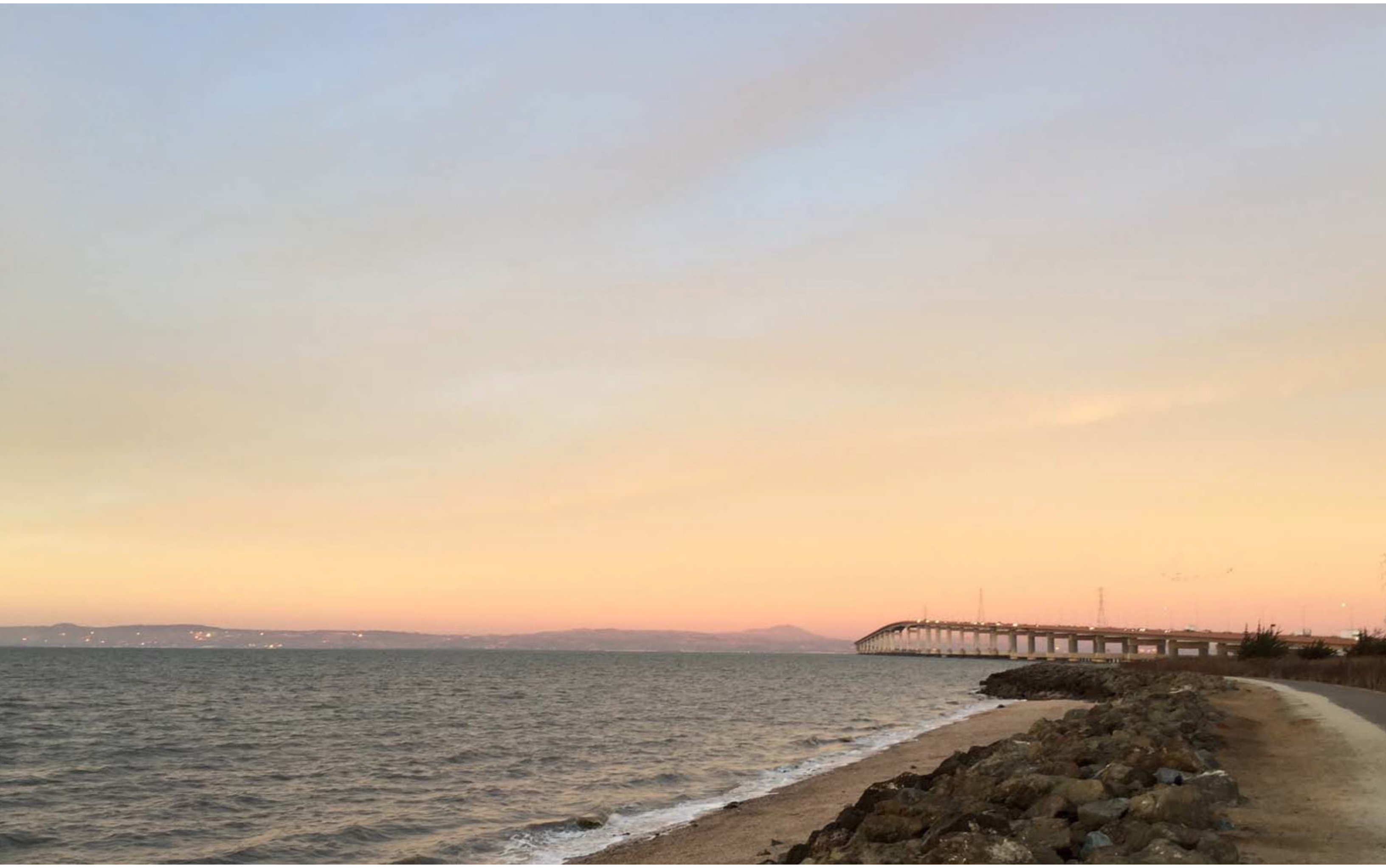
FOSTER CITY LEVEE PROTECTION PLANNING AND IMPROVEMENTS PROJECT

Response to Comments Document

Capital Improvement Project No. 301-657
State Clearinghouse No. 2016012012



Prepared for:

City of Foster City

March 2017

URBAN PLANNING PARTNERS INC.

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Prepared for the City of Foster City

By:

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With:

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March 2017

URBAN PLANNING PARTNERS INC.

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I. INTRODUCTION

A. PURPOSE OF THE RESPONSES TO COMMENTS DOCUMENT

This Response to Comments (RTC) document has been prepared to document responses to comments received on the Draft Environmental Impact Report (Draft EIR) prepared for the proposed Foster City Levee Protection Planning and Improvements project (State Clearinghouse #2016012012). The Draft EIR identifies the likely environmental consequences associated with the implementation of the proposed project, and recommends mitigation measures to reduce potentially significant impacts. This RTC document includes: a short description of the environmental review process, the comments received on the Draft EIR and responses to those comments, and text revisions to the Draft EIR in response to the comments received and/or to amplify or clarify material in the Draft EIR.

This RTC document, together with the Draft EIR, constitutes the Final EIR for the proposed Foster City Levee Protection Planning and Improvements project.

B. ENVIRONMENTAL REVIEW PROCESS

According to CEQA, lead agencies are required to consult with public agencies having jurisdiction over a proposed project and to provide the general public with an opportunity to comment on the Draft EIR. The City of Foster City ('the City') circulated a Notice of Preparation (NOP) that briefly described the proposed project and the environmental topics that would be evaluated in the Draft EIR. The NOP was initially published and submitted to the State Clearinghouse on January 5, 2016. The 30-day public comment period for the scope of the EIR lasted from January 5, 2016 to February 4, 2016. A revised NOP was issued on August 12, 2016 in light of modifications to the project scope which included a slight deviation from the original project footprint and the addition of a third levee improvement type (conventional flood wall). The revised NOP was circulated for a 30-day public comment period through September 12, 2016. The NOP was sent to the State Clearinghouse, responsible and trustee agencies, organizations, and interested individuals. A public scoping session for the project was held on February 4, 2016 in conjunction with a Planning Commission meeting. Comments received by the City on the NOP at the public scoping session were taken into account during the preparation of the EIR. NOP comments were received from the State Department of Transportation (Caltrans), California State Lands

Commission (CSLC), San Francisco Bay Conservation and Development Commission (BCDC), Pacific Gas and Electric Company (PG&E), State Clearinghouse and Planning Unit, FEMA, Amah Mutsun Tribal Band, and one Foster City resident. The NOPs and comment letters are included in Appendix A of the Draft EIR.

The Draft EIR was published on November 23, 2016 and distributed to applicable local and State agencies. Copies of the Notice of Availability of the Draft EIR (NOA) were mailed to all individuals previously requesting to be notified of the Draft EIR, in addition to those agencies and individuals who received a copy of the NOP.

The 45-day public comment period for the Draft EIR began on November 23, 2016 and ended on January 12, 2017. A public hearing was held for the Draft EIR following the comment period, on January 19, 2017. Nine members of the public and one Planning Commissioner provided comments during this hearing. Their comments and the City's responses are provided in *Chapter III, Comments and Responses*, of this document.

C. DOCUMENT ORGANIZATION

This RTC document consists of the following chapters:

Chapter I: Introduction. This chapter discusses the purpose and organization of this RTC document and the Final EIR, and summarizes the environmental review process for the project.

Chapter II: List of Commenting Agencies, Organizations, and Individuals. This chapter contains a list of agencies, organizations, and persons who submitted written comments or spoke at the public hearing on the Draft EIR during the public review period.

Chapter III: Comments and Responses. This chapter contains reproductions of all comment letters received on the Draft EIR as well as a summary of the comments provided at the public hearing. A written response for each CEQA-related comment received during the public review period is provided. Each response is keyed to the preceding comment.

Chapter IV: Text Revisions. Corrections to the Draft EIR necessary in light of the comments received and responses provided, or necessary to amplify or clarify material in the Draft EIR, are contained in this chapter. Text with <u>underline</u> represents language that has been added to the Draft EIR; text with ~~strikeout~~ has been deleted from the Draft EIR. Revisions to figures are also provided, where appropriate.

II. LIST OF COMMENTING AGENCIES, ORGANIZATIONS, AND INDIVIDUALS

This chapter presents a list of letters and comments received during the public review period of the Draft EIR and describes the organization of the letters and comments that are included in Chapter III, Comments and Responses, of this document.

A. ORGANIZATION OF COMMENT LETTERS AND RESPONSES

During the 45-day comment period, the City received written comments from seven agencies and three individuals. This RTC document includes a reproduction of each written comment letter (or email) in its entirety received on the Draft EIR and a summary of comments made at the public hearing before the Planning Commission. Written responses to each comment are provided. Written comments received during the public review period on the Draft EIR are provided in their entirety.

The comment letters are numbered consecutively following the A, B, and C designations. The letters are annotated in the margin according to the following code:

State, Local and Regional Agencies:	A#
Individuals and Organizations:	B#
Public Hearing:	C#

The following agencies and individuals provided written or verbal comments.

State, Local, and Regional Agencies

A1	San Francisco Bay Regional Water Quality Control Board*	January 19, 2017
A2	The Alameda County Flood Control & Water Conservation District	January 12, 2017
A3	California State Coastal Conservancy	January 12, 2017
A4	California State Lands Commission	January 11, 2017
A5	San Francisco Bay Trail	January 10, 2017
A6	Governor's Office of Planning and Research State Clearinghouse and Planning Unit	January 9, 2017
A7	California Department Of Transportation	January 5, 2017

Individuals

B1	The Law Offices Of Mark C. Watson, P.C. representing the Runcos	January 12, 2017

B2	Bonnie Rosseau	January 9, 2017
B3	Bob Cushman	December 23, 2016
Planning Commission and Public Hearing		
	Stephen Baker	January 19, 2017
	Lori Runco	January 19, 2017
	Leslie Flint	January 19, 2017
	Sam Runco	January 19, 2017
C1	Mark Watson	January 19, 2017
	Dirik Liepold	January 19, 2017
	Christina Toms	January 19, 2017
	Shivum Kapoor and Galen Guo	January 19, 2017
	Dorothy Pearl	January 19, 2017
	Commissioner Dan Dyckman	January 19, 2017
	Commissioner Paul C. Williams	January 19, 2017
	Commissioner Ollie Pattum	January 19, 2017
	Chairman Richard Wykoff	January 19, 2017

* Comment letter received after the close of the 45-day public comment period which ended on January 12, 2017. The City is not obligated to respond, but has nonetheless provided a response.

III. COMMENTS AND RESPONSES

Written responses to all comments on the Draft EIR are provided in this section. Letters received on the Draft EIR are provided in their entirety. Each letter is immediately followed by a response keyed to the specific comment. Please note that text within individual letters that has not been numbered does not raise environmental issues or relate to the adequacy of the information or analysis within the Draft EIR. As a result, no comment is enumerated or response required, per *CEQA Guidelines* Section 15132.

A. STATE, LOCAL, AND REGIONAL AGENCIES

CALIFORNIA
Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

San Francisco Bay Regional Water Quality Control Board

Sent via electronic mail and
provided at public meeting

January 19, 2017

City of Foster City
610 Foster City Boulevard
Foster City, CA 94404
Attn: Curtis Banks, Community Development Director
cbanks@fostercity.org

Subject: Comments on the Draft Environmental Impact Report for the Foster City Levee Protection Planning and Improvement Project

Dear Mr. Banks:

The San Francisco Bay Regional Water Quality Control Board (Water Board) appreciates the opportunity to comment on the Draft Environmental Impact Report (DEIR) for the Foster City Levee Protection Planning and Improvement Project (Project). The purpose of the project is to increase the height of Foster City's (City) perimeter levees such that they provide flood protection in accordance with updated Federal Emergency Management Agency (FEMA) guidelines, thereby retaining FEMA accreditation for the levee system.

The Proposed Project recommends a hybrid approach incorporating three different levee improvement types (sheet pile floodwall, earthen levee, and conventional floodwall) along the roughly 8-mile long levee alignment, which the City broke down into 8 different segments. The proposed locations and extents of the different levee types differ depending on whether or not the improvements are designed to accommodate anticipated sea level rise (SLR) in 2050 or 2100 on top of FEMA freeboard. The Proposed Project also includes a minor deviation from the levees' existing alignment in Segment 4. Other alternatives assessed in the DIER include:

- ***No Project/No Build Alternative***, which assumes the project would not be developed and the existing levee would remain in its current condition.

- ***Existing Levee Footprint 2050 Sea Level Rise Alternative***, which assumes the same type/location of improvements as the Proposed Project, without the Segment 4 alignment deviation.

- ***Horizontal Levee 2050 Sea Level Rise Alternative***, which assumes a portion of the levee would be replaced on its bayward side with a gradually sloped "horizontal levee" or "ecotone slope" that would support tidal wetlands under post-project and with-sea-level-rise conditions.

- ***FEMA Freeboard Alternative***, which assumes the same type/location of improvements as the Proposed Project, except with lower top elevations to accommodate only FEMA freeboard, and not anticipated sea level rise.

On November 18, 2016, Water Board staff met with representatives from the City and its consultants Schaff & Wheeler (engineering) and Huffman-Broadway Group (regulatory compliance) to discuss the Project. On Wednesday, November 30th, and Thursday, December 1st, 2016, Water Board Senior Scientist Christina Toms distributed information to the City and its consultants describing alternative approaches to levee shoreline softening from the "horizontal levee" concept assessed in the DEIR. Our comments below are meant to build upon these earlier remarks.

Sea Level Rise, Coastal Squeeze, and Impact Assessment

Sea level rise poses a number of threats to the built and natural communities along the San Francisco Bay shoreline. Rising seas threaten the integrity and functionality of shoreline flood protection structures such as levees and sea walls, as well as the ecosystem services provided by the shoreline's wetlands, beaches, mudflats, and related habitats. A growing body of evidence demonstrates that as sea levels in the estuary rise, these habitats will be "squeezed" between rising Bay waters and urbanized or otherwise hardened shorelines.[1] Recent modeling[2,3] indicates that tidal wetlands, in particular, will find it difficult to accrete mineral and organic sediment fast enough to keep pace with rising sea levels, resulting in their gradual drowning (e.g. downshifting from high marsh to low marsh, low marsh to mudflat, etc.), except in areas with enough room for wetlands to transgress upslope over upland habitats. In an estuary that has already lost the vast majority of its wetlands, beaches, and related shoreline habitats due to human activities, "coastal squeeze" will exacerbate the negative impacts on beneficial uses of the estuary that are described in the Water Board's Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan). The loss of extensive tidal wetlands fringing the Bay would not only decrease water quality and wildlife habitats

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[1] Goals Project. 2015. The Baylands and Climate Change: What We Can Do. Baylands Ecosystem Habitat Goals Science Update 2015 prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. California State Coastal Conservancy, Oakland, CA .

[2] Stralberg, D., M. Brennan, J. C. Callaway, J. K. Wood, L. M. Schile, D. Jongsomjit, M. Kelly, V. T. Parker, and S. Crooks. 2011. Evaluating tidal marsh sustainability in the face of sea-level rise: a hybrid modeling approach applied to San Francisco Bay. PloS ONE 6:e27388.

[3] Schile, L.M., J.C. Callaway, J.T. Morris, D. Stralberg, V.T. Parker, M. Kelly. 2014. Modeling tidal marsh distribution with sea level rise: Evaluating the role of vegetation, sediment, and upland habitat in marsh resiliency. PLoS ONE 9(2): e88760

throughout the Bay, but reduce the wetlands' ability to attenuate wave energy and protect the shoreline from storm surge flooding and erosion.[4]

The Preferred Project described in the DEIR relies almost entirely on shoreline hardening/armoring to improve levee performance, by proposing sheet pile or conventional walls along the top of most of the roughly 8-mile-long levee alignment (the 2050 SLR scenario includes small segments of earthen levees which are eliminated in the 2100 scenario). The DEIR also hints at the placement of additional rock armoring along portions of the shoreline, but the extent and nature of this armoring is not made clear. By implementing a shoreline hardening strategy instead of one that could facilitate estuarine transgression, the Preferred Project will over time exacerbate coastal squeeze along the more than half of the Foster City shoreline that supports beaches, tidal wetlands, tidal-terrestrial ecotones, and associated habitats. This will result in significant negative impacts to the beneficial uses of San Francisco Bay and Belmont Slough, including marine and estuarine habitats, habitat for rare and special-status species, 1
commercial and sport fisheries, and more. In addition, recent research by Prof. Mark Stacey at UC Berkeley indicates that shoreline hardening in the South Bay may exacerbate tidal flooding elsewhere in the Bay, by magnifying the effects of the South Bay's "bathtub" bathymetry and tidal hydrodynamics. The DEIR fails to describe these potentially significant impacts, which would result in the degradation of water quality and beneficial uses of San Francisco Bay and Belmont Slough. As a responsible agency under the California Environmental Quality Act (CEQA), the Water Board is obligated to comment on shortcomings in the DEIR, including impacts and mitigations that should be included in the DEIR (CEQA §15096(b)(d)). We request that the City revise the DEIR to describe the short-term, long-term, and cumulative impacts of shoreline armoring on water quality and beneficial uses, and propose mitigation measures to avoid, minimize, and/or offset these impacts.

Reasonable Alternatives to Shoreline Hardening

The irony of the proposed hardening of the Foster City shoreline is that it already includes some of the finest examples in San Francisco Bay of "soft" shorelines, systems dominated by coarse sediment (sand, gravel, shell) that attenuate wave energy, provide valuable habitat for resident and migratory shorebirds and waterfowl, and are highly desired by residents and visitors for their recreational and aesthetic values. The soft shorelines of the City are primarily beaches and ridges formed by (1) coarse shell from the Central Bay that has been exposed, due to the gradual erosion of overlying Bay Muds and then transported via wave action, and (2) coarse shell from historic shell-rich dredge spoils placed bayward of the City roughly in-between Marlin Avenue and Foster City Boulevard (the Foster City Shell Bar, or FCSB). Though the volumes of shell being mobilized in the area have not been quantified, they are significant enough to drive the net bayward growth of the FCSB – one of the few locations in the estuary where beaches are experiencing net growth. Similar coarse shoreforms can be found

[4] San Francisco Bay Conservation and Development Commission and ESA PWA. 2013. Corte Madera Baylands Conceptual Sea Level Rise Adaptation Strategy. May 8.

throughout this region of the Bay, particularly along Outer Bair Island and the eastern end of Bird Island.

As we have previously discussed with the City and its consultants, coarse shoreforms such as beaches and shell ridges were once common throughout the Bay, but have largely been lost due to human manipulation of the shoreline. The ecological value of these features is underscored by the DEIR's statement that the FCSB *"is one of the most important shorebird habitats in the South Bay… [and is] probably the most important wintering site for red knots in the South Bay."* The wave attenuation functions provided by the FCSB are similarly underscored by the fact that proposed sheet wall elevations in the vicinity of the shell bar (Segment 4) are lower than in areas with similar wave exposure and no coarse bayward shoreforms (Segments 2 and 3). The multiple benefits of coarse shoreforms have made them the focus of increasing attention throughout the Bay, with projects in San Mateo, Albany, Richmond, Corte Madera, and Mill Valley (among others) all considering the application of coarse shoreforms as a strategy to attenuate wave energy, reduce flood vulnerability, increase resilience to sea level rise, and improve shoreline habitats.

As a responsible agency under CEQA, the Water Board is obligated to comment on additional alternatives that should be included in the DEIR (CEQA §15096(b)(d)). These alternatives must be reasonable, and feasibly attain the objectives of the Project while avoiding or substantially lessening its significant effects (CEQA §15126.6). The DEIR includes an alternative which replaces a portion of the proposed sheet pile under the Proposed Project (Segment 2) with a horizontal levee. The assessed "horizontal" (gradually sloped) levee has a 30:1 bayward slope extending into San Francisco Bay approximately 400 ft from the existing shoreline, resulting in the fill of approximately 100 acres of intertidal and subtidal mudflats. The DEIR states that a horizontal levee was considered for this segment *"because there is significant wave action"* among other reasons. For multiple reasons, including the locally significant wave action and depth profile of offshore mudflats, a horizontal levee in this location is an unreasonable alternative. Horizontal or otherwise gradually sloped levees are most effective where they can be placed landward of existing tidal wetlands or intertidal mudflats, and where significant wave energy would not result in the development of scarps and similar erosional features. The persistence and growth of the shell bar bayward of Segment 4 (as well as the persistence of shell ridges with similar wave climates at Outer Bair Island) demonstrates that existing physical processes along the shoreline are better suited to sustaining coarse shoreforms than tidal wetlands. 2

Employing the same criteria that were used to identify the horizontal levee alternative, a coarse shoreform alternative is much more reasonable, feasible, and effective, with fewer short-term, long-term, and cumulative impacts on biological resources and water quality. Due to the wave attenuation properties of coarse shoreforms, their application may also result in the need for relatively lower levee/sheet pile top elevations, which may also reduce Project costs and construction-related impacts. Finally, coarse shoreforms would provide a broader range of aesthetic and recreational benefits than the alternatives currently assessed in the DIER. We therefore request that the City develop a Project alternative that maximizes the application of coarse shoreforms such as beaches, shell ridges, and similar features bayward of the existing shoreline, and revise the DEIR to reflect the analysis of this alternative. 2

Mitigation Requirements

The California Wetlands Conservation Policy (Executive Order W-59-93), also known as the No Net Loss Policy, has been incorporated into the Water Board's Basin Plan. The State's No Net Loss Policy is to ensure no overall net loss and to achieve a long-term net gain in the quantity, quality, and permanence of wetlands acreage and values. As such, once impacts to waters of the State have been avoided or minimized to the maximum extent practicable, we will require compensatory mitigation for temporary and permanent impacts to waters of the State that complies with the No Net Loss Policy.

The Draft EIR states that "USACE jurisdictional areas must be replaced at a minimum 1:1 ratio through wetland creation (preferably at a Mitigation Bank)" and that to offset wetland impacts, "the Permittee shall either purchase mitigation credits from an authorized mitigation bank or implement a Permittee-responsible mitigation plan and establish or restore wetlands". It is the Water Board's preference to compensate for wetland impacts through onsite creation or restoration of the same type of wetlands as the impacted wetlands (referred to as in-kind mitigation). Each site is reviewed on a case-by-case basis and there is no predetermined set of ratios used to determine mitigation. Factors that the Water Board considers in determining whether a mitigation 3
proposal is acceptable and adequately compensates for lost acres, linear feet, and functions include: temporal losses; whether mitigation is in-kind or out-of-kind; whether mitigation is onsite or offsite; indirect impacts to wetlands; loss of or impacts to special status species and their associated habitats; the period of time required for full development of created/restored wetlands; delays in the construction/restoration of mitigation wetlands; and the likelihood of success of the created/restored wetlands. Regarding the purchase of mitigation bank credits, the only mitigation bank in the project's service area is the San Francisco Bay Wetland mitigation bank. This mitigation bank only has credits for tidal wetlands or other waters, and would be considered out-of-kind mitigation resulting in higher mitigation ratios required. Finally, regardless of the mitigation measures that are adopted in the Final EIR, the Water Board may identify additional mitigation requirements as part of our permitting process.

We appreciate the opportunity to comment on the DEIR, and look forward to working with the City during future Project phases. Please contact Christina Toms at 510-622-2506 or christina.toms@waterboards.ca.gov with any questions or comments.

Sincerely,

Naomi Feger
Chief, Planning Division

Cc: USACE: Katerina Galactos, katerina.galactos@usace.army.mil
BCDC: Erik Buehmann, erik.beuhmann@bcdc.ca.gov
CDFW: Randi Adair, RADAIR@dfg.ca.gov
City of Foster City: Jeff Moneda, jmoneda@fostercity.org
Huffman-Broadway Group: Terry Huffman, thuffman@h-bgroup.com
Schaff & Wheeler: Charles Anderson, canderson@swsv.com

LETTER A1
San Francisco Bay Regional Water Quality Control Board
Naomi Feger, Chief, Planning Division
January 19, 2017

Response A1-1. The comment notes that the project relies almost entirely on shoreline hardening/armoring to improve levee performance and states concern that this will exacerbate "coastal squeeze" along the City's shoreline and result in significant negative impacts to the beneficial uses of the San Francisco Bay and Belmont Slough.

Foster City's shoreline is already almost entirely armored with an existing levee, and where exposed to wave-driven wave action, there is rock slope protection (riprap). As discussed on page 49 of the Draft EIR, the project would follow the same alignment as the existing levee, other than a deviation landward for a relatively short segment. The project would not further encroach into San Francisco Bay and there would be no additional shoreline armoring relative to the existing baseline condition other than the potential temporary removal and replacement in-kind of the existing riprap layer to facilitate construction as necessary (see page 73 of the Draft EIR). Any necessary riprap removal and replacement would be conducted from the landward side of the levee. To reiterate, Foster City would not implement a shoreline hardening strategy. Rather, Foster City would be adding freeboard to an already hardened shoreline without exacerbating the hardening.

The San Francisco Bay Regional Water Quality Control Board's (RWQCB) comment suggests that as sea levels in the bay estuary rise, various habitats will be "squeezed" between rising bay waters and urbanized or otherwise hardened shorelines. The City does not necessarily disagree with this assertion, but notes that Foster City's shoreline is already hardened. The project does not exacerbate this squeeze effect and therefore, the potential impacts listed in the RWQCB's comment letter related to "coastal squeeze" would not be a result of project implementation.

This comment also states that recent research by Professor Mark Stacey at UC Berkeley indicates that shoreline hardening in the South Bay may exacerbate tidal flooding elsewhere in the bay, often referred to as the "bathtub effect." The project design team has been in contact with Dr. Stacey at UC Berkeley to discuss his research on the bay and its applicability to the project. Dr. Stacey clarified that he refers to "shoreline hardening" as preventing the bay from encroaching into an area currently subject to tidal flooding. He does not consider improvements to already hardened or armored shorelines, such as the Foster City levee, to be "shoreline hardening" because these shorelines are already protected against encroachment from tidal flooding. Because the existing Foster City levee does not experience overtopping during a 100-year tide event, Foster City is not currently subject to tidal flooding and therefore the project would not prevent the bay from encroaching into an area currently subject to tidal flooding. Therefore, Dr. Stacey believes that raising the Foster City levee to add freeboard would not have any impact on water levels elsewhere along San Francisco Bay shoreline. As such, the proposed improvements to Foster City's existing levee would not exacerbate tidal flooding elsewhere in the bay or contribute to the so-called bathtub effect.[1]

Since the project would not harden the shoreline of San Francisco Bay beyond existing conditions, the project would not contribute to the "coastal squeeze" described in the comment letter. Furthermore, as further explained in response A2-2, the project would not exacerbate future sea level rise. For these explicit reasons, the project would not result in significant negative impacts to the beneficial uses of San Francisco Bay or Belmont Slough. Potential impacts to existing wetlands and tidal terrestrial ecotones that are less than significant with mitigation measures are disclosed on pages 233-236 of the Draft EIR.

The project would in fact result in several beneficial uses of the San Francisco Bay or Belmont Slough including new landscaping to prevent erosion as described on page 316 of the Draft EIR. The project would also implement measures to protect water quality during project construction including Construction Best Management Practices (BMPs), a Storm Water Pollution Prevention Plan (SWPPP), supervision by a Qualified SWPPP Practitioner (QSP), and water quality monitoring, as described on pages 321-324 of the Draft EIR.

In addition, the Bay Trail would be replaced in-kind or improved; the new trail would be 14–16 feet wide (10 feet paved with a 2-foot shoulder on each side and an additional 1 foot of shoulder adjacent to vertical walls where feasible) (see page 320 of the Draft EIR). Furthermore, the project would not result in significant impacts to special-status plant, animal, or fish species. While the Draft EIR identifies potentially significant impacts to Ridgway's rail, salt marsh harvest mouse, and California black rail these impacts would be mitigated to a less-than-significant level by implementation of Mitigation Measure BIO-1a (Draft EIR pages 228-231), which would limit levee construction times and locations and employ a qualified biological monitor.

Response A1-2. The comment requests that the City develop a project alternative that maximizes the application of coarse shoreforms such as beaches, shell ridges, and similar features bayward of the existing shoreline, and revise the Draft EIR to reflect the analysis of this alternative.

In response, the City points out that the energy dissipating effect of existing beaches, shell ridges, and other coarse shoreforms present along the Foster City bayfront are included in the project design (as noted by the comment, top of wall elevations are generally lower

[1] Stacey, Dr. Mark, 2017. Personal communication with Schaaf & Wheeler, February 2.

where such features are present), but such features are not, in and of themselves, effective at sufficiently breaking the wave energy as necessary to achieve the primary project objective of retaining Federal Emergency Management Agency (FEMA) accreditation of the levee system. It should also be noted that the conditions of this project site are different than existing examples of coarse shoreform levees. The Foster City levee is unique in that it is located in an urban environment in close proximity to the San Francisco Bay and Belmont Slough with some buildings located as close as 15 feet away from the existing levee on the landward side as shown in Figure 1 below.

FIGURE 1 EXISTING URBAN CONDITIONS ADJACENT TO LEVEE SYSTEM

Source: Schaaf & Wheeler, 2017

Furthermore, constructing new coarse shoreforms and offshore breakwaters constitutes the placement of fill within San Francisco Bay and therefore would likely not be permitted by the US Army Corps of Engineers (as one example). The US Army Corps of Engineers requires that the least environmentally damaging practicable alternative be implemented. Constructing new coarse shoreforms, more particularly the offshore breakwaters necessary to replace increased levee elevations, would involve the placement of fill and therefore would likely not be considered to be the least environmentally damaging practicable alternative in Foster City in comparison to the proposed project which involves no placement of fill. As such, an alternative incorporating the construction of new coarse shoreforms and offshore breakwaters was not considered as a feasible alternative in the Draft EIR.

Facilitating estuarine transgression as described in this comment is also considered infeasible, as such facilitation would involve encroaching into properties of Foster City that are currently protected by the existing levee, and therefore would not meet the basic project objective of providing flood protection to Foster City that meets FEMA standards for retaining levee accreditation.

The RWQCB's comment that the horizontal levee alternative studied in the Draft EIR is not a feasible alternative is duly noted.

Response A1-3. The RWQCB's No Net Loss policy and its preference for in-kind on-site mitigation of wetlands is noted. The mitigation measure related to compensation of wetland impacts is detailed in Mitigation Measure BIO-3 on pages 235-236 of the Draft EIR. The mitigation measure recognizes that offsetting the project's wetland impacts could entail implementation of a permittee-responsible mitigation plan that establishes or restores wetlands within uplands along the levee alignment. The mitigation measure recognizes that details of such compensation would be developed and approved as part of the Section 404-401 permit process for the project and suggests means under consideration by the City to accomplish the required mitigation as follows: "A permittee-responsible mitigation plan will consider means of incorporating an ecotone levee or horizontal levee feature consisting of a gently-sloped levee designed to mimic the transition from wetlands to uplands and that would provide flood protection, wildlife habitat (including transitional and refugial habitat for Ridgway's rail and salt marsh harvest mouse) as well as water quality benefits. Such a levee may be feasible in areas adjacent to the City's Phase II Sedimentation Basin in the southern portion of segment 5 and the eastern portion of segment 6." In any case, the City understands and accepts that the resource agencies with jurisdiction over the project (including the RWQCB) will determine mitigation ratios during the permitting process and further notes the RWQCB's stated criteria for approving mitigation plans as part of its Section 401 permitting process.

Letter A2

Flood Control & Water Conservation DISTRICT

Daniel Woldesenbet, Ph.D., P.E., General Manager

399 Elmhurst Street • Hayward, CA 94544 • (510) 670-5480 • www.acgov.org/pwa

January 12, 2017

City of Foster City
Curtis Banks, Community Development Director
610 Foster City Boulevard
Foster City, California 94404

Subject: Alameda County Flood Control & Water Conservation District Comments on City of Foster City's Draft Environmental Impact Report for the Foster City Levee Protection Planning and Improvements Project

Dear Mr. Banks:

Thank you for the opportunity to review the City of Foster City's (Foster City's) Draft Environmental Impact Report for the Foster City Levee Protection Planning and Improvements Project (Project).

The Alameda County Flood Control & Water Conservation District's (District's) mission is to support the public safety, health, and welfare of the residents and businesses of Alameda County by developing and maintaining functional and appropriate flood control systems. Alameda County has the longest San Francisco Bay shoreline of any entity in the Bay area, spanning about 75 miles, from Albany to Fremont.

Foster City's Project is approximately 10 miles due west from the Alameda County shoreline. The District respectfully submits the following comments for consideration.

Project Understanding

We understand that Foster City's Project entails modifying the City's existing levee system to satisfy two main objectives: (1) protect the City from flooding associated with levee overtopping from extreme high tides (stillwater or storm surges) and/or wave run-up in response to FEMA's preliminary Flood Insurance Rate Mapping (FIRM), released on August 13, 2015, and (2) protect the City from flooding in response to future increases in sea level.

To accomplish these objectives, the City is proposing to construct a combination of three different levee improvement types, depending on the location along the existing levee: sheet pile floodwall, earthen levee, or conventional floodwall. Per your draft EIR, in order to achieve the first objective, the minimum elevation of the modified levee would need to range from 12.5 to 16.5 feet NAVD 88. To achieve the second objective, the modified levee elevation would need to range from 13.5 to 21.5 feet NAVD 88.

Hydrology and Hydrodynamics of the San Francisco Bay

Several sophisticated hydrodynamic models of the San Francisco Bay, including FEMA's San Francisco Bay Regional Model and USGS's Costal Storm Modeling System (CoSMoS), now enable a much clearer understanding of the effects of extreme tides, storm events, and water-shoreline interaction. 1

Research and modeling has demonstrated that shoreline modifications in one part of the San Francisco Bay will likely have a significant impact on the hydrodynamics in other parts of the Bay. If one jurisdiction builds higher levees or seawalls, for example, the San Francisco Bay waters – and the energy carried by waves, currents, and tides – will be transferred to other jurisdictions.

Impacts on Adjacent Areas

The District recognizes and honors an agency or organization's right to protect the lands over which it has jurisdiction. However, the District is very concerned that Foster City's levee modifications will cause higher San Francisco Bay water levels along Alameda County's and other jurisdictions' shorelines, many of which are already significantly vulnerable to current extreme tides and future sea level rise. Impacts from the Foster City levee modifications may or may not be small, but the cumulative impacts of Foster City's Project combined with other future shoreline projects around the San Francisco Bay will exacerbate these effects on others. 2

Please note that, for fluvial flooding scenarios, FEMA currently considers any action that causes 0.1 feet (1.2 inches) of water level increase an impact. FEMA has not yet established standards for the San Francisco Bay, but the same criterion should apply for shoreline water level increases.

Sea Level Rise as a Regional Issue

There is wide consensus among people and organizations involved in flood protection around the San Francisco Bay that, while considering local flooding vulnerabilities, sea level rise should be treated on a regional or sub-regional basis. To address sea level rise jurisdiction-by-jurisdiction will result in an acceleration in the adverse impacts to other entities around the Bay. 3

Consider the following hypothetical scenario, which demonstrates an "arms race" in shoreline protection: Jurisdiction A builds higher shoreline levees that cause Bay water levels to increase in other parts of the Bay. Jurisdictions B, C, and D are required to increase the heights of their levees in response, causing additional water level increases to the point that Jurisdiction A's shoreline project is then rendered inadequate.

The District is concerned that, by building these sea walls at this time without fully knowing the impacts to surrounding jurisdictions, Alameda County may suffer significant impacts due to even higher extreme tides and sea level rise than would occur without the construction of the walls. We are also concerned that by constructing Segments 4 and 5 of the seawalls to elevation 21.5, 3
Foster City will be inadvertently establishing a precedent that will cause other jurisdictions around the Bay to have to build to that elevation to protect their own shorelines so that they will not be flooded. In many jurisdictions, raising the San Francisco Bay shoreline to that elevation or constructing walls to that elevation is not only prohibitively costly, but may be impractical, detrimental, or completely infeasible.

Additional Analyses are Needed

The District respectfully requests that Foster City perform hydrodynamic modeling of its Project to evaluate the future impacts on water levels in the San Francisco Bay region, including scenarios that model a combination of storm surge, extreme tides, bathometric effects, wave run-up, and fluvial flooding in all shoreline jurisdictions around the San Francisco Bay. Both the 4
FEMA and USGS hydrodynamic models are available in the public domain, as are detailed LIDAR data sets of shoreline elevations.

The modeling and analyses should also include a collaboration with other Bay Area jurisdictions and/or property owners to consider the cumulative impacts from Foster City's Project in combination with other shoreline projects either currently planned or underway.

District staff would be pleased to discuss our concerns and requests with Foster City staff. Please feel free to contact me (510-670-5553 or hank@acpwa.org) if we can be of assistance.

Sincerely,

Hank Ackerman

Hank Ackerman, PE
Flood Control Program Manager
Alameda County Flood Control & Water Conservation District

LETTER A2
Alameda County Flood Control & Water Conservation
Hank Ackerman, Flood Control Program Manager
January 12, 2017

Response A2-1. The commenter expresses concern that based on hydrodynamic models of San Francisco Bay by FEMA and USGS, shoreline modification activities completed in one part of the bay could have an impact on hydrodynamics at other jurisdictions around the bay, implying that the project could result in flooding in other parts of the bay.

