

YERBA BUENA COVE:

REIMAGINING PROTECTIVE INFRASTRUCTURE ALONG SAN FRANCISCO'S EMBARCADERO WATERFRONT

Drawing upon the conclusions of the Port of San Francisco's Multi-Hazard Risk Assessment and the Resilient By Design Bay Area Challenge, this proposed waterfront park extension protects one of the most flood-prone, seismically vulnerable sections of the Embarcadero Seawall through regenerative "ecological infrastructure" and attracts the public to the intertidal edge. This project aims to turn climate change adaptation strategies into a landmark park destination that offers a moment of reflection and reveals "how close to the sea we actually are."



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"We often take things for granted, but this morning's king tide was a reminder of how close to the sea we actually are."

— JOHN RAMOS, CBS KPIX5 BAY AREA REPORTER
DECEMBER 13, 2020



YERBA BUENA COVE AND THE ORIGINAL SHORELINE

In pre-colonial times, the shoreline looked very different.

Yelamu villages were spread across the San Francisco peninsula.

When the Spanish Colonizers came, they named this protected inlet Yerba Buena Cove, after the medicinal plants found in the region.



Figure 1

SITE CONTEXT WITHIN MODERN SAN FRANCISCO

Conclusion: By expanding Rincon Park we have the opportunity to create the premier park destination along the 3-mile Embarcadero Promenade.

Here in red is the location of our site within modern San Francisco. The diagonal blue lines represent the footprint of the original cove. As you can see, our site is surrounded by about 7 city blocks of skyscrapers, attractions, offices, apartments, and nodes of transportation – all built on filled soil.

KEY MAP



LEGEND

- SITE
- DESTINATION / TOURISM
- DOWNTOWN FINANCIAL DISTRICT
- PARK
- ADJACENT RESIDENTIAL / MIXED
- OLD YERBA BUENA COVE
- CONNECTIONS



Figure 2



NTS

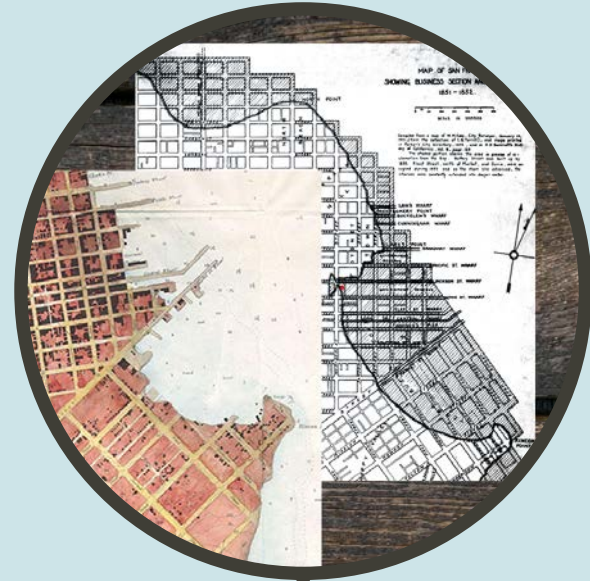
SITE HISTORY: A TIMELINE OF BAY FILL AND HUMAN IMPACT



- Establishment of Mission Dolores and a military fort in the Presidio
- Enslavement of the Ohlone peoples
- Ohlone population declines while European population begins to grow
- Mexican pueblo Yerba Buena established at site location, leading to the name Yerba Buena Cove

1769 - 1846

SPANISH COLONIZATION AND MEXICAN INDEPENDENCE



US ANNEXATION, GOLD RUSH, AND DISAPPEARANCE OF YERBA BUENA COVE

1846 - 1860

- As shown above in the side by side surveys, Yerba Buena Cove begins to be filled in starting in 1849
- Many wooden ships were buried underground when the cove was filled and they remain there today.
- The water from Yerba Buena Cove used to reach the site of the Transamerica Pyramid, meaning that much of Downtown San Francisco is built on bay fill

PRE-COLONIAL

THE NATIVE OHLONE PRECEDED EUROPEANS BY OVER 8,000 YEARS

- Sea levels were high and the Golden Gate was underwater 11,000 years ago. Therefore the Ohlone were living in the region near beginning of the San Francisco Bay
- The Ohlone were master land managers, cultivators, and fishermen. They impacted the shoreline through shellmounds and other impacts of settlements. Obviously, these impacts are almost non-existent when compared to modern interventions



- The Seawall was built between 1879 and 1916
- Over 500 acres of land were filled in behind the Seawall
- The 1906 Earthquake badly damages the city and the Marina district is built from earthquake rubble being pushed into the bay.
- After the Bay Bridge is built in 1936 the neighbourhood fell into disrepair
- Meanwhile the population continued to grow, as well as the size of the buildings downtown

1860 - 1989

EMBARCADERO SEAWALL CONSTRUCTION AND CONTINUED DEVELOPMENT



- Previously the site of freight railways, dirt pathways and warehouses, OLIN remediated this brownfield site and turned it into a gorgeous waterfront park

2003 - PRESENT
RINCON PARK

1989 EARTHQUAKE AND REMOVAL OF EMBARCADERO FREEWAY

1989 - 2003

- The Embarcadero Freeway, built in 1960 was a blight upon the city, separating its downtown core to its heart, the bay.
- The 1989 Loma Prieta Earthquake badly damage the structure and it was torn down.
- The removal of the freeway opened up the Embarcadero promenade, establishing the city treasure that it is today.



A CHERISHED PART OF THE CITY... BUILT ON FILL



BAY BRIDGE

EXISTING SEAWALL

ORIGINAL SHORELINE SEVEN BLOCKS IN →

RINCON PARK AND
CUPID'S SPAN SCULPTURE

THE EMBARCADERO
(STREET)

FERRY BUILDING

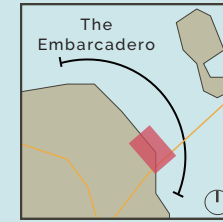
RECREATIONAL PIER 14

ZONING, LOCAL CONTEXT, AND SITE ADJACENCIES

Conclusion: An abundance of restaurants, offices, apartment buildings, hotels, attractions, and modes of transportation surround the site.

Our limit of work is approximately 16 acres along the three-mile Embarcadero Seawall. The site includes a small, existing park called Rincon Park (which has the Cupid's Span arrow sculpture) as well as two restaurants. A recreational pier and fire station mark the northern and southern boundaries of the site, respectively. Running parallel to the site is the highly trafficked Embarcadero Street and high-density downtown neighborhood.

KEY MAP



LEGEND

- COMMERCIAL
- RESIDENTIAL
- PUBLIC
- LIMIT OF WORK
- VEHICULAR
- BIKE LANE
- LIGHT RAIL
- FERRY



NEARBY LANDMARKS AND PARKS

Conclusion: The project site is socially and historically significant and is surrounded by various San Francisco landmarks.



Salesforce Park
Opened 2019



Salesforce Tower
Opened 2018

KEY MAP



LEGEND

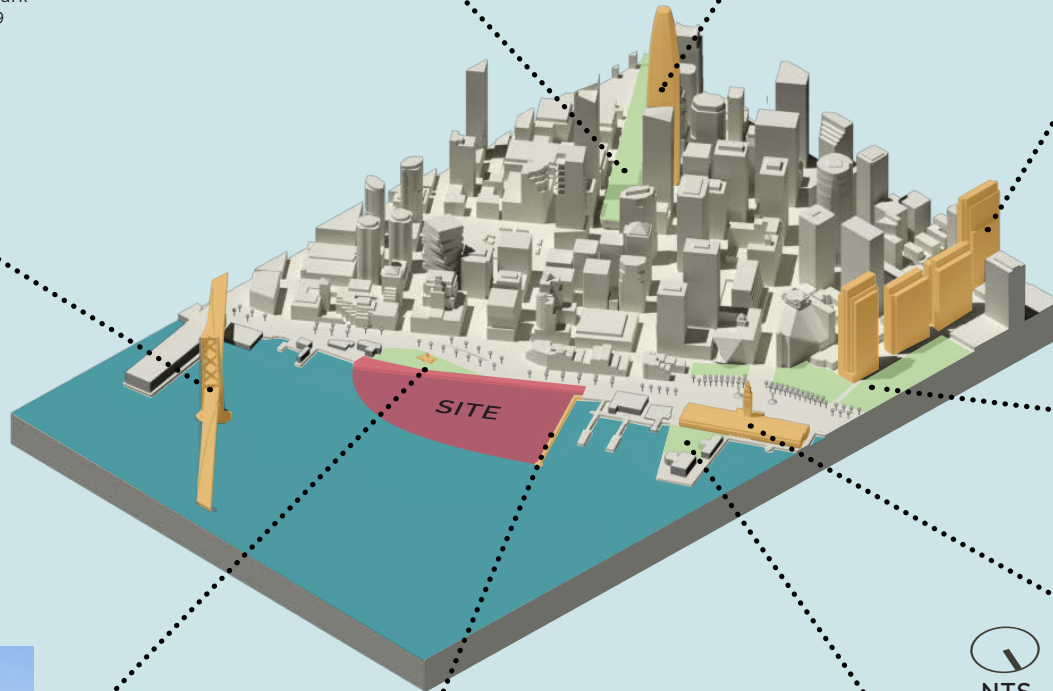
- SITE
- LANDMARKS
- PARKS



Embarcadero Towers
Opened 1971



Oakland-San Francisco Bay Bridge
Opened 1936



Sue Bierman Park and Embarcadero Plaza
Opened 2011



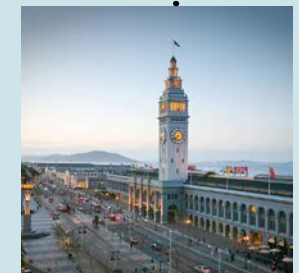
Cupid's Span and Rincon Park
Opened 2003



Pedestrian Pier 14
Opened 2006



The Ferry Plaza Farmer's Market
Opened 1992



The Ferry Building
Opened 1898

PROJECT JUSTIFICATION: \$425M SEAWALL BOND AND SUBSEQUENT EMBARCADERO SEAWALL PROGRAM

Conclusion: This is an opportune moment for design proposals – funding is available and risk assessment has been completed.

San Francisco Chronicle

April 16, 2018

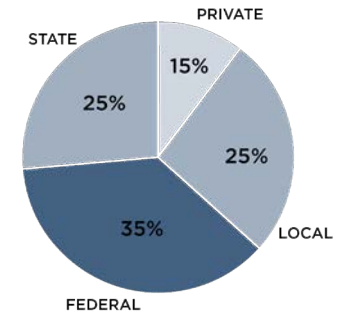
With S.F. seawall crumbling, \$425 million bond for repairs likely to make ballot

SFGATE

November 6, 2018

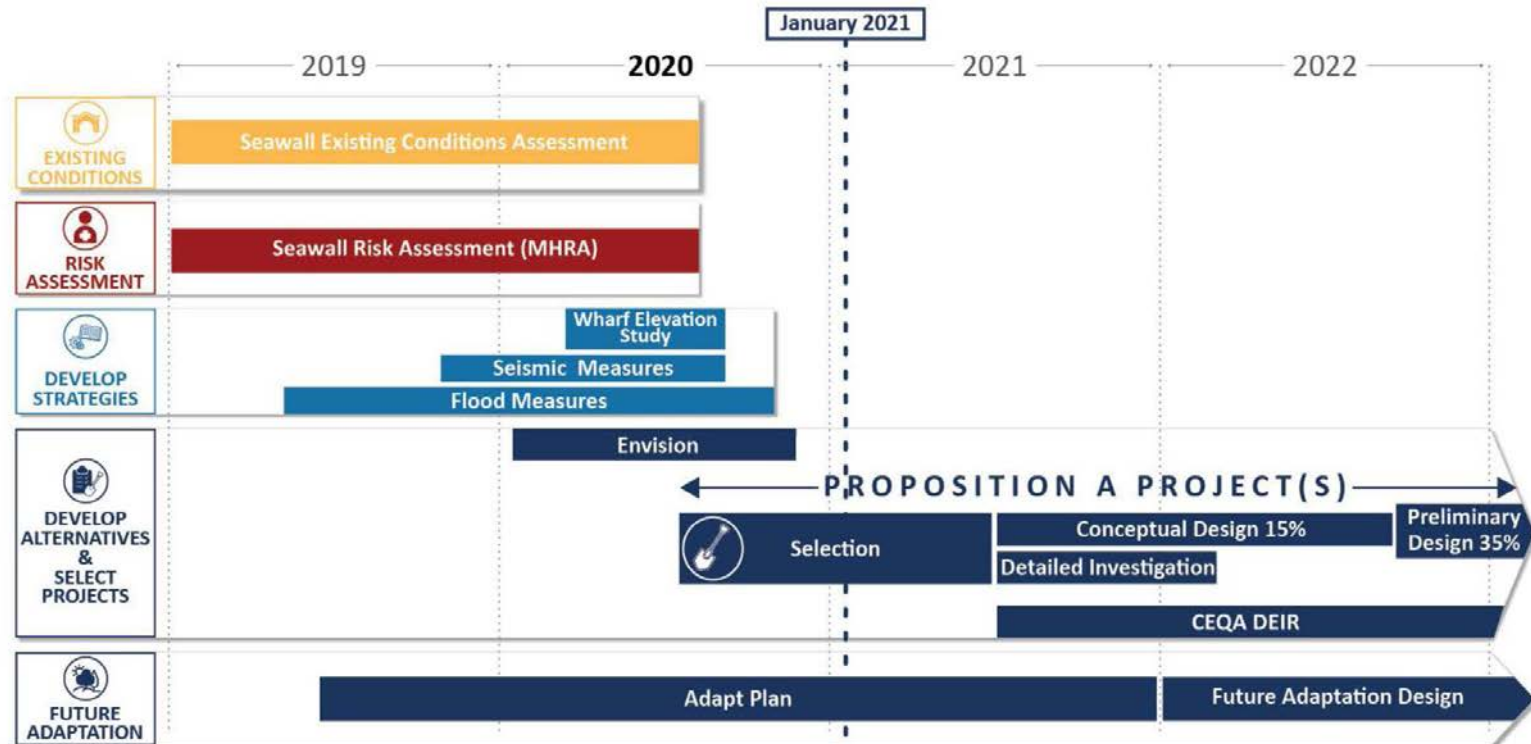
SF's Embarcadero seawall measure wins easily

ADDITIONAL FUNDING FROM MULTIPLE SOURCES



PROGRAM INITIATIVES AND TIMELINE

from SF Port's January 2021 Quarterly Status Update for the 2018 Embarcadero Seawall Earthquake Safety Bond



PROJECT JUSTIFICATION: SF PORT MULTI-HAZARD RISK ASSESSMENT (MHRA)

Conclusion: Flooding and earthquakes are expected to cause casualties and over \$30b in damages by 2100. The chosen project site is the most vulnerable location along the Embarcadero for both risks.

Overall Takeaways:

- The aging and vibrant Embarcadero waterfront presents a complex problem for seismic and flood resilience improvements that are needed to lower the risk for both the Port and City.
- The Port's aging seawall is not the only source of earthquake risk. Weak soil behind and under the seawall and the interaction between the seawall and adjacent historic pile-supported structures contribute to earthquake risk. With strong ground-shaking, weak soil under the Embarcadero will settle and cause extensive damage regardless of whether the seawall moves toward the Bay.
- Up to 40,000 people could be at risk on Port property if an earthquake occurs during the day.
- **The Ferry Building area is one of the highest risk areas on the waterfront. A large earthquake will cause significant settlement and lateral spreading in this area, threatening life safety and disaster response efforts as well as many of the day-to-day functions along the waterfront. This area is the lowest point along the Embarcadero, making it the first section to be impacted by coastal flooding, with king tides already causing some over-topping.** The Ferry Building itself is at the edge of the current 100-year flood zone. **The Port's public outreach confirmed that stakeholders love this area and recognize the concentration of transportation modes and the area's historic significance.**
- Due to the presence of weak soil, the Embarcadero transportation and utility corridor is at significant seismic risk.
- **Combined earthquake and flood impacts at the Embarcadero waterfront are expected to cause as much as \$30 billion of economic losses due to damage and disruption by 2100.**
- Port- and Embarcadero-related earthquake losses are a near-term problem with \$0.9 billion in losses estimated by 2050 and \$1.5 billion estimated by 2100.
- Flood losses are an emerging problem that increases significantly as sea-level rise begins to over-top the seawall. Based on the State of California's most likely and high sea-level rise projections, coastal flood losses are expected to range between \$4.5 billion and \$29 billion on average by 2100. The Embarcadero will experience frequent, disruptive flood impacts several decades before the Port's piers experience flood damages, which are on average 2 feet higher than the roadway.
- When the water level is 3 feet higher than the shoreline, the floodplain extends into the Financial District by more than 0.25 mile, affecting neighbourhoods, small and large businesses, jobs, utilities, regional and citywide transportation, maritime function, and cultural and historic resources.
- **Today, the waterfront segment between Pier 7 and Rincon Park falls below the 100-year flood protection standard** and as sea level rises, other areas will also fall below this protection standard.
- **At approximately 1 foot of sea-level rise, anticipated to occur between 2035 and 2050, the Embarcadero roadway and surrounding buildings near the foot of Market street will be significantly inundated during a 100-year extreme tide, resulting in damages and disruption along with severe impacts to over 1 million trips taken by BART and Muni riders.**
- **At just over 2 feet of sea-level rise, expected to occur between 2050 and 2075, the Embarcadero roadway and promenade will reach a tipping point where the 100-year flood causes widespread over-topping of the shoreline, resulting in significant disruption to multi-modal movement, cutting off landside access to all Port facilities and flooding the Financial District nearly to Beale Street.**



Inundation Map for 100-year Extreme Tide under 3.3 Feet of Sea-level Rise



Cross-Section of Ferry Building Substructure

PROJECT JUSTIFICATION: SF PORT STRATEGIC GOALS

Conclusion: In addition to sustainability and resilience, it is important to focus on equity and income generators.

Strategic Goals

The Port will realize its Mission and Vision and address its challenges through seven goals.

Economic Recovery

Develop and implement strategies to stabilize the Port's financial position from the COVID-19 Pandemic economic impacts.

Productivity

Attract and retain tenants to build an economically successful and vibrant waterfront.

Equity

Empower Black, Indigenous, and other People of Color (BIPOC) in Port operations and opportunities through equitable policies and practices.

Resilience

Reduce seismic and climate change risks to protect the waterfront.

Sustainability

Advance environmental stewardship to limit climate change and protect the Bay.

Evolution

Evolve the waterfront to respond to changing public and Port needs.

Engagement

Engage constituents and public on Port functions and activities.

PROJECT JUSTIFICATION: RESILIENCE BY DESIGN BAY AREA CHALLENGE

Conclusion: 'Takeaway #1: Integrating Ecological Principles' is most relevant to the scope of this project and therefore will be a primary project goal.

Challenge Description: A year-long collaborative design challenge bringing together local residents, public officials and local, national and international experts to develop innovative community-based solutions that strengthen the region's resilience to sea level rise, severe storms, flooding and earthquakes.

RESILIENT

BAY AREA CHALLENGE

BY

DESIGN

Primary challenge takeaways (to be followed if possible):

1. Integrating Ecological Principles
2. Co-Designing with Most-Impacted Communities
4. Bolstering Transportation Infrastructure
4. Regional Governance

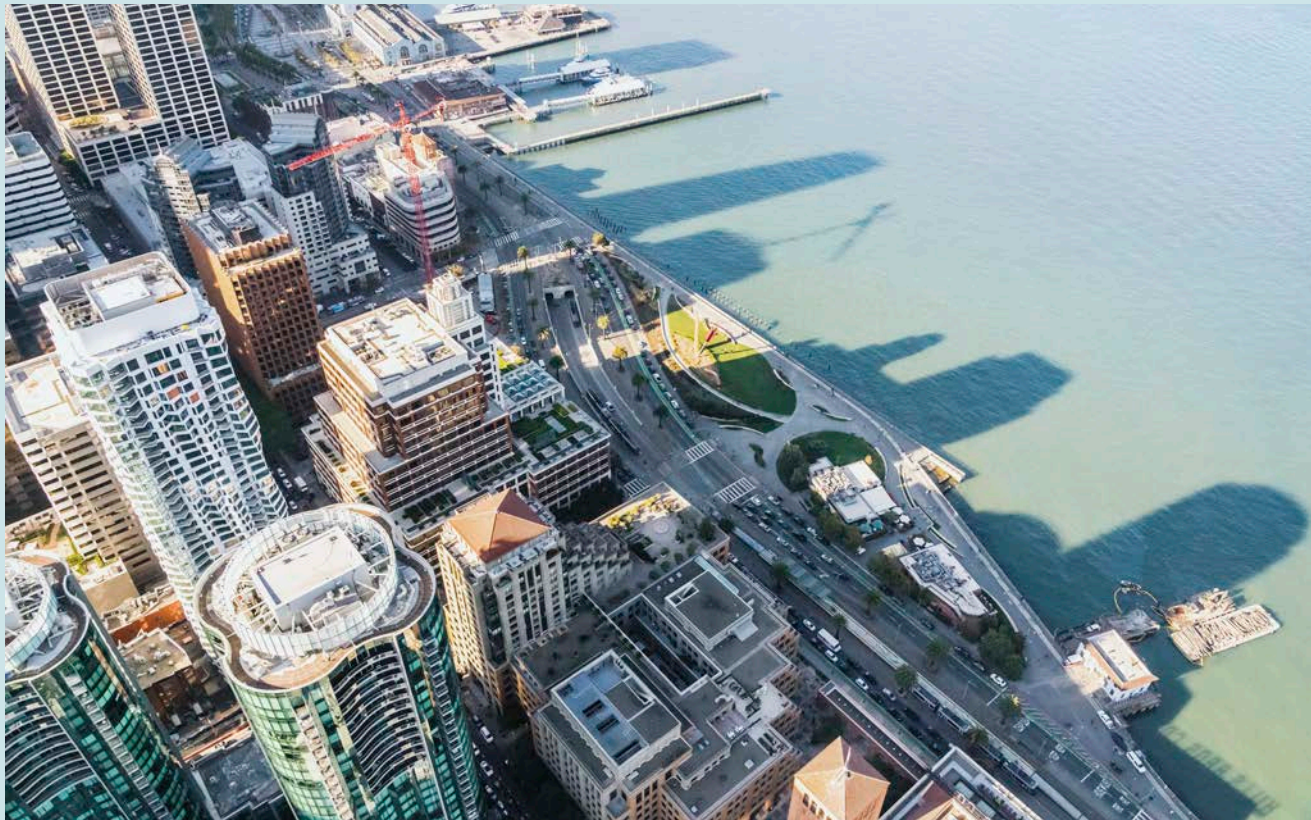
"Through the sculpting of landforms, ponds and expanded streams, East Oakland and Alameda communities can adapt to sea level rise and groundwater flooding and have a network of flourishing parks to enjoy for generations to come. We start by expanding and reshaping the existing MLK Shoreline Park and surrounding sloughs and creeks to provide fluvial flood and sea level rise protection. Arroyo Viejo Creek is rerouted to connect with Elmhurst Creek to provide additional flood capacity within Damon Slough. Each of the sloughs and flood control channels are widened and stepped to set the stage for habitat restoration and reduce flood risk."

— The Estuary Commons, All Bay Collective



PROJECT JUSTIFICATION: SUMMARY — WHY THIS PARTICULAR SITE ALONG THE EMBARCADERO SEAWALL?

1. Lowest point along the Embarcadero and therefore most susceptible to flood risks — the only location that currently falls below the 100-year flood protection standard.
2. Built over a natural cove, the land is almost exclusively bay fill and therefore extremely susceptible to seismic risks such as liquefaction and lateral spreading.
3. Aging infrastructure is in need of maintenance and replacement.
4. Central location and cultural significance to locals and tourists alike make it an ideal location for a landmark attraction that offers a reflection on climate change. The Port's public outreach confirmed that stakeholders love this area and recognize the concentration of transportation modes and the area's historic significance.
5. Existing park is popular, but small. Public outreach identified a desire for more green space, nature, and programmatic elements.
6. The site represents one of the most open sections of the 3-mile Embarcadero. The absence of piers or structures on the bayside of the seawall make it uniquely suited for a park, public space, and tidal habitat.



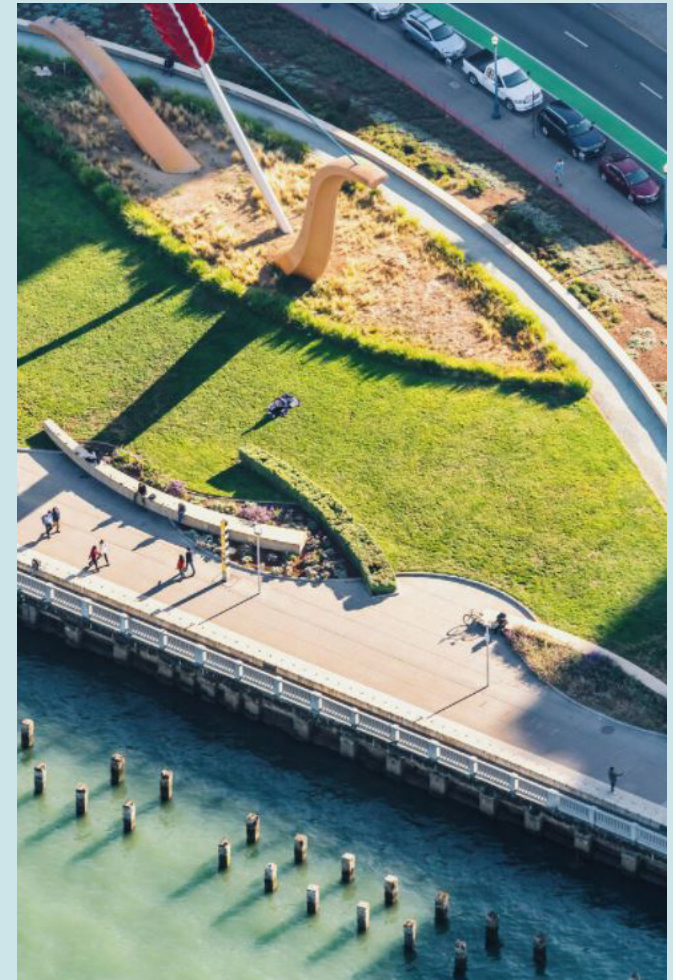
PROJECT PRECEDENT: RINCON PARK - INCLUDED WITHIN LIMIT OF WORK

OLIN LANDSCAPE ARCHITECTURE
SAN FRANCISCO, CA
2003

Conclusion: Integrate new and existing, altering the original park design as little as possible.
Design with the metaphor of waves lapping up on shore in mind.

