Bay Sponge – a framework for 6 cities and 20 miles of Bayfront.


WATER SYSTEM
NDING
PALO ALTO HORIZONTAL LEVEES
SOUTH BAY SALT PONDS
RESTORATION PROJECT
STEVENS CREEK MICRO-DELTA
MOFFETT FIELD SPONGE
ALVISO
SUNNYVALE HORIZONTAL LEVEES
MOUNTAIN VIEW
MOFFETT FIELD 2.0
SUNNYVALE



Above, left: Reimagining a revitalized Bay Trail, Bay Road and Business District for East Palo Alto.

Above, right: The South Bay Multi-Benefit Resiliency District: a new framework for cooperation and coordination across jurisdictions in the South Bay.

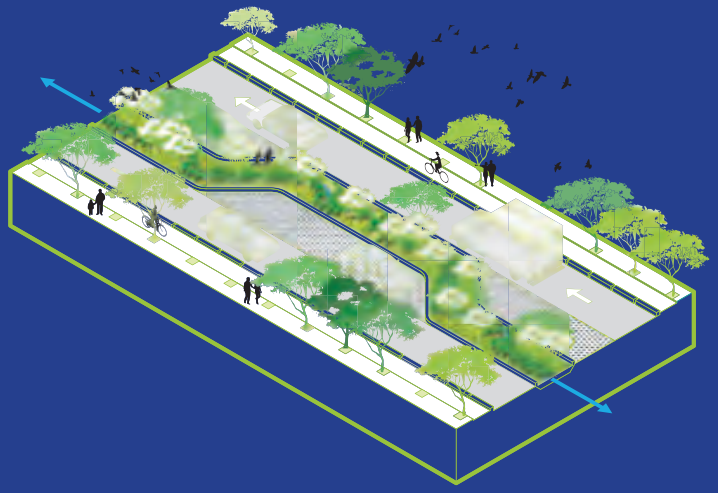
Left: Vision of a protective, adaptive and multi-benefit shoreline park for East Palo Alto.

However, the cooperation involved is necessary. Without a cohesive, multi-jurisdictional solution, massive financial, infrastructural, ecological and human losses will occur and reoccur – and the most vulnerable of South Bay communities will be left behind.

The South Bay Sponge is a framework for design that thoughtfully imagines new possibilities for climate adaptation in the South Bay that can grow in scale, incentivize investment, build public support and excitement, facilitate coordination across jurisdictions, and contribute to the larger effort to increase resilience in the Bay Area. It is a framework for cooperation – for evolving the ways we collaborate across boundaries and jurisdictions to achieve new forms of cooperation, policy and governance. And, above all, it is a framework for the Bay – for understanding the Bay as our region's most important resource, one deserving of even greater protection, enrichment and connection.

Resilient South City

SAN MATEO COUNTY



HASSELL+

HASSELL

Deltares

Goudappel

Lotus Water

Civic Edge

Idyllist

Hatch

Page & Turnbull

Brown and Caldwell

SUMMARY:

Before it became known as the Bay Area's "industrial city", South San Francisco was the kind of place where people could walk the length of the one creek to swim in the bay. HASSELL+ aims to make that possible again.

Through community engagement, research and an inclusive design process, the international collective mapped out ways to make the city stronger and reverse the area's real and symbolic separation from the water – by restoring public access to it and establishing more parks and open spaces.

Opportunity sites across the Colma Creek watershed form a practical, dynamic network of places for people and for the environment. Highlights include:

- A wider, greener creek manages flooding and creates great conditions for a sequence of new parks.
- A South City Circle Bridge serves as a walking and cycling gateway to all transport and a bold statement about community priorities, providing access across the 101 freeway.
- An 'Eco Waterpark' adjacent to the revamped water plant becomes a teaching tool and natural shoreline swimming pool.
- A native plant nursery helps control flooding and treats highway runoff to improve the quality of water flowing into the creek and bay.
- A 'living levee' forms a wetland for restoring habitat and holding storm water in extreme tides.
- Schools located on higher ground become hubs for water treatment and recreation.

Together, these ideas make it easier to reach and enjoy the creek and bay, reduce the impacts of flooding, build resilience to sea level rise and return native flora and fauna to the area. Just as importantly, they make a healthy, active life near the water easier to imagine – and achieve.

Resilient South City proposed a transformation of the Colma Creek corridor from a concrete channel to a lush green connector linking residents and habitat from Orange Park to the Bay shoreline.

The Resilient South City Storefront was created as a community space for the length of the project, welcoming residents to give comment informing research and also contribute to the design proposals.

Approach

HASSELL+ was drawn to the RbD challenge because of their shared passion and unique insight into designing for water and living with water. HASSELL, originating from Australia, and Deltares + Goudappel, based in the Netherlands, share an acute understanding of the social, cultural, economic and ecological potential research-led design can unlock for waterfront communities. Experienced Bay Area partners – Lotus Water + Page & Turnbull + Hatch + Idyllist + Brown and Caldwell – added invaluable local knowledge and connections that shaped the team's overall approach to the project.

Community involvement and feedback

The collective drew heavily on community voices to ensure the South City proposal truly reflects local needs and aspirations. To do that, HASSELL+ transformed the old Bank of South San Francisco on Grand Avenue – a heritage building that had been vacant for decades – into a community meeting place, design hub, education centre and display space.

The 'Resilient South City' storefront became the central spot to learn about the project, chat with the design team, hear from community partners (San Bruno Mountain Watch, Youth Leadership Institute and the South San Francisco Historical Society) and talk to city and county officials.

Visitors were also invited to hear local experts talk about native plants, social history and equitable urban design, and view the historical society's photographs of the area. And a fun, interactive board game at the centre gave locals hypothetical power over urban planning decisions to improve and protect their city.

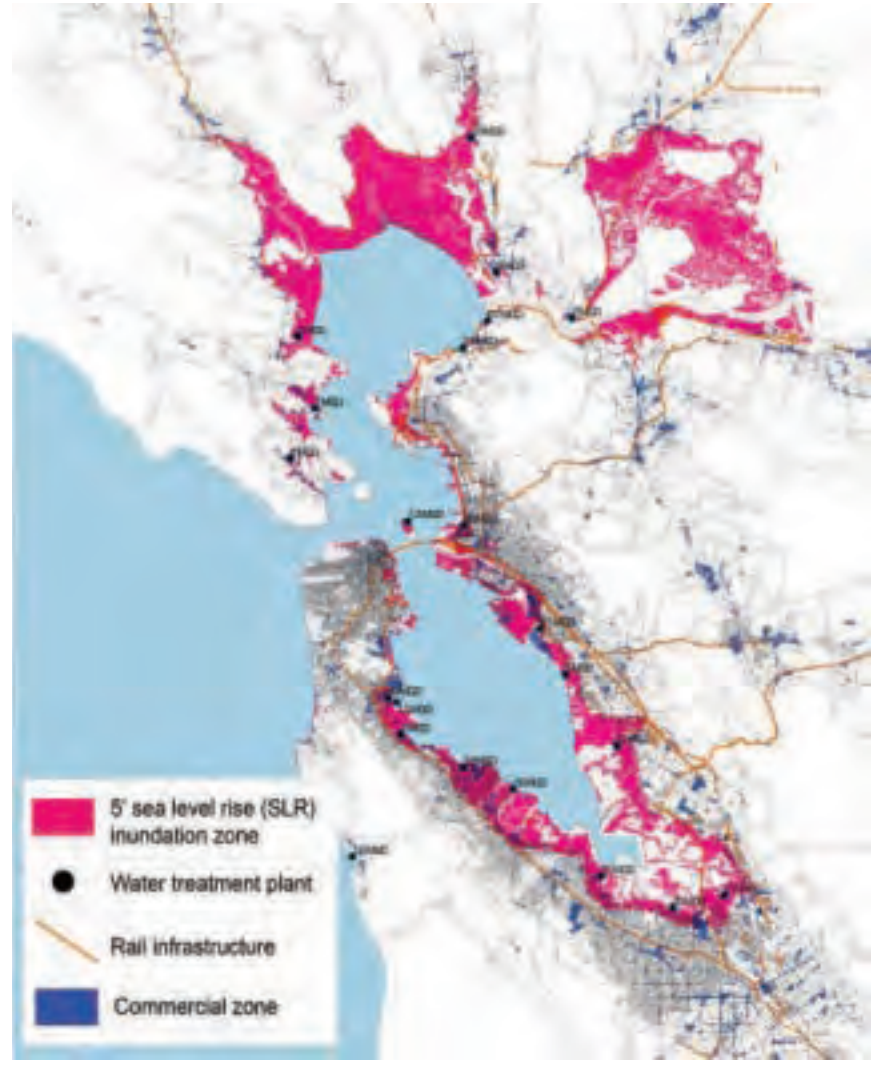
The HASSELL+ team also established a virtual presence to reach an audi ence beyond the storefront. That included a 'Resilient South City' Facebook page and Instagram presence for sharing images and ideas.

Key concerns – and emerging issues

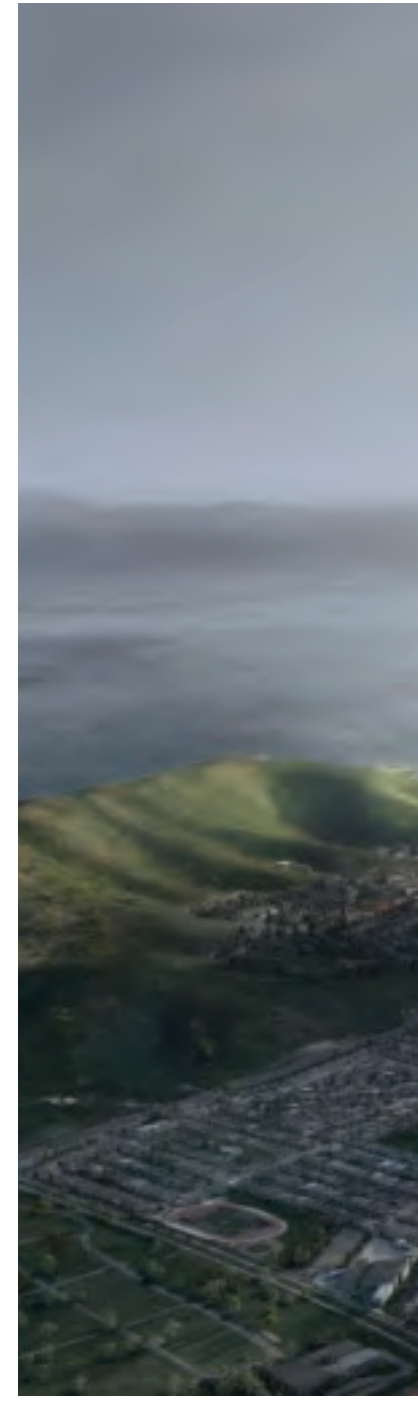
Through all these interactions with the community and stakeholders – as well extensive research, mapping, analysis and site visits – a picture emerged of the key issues South San Francisco was facing, just like communities all around the Bay.

Those issues guided HASSELL+ proposals on resilience for the whole region as well as specific design proposals for the local area. They can be roughly categorized into four areas of concern that guided the team's thinking:

- Low-lying shoreline and creekside areas like South San Francisco – already vulnerable to flooding and sea level rise – are most often the communities already facing economic hardship, affordability issues and challenges associated with low-income populations. They also have the lowest access to public open space.
- These shoreline communities have traditionally been excluded from conversations or education on challenges like sea level rise – and have therefore also been disconnected from any potential solutions.
- People in South San Francisco – like many others living in the Bay Area – have been cut off from nearby waterways by developments such as freeways, rail lines and pockets of industry.
- Many regional projects have been considered and debated over the years. But resilience actually hinges on smaller-scale interventions and improvements within the community. It's about the quality of services and amenities within walking distance of neighborhoods as well as how sites and services can adapt in times of emergency.