The Draft EIR concludes that the project would not directly or cumulatively alter existing drainage patterns resulting in flooding and would not place structures in a flood hazard area (see pages 316-317 and 324-325 of the Draft EIR). The project's proposed levee improvements are based on results from FEMA's San Francisco Bay Regional Model originally completed by DHI Group, as described on page 5 of the Draft EIR. Since FEMA levee accreditation is the primary project objective, FEMA's hydrodynamic model is used for design analyses. Other, potentially conflicting, hydrodynamic models were not relied upon. It is noted that FEMA's hydrodynamic model, as is typical with hydrodynamic models, does not address the local on-shore interactions including wave runup. FEMA's San Francisco Bay Coastal Flood Hazard Study (2014) uses the hydrodynamic model to provide estimates of wave heights associated with certain tides in San Francisco Bay. These data are then used to calculate the maximum wave runup associated with the one-percent stillwater elevation at local transects along bay shoreline through a series of "pass points," which are located up to 300 meters offshore depending upon the local bathymetry. Water level (tide) data and wave height data from the hydrodynamic model are taken from the pass point for each transect, and wave transformation and runup calculations are then applied to estimate the maximum wave runup associated with the one-percent stillwater, which is the controlling elevation for FEMA levee accreditation along the reach of Foster City's shoreline exposed to the open bay.

These same data have been used to evaluate the impact of project construction on water levels in San Francisco Bay. This evaluation is further described in response A2-2 below and it is noted that data are transferred from the pass points to the local transects; but never in the opposite direction. Thus changes in the near shore at the levee structures inform wave runup calculations, but not tidal hydrodynamics or wave set up.

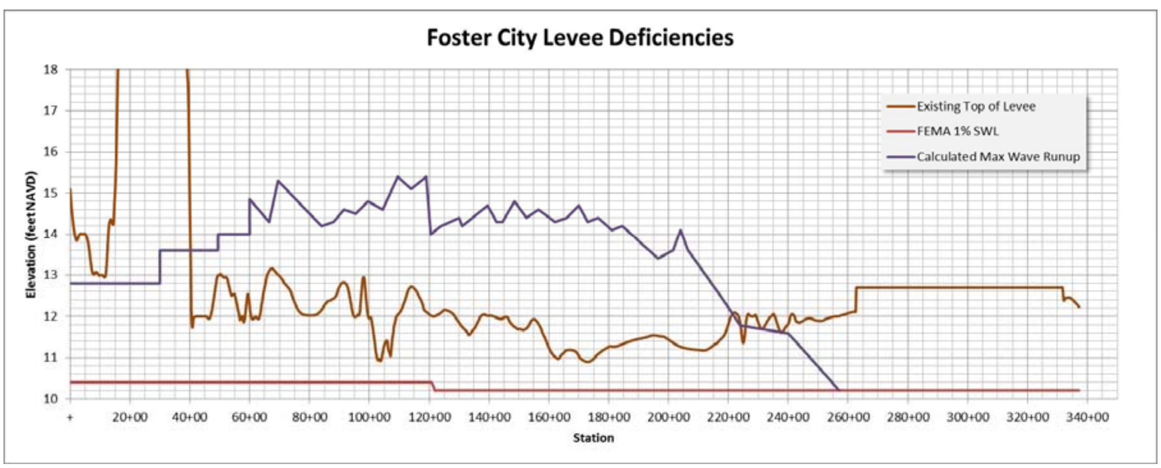
Response A2-2 (below) provides additional information about the type of flooding the project would address, how this flooding was evaluated, and how the proposed levee heights for the project were determined. Please refer to response A2-2 and A1-2 for information about effects of the project at other jurisdictions around the bay, which are on the order of 0.0001 to 0.0002 foot, three orders of magnitude below the comment's identified threshold of significance, and considered negligible.

Response A2-2. This comment raises the concern that modifications to Foster City's levee will cause higher San Francisco Bay water levels along Alameda County's and other jurisdictions' shorelines, implying that the project could result in flooding in other parts of the bay. It also raises concern regarding the potentially cumulative impact of Foster City's project combined with other future shoreline projects around the bay.

The Draft EIR concludes that the project would not directly or cumulatively alter existing drainage patterns resulting in flooding and would not place structures in a flood hazard area (see pages 316-317 and 324-325 of the Draft EIR). Moreover, as explained further below, the project would not substantially alter San Francisco Bay hydrodynamics, including water levels along Alameda County's or other jurisdictions' shorelines.

As shown in Figures III-5 through III-8 of the Draft EIR, the Foster City project improvements are located on top of the City's existing levees. That is, there is no encroachment into San Francisco Bay, defined as the outboard top of levee. As shown in profile (see Figure 2), at no location along the project alignment are high tide elevations associated with the one-percent storm surge anticipated to overtop the existing protective levee. Thus bay tides cannot physically be impeded or redirected by the project. Rather, the levee has inadequate freeboard for FEMA accreditation, both for stillwater surge in some locations and more particularly, for the controlling wave runup. (Existing top of levee elevations shown in Figure 2 are based on a detailed topographic survey conducted in 2016.)

FIGURE 2 EXISTING LEVEE ELEVATION DEFICIENCIES FOR WAVE RUNUP

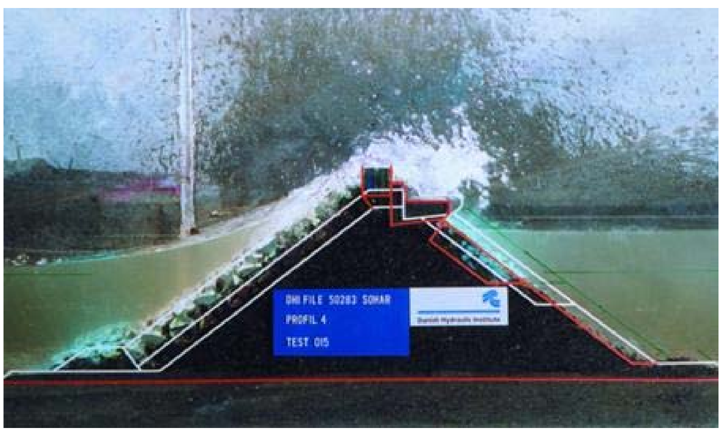


Source: Schaaf & Wheeler, 2017

The project's essential purpose is to provide adequate freeboard to meet the requirements for FEMA levee accreditation and prevent the maximum wave runup associated with a one-percent storm surge from overtopping the levee protection system and inundating the interior of Foster City. Preventing this overtopping is also the project's sole potential impact to San Francisco Bay during a 100-year coastal event.

Two types of wave overtopping can generally occur at a deficient levee system. The first type is referred to as surge overtopping, during which the crest of the levee is exceeded by stillwater and the crest essentially acts as a broad crested weir. This does not occur in Foster City. The second is wave overtopping, during which the levee maintains stillwater freeboard (although not necessarily FEMA freeboard). This does occur in Foster City because the maximum wave runup splashes over the crest. Figure 3 shows typical wave overtopping in a controlled environment. This is what the project would prevent, and the absence of this overtopping thus represents the project's potential impact to flood levels around San Francisco Bay under current conditions.

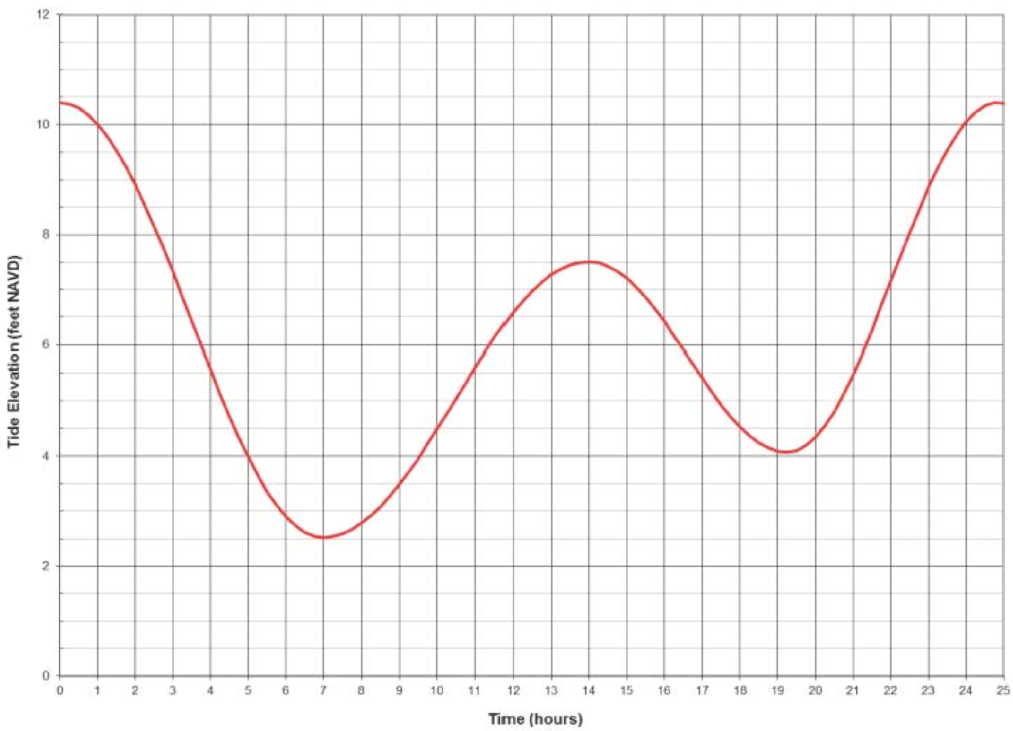
FIGURE 3 WAVE OVERTOPPING



Source: Schaaf & Wheeler, 2017

The 24-hour diurnal tide cycle with high tide elevations of 10.4 feet North American Vertical Datum (NAVD), matching the FEMA California Coastal Analysis and Mapping Program (CCAMP) study results, used for the wave overtopping analysis is presented as Figure 4. Historically recorded storm surge effects have been added to low tide elevations because CCAMP does not specifically address the entire cycle. However, while there are finite probabilities of "rogue" high waves during periods of lower stillwater elevations, which are accounted for in the methodology as described subsequently, the impact of these waves is negligible so the low tide assignment is not critical.

FIGURE 4 100-YEAR TIDE CYCLE



Source: Schaaf & Wheeler, 2017

Wave overtopping volumes are estimated for the two and a half miles of the Foster City levee system exposed to wind driven wave hazards using methodologies presented in the Wave Overtopping of Sea Defences and Related Structures: Assessment Manual[2], the Handbook of Coastal and Ocean Engineering[3], Improvements in Describing Wave Overtopping Processes[4].

Methodologies presented in these publications provide estimates of wave overtopping rates and volumes based on given wave and protective structure characteristics. The portions of Foster City's levees exposed to potential wave overtopping are primarily armored by riprap, with bank slopes ranging from 12 to 30 degrees, averaging 20 degrees. Primary wave characteristics used to estimate overtopping rates include the significant wave height (the height exceeded by one third of a particular wave group) and the average wave period,

[2] EurOtop. 2007. "Wave Overtopping of Sea Defences and Related Structures: Assessment Manual". UK Environment Agency

[3] Schluttrumpf and van der Meer. 2010. "Handbook of Coastal and Ocean Engineering". Chapter 15.

[4] Hughes, Thronton, van der Meer, and Scholl. 2012. "Improvements in Describing Wave Overtopping Processes".

which are used to calculate representative wave "steepness", which is a dimensionless parameter. The breaking parameter (or surf similarity parameter) combines the slope of the structure and the wave characteristics into a single value, generally used to determine breaker type.

To estimate the maximum immediate impact of the proposed Foster City levee improvements on the bay, conservative wave parameters have been chosen to estimate overtopping based on the one-percent tide cycle shown in Figure 4. Offshore pass point data from DHI's hydrodynamic San Francisco Bay Model provide the basis for this impact study.

FEMA's pass-point wave height, period, and depth data are used to perform runup modeling and determine the required floodwall or levee elevations to prevent wave runup overtopping. Results of runup modeling in Matlab provide an estimate of maximum wave runup. A significant wave height of 2.7 feet and a wave period of 3.2 seconds are chosen as conservative parameters, from the DHI pass point data, to estimate the one-percent wave overtopping volume into Foster City for the existing levee system.

With wave characteristics chosen, other parameters must be estimated. The wave steepness is calculated as a ratio of the wave height to the wave length:

$$s_m = \frac{H_{m0}}{\lambda}$$

Wave length is determined from the approximate water depth at the levee toe ($h = 10\ ft$) and the wave period using the wave dispersion relation:

$$\lambda = \frac{g}{2\pi} T^2 \tanh\left(2\pi \frac{h}{\lambda}\right)$$

Sensitivity to water depth is minimal. However 10 feet of depth are assumed to provide a maximum estimate of wavelength, which translates to a more conservative overtopping estimate. The values of various parameters essential to estimating overtopping volume are summarized in Table 1.

TABLE 1 ASSUMED PARAMETERS FOR OVERTOPPING ANALYSIS

Parameter	Symbol	Value
Wave Height	H_{m0}	2.7 ft
Wave Period	T_m	3.2 sec
Wave Length	λ	37.9 ft
Max Stillwater	$SWEL$	10.4 ft NAVD
2% Wave Runup	$R_{2\%}$	4.5 ft
Wave "Steepness"	s_m	0.065
Levee Slope	α	12° - 30°
Break Parameter	ξ_m	Varies

Source: Schaaf & Wheeler, 2017

There is a 2.5-mile stretch of the existing levee system that is subject to overtopping, spanning from the high ground at Mariner's Point on the west end to the shell bench on the east end near the mouth of Belmont Slough (Figure 2). This 2.5-mile stretch is broken into 10 sections, each with a similar average levee slope, and the break parameters and overtopping rates (in cubic feet per foot) are estimated for each section. Two methodologies have been chosen to estimate the mean rate of wave overtopping. The first, formulated by Owen (1980) and updated in the EurOtop overtopping manual, uses empirically derived coefficients for various structure slopes:

$$\frac{q}{T_m * g * H_{m0}} = Q_0 * \exp\left(-b * \frac{R_c}{T_m\sqrt{g * H_{m0}}}\right)$$

q = Mean overtopping rate per foot of structure

R_c = Structure freeboard = $Levee\ Crest\ Elevation - SWEL$

Q_0 & b are empirically derived parameters that vary based on slope for each of the 10 sections

The second method, originally formulated in 1995 by van der Meer, uses previously described levee and wave characteristics in combination with various reduction factors. The "Handbook of Coastal and Ocean Engineering" suggests a deterministic design or safety assessment formulation as follows:

$$\frac{q}{\sqrt{g * H_{mo}^3}} = \frac{0.067}{\sqrt{\tan(\alpha)}} * \gamma_b * \xi_m * \exp\left(-4.3\frac{R_c}{\xi_m * H_{mo} * \gamma}\right)$$

$\gamma = \gamma_b \gamma_f \gamma_\beta \gamma_v$

γ_b = Influence factor for a berm = 1.0 for Foster City

γ_f = Influence factor for slope roughness = 0.6 for rock armoring

γ_β = Influence factor for oblique wave attack = $1 - 0.0033 * \beta = 0.89$
γ_v = Influence factor for a small wall at top of embankment = 1.0 (no wall)

The influence factor for oblique wave attack is formulated based on a β (or wave approach angle) of 32° to account for the variation in shoreline angle and variation in wave approach angle. The variation in wave approach angle averages approximately 10 degrees. This minimizes the influence factor by assuming that waves approach perpendicularly to the average shoreline aspect for at least part of the periods when high tides rise sufficiently close to the levee crest for overtopping to occur.

These two methods provide overtopping rates estimated for 15-minute intervals with varying tidal conditions based on the stillwater cycle (resulting in varying R_c). The method used to estimate overtopping volume uses a statistical approach presented in "Improvements in Describing Wave Overtopping Processes," published in the proceedings of the 2012 Coastal Engineering Conference.[5] The paper presents van der Meer's original assertion that wave overtopping is well represented by the Weibull probability distribution, and discusses improvements for different levee slope ranges and overtopping frequency. Using a method for steeper slopes with somewhat heavier overtopping, a maximum volume is established based on the probability of wave overtopping for the given conditions.

Throughout the entire tide cycle the probability of wave overtopping during each 15-minute period is calculated. For the steepest levee slopes (up to 30°), roughly 52 percent of the predicted wave sets cause appreciable overtopping volumes; for the flattest levee slopes near Mariner's Point (as low as 12°), only 40 percent of the predicted wave sets overtop the levee.

The probability of overtopping is first estimated as:

$$P_{ov} = \exp\left(-\sqrt{-\ln(0.02)} * \left(\frac{R_c}{R_{2\%}}\right)\right)$$

The number of overtopping waves, then, for each 15-minute tide cycle interval is estimated as:

$$N_{ow} = P_{ov} * \frac{15\,min}{T_m/60}$$

This assumes a constant wave period of 3 seconds throughout each interval. Estimating the overtopping volume then requires two parameters:

$$a = 1.13\tanh(1.32b)\left(\frac{q * T_m}{P_{ov}}\right)$$

---

[5] Coastal Engineering Conference. 2012. "Improvements in Describing Wave Overtopping Processes".

$$b = \exp\left(-2.0\frac{R_c}{H_{m0}}\right) + (0.56 + 0.15 * \cot\alpha)$$

In the overtopping volume equation a is a dimensional scale factor that normalizes the Weibull distribution and b is a non-dimensional shape factor. Both are determined based on a fit to empirical data. The mean discharge used to establish the overtopping volume is the higher result of the two previously described methods. Final wave overtopping volume for each 15-minute period is then defined as:

$$V_{max} = a * [\ln(N_{ow})]^{1/b}$$

The two methods of calculating overtopping discharge (q) that is used as an input to the Weibull distribution parameters, are generally very close. The resulting V_{max} from the Weibull distribution is a volume per foot of length for each time step, for each of the ten sections. Therefore, to find the maximum overtopping volume during the entire tide cycle, the 15-minute results are aggregated (integrated) and the maximum value is found. The resulting maximum overtopping volume per unit length for each section is multiplied by the section's length and all sections summed to find the overtopping volume for the entire 2.5-mile stretch of levee vulnerable to wave overtopping. The results of this analysis for each section of the levee are summarized in Table 2.

Construction of the Foster City Levee project is expected to prevent the entry of approximately 23.3 acre-feet of water from San Francisco Bay due to wave overtopping in a 24-hour one-percent storm event, noting that 97 percent of this volume overtops during the 8 hours of highest tide elevations. Under the completed project, this water would remain in San Francisco Bay; under existing conditions it would not.

To analyze the impact of this retained volume of water on the bay, the additional volume is assumed to be evenly spread out over the bay's surface area. Since the surface area of the bay varies based on tidal level, to provide an estimate of the project's cumulative impact in conjunction with other undefined but potential shoreline protection projects, the surface area of the bay at MSL (mean sea level) as defined by the USGS is used. The implicit assumption is that various jurisdictions would generally build protective works so as to remain outside USACE Section 404 jurisdiction, which is defined as MHHW (mean higher high water). The USGS has measured the surface area of the bay and notes that the total surface area of San Francisco bay at MSL is only two percent less than the total surface area at MHHW.[6]

[6] United States Geological Survey (USGS), 2007. San Francisco Bay Bathymetry. Available at: https://sfbay.wr.usgs.gov/sediment/sfbay/geostat.html, accessed February 13, 2017.

TABLE 2 WAVE OVERTOPPING VOLUME

Section	Segment Length (Feet)	van der Meer *q* (cfs/ft)	Owen *q* (cfs/ft)	2-Hour Weibull Volume (Acre-Feet)	8-Hour Weibull Volume (Acre-Feet)	24-Hour Weibull Volume (Acre-Feet)
1	800	0.09	0.10	0.49	0.70	0.72
2	1,600	0.26	0.21	1.96	3.00	3.09
3	2,400	0.27	0.22	3.05	4.68	4.83
4	800	0.33	0.26	1.21	1.89	1.95
5	600	0.18	0.16	0.57	0.86	0.89
6	550	0.13	0.14	0.43	0.63	0.65
7	300	0.25	0.20	0.36	0.55	0.57
8	1,850	0.21	0.18	1.92	2.91	3.00
9	2,300	0.30	0.24	3.23	5.01	5.17
10	2,200	0.12	0.13	1.6	2.34	2.41
			Total	14.8	22.6	23.3

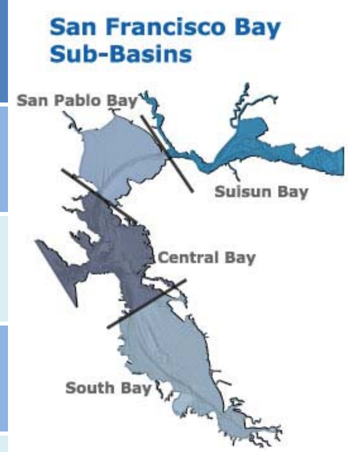
Source: Schaaf & Wheeler, 2017

Table 3 summarizes the impact on bay level based on the cumulative square mileage of each substantial body of water incorporated in the greater Bay Area, working outward from the project location.

The project's impact to bay water levels is negligible and three to four orders of magnitude less than Alameda County's suggested threshold criterion of 0.1 foot. It is noted in passing that this is not a FEMA criterion per se, as FEMA allows riverine floodplains to be within 0.5 foot at tie-in locations for news studies and allows a 1-foot surcharge within a regulatory floodway. A 0.1-foot threshold of significance has been, however, a typical criterion in prior CEQA analyses.

TABLE 3 PROJECT IMPACT ON SAN FRANCISCO BAY BY REGION

Region	Surface Area (Sq. Miles)	Cumulative Surface Area (Sq. Miles)	Increase in WSEL (Feet)
South Bay	165	165	0.00022
Central Bay	126	291	0.00013
San Pablo Bay	106	397	0.00009
Suisun Bay	65	462	0.00008



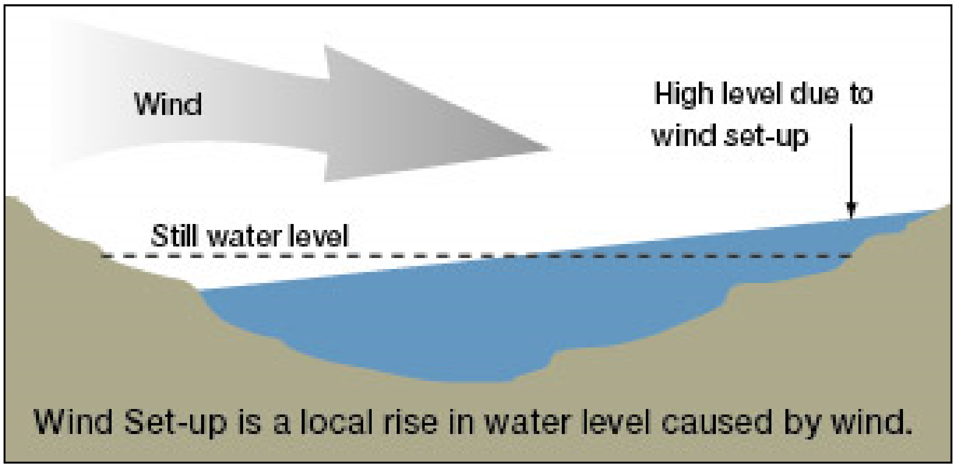
Source: Schaaf & Wheeler, 2017

It is also noted that prevailing winds would also act to render insignificant the impact of increasing freeboard at the Foster City levee system. Generally wave overtopping at Foster City would only occur when waves are directed towards the City's levees with a prevailing southwesterly wind. This condition would generally result in wind-induced setup, or a local rise in water surface downwind and an associated drop in water surface upwind; that is on the levee side of the bay, and in this case specifically, Alameda County. Conversely Alameda County should be more concerned about the impact of wind-driven waves when the prevailing wind is in the northeasterly direction, generally perpendicular to its shores; when at Foster City this prevailing wind is offshore and levee improvements to protect against wave runup are not in play. Figure 5 illustrates this effect.

Lastly, while wave energy reflection would generally increase somewhat with the proposed improvements, this generally remains a less-than-significant localized effect, minimized as is by the armored levee slope. Reflection of a wave occurs with minimum energy loss when a wave is reflected at a right angle, off of a smooth, vertical surface. Because Foster City's existing levees consist of rock-armored slopes with stillwater freeboard, interaction of the wave with the slope can greatly decrease the amount of energy reflected. "Wave Reflection from Coastal Structures"[7] presents compiled data on wave reflection coefficients, relating the breaking parameter to the degree of wave reflection. Because the proposed composite

[7] Zanuttigh and van der Meer, 2006. Wave Reflection from Coastal Structures.

FIGURE 5 OFFSHORE WIND EFFECT ON WAVE SETUP



Source: Schaaf & Wheeler, 2017

improvements do not significantly increase the runup slope under existing tide and wave conditions, the breaking parameter does not increase significantly with the project in place.

Data presented by Zanuttigh and van der Meer also indicate that for Foster City's breaking parameters (generally ranging from 0.5 to 2.0) and rock armored levee structure, the amount of energy reflected is minimal in the first place. With very little impact on the overall composite roughness, runup slope (<1 percent), and breaking parameter, reflection for the proposed composite solution (a small wall placed at the top of the armored slope) would increase by a maximum of just under 5 percent for the steepest portion of the levee (i.e. the highest breaking parameter).

In summary, the proposed project would only negligibly impact bay water levels locally and regionally, and therefore would not significantly impact San Francisco Bay hydrodynamics.

For the same reasons discussed above, and as concluded in the Draft EIR at pages 324-325, the project would not have a cumulatively considerable impact on flooding in other regions of the bay. CEQA Guidelines require an EIR to describe and analyze cumulative impacts only if the impact is significant and the project's incremental effect is cumulatively considerable. This determination is based on the assessment of the project's incremental effects "viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects." 14 Cal. Code Regs Section 15065(a)(3); 14 Cal. Code Regs Section 15355(b). An EIR need not discuss cumulative impacts that do not result in part from the project. 14 Cal. Code Regs Section 15130(a)(1).

As demonstrated above in Figure 5, the project would have only a negligible impact on water levels around the bay, far less than the 0.1-foot water level increase suggested by commenter as a significance threshold. While the commenter references “other shoreline projects around the San Francisco Bay” that when combined with the project would exacerbate the project’s impact on bay water level increases, it does not identify any of these projects specifically and Foster City is not aware of any such projects that rise to the level of a “probable future project” that must be analyzed under CEQA. The City participates in the San Mateo County Vulnerability Assessment and Coastal Hazards Adaptation Resiliency Group (CHARG) meetings and no other participating jurisdiction has put forward any planned improvements for levee projects to include in a cumulative analysis.

Response A2-3. The comment states the opinion that sea level rise should be treated as a state or regional issue and raises the concern that a hypothetical "arms race" amongst jurisdictions to build higher and higher levees will result in water level increases to the point where only the jurisdictions with the highest walls are protected from flooding due to sea level rise.

Note that the primary objective of the project is to retain FEMA accreditation for flood control. While both proposed project scenarios have been developed to address and accommodate varying degrees of anticipated sea level rise, the City points out that sea level rise is anticipated to occur regardless of the completion of the project.

CEQA does not require analysis of the impact of sea level rise on a proposed project. (*Ballona Wetlands Land Trust, et al. v. City of Los Angeles* (2011) 201 Cal.App.4th 455.) “The purpose of an EIR is to identify the significant effects of a project on the environment, not the significant effects of the environment on the project.” (Id.; See also *City of Long Beach v. Los Angeles Unified School Dist.* (2015) 62 Cal.4th 369.) Furthermore, CEQA does not require an EIR to analyze the environmental effects of attracting development and people to a hazardous area, except when the project exacerbates an existing environmental hazard or condition, or when specifically required by statute. (*California Building Industry Association v. Bay Area Quality Management District* (2015) 60 Cal.4th 1086.) None of the statutory exceptions applies to the project nor would the project exacerbate an existing environmental hazard, including flooding.

Please see responses A1-2 and A2-2 concluding that the proposed project would not exacerbate flooding elsewhere in the Bay Area. Please also see response A2-4 addressing commenters request to evaluate the project’s impacts on future water levels due to sea level rise.

Response A2-4. The commenter requests that the City "perform hydrodynamic modeling of its project to evaluate the future impacts on water levels in all shoreline jurisdictions around the San Francisco Bay."

As required by CEQA, the Draft EIR has analyzed the proposed project’s impact of placing structures within a special flood hazard zone that could impede or redirect flood flows relative to existing environmental hazards, and found that impact to be less than significant (see pages 316-317 and 324-325 of the Draft EIR).

This analysis was expanded in responses A1-1, A2-2, and A2-3 and the findings support the conclusion that the project would not alter existing water levels or hydrodynamics of the San Francisco Bay either directly or cumulatively in comparison to the existing baseline.

The commenter requests that modeling be performed to evaluate "future impacts on water levels in the San Francisco Bay, including scenarios that model a combination of storm surge, extreme tides, bathometric effects, wave run-up, and fluvial flooding in all shoreline jurisdictions around the Bay," In essence the commenter is requesting that the project be analyzed in comparison to future, or hypothetical conditions as opposed to existing conditions. This is contrary to the mandate in the CEQA Guidelines which provides that when assessing the environmental impact of a proposed project "the lead agency should normally limit its examination to changes in the existing physical conditions in the affected area as they exist at the time the notice of preparation is published, or where no notice of preparation is published, at the time environmental analysis is commenced." 14 Cal Code Regs Section 15125(a), 15126(a). California case law has made clear that an EIR for a project "must focus on the impacts to the existing environment, not hypothetical situations." (*County of Amador v. El Dorado County Water Agency* (1999), 76 Cal. App.4th.)

It is noted however, that both proposed project scenarios have been developed to address and accommodate varying degrees of anticipated sea level rise, and the City is actively collaborating with the wider Bay Area community regarding a regional response to potential future sea level rise, including the Cities of San Mateo and Redwood City, the CHARG, Sea Change San Mateo, and each regulatory agency with jurisdiction over project construction. The intent of such collaboration is to ensure that sea level rise resilience strategies adopted by the City for this project - above and beyond levee freeboard required for FEMA accreditation - are coordinated with surrounding jurisdictions and the wider Bay Area to the extent feasible.

Letter A3

Carla Violet

From: Curtis Banks <cbanks@fostercity.org>
Sent: Thursday, January 12, 2017 5:06 PM
To: Marlene Subhashini; City Attorney; csteinmetz@adcl.com; Lynette Dias; Carla Violet
Subject: FW: Foster City Levee DEIR - Comments

Importance: High

Curtis

Curtis Banks, AICP
Community Development Director
City of Foster City
610 Foster City Boulevard
Foster City, CA 94404
(650) 286-3239

From: Malinowski, Kelly@SCC [mailto:Kelly.Malinowski@scc.ca.gov]
Sent: Thursday, January 12, 2017 4:38 PM
To: Curtis Banks
Cc: Hilary Papendick; Gerhart, Matt@SCC
Subject: Foster City Levee DEIR - Comments
Importance: High

Hi Mr. Banks,

Thank you for the opportunity to comment on the Foster City Levee Protection Planning and Improvements Project DEIR.

Recently, with support in part from the California State Coastal Conservancy, San Mateo County has conducted sea level rise mapping as a part of their Sea Change San Mateo County effort. Please consult these localized and recently developed resources when finalizing the precise design and height of the project, specifically the 2050 and 2100 scenarios.

The resources available to you are:

1. **Inundation mapping utilizing the Our Coast Our Future model developed by USGS (using their CoSMoS model) which modeled three sea level rise scenarios:**
    a. Baseline/no sea level rise + 1% chance annual flood (present day extreme flood) 1
    b. 3.3 feet of sea level rise + 1% chance annual flood
    c. 6.6 feet of sea level rise + + 1 % chance annual flood
2. **Inundation mapping showing when and where the current levees will be overtopped for the following scenarios, following the Bay Conservation and Development Commission's Adapting to Rising Tides approach (that is being used to conduct these analyses regionally), developed by AECOM:**
    a. MHHW + 12in sea level rise
    b. MHHW + 24in sea level rise
    c. MHHW + 36in sea level rise
    d. MHHW + 48in sea level rise

e. MHHW + 52in sea level rise
f. MHHW + 66in sea level rise
g. MHHW + 77in sea level rise 1
h. MHHW + 84in sea level rise
i. MHHW + 96in sea level rise
j. MHHW + 108in sea level rise

Please let me know if I can be of any assistance in obtaining this information. The contact for this project is Hilary Papendick, CCed here: hpapendick@smcgov.org, and the final report should be released this Spring, though inundation mapping resources are available before then if needed.

Thank you again for the opportunity to comment, and please reach out with any questions.

Best,
Kelly

Kelly Malinowski
Project Manager, San Francisco Bay Area
California State Coastal Conservancy
NOTE NEW MAILING ADDRESS
1515 Clay Street, 10th Floor
Oakland, CA 94612
(p) 510.286.5203 \ (f) 510.286.0470
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LETTER A3
California State Coastal Conservancy
Kelly Malinowski, Project Manager, SF Bay Area
January 12, 2017

Response A3-1. This comment does not address the adequacy of the Draft EIR. No further response is required.

Nonetheless, it is noted that representatives from Foster City and its engineering and design consultants regularly attend local and regional meetings concerning sea level rise as discussed above in response A2-4. The engineering and design team is familiar with the available resources to incorporate resiliency and adaptability to sea level rise in their design, and may consult the listed resources in this comment during the course of detailed project design development. While, as discussed above in response A2-3, CEQA does not require an analysis of impacts from future sea level rise on the project, the City has incorporated sea level rise projections into its adaptive design of both proposed project scenarios and has been meeting with permitting agencies such as the Regional Water Quality Control Board (RWQCB) and the Bay Area Conservation and Development Commission (BCDC) to discuss further design details and their regulatory implications.

STATE OF CALIFORNIA — EDMUND G. BROWN JR., *Governor*

CALIFORNIA STATE LANDS COMMISSION
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January 11, 2017

File Ref: SCH # 2016012012

Curtis Banks
City of Foster City
610 Foster City Blvd.
Foster City, CA 94404

Subject: Draft Environmental Impact Report (EIR) for the Foster City Levee Protection Planning and Improvements Project, San Mateo County

Dear Mr. Banks:

The California State Lands Commission (CSLC) staff has reviewed the subject Draft EIR for the Foster City Levee Protection Planning and Improvements Project (Project), which is being prepared by the City of Foster City (City). The City, as a public agency proposing to carry out a project, is the lead agency under the California Environmental Quality Act (CEQA) (Pub. Resources Code, § 21000 et seq.). The CSLC is a trustee agency for projects that could directly or indirectly affect sovereign lands and their accompanying Public Trust resources or uses. Additionally, if the Project involves work on sovereign lands, the CSLC will act as a responsible agency.

<u>CSLC Jurisdiction and Public Trust Lands</u>

The CSLC has jurisdiction and management authority over all ungranted tidelands, submerged lands, and the beds of navigable lakes and waterways. The CSLC also has certain residual and review authority for tidelands and submerged lands legislatively granted in trust to local jurisdictions (Pub. Resources Code, §§ 6009, subd. (c), 6301, 6306). All tidelands and submerged lands, granted or ungranted, as well as navigable lakes and waterways, are subject to the protections of the common law Public Trust.

As general background, the State of California acquired sovereign ownership of all tidelands and submerged lands and beds of navigable lakes and waterways upon its admission to the United States in 1850. The State holds these lands for the benefit of all people of the State for statewide Public Trust purposes, which include but are not limited to waterborne commerce, navigation, fisheries, water-related recreation, habitat preservation, and open space. On tidal waterways, the State's sovereign fee ownership extends landward to the mean high tide line, except for areas of fill or artificial accretion or where the boundary has been fixed by agreement or a court. On navigable non-tidal waterways, including lakes, the State holds fee ownership of the bed of the waterway landward to the ordinary low water mark and a Public Trust easement landward to the ordinary high water mark, except where the boundary has been fixed by agreement or a court. Such boundaries may not be readily apparent from present day site inspections.

After reviewing the information contained in the Draft EIR, staff has concluded that portions of the Project will extend onto State-owned sovereign lands. The CSLC has several existing leases that include portions of the existing levee and public accessway improvements thereon. The existing leases include:

- Lease No. PRC 8902.9 with the City of Foster City for a portion of a levee and public recreational asphalt pedway; and 1
- Lease No. PRC 7593.9 with the Foster City Estero Municipal Irrigation District for levee improvements and a recreational pathway system.

CSLC staff is conducting additional research to determine if there are portions of the City's levee system outside of the existing lease areas that extend onto State-owned sovereign land, and whether lease amendments will be required. Based on the extent of the Project, CSLC staff will need additional time to make such a determination. As additional information and Project specifics become available, please submit information to Nick Lavoie, Public Land Manager (see contact information below).

Project Description

The City is proposing improvements to the City's levee system to protect properties landward of the levee from flooding by strengthening and elevating the height of the levee system. These improvements are intended to help safeguard the existing levee system from overtopping from high tides and wave run-up. Additionally, these improvements would help the City retain Federal Emergency Management Agency (FEMA) accreditation for its existing levee system. The Project is intended to meet the City's objectives and needs as follows:

- Meet current FEMA standards;
- Expedite permitting and construction of necessary levee improvements to the extent feasible to retain FEMA levee accreditation before accreditation is lost;
- Provide protection from current anticipated sea-level rise, as well as flexibility to adapt to increased levels of protection in the future, as needed;
- Maintain public access and recreational opportunities; and
- Minimize and/or avoid impacts to special-status species and sensitive habitats, such as jurisdictional waters of the United States (U.S.) and State (including wetlands) within San Francisco Bay and on the landward side of the levee system.