Project Statement from Olin Website:

"This reclaimed brownfield on Oakland Bay was previously the site of freight railways, dirt pathways and warehouses. As part of the design considerations, OLIN developed on-site remediation strategies to isolate contaminated soils from non-contaminated soils. Today, the park features inviting expanses of lawn, canted and oriented to provide maximum views to the bay. The lawns are edged with a series of low seat walls, reminiscent of lapping waves on shore. Tucked into and between the seat walls are shrub and perennial plantings native to California and coastal areas. The plantings on the waterside edge of the park ebb and flow along the promenade. Atop a mounded landform sits Cupid's Span, a commissioned piece of large-scale sculpture designed by Claes Oldenburg and Coosje van Bruggen. OLIN worked with the artists to determine the placement of the piece. Given the multiple interpretations of the artwork—Cupid's bow and arrow, a ship, a part of the nearby bridge span, or a quill, among others—it was determined that the sculpture should sit like a ship, gently rolling off the crest of a wave."



PROJECT PRECEDENT: CHINA BASIN PARK

Conclusion: Located about a mile and a half south, this project is a close equivalent. The terraced tidal steps offer an immersive connection to the tidal edge.

SCAPE LANDSCAPE ARCHITECTURE
SAN FRANCISCO, CA
UNDER CONSTRUCTION

"China Basin Park... provides a new, future-ready intertidal landscape and beach. Tidal shelves are carved into the park and "give back" to nature while enhancing a biodiverse and shifting intertidal landscape."



"The softened park edge contrasts to the area's bulkheads and hard coastal infrastructure, bringing a more textured natural experience in reach of the city's growing population."

SCAPE LANDSCAPE ARCHITECTURE
SAN FRANCISCO, CA
UNDER CONSTRUCTION

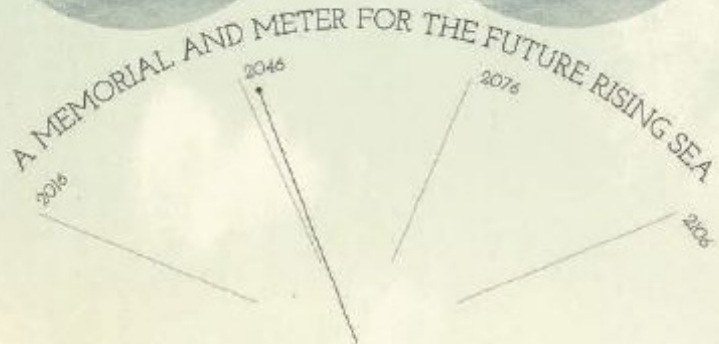
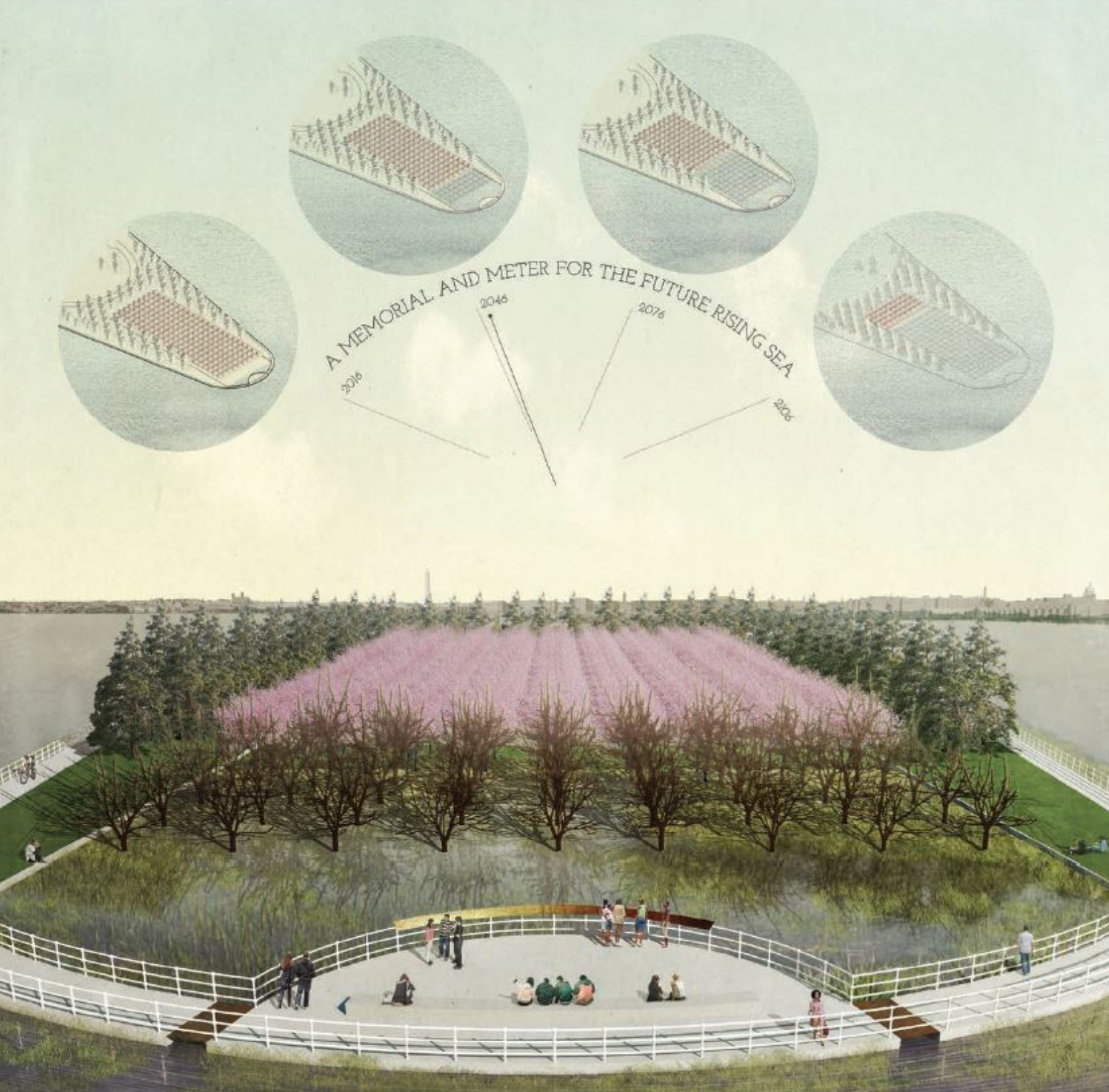


PROJECT PRECEDENT: CLIMATE CHRONOGRAPH

Conclusion: A project goal would be to create a similar heart-breakingly beautiful reflection on climate change, drawing attention to the temporal element.

"Small vertical changes in sea level are allowed to write a spatial record across a proposed tilted plane of land extending to the waterline. Cherry trees are planted in rows across the gradual slope. As waters rise, tides encroach on the land and the trees die in place, row by row, becoming bare-branched rampikes delineating shorelines past. With every fourth row of trees marking one foot of elevation, the composition becomes a processional tidal gauge—a record."

ERIK JENSEN, REBECCA SUNTER
WASHINGTON, DC
AWARD WINNING CONCEPT

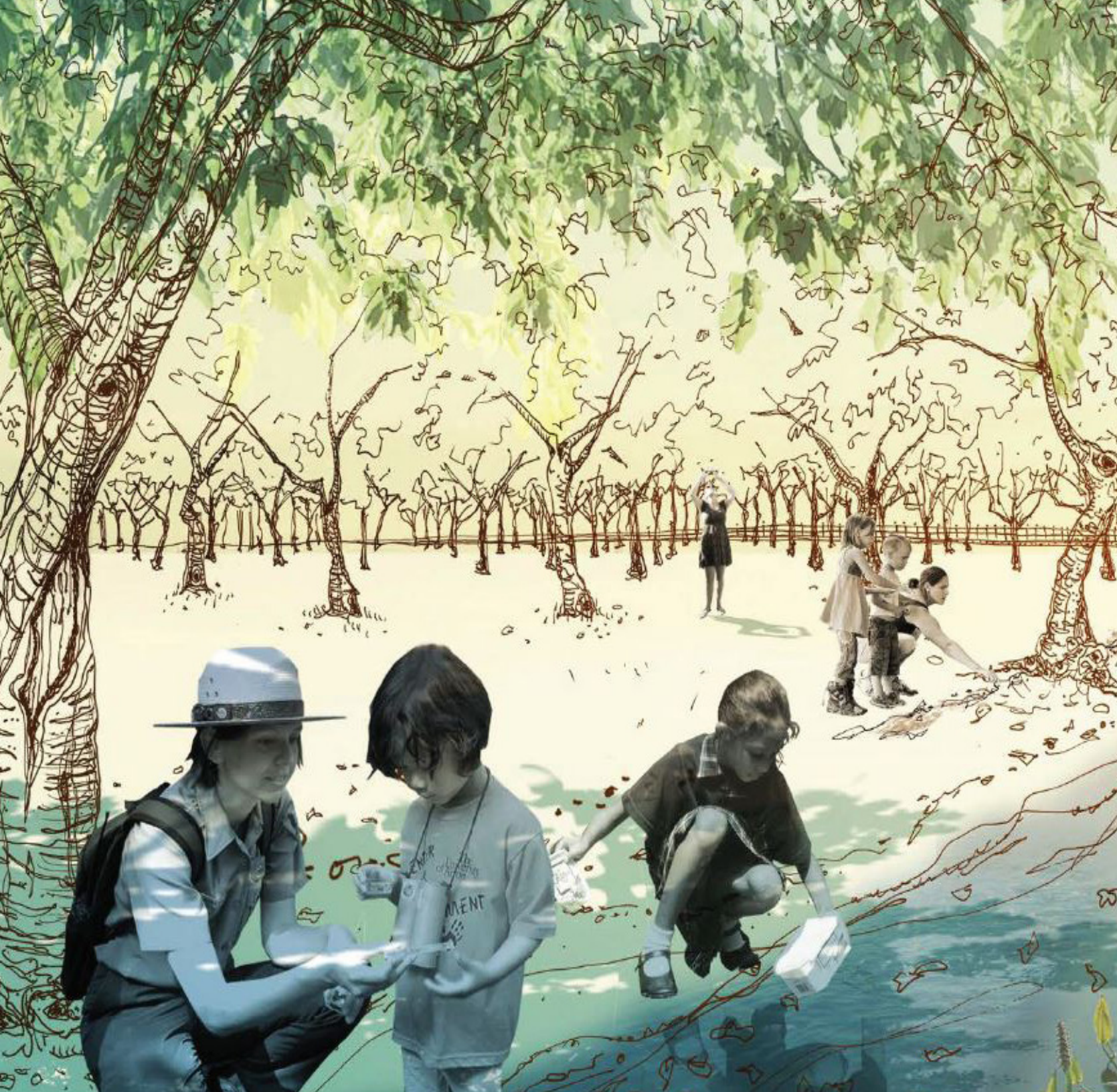


ERIK JENSEN, REBECCA SUNTER
WASHINGTON, DC
AWARD WINNING CONCEPT

"...the memorial's limited intervention and maintenance regime becomes a poignant yet apolitical datum for today's climate challenges and questions."



"Because communities that are poor, marginalized, and rural will suffer disproportionately from the dramatic climatic changes, the memorial becomes an important and visible reminder of the reality of sea level rise for those who are better able to insulate themselves from its disruptions."

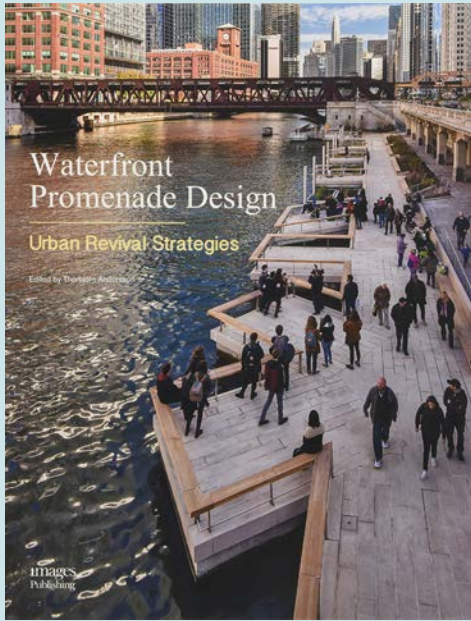


"The advancing water's edge becomes a fecund place for exploration, observation, and learning. The memorial's contained perimeter creates a sheltered cove for discovery and research of an emergent wetland ecosystem."

ERIK JENSEN, REBECCA SUNTER
WASHINGTON, DC
AWARD WINNING CONCEPT

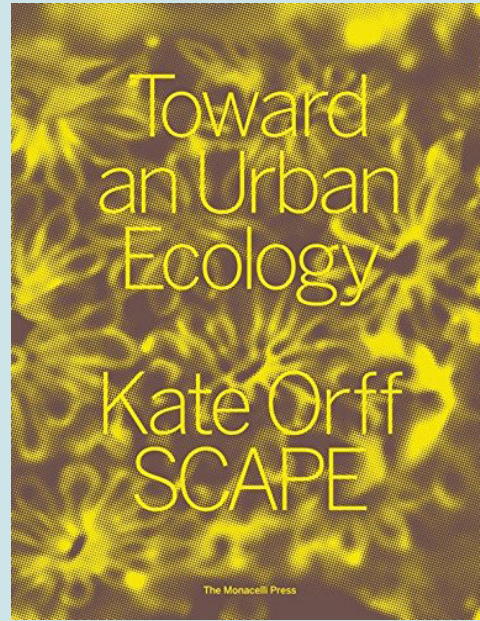
DESIGN METHODOLOGIES: LITERATURE

Conclusion: The following books offer guidance and justification for design decisions.



Relevant Takeaways:

- Promenade should generally be 30 ft wide
- Views of water should be maximized wherever popular
- Create multiple zones within the promenade with different uses
- Create a network of connected smaller outdoor areas that provide amenities for the immediate neighbourhoods while also providing space for regional events.
- Significant material change 6ft of water's edge
- 12 ft sidewalks, 5 ft minimum for bike lanes
- Good materials: stone, bronze, brass, concrete, hardwood
- Leave 25% of area as natural features which limit human engagement
- Increase habitat by more than 50%
- Use locally dredged materials from within 25 miles



Relevant Takeaways:

- Emphasis on science-based solutions
- Landscape design holds a particularly useful potential for forming coalitions
- Create visually intuitive maps that integrate previously separated silos of information
- Through immersive and participatory landscapes and experiences we can create new urban ecosystems that transcend the inherited tropes of “healing industrial land” or “brining nature back into the city.”
- Revive: Overlay natural and cultural systems toward a common purpose of generating eco-awareness. In contrast to “restoration,” revival is a creative, forward looking act, not driven by nostalgia for the past.
- Cohabit: Extend design thinking beyond our own species. Expand social justice and ecological connections.
- Engage: Ground-up community programs and processes
- Scale: Integration and scalability of methodologies



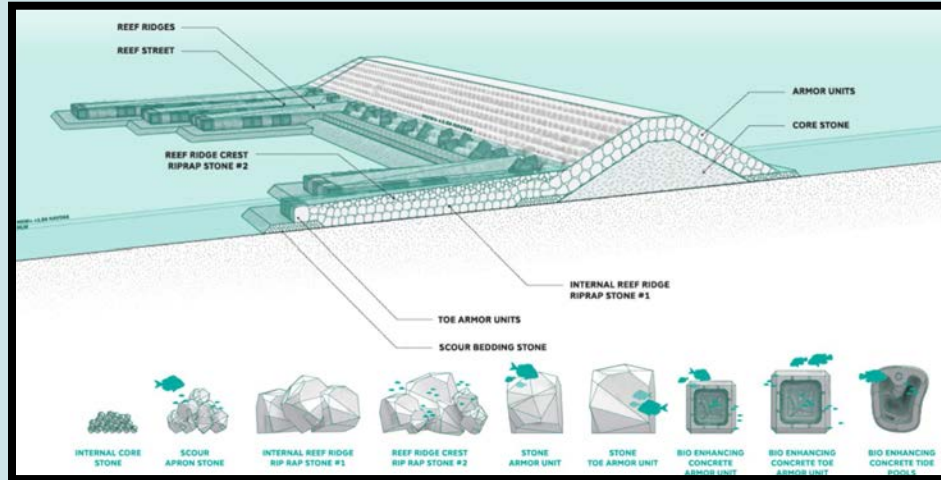
Relevant Takeaways:

- Path Shape: Make a bulge in the middle of a public path, and make the ends narrower, so that the path forms an enclosure which is a place to stay, not just a place to pass through.
- Paths and Goals: Paths go from goals to goals. The goals should never be more than a few hundred feet apart.
- Raised Walk: We conclude that any pedestrian path along a road carrying fast-moving cars should be about 18 inches above the road with a low wall or railing, or balustrade along the edge, to mark the edge. Put the raised walk on only one side of the road. Make it as wide as possible (at least 12 feet.)
- Holy Ground: In each community and neighbourhood, identify some sacred site as consecrated ground, and form a series of nested precincts, each marked by a gateway, each one progressively more private, and more sacred than the last, the innermost a final sanctum that can only be reached by passing through all of the outer ones. (Design idea: intermittently flooded areas, where the inner sanctum can only be reached at the lowest tide)

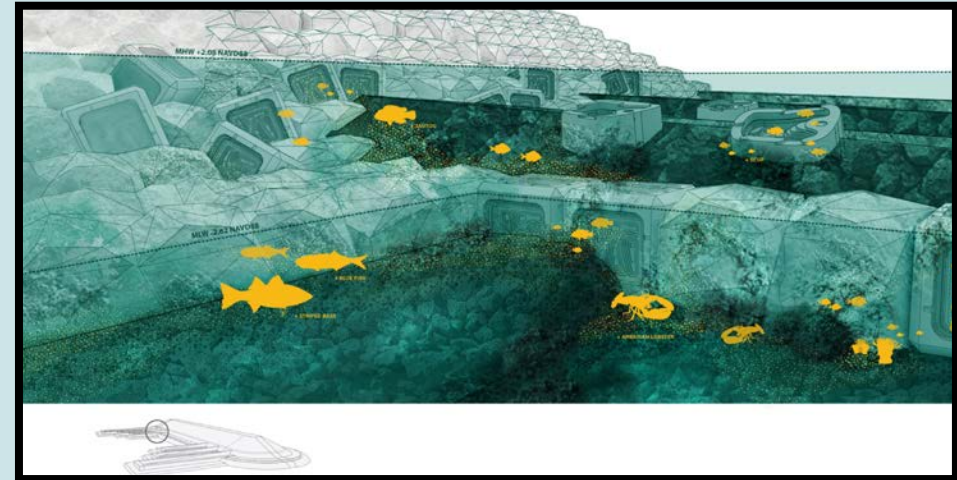
DESIGN METHODOLOGIES: ECOLOGICAL INFRASTRUCTURE

Conclusion: When possible, use infrastructure that regenerates local ecosystems.

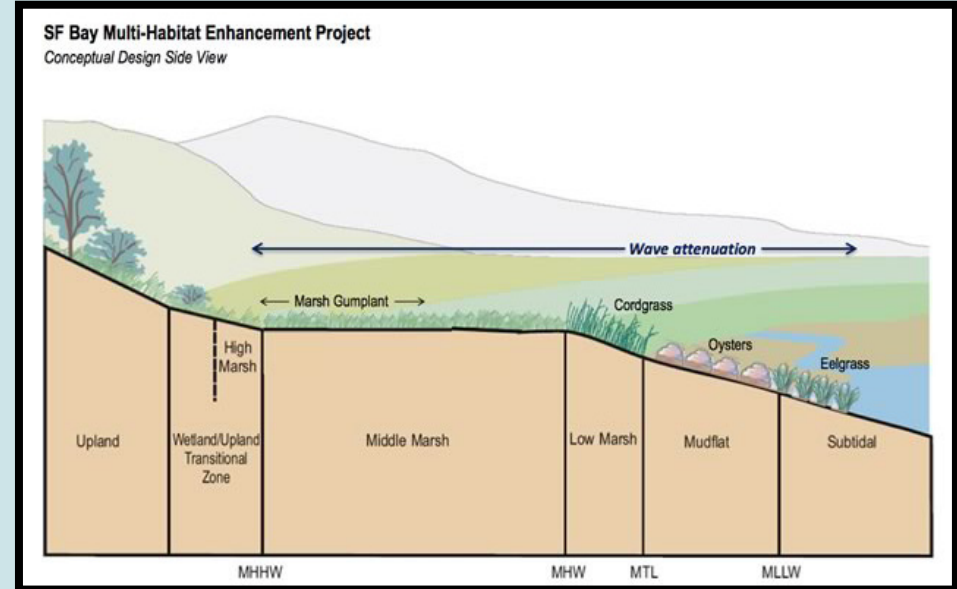
- This project will follow the conclusions of the Resilient by Design Bay Area Challenge and use Ecological Infrastructure when possible.
- Techniques pioneered by SCAPE Landscape Architecture in projects such as Living Breakwaters and Oyster-tecture are currently being tested in the San Francisco Bay as part of the Giant Marsh Living Shoreline trial.



Living Breakwaters, SCAPE
Staten Island, NY




Reef Structures Being Testing at the Giant Marsh Project
Richmond, CA



Section of a Vegetated Revetment by SF Bay Joint Venture

DESIGN METHODOLOGIES: SF PORT MEASURES EXPLORER

Conclusion: The SF Port Resilience Measures Database will be used to analyse site-appropriate infrastructure choices.



Search

Home Connect Program Overview Planning for Our Future Find Your Waterfront Resilience Library Media Port of SF Sign In | Register

Home > Planning for Our Future > Measures Explorer

Measures Explorer

Welcome to the Measures Explorer! Through its Waterfront Resilience Program, the Port has been studying urgent seismic and flood risks along the Port's 7.5 mile jurisdiction. In assessing and analyzing how vulnerable our waterfront is to these hazards, the Port has also begun to identify "measures," or specific strategies for adapting San Francisco's waterfront in the face of earthquakes, flooding, and future sea level rise.

Measures are the basic building blocks of a comprehensive approach to protecting the waterfront now and in the future. The Port's goal is to identify the measures that are most appropriate to protect the many different conditions along the waterfront in ways that reflect city and community priorities, combining seismic and flood risk improvements wherever it's feasible and cost-effective. Ultimately, measures will be selected and refined to build project options for selection for Proposition A bond funding.

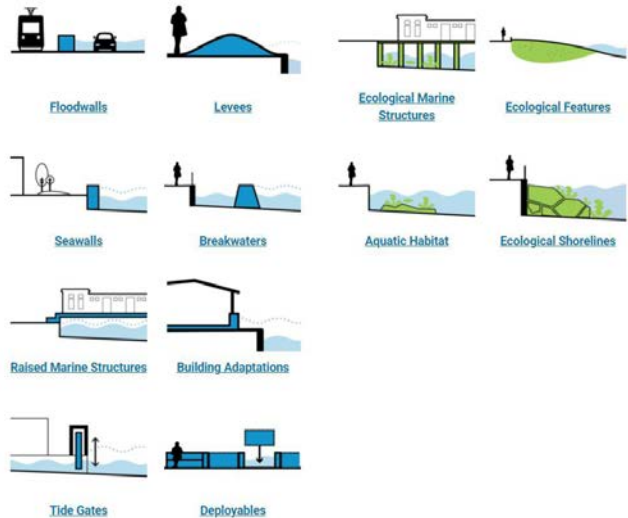
Click on the images from the Measures Explorer grid below to learn more about each specific adaptation strategy.

For a broader view of earthquake and flooding risks along the waterfront, visit the [Waterfront Resilience Story Maps](#).

For more background information, visit the [Seismic and Flood Risk 101](#) page.

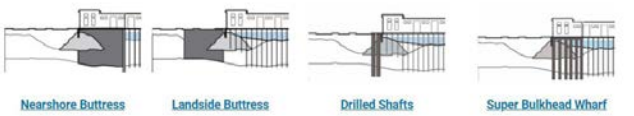
FLOOD MEASURES:

Physical Infrastructure Ecological Infrastructure



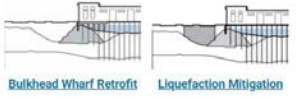
SEISMIC MEASURES:

Shoreline Stabilization



Nearshore Buttress Landside Buttress Drilled Shafts Super Bulkhead Wharf

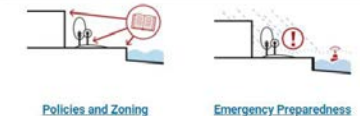
Targeted Measures



Bulkhead Wharf Retrofit Liquefaction Mitigation

FLOOD AND SEISMIC MEASURES:

Policy and Emergency Preparedness




Policies and Zoning Emergency Preparedness

Download Measures Explorer Docs

How to Read the Measures Explorer

Waterfront Resilience Story Maps



Find out more about earthquake and flood risk with the [Waterfront Resilience Story Maps](#)

FAQs: Get to Know Key Terms

- Ecological Infrastructure Measures
- Measures
- Measures Compatibility
- Physical Infrastructure Measures
- Policy & Emergency Preparedness Measures
- Shoreline Stabilization
- Targeted Measures
- more...

