Natural Shorelines

Natural shorelines include a range of shoreline types and conditions. Fully tidal marshes are either exposed to the open Bay or are protected from wave and tidal energy by offshore mudflats. At the other end of spectrum are muted tidal marshes and ponds, that are protected from the Bay by berms and levees and have water levels controlled by tide gates and other structures. These systems provide an array of ecosystem service benefits, the loss of which will ultimately diminish the value of the Bay Area as a desirable place to live.

Natural shorelines help reduce incoming wave heights, protecting shoreline structures from wind, waves, and tidal energy. Natural shorelines provide buffers to neighboring communities of all kinds, including disadvantaged and vulnerable communities, from sea level rise and storm surge. Their loss can place shoreline communities at greater risk of flooding by increasing the likelihood that structural shoreline protection is overtopped or fails, and can increase the cost of maintaining, repairing and upgrading these already expensive structural protection assets. In addition, many natural shorelines, including tidal and muted tidal marshes and ponds, have been restored and represent a significant financial investment. Many of these areas provide habitat to a number of state-listed or federally threatened and endangered species as well as migrating and wintering birds that rely on them for breeding, foraging, and high tide refuge. Additionally, they offer opportunities to view wildlife, provide access to the shoreline, and offer scenic and aesthetic benefits.

Tidal Marshes

Historically, tidal marshes keep pace with sea level rise by accumulating mineral sediment and by moving upward and landward in the tidal frame. The currently accelerating rates of sea level rise in tandem with the declining concentration of Bay sediment may outpace the capacity of these natural dynamic systems. Furthermore, much of the Bay shoreline, including the project area shoreline, is fairly well developed and there are few opportunities for marshes to migrate inland. Tidal marshes throughout the Bay Area, including those within the project area, are unlikely to survive without support and interventions. Potential support includes increasing sediment supplies, allowing for inland migration, among other protection and restoration measures (http://www.sfei.org/projects/baylandsgoals).

Fifteen tidal marshes were evaluated using the Point Reyes Bird Observatory (now Point Blue Conservation Science) online decision support tool (http://data.prbo.org/apps/sfbslr/) that predicts the conditions under which tidal marshes will “downshift” from higher- to lower-elevation marsh habitat (e.g., from high- to mid-marsh or mid- to low-marsh), and eventually to mudflat. This approach was used because tidal marshes are dynamic nearshore systems and their response to sea level rise depends on a number of physical and biological factors, including the rate of sea

level rise, the current elevation relative to the tidal frame, mineral sediment availability either from the Bay or nearby tributaries, and the rate of organic matter. The sea level rise maps used to evaluate the exposure of other assets in the project area do not account for potential changes in nearshore dynamic processes that will impact natural shoreline systems.

KEY ISSUE STATEMENT

Without improved maintenance, restoration and enhancement, the existing tidal marshes in the project area will be lost between 2070 and 2100 (under high sea level rise and low sediment assumptions). Low sediment supply constrains accretion rates, and the lack of broad transition zone habitat or landward marsh accommodation space constrains marsh migration. High marsh that only floods now during extreme high tides may downshift to mid- and low-marsh by mid-century and convert to mudflat before the end of century as sea level rise rates accelerate. Marsh edge erosion will increase due to greater wind-wave action in deeper water, narrowing marshes such as Stege Marsh in the Central Bay.

ASSET DESCRIPTION

Fifteen tidal marshes of varying size (from 4 to 735 acres) are found along the ART project shoreline typically in locations with gentle slopes, and particularly at creek mouths (Map 1). These marshes are adjacent to a variety of land uses ranging from the urban development, highways, ports, and landfills around Richmond, to the Union Pacific Railroad from Point Pinole to I-80 bridge, to the heavy industry and military activities in the eastern project area. Salt marshes occur west of the I-80 Carquinez Bridge, and brackish marshes on the east.