While the precise design and height of proposed levee improvements are not yet finalized, the Draft EIR studies two scenarios at an equal level of detail. The scenarios have different ranges of levee elevations and floodwall heights, as needed to meet

FEMA freeboard requirements and protect against future sea-level rise. The two scenarios are:

- FEMA Freeboard with Sea-Level Rise for the Year 2050; and
- FEMA Freeboard with Sea-Level Rise for the Year 2100.

Based on currently available data, preliminary evaluations, and City Council direction as explained in the Draft EIR, CSLC staff understands that the Project would use a combination of three different levee improvement types. The levee types would depend on location and adjacent site constraints, and are described as follows:

- Sheet pile floodwall (Type 1, Figure III-5 in the Draft EIR);
- Earthen levee (Type 2, Figure III-7 in the Draft EIR); and
- Conventional floodwall (Type 3, Figure III-8 in the Draft EIR).

According to the Draft EIR, this hybrid approach (combining improvement Types 1, 2, and 3) would provide the most flexibility for the City to meet current FEMA standards and retain FEMA accreditation, including the City's overall objectives and needs as discussed above.

Environmental Review

CSLC staff requests that the City consider the following comments when preparing the Draft EIR.

Aesthetics

1. Fill and Floodwall Improvements: The Draft EIR explains that once the new levee and floodwalls are constructed, the appearance of the walls could be enhanced with a variety of landscaping and aesthetic treatments. However, the document does not provide further detail regarding the potential types of aesthetic wall treatments that may be used. Please include illustrations or visual simulations of the different wall types (in particular as viewed from the waterside) to provide examples of potential aesthetic treatments. The EIR should include a discussion that any improvements made to the levee should be designed so they blend, rather than contrast, with the natural environment to minimize the visual impacts of the Project. For example, new fill should be similar in color and type as existing fill on the levee, and aesthetic wall treatments should include natural materials and colors that complement and blend into the City's waterfront and San Francisco Bay's visual setting. 2

Biological Resources

2. Mitigation Measure (MM) BIO-1a: MM BIO-1a includes multiple measures to minimize potential effects to Salt marsh harvest mouse (SMHM), Ridgway's rail, and the California black rail. Measures "n" and "o" explain that U.S. Fish and Wildlife Service (USWFS) personnel could inspect work areas for effects to SMHM or Ridgeway's rail, and that any effects to these species would be included in a post-construction compliance report to the USFWS. However, the California black rail is not included in either measure. It is unclear if the California black rail is not included 3

because it is a State listed species, and not a federally listed species. As a State listed species, please clarify if the California Department of Fish and Wildlife would 3 be given similar access to the Project site, as well as a post-construction compliance report.

Climate Change

3. Sea-Level Rise: A tremendous amount of State-owned lands and resources under the Commission's jurisdiction, including portions of the Project, will be impacted by rising sea levels. Please note that when considering a lease application for the Project, CSLC staff will:

   - Request information from applicants concerning the potential effects of sea-level rise on their proposed projects;
   - If applicable, require applicants to indicate how they plan to address sea-level 4 rise and what adaptation strategies are planned during the projected life of their projects; and
   - Where appropriate, recommend project modifications that would eliminate or reduce potentially adverse impacts from sea-level rise, including adverse impacts on public access.

With these Public Trust responsibilities in mind, CSLC staff appreciates the inclusion of sea-level rise information in the Draft EIR. Clarification and expansion of the two scenarios for levee height and design would facilitate the Commission's evaluation 5 of the Project's design and potential vulnerability when considering any new or amended lease application.

The sea-level rise projections used in the Draft EIR for the 2050 and 2100 scenarios are 1.25 feet and 3.83 feet, respectively. These projections are based on the National Research Council's (NRC 2012) regional projections for the City of San Francisco, and planning guidance established by the City and County of San Francisco. Given 6 the high-range estimate of 5.48 feet of sea-level rise by 2100 (as described in NRC [2012] and the State of California Sea-Level Rise Guidance Document [2013]), the City should explain in the EIR why Project design considerations only incorporate 3.83 feet of sea-level rise by 2100. In the 2050 scenario, the Draft EIR also discusses the potential for the levee to be designed to adapt to future sea-level rise, with the option to install a floodwall suitable for the 2100 scenario at a later date. Given this potential for adaptability, as well as the NRC's (2012) high-range sea-level rise estimate of 5.48 feet by 2100, the EIR should explore and describe whether the 2050 7 or 2100 scenarios have the potential to adapt to water levels higher than the estimates used in the Draft EIR.

Additionally, the City should also consider developing a long-term monitoring program to track shoreline changes and monitor other climate change-related impacts (e.g., 8 storms, high tides) on the improved levee system. The information gathered from such monitoring efforts could help identify triggers that might lead to future modifications of the levee system or additional adaptation efforts.

Recreation

4. Temporary Public Access Impacts for Water-Dependent Uses: The Draft EIR explains that the existing pedway (Bay Trail; Class 1 pathway) on the levee crown provides access to San Francisco Bay, Belmont Slough, and Marina Lagoon. Please 9
update the environmental setting for the Recreation section to further explain any existing water-dependent recreation uses associated with access to these waterways, such as, fishing, non-motorized watercraft uses, etc.

   In addition, Mitigation Measure REC-1 explains that detour routes would be provided for the Bay Trail during temporary closures of the trail during construction, to maintain uses specifically for the Bay Trail and minimize associated impacts. However, there is no impact discussion regarding temporary loss of access to 10
adjacent waterways for water-dependent recreation. Please update the Draft EIR to identify and explain any impacts for temporary loss of water-dependent recreation, and if applicable, provide appropriate mitigation.

Thank you for the opportunity to comment on the Draft EIR for the Project. As a responsible and trustee agency, the CSLC will need to rely on the Final EIR for the issuance of any new or amended lease as specified above, and therefore, we request that you consider our comments prior to certification of the EIR.

Please send copies of future Project-related documents, including electronic copies of the Final EIR, Mitigation Monitoring and Reporting Program, Notice of Determination, CEQA Findings, and if applicable, Statement of Overriding Considerations when they become available. Refer questions concerning environmental review to Kelly Keen, Environmental Scientist, at (916) 574-1938 or via e-mail at kelly.keen@slc.ca.gov. For questions concerning CSLC leasing jurisdiction, please contact Nick Lavoie, Public Land Manager, at (916) 574-0452 or via e-mail at nicholas.lavoie@slc.ca.gov.

Sincerely,

Cy R. Oggins, Chief
Division of Environmental Planning
and Management

cc: Office of Planning and Research
K. Keen, CSLC
N. Lavoie, CSLC
L. Calvo, CSLC
J. Mattox, CSLC

LETTER A4
California State Lands Commission
Cy R. Oggins, Chief, Division of Environmental Planning and Management
January 11, 2017

Response A4-1. This comment states that portions of the project are located on State-owned sovereign lands. This comment does not relate to the adequacy of the Draft EIR analysis. The comment will be considered during the permitting and approval process.

Response A4-2. This comment is related to the appearance of fill and floodwall improvements for the project. The commenter would like to see illustrations of the different wall types and a more robust discussion of wall treatments. Below are examples of wall treatments that could be used. In addition, on page 149 of the Draft EIR, Mitigation Measure AES-1 requires a variety of landscaping treatments to help the wall blend in with the surrounding environment. Decisions on the project's final design and aesthetic treatments will take place during the design review process, which will include community meetings and public hearings.




Source: Schaaf & Wheeler, 2017

Response A4-3. This comment requests Mitigation Measure BIO-1a under measures "n" and "o" include State-listed species and clarify if the California Department of Fish and Wildlife (CDFW) would be given similar access to the project site and a post-construction compliance report.

Page 231 of the Draft EIR, Mitigation Measure BIO-1a, is revised as follows:

n. If requested, before, during, or upon completion of construction, the construction contractor will allow access by USFWS <u>and CDFW</u> personnel to the work areas to inspect effects, if any, of the actions on the salt marsh harvest mouse<u>,</u> ~~or~~ Ridgway's rail<u>, or California black rail</u>.

o. ~~Subsequent to construction,~~ <u>T</u>~~t~~he project proponent will submit a compliance report, prepared by the biological monitor(s), to the USFWS <u>and CDFW</u> within 60 days after completion of the work. This report will detail the dates the work occurred; information concerning the success of the actions in meeting the recommended mitigation measures; any effects on the salt marsh harvest mouse<u>, and</u> Ridgway's rail <u>or California black rail</u>; documentation of the worker environmental awareness training; and any other pertinent information.

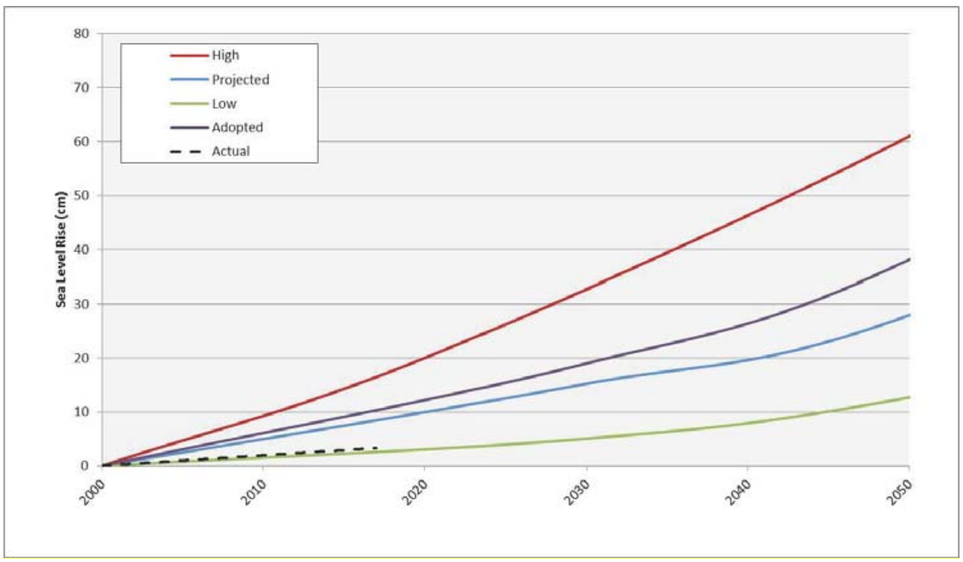
Response A4-4. As noted on page 86 of the Draft EIR, a portion of the Foster City Levee project involves lands under the jurisdiction of the State Lands Commissions. The City is working with the State Lands Commission to determine whether the existing lease is sufficient to permit the proposed improvements or whether an amendment to the existing lease or a new lease will be required. All appropriate considerations will be included during the permitting and leasing process.

Response A4-5. The commenter requests further clarification of the two scenarios for levee height and design. Further details and explanation is provided in responses A6-6 and A6-7.

Response A4-6. The comment requests that the EIR explain why project design considerations only incorporate 3.83 feet of sea level rise by 2100 (when the high range estimate is 5.48 feet of sea level rise by 2100). As discussed in response A2-3, CEQA does not require an analysis of the impact of future sea level rise on a project.

Nonetheless, as discussed on page 56 of the Draft EIR, the project description is based on estimates of projected future sea level rise from the National Research Council's (NRC's) regional projections applicable to San Francisco Bay and planning guidance established by the City and County of San Francisco. The levee/floodwall design scenario elevations use what are considered by the NRC to be the "projected" future sea level rise, plus one standard deviation, plus the full FEMA-required freeboard. FEMA freeboard is set two feet above the 100-year stillwater elevation or one foot above the maximum wave runup associated with the 100-year stillwater, whichever is higher. The 2050 Sea Level Rise scenario would increase the levee height by 0.5–7 feet and the 2100 Sea Level Rise scenario would increase the levee height by 3–10.5 feet (see page 135 of the Draft EIR). Building a project initially resilient to 2100 high range sea level rise would result in the top of levee/floodwall elevation roughly 20 feet above street grade in several locations, which is not considered financially or practically feasible. Furthermore, it is noted in passing that as shown in Figure 6 below, as of now, more than halfway through the initial sea level rise prediction window between 2000 and 2030, sea level rise is tracking closest to the NRC's "low" curve, which is well below the "projected" estimates that the project 2050 and 2100 scenarios incorporate.

FIGURE 6 MEASURED INCREASE IN MEAN SEA LEVEL



Source: Schaaf & Wheeler, 2017

Response A4-7. The commenter requests that the EIR explore and describe whether the 2050 or 2100 scenarios have the potential to adapt to water levels higher than the estimates used in the Draft EIR. As discussed in response A2-3, the EIR need not address the sea level rise impacts on the project. Therefore, this comment is a policy question rather than related to the adequacy of the Draft EIR. However, in connection with their permit authority over the project, the City anticipates that both the RWQCB and BCDC will require the City to demonstrate that its project is resilient to high range sea level rise projections for 2050 and adaptable to high range sea level rise projections for 2100. The NRC's high range sea level rise projections are 2.0 feet for 2050 and 5.5 feet for 2100, respectively. With an average increase in levee height of 5 feet and 8 feet respectively, the 2050 and 2100 sea level rise project scenarios would be resilient against the high range sea level rise projection of 2 feet for 2050. As described in the Draft EIR on pages 63-67, each of the levee improvement types that would be incorporated into either the 2050 or the 2100 sea level rise project scenario include possibilities for adaptation at a later date to protect against higher sea level rise should that prove necessary. These possibilities include adding more fill on top of the earthen levee improvement type, installing a secondary anchor wall to bear higher loading on the sheet pile walls that are initially installed, and the phased construction of offshore features including breakwaters.

Response A4-8. Although this comment does not relate to the adequacy of the Draft EIR, this comment is appreciated. The City will continue to monitor the condition of its levee system. Tracking regional shoreline changes and other climate change related impacts is generally beyond the purview of a municipality. Therefore the City will continue to participate in regionally collaborative efforts where these impacts are evaluated, and respond accordingly.

Response A4-9. This comment requests the environmental setting for the Recreation section be updated with existing water-dependent recreation uses.

Page 396, first paragraph of the Draft EIR, is revised as follows:

> The City of Foster City (City) currently uses the standard of 5 acres of parkland per 1,000 residents as a threshold to measure how well its citizens are provided with park and recreational facilities access. With a 2016 population of 33,201,[8] it is estimated that Foster City currently provides nearly 10 acres of parkland (including recreational waterways) per 1,000 residents, far exceeding the above standard.
>
> <u>Existing water-dependent recreation activities publicly accessible in Foster City near the levee system include Baywinds Park (formerly known as East Third Avenue) for windsurfing and kiteboarding. Access to the water occurs at three primary locations near Baywinds Park. The primary access to the bay is by a steep water entry path in the northern portion of Baywinds Park, near a large astroturf staging area. Access to the water is also available to the south of the park, where a ramp provides access to a small sandy beach. Approximately 0.3 miles from the parking area along the Bay Trail, kiteboarders often access a small beach where wind conditions are more consistent.[9]</u>

Response A4-10. This comment requests the Draft EIR identify and explain any impacts for temporary loss of water-dependent recreation, and if applicable, provide appropriate mitigation.

[8] California Department of Finance, 2016. E-1 Population Estimates for Cities, Counties, and the State. http://www.dof.ca.gov/research/demographic/reports/estimates/e-1/view.php, accessed June 5.

[9] San Francisco Bay Area Water Trail. Baywinds Park (East Third Avenue), 2017. Available at: http://scc.ca.gov/webmaster/project_sites/watertrail/agendas/Baywinds_Reports_20160311.pdf, accessed February 14.

Page 400 of the Draft EIR, Impact REC-1 is revised as follows:

> **Impact REC-1: Construction of the Levee project would temporarily reduce the availability and access of the Bay Trail and water-dependent recreation activities. (S)**

Page 400 of the Draft EIR, Mitigation Measure REC-1, is revised as follows:

> Mitigation Measure REC-1: The Public Works Department shall post signage giving advance notice to recreationists at the locations where water-related recreational activities may be impacted by closures or result in limited access to the waterfront. Additionally, ~~I~~implement Mitigation Measure TRANS-1. (LTS)

Letter A5

January 10, 2017

Mr. Curtis Banks
610 Foster City Boulevard
Foster City, California 94404

Subject: Foster City Levee Protection Planning and Improvements Project

Dear Mr. Banks:

Thank you for the opportunity to comment on the above-referenced document. As you are aware, the San Francisco Bay Trail is a planned 500-mile walking and cycling path around the entire San Francisco Bay. 350 miles are currently in place and enjoyed by countless Bay Area residents.

The Bay Trail Project appreciates the level of detail and attention given to the Trail overall, and to the detours, signage, outreach, and education in particular. It is clear that Foster City residents and visitors depend on and value the Bay Trail for links to and between work, transit, home, and school, in addition to its provision of an easily accessible recreation facility. While the Draft EIR appears to address construction related issues which will necessarily disrupt trail access for the duration, we have the following comments/suggestions.

Finished Trail Width

The Draft EIR states that the Bay Trail will be replaced "in-kind or better" as part of the project, with improvements including observation points, trash cans, benches/seating, and improved access points meeting Americans with Disabilities Act (ADA) requirements. Additionally, the current eight-foot wide path will be replaced by a paved surface ten feet in width with two-foot gravel shoulders and an additional foot of clearance adjacent to the sea wall. The recently released Bay Trail Design Guidelines, which can be downloaded from our website at www.baytrail.org, recommend a minimum traveled width of 12-feet with two-foot shoulders on either side. While this additional width may not be possible with the proposed levee configuration, it is our hope that consideration can be given to a wider path. The level of use the Bay Trail in Foster City receives currently, combined with a reasonable expectation for future increased growth in both commuter and recreational users suggests that more width would be appropriate in this location. 1

Trail Detours

The Bay Trail detour routes depicted in the Draft EIR do not appear to have bike lanes, though they do appear to have right-of-way to accommodate bike lanes in some areas. While Beach Park 2
and Edgewater Boulevard seem to be the logical choices for the detours, given the duration of construction, perhaps temporary bike lanes could be installed to aide safety of cyclists who will now need to share the road with traffic.

Aesthetics

We strongly encourage Foster City to provide attractive landscaping as part of any sea wall construction. Either height option will have visual impacts, and it is important that these impacts be mitigated to the greatest degree possible. The Draft EIR states that interpretive signage will be 3
erected to inform the public about the levee improvement project and we applaud this action. Foster City should also consider a modified/updated version of the interpretive signage to be placed upon completion of the project. Such signage could continue the conversation around climate change and sea level rise.

The Bay Trail Project appreciates being thoughtfully included in the pre-planning for this important levee repair work. We are happy to provide information regarding detours on our website and Facebook page when construction commences. If you have any questions about these comments or about the Bay Trail, please do not hesitate to contact me at (415) 820-7935, or by e-mail laurat@abag.ca.gov.

Sincerely,

Laura Thompson

Laura Thompson
Bay Trail Project Manager

LETTER A5
San Francisco Bay Trail
Laura Thompson, Bay Trail Project Manager
January 10, 2017

Response A5-1. This comment relates to the trail width of the Bay Trail along the Foster City Levee, not the adequacy of the analysis or information within the Draft EIR. No further response is needed. However, concerns regarding the trail width are noted and the City will refer to the San Francisco Bay Trail Design Guidelines and Toolkit updated June 2016, to the maximum extent feasible, for the final construction design.

Response A5-2. As noted at pages 389-392 of the Draft EIR, in Mitigation Measure TRANS-1, a trail temporary closure plan would be put in place and would address bike lane restrictions and closures. In accordance with this plan and the 2014 California Manual on Uniform Traffic Control Devices, bicycle detours and temporary lanes would include signage, accommodations, and markings to further protect bicyclists.

Response A5-3. This comment relates to the merits and components of the design of the proposed project. As noted on page 149 of the Draft EIR, Mitigation Measure AES-1 requires landscaping treatment and/or variations of wall treatments to help reduce any adverse impacts related the new levee wall. See response A4-2 for more detail and examples of possible wall treatments. Furthermore, concerns regarding the trail design, interpretive materials, and signage will be addressed in the final design.

STATE OF CALIFORNIA—CALIFORNIA STATE TRANSPORTATION AGENCY EDMUND G. BROWN Jr., Governor

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January 5, 2017

SCH # 2016012012
GTS # 04-SM-2016-00065
SM- 92 - R13.597

Mr. Banks
City of Foster City
610 Foster City Boulevard
Foster City, CA 94404

Foster City Levee Protection Planning improvements Project – Draft Environmental Impact Report

Dear Mr. Banks:

Thank you for including the California Department of Transportation (Caltrans) in the environmental review process for the Foster City Levee Protection Planning improvements Project. In tandem with the Metropolitan Transportation Commission's (MTC) Sustainable Communities Strategy (SCS), the Caltrans' mission signals a modernization of our approach to evaluate and mitigate impacts to the State Transportation Network (STN). Caltrans' *Strategic Management Plan 2015-2020* aims to reduce Vehicle Miles Travelled (VMT) by tripling bicycle and doubling both pedestrian and transit travel by 2020. Our comments are based on the Draft Environmental Impact Report dated November 2016.

Project Understanding

The purpose of the project is to provide flood protection in accordance with updated Federal Emergency Management Agency (FEMA) guidelines and regain FEMA accreditation for its existing levee system. Current FEMA guidelines require the current levee elevation along the city's levee system to be raised to protect the city from flooding associated with levee overtopping from extreme high tides or storm surges. In addition, the improved levee system will be designed to adapt to future sea level rise while maintaining public access along the levee system and protections for sensitive species. The precise design and height of the project is not yet finalized; therefore, the environmental analysis studies two scenarios at an equal level, which would have different ranges of levee elevations/floodwall heights as needed to meet FEMA freeboard requirements and protect against future sea level rise. The two scenarios are: (1) FEMA Freeboard with Sea Level Rise for the year 2050, and (2) FEMA Freeboard with Sea

Level rise for the year 2100. Based on currently available data, preliminary evaluations, and City Council direction, the City anticipates that the project will utilize a combination of three different levee improvement types, depending on the location along the existing levee and the adjacent site constraints: (1) sheet pile floodwall, (2) earthen levee and (3) conventional floodwall.

The project would not generate a substantial number of trips, or alter circulation patterns upon completion. Construction activity would occur between the hours of 8:00 a.m. and 5:00 p.m. on weekdays unless deviations from this schedule were approved in advance by the City. Haul trucks would travel between the construction staging areas and levee access points and a nearby quarry i.e., Pilarcitos Quarry, which is located 12 miles from the project site on State Route (SR) 92 near Half Moon Bay. Haul trucks would be required to leave the project site by 4:00 p.m. to avoid traveling during the peak evening commute period (4:00 to 6:00 p.m.) when traffic volumes are the highest. Truck trips would be added to the morning commute period but they would not be added to intersections that currently operate near or over capacity during morning peak-hour. No more than 20 workers, including the haul truck drivers, would travel to/from the project sites at one time during the construction period. Workers traveling to the project site in their private vehicles would arrive just before and leave shortly after the hours of construction (8:00 a.m. to 5:00 p.m.).

Lead Agency

As the lead agency, City of Foster City is responsible for all project mitigation, including any needed improvements to state highways. The project's fair share contribution, financing, scheduling, implementation responsibilities and lead agency monitoring should be fully discussed for all proposed mitigation measures. This includes any required improvements to the STN or reductions in VMT which should be completed prior to issuance of the Certificate of Occupancy. The Department will not issue an Encroachment Permit until our concerns are adequately addressed, we strongly recommend that the City of Foster City work with both the
applicant and the Department to ensure that our concerns are resolved during the California 1
Environmental Quality Act (CEQA) process, and in any case prior to submittal of a permit application. See the end of this letter for more information on the Encroachment Permit process.

Transportation Management Plan

Where vehicular, bicycle, and pedestrian traffic may be impacted during the construction of the 2
proposed project requiring traffic restrictions and detours, a Caltrans-approved Transportation Management Plan (TMP) is required. Pedestrian and Bicycle access through the construction zone must comply with the Americans with Disabilities Act (ADA) regulations (see Caltrans'
Temporary Pedestrian Facilities Handbook for maintaining pedestrian access and meeting ADA 3
requirements during construction at:

http://www.dot.ca.gov/hq/construc/safety/Temporary_Pedestrian_Facilities_Handbook.pdf

(See also Caltrans' Traffic Operations Policy Directive 11-01 "Accommodating Bicyclists in Temporary Traffic Control Zones" at: www.dot.ca.gov/trafficops/policy/11-01.pdf).

All curb ramps and pedestrian facilities located within the limits of the project are required to be brought up to current ADA standards as part of this project. The TMP must also comply with the requirements of corresponding jurisdictions. For further TMP assistance, please contact the Caltrans District 4 Office of Traffic Management Operations at (510) 286-4579. Further traffic management information is available at the following website: 4

www.dot.ca.gov/hq/traffops/trafmgmt/tmp_lcs/index.htm.

Truck Traffic Congestion

Please address the following concerns with regards to construction trips:

- Draft Environmental Impact report (DEIR): Page 386; Figure V.K-4: Please provide intersection analysis and 95th percentile queuing analysis using demand volumes with the added truck trips for these intersections:
  - Fashion Island Boulevard/SR 92 Eastbound off-ramp
  - Edgewater Blvd / SR 92 Westbound off-ramp
  - If the two on-ramps at "Chess Drive/ Westbound SR 92, and Fashion Island Boulevard/ Eastbound SR 92" are the only access to SR 92 the project needs to provide ramp analysis. Otherwise, how do hauling trucks access SR 92 to go to their destination at Pilacitos Quarry in Half Moon Bay? 5
  - Chess Drive/SR 92 Westbound off-ramp, during AM peak hour:
    - If the result of analysis shows that truck hauling activity impacts these ramps during AM peak hours, the hauling impacts must be mitigated.
  - Metro Center Boulevard/SR 92 Eastbound off ramp, during AM peak hours:
    - If the result of analysis shows that truck hauling activity impacts these ramps during AM peak hours, the hauling impacts must be mitigated.
- For intersections near the SR 92 / Foster City Blvd interchange, the simulation results from the Vissim Micro Simulation Model do not accurately replicate the actual traffic conditions at the four intersections. Our data shows that these ramps are congested during peak hours. The model must use demand volumes instead of output volumes to replicate the existing condition at these intersection. 6

- The project should provide freeway segment analysis for the entire truck route shown on figure V.K-4. Figure V.K-4 shows the truck hauling route starts at beginning of San Mateo Bridge and continues on to and from Pilarcitos Quarry in Half Moon Bay. 7

- For the construction duration of the project, the project-generated truck trips along SR 92 should occur between the hours of 9:30 AM and 2:30 PM only. 8 This is to avoid causing an impact on SR 92 during the morning and evening commute periods.

Cultural Resources

Caltrans disagrees with City of Foster City's finding of "Less-than-Significant" (Draft EIR Section D.4.b, page 251) for the Foster City Levee System. The Foster City Levee System is eligible for inclusion in the California Register of Historical Resources under both Criteria 1 and 3. This project will re-engineer the levee, increasing its height by 33%-95% along its entirety. Following the project, the original engineering of the levee will no longer be discernable and 9 therefore it appears that the project will significantly affect the historical integrity of the levee system and it will likely no longer be eligible for inclusion of the California Register of Historical Resources. It would appear the project will have a Substantial Adverse Change on the Foster City Levee System. It is recommended that the City of Foster City conduct additional analysis of the project's potential to have a Substantial Adverse Change on the Foster City Levee System and revise Section D.4.b accordingly.

It is also recommended that follow up phone calls be placed to the Native American tribes and individuals that the City of Foster City has already contacted for the project as the use of 10 multiple forms of contact is the professional standard for ensuring that Native American groups and individuals are provided adequate opportunities to respond. Although the project area contains no known archaeological sites, it has a moderate to high potential for submerged archaeological sites. According to the Draft EIR, the sheet piles used for the levee will be driven approximately 10 to 20 feet deep. It is recommended that the City of Foster City considers subsurface testing for submerged archaeological resources along the levee where sheet piles will 11 be installed.

Transportation Permit

Project work that requires movement of oversized or excessive load vehicles on State roadways 12 requires a Transportation Permit that is issued by Caltrans. To apply, a completed Transportation Permit application with the determined specific route(s) for the shipper to follow from origin to destination must be submitted to:

> Caltrans Transportation Permits Office
> 1823 14th Street
> Sacramento, CA 95811-7119.

See the following website for more information about Transportation Permits:

http://www.dot.ca.gov/trafficops/permits/index.html

Encroachment Permit

Please be advised that any work or traffic control that encroaches onto the State right-of-way
(ROW) requires an Encroachment Permit that is issued by Caltrans. Traffic-related mitigation 13
measures should be incorporated into the construction plans prior to the encroachment permit process. To apply, a completed Encroachment Permit application, the adopted environmental document, and five (5) sets of plans clearly indicating State ROW must be submitted to the address below. Traffic-related mitigation measures should be incorporated into the construction plans prior to the encroachment permit process.

David Salladay, District Office Chief
Office of Permits, MS 5E
California Department of Transportation, District 4
P.O. Box 23660
Oakland, CA 94623-0660

See the following website for more information:

http://www.dot.ca.gov/trafficops/ep/index.html

Thank you again for including Caltrans in the environmental review process. Should you have any questions regarding this letter, please contact Jannette Ramirez at 510-286-5535 or jannette.ramirez@dot.ca.gov.

Sincerely,

PATRICIA MAURICE
District Branch Chief
Local Development - Intergovernmental Review

c: State Clearinghouse

LETTER A6
State of California Department of Transportation
Patricia Maurice
District Branch Chief, Local Development – Intergovernmental Review
January 5, 2017

Response A6-1. The commenter notes that the City is responsible for any required improvements to state highways. As specified in the list of project approvals on page 85 of the Draft EIR, the City must seek an encroachment permit from Caltrans prior to the beginning of construction. The Levee project would involve some improvements beneath the San Mateo Bridge/SR 92 where the existing levee is located. The City met with Caltrans on February 24, 2017 to discuss their concerns which have been addressed in responses A6-2 through A6-13.

Response A6-2. This comment notes that a Transportation Management Plan is required to be prepared where traffic may be impacted during construction.

Page 389 of the Draft EIR, Mitigation Measure TRANS-1, is revised as follows:

> Implementation of the following mitigation measure would reduce this impact to a less-than-significant level:
>
> Mitigation Measure TRANS-1: The Levee project shall include a Bay Trail closure plan prepared by the project contractor and reviewed by the City of Foster City Public Works Department and/or the project team that includes recommended detour routes, appropriate signage and striping, and public outreach strategies, as detailed in this section for each phase of construction. <u>A Transportation Management Plan, approved by Caltrans, shall also be prepared.</u> The Bay Trail closure plan shall be consistent with the standards and guidelines listed below, including the 2014 California MUTCD, the San Mateo County Resource Guide, the Bicycle Technical Guidelines, and Caltrans Standards. Additionally, the closure plan shall include a plan for Memorial Benches currently located along the Bay Trail that would include either re-locating or placing them in the same location (depending on final design details and final wall heights).

Response A6-3. The comment notes that pedestrian and bicycle access through the construction zone of the proposed project must comply with the Americans with Disabilities Act (ADA) regulations.

Page 392 of the Draft EIR, Mitigation Measure TRANS-1, is revised as follows:

- Post a sign giving bicyclists advance notice of all bike path closures and of all other detours of more than 0.5 mile. Two weeks' notice of path and roadway closures is recommended.
- A schematic of the detour route shall be posted at the beginning of the detour if the detour route is complex or there are a lot of non-local users of the facility (e.g., a regional trail).
- <u>All pedestrian and bicycle access points will be constructed to City standards, which are consistent with ADA regulations.</u>

Additional guidance and figures, including appropriate signage and striping for constructions zones and detour routes, is included in Appendix F.

Response A6-4. See responses A6-1, A6-2, and A6-3.

Response A6-5. The comment requests intersection analysis and queuing analysis with respect to the impact of construction trips on certain SR 92 off-ramps. As discussed in the Draft EIR, the project would not generate any new permanent vehicle trips, and therefore the analysis prepared for this project is related to temporary construction trips. As outlined on pages 73-76 and 384 of the Draft EIR, construction trips would be generated by (1) delivery of equipment and supplies, which is estimated to generate 46 daily truck trips on average and (2) workers coming to and from work, which is estimated to be no more than 20 trips per day based on the maximum number of employees expected per phase of construction. Maximum hours of construction activity would occur between 8:00 a.m. and 5:00 p.m. with most of the work occurring between 9:00 a.m. and 4:00 p.m. to minimize impacts on the adjacent properties. Trucks would be required to arrive no earlier than 9:00 a.m. and leave the project site no later than 4:00 p.m. and would therefore not be added to the transportation network when there is the most roadway congestion during the evening peak period.

The analysis requested by the commenter is not warranted because as shown in Table V.K-6 and concluded on page 387 of the Draft EIR, construction truck trips would be evenly distributed during weekdays between 9:00 am and 4:00 pm and would not represent a substantial increase to daily traffic volumes on key road segments. Further, as shown in Table V.K-7 and concluded on page 387 of the draft EIR, daily construction truck traffic would not account for a substantial amount of traffic at roadway segments adjacent to the study intersections as construction traffic would not be added to intersections that are currently operating near or over capacity during the morning peak hour and construction traffic would leave the project site by 4:00pm. Therefore, temporary construction traffic associated with the proposed project would not be expected to significantly deteriorate any peak hour intersection Level of Service (LOS) or create (or add to) any unsafe conditions related to excessive queuing.

With respect to the SR-92 off-ramps identified by the commenter, the number of trucks using SR 92 in the morning and afternoon peak hours would be minimal (2-3 trucks between 9:00 and 9:30 a.m. and leaving at 4:00 p.m.) and they would be primarily traveling eastbound in the morning and westbound in the evening which is counter to the most congested commute traffic. Per Table V.K-6 of the Draft EIR, there would be up to a maximum of 121 daily construction truck trips. However, that total includes both 20-ton haul trucks (that would transport material to/from the Pilarcitos Quarry and use SR 92) and 10-ton trucks that would remain on Foster City streets only (i.e. would not use SR 92). The project's construction schedule includes up to a maximum of 24 daily 20-ton truck trips (trucks traveling to/from the quarry using SR 92). As shown on page 38 of Appendix F, phase 3 of construction requires the most amount of fill carried by 20-ton trucks (approximately 4,928 cubic yards). The maximum of 24 truck trips per day was derived by dividing the total cubic yards of fill by the total duration of phase 3 (207 days) which resulted in 24 truck trips per day. Further, those 24 daily truck trips would be spaced over the course of the 7-hour construction window (9:00 a.m. to 4:00 p.m.), and would also be further split by direction of travel on SR 92 and by ramps used to access the construction sites. Because so few construction truck trips would be passing through the freeway ramps mentioned by the commenter in any given hour, no substantial increase to delay or queuing is expected based on the proposed project and the additional analysis requested by the commenter is not warranted.

Moreover, the transportation analysis in the Draft EIR is consistent with Caltrans' Intergovernmental Review Program Interim Guidance (November 2016) which states that "Other projects that typically do not generate permanent traffic (such as levee repairs, signs, pipelines, solar farms, etc.) should follow existing LD-IGR guidance. Comments related to these types of projects should not focus on congestion." According to Caltrans' referenced LD-IGR guidance, the environmental study should not focus on any potential congestion caused by temporary construction trips. Based on the assessment presented in the Draft EIR, Foster City has determined that vehicle trips generated over the period of construction (2–3 years) would not substantially affect traffic conditions nor the 20-year design of roadway facilities.

Response A6-6. Fehr & Peers, a transportation consultant for the City, performed site observations in the vicinity of the project, including the Foster City Boulevard / SR 92 interchange in June of 2016. Foster City staff also conducted 24-hour roadway counts throughout the City in 2015, which are provided in Appendix F of the Draft EIR. Baseline conditions are based on the date of the Notice of Preparation which was published on January 5, 2016. The observed traffic conditions and roadway counts at this interchange were similar to those in 2014 when the original VISSIM analysis was completed for the Foster City General Plan Update EIR (February 2015). The results of this analysis are also included in Appendix F of the Draft EIR. The observations included an assessment of vehicle queues around the interchange, which were observed to start after 4:00 p.m. As noted in response A6-5, substantial traffic would not be added during the evening peak hour. As the traffic conditions have not changed substantially and the project would not produce substantial traffic to this interchange, no update to the VISSIM analysis is required to present a complete assessment of the project's potential impacts to this interchange.

Response A6-7. See response A6-5. According to Caltrans' LD-IGR guidance (November 2016) the environmental study should not focus on any potential congestion caused by temporary construction trips. Therefore, freeway segment analysis requested by commenter is not warranted. Additionally, according to C/CAG's significance thresholds, a significant impact on a freeway segment would only occur if more than one percent of the freeway segment's capacity is added during the peak hour. The project's construction schedule includes up to a maximum of 24 daily 20-ton truck trips (trucks traveling along SR 92). Daily truck trips represent 0.5 percent of hourly capacity for SR 92 freeway segments; hourly truck trips would represent much less than one percent of any freeway segment's capacity. Therefore, construction trips would not trigger a significant impact to any freeway segment.

Response A6-8. As outlined on page 73 of the Draft EIR, construction activity would occur between 8:00 a.m. and 5:00 p.m. and trucks would be required to leave the project site no later than 4:00 p.m. The transportation analysis assumed haul trucks would occur over a 7-hour period between 9:00 a.m. and 4:00 p.m. (see page 387 of the Draft EIR). Therefore, no truck trips would be added to intersections or freeway segments during the PM peak hour and truck trips would not be added to any study intersection that currently operates near or over capacity during the AM peak hour (see Table V.K-3 on page 373 of the Draft EIR for LOS results and LOS calculations starting on page 10 of Appendix F). Additionally, the project is expected to only add up to a maximum of 24 daily 20-ton trucks that would use SR 92. Such a low volume of daily trucks is not expected to produce a noticeable effect on hourly freeway operations and limiting the construction hours is not warranted.