SURVEY

It's Your Turn: Share Feedback on the Measures Explorer

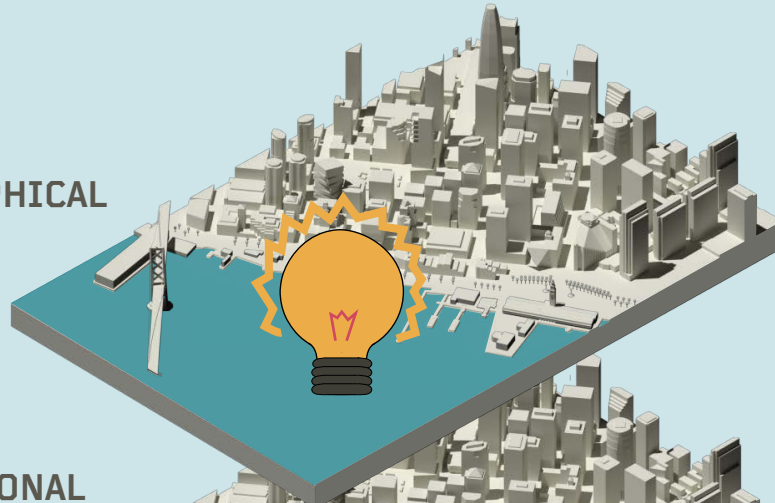
Thank you for learning about ways to strengthen the waterfront through the Measures Explorer! What questions do you have for us about measures? Would you like to see these implemented along San Francisco's waterfront as a solution to flooding as a result of sea level rise? If so, where? Do you have any concerns about it as a potential solution along San Francisco's waterfront? The Port wants to hear from you!

[Share Feedback](#)

PROJECT GOALS IN FOUR LAYERS

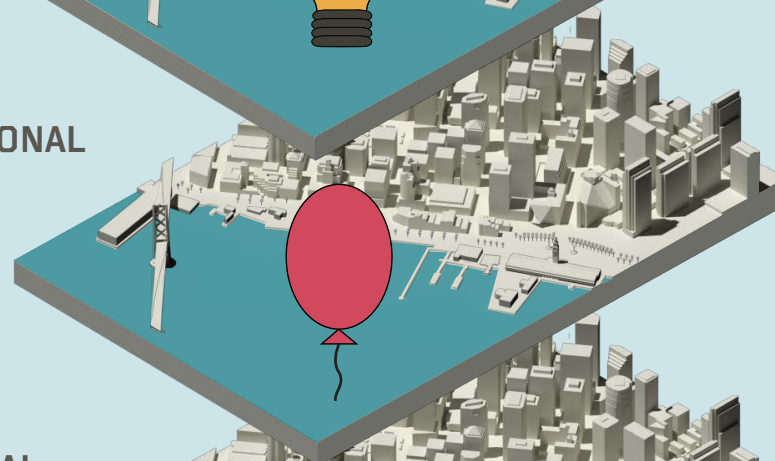
This design will be considered successful only if it meets the goals of all four levels. These layers will be used as a framing device for this book moving forward.

LAYER 4: THE PHILOSOPHICAL



GOAL: STIR...
emotions and offer a moment of reflection on the climate crisis

LAYER 3: THE RECREATIONAL



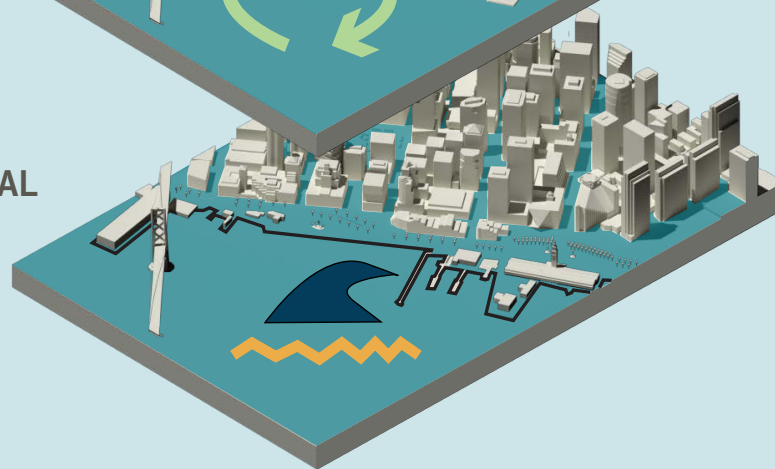
GOAL: ATTRACT...
users to a landmark waterfront park that serves the needs of the community and meets the SF Port's strategic economic and equity goals

LAYER 2: THE ECOLOGICAL



GOAL: REGENERATE...
local and historical ecosystems that sequester carbon, using natural infrastructure when possible

LAYER 1: THE FUNCTIONAL



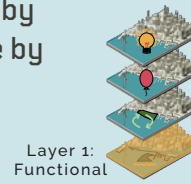
GOAL: PROTECT...
against sea level rise and seismic risks

LAYER 1 ANALYSIS: FLOODING & SEA LEVEL RISE

Conclusion: To protect from the high end scenario of 66 inches of sea level rise by the end of the century, we need to raise the elevation of the lowest point on site by 90 inches [7.5 feet].

- This is calculated by taking the 66 inches of projected sea level rise and adding an extra 24 inches due to tidal surges during a 100-year flood event.

LAYER KEY MAP



LEGEND

- FIRST OVER-TOPPING
- FLOODING / BAY WATER
- SHORELINE

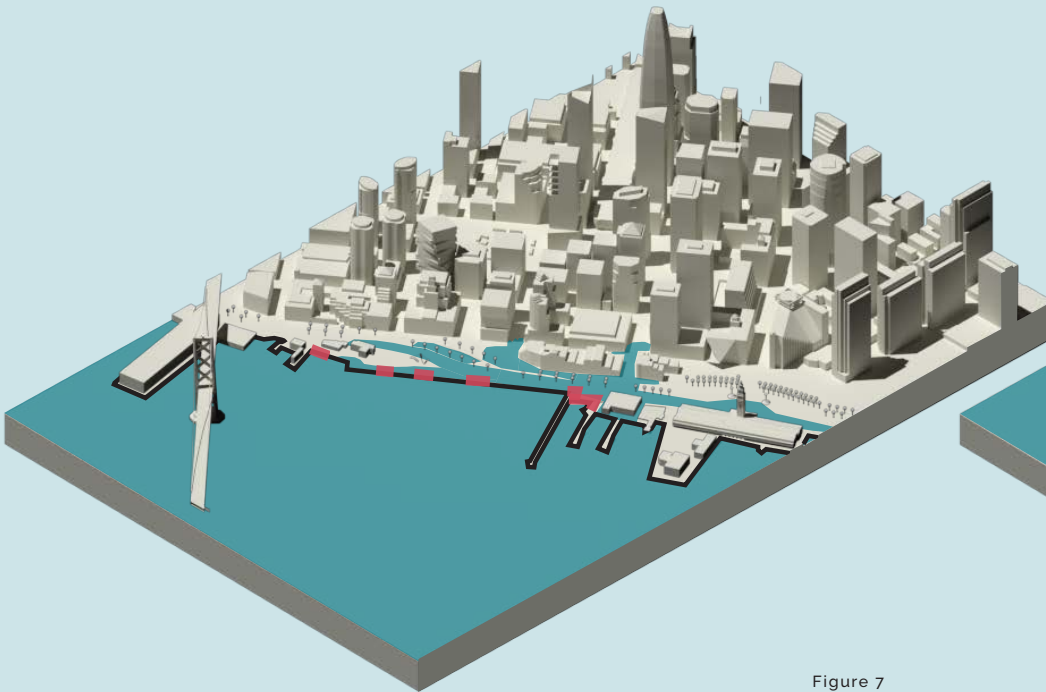


Figure 7

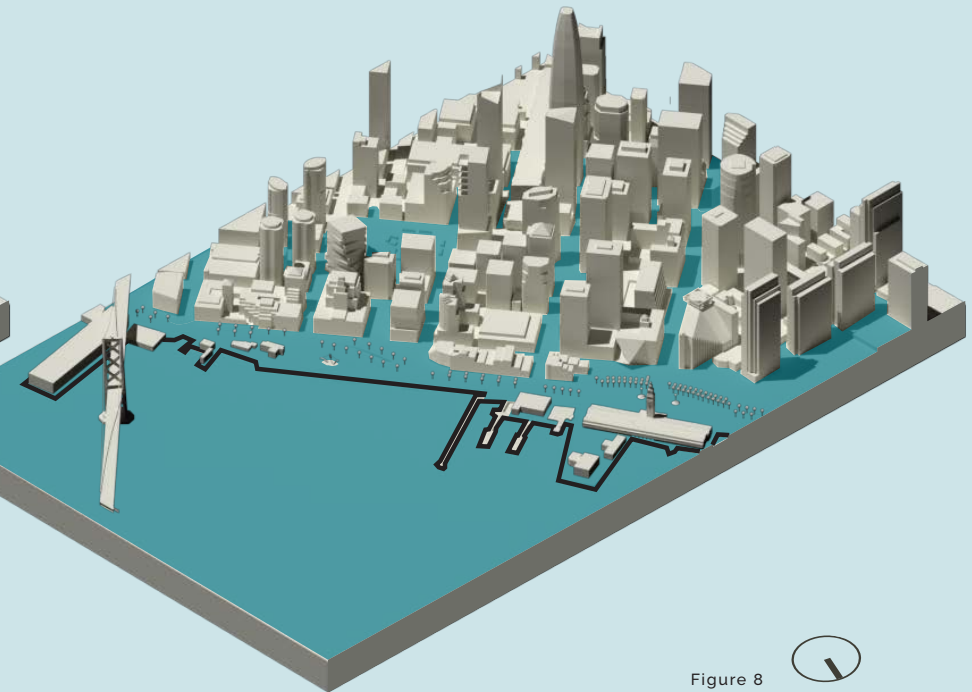


Figure 8



FIRST OVER-TOPPING & TIPPING POINT

PRESENT SITUATION

- The red lines indicate where over-topping currently occurs during a 50-year flood event

WITH 7 INCHES OF SEA LEVEL RISE

- The blue shows the flooding that occurs at the critical tipping point 7 inches of sea level rise combined with a 100-year coastal flood event (or 48 inches of sea level rise without a flood event)

HIGH-END SEA LEVEL RISE PROJECTIONS

BY THE END OF THE CENTURY

- This model projects the risk of a 100-year flood event after 66 inches of sea level rise — a reality by the end of the century. Along the seawall, the 100-year extreme tide is approximately 2 feet higher than a more frequent event expected to occur every year.

LAYER 1 ANALYSIS: SEISMIC RISK

Conclusion: Both liquefaction and lateral spreading are severe risks on site that need to be addressed as soon as possible.

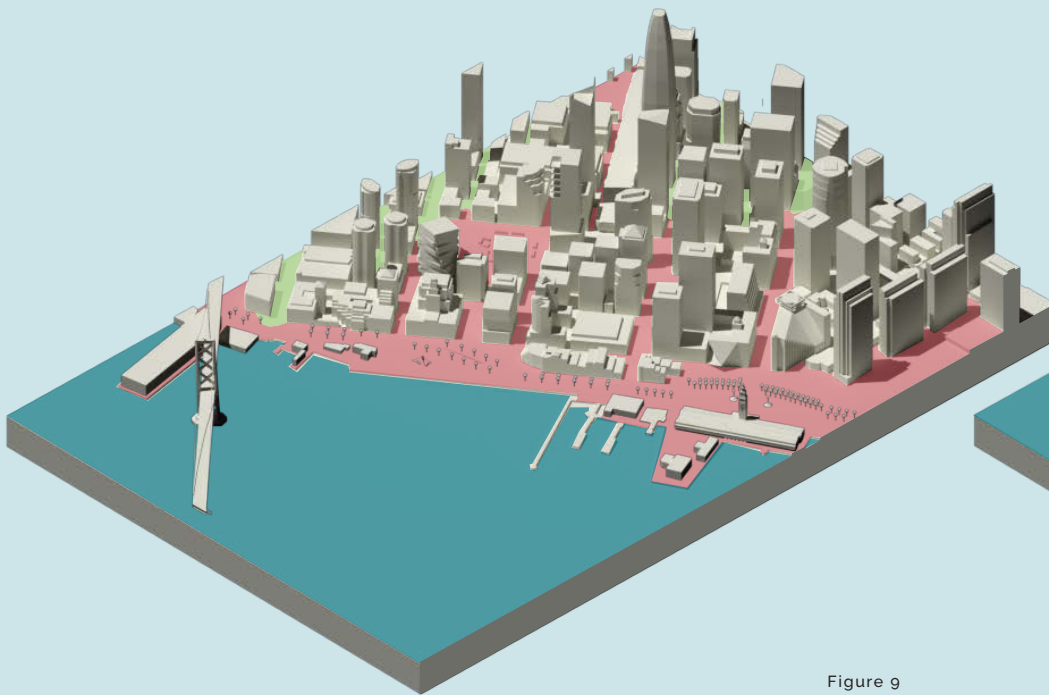
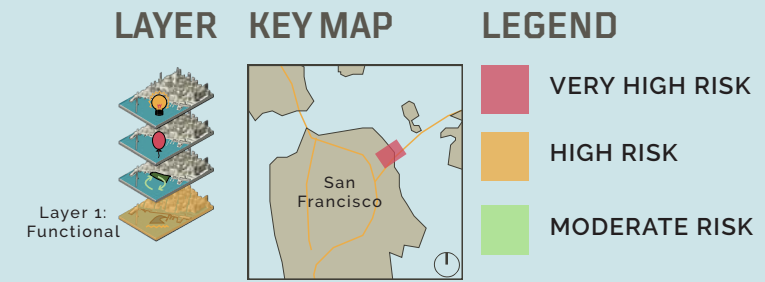


Figure 9

LIQUEFACTION

- The site and surrounding land were created with Bay fill when the Embarcadero Seawall was built in the early 1900s.
- Rincon Park and most of the surrounding buildings are resting on what was previously Yerba Buena Cove
- The green spit of “moderate risk” land near where the Bay Bride connects to the city is the original Rincon Point

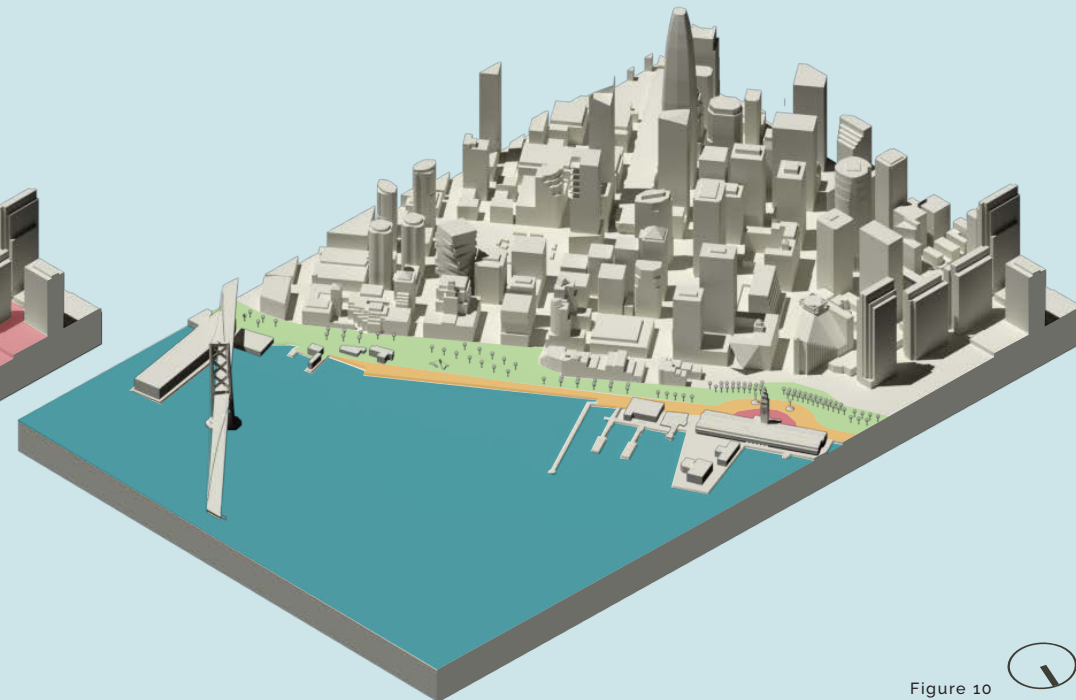


Figure 10



LATERAL SPREADING

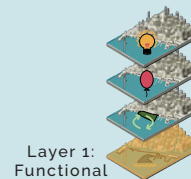
- This section of the seawall is expected to experience the largest lateral spreading of the whole three-mile Embarcadero
- Land could slide two feet into the Bay
- This is due to a slippery layer of Young Bay Mud 250 below the seawall and roadway

LAYER 1 ANALYSIS: SHORELINE TOPOGRAPHY

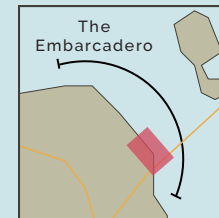
Conclusion: The lowest point along the Embarcadero needs to be raised 7.5 ft to an elevation of 15.9 ft. The top of the hill in Rincon Park reaches 16.3 ft. It might be possible to build a similar earthen levee to protect the low point.

LAYER KEY MAP

LEGEND



Layer 1: Functional



10' 1' CONTOURS

OPPORTUNITIES

CONSTRAINTS

- ① Use existing hill as part of flood protection infrastructure
 - ② Create a hill/levee similar to Rincon park to protect the low point. Expand into the bay. "The final fill."
 - ③ Create raised feature with removable floodgate to bridge the gap between the two hills
- ① Lowest point along Embarcadero is a priority
 - ② Need unimpeded access for Ferry

PROCESS NOTE: USE OF THE ORIGINAL HILL FOR FLOOD PROTECTION WITH DEPLOYABLE FEATURES ON EITHER SIDE WAS EVENTUALLY DEEMED TO BE TOO UNRELIABLE AND THE DESIGN WAS CHANGED TO ONE CONTINUOUS LEVEL.

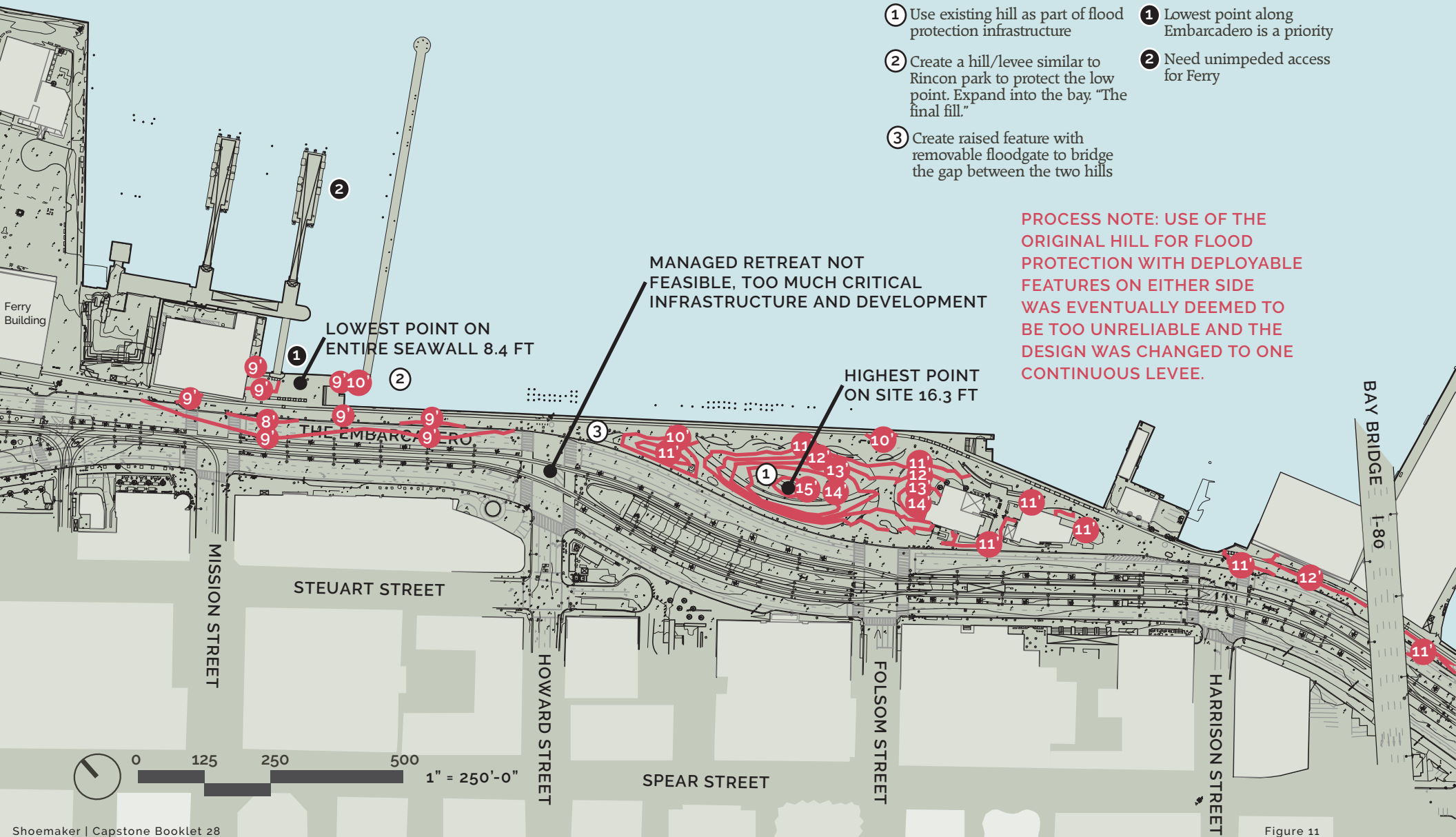
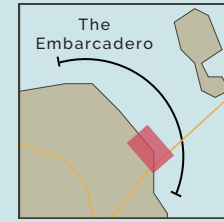


Figure 11

LAYER 1 ANALYSIS: WIND, CURRENTS, AND WAVE ENERGY

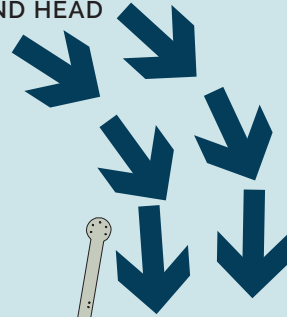
Conclusion: Despite prevailing winds being offshore, wave action can increase inundation levels and should be mitigated where possible.

LAYER KEY MAP LEGEND



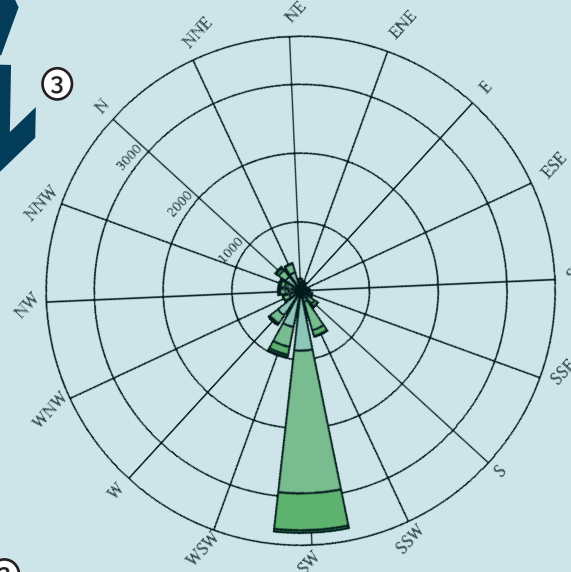
- WIND DIRECTION
- CURRENT DIRECTION

PREVAILING CURRENTS BEGIN TO EDDY AND HEAD TOWARD SHORE



PREVAILING WINDS TO THE W / SW

- 0
- >0
- >3
- >7
- >12
- >17
- >24
- >31
- >38 mph



OPPORTUNITIES

- In-water wave breaks to dissipate wave energy
- Revived tidal ecosystems can also help dissipate wave energy.
- Currents and wind not as strong as other locations along the Embarcadero waterfront — especially the far Northern portion.

CONSTRAINTS

- Keep waterways clear for boats — especially fire boats
- Exposed seawall

EXPOSED SEAWALL LEADS TO MORE WAVE ENERGY THAN REST OF EMBARCADERO — ESPECIALLY DURING STORMS.