In Richmond, Meeker Slough/Stege Marsh is located at the mouth of Baxter Creek, which the Berkeley Hills drain into. Wildcat Marsh and San Pablo Marsh are located at the toe of a large alluvial fan formed by Wildcat and San Pablo Creeks.[1]

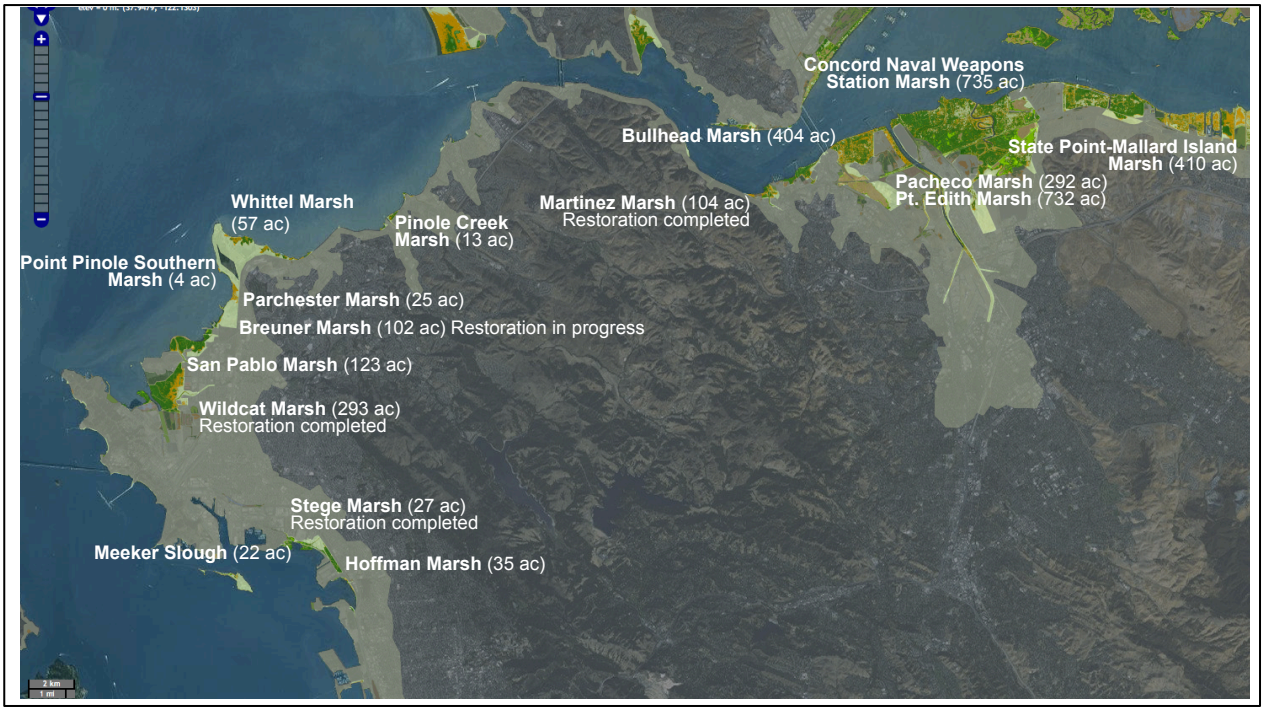
Breuner Marsh and Parchester (also called “Giant”) Marsh are located on the west side of Point Pinole, with a large eelgrass bed offshore. Whittell Marsh is located on the east side of Point Pinole, home to fringe beaches and rocky intertidal areas.

From Point Pinole to the I-80 Carquniez Bridge, a string of very small tidal marshes are located at the mouths of Garrity, Pinole, Refugio, and Rodeo Creeks.

From the I-80 Carquinez Bridge to Martinez, there are no marshes as the shoreline is predominantly steep headlands.

[1] Historically, the creeks meandered, at times joining each other, and shared a large, dynamic marsh.

In Martinez, Martinez Marsh is located at the mouth of Alhambra Creek. Bullhead Marsh, Pacheco Marsh, Point Edith Marsh, and Concord Naval Weapons Station Marsh are large marshes located at the mouths of Walnut and Diablo Creeks and are part of the large Concord Marsh complex, which extends from the I-680 Bridge to Port Chicago. State Point-Mallard Island Marsh is located along the Bay Point shoreline.