Further limiting truck trips to the hours of 9:30 a.m. and 2:30 p.m. would substantially impede the project's ability to complete the construction in the proposed timeline. As discussed on page 79 of the Draft EIR, proposed levee improvements would be constructed in phases over 1.5–2 years for the 2050 Sea Level Rise scenario or 2–2.5 years for the 2100 Sea Level Rise scenario. Furthermore, by extending the project's schedule, many secondary impacts are likely to arise. A longer construction schedule could increase the severity of impacts related to emissions and exposure to noise from hauling trucks and excessive vibration over a longer period of time. Additionally, a longer construction schedule would not meet the project objective of expediting permitting and construction of the project to the extent feasible to retain FEMA levee accreditation before it is lost, and furthermore, could increase the severity of recreation impacts related to detour routes for recreationists. As noted on pages 385-389 of the Draft EIR, the proposed project would result in less-than-significant impacts to roadway segments and intersection operations and no mitigation measures are required. See also response A6-7.

Page 387, last paragraph of the Draft EIR, is revised as follows:

> Based on the project's truck trip assumptions, truck trips would be evenly distributed during weekdays between ~~8~~9:00 a.m. and 4:00 p.m., and would not represent a substantial increase to daily traffic volumes on key roadway segments.

Response A6-9. The comment states that the Foster City levee system is eligible for inclusion in the California Register of Historical Resources under Criterion 1 and Criterion 3 and therefore it appears that the project would significantly affect historical integrity of the levee because the original engineering of the levee would no longer be discernable.

Under CEQA, a project that will have a substantial adverse change on an historic resource is one that will demolish or materially alter the physical characteristics of an historical resource in such a way as to negate its ability to convey historical significance (California Code of Regulations, Title 14, Chapter 3 15064.5).The Draft EIR conclusions regarding the historical significance of the levee were based on the Historical Evaluation of Foster City and the Foster City Levee System dated June 21, 2016 prepared by Vicki R. Beard of Tom Origer & Associates, included as Appendix D to the Draft EIR (Historical Report). The report explains that:

> "[o]nce research began for the evaluation, it was clear that the levee system could not be evaluated without considering Foster City as a whole because the levee system played and continues to play, such an instrumental role in the creation of the city. Therefore this study provides an evaluation of the historical significance of the City of Foster City, and an assessment of proposed impacts to the levee system, as part of an historical resource" (Appendix D, Historical Report, p.1).

Contrary to Caltrans statement, the levee system is not in and of itself an historic resource. Rather, the Historical Report concludes that Foster City as whole, which includes the levee system that helped to form the city, is an historical resource eligible for inclusion on the California Register under Criterion 1 and Criterion 3. The Draft EIR concludes at page 251 that the construction proposed for this project would not change the levee design or appearance in a substantive way. With respect to integrity, the Historical Report concludes that Foster City retains excellent integrity of location, design setting, materials, workmanship, feeling, and association (Appendix D, Historical Report, p. 11).

Integrity is the authenticity of an historical resource's physical identity evidenced by the survival of characteristics that existed during the resource's period of significance. The proposed changes to the levee do not compromise the historical integrity of the City of Foster City under either Criterion 1 or 3. In fact, they help preserve the historical integrity of the City of Foster City by protecting it from inundation from flooding.

A resource significant under Criterion 1 should retain the essential physical features that made up its character or appearance during the period of its association with the important event, historical pattern, or person. Foster City is an example of the new town movement that changed the way communities were envisioned after World War II. A master plan for the city was developed by Wilsey, Ham & Blair for T. Jack Foster and was approved by San Mateo County in 1961. Unlike builder developed subdivisions of the 1940s and 50s, the Foster City master plan was a community design with provisions for civic, commercial, industrial, and recreational activities.

A resource that meets Criterion 3 should retain the distinctive characteristics of the type, period, region, or method of construction that makes it eligible for listing on the California Register under Criterion 3. Foster City was an engineering feat that required coordination between planners, civic engineers, soil scientists, and builders. The result was a unique, man-made land mass and community that is unparalleled in California, and possibly world-wide. Foster City relies on the levee system and lagoons for drainage and flood control. The levee system serves to define the limits of Foster City and create the base upon which it is built. Without the levee there would be no town site. The existing levee is mostly earthen with sections of floodwalls present along Belmont Slough in segment 8. As noted in the Draft EIR, on page 244-245, due to alterations and improvements, the Foster City levee has been altered since it was first built. Most recently, in 1995, the levee was raised 18 inches modifying the original structure.

Proposed levee improvements would result in the levee remaining on its current alignment except for a slight deviation along Beach Park Boulevard in segment 4. The proposed changes to the levee would result in a combination of earthen, conventional floodwall, and sheet pile floodwall levee improvement types. While the levee would be taller and include additional areas of floodwall, with a slight deviation from its existing alignment, those alterations would not detract significantly from its original appearance, and actually would, in fact, preserve the original levee which in turn would preserve Foster City and its essential physical features that makes it eligible as an historic resource under Criterion 1.

The proposed levee improvement types would not introduce new features to the levee system as the majority of the existing levee is earthen and there are already concrete floodwalls in segment 8. Further, no changes would be made to the original earthwork. The original fabric would be retained in its entirety and the original engineering would still be discernible. Fill would be added to increase the levee elevation and stabilize the slope on the landward side. The proposed project would raise the levee elevation by no more than 10.5 feet, depending on the scenario but the wall height would be no more than 3.5 feet above the Bay Trail with the exception of a portion near and under the San Mateo Bridge/SR 92. At this location, the levee conventional wall would be at its highest of 10 feet from grade under the 2100 Sea Level Rise scenario, but only for a short distance of 110 feet along the pathway on the landward side (as described on page 133 of the Draft EIR).

There are certain resource types that demand continual maintenance, such as roads, railroads, dams, canals, and levees. In addressing historic roads specifically, Paul Daniel Marriott writes in The Preservation Office Guide to Historic Roads[10], "They cannot be “snapshots” of life in the past. They must continue to serve the transportation needs of modern American travel—and in that service must meet modern expectations for safety." The same is true of levees.

Therefore, the proposed improvements would not detract significantly from the distinctive characteristics the City of Foster City, which includes the existing levee, that make it eligible for listing under Criterion 3. In fact, the proposed improvements would preserve the historical significance of the City by protecting it from inundation from flooding. This is detailed in an Addendum to the Historical Evaluation (within Appendix D of the Draft EIR) and included as an Attachment to the RTC document.

Page 251, the second paragraph, of the Draft EIR is revised as follows:

(1) Significance of a Historical Resource

> ~~The~~ Foster City, which includes the levee system, appears eligible for inclusion on the California Register under California Register eligibility Criterion 1 as an example of the new town movement that changed the way communities were envisioned after World War II. Additionally, Criterion 3 is met because Foster City was an engineering feat that required coordination between planners, civic engineers, soil scientist, and builders, and resulted in a unique, man-made land mass and community that is unparallel in California, and possibly nationwide. As proposed, the project would not cause changes or introduce new elements that would directly or indirectly affect the ~~levee system's~~ City's historical significance. The levee system is similar to a highway that requires periodic maintenance to extend its period of use. The construction proposed for this project will not change the levee or the City's design or appearance in a substantive way, nor does the setting, feeling, or association of Foster City, which includes the levee system, change. The proposed project would not cause a substantial adverse change in the significance of a historical resource as defined in PRC Section 15064.5.

Response A6-10. California Senate Bill 18 (Chapter 905, Statutes of 2004) requires local governments to consult with Native American tribes to provide an opportunity to participate in local land use decisions. On January 23, 2017, copies of the original notification letters and maps were sent via email or mail to all of the Native American groups and individuals listed on the Native American Heritage Commission contact list (see Appendix D of the Draft

[10] Marriott. 2010. “The Preservation Office Guide to Historic Roads". Washington DC. June

EIR). To date, no responses have been received following the second notification. Copies of the second notification are included in Appendix B of this RTC document.

Response A6-11. This comment recommends that the City consider subsurface testing for submerged archaeological resources along the levee where sheet piles would be installed. We respectfully disagree with the sensitivity assessment made by Caltrans. Historical maps indicate that the project was marshlands, which would not have been conducive to habitation during prehistoric times.[11] Furthermore, as described on pages 251-253 of the Draft EIR, significant impacts would be mitigated by Mitigation Measures CULT-1 through CULT-4 if during construction, archaeological resources, paleontological resources, tribal cultural resources or human remains were encountered. However, historical use of the area was inboard of the existing levee, and features from that time are unlikely to be encountered.

Response A6-12. This comment relates to the permitting process but not the adequacy of the Draft EIR for project approval and is noted.

Response A6-13. See response A6-1.

[11] E. Barrow 2016. *A Cultural Resources Survey for the Levee Protection Planning and Improvements Project, Foster City, San Mateo County, California*. Page 3. V. Beard 2016. *Historical Evaluation of Foster City and the Foster City Levee System, San Mateo County, California. Page 4*

Letter A7

STATE OF CALIFORNIA
GOVERNOR'S OFFICE *of* PLANNING AND RESEARCH
STATE CLEARINGHOUSE AND PLANNING UNIT

EDMUND G. BROWN JR.
GOVERNOR

KEN ALEX
DIRECTOR

January 9, 2017

FOSTER CITY
RECEIVED
JAN 11 2017
PLANNING/
CODE ENFORCEMENT

Curtis Banks
City of Foster City
610 Foster City Blvd.
Foster City, CA 94404

Subject: Foster City Levee Protection Planning and Improvements Project (Capital Improvement Project - CIP 301-657)
SCH#: 2016012012

Dear Curtis Banks:

The State Clearinghouse submitted the above named Draft EIR to selected state agencies for review. The review period closed on January 6, 2017, and no state agencies submitted comments by that date. This letter acknowledges that you have complied with the State Clearinghouse review requirements for draft environmental documents, pursuant to the California Environmental Quality Act. 1

Please call the State Clearinghouse at (916) 445-0613 if you have any questions regarding the environmental review process. If you have a question about the above-named project, please refer to the ten-digit State Clearinghouse number when contacting this office.

Sincerely,

Scott Morgan
Director, State Clearinghouse

LETTER A7
State of California Governor's Office of Planning and Research
Scott Mogan, Director, State Clearinghouse
January 9, 2017

Response A7-1. The comment acknowledges receipt of the Draft EIR by the State of California Governor's Office of Planning and Research and that no state agencies submitted comments by January 12, 2017, the close of the comment period. No additional comments were provided and no further action is required.

B. INDIVIDUALS AND ORGANIZATIONS

Letter B1

THE LAW OFFICES OF MARK C. WATSON, P.C.
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Heidee Valiao
Michelle Mc Kinney
Shelly Wyant
**Admitted in Washington D.C.*

January 12, 2017

Curtis Banks
Community Development Director
610 Foster City Blvd.
Foster City CA. 94044

Re: Capital Improvement Project 301-657; Levee Protection Planning and Improvements Project - Draft EIR Comments

Dear Director Banks:

Our office represents Sam and Lori Runco, and on their behalf, offer the following comments to the above mentioned Draft Environmental Impact Report ("DEIR"). The Runcos own a portion of land that is adjacent to the land where the levee is located on Beach Park Boulevard (the "RUNCO Property"). They are also residents and homeowners in Foster City for approximately 20 years.

I am also attaching three letters, and incorporating their comments herein, that were previously submitted to the City that was submitted prior to the comment period for the DEIR, so that there is no question that the comments are submitted during the comment period. I would like to mention that the DEIR fails to mention that my office submitted a letter dated September 12, 2016 as well. 1

Our letter of February 18, 2016 shows the levee that we proposed to the City. We refer to it in this letter as the Bayside Levee, so that it will not be confused with the terms of a horizontal or hybrid levee that are used in the DEIR. Also attached is a letter from J.C. Miller of Vallier Design Associates, Inc explaining some of the access issues as well as another from Steve Foreman of LSA Associates explaining some of the environmental issues. I would also like to point out that the comment on page 13 of the DEIR concerning the testimony of J. C. Miller is inaccurate. Please see his attached letter where he points out that he proposed the levee that I discussed in my letter of February 18, 2016. 2 I have also attached the *Analysis of the Costs and Benefits of Using Tidal Marsh Restoration as a Sea Level Rise Adaptation Strategy in San Francisco Bay* by Jeremy Lowe. This report should also be included as information submitted to the City to be considered in making its determinations about the DEIR and the levee project. 3

I GENERAL LAW CONCERNING CEQA REVIEWS

The California Environmental Quality Act ("CEQA") mandates that public agencies, such as the City, cannot approve projects as proposed if there are feasible alternatives or feasible mitigation measures available which would substantially lessen the significant environmental effects of the project. Disagreements among experts over which alternative is superior does not make an EIR inadequate.

However, the EIR needs to summarize the main points of the disagreements in a complete manner with good faith effort of full disclosure of the facts concerning the different options.

To be adequate, an EIR must inform the public, and the decision makers, in such a way that they can intelligently weigh the environmental consequences of a contemplated action. The EIR must address all of the significant adverse environmental impacts, including their severity and probability of occurrence. The California Administrative Code requires that the EIR include analysis on impacts such as "physical changes, alterations to the ecological systems and changes induced in population distribution, concentration, and the human use of land (including commercial and residential development).

The EIR must also describe a range of reasonable alternatives to the proposed project, that could achieve the main objectives of the project. The EIR must also evaluate the comparative merits of the alternatives. In doing so, the EIR must examine whether the alternatives are capable of reducing or eliminating the significant environmental impacts of the proposed project.

For the reasons detailed below, my client objects to the City's approval of the proposed project on the grounds of noncompliance with the requirements of CEQA.

II THE DEIR IS DEFICIENT IN THAT IT FAILS TO ANALYZE THE ADVANTAGES AND COSTS OF A BAYSIDE LEVEE ALONG THE SHORELINE BY BEACH PARK BOULEVARD NEAR BOWDITCH MIDDLE SCHOOL

Along Beach Park Boulevard ("Beach Park"), the DEIR's maps of the new levee denote that there is a deviation from the levee's existing location. Building the levee in that location will impact public and private views, established traffic and pedestrian patterns, create noise and vibration issues, limit access to private land and impact the development of the adjacent property.

A <u>The Impact to Beach Park Boulevard is not Fully Addressed</u>

According to the DEIR, the relocation of the levee and the trial will cause the narrowing of Beach Park. The DEIR fails to provide sufficient information concerning how far the levee will go into Beach Park. As such, neither the City or its residents have sufficient information to determine the true impact of either the 2050 or the 2100 alternatives. 4

Furthermore, Beach Park Boulevard is classified as an arterial street. As mentioned in the General Plan and recommended by state guidelines, such streets should have a right of way from 80 to 110 feet. Along the Bowdicth Middle School area, parents drop off their children, not only in front of the school, but also on the bayside of Beach Park. The width of the right away in that area is currently at the minimum of 80. There is parking along Beach Park in that area, functionally narrowing the roadway. If the City adopts either the 2050 or 2100 alternatives as currently presented, the right of way will be further reduced. Additional impacts to the parking along Beach Park are discussed in section V (B) below. The DEIR fails to provide any information concerning these impacts so that a selection of a proper alternative can be made.

B Building the Levee Along the Deviation Line Is Inconsistent With the City's General Plan.

1 The DEIR Fails to Analyze the Impact to the Proper Development of Undeveloped Property and is Inconsistent With the Circulation Element of the General Plan.

As stated in the DEIR, the purpose of the Conservation Element is to "preserve and improve the quality of life in existing neighborhoods, ensure the proper development of undeveloped property, and ensure that redevelopment of developed or underutilized property occurs in the appropriate manner." This is also stated in the City's General Plan. As such, the City is required to look at the project's impact on the undeveloped Runco Property to "ensure its proper development." 5

We feel that the DEIR is deficient in that it fails to accurately evaluate the impact that the project will have on the Runco Property. If the levee is constructed as stated in DEIR, access to the Runco Property will be reduced due to the increase in the height of the levee. J.C. Miller of Valier Designs has opined that the project will make it impractical and financially infeasible to access the property. His letter is attached to this letter. This will kill the proper development of the Runco Property. Whether or not the City agrees with our conclusion, the DEIR should have addressed this issue in its analysis. The DEIR should include an analysis of how the City will restore access to the Runco Property so that it can be developed as indicated not only in the current General Plan, but also as envisioned in the original concept for Foster City.

2 Building the Levee at the Deviation Point is Inconsistent With the City's Land Use & Circulation Element

The Land Use and Circulation Element of the Foster City General Plan states that one of its objectives is:

> Providing adequate opportunities for commercial development allows more flexibility for the business community, thus resulting in a wide range of goods and services available to the City's residents. Commercial, office and industrial development not only provides a healthy and stable tax base, it also provides job opportunities within the City, which in turn can help reduce commuting by residents of Foster City and other nearby communities. 6

The Runco property is currently zoned as waterfront commercial and plans have been submitted to develop the property in accordance with that zoning. Currently, there are no other properties in Foster City that are zoned for waterfront commercial development. As mentioned in the General Plan, "appropriate commercial uses [for waterfront commercial]. . . include restaurants, commercial recreation, marine-related retail and offices and marina berths."

By proceeding with either the current 2050 or 2100 alternative as set forth in the DEIR, development on the site will be impossible. As such, these alternatives are inconsistent with the City's General Plan as it limits rather than widens the range of goods and services that can be offered to the City's residents. These alternatives also will reduce the City's potential tax base and job opportunities within the City, rather than expand them. The current DEIR fails to discuss this impact or compare the impact to other alternatives mentioned in the DEIR.

C Noise and Vibration

As noted in the DEIR, the construction of the levee along Beach Park will cause both noise and
vibration that will be significant. By constructing a traditional horizontal levee or the Bayside Levee, a
sheet pile wall will not be vibrated into the ground. The amount of construction for these alternatives will 7
not only be much less, but it will also occur much further from Beach Park and the adjacent homes. As
such, the impacts will be either eliminated or greatly reduced by using the Bayside Levee System.

D Impact to Public Views.

Also as noted in the DEIR, the construction of the levee along Beach Park will impact public
views. Of course the views from the homes in that area will be impacted as well. The construction of the 8
Bayside levee will mean that the existing levee and Bay Trail, will be not need to be raised. As such, the
views will not be impacted and this impact will be fully mitigated by using the Bayside Levee System.

E The DEIR Fails to Analyze How a Bayside Levee Can Mitigate the Impacts and Improve the Environment Along the Bowditch - Beach Park Corridor.

Previously, we submitted a design for a levee that would run along the bayside of the Runco
Property (the "Bayside Levee"). The placement of the City's levee in this location would mitigate many 9
of the above mentioned impacts by: 1) eliminating the need to go out into Beach Park; 2) allowing greater
access to undeveloped property; 3) reducing the amount of construction, and as such, the amounts of noise
and vibration; 4) reducing the impacts of public and private views; and 5) provide substantial
environmental benefits.

The DEIR fails to discuss the costs of building the levee in that location as discussed in section III
below. The Bayside Levee is also substantially better as it provides significant environmental benefits to
the City. As discussed in the analysis from L.S.A Associates, which is attached hereto as Exhibit A, the 10
Bayside Levee is environmentally superior to the proposed location in the 2050 and 2100 options.

F The DEIR Does Not Fully Address the Project's Impact on Public Views

The DEIR also states:

> Impact AES-1: The increased elevation of the levee would alter the existing visual
> character and may adversely impact scenic vistas of the San Francisco Bay from Shorebird
> Park (segment 4) under the two project scenarios (2050 Sea Level Rise and 2100 Sea Level
> Rise) and scenic vistas of the Belmont Hills from Sea Cloud Park (segment 6) under the 11
> 2100 Sea Level Rise project scenario. (S) Table V.A-I shows the existing levee elevations
> in each segment, as well as the proposed levee elevations and improvement types. The
> change in levee elevation, proposed levee improvement type, and viewer sensitivity would
> determine the magnitude of the impacts on visual character in each segment. The finished
> sheet pile wall elevation for all segments would be no more than 3.5 feet above the Bay
> Trail, except under the San Mateo Bridge/SR 92 where the wall reaches a maximum height
> of 10 feet under the 2100 Sea Level Rise scenario.

The same is true for the area of segment 4 along Beach Park, closer to Bowditch Middle School. The increased elevation will block public views of: people traveling along Beach Park; pedestrians walking on the landward side of Beach Park; and people playing at Bowditch Middle School. The increased elevations will also block the views from the homes in that area as well. 11

Again, this impact would be eliminated if the City were to proceed with the Bayside Levee. The DEIR fails to look at this option. As such, neither the public or the decision makers have the appropriate information to make a decision.

III THE DEIR FAILS TO LOOK AT THE TRUE COSTS OF COMPETING ALTERNATIVES

In analyzing whether a horizontal levee or the Bayside Levee should be used, the DEIR fails to take into account the savings of current construction and future maintenance costs of the 2050 and 2100 alternatives. This should be considered, as the increased maintenance costs are a financial impact that should be provided to the residents and the decision makers of Foster City.

On pages 19 - 20 of the study, *Analysis of the Costs and Benefits of Using Tidal Marsh Restoration as a Sea Level Rise Adaptation Strategy in San Francisco Bay*, Jeremy Lowe points out that a horizontal levee or wetlands can be used in conjunction with a traditional levee. Doing so can greatly reduce the height of the traditional levee or seawall. Lowe also concludes that by adding tidelands of 80 meters, or 262 feet, in front of the sea wall would reduce the size of the sea wall required to achieve the same level of protection and decrease the cost of the sea wall by about 90 percent, or $3,000 per linear foot of sea wall. On page 42 of the report, Lowe lays out the details of future costs. Lowe's analysis shows that even after paying for the restoration of the tidelands in front of the traditional levee, the costs over a fifty year period of building and maintaining a levee such, as the Bayside Levee, will be only fifty percent of that of a traditional levee alone. 12

The alternatives analyzed in the DEIR use an all of nothing approach. They look at the construction and cost of a purely horizontal levee and conclude that the total horizontal levee cannot work. This is true, even though the City's consultants knew that a hybrid approach can be used. The DEIR is inadequate as it fails to even look at, consider or minimally analyze the benefits, drawbacks and costs of the hybrid approach that is included in our Bayside Levee.

IV THE DEIR FAILS TO ANALYZE THE USE OF A HORIZONTAL LEVEE IN SEGMENTS 3, 4 AND 5.

A <u>The DEIR Fails to Assess the Use of A Horizontal Levee In Segment 4</u>

The DEIR acknowledges that "the project site is also home to the harvest mouse, ridgeway rail, and the California Rail, which may be impacted by the project." The DEIR fails to look at how this impact could be mitigated by constructing a horizontal levee or an Bayside Levee in segment 4, or at least around the Runco Property. While the DEIR does provide this analysis for other areas of the levee project, it does not provide the analysis for this area. One of the reasons for looking at this alternative, is that the amount of construction will be less if either a horizontal levee or a Bayside Levee is used. This, in turn, will reduce the impacts on these species. Furthermore, the report fails to look at other environmental and conservation benefits that will be provided by these alternatives in Segment 4. See section II (E) above for a more complete analysis. 13

B **<u>The DEIR Improperly Excludes Consideration of a Horizontal/Bayside Levee in Segments 4 and 5</u>**

The DEIR includes: Alternative 3 – Horizontal Levee 2050 Sea Level rise Alternative. Again, the analysis of this alternative is provided for only Segments 1 & 2. The report is inadequate and incomplete as it ignores Segments 3-5 where the horizontal levee option is also possible. Complete consideration of 14
this alternative would include these portions that are privately held while the remainder of Segment 4 and Segment 5 are State Lands. It can reasonably be assumed that these parties would be cooperative in an effort to construct the Horizontal Levee or the Bayside Levee that is discussed above. In fact, the private property owners have indicated that they would cooperate in such construction.

V THE DEIR FAILS TO PROVIDE THE CITY WITH FACTS CONCERNING KNOWN NOTED ENVIRONMENTAL IMPACTS PRIOR TO DETERMINING WHICH ALTERNATIVE HAS THE LEAST ENVIRONMENTAL IMPACT

A **<u>The DEIR Should Provide at Least Preliminary Information on Known Environmental Impacts Before Making a Decision.</u>**

On page 43 of the DEIR, the report notes (NOISE-4) that there will be a significant impact as there could be excessive vibration. The DEIR recommends that "a project contractor or other qualified professional shall be retained to prepare a vibration impact assessment for residences. . ." However, the DEIR does not assess which project alternative would produce the least amount of vibration.

The DEIR then states that it could be possible that mitigation efforts will not work and in such a case, the assessment should document the existing condition of these structures so that the City can assess 15
the actual damage to the structure. Again, the Planning Commission, the Council, and the residents should know which project alternative, if any, is likely to yield the least liability to the City.

Similarly, with respect to NOISE - 3, the DEIR reports that the noise levels of the project will could exceed those allowed by the Foster City Code and would generate substantial increases in noise levels for intermittent periods. Here, the contractor will be required to submit a Construction Noise Management Plan for review and approval by the City. Our question is why wait until a project alternative is selected by the City to determine the severity of the noise for each option, as well as the cost. Doing such preliminary analysis is not unheard of in Foster City. Without such information, how can the City make an proper selection of the various project alternatives.

B **<u>The DEIR is deficient in that it Fails to Impact the Reduction of Beach Park Boulevard and That It is Inconsistent With the General Plan</u>**

Section II (A) above, talks about certain impacts of narrowing Beach Park. Doing so will have other impacts to the environment as well. The DEIR points out on 380 and 381 several goals and policies of the City's General Plan. The project as proposed is inconsistent with Goals LUC-G; LUC-H; LUC-L; LUC-E-1 and LUC-E-6. Both the 2050 and 2100 proposals not only conflict with these goals, but will also have 16
environmental impacts that are not assessed in the DEIR.

If either of the 2050 or the 2100 alternatives are selected, Beach Park will be narrowed and the parking on its bayside will be eliminated. This contradicts the goal of LUC-G of providing sufficient off-street parking. Previously, the City added parking to that area of Beach Park across from Bowditch. The City must have thought this parking was needed in the area. Eliminating the parking there will also force the cars that are currently parking there into the nearby residential areas, and thus having an environmental impact on these neighborhoods. Currently, parents also pull into the shoulder / parking area to drop off their children as they head to school. If the shoulder/parking is eliminated, these cars will need to make a left on Tarpon and drop off their children at the already congested area in front of Bowditch. The DEIR fails to identify and bring this impact to the public attention or that of the decision makers. The DEIR also fails to mitigate or explain what can be done about the loss of this parking or where these cars will go. This also violates the Goal LUC-3 of maintaining “historical parking patterns of residential and non-residential projects.”

These two proposals will also violate Goal LUC-H by restricting the development of Runco Property. Doing so will not promote this goal as it compromises “future generations to meet their own needs” as it does not promote the land use policy of developing that area. The narrowing of Beach Park
will also inhibit the ability of placing bus stops along there. This will inhibit the ability to service any new 16
development that is built on the Runco property. As such, this is inconsistent with Goal LUC-L. This also contracts Goal LUC-H’s goal of decreasing the use of automobiles and increasing “the use of alternative modes of transportation.

The narrowing of Beach park is also at odds with Policy LUC E-1, as that policy mandates that the “City will maintain and improve the existing system of major and collector streets.” Reducing the size of Beach Park neither maintains or improves this major street and instead inhibits its current ability and future ability to expand the road or place bus stops there.

As you can see from the foregoing, the narrowing of Beach Park will impact traffic, established parking patterns, and the City’s ability to address future issues as well.

C <u>The DEIR Does Not Address the Comments of the San Francisco Bay Conservation and Development Commission</u>

According to the DEIR, the San Francisco Bay Conservation and Development Commission
(“BCDC”) submitted a comment letter to the City. One of the concerns of the BCDC was that “a sheet pile 17
floodwall could lead to erosion and greater impacts to adjacent wetland areas and suggested studying a horizontal levee.” After reviewing the DEIR, it does not appear to include an analysis of the impacts that could occur from the erosion of the sheet pile wall.

VI MISLEADING STATEMENTS & INFORMATION IN THE DEIR

The DEIR mentions that certain options were not considered because the condemnation process would be too lengthy to construct a levee that meets the FEMA standards. In reality, pursuant to section 1255.410 of the Code of Civil Procedure, the City may seek possession of the property at anytime after
filing the complaint by filing a motion. The City only needs to file a declaration that it has the right to take 18
the property and then deposit what the City’s appraiser believe is the fair market value of the property. This type of motion is heard sixty days after filing the motion. As such, the City does not have to wait until the end of a lawsuit or until a court determines the fair market value. As such, the reasons why the DEIR dismiss building a levee on private property is incorrect and misleading and the residents and the decision makers of the City do not have the correct information to properly explore this information.

VII CONCLUSION

As stated above, the DEIR fails to provide both the public and the decision makers of Foster City with all the details of the various alternatives available. At points, the DEIR does not assess how known impacts can or will be mitigated. The DEIR also fails to provide the public and the City’s decision makers with the true costs of the alternatives or their actual environmental effects. As such, it does not contain sufficient information for the public, the Planning Commission, or the City Council to properly assess the alternatives and make an appropriate decision.

Lastly, on behalf of my clients and myself, we thank you for time and consideration of these points.

Respectfully Submitted,

Mark C. Watson

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September 12, 2016

Letter B1
Attachment A

Hon. Herb Perez
Hon. Kevin Miller
610 Foster City Blvd.
Foster City CA. 94044
Hperez@fostercity.org
Kmiller@fostercity.org
Hardcopy by Personal Delivery

Re: City's Levee Project - Location

Dear Mayor Perez & City Manager Miller:

At our last meeting with Kevin Miller, Jeff Moneda, and Jean Saveree. We were informed that the City would like to receive any further input on the location of the City's proposed levee by the end of business on September 12, 2016. We did call the City subsequently and were informed by Allan Shu, that there is no deadline at this time for public comments. However, out of an abundance of caution, we are submitting this correspondence and several attachments for your consideration.

I Information Provided at Our Meeting With the Foster City Team

A Stated Location of the Wall along Beach Park Blvd.

At the last meeting, the team we met with stated that they were planning to build a sheet pile
wall in front of the Runco's property. We were provided with three aerial views that Public Works
Director Jeff Moneda gave us, that indicate the planned location of the wall. We were told that the wall 1
would be placed totally on the City's property or right away. According to Foster City's team, the
yellow line on the aerial views indicate the location of the wall.

B Stated Design of the Wall.

During the meeting, the Foster City team stated that they would not be building a berm type
wall along the yellow line. Instead, the City plans to build a sheet pile wall that will be at least 12 feet
high. The Bay Trail would then be moved closer to Beach Park Boulevard and be located between the
wall and the street. We were also informed that the sheet pile wall would be used for approximately 2
five miles of the eight miles of the levee. So a majority of the levee will be a sheet pile wall instead of
including a berm in the design.

C Narrowing of Beach Park Blvd Near Bowditch Middle School

3

The Foster City team also stated that in order to fit the wall completely on the City's property/right away, the City planned to narrow Beach Park Blvd and might have to reduce it by one lane. The Team also said that they planned to pay for the cost of narrowing Beach Park with a federal grant dealing with safe routes to school. They did not have a cost figure for narrowing Beach Park.

II Problems With the Stated Location and Design

A Narrowing of Beach Park Boulevard.

We studied how Beach Park would be impacted under the City's current plan. In order to maintain the current trail along Beach Park by Bowditch under the new design, the City would have to reduce Beach Park by one lane. Whether or not it reduces Beach Park by one lane, or just "narrows it" there will be problems. Previously, due to problems with traffic on Beach Park along Bowditch, the City decided to restrict parking there. Thus, making a shoulder along Beach Park in that location and giving both motorists and those walking or biking to school, more room to maneuver. Presumably, the evidence that the City had at the time, justified the expense and need for taking away the community's parking. As such, it seems contrary to the City's earlier reasoning that the City would now seek to narrow Beach Park in the same location.

The City Council voted last month to move forward with a traffic study concerning pedestrians and bicyclists, but decided not to move forward with a more comprehensive traffic study. Perhaps the data from the planned study will provide the City with the information needed to accurately assess what impacts a narrowing of Beach Park will have on traffic during school hours. However, we believe that City should do a directed study on this question as residents who drop their children off at Bowditch, those who live in the area, and others who commute along Beach Park have all complained of the traffic issues that currently exist at that location.

4

Both by the City's definition and according to its current use, Beach Park Boulevard serves an arterial roadway. According to the City's standards, as set forth in its circulation element documents, an arterial needs to be between four and six lanes. By reducing a lane of Beach Park, that boulevard will no longer meet this standard and out of compliance with what is depicted in the City's circulation element.

Since school buses are used to service Bowditch, the City should also take into consideration how a new Beach Park Boulevard would impact the turning of buses at the intersection of Tarpon and Beach Park. Caltrans standards should be studied to see if a narrowing can be done.

Based on the foregoing, we contend that there is not sufficient evidence to support a narrowing of Beach Park Boulevard, or that doing so would be in the interests of the Foster City Community. The best approach would be to build a hybrid levee that would run closer to the bay along the water side of the Runco property. While not a perfect solution, a better approach than the sheet pile wall along Beach Park, would be to build the sheet pile wall closer to the Bay along the bay side of the Runco property. We will be submitting plans that show a new location of the levee and the Bay Trail that will be further towards the bay. Doing so would not trigger any involvement by BCDC. Placing the levee further from the street would eliminate the need to reduce the size of Beach Park Boulevard.

B The Environmental Impacts of Constructing a Sheet Pile Wall Will Be Reduced if Done Further from Beach Park Boulevard.

The City is currently planning to build the sheet pile wall by vibrating it into the ground. This process will cause a significant amount of noise, dust, and vibration in close proximity to Bowditch Middle School, the homes to the south of Bowditch, and the apartment buildings on the north side of 5
the Runco property. The students and residents in both areas will be negatively impacted by using this method. Again, building the levee closer to the bay would measurably mitigate these impacts. Therefore, the City should study these impacts at both locations before making a final decision as to where the levee should be located. Our position is that the impacts as set forth in the California Environmental Quality Act will be much lower if the levee is located further from the street.

C Building a Horizontal Hybrid Levee is the Best Approach.

We have previously submitted correspondence outlining why a horizontal hybrid levee would be environmentally better than building either a berm levee, a sheet pile wall, or a hybrid berm-sheet pile wall along the Runco property. In the video that is posted on the City's website, Public Works Director Jeff Moneda said that the City studied the issue and concluded that such an approach could not be done.

One of the reasons that Mr. Moneda stated was that there was not enough City owned property to build such a levee. While that statement is true, it is also misleading. There is certainly enough property owned by the Runcos to build a horizontal levee at the southern end of the property. In fact, the Runcos have submitted multiple sets of plans to the City indicating how this can be done.

Another reason cited by Mr. Moneda was that building a horizontal levee would trigger review by regulatory agencies. The plans that the Runcos submitted earlier to the City, show that there would not need to be any dredging along his property to build a horizontal levee. Our research indicated that using the horizontal levee is the preferred approach of BCDC and other agencies. We previously submitted a lengthy study by the Bay Institute where they discuss tat the horizontal levee is the preferred approach. In fact, Will Travis of BCDC has publically stated: "[Traditional] Levees are expensive to build and they are very expensive to maintain. They break the connection between land
and water and they destroy habitats." 6

Earlier this year, both Jeremy Lowe of Environmental Science Associates, and Marc Holmes of the Bay Institute, presented information to the Foster City Planning Commission during the Scoping Session for the Environmental Review of this project. They in part presented information concerning that the horizontal levee approach was the preferred approach. However, their testimony was cutoff. In his own discussions with BCDC, they have indicated to Mr Runco that they would not be opposed to the horizontal levee approach.

Many of the reasons why building a horizontal hybrid levee will be superior environmentally have already been submitted. However we are including them in our packet again. However, a brief summary of these points is included here for your convenience.

The Hybrid levee will benefit the environment in the following ways: 1) Improve the Habitat for Fish, Mammals, and Birds. 2) Create a Habitat for Endemic Rare and Endangered Species 3) Eliminate Weed Sources 4) Increase the Number of Native Plants 5) Stabilize the Shore; 6) Improve the Storm Water Buffer; 7) Improve Water Quality of the Bay; 8) Increase Carbon Sequestration; and

9) The Horizontal Hybrid Levee Will Create 10 Acres of Additional Wetlands in the Runco Property Alone.

D The Current Plan for the Levee Will Decrease Access to the Bay

The current proposed levee location will eliminate or greatly reduce people's ability to walk to 7
the shoreline as the proposed sheet pile wall will not be able to be crossed by people. The proposed levee will prevent kayakers from accessing the areas where they launch their kayaks. In contrast, the hybrid levee would bring people closer to the Bay and will stabilize the shore to better allow kayakers, canoers and other small boaters, access to the bay.

E The City Will Be Protecting Private Property Rights of Others at the Expense of the Runcos.

The reasons why the City is building the levee is due to the sea level rise as well as storm surges. The City is anticipating that the new levee is needed to retain flood waters from these expected 8
events. As such, the property of other property owners will be protected while the waters are retained by the wall, keeping them on the Runco property. Doing this is not only unfair, but will subject the City to liability in an unknown amount. Building the levee further from Beach Park would bring about a different result, which would not result in City liability. Thus, taxpayers funds would be saved by building the levee further from Beach Park Boulevard.

F The New Levee Will Block Access to the Runco Property and Create Further Liability for the City.

