Sea Level is Rising

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This article is summarized from Analysis of the Costs and Benefits of using Tidal Marsh Restoration as a Sea Level Rise Adaption Strategy in San Francisco Bay, *prepared by The Bay Institute and ESA/PWA, 2013.*

Between 1900 and 2000 the tide gauge located below the Golden Gate Bridge recorded a sea level rise of almost eight inches. Forecasts published in 2013 by the National Research Council[1] forecast a future rise of approximately 5.7±2.2 inches by 2030, 11±3.6 inches by 2059, and 36±10 inches by 2100. The same report also predicts that "the incidence of extreme high water events (1.4 m above historical mean sea level) in the San Francisco Bay area will increase substantially with sea level rise, from less than 10 hours per decade today to a few hundred hours per decade by 2050 and to several thousand hours per decade by 2100." A 1.4 meter rise is 4.6 feet.

Rising sea levels threaten to submerge portions of tidal marshes at the mouth of Corte Madera Creek, Piper Park, and Hal Brown Park and encroach on low-lying areas along the bay and the estuary of Corte Madera Creek. Sea level rise occurs slowly, but storm surges and waves on top of the baseline sea level account for most flooding from the bay and environmental degradation. Wave energy erodes mud flats and causes the marsh edge to retreat; this can be observed at the Corte Madera Ecological Reserve, where there is no protection from wave action. Marsh edges are eroding along Corte Madera Creek in the fringing marshes and at Piper Park due to high stream flows and wave action.

Scientists at the Bay Conservation and Development Commission used tidal wetlands at the mouth of Corte Madera Creek as a laboratory to evaluate wave attenuation. That information was then used by The Bay Institute (TBI)[2] to compare strategies for reducing the damage from storm surges and wave action.

Their analysis showed that tidal marshes can reduce wave energy in extreme storm events by more than 50%, and that a hybrid flood protection system with a landward levee and an adjacent tidal marsh, called a *horizontal levee* by TBI, provides an equivalent level of flood protection to that of a much larger landward levee alone. The cost of the hybrid system is less than half that of the traditional levee.

To quote TBI (2013):

The greatest threat to developed areas along the shoreline of San Francisco Bay prior to the latter part of the century is from flooding caused by storms occurring during periods of high tides, not from elevated sea levels alone.

Until the latter half of the century it is possible to adapt to sea level rise and protect existing land uses by employing strategic modifications of shoreline management systems.

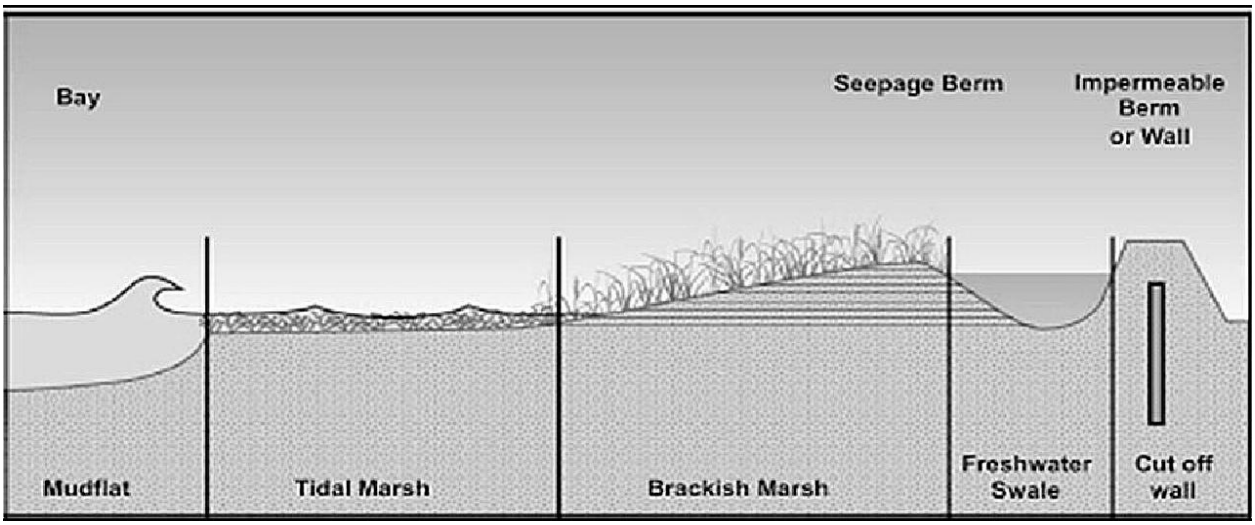
Tidal marshes can provide significant flood protection benefits by reducing wave energy during storms.