The area of major sea-level rise vulnerability coincides with locations of valuable water treatment and transit infrastructure as well as locations of valuable commercial centers.



Increased resilience in a small community like South San Francisco is intertwined with major regional ecological assets (like San Bruno Mountain) and transport assets (like Highway 101 and San Francisco Airport).

Regional concept – ‘Collect & Connect’

The team’s “Collect & Connect” strategy for the region creates a resilient, responsive network for the entire Bay Area.

A series of loops

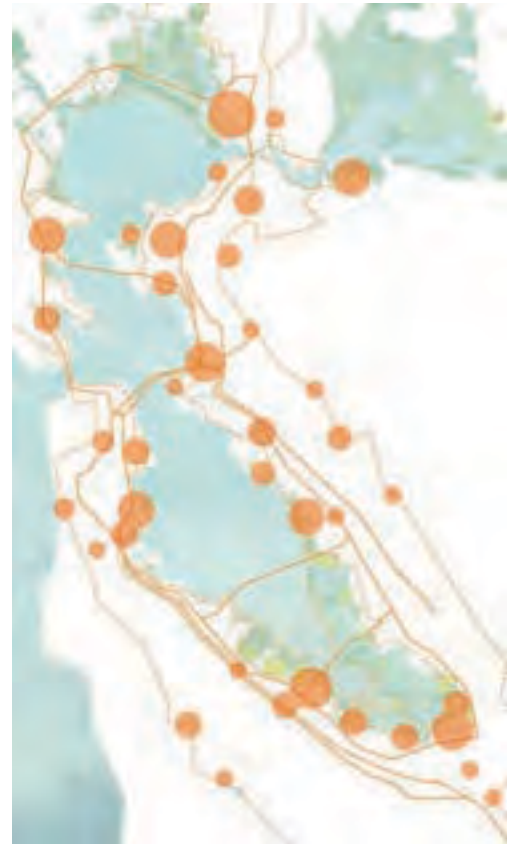
Around the Bay, existing infrastructure – such as the Bay and Ridge trails, rail and motorways – have formed a series of loops. These loops are becoming more and more congested and in danger of breaking. Climate change risks (especially sea level rise) also mean they are increasingly vulnerable to weather events. And just one break can cause disruptions for the entire system.

A diversity of collectors

Within the existing loop system, HASSELL+ proposed creating a number of ‘collectors’ – new spaces for community gatherings, for capture and slow water flows, and for assembly during disasters. These would be located at the Bay’s edge and along ridge lines, with key urban nodes in between. In collaboration with communities, the project team would design a suite of structures, facilities and programs for these spaces,

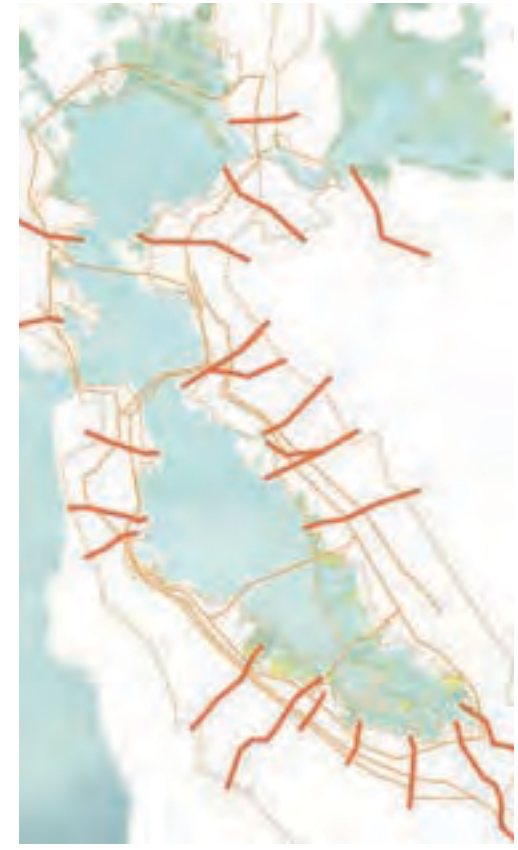
A SERIES OF LOOPS

Freeways
CalTrans & Capital Corridor
BART Corridor



A DIVERSITY OF COLLECTORS

Town Squares
Community Parks
Waterfront public parks



A NUMBER OF CONNECTORS

Local creeks for restoration
Local main streets

from libraries to Resilience Education Centers, from sports fields to market halls. These would become the places communities get together to learn, develop, and implement programs to build social and ecological resilience.

A number of connectors

The 'collector' spaces would then be linked by a series of 'connectors' – primarily local streets and creek lines. They would provide better access to the waterfront and to the ridgetops, public transportation, retail, employment and residential areas. Where these connectors meet the water would be ideal places for new ferry wharves, linking communities across the Bay and creating a greater focus on waterfront gathering, recreation and activity. During emergencies, the connectors would become critical 'streets of retreat' from rising flood water, hillside flooding and forest fires.

A stronger regional structure

Overall, there are between 25 and 40 potential applications of the 'Collect & Connect' model. Creeks and streets could be transformed into linear corridors of water management and community gathering to transform the regional structure from a vulnerable loop to a resilient network.

By committing to 'Collect & Connect' both water and communities, a polycentric regional system would form that distributes amenity and strengthens the resilience and lifestyle of smaller cities for the benefit of the entire Bay Area.

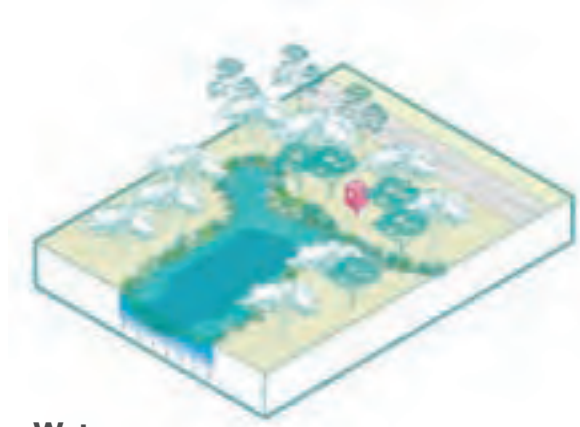
A REGIONAL RESILIENCE NETWORK

The Critical Role of Public Space

Cities no longer create new open spaces or parks like they once did. But those spaces are a powerful tool for making cities like South San Francisco stronger – and more liveable.

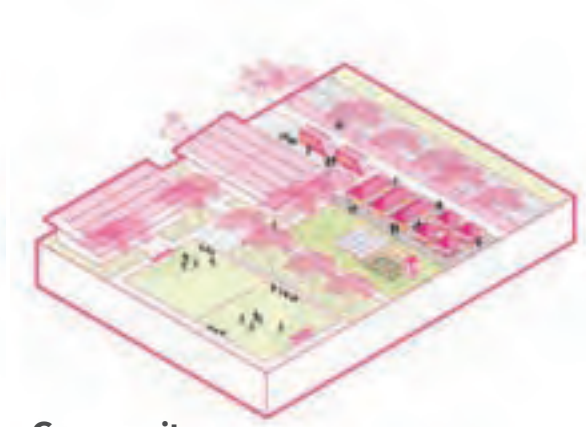
Through its research phase, HASSELL+ found that open spaces are critical to achieving as many project objectives as possible for managing water, restoring native ecologies, supporting and connecting communities, and enhancing the abilities of those communities to respond to disaster.

The team's design concept was built on a conviction that calling on all available green, open and public (or semi-public) land was the best path to success. HASSELL+ looked at the need for public open space in four key areas:



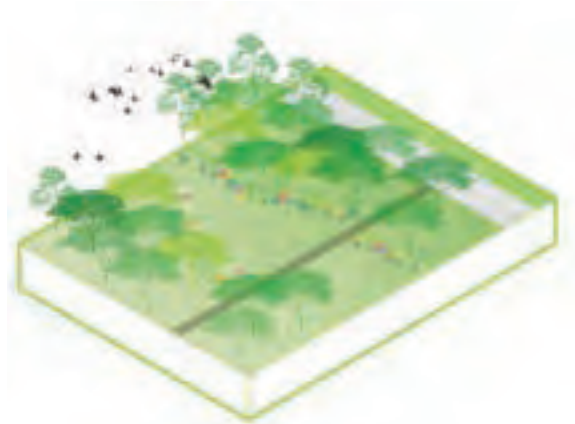
Water

Public open space is critical to managing water. Aside from being 'green infrastructure' to reduce urban runoff and urban heat, it's also a critical early-warning mechanism for flooding because its open, green inundation areas provide the community with visible cues for rising flood waters.



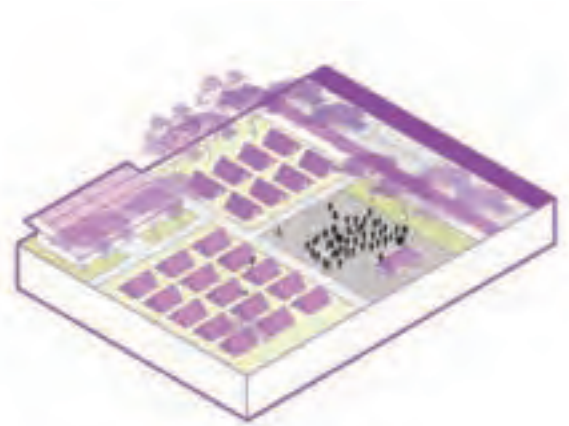
Community

Public open space is where communities gather. Social resilience is stronger when community members know each other and these spaces – and the facilities that are created within them are crucial to this. These places are also needed for community events like markets and sports. They support healthy, connected communities.



Ecology

Public open space planted with natives from the historic Colma Creek watershed could support the biodiversity needed to create resilient landscapes. These landscapes require less maintenance and are more resilient to extreme weather events.



Emergency

Public open space, throughout history, has been vitally important as a place for communities to gather, organise and rebuild in times of disasters. They can – and have – become centers of shelter as well as temporary hospitals and schools after major earthquakes or fires.

Colma Creek has the potential to support ecology, community and emergency functions in addition to its functional water management role. Its transformation back into a public open space would turn the city back towards this waterway.

A resilient network of open spaces

The Resilient South City project identified sites and measures across the entire Colma Creek watershed that can build resilience related to the four key areas above – Water, Ecology, Community and Emergency.

Through adaptation projects at key opportunity spaces across the creek's watershed (mountain-side reservoirs, cemetery-side reservoirs and resilient schools) as well as new 'slow streets' for mobility and water, a resilience network could begin to form across South City and neighboring areas within the creek watershed.

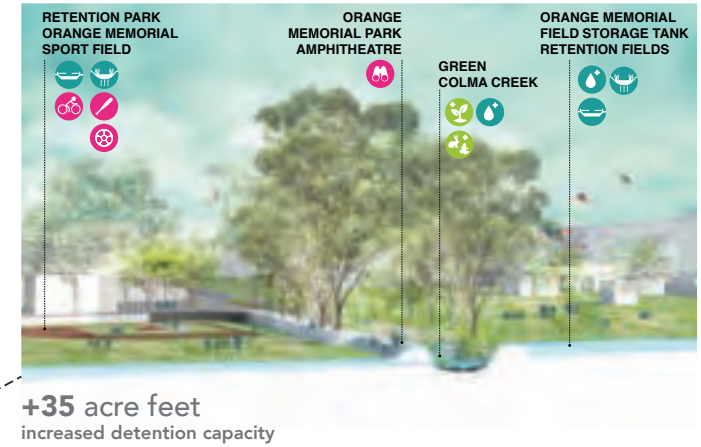
This woud be a network enabling better disaster response and water management, but also contributes to greater liveability and connectedness across the community-at-large.