Currently, there is a berm type levee at the street side of the Runco property. The Runcos have previously submitted plans to the City showing how their property can be accessed with the berm levee in place. The Runcos will be submitting new plans to the City, which will again show how this can be accomplished. The proposed plan presented by the Foster City team, to the Runcos, show that a wall several feet higher then the current berm, will be built on City property. Again, this will be right in 9
front of the Runco property. This will completely cutoff access to the Runco's property. The Runcos view this action as a taking of their property and California case law supports their position. As such, the City will incur liability as it will need to compensate the Runcos for the loss of use of their property. Previously, the Runcos have submitted an estimate of the loss in value to their property. The Runcos have been told by the City that the cost of building the levee around their property will be an additional ten million dollars. This cost is well below what the City would have to pay the Runcos for the loss of value to their property. Again, this is a useless waste of taxpayers' monies.

Sincerely,

Mark C. Watson

Enclosures:
Letter to Kevin Miller Dated 10-5-2015
Letter to City Council Dated 2-18-16

CC: Doris Palmer
Charles Bronitsky
Catherine Mahanpour
Sam Hindi
Gary Pollard

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February 18, 2016

Letter B1
Attachment B

Hon. Herb Perez
Hon. Charlie Bronitsky
Hon. Gary Pollard
Hon. Catherine Mahanpour
Hon. Sam Hindi
City Manager Kevin Miller
610 Foster City Blvd.
Foster City CA. 94044

Re: City's Levee Project

Dear Mayor Perez, Council Members and City Manager Miller:

On Monday night you will be hearing a presentation by Schaaf & Wheeler concerning the construction of a levee. The proposed levee will seek to protect homeowners in Foster City from potential tidal waves and future sea level rise. The property of our clients, Lori and Sam Runco, is adjacent to the San Francisco Bay along the shores of Foster City. As such, we request that you consider the information below, and as the process proceeds, to ask certain questions about how and where a new levee should be built.

I would like to point out that Will Travis of BCDC stated: "Levees are expensive to build and they are very expensive to maintain. They break the connection between land and water and they destroy habitats." Travis was talking about a traditional levee such as the one proposed by Schaaf & Wheeler (hereinafter referred to as "S&W). To avoid these consequences, we believe a hybrid approach will best mitigate the financial and environmental impacts of a levee. The reason is it will reduce maintenance costs, and not only continue the public's ability to access the water, but actually increase it. The Runcos would like to work with the City to create a restored wetlands along the Foster City shoreline, and to help bring about a more environmentally friendly hybrid levee.

I A HYBRID LEVEE

A What is a Hybrid Levee

As explained by the Bay Institute, the concept of a horizontal levee involves using tidal marshes and plant life to "significantly reduce the destructive power of a storm surge." [1] On February 4, 2016, Marc Holmes of the Bay Institute appeared at the Foster City Planning Commission meeting. Mr Holmes both

[1]The Bay Institute; *The Horizontal Levee; Coastal Storm Surge Barrier*; p 6.

spoke to the commissioners and presented them with an executive summary of the Institute's study. The study points out that:

> Shoreline flood protection is improved significantly when areas of tidal marsh exist between the open waters of the bay. Further, it indicates that by using tidal marsh in combination with a levee constructed at the landward edge of the marsh, **the size of the levee can be reduced significantly while providing the same level of flood protection** as would be provided by a larger levee that was not fronted by tidal marsh.[2]

We refer to the approach of using both a horizontal levee in combination with a smaller traditional levee as a "hybrid levee."

B The Schaaf & Wheeler Report Does Not Include Information Concerning a Hybrid Levee

The thirty six page of the S&W study, which was updated in July of 2015, briefly mentions a horizontal levee and dismisses it.[3] Their reason is that there would need to be substantial fill added into the Bay. S&W analyzed the situation using only a pure horizontal levee, but failed to look at the hybrid levee, which is preferred by the Bay Institute and other groups.

Further, in many areas of Foster City, there is already significant sloping, making these areas great candidates for a hybrid levee. The Runco property is one such area. Other areas include all of the Foster City shoreline that is south of the Runco property. Steve Foreman of LSA Associates has studied the Foster City shoreline.[4] He tells us that all of the shore that is south of the Runco property is already functioning as a horizontal levee and can be incorporated to use a hybrid levee in lieu of the proposed levee. North of the Runco property may offer additional opportunities. However, much of that area is not as adaptable to the use of a hybrid levee as the south. Towards this end, we have already contacted CalTrans about acquiring the clean fill that would be needed. They can provide the fill at either low or no cost to use where necessary.

C The Hybrid Levee Will Provide More Protection in Many Areas of Foster City.

In many areas the hybrid levee will actually be higher than the current levee. Another advantage of incorporating a horizontal levee into a hybrid levee is that the permeable edge of a horizontal levee is better than a seawall or a berm levee. In these areas, there are horizontal levees right now. In contrast to the proposed levee, the wall would not have to be as high. The City can improve the current horizontal levee. There is already a Rifrap berm at the edge, which can be improved to work as a hybrid levee. Here is a rendering of how the hybrid levee will look. As you can see, the wall is imbedded and the land at the bay side is higher than along Beach Park Blvd, on the right. We are including a larger rendering at the end of this letter so you can better see the design.

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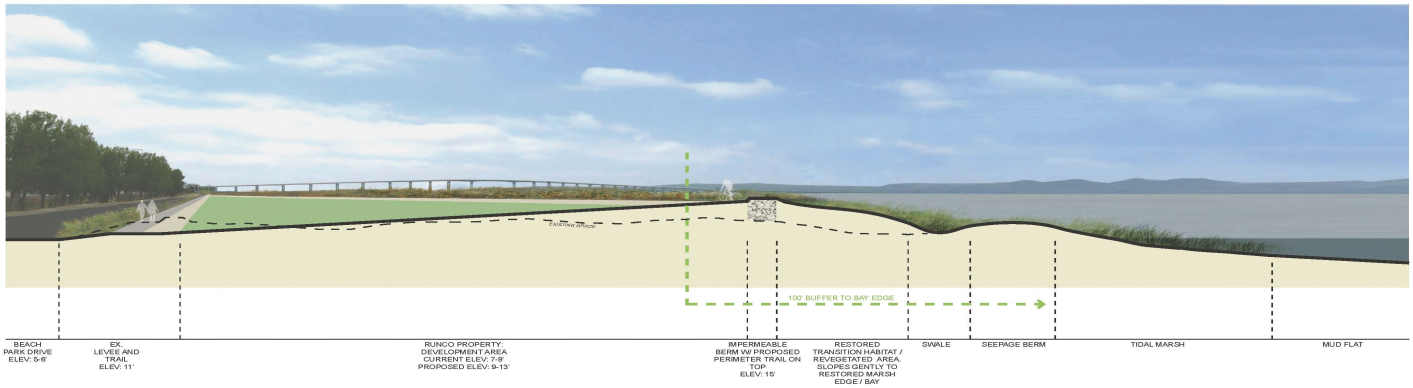
[2] *Id.*

[3] Schaaf & Wheeler, *City of Foster City Levee Protection Planning Study*, (updated July 2015) p. 20

[4] Unless a citation is provided, the environmental information herein was provided by Steve Foreman or J.C. Miller of Vallier Design Associates.



II BENEFITS TO THE ENVIRONMENT

As required by the California Environmental Quality Act ("CEQA") the City must select the least environmentally damaging practicable alternative available to it. The City must also provide adequate mitigation for alternative impacts. Here are some of the reasons why we feel a hybrid levee is the best alternative.

A The Quality of the Shore's Environment Will Continue to Erode With the Proposed Levee

We would like to point out that the proposed levee system adds nothing to the quality of wildlife or plant life habitat in the area and will lead to further degradation of the environment. For instance:

1. The wetlands will continue to deteriorate. Under present conditions, the plant life in the area is deteriorating. There is no suitable ground cover to promote the presence of the California clapper rail, the marsh harvest mouse, or any other marsh dependent wildlife. Currently, there is no or little pickleweed present. Pickleweed is the natural food of the California Clapperrail and other endangered species present.

2. The barren scares on the land promote growth of invasive weeds, which are counterproductive to maintaining the area's environmental health. 5

3. The area will continue to be a poor habitat for natural species.

4. The area will continue to be a poor habitat for the rare and endangered species.

B The Hybrid Levee Improves the Environment

The Hybrid levee will benefit the environment in the following ways.

1 Improving the Habitat for Fish, Mammals, and Birds.

The filling of the sites along the Bay, including Foster City, in the 1960s buried the existing marsh 6 and filled in tidal channels. The current marsh vegetation along parts of the Foster City shore are sparse and low (typically less than 6 inches) and the lack a network of tidal channels allow for neither good tidal circulation nor fluctuating water levels in the marsh. Ongoing human activities perpetuate a cycle of habitat destruction and disturbance which:

a Precludes establishment of necessary tall, dense marsh vegetation on this and adjacent lands necessary to support rare endemic species such as the Ridgway's clapper rail and salt marsh harvest mouse.

b Displaces and disturbs shorebirds and other wildlife using the adjacent bay and mudflats, this disturbance is particularly an issue during high tides when shorebirds are confined to narrow bands and roosts along the immediate shoreline.

c Creates conditions that favor establishment and expansion of several very invasive and undesirable plant species which displace native plants and animals.

2 Create a Habitat for Endemic Rare and Endangered Species

A hybrid levee will rehabilitate Foster City wetlands and establish productive salt marsh, transition, and upland habitats, reversing years of historic and current manmade degradation to this area. The hybrid levee will lead to restoration that incorporates elements that are consistent with the US Fish and Wildlife Service's Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California, including San Francisco Bay. The current environment, which will remain in place with the proposed levee, contains sparse, low vegetation and the lack of tidal channels provides little if any value as habitat for the threatened or endangered species endemic to San Francisco Bay marshes. This includes species such as the Ridgway's rail or salt marsh harvest mouse. Both of these species require tall dense cover (18 inches is considered optimum). Ridgway's rail habitat is also characterized by a network of tidal channels which support their preferred food items and serve as the primary foraging areas for this species.

3 Eliminate Weed Sources

Invasive species are a major economic and ecological concern. Invasive species may drive local native species to extinction via competitive exclusion, niche displacement, or hybridization/genetic pollution with related native species. In San Francisco Bay, nonnative cordgrass are aggressive invaders that significantly alter both the physical structure and biological composition of the region's tidal marshes, mudflats, and creeks. Key affects have included:

- Competition for space the federally-listed pant Cordylanthus mollis sp. mollis.
- Choke channels which the endangered California clapper rail uses to forage.

  Colonize middle and upper marsh, displacing native pickleweed marsh, habitat of the endangered salt marsh harvest mouse.
- Loss of mudflat feeding habitat for shorebirds.
- Localized extinction of and hybridization with native cordgrass.

Between \$1.5 to \$2 million dollars is spent annually on control of invasive Spartina along the San Francisco Bay. The marshes along the Foster City shoreline are infested with several additional invasive species that pose similar risks to native species diversity. These species include Algerian sea lavender, stinkwort, sweet fennel, and iceplant. Unless controlled and conditions are corrected, infested sites like this become nurseries for the spread of seeds to other areas. A key to controlling these species is reestablishing tidal marsh productivity and controlling unregulated public access into the marsh which creates bare ground where these invasive species can gain a foothold.

4 Increase the Number of Native Plants

While improving the shore with a hybrid levee, the non-native plants that currently dominate the Foster City shore can be removed and replaced with native plants. This will benefit the environment as it will make the area more suitable for wildlife. The native plants will also improve the water quality of the area as explained below.

5 Stabilize the Shore

The addition of plants to the Foster City shoreline where a hybrid levee is used, will help stabilize the shore. This will prevent degradation of the area and provide a stable environment for both plants and wildlife. A stable shoreline will also help to reduce the energy of any storm surges that hit Foster City. A stable shore will also allow both present and future kayakers to successfully launch their kayaks into the Bay. 6

6 Improved Storm Water Buffer

Urbanization changed the condition and function of watershed. The impervious surfaces prevalent in urban areas absorb very little storm water compared to open land and produce large volumes of runoff into creeks from far less rainfall than a natural watershed. Increasing and improving the vegetation along the shore can help control runoff from these surfaces, by catching rain in their canopies and increasing the infiltration rate of deposited precipitation. Reducing storm water flow reduces stress on urban storm water and of urban sewer systems by limiting the risk of hazardous sewer overflows.[5]

7 Improve Water Quality of the Bay

In his ANALYSIS, Jeremy Lowe points out that wetlands, associated with a hybrid levee, will "remove pollutants from water through a variety of physical , chemical, and biological processes." Lowe describes the levee as the "kidneys" of the process, which are "capable of efficiently removing a broad range of pollutants . . ." As previously stated, we would like to work with the City, not only to maintain, but improve the wetlands on the Runco property, which will improve the quality of the Bay water along the Foster City shore. This will make the Foster City shoreline, even a better place to live and play.

8 Increase Carbon Sequestration

Carbon sequestration describes long-term storage of carbon dioxide or other forms of carbon to either mitigate or defer global warming and avoid dangerous climate change. It has been proposed as a way to slow the atmospheric and marine accumulation of greenhouse gases, which are released by burning fossil fuels.[6] Jeremy Lowe's ANALYSIS points out that the ability of the shoreline

[5]Safford, H.; Larry, E.; McPherson, E.G.; Nowak D.J., Westphal, L.M, 2013. Urban Forests and Climate Change. U.S. Department of Agriculture Forest Service Climate Change Resource Center. August. Available online at: http://www.fs.fed.us/ccrc/topics/urban-forests/ (Accessed 8 January 2014).

[6]Hodrien, Chris (October 24, 2008). Squaring the Circle on Coal - Carbon Capture and Storage (PDF). Claverton Energy Group Conference, Bath,. Retrieved May 9, 2010

surrounding the Bay, to reduce the amount of carbon dioxide was greatly reduced over the last two centuries due to the draining and diking of the Bay.[7] Lowe points out that by using a hybrid levee, the process will be reversed and carbon sequestration will be improved.[8]

9 The Hybrid Levee Will Create 10 Acres of Additional Wetlands in the Runco Property Alone, 6

Steve Foreman of LSA Associates and J.C. Miller of Vallier Design Associates, estimate that at least a total of 10 acres of wetlands will be added by using the hybrid levee, along the Runco property alone. This will consist of five acres of wetland habitat restoration and another five acres of upland habitat restoration. The number will increase as other areas can employ a hybrid levee as well.

III ACCESS TO THE BAY

In many places, the proposed levee will result in less access for the public to enjoy the Bay. In many locations, where Schaaf & Wheeler proposes to use a sheet pile wall, which is a 4 foot wall on top of the current levee along many portions of the City, including along the Runco property. The 7
proposed levee built by the City will eliminate or greatly reduce people's ability to walk to the shoreline as the proposed wall/levee will not be able to be crossed by people. At the north end of the Runco property, the proposed levee will prevent kayakers from accessing the areas where they launch their kayaks. In contrast, the hybrid levee would bring people closer to the Bay and will stabilize the shore to better allow kayakers, canoers and other small boaters, access to the bay.

IV THE HYBRID LEVEE WILL BE MORE AESTHETIC THAN THE PROPOSED LEVEE.

A hybrid levee would be less unsightly and give a more natural presence to Foster City's shore.

Here is a photo of the sheet pile levee that was installed in Fremont. You can see how a graffiti bandit could vandalize them, similar to the situation in Sea Cloud Park. Plus, the Fremont levee adds little to the to the scenic value of the landscape. In fact, many would argue that it reduces the aesthetics of the area. 8

Here is an image of what a hybrid levee will look like along the Foster City shore. In a hybrid levee, the wall can be imbedded below the land and it will still act to stop the storm surge. That is the case here as the wall is imbedded under the path. You can see that the hybrid levee will enhance the beauty of the shoreline and bring people closer to the Bay.

[7] Jeremy Lowe, *Analysis of the Costs and Benefits of Using Tidal Marsh Restoration as a Sea Level Rise Adaptation Strategy in San Francisco Bay* (ESA PWA Feb. 2013) (hereinafter referred to as "ANALYSIS") P. 17.

[8] *Id.* P. 21

V HOW THE HYBRID LEVEE WILL REDUCE COSTS.

According to Jeremy Lowe's ANALYSIS, incorporating a horizontal levee could save up to 50% of the cost of an earthen levee.[9] The savings will be even more in places where the sheet plie wall 9
is planned. Jeremy Lowe began presenting evidence to this effect at the Planning Commission meeting on February 4, 2016, but was stopped. We understand that he plans to present this evidence to the Council as well. Importantly, along the area of the Runco property, the savings will be even more as it does not need to be filled in as much as Lowe's model since it's already slopped.[10]

VI IMPACT ON PRIVATE PROPERTY RIGHTS

In its analysis, the Schaaf & Wheeler study on page 21 says that a raised earthen levee can be built. It's statement is:

> In general, the height of an earthen levee cannot be increased without widening the base of the levee. The Foster City levee system appears to have sufficient rights-of-way to increase the footprint of the levee system without having to tear down streets.

That is not the case with the Runco Property. Currently, the toe of the levee already encroaches on the Runco Property by several feet. To heighten the levee, the City needs to widen the base. The City is limited on the land side of the levee as Beach Park Blvd runs along the edge. As such, the City can 10
only build the proposed levee by either condemning the Runco Property or by re-engineering the levee and bringing it further into the street. Either way, the City would need to spend additional funds, adding to the planned cost of the project.

After discussing the matter with engineers, the City will need a construction easement on the Runco property to build the proposed levee. As such, the City will need to compensate the Runcos for the construction easement as well. There may also be a dispute over what the fair market value of the property, as well as the impact that any taking would have on the value of the rest of the Runco property. We suggest that the City could save these funds by using a hybrid levee, not only along the Runco property, but at similar areas on the Bay.

To use a hybrid levee at the Runco property, the path of the levee would need to be rerouted. However, in such a case, the Runcos would cooperate with the City and there would no need to condemn the property. There would also be no dispute over the value of the property. This would be a huge cost savings to the City.

VII CONCLUSION

In closing, we would like to point out that a hybrid levee is environmentally superior than the proposed levee. In the long run, it will be much less expensive than the proposed levee. The hybrid levee will also be much more aesthetically pleasing and offer much more access to the Bay. As such, 11
we feel it is the least environmentally damaging practicable alternative available to the City. In fact we feel it will actually improve the environment in the long run.

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[9] ANALYSIS, p. IV.

[10] Lowe's ANALYSIS includes the cost of "creating and maintaining an upland ecotone slope." p 40.

We thank you for considering the information that we presented and look forward to presenting further information as the process proceeds. We have included the Bay Institute's Executive Summary in this submission. However, due to its size, we will provide you with Jeffrey Lowe's complete study under separate cover.

Sincerely,

Mark C. Watson

CC: Doris Palmer, City Clerk
Jean Savaree, City Attorney

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www.markcwatson.com

Mark C. Watson, Esq
Kevin Fusch, Esq.
Heidee Valiao

October 16, 2015

Letter B1
Attachment C

Kevin Miller
City Manager
City of Foster City
610 Foster City Blvd
Foster City, CA 94404

RE: Foster City Levee Project & The Runco Property

Dear Mr. Miller:

As you know, my office represents Sam Runco with regard to his property located along the shores of Foster City (hereinafter referred to as the "Runco Property"). The Runco Property is on the east side of Beach Park Boulevard at Swordfish Street (the "Project Site"), on the eastern edge of the City. The Runco Property is located approximately 1.4 miles south of the San Mateo Bridge (SR-92), 2.3 miles east of US 1
Highway 101, and 1.6 miles east of the Foster City Town Center. Just south of the Runco Property is the City's Shorebird Park and to the north are the State Tidelands. The Runco Property is currently zoned "waterfront commercial," which legally allows Mr. Runco to develop the property so long as it falls within that designation.

Surrounding the shores of Foster City is the City's levee system. The levee is about 8 miles long. Today one of its main purposes is to protect properties from flooding. According the City's documents, the levee protects 9000 properties in Foster City and another 8000 in San Mateo. Yet it does not protect the Runco Property. The levee also provides the City with several recreational uses. The levee is a few feet 2
high in the area of the Runco Property.

The City now plans to reconstruct and improve its levee system by raising it by an additional 2 to 5 feet. The reason is to bring the levee up to federal standards so that the Federal Emergency Management Agency ("FEMA") does not classify Foster City as an area that is unprotected from a "100 year flood," which will require many of its landowners to purchase flood insurance.

Mr. Runco and I met with Jeff Moneda, Curtis Banks and yourself on Tuesday, October 6, 2015 to discuss the matter. At that time, we requested that the City build the wall around the Runco property so that it would be protected. You said that you were not authorized to discuss that possibility. However, during the meeting, Mr. Moneda informed us that the City was planning on building an eight foot high 3
sheet wall between Beach Park Boulevard and the Runco Property. As such, the sheet wall will act as a dam which would artificially retain waters on the Runco Property, that would normally flow past it and onto the properties of others. Therefore, the design of the new levee will protect the properties of others while damaging the Runco Property. Actually, the value of the Runco Property will be damaged now as

potential buyers will see that the City is using a design plan that will eventually lead to damage to the Runco Property.

As mentioned in the meeting, we feel that the City's plan is unreasonable for several reasons. The first is that it protects others at the expense of Mr. Runco. The next is that the City is altering the levee in a manner that will increase the amount of damage to the Runco Property. Furthermore, the cost of moving the levee around the Runco Property will not be borne by the City itself, but rather by an assessment district that would be formed to pay for the new levee. Like every other property owner in Foster City, Mr. Runco has paid his fair share of taxes in the City, yet receives no benefit from the current levee and will actually be further damaged by the new levee system.

Public entities can be held liable for levee systems that cause damage to private property. *Paterno v. California* (2003) 113 Cal. App. 4th 998, 1003. The liability is based on the California Constitution and not on any theories of tortuous conduct. See *Albers v. County of Los Angeles* (1965) 62 Cal.2d 250, 261-262. "California Supreme Court precedent dictates that a landowner should not bear a disproportionate share of the harm directly caused by failure of a flood control project due to an unreasonable plan." *Paterno* 113 Cal. App. 4th at 1003. *Paterno*, also held that a public entity can be held liable for a levee that was built by another if the entity takes over the system.

Furthermore, when a city builds a flood control system, like the levee, it will be liable for the
damages of a landowner if the city acted unreasonably. Miller & Starr, CAL REAL ESTATE, Inverse 3
Condemnation (3rd Ed) 30:8; *Hauselt v. County of Butte* (2009) 172 Cal App 4th 550, 557-8. Unreasonable
conduct can be found when the city builds or maintains a levee system that increases the volume of water
that will flow onto the property of another. Liability can also be imposed when the City protects some
landowners at the expense at the other. Miller & Starr 30:7 & 14:16. Other cases have held that liability
may be imposed when a City deliberately alters a system in a manner that will result in such damage.
Miller & Starr 30:7.

In the present case, the City will increase the height of the levee causing waters that were intended to flow onto the properties of others to flow onto, or remain on, the Runco Property. As such, the City will be protecting the properties of many at the expense of damaging the Runco Property; while the cost of the new levee project is approximately $70 million and will be spread over the 9000 benefitted properties in Foster City. In light of those numbers, imposing the cost of protecting the Runco property solely on Mr. Runco is unreasonable compared to the alternative.

The alternative would be to also protect the Runco Property at the cost which is negligible as compared to the $70 million cost of the project. That cost would not be borne by the City, but instead by the 9000 protected properties. We feel that this is the more equitable solution and we hope that the City will follow this course.

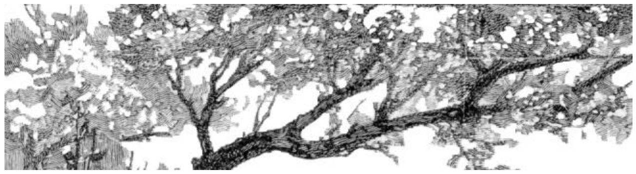
As we discussed in the meeting, Mr Runco has already discussed building a levee on the waterside
of the Runco Property with BCDC. They visited the property, looked at the plans and said that building
it in that location was not really an issue for them. You expressed concerns about the position the the Army 4
Corp of Engineers might take and offered to discuss the matter with them and report back to us any
concerns that they might have. On behalf of Mr. Runco, we thank you for your offer and look forward to
hearing from you.

As also stated in the meeting, we are agreeable to discuss this matter further and hope that litigation will not be needed to resolve this matter. While Mr. Runco did say that he would result to legal action if necessary, we are hopeful that this matter will resolve itself in a fair and amicable manner.

Sincerely,

Mark C. Watson

CC: Mayor Art Kiesel
Jean Savaree



Letter B1
Attachment D

January 9, 2017

Mark C. Watson
The Law Offices of Mark C. Watson, P.C.
1633 Bayshore Highway, Suite 250
Burlingame, CA 94010

RE: Runco Property, Foster City, CA

Mark,

Beginning in November 2012, Vallier Design Associates, Inc. has been studying development alternatives for the Runco property in Foster City, California. Two date two site plans that depict possible development projects have been designed and submitted to the Foster City Planning Department for consideration. Both of these alternatives propose a sloped entry drive to allow vehicle access to the property from Beach Park Boulevard. This driveway is necessary as the Runco property sits at elevations that are 5’ to 9’ higher than the elevation of the Beach Park Boulevard. Despite
considerable time and effort in study and analysis, no viable alternative has been found to the proposed 1
sloped entry drive.

The sheet pile wall proposed for the west property line of the Runco property makes the entry driveway impossible to execute, effectively blocking vehicular access to the Runco property. The increase in height to be traversed imposed by the wall requires a steeper and longer entry drive. The increased length of the driveway cannot be accommodated by the physical dimensions of the Runco property.

I would also like to point out that the description on page 13 of the DEIR concerning my testimony
before the Planning Commission is inaccurate. What I proposed at that Planning Commission meeting 2
was a hybrid horizontal levee that is included in Mr. Watson’s letter of February 18, 2016.

Sincerely,
VALLIER DESIGN ASSOCIATES, INC.

JC Miller

JC Miller, ASLA
Principal, Landscape Architect L#5107

VALLIER DESIGN ASSOCIATES, INC.
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LSA

BERKELEY
CARLSBAD
FRESNO
IRVINE
PALM SPRINGS
POINT RICHMOND
RIVERSIDE
ROCKLIN
SAN LUIS OBISPO

January 11, 2017

Mark Watson, P.C.
The Law Offices of Mark, C. Watson, P.C.
1633 Bayshore Highway, Suite 250
Burlingame, CA 94010

Subject: Environmental Restoration Benefits

Dear Mark:

What is now the Runco Property and portions of the adjoining lands along Belmont Slough within the California Department of Fish and Wildlife Redwood Shores Ecological Reserve were filled in the period between 1958 and May 1965 concurrent with development of the eastern portions of Foster City. Attached is a copy of May 1965 aerial photograph showing the Runco Property and adjoining shoreline. I have also attached a recent (April 2016) Google Earth image of the same area. As can be seen in comparing the two images, there has been remarkably little recovery of this area in the intervening 50+ years. This is especially evident in the low land area adjacent to Discovery Park. Both the current uplands (referred to as a Fennel Patch in the Flood Control DEIR) and low lying lands remains highly degraded and dominated by exotic invasive plants and substantial bare ground. 1
As noted in the DEIR, these current conditions provide little if any value as habitat for the threatened or endangered species endemic to San Francisco Bay marshes such as the California clapper rail or salt marsh harvest mouse.

Incorporating the Runco Property into the City's flood control project provides significant opportunity for the City to mitigate air quality/global climate change, visual, public access, and environmental degradation impacts identified in the Draft EIR for the proposed City's Flood Control Project as well as the ability to incorporate environmental benefits. Public access to and views of the Bay can be provided in an environmentally superior manner.

The habitat along the shoreline on both the Runco Property and Ecological Reserve are deteriorating and will continue to decline without active intervention. Ongoing human activities perpetuate a cycle of habitat destruction and disturbance which:

- Precludes establishment of necessary dense marsh vegetation necessary to support species such as the clapper rail and salt marsh harvest mouse; 2

- Displaces and disturbs shorebirds and other wildlife using the adjacent bay and mudflats, this disturbance is particularly an issue during high tides when shorebirds are confined to narrow bands and roosts along the immediate shoreline;

- Creates conditions that favor establishment and expansion of several very invasive and undesirable plant species. These barren scares on the land promote growth of invasive weeds, which are counter -productive to maintaining the area’s environmental health. 2

Incorporating these shoreline lands into the Flood Control Project provide an opportunity to:

- Incorporate public access in an environmentally compatible manner;

- Improve aesthetics and views of the Bay; 3

- Rehabilitate valuable tidal marsh habitat and transitional habitat by re-establishing a network of shoreline tidal channels to increase water circulation and fluctuation to promote native plant species growth and establishment over invasive exotic plants to benefit of rare, threatened, and endangered endemic plants and animals; 4

- Improve water quality in the Bay; and

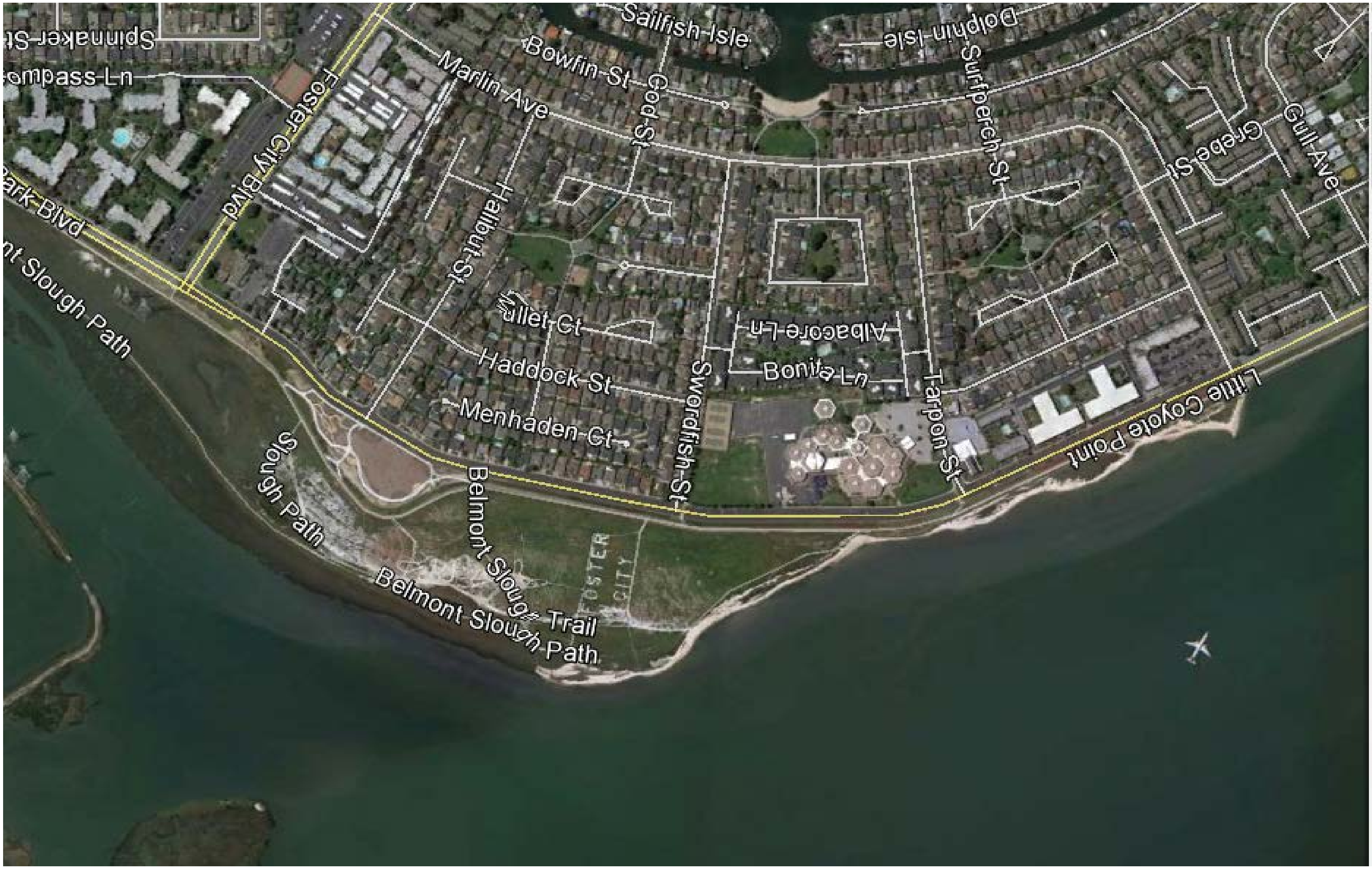
- Minimize impacts associated with Green House Gas emissions through increased carbon sequestration. 5

Sincerely,

LSA Associates, Inc.

Steve Foreman
Principal/Wildlife Biologist

Foster City, Belmont Slough Shoreline. May 11, 1965. Source: UC Berkeley Earth Science Lab & Map Library, Cartwright Aerials Surveys from a State of California, Bay Area Transportation Study.



Foster City, Belmont Slough Shoreline. Source Google Earth Image Date of April 5, 2016

LETTER B1
Law Office of Mark C. Watson
January 12, 2017

Response B1-1. This comment notes the letter from the Law Office of Mark C. Watson, dated September 12, 2016 was missing from the list of comments received during the second NOP comment period. This letter was in response to discussions with the City Manager related to the location and materials for the levee project. The letter was not submitted to the Community Development Department with comments related to the Draft EIR.

Response B1-2. This comment states that the summary of J.C. Miller's testimony from the public scoping session held in conjunction with the Planning Commission meeting on February 4, 2016, was inaccurate.

Page 13, the third paragraph, of the Draft EIR is revised as follows:

> Lastly, JC Miller, with Vallier Design Associates, Inc. suggested that a <u>hybrid</u> horizontal levee be studied sincerely in the EIR.

Response B1-3. This comment recommends considering a report called "Analysis of the Costs and Benefits of Using Tidal Marsh Restoration as a Sea Level Rise Adaptation Strategy in San Francisco Bay" by Jeremey Lowe. While this does not directly relate to the adequacy of the Draft EIR, this report was received by the City and will be considered during the project approval process.

Response B1-4. This comment claims there is insufficient information concerning how far the levee would go into Beach Park Boulevard in the Draft EIR for the City or residents to determine the true impact of the project under the 2050 and 2100 Sea Level Rise scenario. The alignment deviation included in the proposed project is a minor realignment from the original levee that was analyzed throughout the Draft EIR. As described on page 58 of the Draft EIR, and depicted on Figure III-1, the deviation from the existing levee/Bay Trail would result in the loss of parking on the bayside of Beach Park Boulevard between Swordfish Street and the northern edge of Shorebird Park. As a preliminary matter, according to Appendix G of the CEQA Guidelines, parking—in and of itself—is no longer a consideration in determining if a project has the potential to result in significant environmental effects for projects. Nonetheless, the City held a meeting with residents adjacent to the alignment deviation on October 27, 2016 to explain the removal of up to 50 spaces and no concerns were expressed by meeting attendees. Contrary to the commenter's assertion, the loss of parking is not adjacent to the Bowditch Middle School but approximately 1,000 feet south of the entrance to the school between Swordfish Street and the northern edge of Shorebird

Park. Parking is restricted adjacent to Bowditch Middle School and no stopping is permitted from 7:30 a.m. to 3:30 p.m. on school days.

The public parking to be removed along the alignment deviation between Swordfish Street and the northern edge of Shorebird Park does not directly serve either Bowditch Middle School or residents across the street. Furthermore, both Shorebird Park and the Bay Trail are not vehicular destinations. These are passive recreational areas primarily frequented by pedestrians and bicyclists. While the 8-foot lane of parking on the bayside of Beach Park Boulevard would be removed for a length of approximately 1,000 feet (resulting in up to 50 spaces removed), the two travel lanes on Beach Park Boulevard would be maintained at their existing width in each direction. Therefore, contrary to the commenter's assertion, the roadway at this location would not be further narrowed. Therefore, the reduction in parking resulting from the project would not result in a significant environmental impact.

The City also sent a Code Enforcement Officer to observe parents dropping off near Bowditch Middle School at 7:45 a.m. and 3 p.m. to assess the use of the shoulder on the bayside of Beach Park Boulevard as a loading and/or parking area.

On February 15 and February 17, 2017, the Code Enforcement Office observed:

1. Most of the bayside of Beach Park Boulevard (from Shorebird Park to Tarpon St.) has signage that says “No Stopping 7:30 am – 3:30 pm School Days”.
2. Most of the drop-offs occur on the school side of Beach Park Boulevard, with many illegal U turns to get to that side.
3. The bayside drop-offs that do occur are just north of Tarpon Street, so that kids can cross using the crosswalk. Most cars stop in the areas that are just north of the “No Stopping” zone, but once those few spots are filled, then some do stop in the “No Stopping” area closest to the crosswalk.

These observations indicate that the use of the shoulder on the bayside of Beach Park Boulevard is not a concern because the majority of drop-offs are occurring on the school side of Beach Park Boulevard. Moreover, any drop-offs or stopping occurring on the bayside of Beach Park Boulevard are north of Tarpon Street. To reiterate, neither the paved roadway width nor the right-of-way width across from the middle school would be changed by the alignment deviation.

This comment also states that the loss of parking at the alignment deviation would be inconsistent with the General Plan which recommends that all arterial streets have a right-of-way from 80 to 110 feet. As previously stated, the right-of-way at the alignment deviation would not be narrowed and therefore, this change would not be inconsistent with the General Plan.