Flood protection costs could be reduced by almost 50% by integrating marsh restoration into a new multi-purpose system.

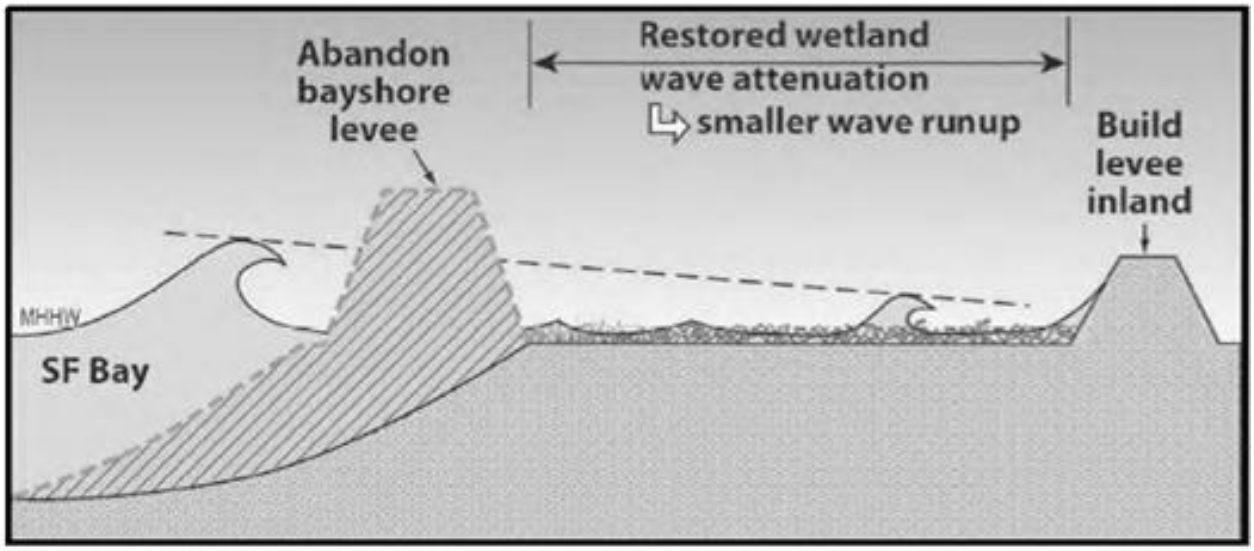
A "Horizontal Levee," a hybrid tidal marsh-flood protection system, can be constructed to keep pace with sea level rise for several decades in critical locations if construction begins immediately.

If construction of the horizontal levee system is delayed for too long, it will be unable to keep pace with expected sea level increases and will fail to provide the desired flood protection and habitat benefits.