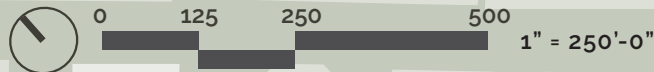
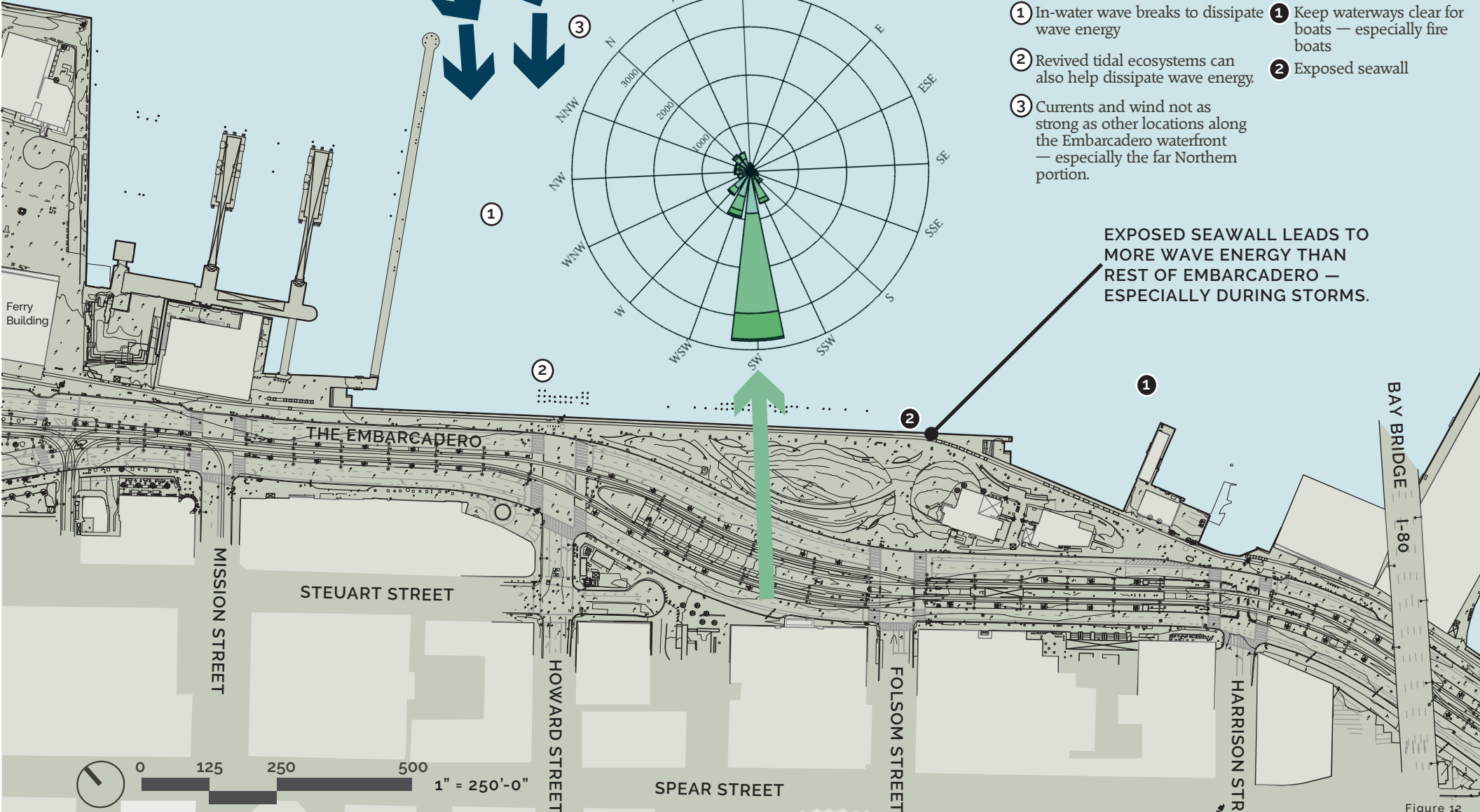


Figure 12

LAYER 1 & 2 ANALYSIS: SEA LEVEL RISE AND WAVE ATTENUATION MEASURES

Conclusion: For sea level rise protection, use a bayward earthen levee with a vegetated terrace.

For habitat regeneration and wave attenuation, use a combination of oyster reefs and intertidal wetlands.

- This follows the previous conclusion of using ecological infrastructure when possible.
- Filling in a portion of the bay will result in lengthy permitting, but the complexity is worth it to revive local ecosystems with a more natural shoreline.
- The choice for more expensive, more permanent solutions take inspiration from Community Meeting #6 feedback: "Do it once, do it right."
- Original concepts used the existing hill as flood protection and utilized deployable floodgates. After consultations with CMG Landscape Architecture, both measures were deemed unreliable or infeasible and the concept was changed to one continuous levee.

LEGEND

 CHOSEN MEASURES

LAYER



NEW SEAWALL BAYWARD



SUITABILITY FOR SITE	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
COST	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
LIFESPAN	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
ECOLOGICAL BENEFITS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

NEW SEAWALL IN-PLACE



SUITABILITY FOR SITE	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
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LIFESPAN	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
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RIP-RAP REVETMENT



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3 EARTHEN LEVEE



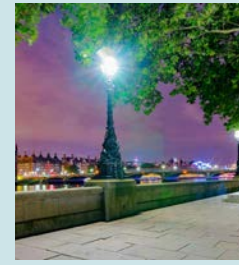
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ECOLOGICAL BENEFITS	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

RAISED ROADWAY LEVEL



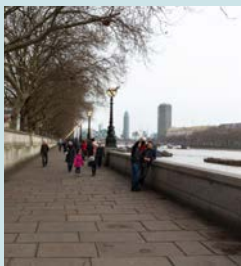
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LIFESPAN	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
ECOLOGICAL BENEFITS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

RAISED PATHWAY LEVEL



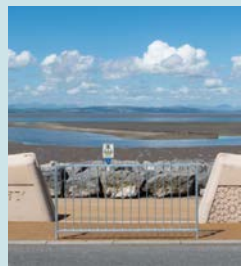
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BARRIER RAILING



SUITABILITY FOR SITE	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
COST	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
LIFESPAN	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
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RAISED FEATURES



SUITABILITY FOR SITE	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
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LIFESPAN	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
ECOLOGICAL BENEFITS	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

ELEVATED WHARF



SUITABILITY FOR SITE	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
COST	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
LIFESPAN	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
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ELEVATED PIER



SUITABILITY FOR SITE	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
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LIFESPAN	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
ECOLOGICAL BENEFITS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

STEPPED SLOPES



SUITABILITY FOR SITE	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
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LIFESPAN	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
ECOLOGICAL BENEFITS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4 VEGETATED TERRACE



SUITABILITY FOR SITE	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
COST	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
LIFESPAN	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
ECOLOGICAL BENEFITS	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

LOW MED HIGH

- SUITABILITY FOR SITE: an amalgam of aesthetic and site-specific considerations
- COST: considers construction impact as well as monetary cost
- LIFESPAN: from a couple decades to over a century
- ECOLOGICAL BENEFITS: potential for ecosystem regeneration

LEGEND

CHOSEN MEASURES

LAYER



VEGETATED CRIB WALL



- SUITABILITY FOR SITE
- COST
- LIFESPAN
- ECOLOGICAL BENEFITS

VEGETATED REVETMENT



- SUITABILITY FOR SITE
- COST
- LIFESPAN
- ECOLOGICAL BENEFITS

4 NATURAL FIBER BLANKETS



- SUITABILITY FOR SITE
- COST
- LIFESPAN
- ECOLOGICAL BENEFITS

GABION BASKETS



- SUITABILITY FOR SITE
- COST
- LIFESPAN
- ECOLOGICAL BENEFITS

ECOLOGICAL CONCRETE



- SUITABILITY FOR SITE
- COST
- LIFESPAN
- ECOLOGICAL BENEFITS

BEACHES



- SUITABILITY FOR SITE
- COST
- LIFESPAN
- ECOLOGICAL BENEFITS

WAVE BARRIER



- SUITABILITY FOR SITE
- COST
- LIFESPAN
- ECOLOGICAL BENEFITS

ARTIFICIAL REEF



- SUITABILITY FOR SITE
- COST
- LIFESPAN
- ECOLOGICAL BENEFITS

5 NEARSHORE REEFS



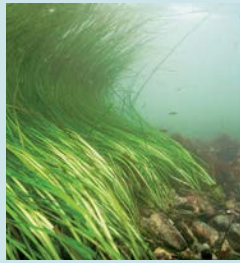
- SUITABILITY FOR SITE
- COST
- LIFESPAN
- ECOLOGICAL BENEFITS

FLOATING WETLANDS



- SUITABILITY FOR SITE
- COST
- LIFESPAN
- ECOLOGICAL BENEFITS

4 EELGRASS RESTORATION



- SUITABILITY FOR SITE
- COST
- LIFESPAN
- ECOLOGICAL BENEFITS

6 TIDE POOL UNITS



- SUITABILITY FOR SITE
- COST
- LIFESPAN
- ECOLOGICAL BENEFITS

LAYER 1 & 2 ANALYSIS: SEISMIC MEASURES

Conclusion: Utilize a combination of a nearshore buttress and liquefaction mitigation.

- The nearshore buttress can create a foundation for sea level rise protection measures such as an earthen levee with vegetated terrace.
- Waterside construction allows for minimal impact to existing promenade.
- Neashore buttress protects from lateral spreading risks, but not liquefaction. Therefore, it must be used in combination with onshore liquefaction mitigation and strengthening of in situ soils.

LEGEND

 CHOSEN MEASURES

LAYER



DRILLED SHAFTS



SUITABILITY FOR SITE	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
COST	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
LIFESPAN	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
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BULKHEAD WHARF RETROFIT



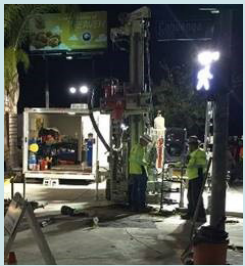
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COST	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
LIFESPAN	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
ECOLOGICAL BENEFITS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

SUPER BULKHEAD WHARF



SUITABILITY FOR SITE	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
COST	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
LIFESPAN	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
ECOLOGICAL BENEFITS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

1 LIQUEFACTION MITIGATION



SUITABILITY FOR SITE	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
COST	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
LIFESPAN	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
ECOLOGICAL BENEFITS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

1 NEARSHORE BUTTRESS



SUITABILITY FOR SITE	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
COST	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
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LANDSIDE BUTTRESS

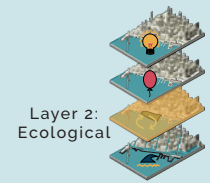


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LIFESPAN	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
ECOLOGICAL BENEFITS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

LAYER 2 ANALYSIS: KEY SPECIES

Conclusion: Reintroducing key foundational species will regenerate the bay ecosystem from the ground up.

LAYER



EELGRASS (*ZOSTERA MARINA*)

- Subtidal (almost always submerged)
- Acts as a foundation species for a complex food web
- Example: eelgrass feeds the Pacific herring (*Clupea pallasii*), which in turn feeds a variety of bird species including Brant geese (*Branta bernicla*) and Surf Scoters (*Melanitta perspicillata*).



OLYMPIA OYSTER (*OSTREA LURIDA*)

- Intertidal Mudflats (partially submerged)
- Once abundant native species now mostly absent
- Projects such as the Giant Marsh Project are reintroducing the species
- Can be used in nearshore reefs to dampen wave energy
- Filters water



PACIFIC CORDGRASS (*SPARTINA FOLIOSA*)

- Intertidal Low Marsh (partially submerged)
- Currently being out-competed by non-native *Spartina* species hybrids
- Preferred habitat of the threatened Ridgway's Rail



ROCKWEED (*FUCUS DISTICHUS*)

- Rocky Intertidal Mid Marsh (partially submerged)
- Provide food and shelter to a number of other organisms
- Populations have been heavily impacted by oil spills



MARSH GUMPLANT (*GRINDELIA STRICTA*)

- Intertidal Mid Marsh (partially submerged)
- Variant *augustifolia* threatened by loss of habitat
- Provides food and habitat to animals such as the Ridgway's Rail and froghoppers



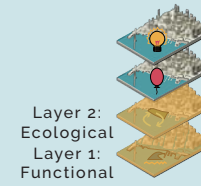
CALIFORNIA SEABLITE (*SUAEDA CALIFORNICA*)

- Intertidal High Marsh (submerged only at high tide)
- Federally protected endangered species
- Symbiotic nutrient relationship with eelgrass being studied by SF State University

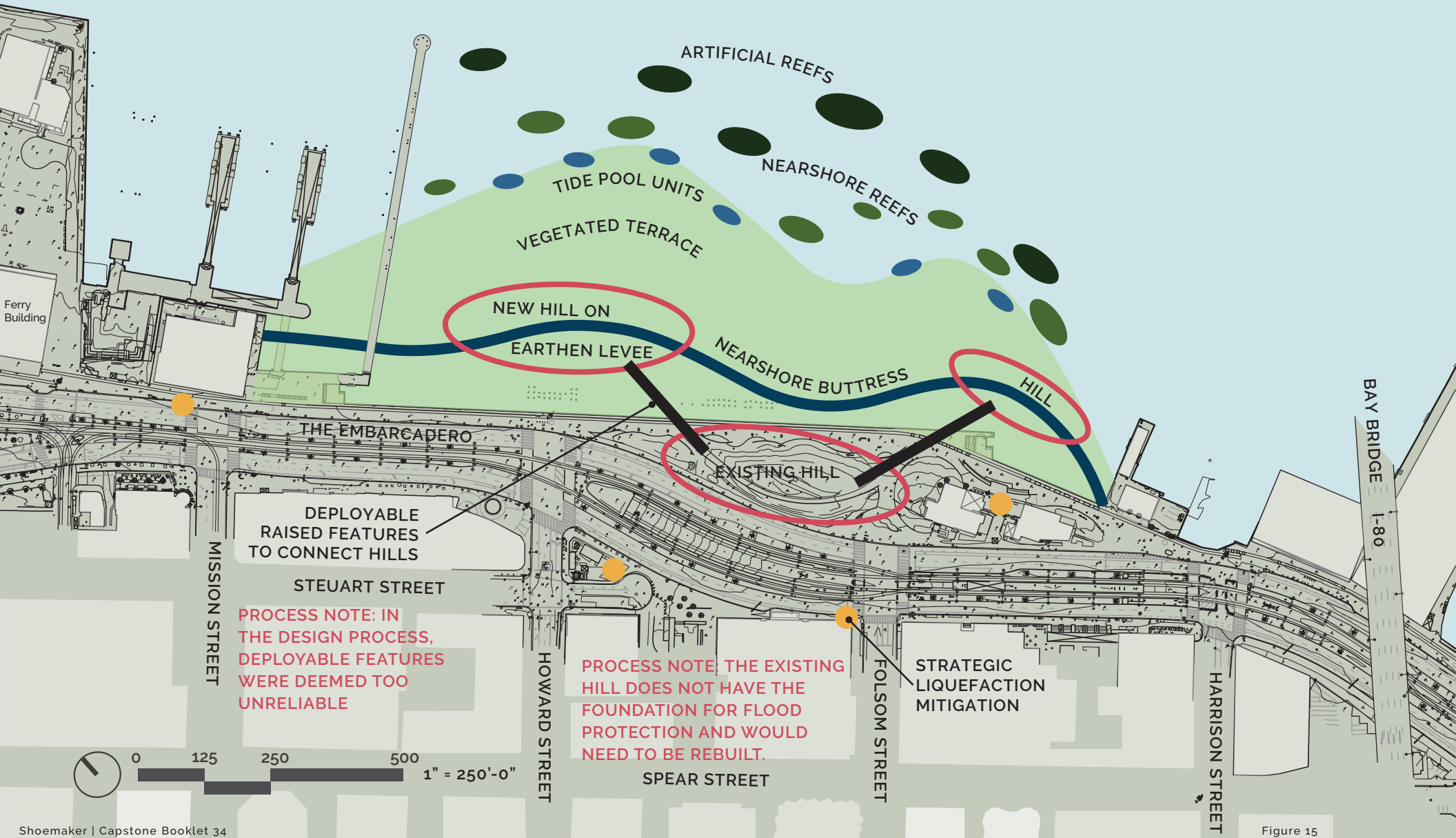
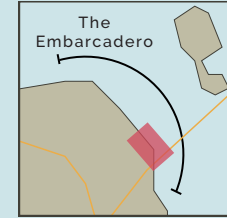
LAYER 1 & 2 ELEMENTS: CONCEPT BUBBLES

Conclusion: A series of hills connected by deployable raised features, built on top of a nearshore buttness and earthen levee. The bayward side becomes a vegetated terrace leading down to tide pool ecosystems and reefs for wave attenuation.

LAYER KEY MAP



Layer 2:
Ecological
Layer 1:
Functional



DEPLOYABLE RAISED FEATURES TO CONNECT HILLS

PROCESS NOTE: IN THE DESIGN PROCESS, DEPLOYABLE FEATURES WERE DEEMED TOO UNRELIABLE

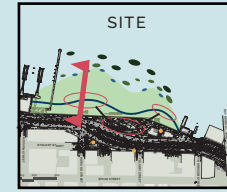
PROCESS NOTE: THE EXISTING HILL DOES NOT HAVE THE FOUNDATION FOR FLOOD PROTECTION AND WOULD NEED TO BE REBUILT.

STRATEGIC LIQUEFACTION MITIGATION

LAYER 1 & 2 ELEMENTS: GENERALIZED SECTION

Conclusion: An earthen levee built on top of the foundation of a nearshore buttress.

KEY MAP



LAYER

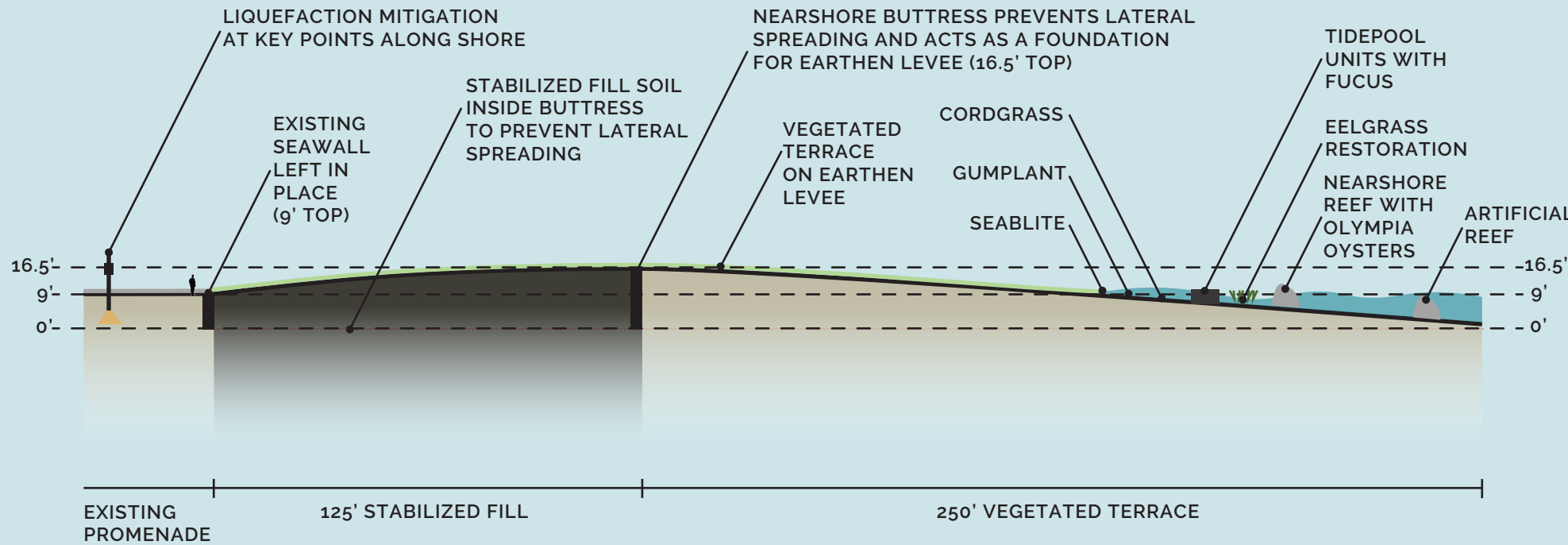
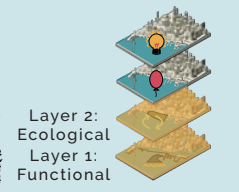


Figure 16

LAYER 3 ANALYSIS: USERS AND COMMUNITY MEETINGS

Conclusion: Focus on family-friendly activities, exercise, and passive recreation.

LAYER



Layer 3:
Recreational



COMMUNITY MEETINGS

As part of the Embarcadero Seawall program, SF Port held more than six community meetings with local residents.

Here are some key takeaways specific to the ferry building region:

- Enhance and expand open space, parks, and family friendly activities
 - A desire to preserve and enhance jobs and diversity of jobs along the Embarcadero
 - The Promenade is viewed as a critical asset and there is a strong desire to preserve and enhance it
 - Preserve and enhance access to the Bay and Bay ecology
 - Improve walkability and bike paths
- "nature in the city..."*

PRIMARY USERS

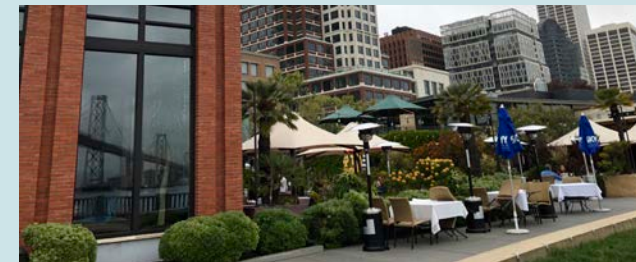
The site attracts an incredibly wide array of users, from commuters to local residents to tourists.

A certain emphasis will be placed upon:

- Exercise and recreation: bikers, runners, roller bladers, etc
- Family friendly opportunities open for everyone, from local residents to visitors
- Diverse microentrepreneur opportunities, such as street vendors or food carts
- Educational activities in new wetlands
- Outdoor gathering space: possibly for small concerts, school groups, or protests

The site is not particularly suitable for:

- Organized sports
- Community services for unhoused
- A large playground



LAYER 3 ANALYSIS: CIRCULATION AND CURRENT RECREATION

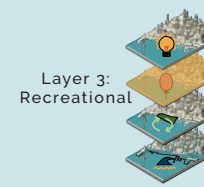
Conclusion: Expand multi-use green space and widen promenade at select points.