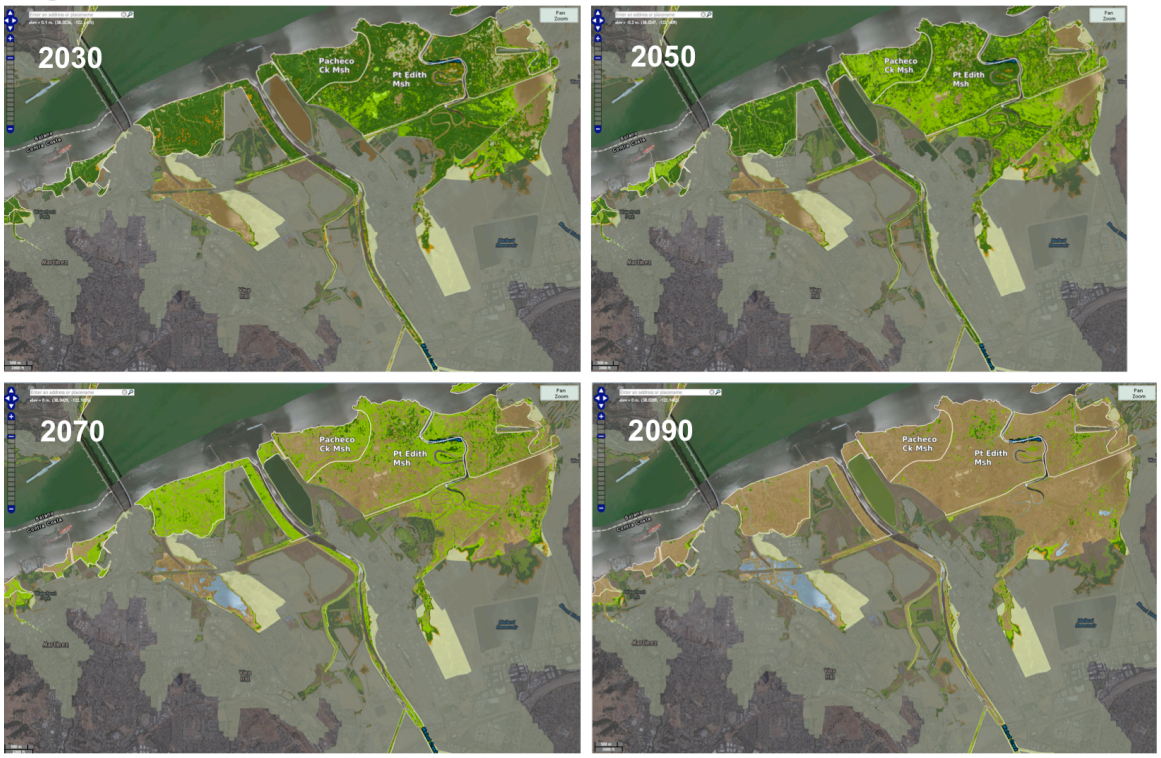
Map 1: Project area showing marsh habitats (http://data.prbo.org/apps/sfbslr/) and status of key projects (http://www.ecoatlas.org/regions/ecoregion/bay-delta). Point Blue Conservation Science (formerly PRBO) relied on previous studies to delineate site boundaries.

Many of the marshes in the project area are managed by East Bay Regional Parks District (EBRPD), which invests more in restoration projects than in annual maintenance and monitoring. For example, EBRPD provided $1,000,000 to restore Breuner Marsh and secured more than 10 separate grants for the remaining $7,500,000. Similarly, to restore Martinez Marsh, EBRPD took advantage of an opportunity to partner with Caltrans, which needed to mitigate impacts related to bridge projects, and the City of Martinez, which needed to reduce flooding impacts to downtown. Most marshes do not have management plans and annual activities may be limited to annual invasive species treatment through the Invasive Spartina Project (for marshes from El Cerrito to Point Pinole).

The largest two marshes in the project area are managed by the California Department of Fish and Wildlife (Point Edith Marsh) and the Department of Defense (Concord Naval Weapons Station Marsh). Available information is limited on Concord Naval Weapons Station Marsh. Point Edith Marsh is currently being investigated through local and

regional planning efforts. Contra Costa County Flood Control and Water Conservation District (CCFC&WCD) is working on the innovative Lower Walnut Creek Restoration Project to reduce current flood risk, improve wildlife habitat, accommodate sea level rise, and provide more recreational opportunities. This work is being conducted in conjunction with the San Francisco Estuary Institute's regional Flood Control 2.0 project, which aims to develop approaches to reconnect watershed freshwater flows and sediment transport to marshes. Increasing the sediment supply to the marsh and identifying transition zone habitat would help Point Edith Marsh build upward or move landward, to avoid drowning as sea level rises.