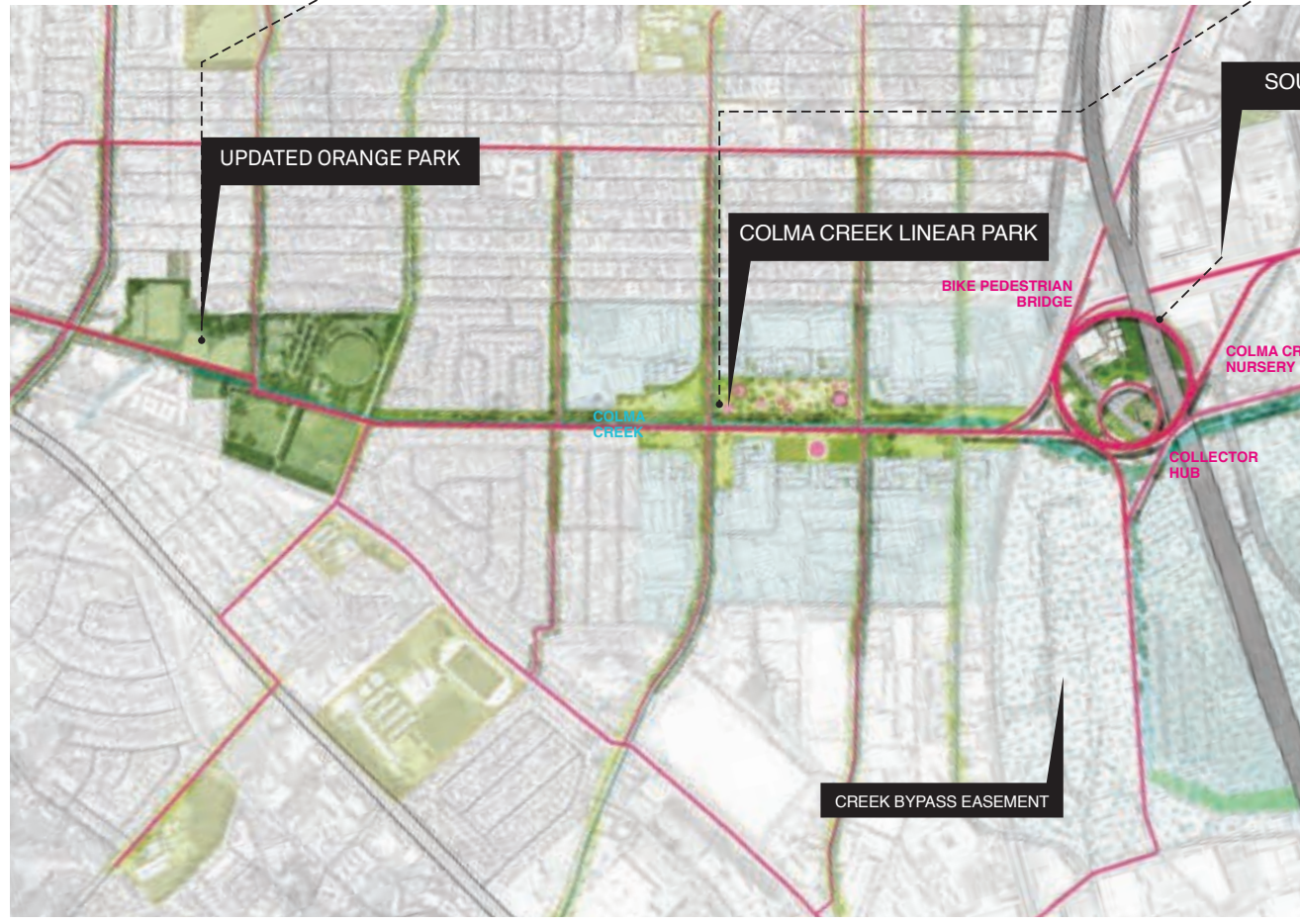
A master plan for Colma Creek

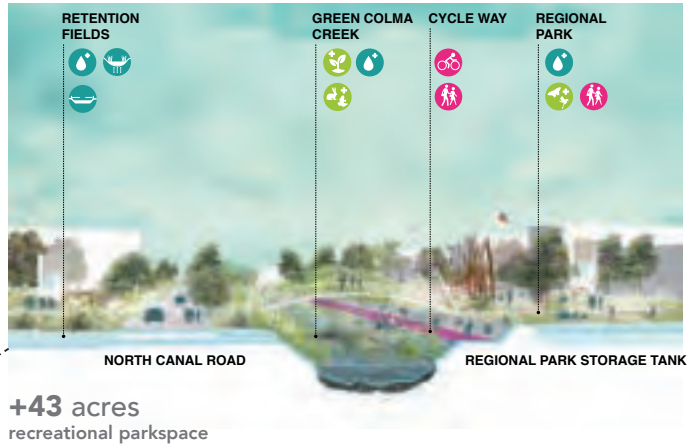
The master plan for the creek sought to connect a series of different projects for new and improved public spaces while restoring the lost ecologies of this natural connection to the Bay's shore. In simple terms, the project could form a continuous green corridor of parklands and public access, connecting residents from park to park and pool to pool. It would create both a new public destination on the Bay as well as a continuous, safe route to access it, through a mix of public policies and projects.

A new Colma Creek – from park to shore

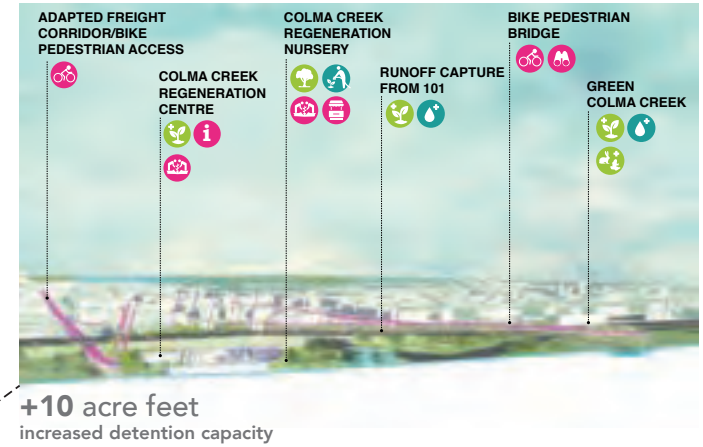
This project focuses on the section of creek between Orange Memorial Park and the South San Francisco Water Quality Control Plant. The primary objectives were to reduce the impacts of recurring flooding (from annual to 100-year events), protect against sea level rise, increase amenity and recreation opportunities, and re-establish continuous public access to the shoreline.



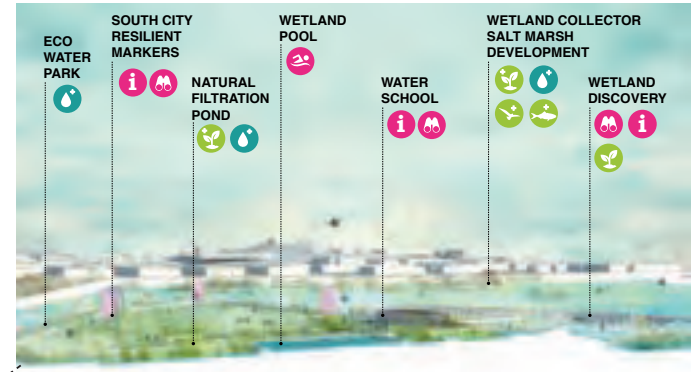




+43 acres
recreational parkspace



+10 acre feet
increased detention capacity



+4.4 acres
natural treatment zones

+1.5 acres
new recreational parkland

COLMA CREEK MASTER PLAN

A series of projects were proposed along the Colma Creek corridor, each reducing the existing flood risk originating from the creek while also adding vital ecological and community functions for the City.

Key sites – South San Francisco

Orange Memorial Park

Design proposal

This is a proposal to complete the existing master plan for Orange Memorial Park while extending the current water quality project to include flood mitigation. This is accomplished by adding capacity to below ground storage tanks and lowering playing fields for inundation to mitigate downstream flooding. Additionally this proposal calls for an increase to the native plant population.

Estimated impact

Increased detention of up to 70 acre feet and the addition of five sporting facilities within the new 35-acre parkland area

Phasing

Staged excavation of each quadrant of the park with excavated material used in construction of living levee at shoreline

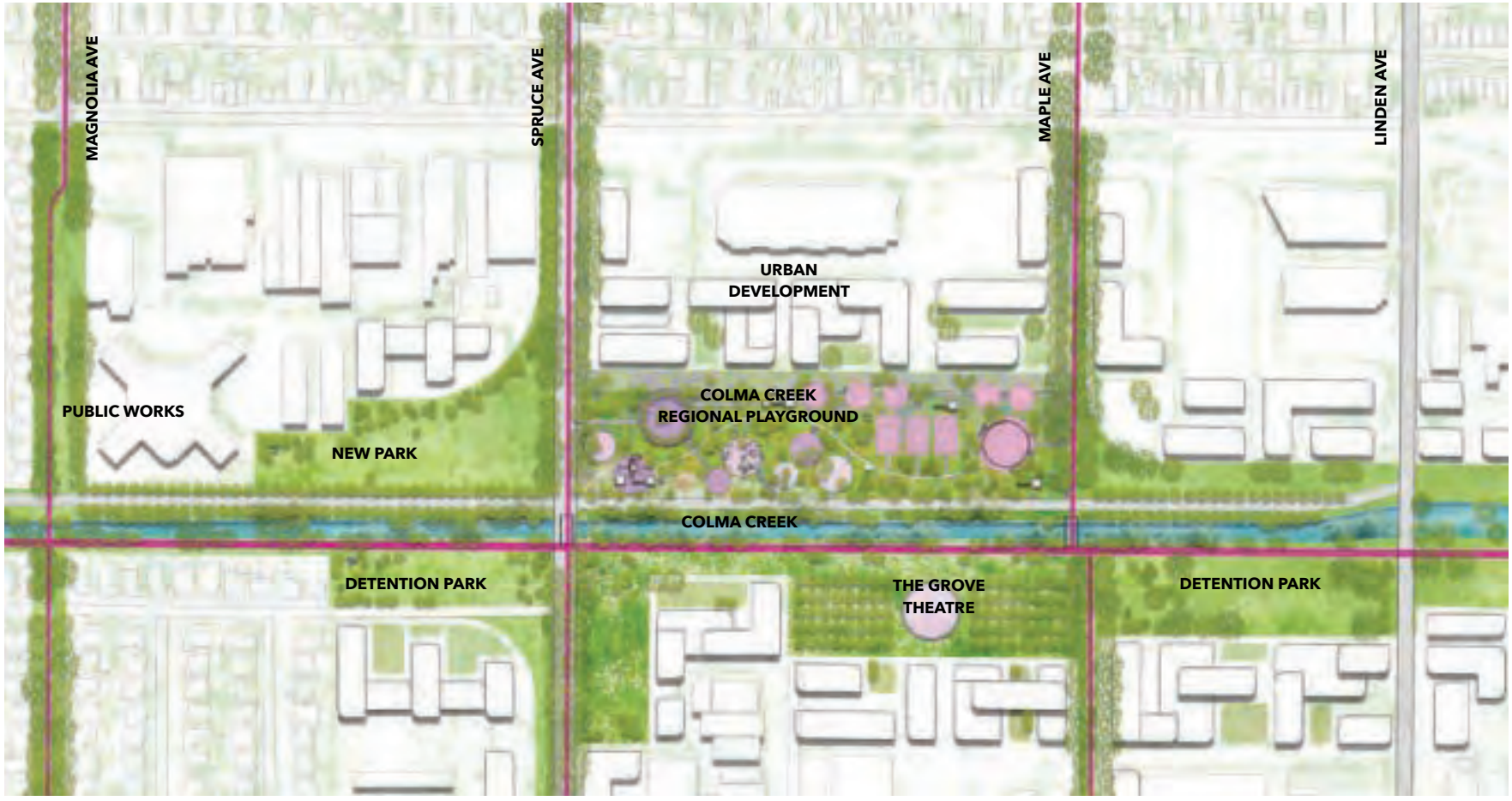
Creekside Parks

Design proposal

- Increase capacity of Colma Creek by widening channel and lowering adjacent access paths to include additional area within the channel
- Create new water retention/detention parks adjacent to creek through land acquisitions, rezoning and contributions associated with new development