Tourists: 25.8 million visitors to SF 2018, with the Ferry Building and Embarcadero listed as Top 4 destinations

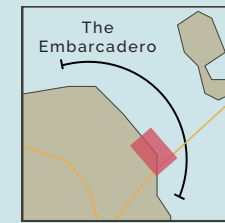
Commuters: Pre-pandemic the city would swell by over 247,000 people during work hours, most going to the adjacent downtown financial district

Locals: It is estimated around 48,000 people live within a 1-mile radius of the site

LAYER



KEY MAP



LEGEND

- PART OF 500 MILE BAY TRAIL
- PEDESTRIAN CIRCULATION
- BIKE LANES
- VIEWS

OPPORTUNITIES

- 1 Expand multi-use green space
- 2 Add observation deck to highlight views, one that is closer to the restaurants
- 3 Expand promenade in this area, perhaps adding a bike lane as bikes like to ride along the water
- 4 Enhance outdoor dining experience

CONSTRAINTS

- 1 Maintain integrity of existing park
- 2 Retain firehouse access
- 3 Promenade narrows and bikes, runners, and walkers are sometimes too close

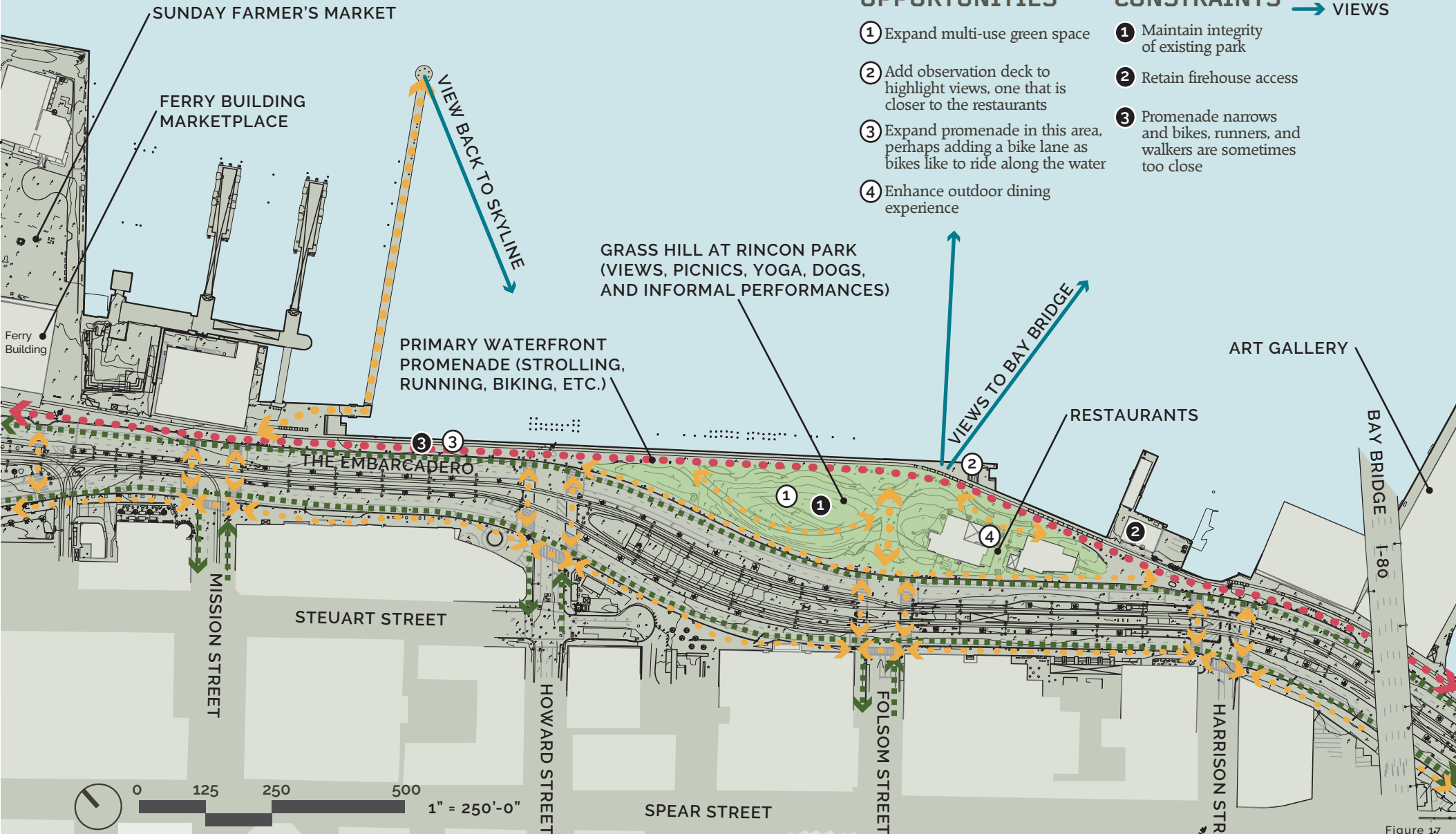
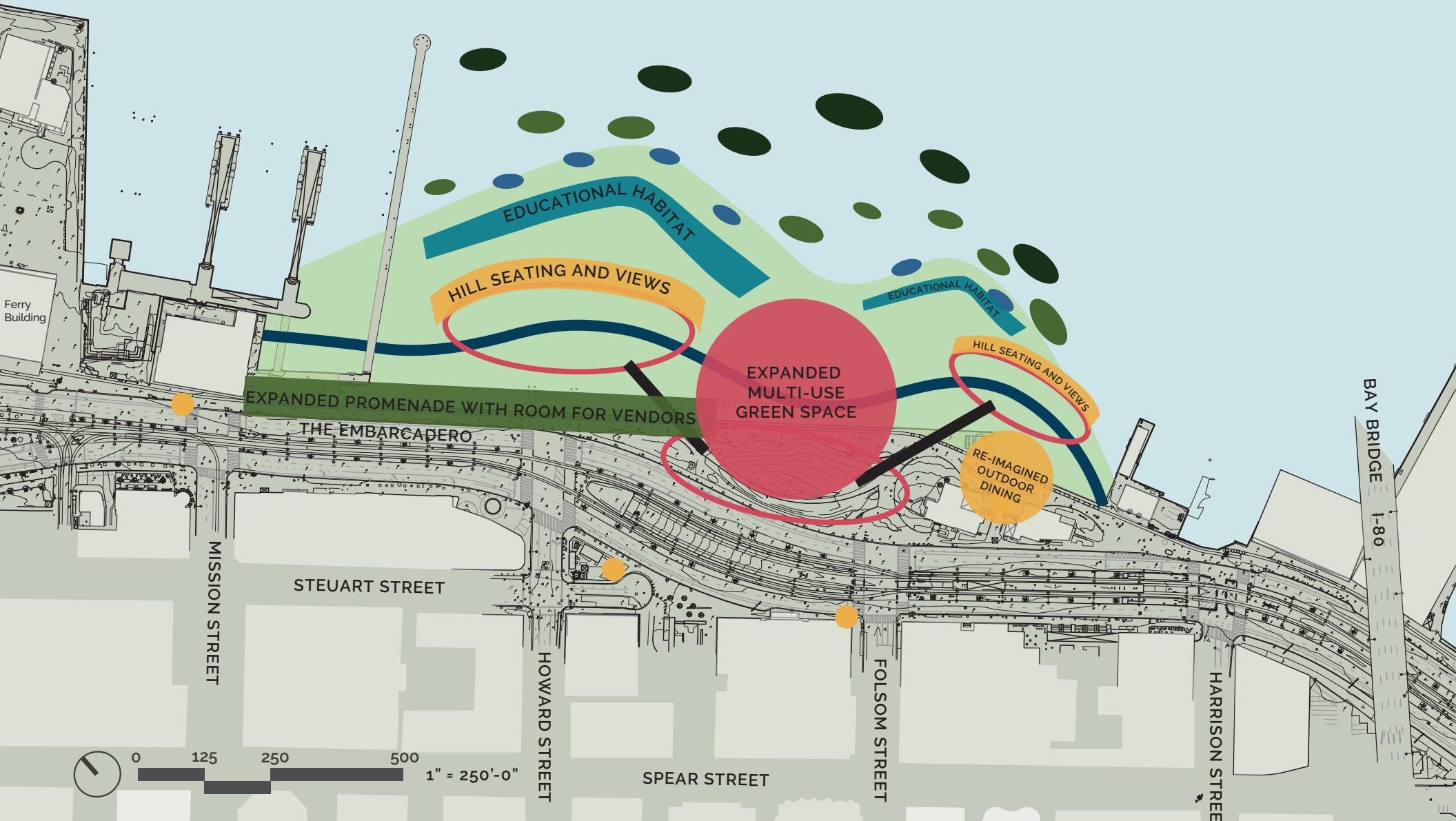
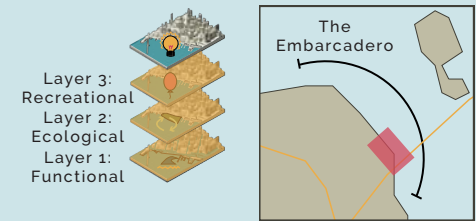


Figure 17

LAYER 3 ELEMENTS: CONCEPT BUBBLES

Conclusion: Expand promenade and multi-use public space while adding educational program elements.

LAYER KEY MAP

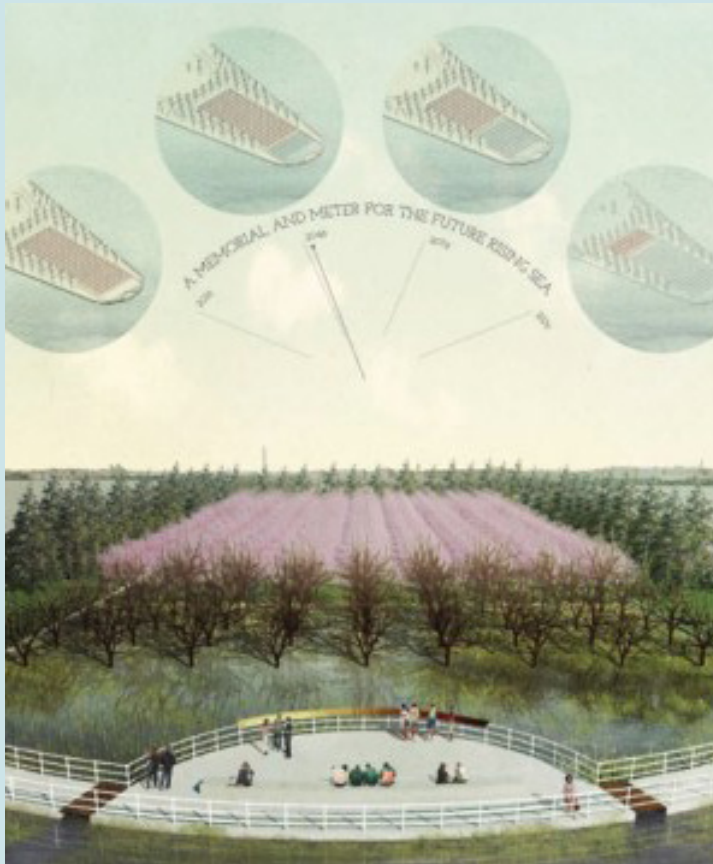


LAYER 4 ANALYSIS: LANDSCAPES OF LOSS

Conclusion: Many successful memorials utilize water and voids to offer a moment of reflection and evoke feelings of loss.



FDR Memorial, Lawrence Halprin
Washington, DC



Climate Chronograph, Erik Jensen and Rebecca Sunter
Proposal for Washington, DC

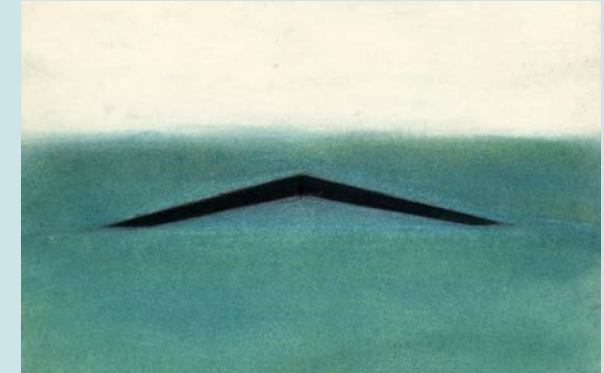
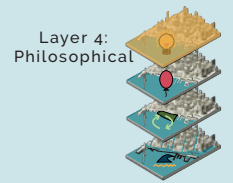


Greenwood Pond: Double Site, Mary Miss
Des Moines, IA

GOAL

*"...stir emotions and offer
a moment of reflection on
the climate crisis"*

LAYER



Vietnam Memorial, Maya Lin
Washington, DC



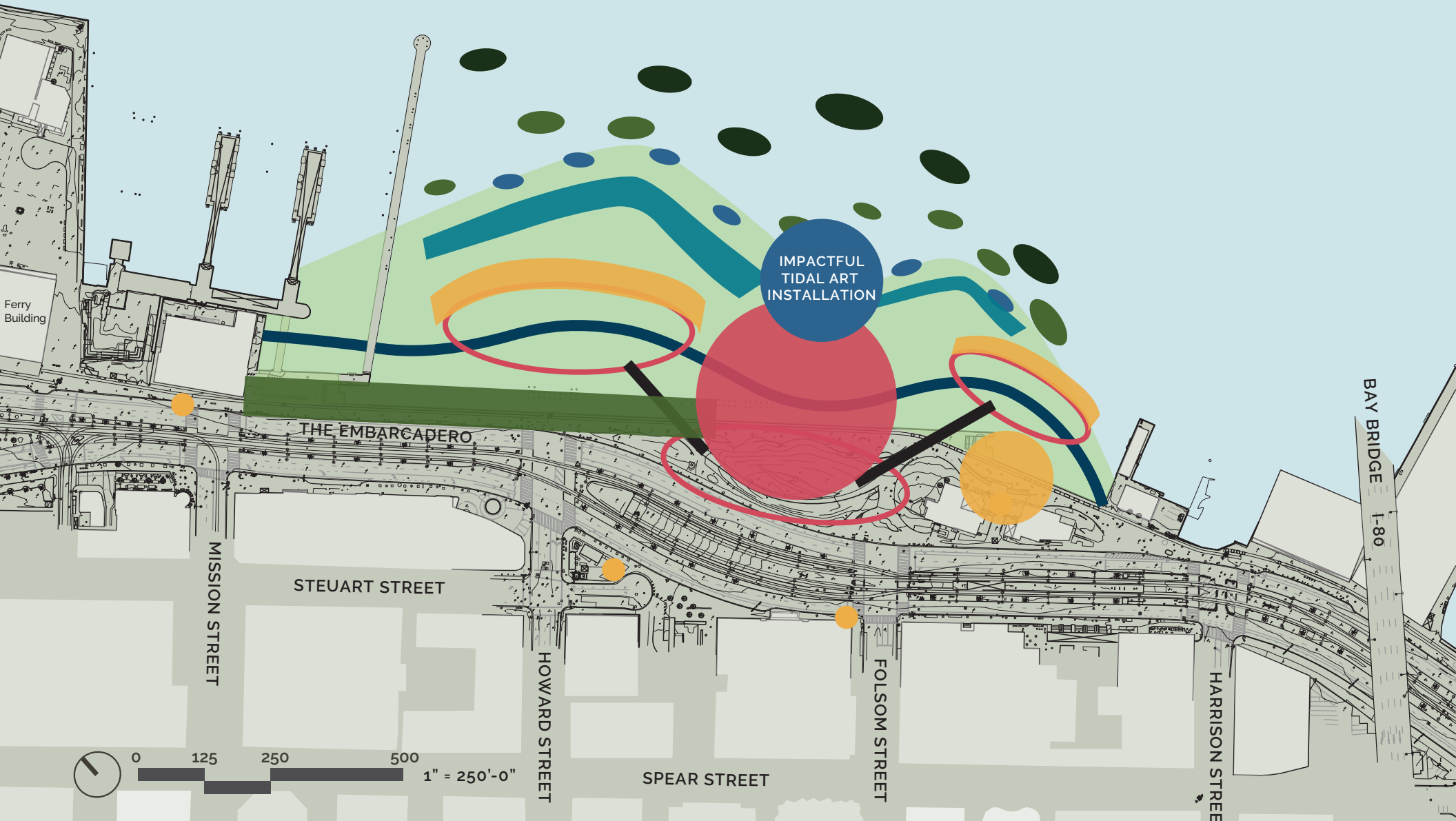
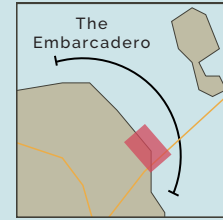
9/11 Memorial, Michael Arad, Handel Architects
New York, NY

LAYER 4 ELEMENTS: CONCEPT BUBBLES

Conclusion: Place an art installation that utilizes tidal water and voids in a central location that can be seen from most seating locations in park.

LAYER KEY MAP

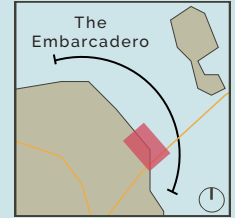
- Layer 4: Philosophical
- Layer 3: Recreational
- Layer 2: Ecological
- Layer 1: Functional



ALL LAYERS: PRIMARY OPPORTUNITIES & CONSTRAINTS

LAYER KEY MAP

- Layer 4: Philosophical
- Layer 3: Recreational
- Layer 2: Ecological
- Layer 1: Functional



OPPORTUNITIES

- 1 PROXIMITY TO DOWNTOWN, BART, FERRY BUILDING, ETC
- 2 RAISE ELEVATION TO PROTECT FROM SEA LEVEL RISE
- 3 EXPAND EXISTING PARK AS MULTI-USE OPEN SPACE
- 4 MAINTAIN OPEN WATER BASIN
- 5 EXPAND REVENUE GENERATING OPPORTUNITIES SUCH AS RESTAURANTS

CONSTRAINTS

- 1 LOWEST POINT ALONG EMBARCADERO
- 2 LIMITED SPACE AND NO POSSIBILITY OF MANAGED RETREAT
- 3 RETAIN FIRE BOAT ACCESS
- 4 PRESERVE BEAUTIFUL, ROMANTIC NATURE OF SITE



Figure 20

DESIGN PROCESS: POSSIBLE DESIGN METAPHOR SKETCHES

FISHING NET: STRAIGHT LINES AND NODES

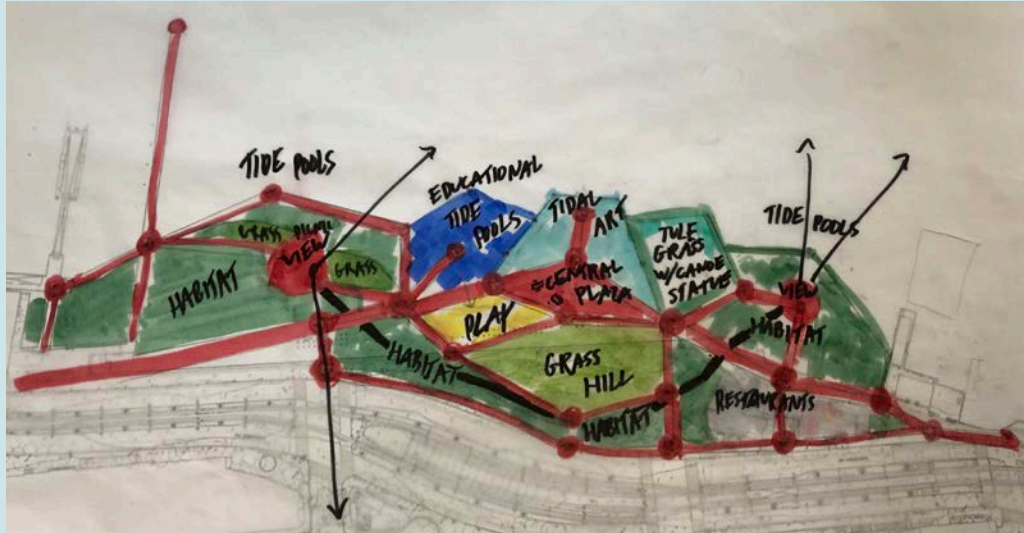


Figure 21

OYSTER BED

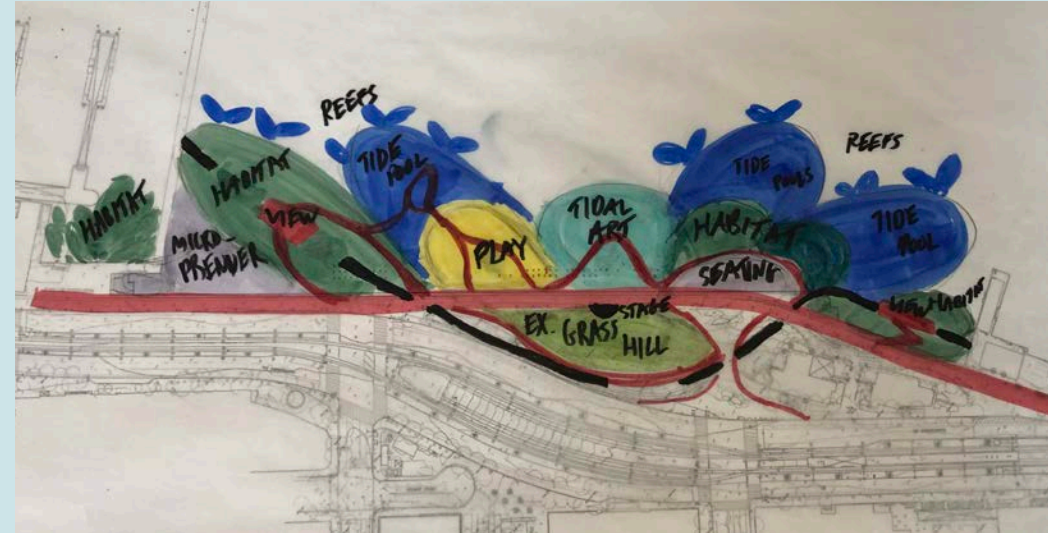


Figure 22

WAVES AND THE COVE

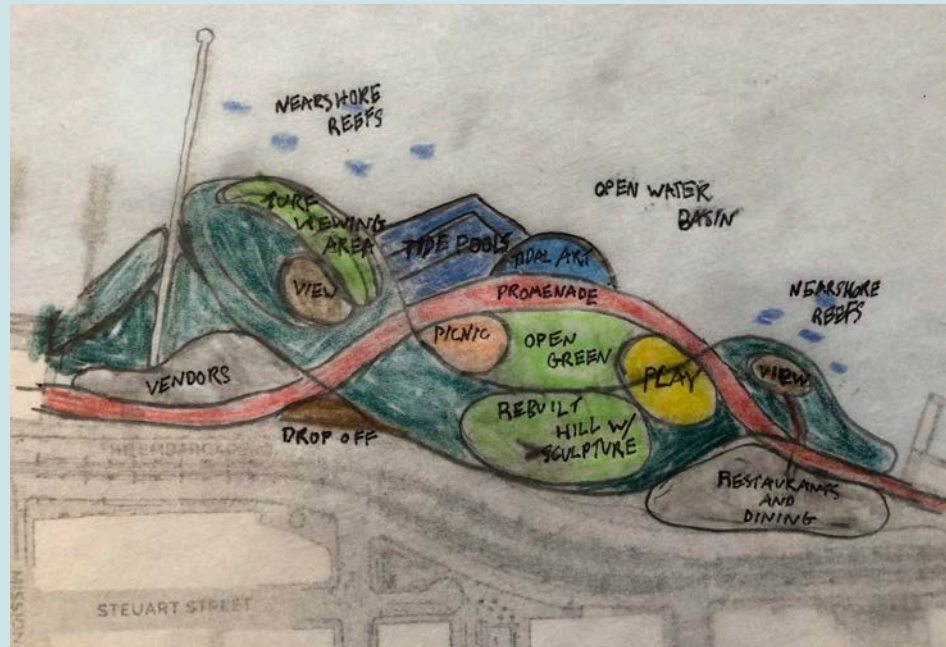
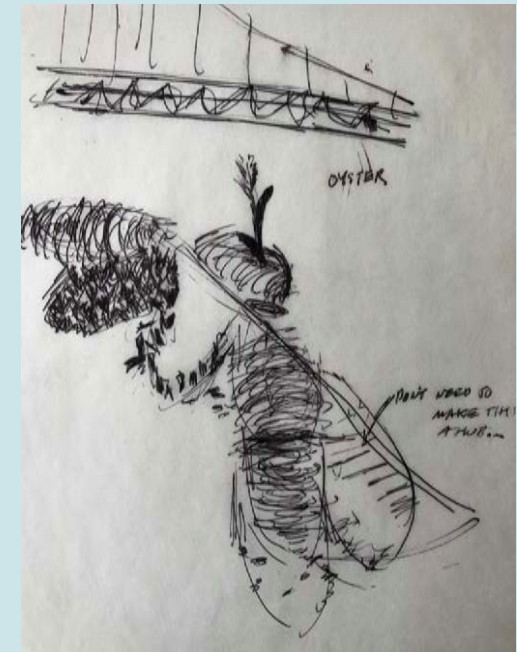
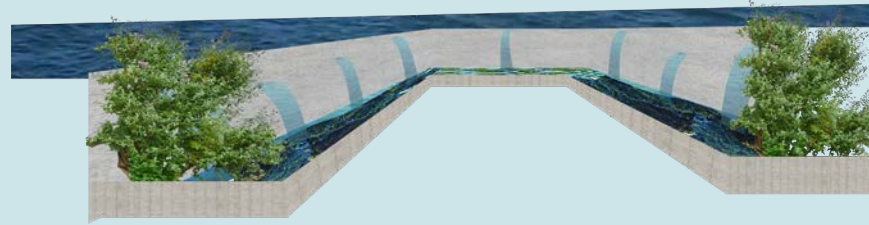


Figure 23



DESIGN PROCESS: TIDAL ART BRAINSTORM



ORIGINAL COLLAGE CONCEPT

Figure 24

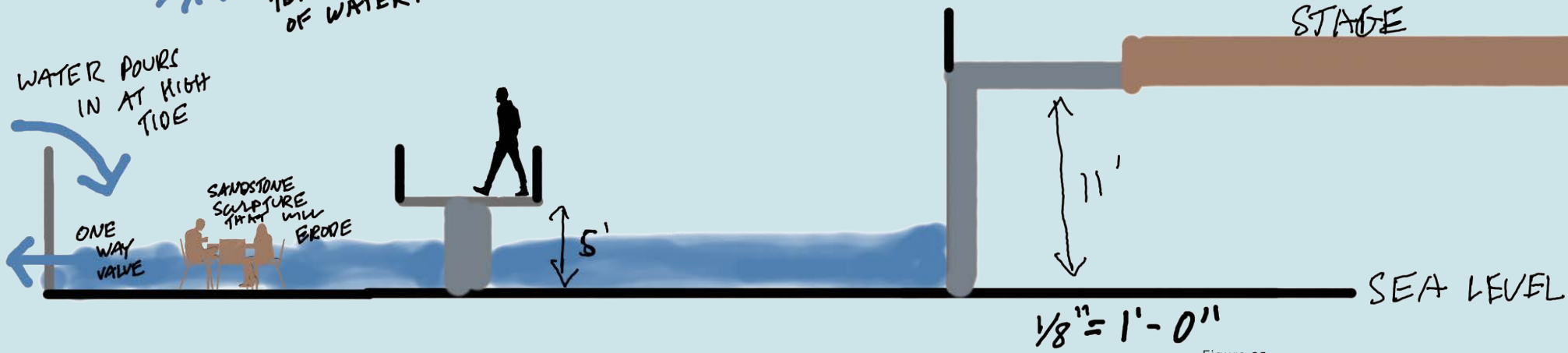
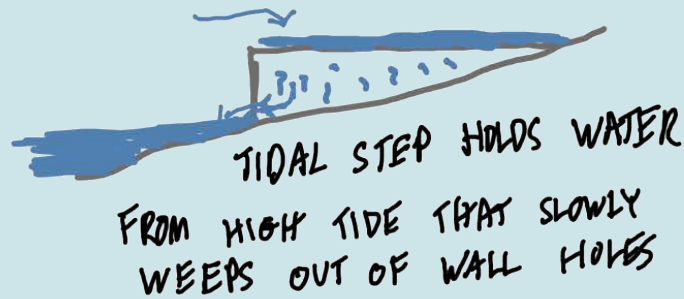
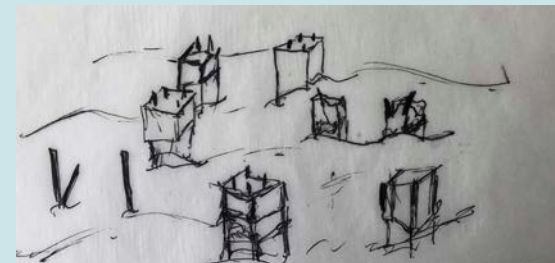
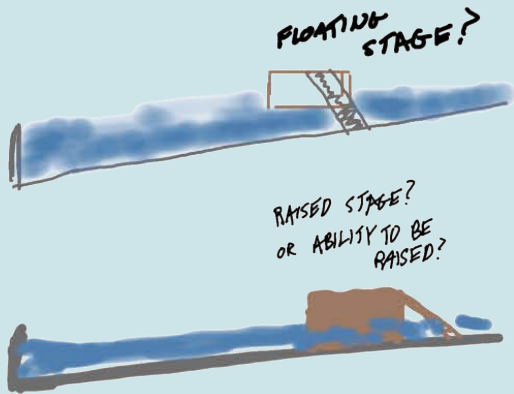


Figure 25



FINAL CONCEPT AND METAPHOR: THE COVE

The metaphor of the Cove was chosen for the historical context, as well as its symbolism for safety.