Sea level rise will increase the depth, duration, and frequency that Point Edith Marsh is flooded, and by 2070 the marsh is predicted to shift to low marsh and mudflat under high sea level rise and low sedimentation assumptions (Map 2). Dominant species in Point Edith Marsh are alkali bulrush, pickleweed, Olney's bulrush, tule, broadleaf cattail,



Map 2: Tidal marsh sustainability based on modeling results for a high sea level rise rate (1.65 m/century or 65 inches between 2010 and 2110) and low sediment supply (50 mg/L) in 2030, 2050, and 2070 (http://data.prbo.org/apps/sfbslr/). Given observed greenhouse gas emissions are exceeding climate change model emission scenarios, high sea level rise rate is shown. Regional experts report this part of the Bay has relatively low sediment supply, and since sediment concentrations in the Bay are declining, the low sediment supply may be closer to natural conditions.

rush, saltgrass, and sedges. The marsh also supports black rails (threatened), Ridgway's rails (endangered), American bitterns, Suisun song sparrows, and thousands of shorebirds and waterfowl. In addition, the marsh provides habitat for the endangered salt marsh harvest mouse. In addition, Point Edith Marsh is currently over 6,000 feet wide and therefore provides a substantial amount of natural flood protection benefits. The Corte Madera study (http://www.adaptingtorisingtides.org/project/corte-madera-baylands-conceptual-sea-level-rise-adaptation-strategy/) and other studies have shown that approximately 1,000 feet of tidal marsh can reduce wave height and energy associated with extreme storm events by over 50%, decreasing the necessary height of the inland flood protection structures. Wider marshes provide even greater natural flood protection benefits, which if no action is taken, could be lost as sea levels rise and the marsh downshifts to mudflat.

VULNERABILITIES

INFO: There is a limited understanding of how tidal marshes and mudflats, and adjacent upland ecotone habitats and subtidal habitats, will respond to accelerating sea level rise, how these habitats will be affected by management actions to increase sediment supply or provide transition zone habitat to support upland migration, or how they will respond to shoreline adaptation measures.

GOV1: Proactive management of tidal marshes, mudflats, adjacent upland ecotone habitats and subtidal habitats to improve resilience to sea level rise and storm events will require review and authorization from multiple local, state and federal agencies, which can be cumbersome and time consuming and often results in limited work windows and/or restrictions on the types of actions that can be taken.

GOV2: Marsh restoration and enhancement projects that include railroad tracks, highways, pipelines, PG&E towers, etc. require additional approvals and coordination

GOV3: The prevailing model of fragmented decision-making, existing natural resources laws, and a history of passive management limits the ability to advance innovative or untested marsh restoration and enhancement actions and nature-based shoreline resilience solutions

FUNC: The wildlife habitat, recreation, flood protection and other ecosystem service benefits provided by tidal marshes will not be sustained if these systems downshift to low marsh or convert to mudflat.

PHYS1: Almost all of the tidal marshes in the project area are mostly mid-marsh and predicted to drown by 2070 (depending on sea level rise rates, sediment supply, and management interventions). The marshes with more high marsh habitat now – Parchester Marsh, Whittell Marsh, Bullhead Marsh, and State Point-Mallard Island Marsh – are predicted to convert to mudflat a few decades later.

PHYS2: All of the tidal marshes except Point Pinole Southern Marsh and Whittell Marsh are bordered or constrained by development and transportation assets, such that there is no accommodation space for them to migrate landward to avoid being squeezed by a rising Bay.

CONSEQUENCES

Society and Equity: Loss of marshes would be a loss of shoreline recreational opportunities since people enjoy views of marshes and the species within them. Natural areas buffer developed areas from inundation, including disadvantaged communities.

Environment: Marshes provide habitat for threatened and endangered species. Storm event flooding makes these species more vulnerable to predation and can reduce reproductive success if nests are flooded. Downshifting habitat means marshes will be flooded more often, exacerbating these population stresses, until conversion of marsh to mudflat results in complete loss of tidal marsh species at this marsh.

Economy: All of the tidal marshes except Hoffman Marsh, Stege Marsh/Meeker Slough, Point Pinole Southern Marsh, and Whittel Marsh are the first line of defense against coastal flooding of adjacent development and transportation assets. Loss of this nature-based flood protection would increase the height and cost of structural shoreline protection.

RESOURCES

California Wetlands Monitoring Workground. EcoAtlas.
http://www.ecoatlas.org/regions/ecoregion/bay-delta

Point Blue Conservation Science and California Landscape Conservation Cooperative. Future San Francisco Bay Tidal Marshes: a Climate-Smart Planning Tool.
http://data.prbo.org/apps/sfbslr/

San Francisco Estuary Institute. Baylands Ecosystem Habitat Goals Project.
http://www.sfei.org/projects/baylandsgoals

San Francisco Bay Conservation and Development Commission, Adapating to Rising Tides Program. 2013. Corte Madera Baylands Conceptual Sea Level Rise Adaptation Strategy.
http://www.adaptingtorisingtides.org/project/corte-madera-baylands-conceptual-sea-level-rise-adaptation-strategy/