Page 62, the third paragraph of the Draft EIR, is revised:

> The deviation would result in the loss of parking <u>(approximately 50 spaces)</u> on the bayside of Beach Park Boulevard between Swordfish Street and the northern edge of Shorebird Park.

Response B1-5. This comment recites the three primary concerns that comprise the vision of the Conservation Element and concludes that the Conservation Element of the General Plan requires the City to look at the project's impact on the undeveloped Runco Property to "ensure its proper development". The commenter's conclusion takes the Conservation Element out of context. The commenter is concerned with the project's impact on development opportunities for an undeveloped site while the purpose of the Conservation Element (as mandated by Section 65302(d) of the California Government Code) is to address the preservation of conservation of natural resources in Foster City.[12] The Conservation Element does not call for development of the Runco Property as implied by the comment. As such, the General Plan does not require the City to analyze the impact of the project on the ability to develop the Runco Property.

CEQA however requires that an EIR must describe any growth-inducing impacts of the proposed project. A project is considered to be growth inducing if it would directly or indirectly foster substantial economic or population growth or the construction of additional housing.[13] The Draft EIR concludes that the project as proposed would not have a growth-inducing impact (see page 446 of the Draft EIR). However, the Extended/Realigned Horizontal Levee 2050 Sea Level Rise Alternative, which is similar to the Bayside Levee alternative, suggested by the commenter was rejected from consideration for several reasons including because it could potentially be growth inducing as it would result in protecting an additional 13 acres, which includes the Runco Property, from flooding and thereby removes a major constraint against future development (see pages 439-440 of the Draft EIR).

This comment also states that the Levee project would make it impractical and financially infeasible to access the property which would "kill development of the property" and therefore the Draft EIR should include an analysis of how access would be restored. It should be noted that on September 20, 2016, Mr. Runco submitted a separate application to develop the Runco Property including 27,800 square feet, distributed over five buildings, consisting of:

- a one-story 4,500 square foot building for commercial waterfront activities;
- a one-story 4,000 square foot building for commercial waterfront activities;

[12] City of Foster City, 2003. General Plan, Conservation Element. May.
[13] Public Resources Code Section 21100(b)(5); 14 Cal Code Regs Section 15126(d).

- a three-story 6,300 square foot hotel, with 101 rooms that would include a waterfront theme;
- a 7,500 square foot restaurant;
- a 5,500 square foot waterfront themed café, which would be required to undergo its own independent CEQA review.

Mr. Runco's proposal includes realigning the existing levee to the perimeter of the Runco property which would be required to provide flood protection and vehicular access to the property and would allow the levee wall in front of his property to be removed if he received approval from the City and appropriate state and Federal regulatory agencies.

CEQA generally does not require analysis of a project's economic and social effects because they are not considered to be effects on the environment.[14]

Nonetheless, it is noted that the Runco Property is currently not protected by the existing levee or accessible by vehicles due to the existing levee alignment; it is only accessible to bicycles and pedestrians via an existing asphalt ramp located at the eastern side of the intersection of Swordfish Street/Beach Park Boulevard to the top of the existing Bay Trail bordering the property. The Runco Property would be required to obtain the proper access easements from the City's rights-of-way as part of the development's entitlement process. The proposed levee improvements would not alter these existing conditions. The property would still continue to be inaccessible by vehicles and would continue to be accessible to bicycles and pedestrians; however, as depicted on Figure 7, the improvements would increase both the width and the grade of the existing ramp to provide access for Public Works Maintenance vehicles while meeting Americans with Disabilities Act (ADA) requirements in conjunction with the Bay Trail. As such, the project would not result in any further obstruction of the property's access. Moreover, even if it did, CEQA only requires an analysis of the project's physical impacts on the environment. Any obstruction of access would only be considered to be a physical impact on the environment if it resulted in the exceedance of the significance criteria listed in the Traffic and Transportation Section of the Draft EIR, which it would not (see pages 383-384 of the Draft EIR). Because the project does not obstruct the Runco property access and even if it did would not result in a significant environmental impact, no mitigation to "restore" the property's access is required under CEQA.

[14] 14 Cal. Code Regs Section 15131(a).

FIGURE 7 RENDERING OF PROPOSED RAMP FOR PUBLIC WORK MAINTENANCE

Source: BFS Landscape Architecture, 2016

Nor does CEQA require an analysis of an alternative that would provide access to Mr. Runco's property or increase its level of flood protection. The purpose of an alternatives analysis is to reduce or avoid any identified significant environmental effects of the proposed project. Providing flood protection and access to Mr. Runco's property would not avoid or reduce any identified significant environmental effects of the proposed project. On the contrary, it may result in potential growth inducing impacts since providing flood protection and access where none currently exist would make the Runco property more developable. This is evidenced by Mr. Runco’s development application which includes realignment of the levee to encompass his property.

Response B1-6. This comment asserts that the proposed project is inconsistent with one of the objectives of the Land Use and Circulation Element to provide opportunities for commercial development because it will make development of the Runco Property impossible, which in turn would reduce the City’s potential tax base and job opportunities within the City. The comment states that the Draft EIR fails to analyze this economic impact. As stated in response B1-5, the project would not change the property in its current condition which is currently inaccessible and unprotected from flooding due to the existing levee. Additionally, assessing the economic impact of the Levee project on the City's potential tax base and job opportunities is outside of the scope of CEQA.

Response B1-7. The comment argues that a traditional horizontal levee or "Bayside Levee" alternative would avoid the construction noise from the proposed project which requires a sheet pile wall, The City understands the "Bayside Levee" to be similar to the Extended/Realigned Horizontal Levee 2050 Sea Level Rise Alternative which was rejected from further consideration. As stated on page 439 of the Draft EIR, the Extended/Realigned Horizontal Levee 2050 Sea Level Rise Alternative would have similar impacts to the Horizontal Levee 2050 Sea Level Rise Alternative which was analyzed in detail as one of the four project alternatives. As noted on page 430 of the Draft EIR, the noise and vibration impacts of the Horizontal Levee 2050 Sea Level Rise Alternative would be similar to the proposed project. However, contrary to the commenter's assertion, this alternative would result in more severe noise impacts than the proposed project due to the substantial increase in fill that would require more truck trips. This would likely result in exposure to noise from hauling trucks and excessive vibration over a longer period of time due to a longer construction schedule which would adversely impact residents and species in the immediate area.

Also see response B1-13.

Response B1-8. This comment addresses the visual impacts of the proposed project along Beach Park Boulevard in comparison to the "Bayside Levee" alternative. As stated above in Response B1-7, the City understands the "Bayside Levee" to be similar to the Extended/Realigned Horizontal Levee 2050 Sea Level Rise Alternative which was rejected from further consideration. As stated on page 439 of the Draft EIR, the Extended/Realigned Horizontal Levee 2050 Sea Level Rise Alternative would have similar impacts to the Horizontal Levee 2050 Sea Level Rise Alternative which was analyzed in detail as one of the four project alternatives. The commenter states that the visual impacts of the "Bayside Levee" alternative would be less than those of the proposed project. The commenter is correct that the impact AES-1 at Shorebird Park (segment 4) would be eliminated because the levee elevation would be lower. This is discussed in the Horizontal Levee 2050 Sea Level Rise Alternative on pages 424-425 of the Draft EIR. However, as stated in response B1-13, this alternative was rejected from further consideration because it increases other identified significant environmental impacts of the proposed project, it does not meet the basic project objective of retaining FEMA accreditation, it is unlikely to be capable of being accomplished in a successful manner within a reasonable period of time, and its implementation is remote and speculative as there is risk that it would not be permitted by the regulatory agencies with jurisdiction over the project.

Response B1-9. The comment refers to mock-up renderings submitted by the Offices of Mark C. Watson, referred to as the "Bayside Levee" suggested by the commenter and included as Figure 8. These renderings appear similar to the levee realignment Mr. Runco proposes in his separate development application for his property. The "Bayside Levee" concept would apply to segment 3 through 5 which includes the Runco Property and lands held by the California State Lands Commission (CSLC). Note that the CSLC does not request an analysis of this alternative.

The alternative advocated by the commenter is not to be confused with a "horizontal levee" with hundreds of feet of offshore fill. A true horizontal levee that would effectively dissipate wave energy needs to typically be laid back with 30:1 side slopes as measured horizontal to vertical. Such a levee configuration could extend a significant distance into San Francisco Bay at the location shown on conceptual plans (shown in Figure 8) for this requested alternative. The alternative suggested by the commenter is rather a relatively traditional levee system, but with restored habitat on the offshore slope. Since an offshore breakwater is not shown, the levee elevation still needs to be sufficiently high to provide the requisite FEMA freeboard against wave overtopping.

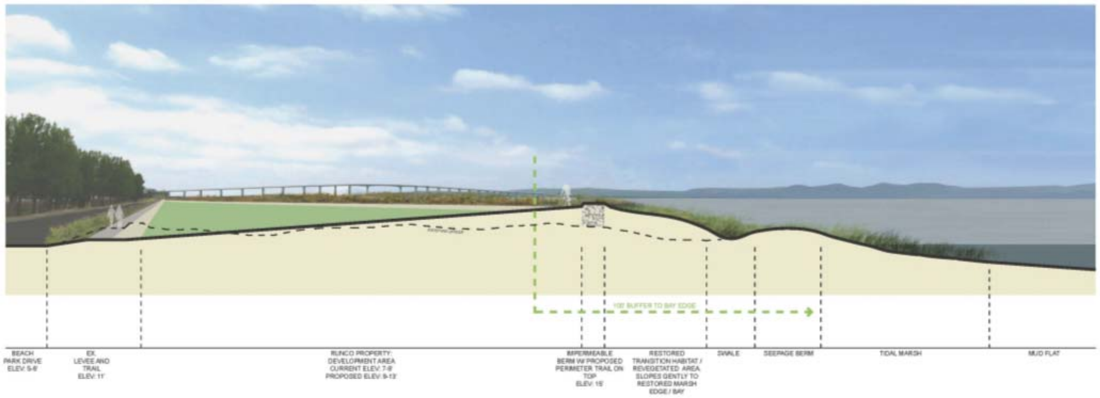
Due to the limited details provided, the commenter's assertions cannot be adequately evaluated.

The alignment of the "Impermeable Berm with Proposed Perimeter Trail" is not sufficiently precise to allow for a meaningful impact analysis. Figure 8 shows the location of the berm as apparently 100 feet away from the "bay edge," with that edge defined as "tidal marsh," but that edge is not defined in terms of tidal elevation. The requisite elevation of the "Bayside Levee" alignment would, therefore, need to be verified to determine its viability for wave protection since it is much closer to the shoreline than the existing levee alignment, which has been evaluated by the City in terms of required wave protection elevations.

That said, the City understands the "Bayside Levee" to be generally similar to the Extended/Realigned Horizontal Levee 2050 Sea Level Rise Alternative which was rejected from further consideration because, in comparison to the project, it would not satisfy most of the project objectives, it would increase environmental impacts in most CEQA topic areas, including potentially inducing growth along the waterfront (see Draft EIR, pages 439-440), it is unlikely to be capable of being accomplished in a successful manner within a reasonable period of time, and its implementation is remote and speculative as there is risk that it would not be permitted by the regulatory agencies with jurisdiction over the project. Also see response B1-14. An EIR need not consider alternatives that do not offer significant environmental advantages to the proposed project, nor must it include multiple variations of alternatives that it does consider under CEQA.

Note however, that the City's conclusion that the Bayside Levee alternative is not a feasible project alternative under CEQA, does not preclude the Bayside Levee alternative from being incorporated into or approved as part of Mr. Runco's separate development project application which will require its own separate environmental review under CEQA and will have its own project objectives.

FIGURE 8 "BAYSIDE LEVEE" RENDERING PREVIOUSLY PROVIDED BY LAW OFFICES OF MARK C. WATSON



Source: Watson, Mark C., 2016. Written correspondence to the Hon. Herb Perez and Hon. Kevin Miller of Foster City. February 18.

Response B1-10. The commenter asserts that the “Bayside Levee” is the environmentally superior alternative and complains that the Draft EIR fails to discuss the costs of building the levee. As discussed in Response B1-9, the Extended/Realigned Horizontal Levee 2050 Sea Level Rise Alternative, which the City understands is similar to the “Bayside Levee”, is not environmentally superior to the project as proposed; in fact it would increase environmental impacts in most CEQA topic areas. As noted on page 420 of the Draft EIR, the costs associated with the Horizontal Levee 2050 Sea Level Rise Alternative would more than double the cost of the proposed project 2050 Sea Level Rise scenario. Furthermore, while monetary impacts are evaluated qualitatively in the Draft EIR, they are not within the scope of CEQA, and therefore an economic analysis of each alternative is not required. This comment will be considered in discussion of the merits of the project prior to approval.

Response B1-11. See response to B1-8.

Response B1-12. See response to B1-10.

Response B1-13. The commenter asserts that a horizontal levee alternative in segment 4, where the Runco property is located, would mitigate the project’s impacts on the salt marsh harvest mouse, Ridgway’s rail, and California black rail.

Impact BIO-1, on page 223 of the Draft EIR, states:

> “<u>Impact BIO-1</u>: The Levee project could result in significant impacts to special-status animal species, including the Ridgway’s rail, salt marsh harvest mouse, and California black rail.”

The Draft EIR includes Mitigation Measure BIO-1a, on pages 228-231, which would mitigate any potential impacts on these biological resources by limiting levee construction to times, locations, and employing a qualified biological monitor.

CEQA requires an analysis of a reasonable range of alternatives. The purpose of alternatives is to evaluate options for mitigating significant impacts of a project. However, alternatives must be feasible. The City understands that the "Bayside Levee" is similar to the Extended/Realigned Horizontal Levee 2050 Sea Level Rise Alternative, discussed on page 439-440 of the Draft EIR. The Draft EIR did not conduct further analysis of this alternative as it did not satisfy most of the project objectives, would increase environmental impacts in many topic areas, is unlikely to be capable of being accomplished in a successful manner within a reasonable period of time, and its implementation is remote and speculative as there is risk that it would not be permitted by the regulatory agencies with jurisdiction over the project. Indeed, the RWQCB's comment letter to the Draft EIR states that it does not consider a horizontal levee to be feasible in segment 2 or segment 4:

> "As a responsible agency under CEQA, the Water Board is obligated to comment on additional alternatives that should be included in the Draft EIR (CEQA §15096(b)(d)). These alternatives must be reasonable, and feasibly attain the objectives of the project while avoiding or substantially lessening its significant effects (CEQA §15126.6). The Draft EIR includes an alternative which replaces a portion of the proposed sheet pile under the proposed project (segment 2) with a horizontal levee. The assessed "horizontal" (gradually sloped) levee has a 30:1 bayward slope extending into San Francisco Bay approximately 400 ft from the existing shoreline, resulting in the fill of approximately 100 acres of intertidal and subtidal mudflats. The Draft EIR states that a horizontal levee was considered for this segment 'because there is significant wave action' among other reasons. For multiple reasons, including the locally significant wave action and depth profile of offshore mudflats, a horizontal levee in this location is an unreasonable alternative. Horizontal or otherwise gradually sloped levees are most effective where they can be placed landward of existing tidal wetlands or intertidal mudflats, and where significant wave energy would not result in the development of scarps and similar erosional features. The persistence and growth of the shell bar bayward of segment 4 (as well as the persistence of shell ridges with similar wave climates at Outer Bair Island) demonstrates that existing physical processes along the shoreline are better suited to sustaining coarse shoreforms than tidal wetlands." (Letter from Naomi Feger, Chief of Planning Division to Curtis Banks, Foster City Community Development Director; January 19, 2017.)

In the time since the publication of the Draft EIR, City representatives have met with the RWQCB.

These meetings suggest that the RWQCB does not consider horizontal levees to be a feasible alternative within any project segment, including segment 4 for the same reasons described above in its letter (there are no existing tidal wetlands or intertidal mudflats along any of the segments of the Foster City shoreline).

Response B1-14. As discussed in response B1-9, the City attempted to evaluate the "Bayside Levee" presented by Mr. Runco with the materials provided in the analysis of the Extended/Realigned Horizontal Levee 2050 Sea Level Rise Alternative on page 439-440 of the Draft EIR. This alternative fails to satisfy most of the Levee project objectives and would increase the environmental impacts in most CEQA topic areas. In addition, it is unlikely to be capable of being accomplished in a successful manner within a reasonable period of time, and its implementation is remote and speculative as there is risk that it would not be permitted by the regulatory agencies with jurisdiction over the project. Therefore, this alternative was rejected for detailed analysis. Please also see response B1-13.

Response B1-15. The commenter states that the Draft EIR does not assess which project alternative would produce the least amount of vibration. The commenter also asks why the Draft EIR does not determine the severity of noise and the cost for each project alternative.

As discussed on page 404 of the Draft EIR, CEQA requires an EIR to include sufficient information about each alternative to allow evaluation, analysis, and comparison to the proposed project. CEQA does not require an evaluation, analysis, and comparison of an alternative to other alternatives, although the alternatives analysis in Chapter VI of this Draft EIR can be used for this purpose, as discussed below.

Table VI-1 on page 408 of the Draft EIR summarizes the severity of the impact of each alternative relative to the proposed project. This table indicates that only the No Project/No Build Alternative would result in reduced noise and vibration impacts because no construction would occur. As described on pages 418-419 and pages 435-436 of the Draft EIR, the Existing Levee Footprint 2050 Sea Level Rise Alternative and the FEMA Freeboard Alternative would use similar construction methods to the proposed project and therefore would not substantially alter the severity of potential noise and vibration impacts relative to the proposed project. The difference between the Existing Levee Footprint 2050 Sea Level Rise Alternative and the proposed project is that the slight deviation along segment 4 would not occur (refer to Figure III-1 in the Draft EIR for an illustration of the deviation that would occur under the proposed project). However, because the difference in the alignment between the proposed project and the Existing Levee Footprint 2050 Sea Level Rise Alternative is slight, construction under this alternative would expose nearby receptors to construction-generated noise and vibration levels that are similar in duration and intensity to the potential exposure under the proposed project. Furthermore, the difference between the FEMA Freeboard Alternative and the proposed project is that the top elevation of the levee/floodwall would be lower. The duration of construction would not be substantially shorter relative to the proposed project and the location of the alignment would be the same as the proposed project, and therefore construction under the FEMA Freeboard Alternative would still expose nearby receptors to construction-generated noise and vibration levels that are similar in duration and intensity to the potential exposure under the proposed project. For these reasons, the potential noise and vibration impacts of these two alternatives would not be substantially different from the impacts of the proposed project, and therefore would not be substantially different from each other. The costs of mitigating these potential impacts, which is not a CEQA issue, would also be similar.

As described on pages 429-430 of the Draft EIR, construction under the Horizontal Levee 2050 Sea Level Rise Alternative would potentially increase noise impacts relative to the proposed project. This alternative would involve construction of a gently sloped (30:1 instead of 2:1) levee extending out into the bay along segment 2 and a portion of segment 3. Neither the Horizontal Levee 2050 Sea Level Rise Alterative nor the proposed project would have the potential to expose receptors along segments 2 and 3 to noise levels above 100 dBA, and therefore neither scenario would trigger Mitigation Measure NOISE-3. However, the substantial increase in fill needed for the horizontal levee alternative would require a substantial increase in the number of truck trips and construction duration along segments 2 and 3, and therefore the intensity and duration of exposure of nearby receptors to haul truck-generated noise would be greater than under the proposed project. For this reason, the Horizontal Levee 2050 Sea Level Rise Alternative would have a more severe noise impact than the proposed project and the other alternatives.

The Horizontal Levee 2050 Sea Level Rise Alternative would avoid the installation of sheet pile walls potentially using a vibratory driver, thereby reducing the vibration generated along the levee during construction of segments 2 and 3 relative to the proposed project. However, the potential impacts of vibration would be similar to the proposed project because, as discussed on pages 361-362 of the Draft EIR, even with the use of a vibratory pile driver, the vibration generated by construction of the proposed project would not result in damage to structures or result in a significant disturbance impact to receptors near segments 2 and 3. As discussed on page 361 of the Draft EIR, although vibration from sheet pile driving would be perceptible at the nearest receptors along segment 3, the potential disturbance impact would be less than significant because the exposure of any given residence to vibration levels at or above the disturbance threshold would last no more than one day. For these reasons, neither the proposed project nor the Horizontal Levee 2050 Sea Level Rise Alternative would trigger Mitigation Measure NOISE-4a or NOISE-4b. Because the severity of the noise and vibration impacts under the Horizontal Levee 2050 Sea Level Rise Alternative would be higher than or similar to the proposed project and the other alternatives, the cost of mitigating these impacts, which is not a CEQA issue, could also be higher or similar for the Horizontal Levee 2050 Sea Level Rise Alternative.

Response B1-16. The project's consistency with the applicable General Plan goals and policies are addressed on pages 89-110 of the Draft EIR. The commenter incorrectly states that Beach Park Boulevard will be narrowed and that the location of the alignment deviation is located across from Bowditch Middle School. As noted in response B1-4, the alignment deviation would be located 1,000 feet south of the entrance to the school and parking is no longer a consideration in determining if a project has the potential to result in significant environmental effects for projects. Therefore, the reduction in parking would not result in an impact.

Response B1-17. It is noted in passing that the BCDC did not submit comments to the Draft EIR.

With respect to erosion of the sheet pile wall, the sheet pile walls themselves would be driven sufficiently deep into the underlying foundation material that erosion against a sheet pile wall would not have any impact. As noted on page 63 of the Draft EIR, it is anticipated that piles would be driven to approximately 10–20 feet underground.

However, based on the September 15, 2016 letter from the BCDC referenced implicitly in the comment, the BCDC is not concerned with erosion of a sheet pile wall per se, but rather, the erosion caused by a sheet pile wall adjacent to a wetland, presumably by preventing levee overtopping.

Along wave-protected levee reaches, more specifically adjacent to Belmont Slough wetlands, new sheet pile walls strictly provide freeboard, as the top of the existing levees and floodwalls already prevents overtopping from 100-year tide elevations. Thus there is no change in erosion potential, which field observation shows to be minimal.

Where wind-driven waves meet the shore elsewhere, wave energy reflection would generally increase somewhat with the proposed improvements, although this generally remains a less-than-significant localized effect, minimized as is by the levee slope itself, which will not be modified. Reflection of a wave occurs with minimum energy loss when a wave is reflected at a right angle, off of a smooth, vertical surface. Because Foster City's levees consist primarily of rock-armored slopes with stillwater freeboard, interaction of the wave with the slope can greatly decrease the amount of energy reflected. "Wave Reflection from Coastal Structures"[15] presents compiled data on wave reflection coefficients, relating the breaking parameter to the degree of wave reflection. Because the proposed composite improvements do not significantly increase the runup slope under existing tide and wave conditions, the breaking parameter does not increase significantly with the project in place.

Data presented by Zanuttigh and van der Meer also indicate that for Foster City's breaking parameters (generally ranging from 0.5 to 2.0) and rock armored levee structure, the amount of energy reflected is minimal in the first place. With very little impact on the overall composite roughness, runup slope (<1 percent), and breaking parameter, reflection for the proposed composite solution (a small wall placed at the top of the armored slope) would increase by a maximum of just under 5 percent for the steepest portion of the levee (i.e. the highest breaking parameter).

[15] Zanuttigh and van der Meer, 2006. Wave Reflection from Coastal Structures.

Response B1-18. This comment raises concerns that the Draft EIR rejected certain alternatives from detailed analysis because the condemnation process would be too lengthy and asserts that this reason is incorrect and misleading. The Draft EIR includes a discussion of alternatives that were considered but rejected for detailed analysis. Two of these rejected alternatives – the Alternative Location alternative and the Extended/Realigned Horizontal Levee 2050 Sea Level Rise Alternative – mention potential condemnation proceedings as one of the reasons for not further considering these alternatives. The discussion of the rejected Alternative Location alternative states that "[i]n some locations, it would move the project out of City-owned property and right-of-way thereby potentially requiring lengthy condemnation proceedings which would not meet the schedule required to retain FEMA accreditation (not meeting objective 2), as stated on page 437 of the Draft EIR. The discussion of the rejected Extended/Realigned Horizontal Levee 2050 Sea Level Rise Alternative states that "this alternative would encroach on private property perhaps requiring condemnation proceedings (thereby delaying the project and failing to satisfy objective 2) as noted on page 440 of the Draft EIR. One of the primary project objectives is to "[e]xpedite permitting and construction of necessary levee improvements to the extent feasible to retain FEMA accreditation before such accreditation is lost" (see page 404 of the Draft EIR).

An EIR need not consider alternatives that are not "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, legal, environmental, social and technological factors. (Public Resource Code Section 21061.1; 14 Cal. Code Regs Section 15364.) While the commenter's summary of the statutory condemnation process and timeline itself is generally correct, it does not account for the additional time that would be taken for the City's internal decision making process in determining whether to proceed with condemnation in the first place and/or the preliminary negotiations with the property owner that would are a required prior to proceeding with condemnation. Likewise, the commenter also does not address any potential objections that can be raised by a property owner regarding a public entity's right to condemn the property which can also have an impact on a court deciding whether to grant prejudgment possession. In any event, delay due to potential condemnation proceedings is given as only one of several reasons for rejecting these alternatives as infeasible, most importantly, that these alternatives would generally result in more significant environmental impacts and satisfy fewer project objectives than the proposed project.

Moreover, it is reasonable to assume that since both the Alternative Location alternative and the Extended/Realigned Horizontal Levee 2050 Sea Level Rise Alternative, as well as the Bayside Levee alternative suggested by the commenter involve construction of levee improvements on private property, that these alternatives would involve financial compensation to the property owners, thereby significantly increasing the cost of the project which may not be economically feasible. Implementation of these alternatives is also potentially legally infeasible, remote and speculative as there is risk that it would not be permitted by the regulatory agencies with jurisdiction over the project as described in responses to B1-14.

LETTER B1 – Attachment A
Law Office of Mark C. Watson
September 12, 2016

Response B1-A1. The comment addresses the location of the levee wall along Beach Park Boulevard. This comment is noted, however it does not specifically address the adequacy of the Draft EIR; no further response is necessary.

Response B1-A2. The comment addresses the design of the levee wall. This comment is noted, however it does not specifically address the adequacy of the Draft EIR; no further response is necessary. Examples of potential wall treatments are shown in response A4-2.

Response B1-A3. The comment incorrectly states Beach Park Boulevard will be narrowed near Bowditch Middle School. As discussed in response B1-4, the roadway would not be narrowed and two travel lanes would be maintained on Beach Park Boulevard.

Response B1-A4. See response B1- 4.

Response B1-A5. See response B1-9 and B1-14.

Response B1-A6. See response B1-9 and B1-14.

Response B1-A7. The comment addresses concerns that the current plan for the levee will decrease access to the bay. This statement is inaccurate as existing public access points to the bay would be maintained. See responses A4-9, A4-10, and B1-5 for further information.

Response B1-A8. See responses B1-5 and B1-10.

Response B1-A9. See responses B1-5 and B1-10.

LETTER B1 – Attachment B
Law Office of Mark C. Watson
February 18, 2016

Response B1-B1. See response B1-5 and B1-10.

Response B1-B2. The comment defines a hybrid levee. This comment is noted, however it does not specifically address the adequacy of the Draft EIR; no further response is necessary.

Response B1-B3. See response B1-9 and B1-14.

Response B1-B4. See response B1-9 and B1-14.

Response B1-B5. See responses A1-1 and B1-14.

Response B1-B6. See responses B1-5 and B1-14.

Response B1-B7. The comment addresses concerns that the current plan for the levee will decrease access to the bay. This statement is inaccurate as existing public access points to the bay would be maintained. See response A4-9, A4-10, and B1-5 for further information.

Response B1-B8. See response B1-8.

Response B1-B9. See response B1-10.

Response B1-B10. The comment refers to the potential impact on private property rights. However, the project location, as described on page 49 of the Draft EIR, would include a deviation to avoid private property. Therefore, no easement or additional cost would be required.

Response B1-B11. See response B1-4, B1-5, B1-8, B1-10, and B1-14.

LETTER B1 – Attachment C
Law Office of Mark C. Watson
October 16, 2015

Response B1-C1. See response B1-5.

Response B1-C2. See response B1-5.

Response B1-C3. See response B1-5 and B1-10.

Response B1-C4. See response B1-5.

LETTER B1 – Attachment D
Vallier Design Associates, Inc.
January 9, 2017

Response B1-D1. See response B1-5.

Response B1-D2. See response B1-2.

LETTER B1 – Attachment E
LSA Associates, Inc.
January 11, 2017

Response B1-E1. See response B1-14.

Response B1-E2. The commenter notes that the habitat along the shoreline of the Runco Property and Ecological Reserve are deteriorating and will continue to deteriorate without active intervention. However as stated in response A2-3, sea level rise is anticipated to rise regardless of the project. See also response A1-1.

Response B1-E3. See response B1-8.

Response B1-E4. See response A1-1.

Response B1-E5. The commenter states that incorporating the Runco Property and Ecological Reserve into the flood control project provides an opportunity to minimize impacts associated with GHG emissions. However, as noted on pages 281-282 of the Draft EIR, the proposed project would have a less-than-significant impact on GHG Emissions. See also response B1-14.

Letter B2

1398 Swordfish Street
Foster City, California 94404
January 9, 2017

FOSTER CITY
RECEIVED
JAN 1 1 2017
PLANNING/
CODE ENFORCEMENT

Community Development Director
610 Foster City Boulevard
Foster City, California 94404

Attention: Curtis Banks

To Whom It May Concern:

Thank you for the thorough report that you had in the January Foster City communication about the needed improvements for the levee. I have owned my residence on Swordfish Street for 40 years. As a former teacher for the San Mateo Foster City School District, I do accept the reality of climate change and appreciate your efforts to improve our safety and property values.

I looked at Figure V.A.-15 which shows the view of the levee designed for a 2100 Sea Level Rise . I have no complaints. I would appreciate the added safety and property protection. I am hoping that there is a moderate difference in price between a levee designed for a 2050 Sea Level Rise and the 2100 Sea Level Rise. 1

I am less concerned with views and more concerned with safety (particularly schools) and personal property loss. I don't want a lower horizontal "hybrid levee" to please Mr. Sam Runco. If we lower the levee between Tarpon and Swordfish to please Mr. Runco, it would endanger the children in Bowditch School and the adjacent homes. Mr. Runco owns the undeveloped land across the street from Bowditch Middle School. The land is between Beach Park Boulevard and the existing levee and Bay. No lives are endangered in a flood event on his undeveloped property. The levee was present when he purchased his land. The levee was present when I purchased my home. It has had improvements in the past. It is reasonable to expect that it is time to improve the height of the levee again. I read that the level of the water in the Bay has risen 8 inches in the last 100 years. 2

Now water is rising at a faster rate due to climate change. The 2050 design would only offer a very temporary less effective solution and future adjustments would be more costly at a later date. The 2100 design would give Bowditch more protection. After looking carefully at the diagrams that you provided, it seems appropriate to use the secondary sheet pile wall design across from Bowditch Middle School. I can't see how hybrid levees with more marshes and mudflats are going to give Foster City the maximum protection. As we saw in Louisiana, the engineers needed to improve the marshes as well as the levee system. 2

My husband owns an insurance agency in San Mateo. I am aware that homeowners and businesses with mortgages north of Third Avenue and East of 101 all the way to Burlingame already are required to purchase flood insurance. Improvements will be done to the South Bayfront Levee to provide protection from flooding. I enclosed a map to show the area that is also facing levee problems in San Mateo. 3

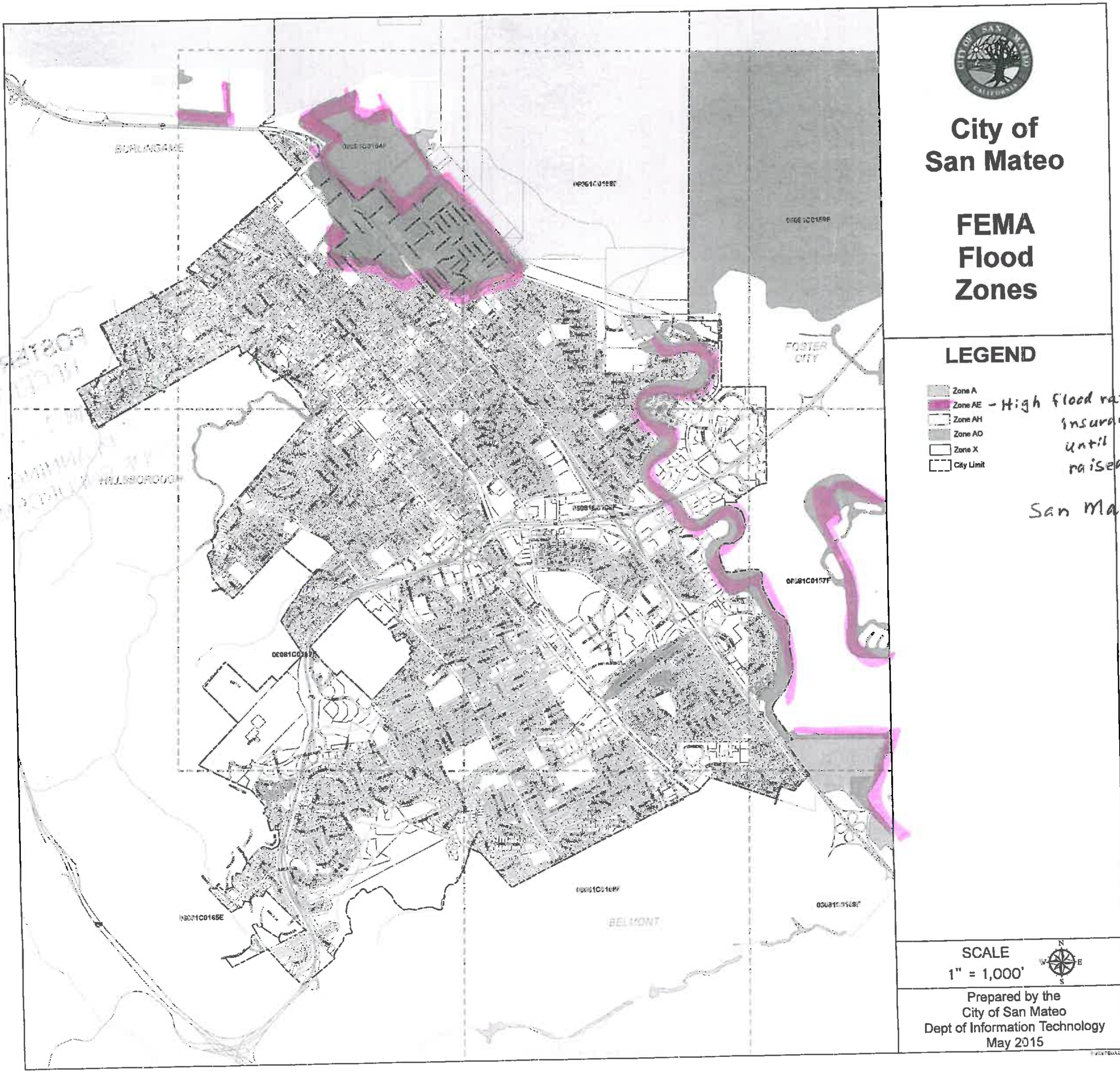
It is not just a matter of expensive insurance. Living in a flood zone would be a dangerous situation for everyone. I hope that Mr. Runco and others do not try to interfere with the levee project. Perhaps he could start planning a Foster City houseboat community for the distant future.

Thank you for all of your hard work on this project.

Sincerely yours,

Bonnie K. Rousseau

Bonnie K. Rousseau


BURLINGAME
FOSTER CITY
HILLSBOROUGH
BELMONT
City of San Mateo
FEMA Flood Zones
LEGEND
Zone A
Zone AE - High flood rate for insurance until levee raised
Zone AH
Zone AO
Zone X
City Limit
San Mateo
SCALE
1" = 1,000'
N
W
E
S
Prepared by the
City of San Mateo
Dept of Information Technology
May 2015

LETTER B2
Bonnie K. Rousseau
January 9, 2017

Response B2-1. The commenter’s support of the proposed project is noted.

Response B2-2. The commenter's safety concerns about the horizontal levee are noted.

Response B2-3. This comment summarizes the requirements for flood insurance and provides a similar case study in San Mateo. While this comment does not address the adequacy of the Draft EIR, the map and comment have been reviewed by the City.

Letter B3

From:	Curtis Banks
To:	Marlene Subhashini
Subject:	FW: Public Comment - DEIR for the Foster City Levee Protection Planning and Improvements Project.
Date:	Tuesday, January 03, 2017 8:19:05 AM
Attachments:	Flood Protection.pdf ATT00001.htm

FYI

Curtis

Curtis Banks, AICP
Community Development Director
City of Foster City
610 Foster City Boulevard
Foster City, CA 94404
(650) 286-3239

From: Bob Cushman [mailto:boborsandy@aol.com]
Sent: Friday, December 23, 2016 11:15 AM
To: Curtis Banks
Cc: Foster City City Council
Subject: Public Comment - DEIR for the Foster City Levee Protection Planning and Improvements Project.

To: Curtis Banks,
Community Development Director

Subject: Public Comment DEIR for the Foster City Levee Protection Planning and Improvements Project.

Hearing: Planning Commission January 18 2017 and subsequent hearings by the PC and/or City Council

From: Bob Cushman, Foster City resident.

Please include this email and the attached public comment for the benefit of Planning Commissioners for their hearing on this matter, scheduled for January 18 2017.