LAYER KEY MAP

- Layer 4: Philosophical
- Layer 3: Recreational
- Layer 2: Ecological
- Layer 1: Functional

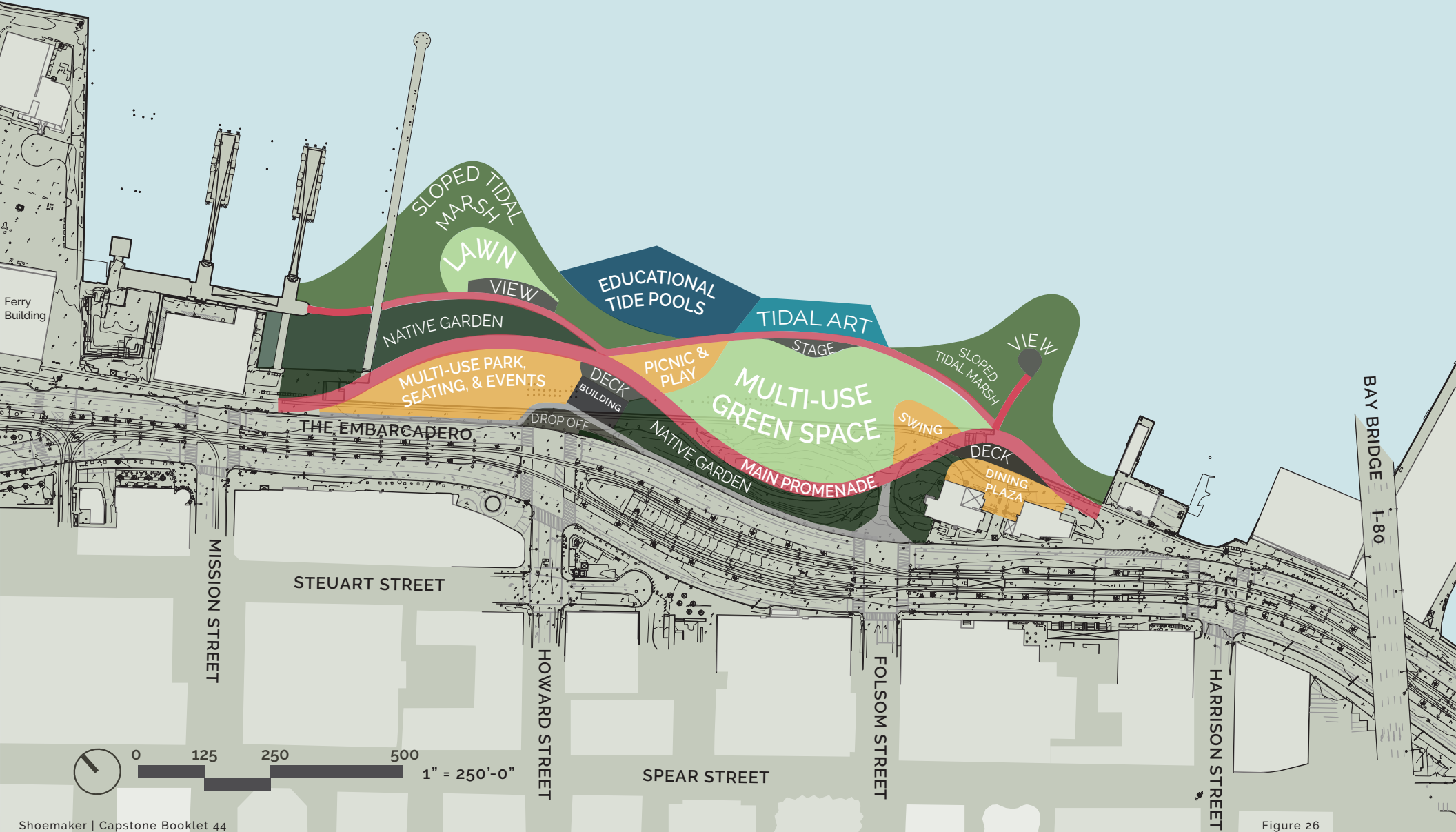
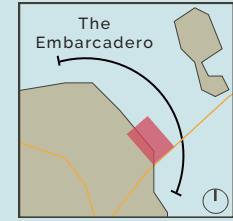


Figure 26

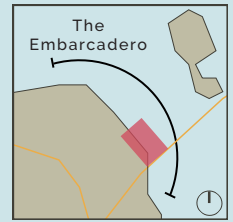
FINAL CONCEPT: FOUNDATION

This diagram looks underneath to reveal the footprint of the levee and the line of the nearshore buttress.

LAYER KEY MAP



Layer 1:
Functional



- FOOTPRINT OF EARTHEN LEVEE FOR SEA LEVEL RISE PROTECTION
- NEARSHORE BUTTRESS TO PREVENT LATERAL SPREADING AND PROVIDE FOUNDATION FOR EARTHEN LEVEE

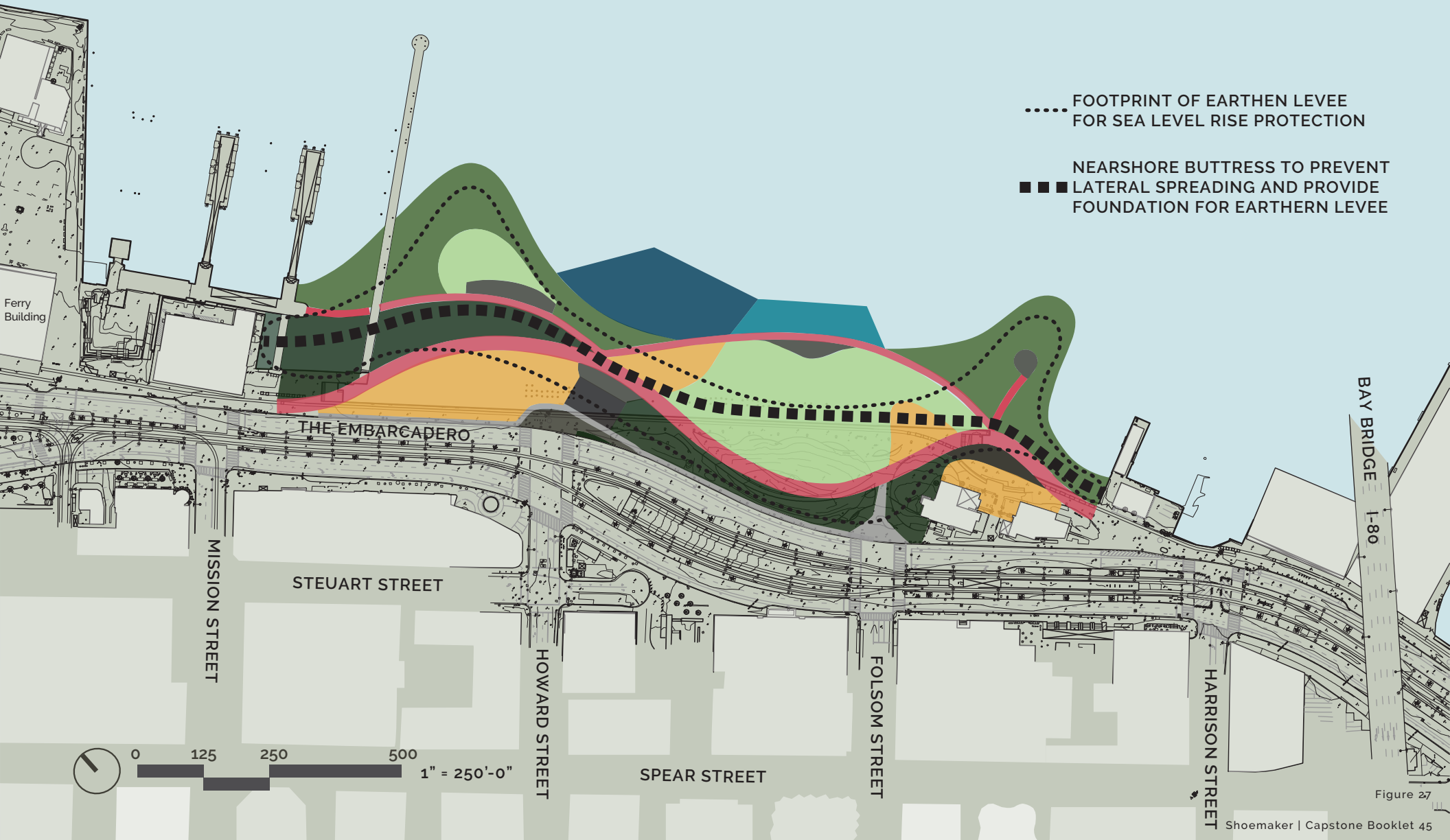
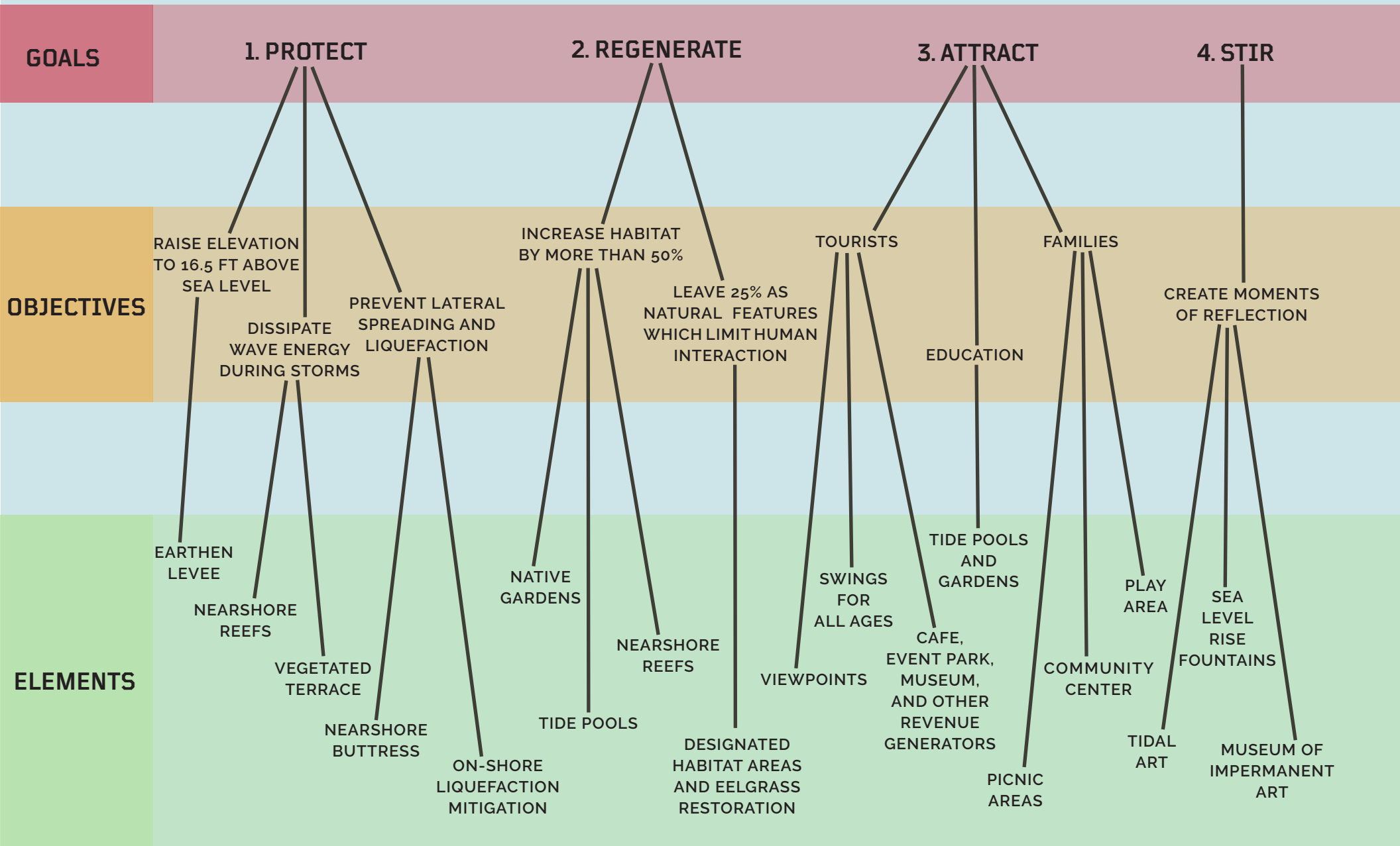


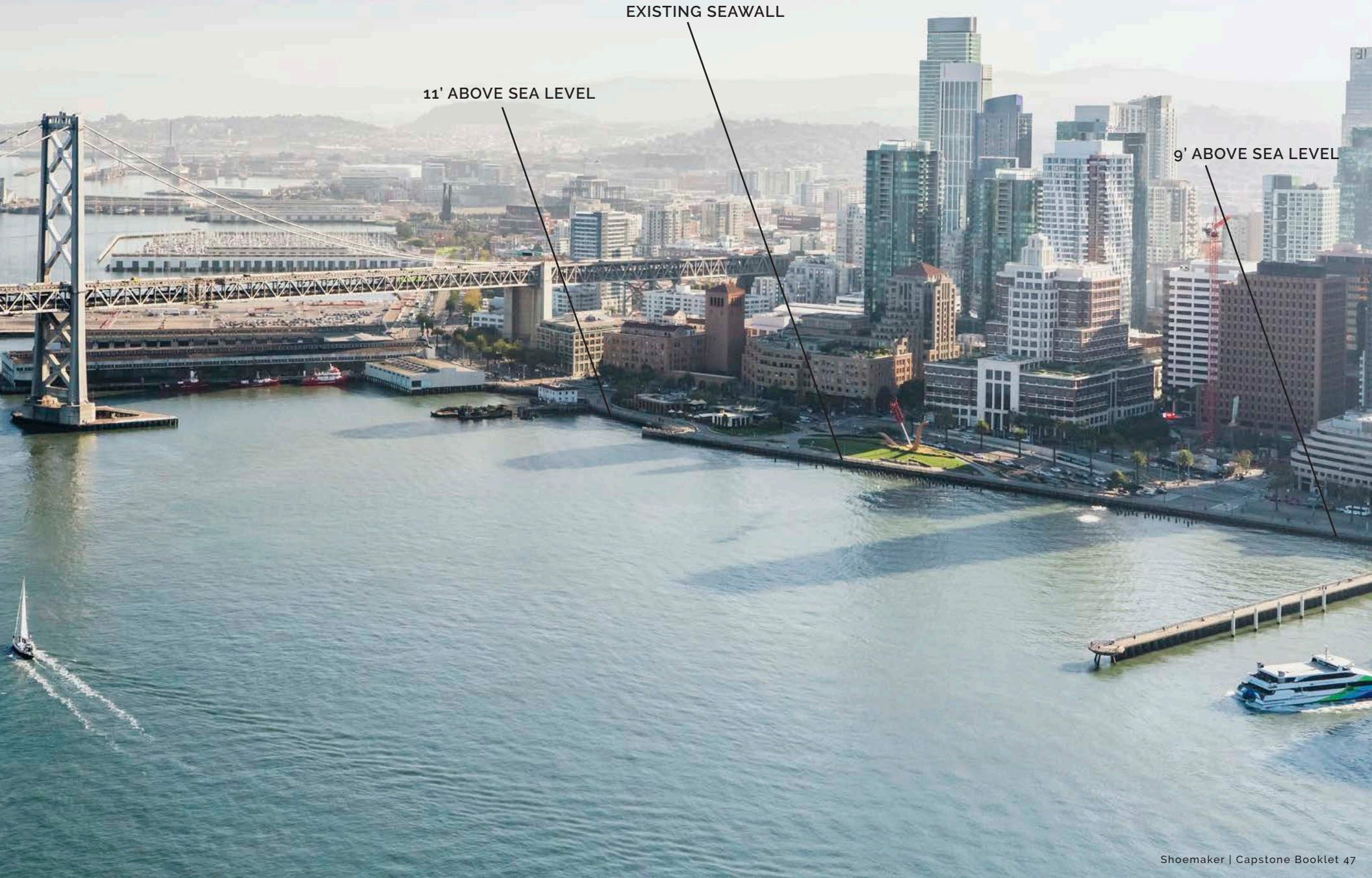
Figure 27

GOALS, OBJECTIVES, AND ELEMENTS



LET'S BUILD A PARK!

Here is the existing site, with a seawall that ranges from 8.4' to 11' above sea level.



EXISTING SEAWALL

11' ABOVE SEA LEVEL

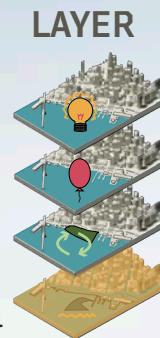
9' ABOVE SEA LEVEL

1 NEARSHORE BUTTRESS AND LIQUEFACTION MITIGATION



NEARSHORE BUTTRESS TO PREVENT LATERAL SPREADING

ONSHORE LIQUEFACTION MITIGATION AT KEY POINTS

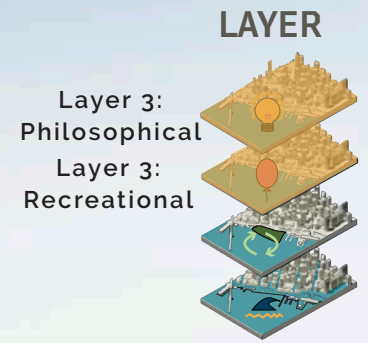


Layer 1:
Functional

First we add a Nearshore Buttress to prevent lateral spreading, and also introduce liquefaction mitigation at key points on shore. The nearshore buttress essentially acts as a barrier to prevent the land from sliding into the bay during an earthquake.

2 SUBTERRANEAN MUSEUM OF IMPERMANENT ART

SUBTERRANEAN MUSEUM OF IMPERMANENT ART
WITH TIDAL ART OBSERVATION WINDOW



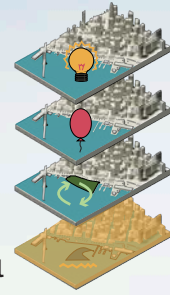
Next we add the subterranean Museum of Impermanent Art with a Tidal Art Observation Window, because this is a student project and a student project is no place for small plans.

3 EARTHEN LEVEL



EARTHEN LEVEL WITH CONTINUOUS CREST OF 16.5 FEET ABOVE SEA LEVEL FOR FLOOD AND SEA LEVEL RISE PROTECTION

LAYER



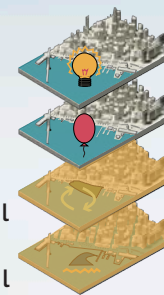
Layer 1:
Functional



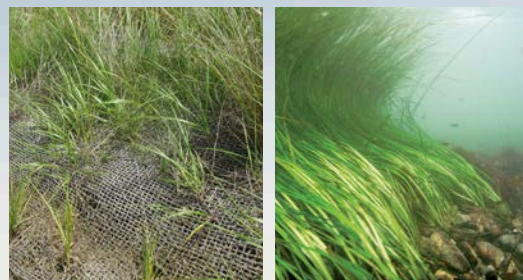
Using the Nearshore Buttress as a foundation, we then construct an earthen levee with a continuous crest of 16.5' above sea level. This would protect from the high-end flood projections for the year 2100. This elevation is not much higher than the existing hill on site where you can find the Cupid's Span Sculpture, but it would extend much further to either side as well as out into the bay. The levee would be built with recycled materials, particularly leftover soils from the routine dredging of the shipping channels and repurposed urbanite from nearby construction projects.

4 VEGETATED TERRACES AND HABITAT RESTORATION

LAYER



VEGETATED TERRACES WITH NATURAL FIBER BLANKETS AND EEL GRASS RESTORATION (SEQUESTERS CARBON AND ABSORBS WAVE ENERGY DURING STORMS)



REGENERATIVE GARDENS WITH NATIVE AND CLIMATE-APPROPRIATE PLANTS

The earthen levee creates a base for vegetated terraces. These sloped tidal marshes will help sequester carbon and restore native species, such as Eel Grass. There is a potential opportunity here to make these habitat areas an official restoration bank, which could open up additional sources of funding. The vegetated terraces also help absorb wave energy during storms.



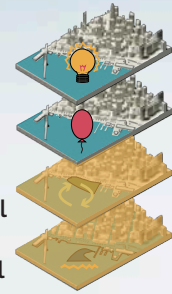
Figure 32

5 NEARSHORE OYSTER REEFS

NEARSHORE OYSTER REEFS
BRING BACK THE NATIVE OLYMPIA OYSTER WHILE
DISSIPATING WAVE ENERGY DURING STORMS AND
FILTERING OUT BAY POLLUTANTS



LAYER



Layer 2:
Ecological
Layer 1:
Functional

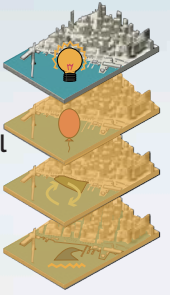
Next we add Nearshore Oyster Reefs that bring back the native Olympia oyster, provide further storm protection, and filter pollutants out of the bay. Similar protective features are currently being built off the coast of Staten Island by Scape Landscape Architecture.

6 EDUCATIONAL TIDE POOLS



EDUCATIONAL TIDE POOLS
RESTORE THE INTERTIDAL ECOSYSTEM
WHILE OFFERING STORM SURGE PROTECTION

LAYER



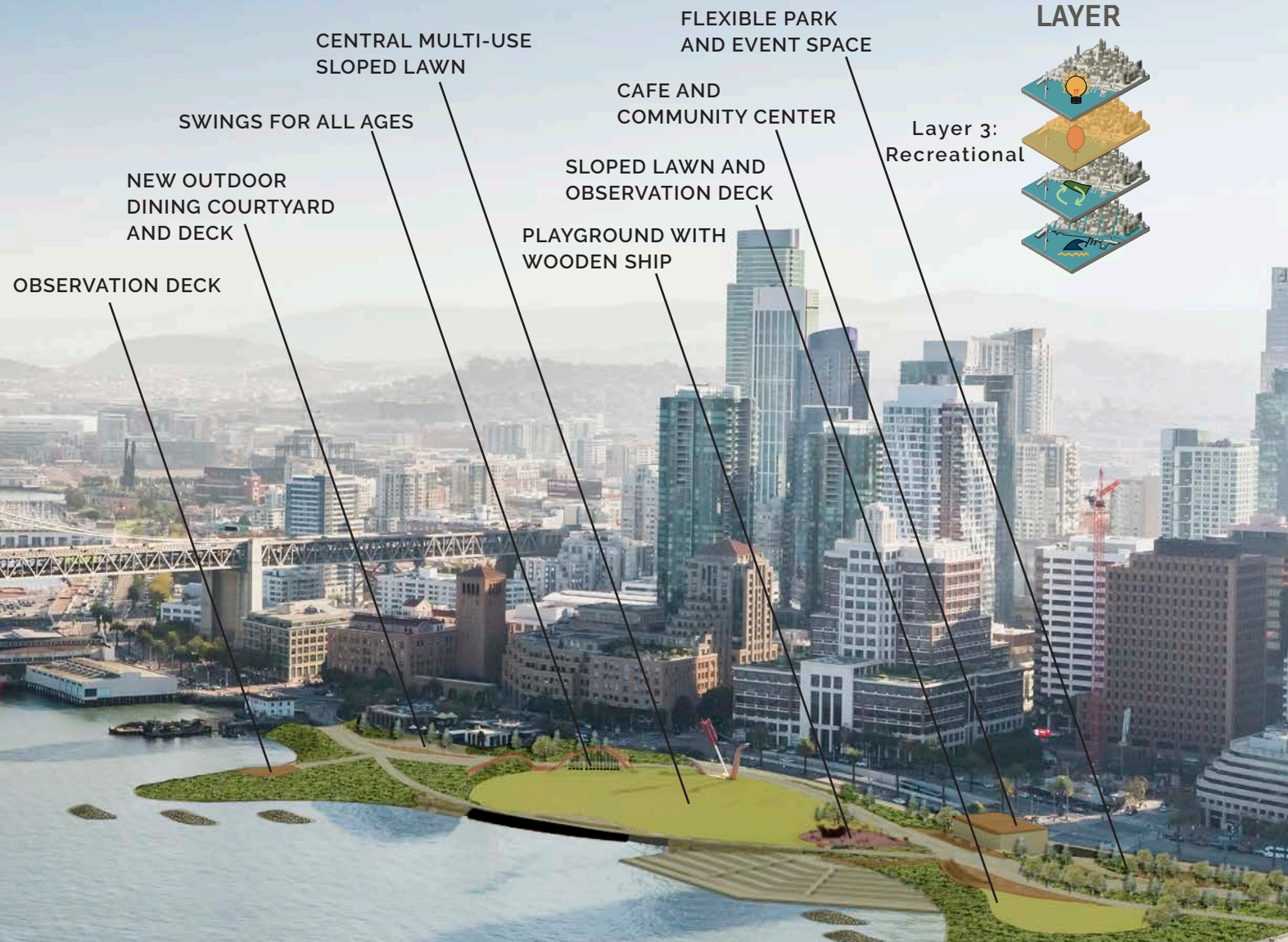
Layer 3:
Recreational

Layer 2:
Ecological

Layer 1:
Functional

Then we add a series of concrete terraces that create Educational Tide Pools. These can be used by local schools for class field trips.