Estimated impact

- Creation of additional peak flow capacity to reduce flooding directly adjacent to the creek segment in small and mid-size storm events (25-year)
- Increased ability to manage upstream flow connections
- Continuous, safe pedestrian/cycle access from Orange Avenue to Linden Street (.8 miles)
- Extension of green space from Orange Memorial Park alongside the creek to Linden Street, creating a Colma Creek Linear Park that provides an additional 43 acres of recreational area



'The Circle'

Design proposal

- Develop a pedestrian and cycle bridge from Colma Creek (at Linden) over the rail corridor to Caltrain, over Produce Avenue / Highway 101 / Airport Blvd to lower Colma Creek, as well as under the 101 on the former freight rail line
- Create green area below for a new native plants nursery providing both flood detention and 101 runoff treatment
- Design 'gateway' lighting and landscaping to South City

Estimated impact

- Increased access to Caltrain and safe, continuous access east-west between downtown and major employers for over 5,000 people living east of 101 and working on the west side
- Up to 10 acre-feet of detention to reduce flooding from Colma Creek using a bypass directly from the creek and under 101 via a culvert
- A water quality project that can share space with the floodable space
- Extra runoff collected from 101 assists flood attenuation
- Part of an overall adaptive management strategy for large flooding events but also effective as an individual project during small events (eg less than 10 year)

Phasing

- Temporary access over rail corridor to station as first priority for access
- Hardscape removed and converted to softscape

A vital new connection over the CalTRain Corridor and Highway 101, the Circle would link residential and employment centers on either side of the City as well as improve access to the CalTrain station.

Water Quality Control Plant (WQCP) & Eco Water Park

Design proposal

- Create additional natural treatment areas at the shoreline of the WQCP
- Restore SamTrans depot to create a public park for recreation and education associated with water quality (in partnership with commercial facilities)

Estimated impact

- 12.4 acres of natural treatment zones adjacent to the WQCP
- Extended treatment wetland habitat in 23.5 acres of new recreational parkland

Phasing

Initial habitat creation and ecological treatment within the disused wharf fingers before expansion of restoration efforts at SamTrans site

Living Levee & Wetland Collector

Design proposal

Create a new 'living levee' tidal barrier – a 'wetland collector' for habitat restoration and recreation that's also capable of detaining storm water during king tides in long-term sea-level rise scenarios

Estimated impact

Protection from 60 inches of sea level rise and detention for 1,900 acre-feet of stormwater to contain a 50-year event (within a 12-hour maximum tidal period) within a 300-acre area for habitat restoration and water recreation

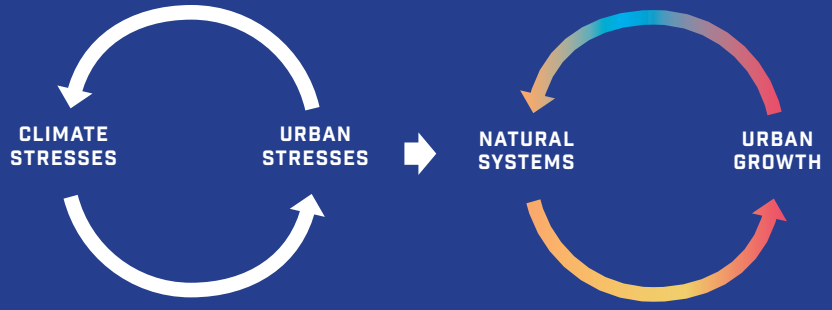
Phasing

- 36 inches sea level rise at outer edges of collector
- Partial barriers then built to understand sediment build-up patterns
- Final barrier and tidal control then built

The Bay Pool restores a historic connection between South City residents and the Bay. Residents will once again be able to swim in the Bay

Islais Hyper-Creek

SAN FRANCISCO COUNTY



BIG + ONE + Sherwood

Bjarke Ingels Group (BIG)

One Architecture & Urbanism (ONE)

Sherwood Design Engineers

Moffatt & Nichol

Nelson Nygaard

Strategic Economics

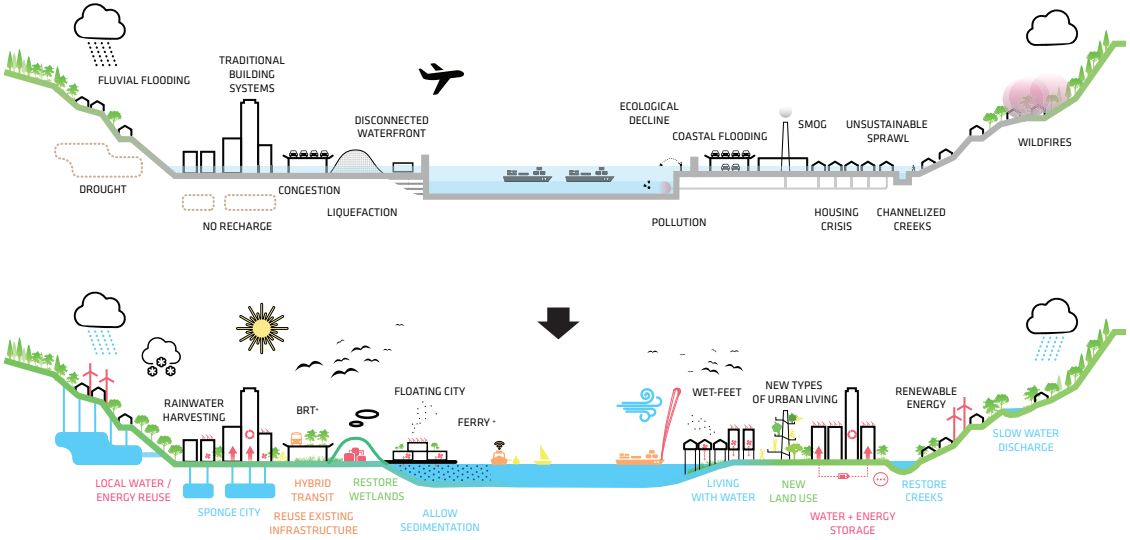
The Dutra Group

Stanford University

APPROACH

Regional Understanding

The Bay as a Social Ecosytem



The BIG + ONE + Sherwood Team is co-led by Bjarke Ingels Group (BIG), One Architecture & Urbanism (ONE), and Sherwood Design Engineers (Sherwood). The team also includes experts from Moffat & Nichol, Nelson Nygaard, Strategic Economics, and The Dutra Group. The team brings together significant international expertise from Denmark, the Netherlands, and the Bay Area with a variety of experience in designing spaces vulnerable to climate events by understanding a region's economic, political and social environment.

For us, the Bay Area is a place of natural beauty, richness, and resource. For centuries, it has been inhabited by those taking advantage of its sheltered waters, from early native settlement, to the Gold Rush, to modern times. These development patterns and lifestyles have both helped generate, and have left the Bay vulnerable to the climate stresses it feels today – sea level rise, stormwater flooding, drought, wildfires, earthquakes, and liquefaction. At the same time, this growth has been the source of many of the urban challenges the Bay now faces – declining ecology, massive congestion and pollution, strained infrastructure bringing flows from far away, and an affordable housing crisis. We propose that in order to create a more resilient, sustainable, and equitable Bay, urban stresses and climate stresses must be thought of as one – and to work on these issues, we must break the traditional silos of city-making. The BIG + ONE + Sherwood team think of the Bay as a Social Ecosystem: one where, rather than working as opposing forces, ecology, people, infrastructure, and mobility work together, as self-reinforcing systems. For our regional approach, we proposed a series of bay-wide strategies that can work in concert to build a more resilient bay and identified three design opportunites where these strategies intersect in an actionable way.

SYSTEM A: HYPER-CREEKS

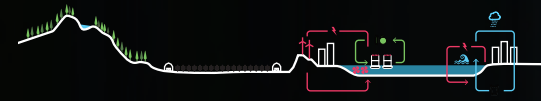
Can we naturalize and re-center communities around new Hyper-Creeks, helping manage stormwater while providing firebreaks, wildlife corridors, and room for the Bay to grow?

SYSTEM B: NEW LINKS

Can we re-connect the Bay by using the assets we have, creating flexible New Links by enhancing the Bay Trail, expanding ferry service, and transforming roadways into efficient routes for collective transit and density?

SYSTEM C: LIVING EDGE

Can we re-think the threatened and forgotten bay edge as a Living Edge, providing space both for nature and water management but also for local production of energy, food, and badly needed housing?



SYSTEM D: INFRA-CLOUD

Can we modernize and decentralize the Bay's water and power supplies into a series of local Infra-Clouds, providing redundancy, sustainability, and integration with community?


REGIONAL VISION: A BAY OF CREEKS
DESIGN OPPORTUNITIES
B. FERRIES
B. E-TRAIL
GOLDEN SHOALS
ISLAIS HYPER-CREEK
D. LOCALIZED INFRASTRUCTURE
B. BRT LOOP
LIVING EDGE C.
GREEN GRID A.
HYPER-CREEKS A.
SOUTH BAY LIVING

Design Opportunity:
Golden Shoals

Adapting to Extreme Sea Level Rise and Tides

While a multitude of localized strategies can be employed over time to adapt to sea level rise (SLR), a singular, large-scale infrastructure investment to protect the Bay may prove attractive if the more extreme SLR projections are realized. The Rising Tides competition put forth by BCDC in 2009 contemplated the possibility of a tidal barrage at the Golden Gate. However, due to the tidal prism and outward drainage from the Delta, high volume flows have created a canyon over 350 feet deep in this location. Such a deep barrage is not only costly but also presents numerous ecological and logistical challenges.

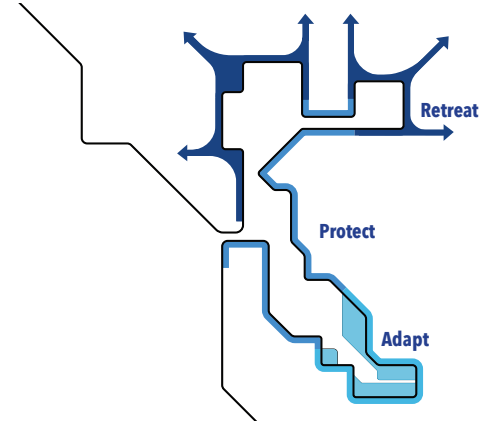
As a counterpoint to the complex analysis required for localized solutions, our team contemplated a Bay-wide solution to SLR that departed from those presented by the Rising Tides teams. Instead of looking at the Gate itself, we looked offshore, where waters as shallow as 30 feet form a natural crescent approximately seven miles long. The estimated 7M cubic yards of fill material required to form the shoals in this location is almost a third of what might be required at the Golden Gate.

This 7-mile long crescent of underwater shoals could be transformed into a new, ecologically-attuned land mass. Multiple points of entry allow for passage of wildlife and boat traffic including cargo ships, fishing and whale watching boats and recreational sail boats. The shoals could become a recreational destination where breakwaters provide calm waters leeward and allow for exploration of a new reef ecology. The shoals would create swimming beaches – "Golden Gate Beach" – and wetland habitat – "Golden Marshes". Structures such as cultural pavilions could be built along the shoal and into the calm water with wet feet.