I have written this piece so we can better understand the added level of protection provided by our lagoon system and assure that it becomes part of the discussion about our need to raise the height of the levee, now and in the future. 1

The attachment begins with three emails, showing correspondence between me and the Director of Public Works. These are followed by a Report titled “Flood Protection Provided By Our Lagoon Drainage System.”

The three emails and the report can also be accessed at: http://cushmansite.com/cgi/Flood%20Protection.pdf

Bob Cushman

602 Greenwich Lane
Foster City, CA 94404
boborsandy@aol.com
650-341-4309

Letter B3
Attachment A

Flood Protection Provided By Our Lagoon Drainage System

LETTER TRANSMITTING DRAFT REPORT

From: Bob Cushman <boborsandy@aol.com>
Subject: Re: Lagoon pumping capacity
Date: October 28, 2016 at 9:51:41 AM PDT
To: "jmoneda@fostercity.org" <jmoneda@fostercity.org>

Hi Jeff: I have attached a <u>discussion</u> draft titled: "Flood Protection Provided by Our Lagoon System". As you know, I support raising the levee. I have written this piece so we can better understand the level of protection provided by our lagoon system and assure that it becomes part of the discussion about our need to raise the height of the levee, now and in the future

Would you share this with your staff people, have them evaluate it, and share the result with me. Please also share it with our consultants, Terry Huffman and Robin 1
Lee. They expressed an interest in receiving a copy of this piece, too. I was impressed with them. I'm glad they are on board.

As i mentioned to you last night, I need to leave town again to tend to my brother, who is in Portland. I will be back Tuesday night. I have a series of questions I would like to ask about the levee so please set me up for a time to meet with you. I am retired so can meet most any time. Please avoid Tuesday and Thursday mornings. That is when I play senior "swing and miss" softball.

Thank you for your continued good service to our City.

Bob Cushman
602 Greenwich Lane
Foster City, CA 94404
boborsandy@aol.com
650-341-4309

RESPONSE FROM DIRECTOR OF PUBLIC WORKS

From: Jeff Moneda <jmoneda@fostercity.org>
Subject: RE: Lagoon pumping capacity
Date: November 7, 2016 at 4:19:37 PM PST
To: Bob Cushman <boborsandy@aol.com>

Hi Bob,
Thank you for your report. We have reviewed your request to consider only meeting FEMA requirements for the Levee Improvement project. You indicate that the lagoon is capable of serving as a detention basin if we lower the lagoon level by a few feet. Removal of water would most likely jeopardize property owner's bulkheads. The water in the lagoon currently provide lateral pressure to bulkheads. In addition, please note that this would deem our lagoon not usable for recreational use. We already receive complaints from users of the lagoon when we lower the lagoon water level.

In addition, our lagoon pumps are at an elevation several feet below the top of levee. Due to the difference in elevation and resultant head pressure, a breach of the levee would deem our pumps not usable, and even the largest of pumps would not be able to keep up and large head pressures could cause a back-siphon of water from the Bay into the lagoon.

The City's hybrid design (sheet pile and earth backfill), earthen levee, block wall levee, and horizontal levee alternatives are being considered as design alternatives in the Environmental Impact Report. Please note that the public will be given an opportunity to comment on the EIR and the various levee alternatives, which is anticipated to be adopted in January 2017. We anticipate the City Council to provide direction on levee height alternatives at its meeting in February 2017.

We appreciate your input regarding the project. If you would still like to meet on Monday, November 14th, please let me know. Also, if you have any additional questions, please contact me.

Thank You,

Jeff

Letter B3
Attachment B

From: Bob Cushman <boborsandy@aol.com>
Subject: Re: Lagoon pumping capacity
Date: November 16, 2016 at 10:21:07 AM PST
To: "jmoneda@fostercity.org" <jmoneda@fostercity.org>

Hi Jeff: Thanks for responding. And thanks for letting me know that we have a third pump that we are not using. This changes the calculations but not the basic notion.

Your response, below, leads me to some suggestions. I would like your advice about how these can be implemented.

Let's assume we have raised the levee but still encounter a storm scenario in which water from the Bay begins to flow over the top of our levee. What adaptability options do we have? We can add sand bags to the top of the levee and do all the usual stuff. But, in addition, we have a lagoon drainage system we should plan to employ. Your response to me suggests two clear actions we should take:

1. We should not allow ourselves to get into a situation where
the pumps cannot be employed because, as you said in your
response, they are currently "at an elevation several feet 1
below the top of the levee." How can we make sure that we
raise the pumps as we raise the levee. There may be other
options; e.g., submersible pumps to help lower the lagoon,
pumps mounted on floats; and/or we might also increase our
pumping capacity.

2. We need to define the flood circumstances that will justify emptying the lagoon so our pumps can attempt to stay ahead of the water entering our lagoon system. Also, we need to establish the protocol for doing so. I realize this would put some of our bulkheads at risk but I can foresee a situation in which risking possible damage to the bulkheads would be preferred to the certainty of much greater property damage. This is not something we want to leave to when we might have a dire emergency on our hands. How do we get this put into place?

3. The third action, which is pretty basic, is to incorporate this adaptability feature into our flood prevention and flood management emergency planning, and is a part of our strategy, 1
as we consider raising the levee.

Bob Cushman
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650-341-4309

10-28-16 discussion draft Cushman

Flood Protection Provided by our Lagoon System

Our lagoon system provides the City with a unique advantage if water were ever to top our Foster City levee.

"The Foster City Lagoon as a drainage detention basin is designed to withstand successfully a storm of 100 year return frequency, or a storm of such severity that it is likely to occur only once each century. The lagoon therefore provides maximum drainage security for Foster City. Stormwater collected throughout the City flows to the Foster City Lagoon. All storm water enters the storm drain system through curb inlets and catch basins, and drains into the lagoon from which it is pumped into the bay.

How well does the Foster City Lagoon system work as drainage catch basin? During the El Niño rainstorms of 1997/98, which were very close to a 100-year frequency severity, the City of Foster City experienced no flooding while surrounding cities in San Mateo County experienced major drainage problems. Thanks to the effectiveness of its lagoon system, Foster City has never experienced major flooding." [1]

The following is a layman's attempt – a beginning attempt[2] -- to quantify the extent of this protection.

The purpose of the piece is to better understand the level of protection provided by our lagoon system and assure that it becomes part of the discussion about our need to raise the height of the levee, now and in the future

The assessment is based on the following:

1. The total capacity of our lagoon system is 64,643,040 cubic feet of water.[3]

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[1] Source: http://www.fostercity.org/publicworks/lagoonandlevee/Lagoon-Information.cfm

[2] The Department of Public Works has retained consultant expertise to evaluate and add to this analysis.

[3] One acre =43,560 square feet. Our lagoon system covers 212 acres and averages 6 feet in depth. It is kept one to two feet below 100 elevation, the point at which water would begin to flow over the lagoon bulkheads. This means the total capacity of the lagoon can be conservatively

2. We can pump water from our lagoons to the Bay at a maximum rate of 560 cubic feet per second. At that rate it would take 32.065 hours to pump all the water out of the lagoon.

3. If our lagoon were full, and water came over the top of the levee at the same rate it was being pumped out, the level of water in the lagoon would remain unchanged. It would be at steady state.

4. Our 8-mile levee system is 42,240 linear feet long [4]

5. The lagoons would remain at steady state if no more than 1,530.75 cubic feet of water came over the top of each linear foot of the levee in a 32.065 hour period. This rate is just under one tenth of a gallon per second along the entire length of the levee.[5]

6. If the lagoon were empty or near empty at the time the water topped the levee, the amount of water that could be allowed to flow over the top of the levee could be doubled. (To 0.19489596 gallons per second) However, there is risk of bulkhead failure if the level of the lagoon were to be emptied. This is because the water exerts pressure on the bulkheads.

7. Bigger capacity pumps could provide increased protection from any flooding. For example, pumps with five times the current pumping capacity could accommodate about one full gallon of water topping the entire length of the levee every second over a 32 hour period.

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estimated at 212 acres x 7 feet in depth. 212 acres x 43,560 sq ft x 7 foot depth = 64,643,040 cubic feet of water.

[4] We have 8 miles of levee. A mile = 5,280 feet, thus our levee system consists of 42,240 linear feet.

[5] The pumps can pump out 560 cubic feet of water per second, so it would take 32.065 hours to empty the lagoon or, conversely, it would take 32.065 hours [115,434 seconds] to fill the lagoon if a total of 560 cubic feet of water/second came in over the top of the levee. Total capacity of the lagoon system= 64,643,040 cubic feet of water divided by 42,240 feet of levee means a total of no more than 1,530.75 cubic feet of water could flow over the top of the levee in a 32 hour period to equal the amount of water being pumped out. This would produce a steady state level of the water in the lagoon system. 1,503.75 cubic feet/115,434 seconds = 0.0132575 cubic feet per second over the entire length of the levee. This is just under one tenth of a gallon per second of water coming in along the entire length of the levee. (.0130269 cubic feet =0.09744798 gallons of water.).

8. Rainfall during this 32-hour period would invalidate all these calculations. On the other hand, these are conservative estimates because the soil and vegetation will absorb some floodwater before it runs into the lagoon.

9. A talented engineer provided a more complex formula for estimating the flow over the levee that would exactly match the ability of the pumps to discharge the water, thereby creating a steady-state level of water in the lagoon.

This approach tells us that a steady 0.22 inch of water higher than the top of the levee would allow 561.0 cubic feet of water/second to flow over the top of the entire length of the levee. This is about the maximum amount of floodwater the existing pumps could handle.

The first column in the following table shows the capacity of the pumps needed to create a steady state in the level of water in the lagoon system if the water is anywhere from 0.20 inches to 1 inch above the top of the levee.

For example, if the water were a constant 0 .20 inches above the top of the levee, the steady state of water in the lagoon system could be achieved by pumps with 486.2 cubic ft/second capacity. If the water were a constant 1.00 inch above the top of the levee the pump capacity would need to rise to 5,436.3 cubic feet/second, or nearly ten times the capacity of our existing pumps.

Calculating Pump Capacity (Q flow) to Absorb Water Higher From .20 inches to 1.0 inches Than the Levee (Hin)

Q flow cu ft/sec	H(in)	H (ft)	B levee in ft	G gravity	Levee (mi)
486.2	0.20	0.017	42240	32.2	8
523.2	0.21	0.018	42240	32.2	8
561.0	0.22	0.018	42240	32.2	8
599.6	0.23	0.019	42240	32.2	8
679.5	0.25	0.021	42240	32.2	8
5436.3	1.00	0.083	42240	32.2	8

The formula is:

Q = (2/3)*B*sqrt(2*G)*H*sqrt(H) flow rate in qu ft per sec, H in ft, B in ft.

Discussion:
The very basic calculations provided here show that our existing pumps can handle a constant flow of about 1/10th of a gallon per second over the top of the entire length of our 8 mile levee over a 32 hour period. At this rate, the lagoons would be in steady state; that is, the level of the water would remain unchanged. This is because the rate at which the water is being pumped out would equal the amount of water flowing over the top of the levee.

A second calculation, using a formula provided by an engineer, shows that if the Bay water stayed at a constant 0.22 inches above the top and all along the entire 8 mile levee, our pumps would create this same steady-state in the level of water in our lagoons.

Both of these calculations assume the lagoon system is full when the flooding starts and produces a steady state, where the level of the water in our lagoon systems neither rises nor falls.

The two estimates, one of one tenth of a gallon/sec; the other a flow of 0.22 inches/second suggest that flooding will occur even if a very small amount of water tops the levee. This is because the models have the water constantly flowing over the entire 8 miles of levee.

Five more considerations that increase our protection:

1. If the lagoon levels were lowered, prior to the flooding, then the ability of the lagoon system to absorb floodwater would increase. The maximum case would be if the lagoon system were empty when water began to top over the levee. In that case twice as much water could drain into the lagoon over a 32 hour period before it would reach capacity and flood. This would double the flow from $1/10^{th}$ of a gallon/sec to 2/10ths of a gallon /sec., or in the second example, from 0.22 inches/second to 0.44 inches per second.

2. It is unlikely that the flow of water topping the levee will be constant. This will give the pumps opportunities to “catch up” by continuing to pump out water when it is not flowing in over the top of the levee. For example, it is reasonable to expect that, at least initially, small waves will wash up and over the top of the levee. In that case, the flow of water over the top of the levee is unlikely to be constant. For example. a constant flow of $1/10^{th}$ of a gallon of water/second would be roughly equal to waves containing one full gallon of water topping the levee, arriving 10 seconds apart.

3. It is unlikely that any constant flow of water over the top of the levee will last more than 32 hours. High tide will pose the most risk but low tide will considerably lower the water on the Bay side of the levee. This would give our pumps time to "catch up" by continuing to pump water back into the Bay while water is not coming in over the top of the levee.

4. The City could add more pumping capacity. Once FEMA certification is attained, this would be cheaper than adding more height to the levee. This is an example of how adaptability can be built into the project.

5. These calculations do not include any provision that might account for rainfall during the time water may be topping over the levee.

Conclusion: Our lagoons provide flood protection not available to other communities. For flooding to occur in Foster City, more water would have to come over the top of the levee, and at a faster rate, than our existing pumps could discharge it back into the Bay.

The rough calculations provided here show that the lagoon system is capable of accepting heavy rainfall without filling up, even very heavy rainfall. It is also capable of accepting small amounts of water topping over the levee. But it is not sufficient to accommodate large volumes of water that might top the levee. Thus, we cannot depend solely upon the lagoon system for protection during severe storm surge. it is important for us to raise the levee

The analysis suggests:

1. We should increase the height of our levees only to a height that matches our neighbors. Anything less puts them at risk; anything more will not protect us from water coming in from other cities.

2. At any given height of the levees agreed to with our neighboring cities, we will have more flood protection than they will because of our lagoon drainage system.

3. The analysis supports an argument to improve our levee to meet only the MINIMUM needed to achieve FEMA certification (accreditation). Our lagoon system provides additional protection.

4. Once FEMA certification has been achieved, buying bigger pumps will be cheaper than building an even higher levee. It adds adaptability.

LETTER B3
Bob Cushman
December 23, 2016

Response B3-1. The commenter provides three emails, showing correspondence with the Director of Public Works and a report on flood protection provided by the Foster City Lagoon drainage system. While this comment is not directly related to the adequacy of the Draft EIR, the City will evaluate the report and address any relevant concerns in an adaptive management plan. Below are responses to the two emails submitted to the Director of Public Works.

LETTER B3 – Attachment A
Bob Cushman
December 28, 2016

Response B3-A1. After listing a series of factual assumptions and recommendations to increase existing flood protection, the commenter concludes that Foster City's lagoons provide floor protection not available to other communities but while they are capable of accepting small amounts of water topping over the levee, they are not sufficient to accommodate large volumes of water that might top the levee. Therefore it is important for us to raise the levee with the following considerations: (1) increase the height of levees only to a height that matches neighboring jurisdictions; (2) at any given height of the levees agreed to with our neighboring cities, we will have more flood protection than they will because of our lagoon drainage system; and (3) the City should improve levees to meet only the minimum needed to achieve FEMA certification because the lagoon system provides additional protection and; (4) once FEMA certification has been achieved, buying bigger pumps will be cheaper than building an even higher levee, adding adaptability.

The Draft EIR did not study an alternative with levee heights matching neighboring jurisdictions because it does not meet the basic project objective of retaining FEMA accreditation. The adjacent levee elevation at the northwestern San Mateo City limit near Mariner's Point currently meets FEMA accreditation standards, but requisite levee elevations (specifically for adequate wind-wave protection) are generally unique to levee location, particularly with respect to wind exposure. Thus a levee elevation that meets FEMA standards at one location (San Mateo) would not necessarily meet FEMA standards in another location; for example, Foster City between the San Mateo Bridge and Belmont Slough. The adjacent levee elevation at the southwestern San Mateo City limit at the O'Neill Slough Tide Gate also meets FEMA accreditation standards, and here there is no significant wave action so the standard is the same for Foster City and San Mateo. Along Belmont Slough, where there is no significant wave runup, this would be equivalent to the FEMA Freeboard Alternative analyzed in the Draft EIR.

While it is generally true Foster City will have more flood protection because of our lagoon drainage system, since the Central Lagoon does not drain runoff generated outside of the levee-protected area, this comment does not address the adequacy of the Draft EIR.

The commentator's preference for the FEMA Freeboard Alternative is noted. While not specifically addressing the adequacy of the Draft EIR, the following additional information is provided. Adaptive solutions to future sea level rise (implied by this comment) will be addressed during the design development and permitting phases of the project. Alternative adaptive solutions will be presented to the public for comment as well, noting that pumping out water that overtops the levee system would not provide for FEMA accreditation.

LETTER B3 – Attachment B
Bob Cushman
November 16, 2016

Response B3-B1. The commenter submitted an email attachment to the original email dated December 23, 2016. The attachment addresses the commenter's interest in increased awareness of the level of flood protection provided by the Foster City lagoon system.

The floor of the pumping station, which houses the important pump controls, is situated at an elevation of approximately 10.9 feet NAVD. By way of comparison, the crown of East Third Avenue is at approximately 10.3 feet NAVD and the top of levee elevation opposite East Third Avenue from the pump station is approximately 12.8 feet NAVD. So the pump house floor is currently about two feet below the top of levee, and after the levee is raised, the pumps will be several feet below the top of levee.

This is an acceptable condition as long as water on the inside of the levee system does not become deep enough to drown out the pumping station. The pumps are already of sufficient capacity to discharge 100-year storm water runoff that accumulates inside of the levee system, with a great deal of robustness. Since the purpose of the levee raising project is to prevent water from the bay flowing over the top of the levee, what is described by this comment is not "adaptation" as much as an emergency procedure, should something go unexpectedly wrong.

The pumps do not necessarily need to be raised when the levee system is raised. Since the pumps will not be discharging bay water that has overtopped the levee system and the existing pumping capacity is adequate to evacuate storm water runoff generated behind the levees, increased pumping capacity is not needed. An emergency pumping situation is addressed below.

To obtain the necessary regulatory permits for construction, the City anticipates providing a levee system resilient against 100-year overtopping from bay water, including wind-driven waves, through 2050 assuming the high range of sea level rise projections. Adaptability to high range sea level rise projections through 2100 will also be part of the project design. After project completion, the levee system would meet FEMA and U.S. Army Corps of Engineers requirements for freeboard and structural integrity, so bay overtopping would not be likely without some sort of unanticipated damage to the levee system, which would be considered an emergency situation.

However, as noted on page 54 of the Draft EIR, Foster City (with the exception of the Central Lagoon) is currently located in Zone X with moderate-to-low risk of flooding from a 100-year flood. The comment is addressed below, relative to the existing condition. The profile in Figure 2 in response A1-2 shows the existing top of levee based on a detailed topographic survey conducted in 2016. While there is not enough freeboard to meet FEMA standards for levee accreditation, the one-percent stillwater level (SWL) that represents the 100-year storm surge without wave action is not anticipated to overtop the existing levee. For a roughly 2.5-mile stretch of the levee system exposed to open water and wind driven waves, however, the calculated maximum wave runup associated with the 100-year is anticipated to overtop the existing levee system. The questions are: what happens to that water, and how would it be dealt with prior to levee improvements that would keep that water out?

Two types of wave overtopping can generally occur at a deficient levee system. The first type is referred to as surge overtopping, during which the crest of the levee is exceeded by stillwater and the crest essentially acts as a broad crested weir. The second is wave overtopping, during which the levee maintains stillwater freeboard (although not necessarily FEMA freeboard), but wave runup splashes over the crest. The mechanism of overtopping for Foster City's existing levee system, based on tide statistics, is wave overtopping. This is what the project would prevent. Figure 3 in response A1-2 shows typical wave overtopping in a controlled environment.

The 24-hour diurnal tide cycle with high tide elevations of 10.4 feet NAVD, matching the FEMA CCAMP study results, used for the wave overtopping analysis is presented as Figure 4 in response A1-2. Historically recorded storm surge effects have been added to low tide elevations because CCAMP does not specifically address the entire cycle. However, while there are finite probabilities of "rogue" high waves during periods of lower stillwater elevations, which are accounted for in the methodology as described subsequently, the impact of these waves is negligible so the low tide assignment is not critical.

The 2.5-mile stretch of the existing levee system subject to wave overtopping is located between the high ground at Mariner's Point on the west end to the shell bench on the east end near the mouth of Belmont Slough (Figure 2 in response A1-2). This 2.5-mile stretch is broken into 10 sections, each with a similar average levee slope, and methodologies found in the literature are used to estimate overtopping rates (in cubic feet per foot) for each section and the volume of water spilling over the levees throughout the tide cycle is established based on the probability of wave overtopping for the given conditions.

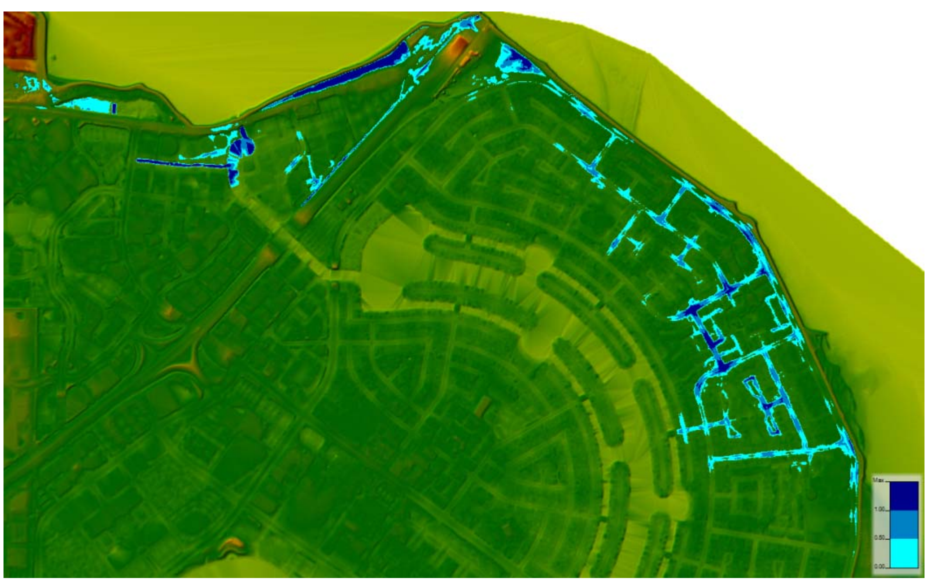
The resulting maximum overtopping volume per unit length for each section is multiplied by the section's length and all sections summed to find the overtopping volume for the entire 2.5-mile stretch of levee vulnerable to wave overtopping. The results of this analysis for each section of the levee are summarized in Table 2 in response A1-2.

Without considering levee failure, approximately 23.3 acre-feet of water from San Francisco Bay would flow into Foster City due to wave overtopping in a 24-hour one-percent storm event, noting that 97 percent of this volume overtops during the 8 hours of highest tide elevations.

Figure 9 shows the results of a two-dimensional flow model that routes this volume of water from the perimeter levee system into the Central Lagoon; again, assuming that none of the levee system fails due to this overtopping. Although the levees are not designed with erosion protection for such overflow, it is noted that maximum overflow velocity is on the order of 2 to 3 feet per second, and while not acceptable for FEMA accreditation, it is relatively likely that the majority of the levee system would remain intact.

Figure 9 shows that bay waters are able to flow into the storm drain system and lagoon without excessively deep water spread over private properties. At its normal winter operating “storm level” of 1.0 foot NAVD, the surface area of the lagoon is 230 acres. The 23.3 acre-feet of water overtopping the levees would add about 1.0 foot of water to the lagoon. Without any pumping, the increase in water level would match the lagoon’s normal summer level of 2.0 foot NAVD. Thus the City’s existing facilities can accommodate the 100-year spill event under existing conditions, even without warning or prior evacuation of the lagoon; and there is no need to raise the pumping facility or equipment therein.
Raising the levee as part of the project would greatly reduce the risk of wave overtopping and bay overflow into Foster City as shown in Figure 9, particularly since additional freeboard is provided relative to existing conditions. Since there would be no change to lagoon operations and the pumping facility is already protected against flooding, the pumps do not need to be raised in the future. Possible future sea level rise could result in higher levels in the bay that must be pumped against, but this can be adapted to by increasing individual pump horsepower within the existing facility.

Figure 9. Model for 100-year Wave Overtopping of Existing Levees



Source: Schaaf & Wheeler, 2017

C. PLANNING COMMISSION AND PUBLIC HEARING COMMENTS

A Public Hearing on the Draft EIR was held before the Planning Commission on January 19, 2017. A total of nine members of the public and four Planning Commissioners provided comments regarding the EIR. The following provides a summary of the comments and responses to the comments that are relevant to the EIR.

Letter C1

City of Foster City Planning Commission
January 19, 2017

Planning Commission Public Hearing Comments Summary

Stephen Baker

- The Draft EIR does not mention the option of acquiring the Runco property for wetland restoration. 1
- The discussion of wave run up in the Draft EIR is not adequately portrayed; it is exaggerated. 2
- Visual impacts are not adequately addressed in the Draft EIR. There is no mention of visual impacts along Beach Park Boulevard from San Mateo Bridge to Shorebird Park. 3

Lori Runco

- The Draft EIR does not address purchasing the Runco property. 4
- The Draft EIR does not mention how to access the Runco property once the levee project is complete 5
- The Draft EIR does not consider the option to go around the bayside and the Runco property. 6

Leslie Flint

- The Draft EIR does not mention the fact that the shoreline of Foster City is an important bird area. 7
- Requests that the Draft EIR identifies the important shorebird area.

Sam Runco

- The Draft EIR is inadequate in that it will build a wall around the Marina property [the Runco property] and cutoff access. 8

Mark Watson

- The levee project will remove 1,000 feet of shoulder near Bowditch Middle School.
- The Draft EIR does not discuss what impacts there will be on traffic turning left from Beach Park Boulevard onto Tarpon Street. 9
- The Draft EIR doesn't discuss where cars will park near Bowditch Middle School if the 1,000-foot shoulder is removed. 10
- The Draft EIR does not discuss noise impacts on children at Bowditch Middle School. 11

Dirik Liepold

- The Draft EIR does not consider purchasing all of or part of the Runco property. 12
- The do-nothing alternative wouldn't protect Foster City and this is not adequately addressed in Draft EIR. 13
- The budget and timeline is underestimated. 14
- Quality of life is not the priority of the levee project. 15

Christana Toms

- The Draft EIR does not adequately address and evaluate an alternative that would include coarse shoreform, as described in the letter from the Regional Water Quality Board submitted January 19, 2017. 16

- The Draft EIR does not adequately address the impacts and mitigation measures of armoring the levee. 17

Shivum Kapoor and Galen Guo

- How will the levee construction affect the wetlands? 18

Dorothy Pearl

- The Draft EIR does not adequately portray what the materials of the levee would be. 19
- I would like pictures from my house, along Beach Park Boulevard, that better portray what the levee will look like. 20

Commissioner Dan Dyckman

- The Belmont Hills are considered a visual resource but are the East Bay Hills not considered a visual resource? This should be clarified. 21
- One of the EIR alternatives looks at moving the levee out to protect private property that is currently not protected. Is there an approximate additional cost to that? Is this something the EIR should be addressing? 22

Commissioner Paul C. Williams

- This document addresses the same topics we address on many other developments including views, biological, and traffic impacts. All of the topics are included. The document was easy to locate on the Foster City website. From my opinion, there is a lot of information here and the Draft EIR adequately provides guidelines for the review process. 23

Commissioner Ollie Pattum

- All the information is included. The only problem is resolving the private property issue. It is an adequate document. 24

Chairman Richard Wykoff

- The Draft EIR is adequate. The EIR should be sufficiently prepared to enable decision-makers to make a decision. A disagreement among experts is not a reason to reject the EIR. 25

LETTER C1
City of Foster City Planning Commission
January 19, 2017

Response C1-1. The Runco property would not need to be acquired as part of the project because it is not located within the project site. See also response B1-14.

Response C1-2. See response A2-1.

Response C1-3. The comment states that there is no mention of the visual impacts along Beach Park Boulevard from the San Mateo Bridge to Shorebird Park. Four visual simulations along Beach Park Boulevard were analyzed in the Aesthetics section of the Draft EIR, which can be seen in Figures V.A-4 (page 124), V.A-5 (page 126), V.A-6 (page 127), and V.A-7 (page 129). Impact AES-1 and Mitigation Measure AES-1 address the potential visual impacts to the San Francisco Bay under both 2050 and 2100 Sea Level Rise scenarios. See Draft EIR at pages 134 and 149.

Response C1-4. See response C1-1.

Response C1-5. See responses B1-5, B1-7, B1-8, and B1-13.

Response C1-6. The City attempted to evaluate the "Bayside Levee" presented by Mr. Runco with the materials provided in the analysis of the Extended/Realigned Horizontal Levee 2050 Sea Level Rise Alternative on page 439-440 of the Draft EIR. This alternative fails to satisfy most of the projects objectives and would increase the environmental impacts in most CEQA topic areas. Therefore, this alternative was rejected for detailed analysis. See also response B1-14.

Response C1-7. Audubon's Important Bird Areas (IBA) Program is a global effort to identify and protect habitat that will protect sustainable populations of birds. The project area is included in the San Francisco Bay-South IBA which extends in a U-shaped band from near Millbrae, southeast along the Bayshore to Milpitas/Alviso, and then north up the East Bay into Alameda County to the vicinity of the Oakland International Airport.

Page 198, paragraph 1 of the Draft EIR, is revised as follows:

> The wetland habitats and the disturbed urban habitats onsite support a variety of wildlife species. The complex of habitats includes the San Francisco Bay and the presence of tidal regimes and marshes which can accommodate wildlife adapted to aquatic areas, and upland vegetation including mostly planted trees and shrubs that provide potential nesting and roosting sites for birds, in addition to foraging areas for

species of mammals, reptiles, amphibians and birds. The project area is also included in Audubon's Important Birds (IBA) Program. The Foster City shoreline is included in San Francisco Bay-South IBA, which extends in a U-shaped band from near Millbrae, southeast along the bay shore to Milpitas/Alviso, and then north up the East Bay into Alameda County to the vicinity of the Oakland International Airport.

Response C1-8. See response B1-5.

Response C1-9. The comment addresses concerns around traffic impacts on Beach Park Boulevard turning left on Tarpon Street. Contrary to the commenters' understanding, the removal of the 1,000-foot shoulder on Beach Park Boulevard would be located further south and not adjacent to Bowditch Middle School. For more details see response B1-4.

Response C1-10. See response B1-4.

Response C1-11. As discussed on pages 340-341 of the Draft EIR, the Bowditch Middle School is identified as a sensitive receptor which is defined as a land use where noise-sensitive people may be present or where noise-sensitive activities will occur. The Draft EIR concludes that construction noise, construction vibration and noise from hauling trucks associated with project construction on area roadways and along the levee would have a potentially significant impact on sensitive receptors and identifies mitigation measures to reduce these impacts to a less-than-significant level. The only exception is construction equipment noise on the Levee project site and in the staging areas that could generate substantial increases in noise levels for intermittent periods when certain construction activities occur (which would be a significant and unavoidable impact). See pages 350-364 of the Draft EIR.

Response C1-12. See response C1-1.

Response C1-13. As noted on pages 407-413 of the Draft EIR, the no project alternative would not meet any of the project objectives. However, in accordance with CEQA the City is required to study a "No Project/No Build Alternative."

Response C1-14. This comment does not specifically address the adequacy of the Draft EIR; no further response is necessary.

Response C1-15. This comment does not specifically address the adequacy of the Draft EIR; no further response is necessary.

Response C1-16. See response A1-2.

Response C1-17. See response A1-1.

Response C1-18. Please see discussion in the Draft EIR regarding wetlands impacts and identified mitigation measures to reduce these impacts at pages 200-212 and 233-236. See also response A1-3.

Response C1-19. The commenter's concerns about the construction materials are noted. A discussion of the type of material and aesthetic treatments for the levee wall will be considered during the City's design review process. The design review process will include ample time for community input, review of design choices, and opportunities to provide feedback.

Response C1-20. The commenter requests the Draft EIR Include visual simulations from her house along Beach Park Boulevard. As noted on page 118 of the Draft EIR, views of private property owners are not considered significant because California Environmental Quality Act (CEQA) (Pub. Resources Code, §21000 et seq.) case law has established that only public views, not private views, need be analyzed under CEQA. Furthermore, the Draft EIR already includes two viewpoints from Beach Park Boulevard on pages 146-148.

Response C1-21. As noted in the Draft EIR on page 134, there are no official scenic vistas in Foster City; however there are several scenic resources including Belmont Slough and San Francisco Bay. For the purpose of providing a conservative analysis, the Belmont Hills are also considered a scenic resource. Although the East Bay Hills are not considered a visual resource, views of San Francisco Bay with the East Bay Hills in the distance are considered a scenic resource. As such, it was determined an impact would occur from Shorebird Park because views of San Francisco Bay (and the East Bay Hills) would remain partially obscured for recreationists (see Impact AES-1).

Response C1-22. The Extended/Realigned Horizontal Levee 2050 Sea Level Rise Alternative analyzes a levee that would afford flood protection to 13 acres of private property that is currently not protected by the levee (see pages 439-440 of the Draft EIR). The additional cost is not discussed in the Draft EIR, however it is noted the Horizontal Levee would include approximately 1.6 million cubic yards of clean fill into the bay that would extend out into the existing bay water approximately 400 feet beyond the existing shoreline and cover an area of about 195 acres. The level of adverse and beneficial effects would nearly twice as much as what is described for the Horizontal Levee 2050 Sea Level Rise Alternative (see pages 420-431 of the Draft EIR).

Response C1-23. These comments about the adequacy of the analysis in the Draft EIR are noted.

Response C1-24. These comments about the adequacy of the analysis in the Draft EIR are noted.

Response C1-25. These comments about the adequacy of the analysis in the Draft EIR are noted.

IV. TEXT REVISIONS

This RTC document presents specific revisions to the text of the Draft EIR that were initiated by City staff for the purpose of clarifying material in the Draft EIR. Where revisions to the main text are called for, the page and paragraph are noted, followed by the appropriate revision. Added text is indicated with underlined text. Deletions to text in the Draft EIR are shown with ~~strikeouts~~. Page numbers correspond to the page numbers of the Draft EIR. Revisions presented in this RTC Memo do not significantly alter the conclusions or findings of the Draft EIR.

Page 13, the third paragraph of the Draft EIR, is revised as follows:

> Lastly, JC Miller, with Vallier Design Associates, Inc. suggested that a hybrid horizontal levee be studied sincerely in the EIR.

Page 62, the third paragraph of the Draft EIR, is revised as follows:

> The deviation would result in the loss of parking (approximately 50 spaces) on the bayside of Beach Park Boulevard between Swordfish Street and the northern edge of Shorebird Park.

Page 198, the first paragraph of the Draft EIR, is revised as follows:

> The wetland habitats and the disturbed urban habitats onsite support a variety of wildlife species. The complex of habitats includes the San Francisco Bay and the presence of tidal regimes and marshes which can accommodate wildlife adapted to aquatic areas, and upland vegetation including mostly planted trees and shrubs that provide potential nesting and roosting sites for birds, in addition to foraging areas for species of mammals, reptiles, amphibians and birds. The project area is also included in Audubon's Important Birds (IBA) Program. The Foster City shoreline is included in the San Francisco Bay-South IBA, which extends in a U-shaped band from near Millbrae, southeast along the Bay shore to Milpitas/Alviso, and then north up the East Bay into Alameda County to the vicinity of the Oakland International Airport.

The Draft EIR acknowledges that burrowing owl have occurred along the Foster City shoreline and that the last known breeding pair in San Mateo County, located along the Bay Trail near the Mariner's Point Golf Center, was extirpated at least 10 years ago. In December of 2016, a burrowing owl has been present in an elevated area of fill within the salt marsh about 30 feet from the Bay Trail and levee at the south end of Shoreline Park. Given that a wintering burrowing owl is present along the levee, the Draft EIR is revised to acknowledge that construction work conducted in close proximity to either wintering or breeding burrowing owl could result in disturbance to the species, including abandonment of the burrow.

Page 204, fifth paragraph of the Draft EIR, is revised as follows:

> In addition to the state and federally listed species noted below, Burrowing Owl (*Athene cunicularia*) has also been known to occur along the Foster City shoreline. Burrowing Owl is not a listed species but is a state-designated species of special concern and a USFWS-designated Bird Species of Conservation Concern. The last known breeding site for Burrowing Owl in San Mateo County was along the Bay Trail to the west of the Mariner's Point Golf Center in the area between levee segments 1 and 2, but the species has been extirpated from that site. Commencing in December of 2016, a burrowing owl has been present in an elevated area of fill within the salt marsh about 50 feet from the Bay Trail and levee near the south end of Shoreline Park at the south end of segment 4.