7 RECREATION



After the Functional and Ecological Layers are established, we think about Recreation, adding a flexible event park, café and community center, playground, central sloped lawn with stage, swings for all ages, new outdoor dining, and observations decks.

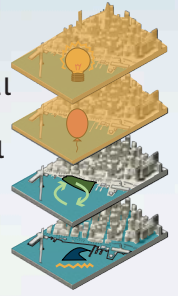
8 PHILOSOPHICAL LAYER

WATER FEATURES ON SLOPED LAWN
INDICATE PROJECTED SEA LEVELS

TIDAL ART WALL AND BASIN
WITH MUSEUM OBSERVATION WINDOW

LAYER

Layer 4:
Philosophical
Layer 3:
Recreational



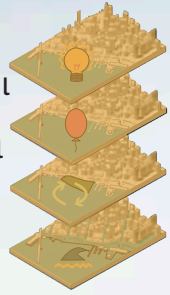
Lastly, we move on to the philosophical layer, meant to stir emotions about the climate crisis in a way that is impactful, but not overly heavy-handed. To do this we have water features that indicate projected sea levels over the next 80 years. We also have a tidal art wall and basin that can be observed from both the sloped lawn up above and the underground museum.

Figure 36

FINAL DESIGN: YERBA BUENA COVE

LAYER

- Layer 4: Philosophical
- Layer 3: Recreational
- Layer 2: Ecological
- Layer 1: Functional

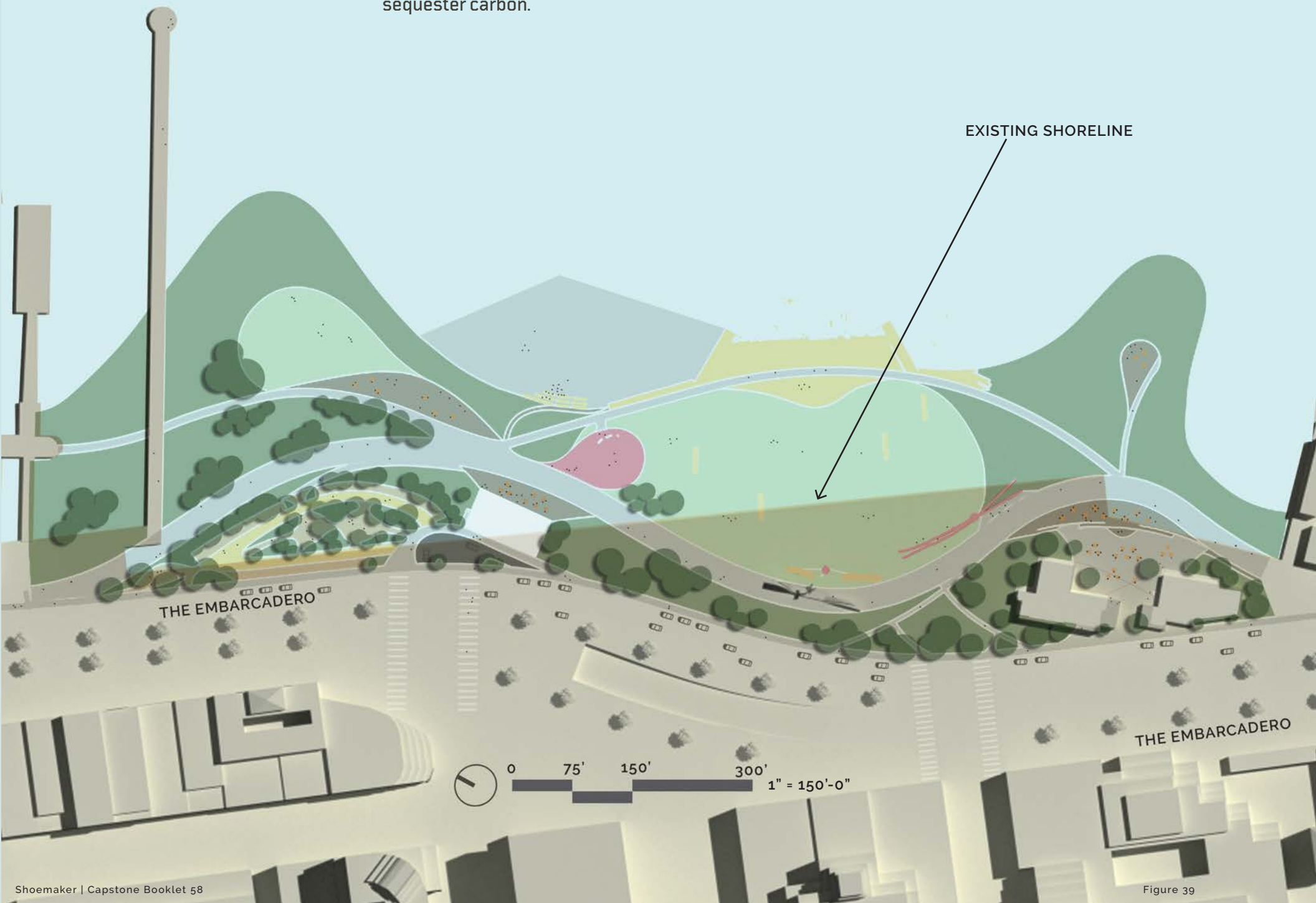


MASTER PLAN



Figure 38

Here is a view of the original shoreline in relation to the proposed park. You can see we are greatly increasing habitat area that can effectively sequester carbon.



EXISTING SHORELINE

THE EMBARCADERO

THE EMBARCADERO

0 75' 150' 300' 1" = 150'-0"

LET'S GO FOR A WALK IN THE PARK!

We will now take a stroll through the park, stopping and taking pictures in 5 locations.



Figure 40

STOP # 1: FLEXIBLE PARK AND EVENT SPACE

Our first stop is the new flexible park and event space, next to the café and community center.



FLEXIBLE PARK AND EVENT SPACE

This park has an outer walking loop wide enough for vehicles to drive on, and an interior picnic area. The park could be used for food trucks, craft markets, and other types of outdoor events.

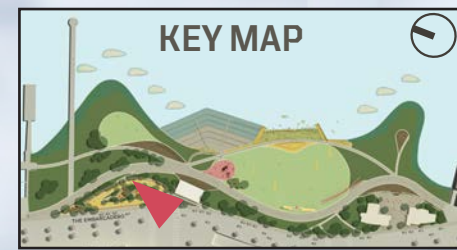


Figure 41

SECTION/ELEVATION

This is an enlargement and section of immediate area surrounding the event park. As you can see in the section at the top of the page, the event park is at the same grade as the existing sidewalk. From there you can walk up a ramp that takes you to the top of new levee and the promenade.

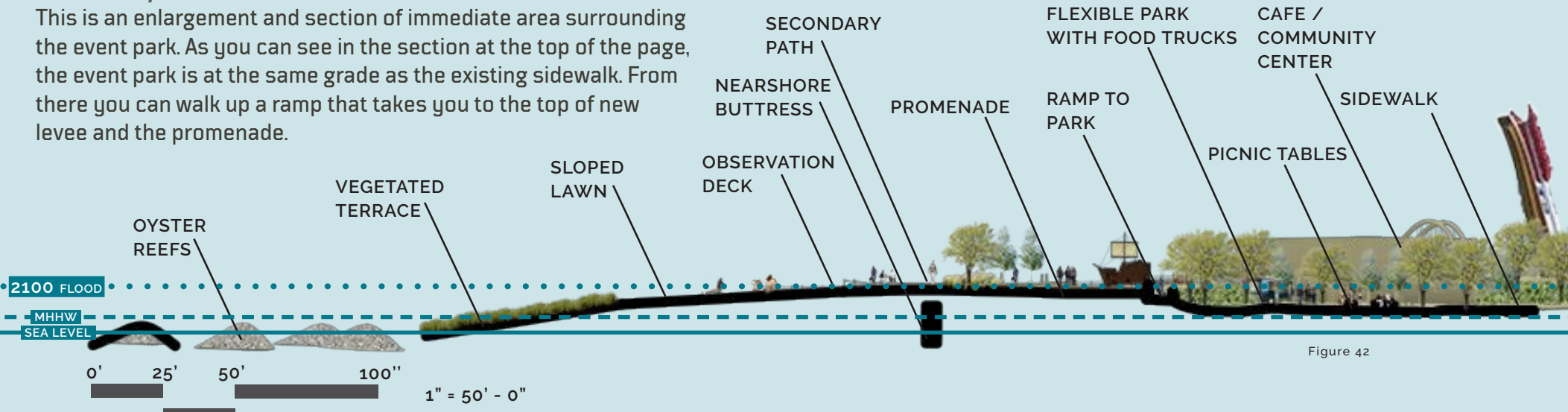


Figure 42

ENLARGEMENT

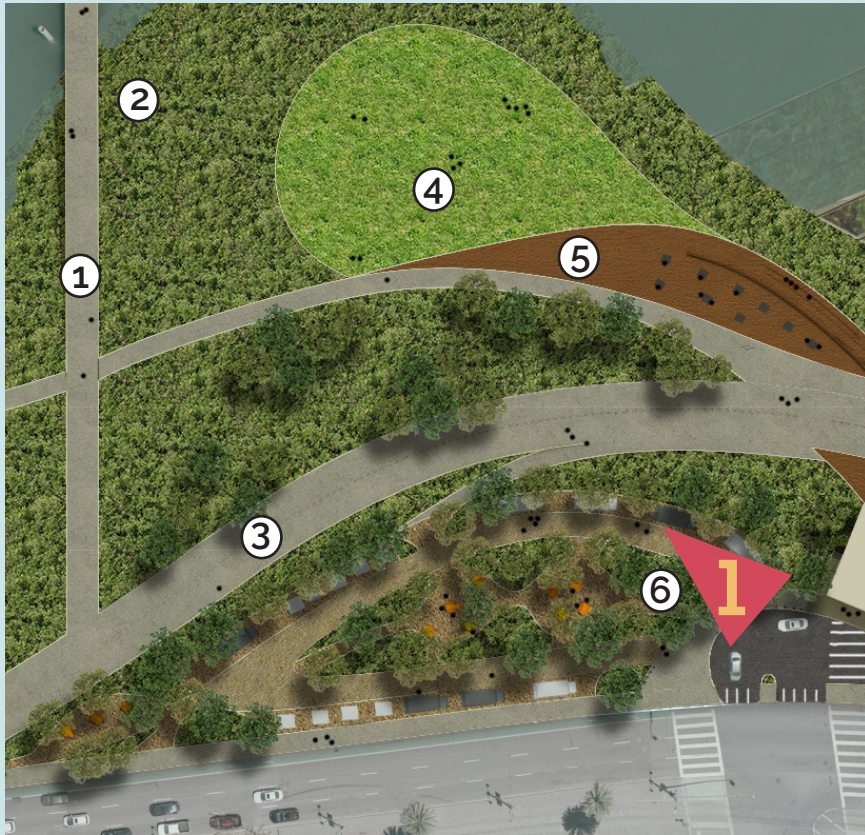


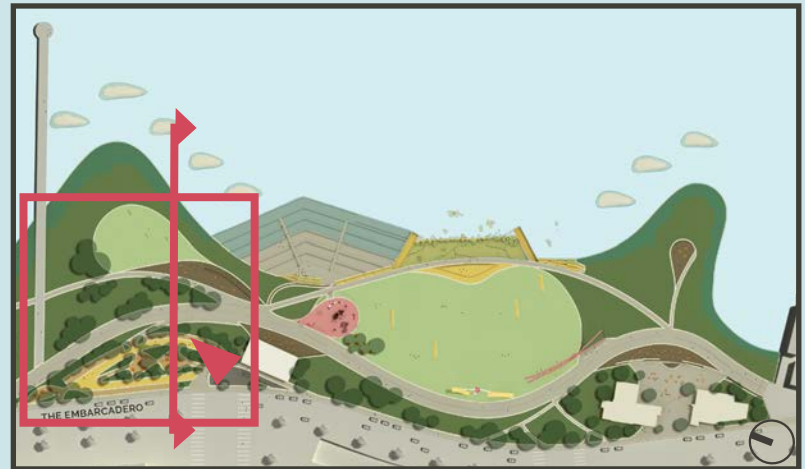
Figure 43

- 1 EXISTING RECREATIONAL PIER
- 2 VEGETATED TERRACE
- 3 PROMENADE
- 4 SLOPED LAWN
- 5 OBSERVATION DECK
- 6 FLEXIBLE PARK AND EVENT SPACE

INSPIRATION IMAGES

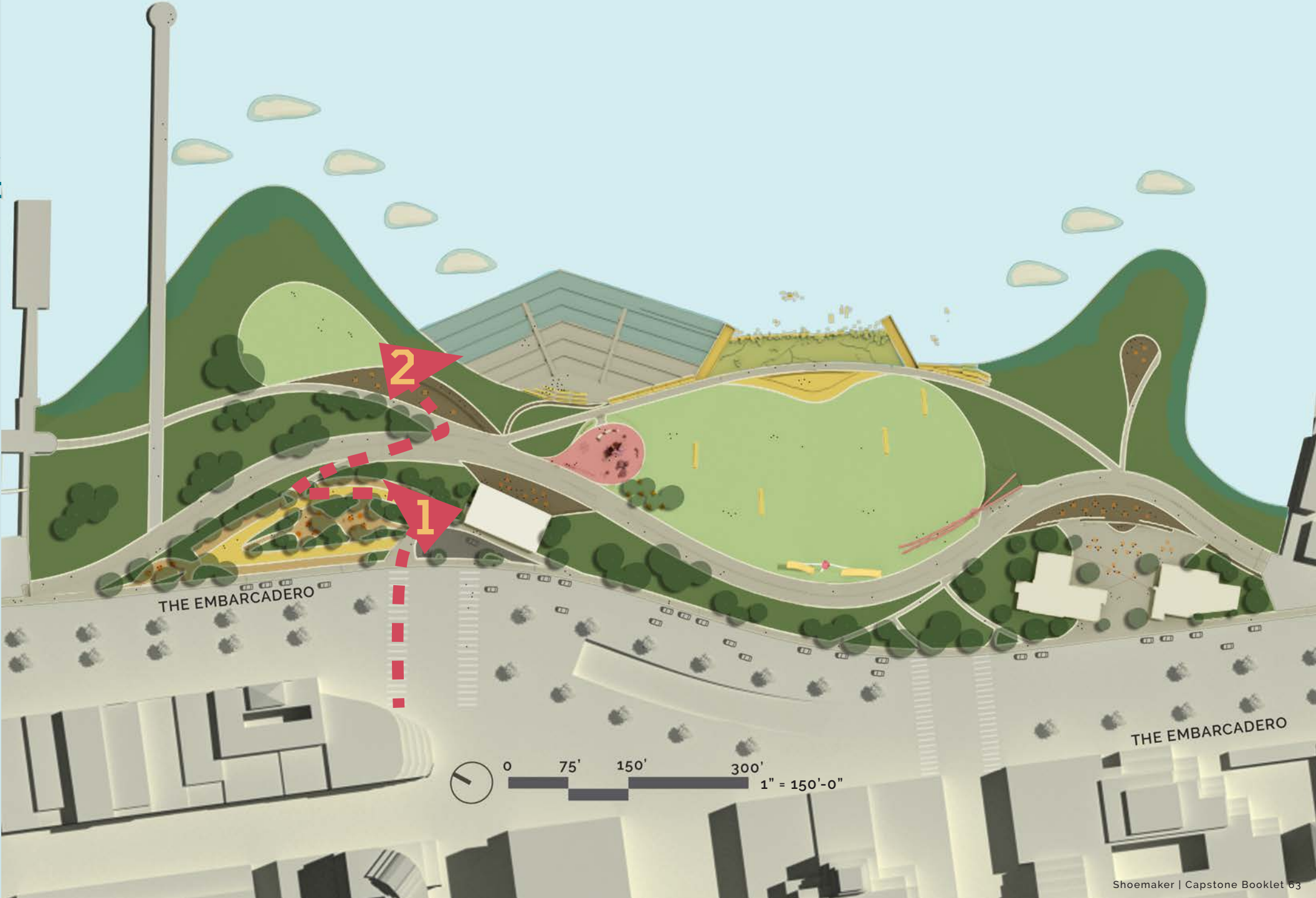


KEY MAP



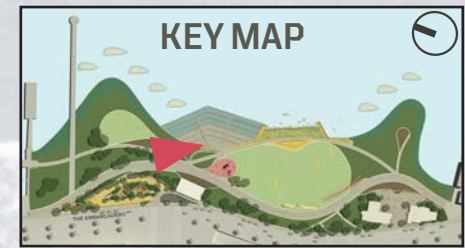
STOP # 2: NORTHERN OBSERVATION DECK

Walking further out, you reach an observation deck.



NORTHERN OBSERVATION DECK AND EDUCATIONAL TIDE POOLS

From here you can look out over a wooden lounge area, vegetated terrace, play area, and the Educational Tide Pools.



SKETCH OF WOODEN SHIP IN PLAY GROUND

Here is a quick sketch of the wooden ship in the play area, paying homage to the buried ships of Yerba Buena Cove.

WOODEN SHIP IN PLAYGROUND

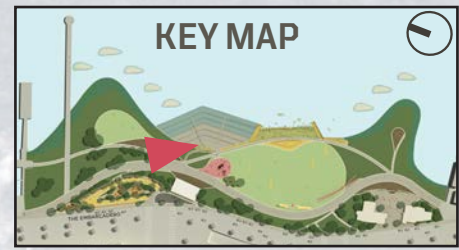


Figure 45

EDUCATIONAL TIDE POOLS

Here is a close up view of the tide pools. This will be a wonderful area for school field trips and anyone interested in tide pool critters.

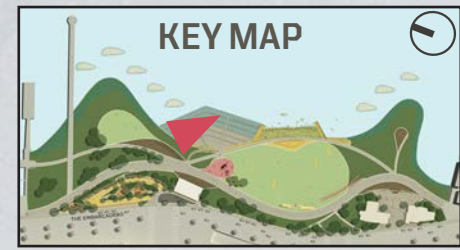


Figure 46

SECTION/ELEVATION

Here is a section and enlargement of area we just saw from the observation deck. The café and community center entrance is at street level, but the back dining deck and restrooms are about 7ft higher at the elevation of the promenade. You can see in the section the nearshore buttress below the levee. Past that you can see the tide pool terraces step down into the bay.

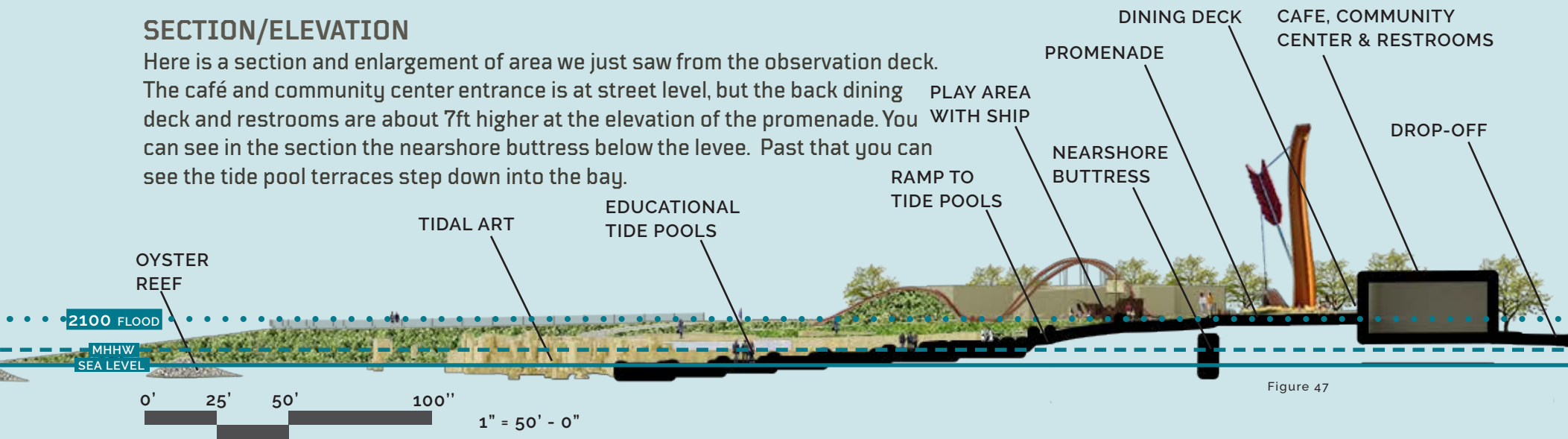


Figure 47

ENLARGEMENT

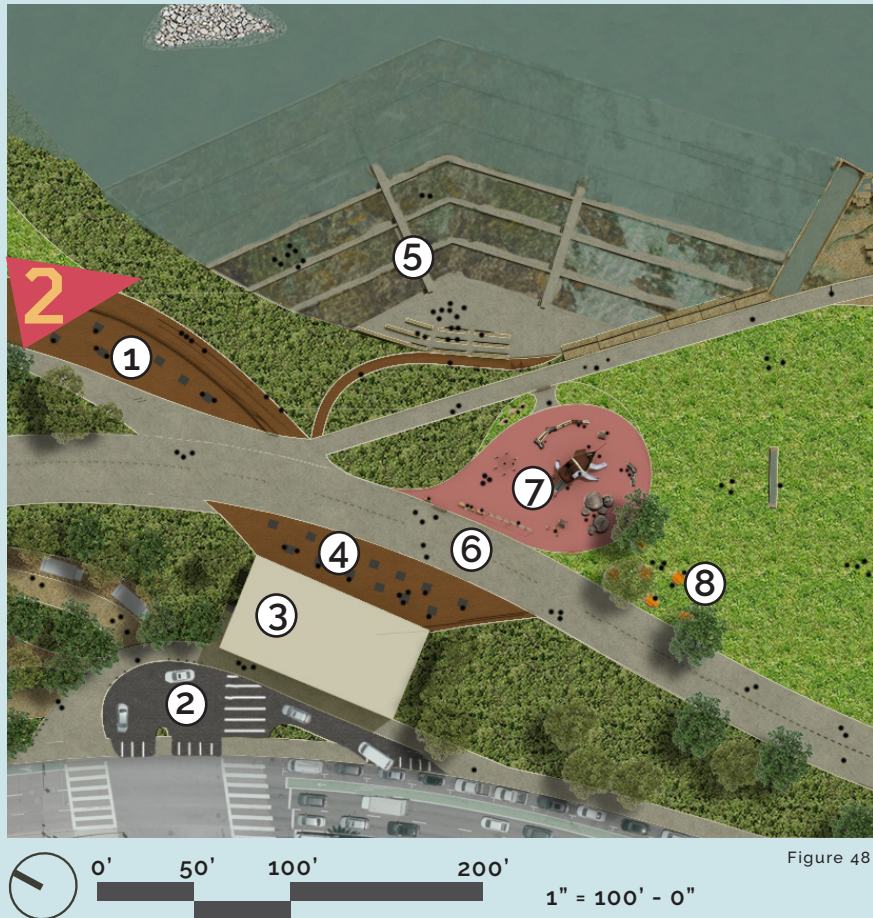


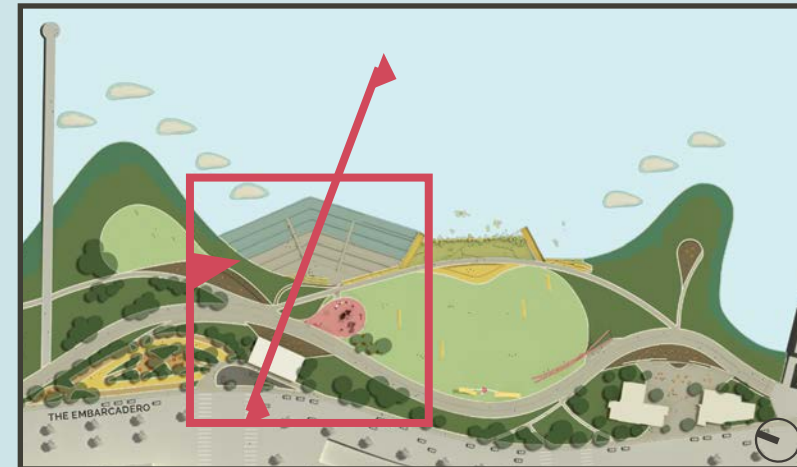
Figure 48

INSPIRATION IMAGES



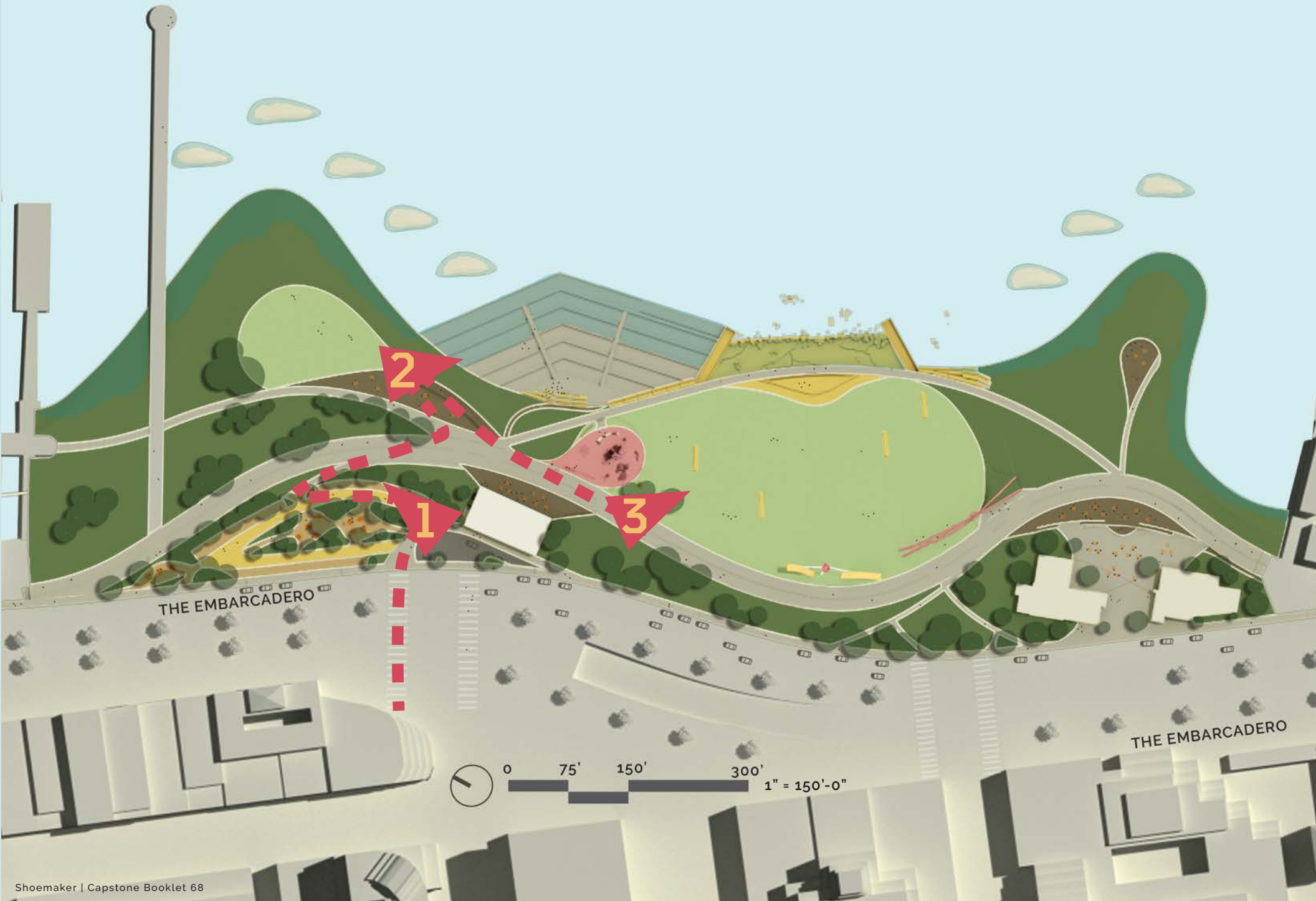
- ① OBSERVATION DECK
- ② DROP-OFF
- ③ CAFE, COMMUNITY CENTER & RESTROOMS
- ④ DINING DECK
- ⑤ EDUCATIONAL TIDE POOLS
- ⑥ PROMENADE
- ⑦ PLAY AREA WITH SHIP
- ⑧ PICNIC AREA

KEY MAP



STOP # 3: CENTRAL SLOPED LAWN

Now we are going to walk over and look out over the central sloped lawn.