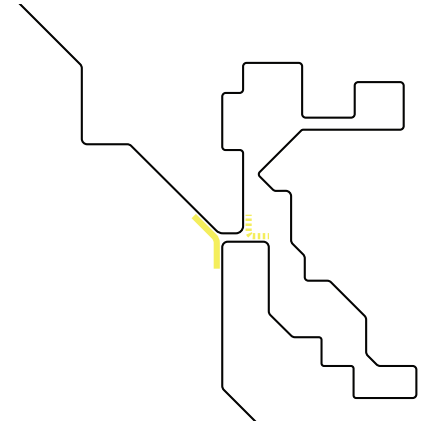
As a jetty, the shoals could solve the problem of sand erosion at Ocean Beach, saving one of the region's most popular beaches. Spanning from Ocean Beach to the Marin Headlands, the ocean side of the shoals could create one of the longest surf breaks on the West Coast.

Tide gates placed strategically along the shoals would only need to be closed during extreme tide events. During most events, terrestrial floodwaters from the Delta will be able to escape through the perforated shoals. As the ocean more frequently reaches problematic elevations, pumping requirements intensify. This energy demand could be met by renewables installed along the shoals including tidally-driven hydropower, wind energy, and generators fueled by biodiesel from algae feedstocks.

Bridges from the shoals to land could provide access from the Gate up and down the coasts where recreational ships typically enter and exit. An opening in the middle of the shoals could provide access for logistics vessels including cargo ships and oil tankers. A dune walk could provide accessible pathways for all Bay Area residents to enjoy and would create a new recreational loop, linking the western edges of San Francisco and Marin.

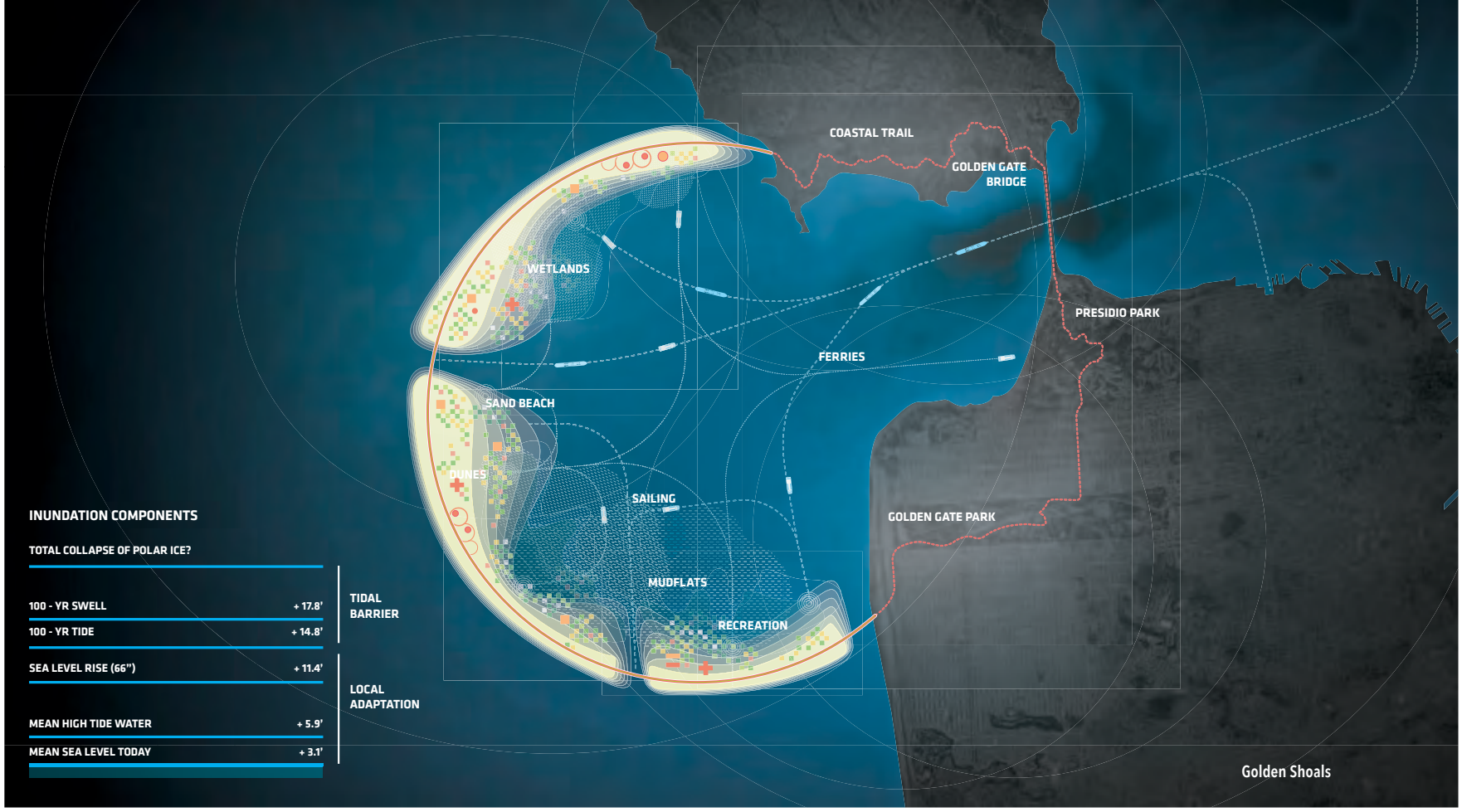


Localized Strategies



Single Move

Underwater Sediment Crescent. Courtesy USGS.


COASTAL TRAIL
GOLDEN GATE BRIDGE
WETLANDS
PRESIDIO PARK
FERRIES
SAND BEACH
DUNES
SAILING
GOLDEN GATE PARK
MUDFLATS
RECREATION
INUNDATION COMPONENTS
TOTAL COLLAPSE OF POLAR ICE?
100 - YR SWELL + 17.8'
100 - YR TIDE + 14.8'
TIDAL BARRIER
SEA LEVEL RISE (66") + 11.4'
LOCAL ADAPTATION
MEAN HIGH TIDE WATER + 5.9'
MEAN SEA LEVEL TODAY + 3.1'
Golden Shoals


View from Lands End

Design Opportunity:
South Bay Living

Re-Activating a Productive Edge

For decades, the South Bay has been the economic heart of the region and responsible for much of the Bay's growth. With thousands of acres of flood prone area, it is also emblematic of many of the region's most challenging issues – massive commuter congestion, lack of affordable housing, and its patchwork of uncoordinated cities lacking a comprehensive plan. For the South Bay, we proposed new forms of living and transit, taking advantage of flexible new transit technologies and underdeveloped areas – both mitigating the emissions that cause climate change while providing a framework for resilient growth.

Automated and electric vehicles could allow for much more distributed transit. A new Vehicle Rapid Transit system could transform the highway network into an efficient loop for transit, connecting the South Bay to local and regional networks. A transition to VRT requires very little capital investment compared to building new, dedicated modes of rail transit. Lanes of existing highway would be dedicated to buses and other shared vehicles that could serve new station stops along existing highway routes.

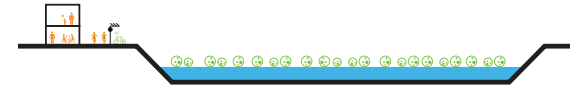
Last mile issues would be resolved in part by the development of the green grid, making room for e-bikes, e-scooters, e-skates, and light autonomous vehicles on pedestrian friendly streets. The large swaths of parking could be repurposed as green infrastructure that mitigates stormwater flooding and for new housing developments. Connections to VRT stations would continue as spurs toward the Bay edge, providing corridors for growth that harken back to the historic patterns of Bay cities, from water to upland.

The South Bay Salt Pond Restoration Project is the largest tidal wetland restoration project on the West Coast and aims to restore 15,200 acres of industrial salt ponds to a rich mosaic of tidal wetlands and other habitats, albeit at a great cost. Tidal wetlands that cannot migrate upland to keep pace with SLR may be lost underwater – an issue made worse by lack of sufficient sediment flow. Can we be strategic about the way we invest in the edge, leaving room not only for nature, but for local food production, water rentention and treatment, energy generation, and sorely needed affordable housing and connections to the water?

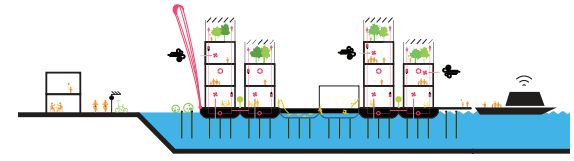
Productive ponds can begin as innovation test beds. Stormwater management, nutrient recovery for food production, and energy storage through the management of tides, wind energy production, and fabrication of materials needed for the new floating structures would provide ecosystem services and bring new jobs to the South Bay. These localized energy, materials and water flows would build resilience into the existing centralized infrastructure by providing increased redundancy and, as a result, reliability. Areas with easy access to deep water channels and ferry access could become nodes of density for resilient, floating villages – creating space for up to 75,000 units of housing and a new lifestyle for the South Bay.

A. 101 Bus rapid transit network

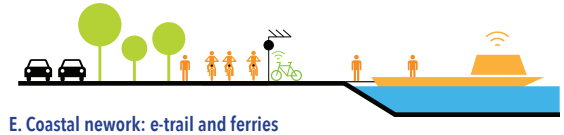
B. Green grid



C. Productive ponds



D. Floating villages



E. Coastal nework: e-trail and ferries

Floating villages

Highway VRT system

Food and energy production

SUMMARY:

The historic watershed of Islais Creek, emerging into the Bay at the south-east shore of San Francisco, is located at the juncture of several of the city's most diverse neighborhoods including Bayview-Hunters Point, Dogpatch, and Potrero Hill. The area is a unique nexus for the city's working-class, industrial jobs and is a critical infrastructural hub: home to shipping centers, the city's wholesale produce market, a wastewater treatment plant and many other supporting businesses that provide roughly 22,000 jobs.

The present-day Islais Creek is in fact an underground channel rather than a creek, and its low-lying surroundings that were once marshland are now filled in with debris, resulting in a series of overlapping hazards – from current storm water inundation and sewage overflow to long-term sea level rise. At the same time, unstable soils create high liquefaction risks during a seismic event. A catastrophic shock to Islais Creek, the city's logistical and infrastructural hub, would bring San Francisco to a standstill.

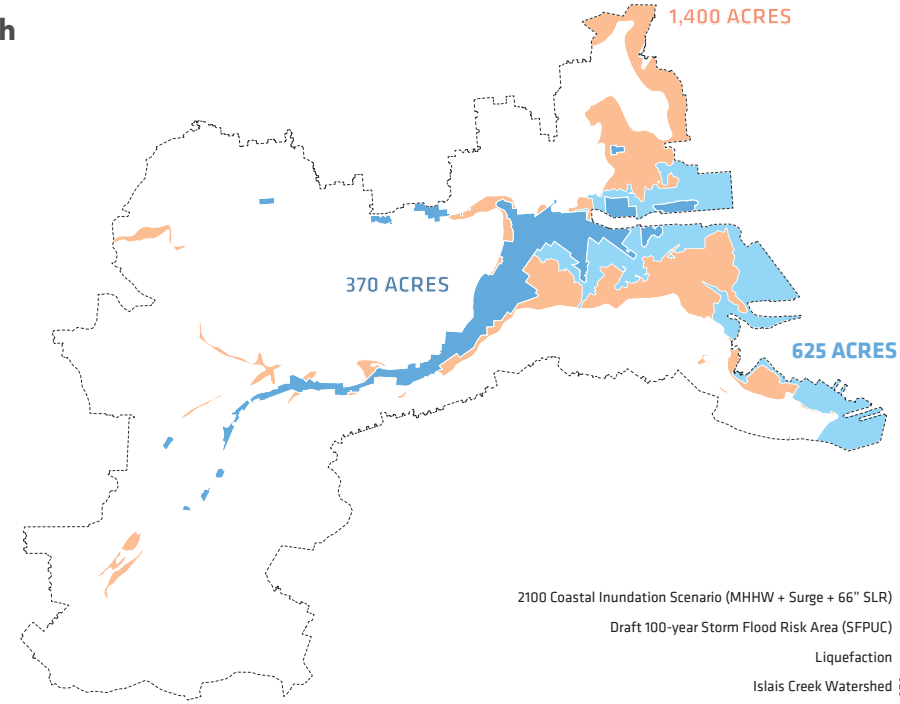
Islais Hyper-Creek is a vision for the area where people, ecology, and new, clean forms of industry co-exist in harmony as a Social Ecosystem. It is built from a series of scalable interventions centered around a large riverine park with a restored tidal creek system and soft shoreline that at the same time embraces and creates space for maritime operations, light manufacturing, and logistics that have existed in the area for decades – providing new economic opportunities for the surrounding districts while making it a valuable resource and destination for the city at large.