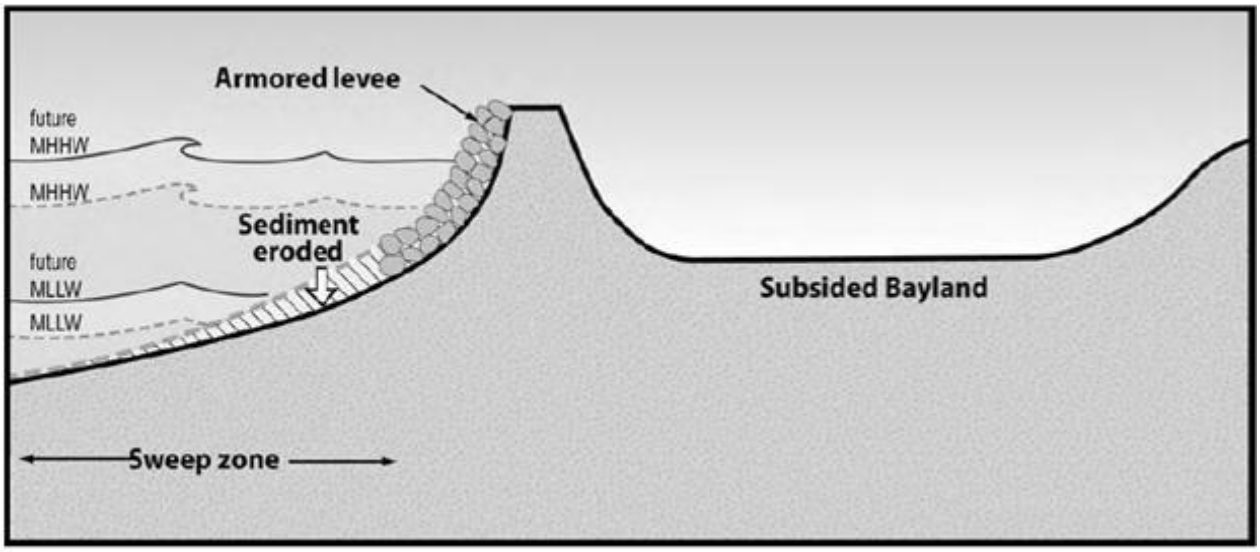
Potential locations for horizontal levees or a simpler version with a sloped transition zone without a freshwater swale in our watershed include parcels of College of Marin property filled by the Army Corps of Engineers when the Corte Madera Creek Flood Control Project was constructed. Lot 13 and the vacant parcel used as an informal dog park would be ideal locations to implement TBI's ideas, creating new tidal wetlands and reducing flood risk for homes, businesses, and College of Marin facilities nearby. These would be complex projects requiring long periods to plan and obtain permits and funding. When Corte Madera Creek is next dredged – probably sometime in the next decade – the spoils could be used to construct berms. It would take a few years for the vegetation to become established, and weed control, irrigation, and perhaps protection for big storms during this period would be needed. It is time to start planning now. However, sea level rise for perhaps half a century could be accommodated.



Horizontal Levee: *The horizontal levee, shown in cross-section, incorporates a tidal marsh, a brackish marsh, a freshwater swale, and an impermeable berm or wall. It is effective at attenuating wave height for two main reasons. First, the roughness of the marsh vegetation dissipates wave energy and reduces wave height. Second, the slope of the brackish marsh dissipates more wave energy. As sea level rises, the tidal marsh would accrete sediment and gradually move up the face of the brackish marsh. This would slow down the loss of tidal marsh caused by rising sea level and preserve the additional benefits of the tidal marsh: carbon sequestration, water quality improvements, and habitat for wildlife and fish. Graphic courtesy The Bay Institute and ESA/PWA.*



Marsh and Levee: *An alternative without the freshwater swale and brackish marsh provides wave attenuation, but not the resilience to sea level rise. It is an option if a horizontal levee is not feasible. Even where there are no bayshore levees, this could be an option to reduce flood risk as sea level rises. Graphic courtesy The Bay Institute and ESA/PWA.*



Traditional Levee: *A traditional levee allows waves to reach the levee at full height. The detailed studies show that traditional levees must be twice as high as the impermeable berm of a horizontal levee to provide the same level of flood protection. Graphic courtesy The Bay Institute and ESA/PWA.*

Friends of Corte Madera Creek Watershed P.O. Box 415, Larkspur, California 94977
info@friendsofcortemaderacreek.org