PROMENADE AND CENTRAL SLOPED LAWN

From here you can see that the promenade has been split between bikes and pedestrians. Next to the promenade is the Cupid's Span sculpture, which will be preserved and placed on top of the new levee.

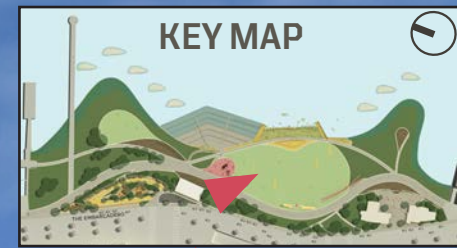


Figure 49

SKETCH OF SWINGS AND MUSEUM ENTRANCE

Next to Cupid's Span you can see the Swings for All Ages and Entrance to the Museum of Impermanent Art. These are formed by a sculptural sailor's rope and connected by a lover's knot. Expanding even further upon the romantic theme of the site, the swings will be loveseat sized.

LOVER'S KNOT

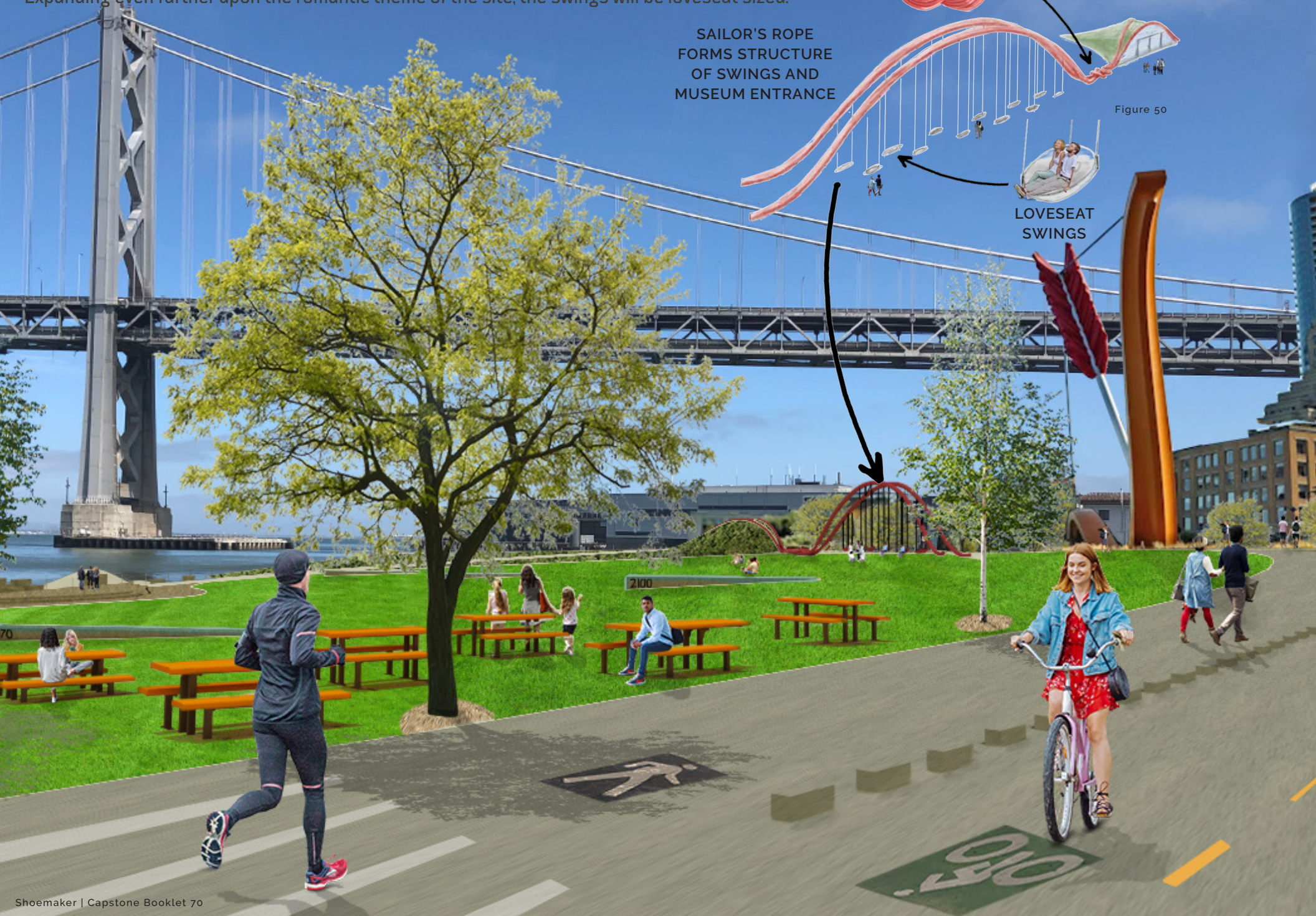


SAILOR'S ROPE FORMS STRUCTURE OF SWINGS AND MUSEUM ENTRANCE



Figure 50

LOVESEAT SWINGS



SKETCH OF SEA LEVEL RISE WATER FEATURES

Spread throughout the lawn are four water features that indicate the projected sea levels at milestone years. The sandstone features will have a thin layer of reflective water on top that spills off the front.

THIN LAYER OF REFLECTIVE WATER ON TOP

SEA LEVEL RISE WATER FEATURES

SPILLS OFF END

2050

Figure 51



SECTION/ELEVATION

Here is a section and enlargement of the central sloped lawn. The lawn slopes down to a concert and event stage. The stage itself is directly above the main gallery of the Museum of Impermanent art.

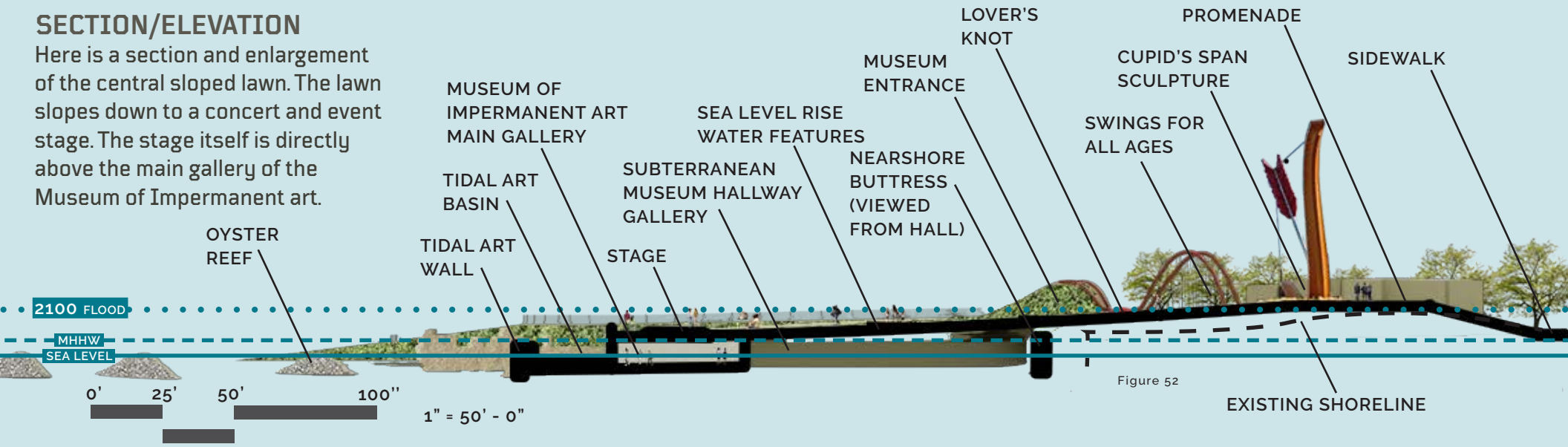


Figure 52

ENLARGEMENT

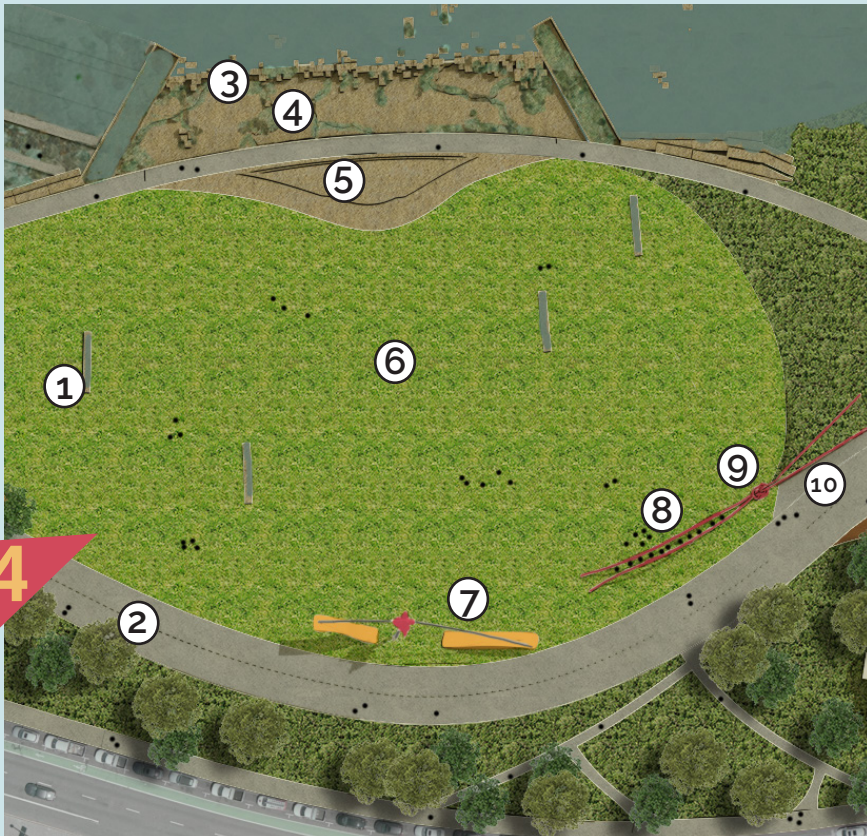
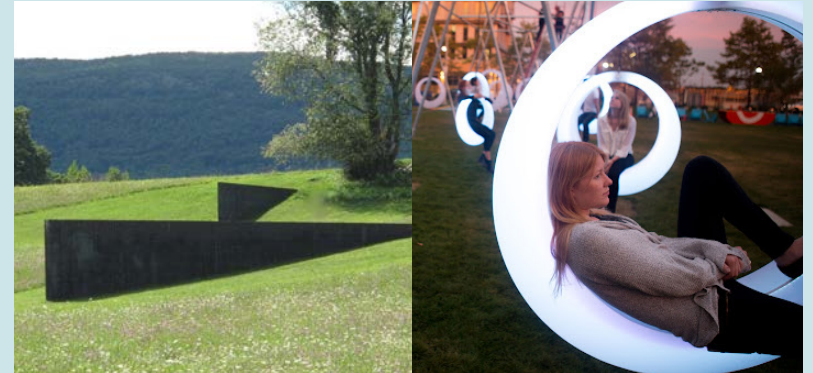
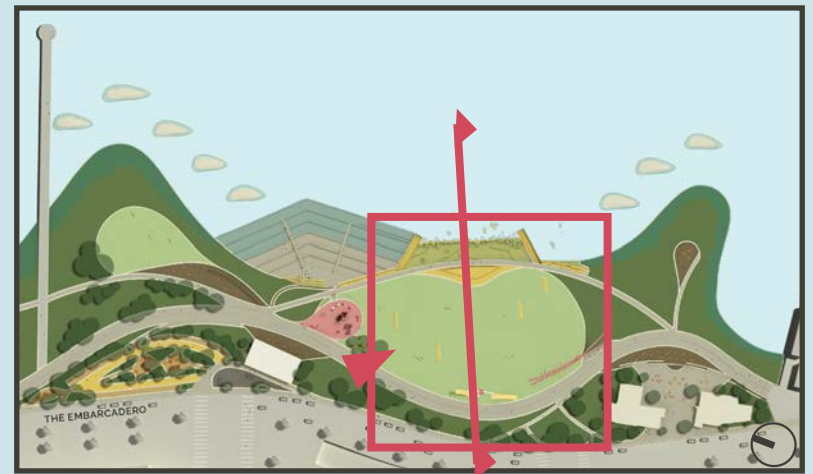


Figure 53

INSPIRATION IMAGES



KEY MAP



- ① SEA LEVEL RISE WATER FEATURES
- ② PROMENADE
- ③ TIDAL ART WALL
- ④ TIDAL ART BASIN
- ⑤ STAGE
- ⑥ MAIN SLOPED LAWN
- ⑦ CUPID'S SPAN SCULPTURE
- ⑧ SWINGS FOR ALL AGES
- ⑨ LOVER'S KNOT
- ⑩ ENTRANCE TO MUSEUM OF IMPERMANENT ART

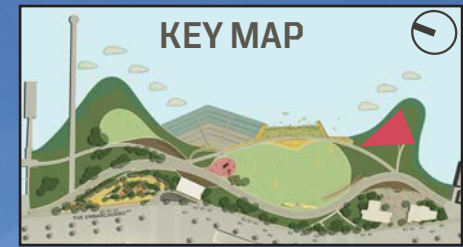
STOP #4: SOUTHERN OBSERVATION DECK

For our 4th stop will walk out onto southern arm, and look back at the park from the other direction.



SOUTHERN OBSERVATION DECK

Here you can really see the tidal marsh ecosystem and distinct tidal ranges with their respective plant species. In the lower tidal range you have the eelgrass, and as you move higher you can get cordgrass, gumplank, and seablite. From here, you can also see the tidal art basin and museum observation window, where we will be walking next.



STOP # 5: MUSEUM OF IMPERMANENT ART

For our final stop we will head to the museum entrance and go underground into the Museum of Impermanent Art. The hallway to the main gallery is itself a gallery. The hallway passes over the top of the nearshore buttress and then drops down next to it, so that the buttress can be observed through a gallery window, becoming part of the exhibit.



SECTION/ELEVATION

This leads us down into the main gallery, which as you can see in the section is directly under the stage at the bottom of the central lawn. From the main gallery you can look out an observation window into the tidal basin. The concept is that at high tide, bay water pours over the wall, filling the basin and submerging the observation window.

2100 FLOOD

MHHW

SEA LEVEL

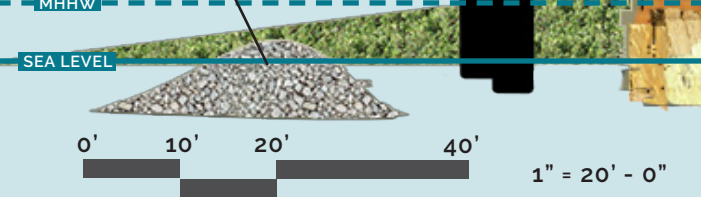


Figure 55

ENLARGEMENT

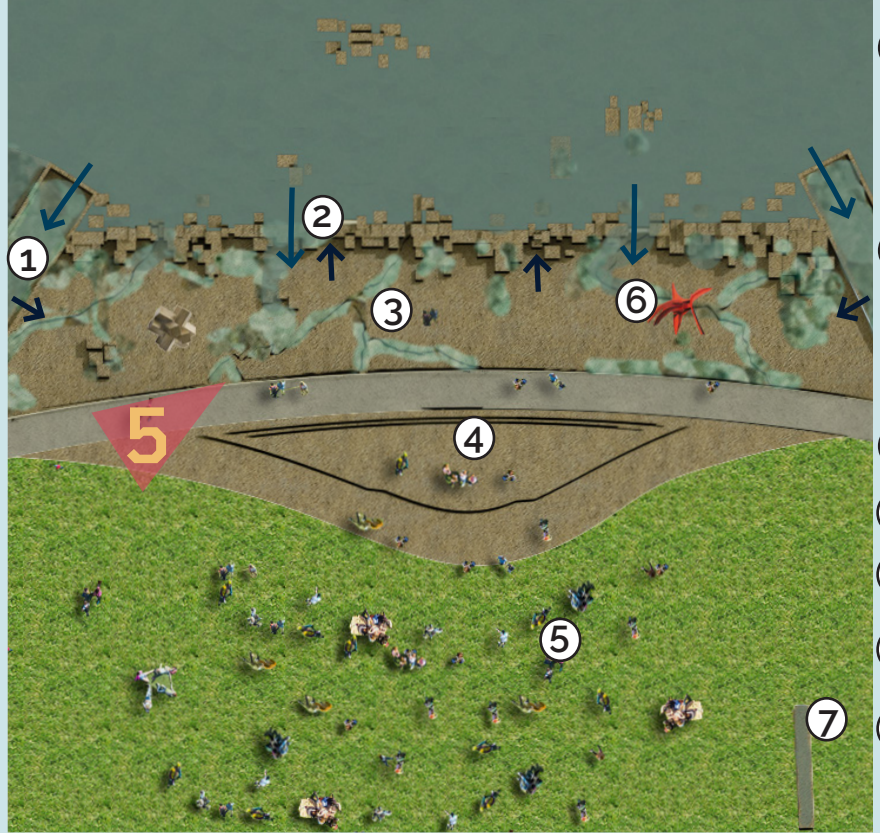


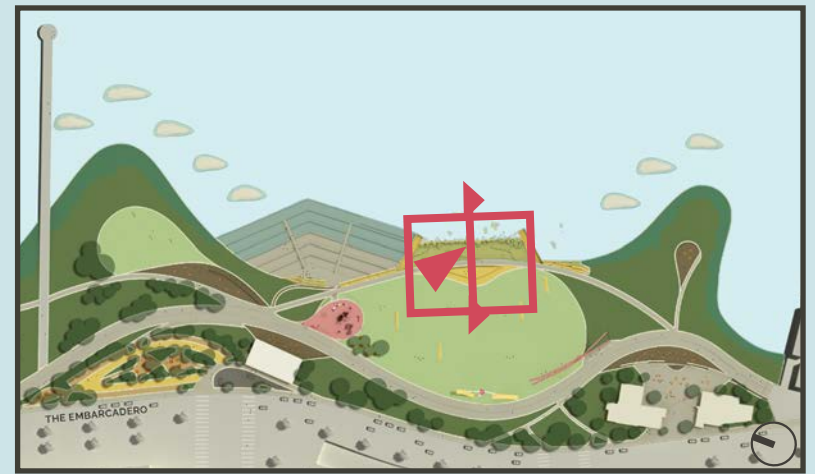
Figure 56

INSPIRATION IMAGES



- ① SIDE TROUGHS FILL AT HIGH TIDE AND SLOWLY DRAIN INTO BASIN THROUGH WEEP HOLES
- ② TIDAL ART WALL GETS TOPPED AT HIGH TIDE AND DRAINS THROUGH ONE-WAY VALVES AS TIDE RECEDES
- ③ TIDAL ART BASIN
- ④ STAGE
- ⑤ SLOPED LAWN DURING CONCERT
- ⑥ IMPERMANENT ART INSTALLATIONS
- ⑦ SEA LEVEL RISE WATER FEATURES

KEY MAP



This concept came to me after the king tide of December 2020, when the sea wall was over-topped. This created quite a stir and drew excited and worried people to the tidal edge. I wanted to design a piece of tidal art where this experience of the over-topped wall, and the excitement and emotions that come with it, could happen on a daily basis. The potential impact of this is revealed in the quote below:

"We often take things for granted, but this morning's king tide was a reminder of how close to the sea we actually are."

— JOHN RAMOS, CBS KPIX5 BAY AREA REPORTER
DECEMBER 13, 2020

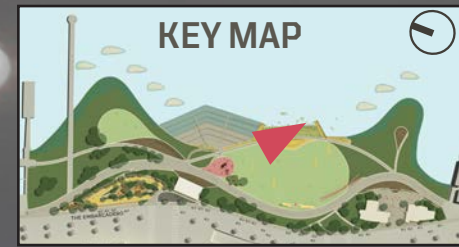


TIDAL ART OBSERVATION WINDOW AT MUSEUM OF IMPERMANENT ART

ONE WAY VALVE THAT HOLDS BACK THE
INCOMING TIDE UNTIL IT SPILLS OVER THE
WALL, BUT LETS THE WATER DRAIN OUT
WHEN THE TIDE IS RECEDING

WINDOW TO SEE
WATER LEVEL

FIRST WALL OVER-TOPPING
HAPPENS THROUGH OLD
PROMENADE GUARDRAIL

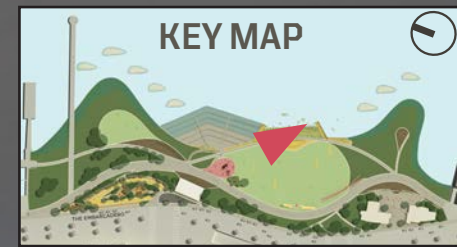


IMPERMANENT ART BY
LOCAL AND GLOBAL ARTISTS

This is the moment of over-topping as seen from the Observation Window in the Museum of Impermanent Art. You can see the water starting to cascade in over the lower points of the wall, almost like a waterfall or a fountain. This is made possible by one-way valves that hold the water out until the wall is over-topped, but then allow the basin to empty with the receding tide. The basin, like the interior museum gallery, would contain artworks from local and global artists that are meant to be destroyed or disappear over a period of time.

TIDAL ART OBSERVATION WINDOW AT MUSEUM OF IMPERMANENT ART

AFTER THE WATER SPILLS IN, THE
OBSERVATION WINDOW REMAINS
SUBMERGED UNTIL THE TIDE RECEDES



After the wall is over-topped, the observation window becomes fully submerged. This underwater museum gallery will be a major attraction and revenue generator, but it also sends an incredibly clear message about climate change. Climate change in the abstract is a difficult concept to swallow. But if the increase of natural disasters recently has taught us anything, it is that sometimes these difficult concepts need to be experienced locally to be fully understood. That is what this installation intends to do.

YERBA BUENA COVE: A PLACE OF PROTECTION

That concludes our walking tour of Yerba Buena Cove. The metaphor of the Cove is not only a reference to the historical context of the site. Coves, throughout history, have been seen as locations of protection. A safe harbor for weary mariners to weather the storm. In that vein, this park offers protection to one of the most beloved shorelines in San Francisco. It offers this protection while enhancing the romantic beauty of the site, regenerating local ecosystems, sequestering carbon, and providing for the local community.

LAYER

- Layer 4: Philosophical
- Layer 3: Recreational
- Layer 2: Ecological
- Layer 1: Functional



A BIG THANK YOU TO...

- CAPSTONE PROFESSORS MEG RUSHING COFFEE, JIM PICKEL, PAMELA BRIEF, AND EILEEN ALDUENDA
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- ALL MY PROFESSORS AND MENTORS OVER THE YEARS
- AND OF COURSE MY FAMILY AND FELLOW STUDENTS THAT GOT ME THROUGH!

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