FINAL PROPOSAL:

Selected Opportunity:

Islais Hyper-Creek

Making Space for Water and Growth



Historical Basin

Up until the 1800s, Islais Creek was the area's largest freshwater body and its main drinking source – part of a rich fluvial valley home to the indigenous Muwekma Ohlone tribe who harvested mussels, shrimp, and clams. As the city grew, it began to exploit these naturally wet flatlands – first for irrigation and farming, and later for livestock raising and processing. After the devastating 1906 earthquake, the creek became a dumping ground for the city's mountains of rubble, and previous plans for parkland gave way to a full program of land reclamation, filling in the entire marshland area to the boundaries we know today. As industry and deep-water port operations grew, paved surfaces and pipes replaced the natural flushing of the watershed, with the entirety of the creek placed below ground in a large channel beneath Highway 280. Today, with the added shocks and stressors of climate change, these systems and the land they occupy are becoming increasingly strained.

Historical creek and basin

Landfill and creek culvert

Tomorrow's hazards

Hyper-creek concept

What is at Risk

To better understand the impact of compound urban and climate stresses, the team performed an initial mapping of assets at risk within the total area affected by one or more of the three major risks (liquefaction, stormwater flooding, coastal inundation) – adding up to approximately 1,600 acres: 23 percent of the total 6,990 acres of Islais Creek watershed. Within the unique context of the affordable industrial basin, characterized by an abundance of publicly owned lands and working shoreline, initial research shows that more than 450 acres of publicly owned parcels are at risk, exposing 40% of City-owned parcels in the watershed. These exposed uses include critical infrastructure for the City such as MTA bus and rail yards, the 3rd Street Corridor, DPW staging and administrative spaces, 337 acres of SF Port land, and 63 acres of PUC property, including 22,000 linear feet of wastewater infrastructure and the Southeast Treatment Plant (SEP), which treats 80 percent of the City's wastewater. Total value of the affected privately-owned parcels adds up to $700 million, with 270 acres of PDR (Production-Distribution-Repair), 80 acres of mixed-use space, 58 acres of cultural space, and 52 acres of residential parcels located in the risk area. More than 800 businesses in construction, wholesale, retail, warehousing, and food services are exposed to flood risk, representing a significant portion of the 22,000 jobs in the study area. These businesses form the backbone of local commerce and the economic vitality of neighborhood corridors. To mitigate risk at such a large magnitude, it is critical to think large-scale and long-term.

Shared Goals

During the Design Phase, the BIG + ONE + Sherwood team met with over 80 groups and agencies for direct discussions that explored the issues critical to area stakeholders. Our community partners – including APRI, Resilient Bayview, and RDJ Enterprises – helped identify disadvantaged communities associated with the site and prioritize focus areas and key topics for our extensive public engagement process. It was important to include adaptation strategies and near-term projects that could address pressing local issues and priorities such as lack of parks and open space, job and education opportunities, and improved housing and transit options in order to arrive at a resilient long-term vision. Based on research findings and first interactions with community members and City officials, four goals for the site emerged: protect - restore - connect - grow. A series of tools were then articulated as potential strategies, to be discussed and spatialized iteratively throughout extensive community engagement.

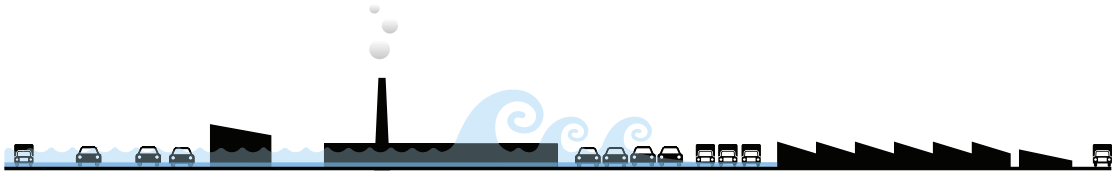
Protect - Sea level rise and storms, seismic hazards, and the potential value of the shoreline pose a critical demand for enhanced protection of Port operations, PDR uses, and the local jobs they sustain. In order to achieve these goals, we must work with nature to adapt to the long-term effects of climate change, integrating soft and hard measures along the shoreline. In addition, it is necessary to adapt our existing economic and social structures to confront the risks of climate change in order to protect the deep-water port, which is comprised of a lattice of critical infrastructure providing thousands of jobs throughout both the PDR and flood zones.

Restore – It is certain that more frequent storms and heavy rain events will result in extensive floods in the low-lying areas surrounding Islais Creek. Building

and production practices in the past decades have produced severe contamination, requiring sober attention to environmental consequences. To address these issues, Islais Hyper-Creek focuses on restoring the creek's ecological functions at the watershed scale while increasing its retention capacity. A restored natural framework could become a resource for economic growth and community development. In this design, we recognize the importance of refiguring the community's connection with its waterfront and local food production, helping revive local stewards and champions around a green, healthy waterfront.

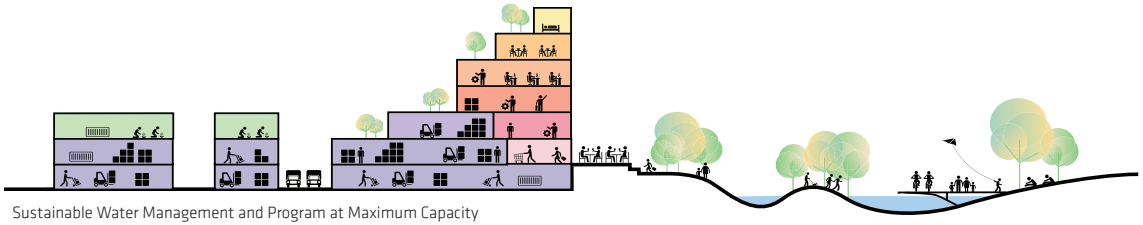
Connect – In the neighborhoods surrounding Islais Creek, traffic congestion on the highways, redundant truck routes, lack of accessibility in Bayview, and decades of exclusion of community members in decision-making processes have fostered a great deal of mistrust. These dynamics highlight a need to connect individuals and communities on multiple levels, leveraging both physical and social interventions. By improving accessibility between neighborhoods and water's edge through innovative new modes of transit, it becomes possible to connect communities to activities, nature, and open spaces while linking resources and infrastructure in a more sustainable loop.

Grow - The importance of PDR as a locus for local jobs and industrial operations for the city, the potential to rethink innovation in the Port areas, and years of disinvestment in the adjacent communities all demonstrate the need to grow and modernize logistics and port operations to ultimately enhance and increase local job opportunities. In addition, it is crucial to help invest in local education, training and culture to help empower the community around its identity, economic development, and growth.



Current Situation and Climate Stresses

Land Purchase and Assembly



Sustainable Water Management and Program at Maximum Capacity

Vision

Connecting hazard mitigation to land use, industry to open space, access to jobs, and water to waste systems requires an integrated planning approach at a large scale with a long-term horizon. Climate and urban challenges force us to think collectively to envision a future where water is no longer constrained but has space to flow, slow down, and be absorbed. A clear concept emerged through our design process: we need to make space for water while allowing industries, communities and local stewards to live, grow and thrive alongside it.

The BIG + ONE + Sherwood team's vision for Southeastern San Francisco is Islais Hyper-Creek – a restoration of the natural ecosystems in a new major park that addresses risk from coastal and stormwater flooding and serves as an opportunity to bring the existing industrial ecosystem into the next economy. We envision an elegant mechanism allowing for selective retreat and program stacking to achieve this resilient future that holistically addresses the community's needs. Sensitive landscapes would be protected and lost habitats would be restored to floodplains and wetlands. Winding through its center, Islais Creek could flow freely, unconstrained by the pipes and hard edges that held it for 100 years. In fact, the Hyper-Creek could absorb millions of gallons of stormwater every year that would have otherwise flooded its surrounding neighborhoods; it would be a vital part of San Francisco's efforts to adapt to a changing climate.

Adjacent to the park, the area's industrial, logistics, and Port functions, currently located on the creek's

HYPER-CREEK VISION AND PILOTS

channel, would be strengthened and adapted to resist earthquakes and flooding. Organized more compactly, clusters comprised of complementary functions would form a new industrial ecosystem of diverse and accessible jobs. This new industrial ecosystem would be as dynamic as the first industrial boom of the 1940s in this area. In the 21st century these industries would be clean and safe for its workers, many of whom would come from the Bayview and other surrounding residential areas. The area's businesses host fabricators, artists, food related activities, and e-logistics: a whirr of new technology and the old way of working with your hands. These industries would offer high-paying jobs and allow room for affordable work spaces to host the raw processes that would still take place here and provide an entry point into the workforce. Befitting San Francisco, the project area could become a global showcase of innovative and clean urban industries and logistics linking the digital economy to the physical economy and would continue to provide essential functions and working-class jobs for the City.

Implementation

Our approach during the Design Phase has helped set up a robust structure for the next phase of the project. Our team has identified funding and financing principles that can best be delivered by a single entity empowered to marshal multiple resources and direct these resources towards a unified purpose across an extended time span and by delivering multiple projects. We propose establishing a new entity: the Islais Creek Authority (ICA) based on the many joint powers authorities already operating in the Bay Area. The ICA would support the next phase of the project, managing pilot projects and continuing to envision a holistic approach to the Islais Creek watershed.

Pilot Projects

In order to jumpstart this process and to make possible outcomes more resilient and adaptive, the BIG + ONE + Sherwood team has formulated an approach that grows out of a small number of distinct pilot or "Phase 1" projects. Six potential projects were identified, aligned with various current and planned projects or studies initiated by the City and the Port. These short-term projects become the opportunity to kickstart the long-term vision for a resilient Islais Hyper-Creek.

1. ISLAIS CREEK GATEWAY AT PIER 90

At Pier 90, underutilized lands could be naturalized into a soft shoreline to adapt to rising sea levels and to better handle storm flows throughout the area (pictured at chapter introduction). This pilot would create an expanded Gateway park to the Bayview and space for stacked vertical industry alongside working spaces near the iconic grain silos, kicking off a longer-term naturalization of the creek's southern edge. Islais Creek Gateway would connect the neighborhood and its future economy to the creek. Building on the recent improvements on the southern side of Islais Creek's crossing with 3rd Street, such as the skatepark and the kayak launch, the Port and its partners could develop the underutilized areas east of 3rd street, on Pier 90, into a substantial park with shoreline access, restored wetlands and neighborhood amenities. A dual strategy of natural shoreline restoration at the Creek southern edge and hard coastal protection on the northern area is envisioned, where an elevated urban waterfront would open up into a wide and landscaped plaza with a ferry landing on the eastern side. These moves would open up much-needed open space for the Bayview community, space for economic development, and widening of the flow channel, playing an important role in strengthening cultural and functional connections while adapting to SLR.

2. LIVING LEVEE AT SOUTHEAST PLANT

At the South-East Plant, natural treatment systems could be piloted along the creek, together with sea level rise adaptation using wetlands to process wastewater, accomplish resource recovery, and tie into a future decking of the plant itself. These interventions could create space for much needed recreation, open space, and educational opportunities for the neighborhood. On the lots just north of the wastewater treatment plant, the San Francisco Public Utilities Commission could combine community benefits and educational programs with a number of interventions focused on flood protection, water treatment, resource recovery, and urban farming. East, along the Islais Creek channel, a living levee system, such as that piloted across the Bay at the Oro Loma Sanitary District, could be integrated as part of the treatment processes. While protecting from SLR and storm surge, the living levee would provide de-nitrification and removal of Contaminants of Emerging Concern (CECs) such as pharmaceuticals and persistent industrial organics

Successful pilots and greater community acceptance could form the basis of the future integration of the Southeast Plant in Islais Hyper-Creek through nature-based systems. Evolution in treatment efficiency could reduce the footprint of the current plant and help free up space for other functions.

Living levee at southeast plant

3. RIVER PARK AT CESAR CHAVEZ CORRIDOR

Building on green infrastructure improvements along Cesar Chavez itself, areas of bio-diverse habitat and water detention could be reintroduced to the neighborhood. This would be the start of a continuous alignment that eventually would become a restored Islais Creek integrated with significant areas of storage volume to intercept peak flows and spaces for living along its banks. Combined with green infrastructure and transportation improvements on Cesar Chavez Street new buildings could have increased density and creek access allowing both space for water and space to grow local industry and identity.

An affordable housing complex would be located at the interface between Cesar Chavez Street and the daylit creek, connecting urban and natural environments. A series of alternating green and paved roofs would offer areas to rest and enjoy the views toward the surrounding landscape while allowing a seamless accessibility by bridging the current elevation gap between the road and the basin. This pilot could be partially linked to the temporary San Francisco Flower Market, setting back new buildings in a restored channel. In the longer term, land acquisitions along the alignment of the former creek, combined with consolidations of PDR program in the basin, will make it possible to develop significant parts of Islais Hyper-Creek for water retention, treatment, and conveyance.

4. SF FOOD DISTRICT AT PDR BASIN

The San Francisco Wholesale Produce Market has already begun a process of modernization. By stacking additional functions in this part of the district, this pilot could be a catalyst for a food and high-tech logistics district in the heart of the basin. This could be a place where production, storage, goods exchange, workers, and visitors come together as a new destination in the Bayview.

In the next series of capital investments in the SF Wholesale Produce Market, complementary functions such as food production, food processing, food distribution, a culinary school, and even food consumption could be stacked on top of the market.

River Park at Cesar Chavez Corridor

Such a proof-of-concept can be replicated with other complementary programs in the PDR area, creating space for water retention and creek restoration. This investment would add jobs while allowing the low-revenue generating programs to stay in San Francisco and, as better building stock is introduced, would increase the areas resistance to earthquakes.

The clustering of complementary functions can develop, over time, into a number of distinct districts, each with their own identity, such as an arts district, a production/light industrial district, a home improvement and construction district, and a logistics district. Most of these high-density clusters would be located close to the new Caltrain station, facilitating transit access for workers and visitors, and would offer seamless connections to Islais Hyper-Creek.

5. LIVING WITH WATER AT ALEMANY FARMERS MARKET

Alemany Farmers Market sits at a critical reach in the creek's naturalization plan. Here, California's first city-run farmers market has operated every Sunday since 1943, offering low-priced local and organic produce with stalls for ready-to-eat foods. The Alemany Farmers Market is situated at the very downstream node of the watershed surrounded by municipal staging yards and a network of on and off ramps to the freeway. In this location, the entire upper watershed drains to reach the Bay through the Islais Creek underground channel.

With a multi-functional site design, this area could accommodate space for water, while enhancing and strengthening the market and retail facilities, and could even accommodate much-needed mixed-income housing, building on in-progress studies by the District Supervisor's office. To avail this space, adjacent parcels under the freeways could double as parking and water storage, with housing forming a sheltered ring around the site, market functions accommodated underneath, and a park in its center doubling as stormwater retention. Under the highway interchange, water storage would combine with

Living with water at Alemany Farmer's Market

improvements in traffic circulation, parking efficiency, pedestrian circulation, and bike connectivity. Rainwater gardens in an underutilized right-of-way would further alleviate recurring stormwater flooding.

6. INNOVATION COVE AT PIER 80

At the Bay shore, lands ringing Warm Water Cove could help extend the city's waterfront network into the south-east, providing a platform for a new Innovation Dock where local business incubators, research facilities, and experiments in resilient floating architecture would form a hub of innovation for the city.

The extension of Warm Water Cove to the south with additional shoreline park improvements would provide ecological and public realm benefits for many of the new residents. The existing natural shoreline could be enhanced to allow waterfront access and waterfront amenities, creating a destination for both residents and visitors. A new Innovation Park would become the display for outdoor experiments and innovation, where new technologies could explore the use of natural resources, such as sun, wind, or water.

As part of this development, experimental floating buildings could be moored along the cove's southern shoreline. Integrated with kayak launch sites and floating decks, this underutilized Port land could re-discover its connection with the waterfront. In the longer term, the Innovation Cove and related mixed program could be expanded south and west, on either side of 3rd Street, underlining the significance of this corridor.

Innovation Cove at Pier 80

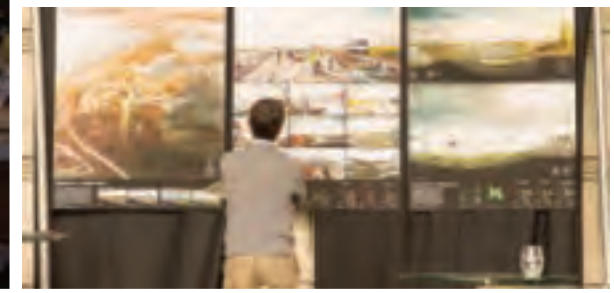
Moving Forward

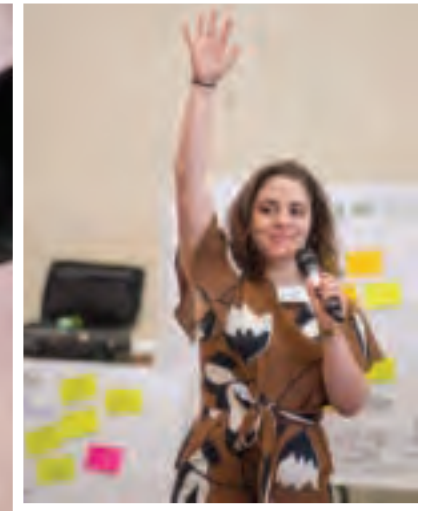
Designing Our Own Future Resilient Bay Summit

Left: Home Team poses for a photo on their Sea Leveling Rod installation at the Resilient Bay Summit in Alameda.

Right: Clockwise from top left, all at Resilient Bay Summit in Alameda: visitors browse the Y-PLAN display; visitor examines the Design Team boards; floor display of San Pablo Baylands; Zoe Siegel assisting during program; food truck line outside.

After the final designs were presented to the Jury, the Design Teams, Research Advisors, and Jury gathered with scientists, community members, local elected leaders, financial specialists, and youth to explore key takeaways and lessons learned from the Resilient by Design process in a World Cafe style format. They brainstormed ways to collectively support and advance Resilient by Design projects as well as resilience efforts around the region more broadly.





Left to Right: Emily Sheppard the Summit Graphic Recorder visually captured the ideas that were discussed during the World Cafe style conversations; Pandora Thomas presenting the People's Plan; a Bionic flood model of San Rafael; conversations during Summit.

Left to Right: Design Team final presentations at SFJAZZ; browsing Design Team boards at SFJAZZ; All Bay Collective receiving a recognition at Resilient Bay Summit; HASSELL+ receiving a recognition from San Mateo County Supervisor Dave Pine at Resilient Bay Summit.

Challenge Impact

The premise of the Resilient by Design | Bay Area Challenge was both simple and audacious. As flood risks increase due to severe storms and sea level rise, organizers asked the questions: Can the Bay Area come together to shift its course and build a more resilient region before disaster hits? And can we use this opportunity to address other regional challenges along the way?

The pace of climate change related destruction continues to increase. During the Resilient by Design | Bay Area Challenge, our country experienced the deadliest hurricane season on record, in which Hurricanes Harvey, Irma, Jose and Maria all struck the nation's coasts. But that wasn't the end of it. In California in October 2017, just days after the Design Teams toured the North Bay, the Tubbs Fire burned 36,800 acres in three counties. A year later, the devastating Camp Fire topped Tubbs in size, cost, and fatalities. Yet, even in the face of these mounting threats to life and property, our nation's proactive programs to reduce risk remain woefully under-resourced. Time and time again, we wait to come together and invest in rebuilding only after the latest hurricane, wildfire or heatwave. The Resilient by Design | Bay Area Challenge aimed to change that script. The Challenge called for design and investment in advance of flooding and sea level rise, and before loss of life, economic devastation, and costly post-disaster recovery.

Participants at the Resilient Bay Summit in May 2018 looking out at the San Francisco Skyline from Alameda, CA

BAY AREA CHALLENGE IMPACTS

Built on **growing momentum** to proactively **think, plan, and invest in our shoreline** at a **regional scale**

Brought resilience to the forefront and **heightened the public's awareness of growing flood risk**

Integrated **social equity, natural systems, and the built environment** to manage sea level rise while addressing other vulnerabilities related to transportation, housing, and the environment.

Reached a broader audience than a traditional planning process using **Innovative design thinking** to inspire action to proactively address risks.

Above: The Resilient by Design | Bay Area Challenge provided a space to start to reinvision how we invest in our region's infrastructure in the future. An independent assessment carried out by the Consensus Building Institute (CBI) distilled the Bay Area Challenge's high-level impacts, highlighting the benefits of a collaborative and visionary process to accelerate the region's resilience efforts.

Call to Action

As a region and as a nation we must rethink how we invest in infrastructure. We must maximize the impact of every dollar, providing essential improvements today while ensuring we can weather extreme events in the future. We need to bring climate adaptation to the forefront of conversations around the future development of our region. We must also acknowledge and plan for the changes to our environment and quality of life that we have already caused, and cannot fix. It's time to accelerate action and adaptation significantly and across the nation. Public investment must be prioritized in a way that increases resilience by design. This path to resilience includes more collaboration; more integration between natural systems, the built environment and social equity; and more innovation in design thinking. Partnering with leaders in the design field can help local governments and communities imagine more possibilities, connect with a broader audience, and motivate a movement to advocate for investment in resilient communities and infrastructure.

As part of this effort, we need to create processes, plans and design solutions that **allocate more decision making power** to those most impacted by both climate change and regional adaptation efforts. We must dream big and continue to **build a vision** that is rooted in an understanding of our history, both ecological and social, and our future, which promises to be quite different from the past.

To highlight the myriad ideas generated by the Resilient by Design effort, and to catalyze more holistic thinking about infrastructure investment and development in the region, we've identified the most prevalent major themes among the design solutions and emerging from the overall endeavor. These themes inspire us to move beyond our silos and embrace urgent change and innovation in planning for the region's future.

Major Themes

Bionic Team proposed a living reef in an effort to expand the existing living shoreline program and integrate the ecology of the bay edge.

While in many ways our communities within the Bay Area are unique and have their own assets and context, the challenges we face are more similar than different. The themes here are essential challenges that the region must work on together as we face an uncertain future: integrating ecological principles, increasing access to housing, co-designing with most-impacted communities, greater regional collaboration, and bolstering transportation infrastructure.

Integrating Ecological Principles

Engineers and planners created much of our current shoreline infrastructure to keep water out and preserve existing property lines. Rising sea levels call for less static, and more dynamic, shorelines, waterfronts that have a more adaptive relationship to San Francisco Bay and its natural hydrology. Rather than increasing long-term stability, conventional strategies, such as building larger and larger sea walls, may only increase the flood risk to adjacent areas without equivalents. In many cases, these hardscape types of shorelines offer only short-lived or incomplete solutions. The best options are likely to employ natural or hybrid solutions that will evolve as sea levels rise.

Apart from reducing the construction and maintenance expense of sea walls, levees, and other flood control measures, green and blue infrastructure can provide huge benefits. Strategies include expanding space for marshes, opening up creek culverts and floodplains, vegetating or reshaping levees, and building artificial reefs. Green or hybrid options often offer significant ancillary benefits to ecosystems and communities. These nature-based solutions can increase wildlife habitat and access to open space, as well as contribute to better air and water quality for the region. By employing these techniques, Resilient by Design projects demonstrate how landscape architects can work hand-in-hand with engineers to reimagine how we live with water. The result can protect our residents and businesses, reduce the need for costly and bulky gray infrastructure, and improve the quality of life in our communities.

Above: The All Bay Collective proposed floating walk-up apartments and pile supported mixed use buildings on top of sea level rise protected street berms.

Increasing Access to Housing

The Bay Area is in a housing crisis. Throughout the Challenge, teams grappled with how to create solutions to sea level rise that would also provide access to housing and guard against displacement. For many, working through these issues provided a new perspective on what constitutes a disaster. The destruction of homes and communities from a storm or flooding is tragic, but so too is the uprooting of long-established communities as the result of a slower-moving social and economic crisis. Soaring housing prices and income inequities in the Bay Area, for example, often place homes in new developments out of reach of existing residents and communities of color. Investment in flood protection should create housing development opportunities targeted at all income levels. This approach can build long-term resilience, leverage investments in a protected and inclusive future, and keep communities intact and in place.

Below: The Home Team proposed methods of home ownership including community land trusts, small lot home ownership and multi-family housing with shared amenities as a path for community wealth building.

As a method of integrating community priorities into longterm financing mechanisms and cross-jurisdictional governance frameworks, the All Bay Collective team proposed Resilient Equity Hubs (REHBs), alliances among agencies, community advocates, and residents that can leapfrog jurisdictional and property boundaries to achieve common stewardship and deliver shared benefits.

Co-Designing with Most-Impacted Communities

Marginalized communities often bear the brunt of natural disasters, and the effects of increasing and intensified flooding in the Bay Area due to climate change are no different. At the same time, Bay Area communities are facing unprecedented displacement pressure due to high housing costs and short supply. While the Resilient by Design model created space for an uncommon level of collaboration and co-creation with communities, many stakeholders illuminated the need to reorient toward leadership and ownership from within impacted communities. Solutions created with and by the communities they intend to serve will be more effective and build longer-term resilience than solutions devised by those with less lived experience of the issues they are working on.

The social challenges that Bay Area communities face related to housing, affordability, and environmental justice are complex and the legacy of planning processes that exclude low income communities of color runs deep. Building the trust necessary for collaboration is a formidable challenge. Involvement of community members at all points of a visioning, planning and design process is crucial. So is a concerted effort to bring new voices into the conversation. This must be undertaken in a sustainable way that isn't burdensome to residents and communities. Only with their help can urgent climate-related threats be addressed collaboratively and with tangible benefits to the most vulnerable. Long-term relationships, trust, accountability, and investment are foundational elements in any reciprocal exchange that aims to yield truly innovative and responsive results.

The Common Ground Team proposed to resolve the transportation problem of Highway 37 by designing a scenic causeway elevated on columns 20 feet high, allowing tidal flows and marsh migration to return to a natural condition.

Bolstering Transportation Infrastructure

The Bay Area's growing population places increasing pressure on the region's transportation infrastructure. This infrastructure supports the local economy, regional mobility, and access to work, stores, services, and recreational activities. The Bay Area invests millions of dollars every year in this infrastructure. Highway repairs, bike lanes, rail expansions, urban trail networks, and other priority projects all compete for scarce funds. Adding climate adaptation measures into this mix creates a new layer of planning complexity and demand on capital investments. Often the enormity of these new demands overwhelms efforts to make adaptation investments a top priority. Big ideas emerged from Resilient by Design to alleviate these pressures, however. These included adding ferries, building out new multi-modal transportation hubs, and elevating or burying highways at critical bottlenecks, locations that already flood during high tides or heavy rainfall, or that are projected to flood with sea level rise.

While implementation of these big ideas may seem daunting, recent research has shown that climate impacts to our transportation system are being felt much more quickly than anticipated. Design Team findings reaffirmed these results. Across all types of shorelines, urban and rural, those containing transportation assets are among the most vulnerable and most costly to protect. Many major transit lines that Bay Area families use to get to and from work and school are also vulnerable. Indeed it is our most vulnerable residents – children, the elderly, lower-income families and workers reliant on transit or wheelchairs –that may be stranded first in any flood event.

Regional Governance

We often refer to the Bay Area as a defined region. But from a governance perspective, we are a set of loosely affiliated cities, counties and communities. The nine-county Bay Area includes 101 incorporated cities as well as many special districts that oversee transit, parks, wastewater and other critical services. Even cities vary in structure significantly – San Francisco is a consolidated city and county while San Mateo County is comprised of 20 separate municipalities.

In recent years, local leaders have begun to discuss the need for more collaboration and regional agencies have taken some steps to coordinate and consolidate. Progress can be slow and resistance strong, however.

Though forging new ways of working together can be challenging, regional collaboration to address climate impacts is unavoidable. Climate impacts will not fall neatly within jurisdictional boundaries. The economic viability of our entire region, and the safety of our residents, is at risk. The housing, equity, and transportation challenges we face today will expand into new areas with climate change, spreading impacts from one municipality into others. Coordination is both possible and an urgent priority. Ideas for effective multi-jurisdictional collaboration, from resilience districts to collaborative infrastructure planning and design are embedded into many of the Resilient by Design plans. At all levels – local, regional, and state – it's time to make the most these and other collaborative tools, ideas and opportunities, including exploring new legislative and funding incentives.

Many of the Design Teams, including the BIG+ONE+Sherwood Team (left) mapped out the complex map of stakeholders that need to cooperate and collaborate to move projects forward.

Next Steps

The Resilient by Design | Bay Area Challenge built relationships and generated ideas that inspired people around the Bay. It created a catalyst and amplified momentum for climate adaptation measures across the region. As Challenge projects move forward, communities will continue to shape the best possible plans for adapting to sea level rise at the local level.

The Resilient by Design visions helped us reimagine how to invest in and prepare for the future. Living shorelines, for example, provide wildlife habitat and opportunities for people and nature to interact in the urban environment while adding crucial flood protection. Multi-modal transportation planning that integrates climate adaptation measures will minimize disruptions due to coming storms and rising groundwater tables and make sure that everyone will be able to get where they need to go. Community-led planning and design will ensure that investment in the next generation of public infrastructure benefits current as well as future residents. Creating more opportunities for regional collaboration will mobilize the incredible creative forces alive in the Bay Area. The Bay Area has a history of being a world leader across sectors – from social justice movements to technological innovation. Resilient by Design builds on that legacy and provides inspiration for this region and beyond. We must come together to address head on the biggest challenge facing the next generation and prepare ourselves for a more resilient future.

Special Thanks

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Acorn Woodland Elementary
Acta Non Verba
Acterra
AIA SF
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Alameda County Flood Control District
Alameda County Public Works Agency
Alameda County Resource Conservation District
Alameda County Water District
Alameda Creek Alliance
Alameda Point Collaborative
APRI SF
Artiszen
Asian Pacific Environmental Network
Aspire East Palo Alto Phoenix Academy
Association of Bay Area Governments (ABAG)
Autodesk
Balboa High School
Bay Area Air Quality Management District (BAAQMD)
Bay Area Council
Bay Area Regional Collaborative
Bay Area Regional Health Inequities Initiative (BARHII)
Bay Conservation and Development Commission (BCDC)
Bayview Advocates
Bayview Hill Neighborhood Association
Bayview Hunters Point
Bayview Hunters Point Public Housing
Black Pine Circle School
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California College of the Arts
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California State Water Resources Control Board
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Canal Alliance
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Cargill
Castlemont High School
Center for Cities + Schools / Y-PLAN
Center for Ecosystem Management and Restoration
Citizen Advisory Committee
Citizens to Complete the Refuge
City and County of San Francisco
City of Alameda
City of Alameda Public Works
City of Benicia
City of Benicia Community Development Department
City of Benicia Parks and Community Services
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City of Oakland
City of Oakland Planning Department
City of Pittsburg
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Dolphin Charters
Don Edwards San Francisco Bay Wildlife Refuge
Ducks Unlimited
Earhart Elementary School
East Bay Dischargers Authority
East Bay Regional Parks District
East Oakland Building Healthy Communities
East Oakland Collective
Enterprise Community Partners
Environmental Forum of Marin
Environmental Science Associates
Exploratorium
Facebook
Fresh Air Vallejo
Friends of Alhambra Creek; Alhambra Creek Watershed
Friends of Islais Creek
Friends of Lake Chabot/Vallejo Watershed Alliance
FUSE – Fremont
Google
Green Benefits District
Greenaction
Greenbelt Alliance
Guerrero Gallery
Hamilton Families
Hanson Aggregates
Higher Ground
HOPE Collaborative
Institute for Environmental Entrepreneurship
Institute for Sustainable Policy Studies & Action
Joint Venture Silicon Valley - Public Sector Climate Initiatives
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Laurel Dell Elementary
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Literacy for Environmental Justice
Malcolm X Academy
Mare Island Historic Park Foundation
Mare Island Shoreline Heritage Trust
Marin Audubon Society
Marin City Community Services District
Marin Community Foundation
Marin Conservation League
Marin County
Marin Environmental Housing Collaborative
Mary Collins School
McClymonds High School
Metropolitan Transportation Commission (MTC)
Mid-Peninsula Regional Open Space District
Miller Creek Middle School
Muwekma Ohlone Tribe
Napa County
Napa County Parks and Open Space District
Napa County Public Works
Napa County Watershed & Flood Control
Neighborland
Neighborly
NHA Advisors
North Coast Regional Water Quality Control Board
North Richmond Center for Health
North Richmond Municipal Advisory Council
Oakland Climate Action Coalition
Oakland Tech High School
Oakland Zoo
Occidental Arts and Ecology Center
Oro Loma Sanitary District
Planting Justice
Point Blue Conservation Science
Port Costa - Bull Valley Roadhouse, Burlington Hotel
Port of Oakland
Port of San Francisco
Poseidon and Obsidian Ridge Vineyards
Public Advocates
RDJ Enterprises
REACH Teen Center
Repaired Nations
Resilient Bayview
Resilient Communities Initiative
Resilient Shore
Resources Legacy Fund
Richmond Community Foundation
Richmond High School
Richmond Mayor's Office
Rohnert Park
Ruggieri Senior Center

Safe Return Project
San Bruno Mountain Watch
San Francisco Airport
San Francisco Bay & Water Trail
San Francisco Bay Ferry
San Francisco Bay National Wildlife Refuge Complex
San Francisco Bay Regional Water Quality Control Board
San Francisco Baykeeper
San Francisco Department of Public Health
San Francisco Department of Public Works
San Francisco Department of the Environment
San Francisco Estuary Institute
San Francisco Estuary Partnership
San Francisco International Airport
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San Francisco Office of Community Investment and Infrastructure
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San Francisco Parks Alliance
San Francisco Planning Department
San Francisco Public Utilities Commission
San Francisquito Creek Joint Powers Authority
San Jose State University
San Leandro Creek Alliance
San Leandro Police Department
San Leandro Water Pollution Control Plant (WPCP)
San Mateo County
San Mateo County Office of Sustainability
San Mateo County Parks Foundation
Santa Clara Valley Audubon Society
Santa Clara Valley Water District
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SPUR
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Sustainable San Rafael
The Environmental Justice Coalition for Water
The Watershed Project
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