Page 223, Impact BIO-1 of the Draft EIR, is revised as follows:

> **Impact BIO-1: The Levee project could result in significant impacts to special-status animal species, including the burrowing owl, Ridgway's rail, salt marsh harvest mouse, and California black rail. (S).**

Page 231, Mitigation Measure BIO-1c of the Draft EIR, is revised as follows:

> Mitigation Measure BIO-1c: Pre-construction surveys for burrowing owls shall be conducted prior to any construction activity within each levee segment to ensure that there are no impacts to burrowing owls. If burrowing owls are present near the construction area, construction should not proceed in the vicinity of the active burrow. The pre-construction surveys will be conducted within two weeks prior to the onset of any ground disturbing activities. Surveys will be conducted by a qualified biologist following CDFW survey methods (CDFW, 2012) to establish the status of burrowing owl on the Project Site.
>
> If burrowing owls are found to occupy the property during the non-breeding season (September 1 to January 31), occupied burrows will be avoided by establishing a no-construction buffer zone around the burrow determined in consultation with CDFW. If avoidance is not possible a passive relocation effort may be instituted to relocate the individual(s) out of harm's way pursuant to a Burrowing Owl Exclusion Plan approved by CDFW.
>
> If burrowing owls are found to be present during the breeding season (February 1 to August 31), the project ground disturbing activities will follow the CDFW

recommended avoidance protocol whereby occupied burrows will be avoided with a no-construction buffer zone determined in consultation with CDFW. (LTS)

Implementation of **Mitigation Measures BIO-1a,** ~~and~~ **BIO-1b**, and **BIO-1c** would ensure that potential impacts to burrowing owl, salt marsh harvest mouse, Ridgway's rail, and California black rail would be less than significant.

Page 231, Mitigation Measure BIO-1a of the Draft EIR, is revised as follows:

n. If requested, before, during, or upon completion of construction, the construction contractor will allow access by USFWS and CDFW personnel to the work areas to inspect effects, if any, of the actions on the salt marsh harvest mouse, ~~or~~ Ridgway's rail, or California black rail.

o. ~~Subsequent to construction,~~ T~~t~~he project proponent will submit a compliance report, prepared by the biological monitor(s), to the USFWS and CDFW within 60 days after completion of the work. This report will detail the dates the work occurred; information concerning the success of the actions in meeting the recommended mitigation measures; any effects on the salt marsh harvest mouse, and Ridgway's rail or California black rail; documentation of the worker environmental awareness training; and any other pertinent information.

Page 251, the second paragraph, of the Draft EIR is revised as follows:

(1) Significance of a Historical Resource

~~The~~ Foster City, which includes the levee system, appears eligible for inclusion on the California Register under California Register eligibility Criterion 1 as an example of the new town movement that changed the way communities were envisioned after World War II. Additionally, Criterion 3 is met because Foster City was an engineering feat that required coordination between planners, civic engineers, soil scientist, and builders, and resulted in a unique, man-made land mass and community that is unparallel in California, and possibly nationwide. As proposed, the project would not cause changes or introduce new elements that would directly or indirectly affect the ~~levee system's~~ City's historical significance. The levee system is similar to a highway that requires periodic maintenance to extend its period of use. The construction proposed for this project will not change the levee or the City's design or appearance in a substantive way, nor does the setting, feeling, or association of Foster City, which includes the levee system, change. The proposed project would not cause a substantial adverse change in the significance of a historical resource as defined in PRC Section 15064.5.

Page 387, last paragraph of the Draft EIR, is revised as follows:

Based on the project's truck trip assumptions, truck trips would be evenly distributed during weekdays between ~~8~~9:00 a.m. and 4:00 p.m., and would not represent a substantial increase to daily traffic volumes on key roadway segments.

Page 389, Mitigation Measure TRANS-1 of the Draft EIR, is revised as follows:

Implementation of the following mitigation measure would reduce this impact to a less-than-significant level:

Mitigation Measure TRANS-1: The Levee project shall include a Bay Trail closure plan prepared by the project contractor and reviewed by the City of Foster City Public Works Department and/or the project team that includes recommended detour routes, appropriate signage and striping, and public outreach strategies, as detailed in this section for each phase of construction. <u>A Transportation Management Plan, approved by Caltrans, shall also be prepared.</u> The Bay Trail closure plan shall be consistent with the standards and guidelines listed below, including the 2014 California MUTCD, the San Mateo County Resource Guide, the Bicycle Technical Guidelines, and Caltrans Standards. Additionally, the closure plan shall include a plan for Memorial Benches currently located along the Bay Trail that would include either re-locating or placing them in the same location (depending on final design details and final wall heights).

Page 392, Mitigation Measure TRANS-1, is revised as follows:

- Post a sign giving bicyclists advance notice of all bike path closures and of all other detours of more than 0.5 mile. Two weeks' notice of path and roadway closures is recommended.
- A schematic of the detour route shall be posted at the beginning of the detour if the detour route is complex or there are a lot of non-local users of the facility (e.g., a regional trail).
- <u>All pedestrian and bicycle access points will be constructed to City standards, which are consistent with ADA regulations.</u>

Additional guidance and figures, including appropriate signage and striping for constructions zones and detour routes, is included in Appendix F.

Page 396, the first paragraph of the Draft EIR, is revised as follows:

The City of Foster City (City) currently uses the standard of 5 acres of parkland per 1,000 residents as a threshold to measure how well its citizens are provided with park and recreational facilities access. With a 2016 population of 33,201,[5] it is estimated that Foster City currently provides nearly 10 acres of parkland (including recreational waterways) per 1,000 residents, far exceeding the above standard.

Existing water-dependent recreation activities publicly accessible in Foster City near the levee system include Baywinds Park (formerly known as East Third Avenue) for windsurfing and kiteboarding. Access to the water occurs at three primary locations near Baywinds Park. The primary access to the bay is by a steep water entry path in the northern portion of Baywinds Park, near a large astroturf staging area. Access to the water is also available to the south of the park, where a ramp provides access to a small sandy beach. Approximately 0.3 miles from the parking area along the Bay Trail, kiteboarders often access a small beach where wind conditions are more consistent.[6]

[5] California Department of Finance, 2016. E-1 Population Estimates for Cities, Counties, and the State. http://www.dof.ca.gov/research/demographic/reports/estimates/e-1/view.php, accessed June 5.

[6] San Francisco Bay Area Water Trail. Baywinds Park (East Third Avenue). Available at: http://scc.ca.gov/webmaster/project_sites/watertrail/agendas/Baywinds_Reports_20160311.pdf, accessed February 14, 2017.

Page 400, Impact REC-1 of the Draft EIR, is revised as follows:

Impact REC-1: Construction of the Levee project would temporarily reduce the availability and access of the Bay Trail and water-dependent recreation activities. (S)

Page 400, Mitigation Measure REC-1 of the Draft EIR, is revised as follows:

Mitigation Measure REC-1: The Public Works Department shall post signage giving advance notice to recreationists at the locations where water-related recreational activities may be impacted by closures or result in limited access to the waterfront. Additionally, ~~I~~implement Mitigation Measure TRANS-1. (LTS)

Page 450 through 462, B. References, have been revised:

Ballona Wetlands Land Trust, et al. v. City of Los Angeles (2011) 201 Cal.App.4th 455.

California Department of Finance, 2016. E-1 Population Estimates for Cities, Counties, and the State. http://www.dof.ca.gov/research/demographic/reports/estimates/e-1/view.php, accessed June 5.

City of Long Beach v. Los Angeles Unified School Dist. (2015) 62 Cal.4th 369.

Coastal Engineering Conference. 2012. "Improvements in Describing Wave Overtopping Processes".

County of Amador v. El Dorado County Water Agency (1999), 76 Cal. App.4th.

EurOtop. 2007. "Wave Overtopping of Sea Defences and Related Structures: Assessment Manual". UK Environment Agency

Hughes, Thronton, van der Meer, and Scholl. 2012. "Improvements in Describing Wave Overtopping Processes".

Keller, J. and G. Keller, 1987. How to Evaluate and Nominate Designed Historic Landscapes. National Register Bulletin 18. National Park Service, Washington, D.C.

Marriott. 2010. "The Preservation Office Guide to Historic Roads". Washington DC. June

San Francisco Bay Area Water Trail. Baywinds Park (East Third Avenue), 2017. Available at: http://scc.ca.gov/webmaster/project_sites/watertrail/agendas/Baywinds_Reports_20160311.pdf, accessed February 14.

Schluttrumpf and van der Meer. 2010. "Handbook of Coastal and Ocean Engineering". Chapter 15.

Stacey, Dr. Mark, 2017. Personal communication with Schaaf & Wheeler, February 2.

United States Geological Survey (USGS), 2007. San Francisco Bay Bathymetry. Available at: https://sfbay.wr.usgs.gov/sediment/sfbay/geostat.html, accessed February 13, 2017.

Zanuttigh and van der Meer, 2006. Wave Reflection from Coastal Structures.

APPENDICES

Add an Addendum prepared in March 2017 to the Historical Evaluation in Appendix D.

ATTACHMENT A: Addendum to the Historical Evaluation

ATTACHMENT A

Addendum to the Historical Evaluation

Addendum to:

Historical Evaluation of Foster City and the Foster City Levee System San Mateo County, California

Vicki R. Beard
March 20, 2017

Assessment of Project Effects

The evaluation prepared for the Foster City Levee and Improvements Project EIR in June 2016 lacked a discussion of the overall effects of the project on the engineered City of Foster City. As stated in the evaluation, in order to evaluate the levee system's importance, it was necessary to consider the whole of Foster City as a resource because of the unique correlation between the two. The evaluation found that Foster City, and subsequently the levee system, meets California Register of Historical Resources (California Register) criteria 1 and 3 through its association with the post World War II, modern new town movement.

Criterion 1

Foster City meets Criterion 1 for inclusion on the California Register as an example of the new town movement that changed the way communities were envisioned after World War II. A master plan for the city was developed by Wilsey, Ham, & Blair for T. Jack Foster, and was approved by San Mateo County in 1961. Unlike the builder developed subdivisions of the 1940s and 50s, the Foster City master plan was a community design with provisions for civic, commercial, industrial, and recreational activities in additions to housing. It was among the first, if not the first, California new town to be planned and constructed, and one of the only towns that carried through to incorporation.

Criterion 3

Foster City meets Criterion 3 for inclusion on the California Register. Criterion 3 requires that a resource embody distinctive characteristics of a type, period, region or method of construction. From the ground up, Foster City was an engineering feat that required coordination between planners, civic engineers, soil scientist, and builders. The result was a unique, man-made land mass and community that is unparallel in California, and possibly nationwide.

The levee system itself will undergo some modification but the levee system is one element of the larger resource. Proposed changes to the levee system will not affect the California Register eligibility of Foster City. Rather, the proposed project will protect the resource by ensuring that flood waters do not inundate the landform upon which the city is built nor damage buildings and structures comprising Foster City's built environment.

APPENDIX A

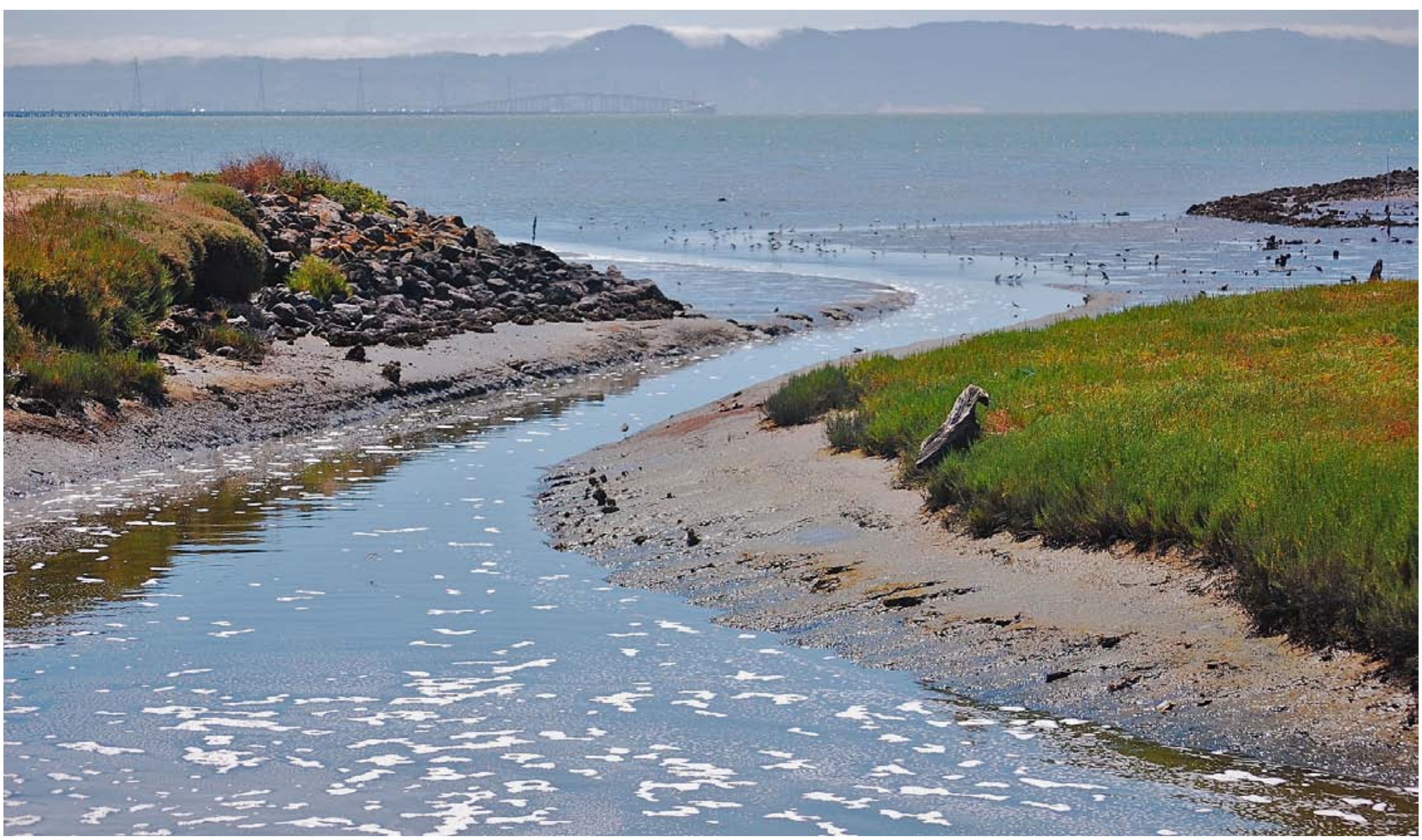
The Bay Institute Report

Final

ANALYSIS OF THE COSTS AND BENEFITS OF USING TIDAL MARSH RESTORATION AS A SEA LEVEL RISE ADAPTATION STRATEGY IN SAN FRANCISCO BAY

Prepared for
The Bay Institute

February 22, 2013



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February 22, 2013

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Acknowledgements

We would like to acknowledge the work of ecologist Peter Baye for his original ideas on the upland ecotone slope and the use of treated effluent to support moist grasslands. Jason Warner of Oro Loma Sanitary District and Mike Connor of East Bay Dischargers Authority have been pivotal, along with Peter, in developing these concepts on the Hayward Shoreline.

We would like to thank the BCDC *Innovative Wetland Adaptation Techniques in Lower Corte Madera Creek Watershed* project for providing valuable information from their recent study on the attenuation of waves over marshes. The BCDC study was supported with funding from the San Francisco Estuary Partnership (SFEP) through a *Resilient Watersheds for a Changing Climate* grant of the San Francisco Bay Water Quality Improvement Fund from the U.S. Environmental Protection Agency.

List of Preparers

The report was funded by The Bay Institute (TBI) and prepared by the following TBI, ESA PWA, and ECONorthwest staff:

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Executive Summary

Introduction

An informal program of tidal marsh restoration has been underway in San Francisco Bay for over thirty years. These marsh restoration projects are part of a regional initiative that has quietly grown into the largest coastal wetland restoration program in the United States. The purpose of the program is to reverse the historic trend of wetland destruction in order to recover the significant benefits provided by tidal marshes and associated wetlands. Those benefits include providing habitat for numerous wildlife species and performing vital flood risk management and pollution abatement functions. Examples of successful restoration projects exist all around the Bay. The fundamental premise of the restoration program is that tidal marshes will restore themselves naturally if the proper conditions are created initially through proactive engineering and intervention. Wetland restoration scientists have learned that natural tidal marsh restoration processes can take from years to decades to subsequently develop a healthy, self-sustaining marsh.

These two basic presumptions— that the primary purpose of marsh restoration is to recover depleted habitat and that the natural processes of restoration should take as long as needed to reestablish healthy marshes— have been called into question by forecasts of sea level rise caused by climate change. Wetland restoration scientists and project managers now believe that many marshes may have difficulty keeping up with accelerating rates of sea levels towards the end of the century if no action is taken.

Rising seas will significantly increase the flood risk of San Francisco baylands in the future, threatening large areas of essential shoreline development. Consequently, it may be possible to modify current restoration strategies to accomplish two new objectives: (1) enable restored marshes to keep pace with sea level rise, and (2) improve flood risk management for developed shoreline areas.

This study considers whether it is possible to accomplish these two objectives by employing a co-beneficial, integrated approach to restoring and managing San Francisco Bay's intertidal zone.

Purpose

The purpose of this study is to examine opportunities to protect San Francisco Bay's recovering tidal marsh ecosystems while helping bayshore communities to manage the impacts of sea level rise. Specifically, it considers the flood risk management functions that tidal marshes perform naturally and evaluates the possibility of integrating those functions into a co-beneficial shoreline management strategy. The study's intended audience is planners, politicians, regulators, and other stakeholders with the authority to make or affect decisions that influence the configuration and use of the San Francisco Bay shoreline. The study examines the current functions of San Francisco Bay tidal marshes as well as existing flood risk management strategies. It considers how environmental conditions are likely to change in the era of climate change, and how we can adapt our marshes and our flood risk management practices to accommodate these changes.

The Problem

San Francisco Bay's existing shoreline flood risk management system is an aging network of earthen levees that is continually sinking into soft bay mud. It was designed in piecemeal fashion, calibrated for present-day sea levels and is inconsistently maintained. Some levees in key locations are regularly over-topped resulting in flooding of vital public facilities, especially heavily used roads and highways. Rising sea level is making the existing levee system obsolete.

Sea level rose in San Francisco Bay by over seven inches between 1900 and 2000 as a result of climate change. The California Ocean Protection Council estimates that sea level will rise an additional fourteen inches by 2050 and to fifty-five inches by 2100. The greatest threat to the developed shoreline in the near term is not posed by increased static sea levels on calm days, but by storms that occur in tandem with high tides.

The Lost Marshlands of San Francisco Bay

Extensive areas of the shoreline of San Francisco Bay consist of former tidal marshes that were filled, diked or drained over the past 160 years. Of 196,000 acres of tidal marshes that existed prior to 1850, approximately 180,000 acres were destroyed by conversion to other uses (Goals Project 1999). Solar salt evaporation ponds and agriculture comprise a large portion of the uses to which tidal marshes were converted. Though more intensive development occurred on some of the 180,000 acres of converted marshlands, (San Francisco's Financial and Marina districts, Foster City, and Oakland Airport, for example,) most of the diked wetlands were not developed intensively. They remain today as salt ponds, hay farms and other open spaces that lie between the open waters of the bay and the developed shoreline (Figure ES-1).

The San Francisco baylands have subsided relative to sea level as a result of having been disconnected from the tidal waters of the bay. Though the original marsh plains once existed at an elevation well above mean sea level, their surface elevation has subsided up to five to ten feet below sea level in parts of the South Bay. An extensive network of earthen levees prevents bay tidal waters from inundating these subsided baylands. The levees are aging in many locations, though levees that protect more intensively developed areas are maintained to a higher standard.

Not surprisingly, the destruction of ninety-two percent of the Bay's tidal marshes has inflicted enormous damage on the Bay's aquatic ecosystem. The populations of wildlife species that relied on tidal marshes during a part or all of their life cycle declined, in some cases to the brink of extinction. Since tidal marshes served as the nursery ground for many estuarine fish, those populations experienced permanent damage. Among other species, salmon and steelhead numbers fell, California clapper rail and salt marsh harvest mice were declared to be endangered, and migratory shorebird and waterfowl species abundance and diversity dropped as suitable winter habitat was severely diminished.

Most of the 180,000 acres of tidal marshes that were converted to other uses were not intensively developed. Almost 40,000 acres were operated as solar salt evaporation ponds, while roughly 50,000 acres became farmlands. About 55,000 acres of tidal marshes near Suisun Bay were converted to managed freshwater/brackish wetlands to serve as private duck hunting clubs.

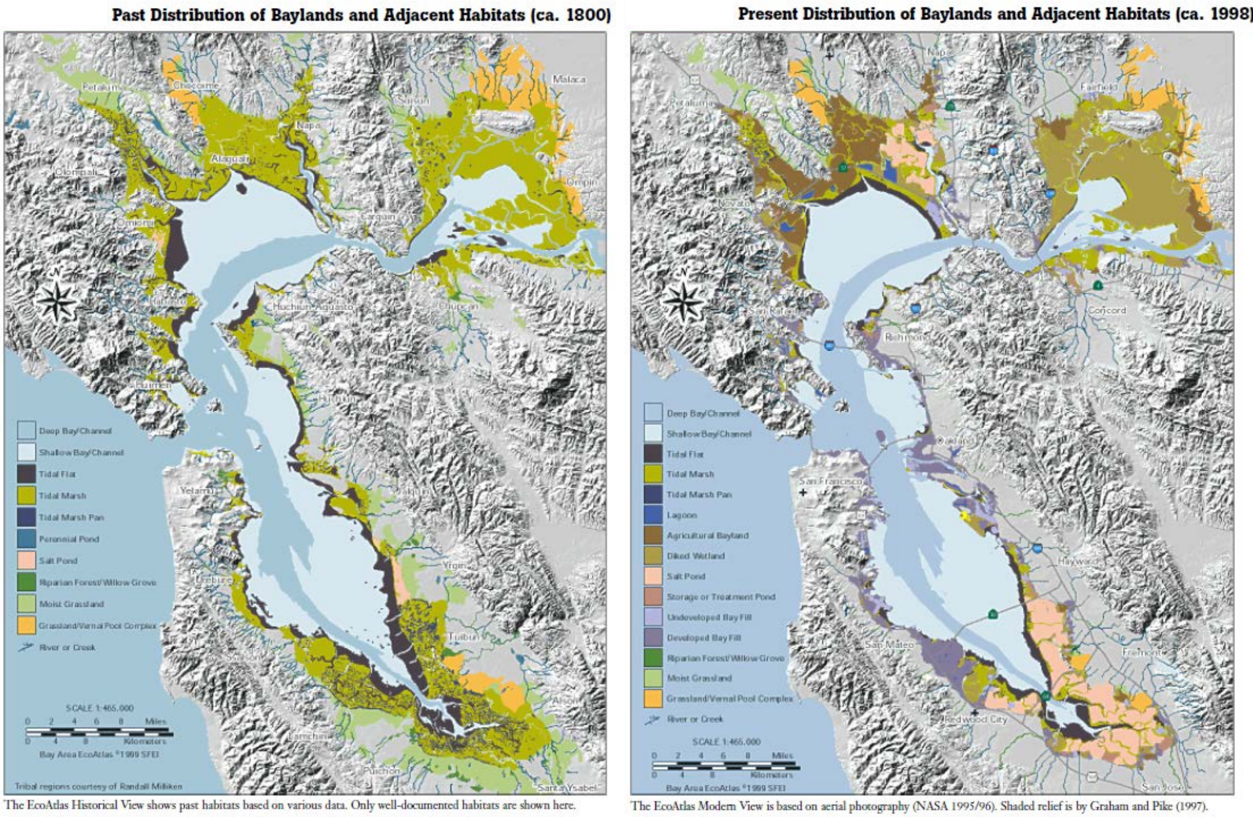

Figure ES-1. Historic and existing baylands habitats throughout San Francisco Bay. Most baylands in the North Bay were converted to agricultural fields, while baylands in the South Bay were largely converted to commercial salt ponds and other industrial uses. From the Goals Project 1999.

Sea Level Rise and Shoreline Flooding

Storm surges occurring atop higher sea levels already are causing increased flooding within the baylands, inflicting damage on both undeveloped and developed areas therein. Major regional roads along the bay shoreline are regularly flooded during winter storms (e.g. Highways 101 and 37). Residential and commercial areas within Bay Area cities similarly are experiencing increased flooding. The aging network of bayland dikes is failing to provide adequate protection and will prove increasingly inadequate as sea level continues to rise during the coming decades. In addition to the threat posed to shoreline development, rising sea levels also threaten to increase the depth of submergence of large areas of tidal marshes, including areas that have been restored over the past thirty-five years.

Blue ribbon panels convened at the national and international level have recognized the multiple threats posed by climate change, and by sea level rise in particular. Restoration of San Francisco Bay's marshes could provide tangible flood risk management benefits during these decades, buying time to plan for long-term solutions to the problem of sea level rise. A restored tidal wetland buffer would reduce the frequency and magnitude of periodic flooding, and thereby also reduce the significant costs of rebuilding. It would also provide significantly expanded areas of habitat for wildlife on the brink, sequester carbon from the atmosphere, and reduce ambient pollution within the Bay.

The Study

This study describes and evaluates the costs and benefits of employing marsh restoration as an adaptation strategy to rising sea levels in San Francisco Bay. The study examined two strategies available to prevent or reduce the impact of shoreline flooding in San Francisco Bay caused by sea level rise. It compared the traditional approach that relies on construction of engineered earthen levees to a hybrid approach that combines tidal marsh restoration with construction of levees. The study analyzed the capacity of tidal marshes to reduce waves during storm surges and, thereby, reduce the need to build larger levees in the absence of buffering tidal marsh. Further, the study calculated the costs of the two approaches to determine whether one is more cost effective than the other.

Findings

Tidal marsh can reduce storm wave heights by over 50% depending on water depth and marsh width. This finding suggests that flood risk management is improved significantly when areas of tidal marsh exist between the developed shoreline and the open waters of the Bay. Further, it indicates that by using tidal marsh in combination with a levee constructed at the landward edge of the marsh, the size of the levee could be reduced significantly while still providing the same level of flood protection benefit as would be provided by a larger levee that was not fronted by tidal marsh.

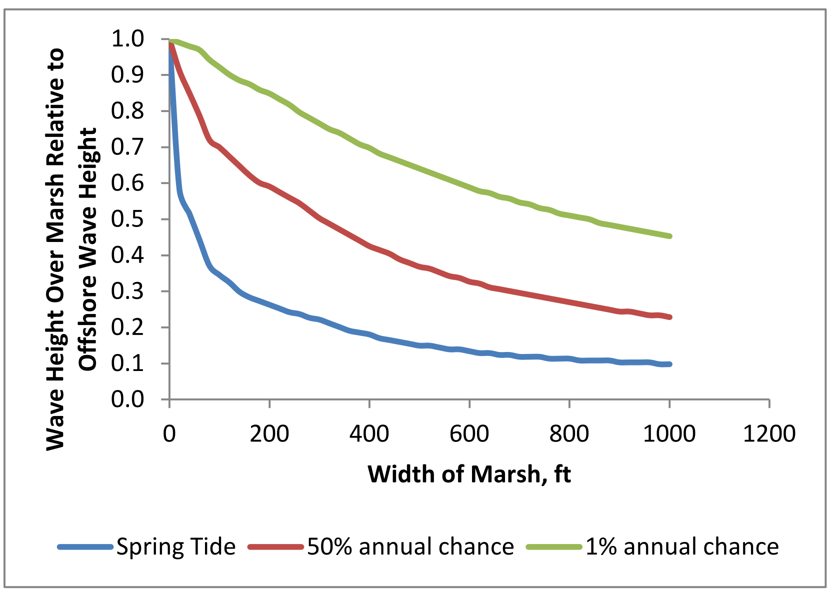

Figure ES-2. Wave attenuation over a marsh for varying water depths (based on BCDC 2013).

Our analysis concluded that a flood risk management system comprising a landward levee and an adjacent tidal marsh provides an equal level of flood protection to that of a much larger landward levee alone. Moreover, the cost of the levee with tidal marsh is about half that of the traditional levee alone. The size of a levee is primarily set by the elevation of the crest height and toe. The crest elevation is determined by how high waves run up the levee, a function of the size of the waves – waves that run up higher than the crest will overtop the levee and cause flooding. The toe elevation is determined by the ground surface elevation. With a marsh in place, waves heights and run-up are smaller so the crest can be lower; the marsh surface is higher so the toe elevation can be higher. Together, reducing crest elevation and increasing toe elevation reduces the size of the levee. Wave attenuation varies with the depth of water. Vegetated marshes are particularly effective at reducing waves at more common, lower water levels which means that the levee is protected most of the time and remains in serviceable condition in preparation for extreme water level and wave events. Wave attenuation increases with width of marsh. A wider marsh will also be effective for longer in areas where there is shoreline retreat. These results indicate that it would be more cost effective to build a flood risk management system that incorporates a tidal marsh than it would to build a conventional earthen levee.

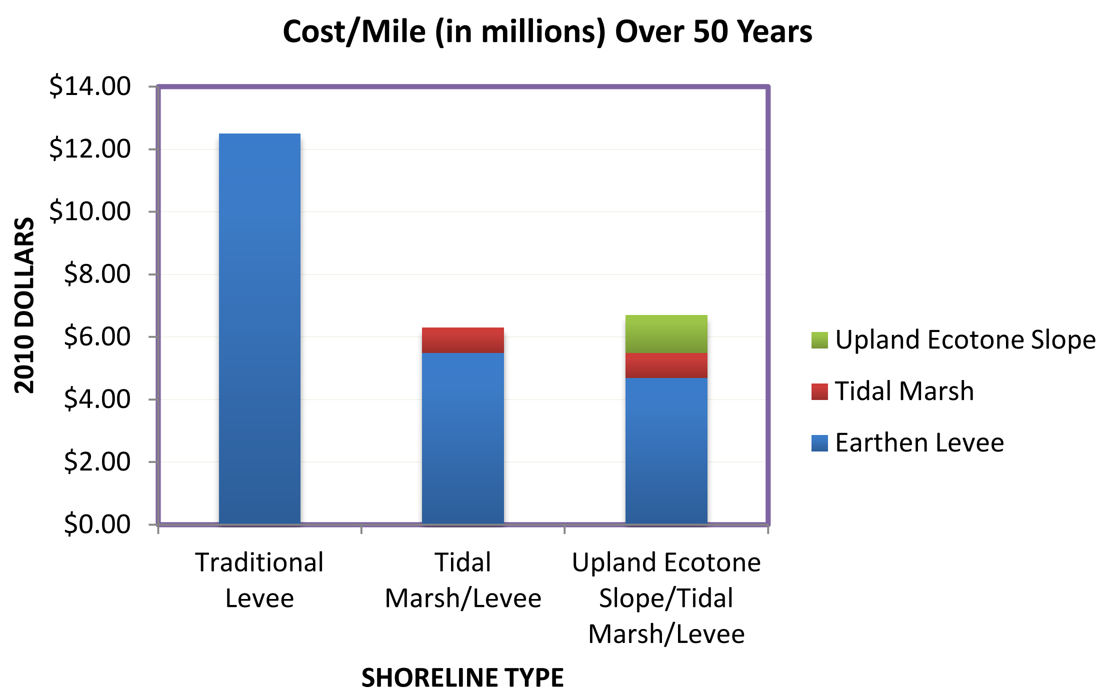

Figure ES-3. Levee cost comparison for various flood risk management scenarios.

New Flood Risk Management Paradigm—the Horizontal Levee

Significant marsh restoration efforts already are underway in San Francisco Bay. What began with a small, one-off project in the late 1970s has evolved into a regional program with the goal of restoring over 100,000 acres of bay marshes. However, that program has only lately come to incorporate sea level rise projections into marsh restoration design. Restoration scientists now recognize that many of the restored wetlands are at risk of being drowned by rising tides. In addition, the decreasing availability of suspended sediment in bay waters also poses a threat to the success of marsh restoration efforts.

A new restoration design is needed in order to respond to these changing conditions. This study describes a new marsh restoration paradigm that is appropriate in many parts of the Bay and that can provide an interim solution to the problem of tidal marsh inundation and low sediment supply. The new paradigm recommends the addition of an upland ecotone slope of moist grasslands and brackish marshes landward of the existing tidal marsh. The upland ecotone slope would provide both elevation and salinity gradients that would allow the tidal marsh to both move landward and accelerate vertical accretion in order to keep pace with sea level rise. In addition, the new marsh restoration paradigm proposes the use of sediment dredged from nearby flood control channels as construction and maintenance material for the upland ecotone substrate. Reclaimed wastewater effluent from existing public water treatment plants along the shore could be used to irrigate the upland ecotone slope.

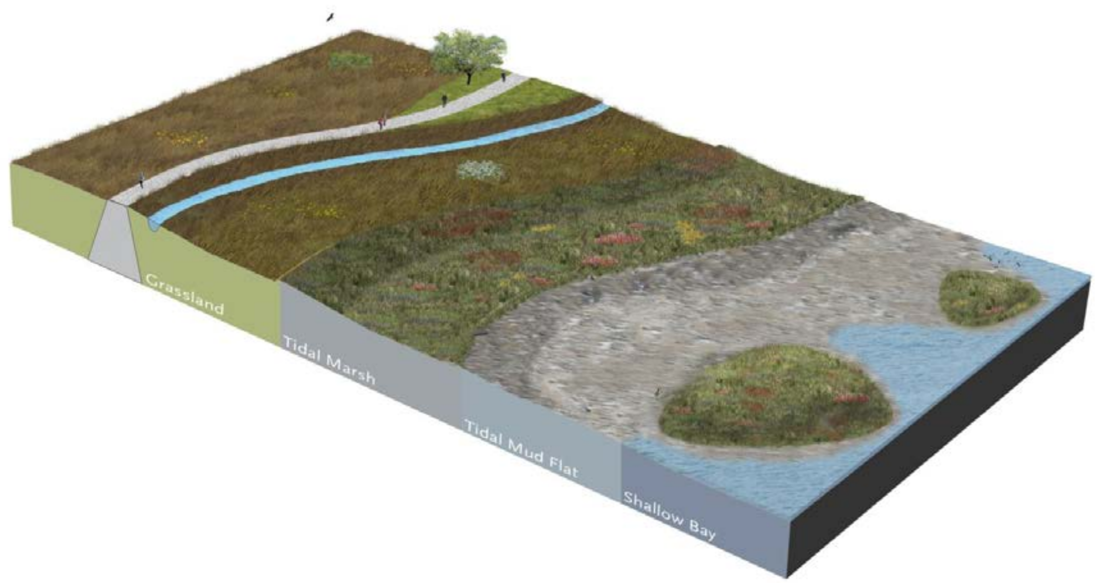

Figure ES-4. Conceptual cross-section of a “horizontal levee”, with an upland ecotone slope bayward of a flood risk management levee and landward of a tidal marsh.

By constructing an ecotone slope adjacent to the landward levee, silt from nearby flood control channels could be captured and applied to restoring marshes to build surface elevation. Further, the ecotone slope would function as a self-maintaining levee, building in elevation as root systems grow. Another significant feature of the brackish marsh would be the ability to receive treated wastewater effluent from existing water treatment plants that ring the shoreline. Those plants currently spend considerable sums to pipe, pump and discharge wastewater at distant locations in the bay. Similar brackish, back-marsh networks existed historically throughout the Bay, but were destroyed to make way for development.

Conclusions

Sea level rise caused by climate change is already causing damage to developed areas of the San Francisco Bay shoreline. That damage and its associated costs will increase as sea level rise accelerates. The current flood risk management system will have increasing difficulty to maintain adequate levels of protection as sea level rises. Important public infrastructure, including highways, bridges, roads, rail lines, utilities, and airports, will experience increased damage from flooding in the coming decades. In the near term, between now and 2070, the bulk of that damage will be inflicted by storms arriving on higher tides.

The traditional and, until now, least costly approach to addressing flood risk has been to increase the height and width of levees. Although it has been recognized for many years that tidal marshes and associated wetlands provide tangible flood risk management benefits, this has not always been included during the planning of flood risk management projects.

A region-wide effort is currently underway to restore tidal marshes and associated wetlands in San Francisco Bay. However, design of the restoration projects has generally not incorporated provisions for long-term sea level rise. In order to fully realize the benefits of the marsh restoration program, new measures must be developed and implemented that can accommodate increasing sea levels.

This study identifies two strategies that can be employed to accomplish two critical public policy objectives. First, tidal marsh restoration can be used as an effective flood risk management method that is more cost effective than traditional approaches. Second, a new marsh restoration paradigm can facilitate marsh survival during the current era of sea level rise and low suspended sediment, thereby protecting valuable marsh wildlife.

Major Conclusions

- The greatest flooding threat to developed areas along the shoreline of San Francisco Bay during the next several decades is from flooding caused by storms occurring during periods of high tides, not from elevated sea levels alone.
- Prior to the latter half of the 21st century it may be possible to adapt to increased sea level and protect existing land uses by employing strategic modifications of the current shoreline management paradigms.
- Later in the 21st century protection of low-lying developed areas along the Bay shoreline may not be sustainable without extensive modification of shoreline protection structures.
- Tidal marshes can provide significant flood protection benefits by attenuating wave energy during storms, and at significantly lower cost than traditional flood risk management structures.
- By combining current regional marsh restoration and regional flood risk management planning into a new shoreline management paradigm, flood protection costs could be significantly reduced while providing equivalent levels of protection.
- A network of restored shoreline marshes could be designed to provide significant flood risk management benefits for several decades if construction begins soon. If construction of an integrated marsh-levee system is delayed for too long, it may be unable to keep pace with expected sea level increases and fail to provide the desired benefits.

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TABLE OF CONTENTS

1 Introduction

Climate change and sea level rise are globally recognized as threats to the safety and integrity of coastal communities. The San Francisco Bay Area is particularly vulnerable to the effects of climate change, as much of the urban development has occurred on low-lying marshes that surround the estuary. These marshes and associated lowlands are vulnerable to flooding from sea level rise, as well as the stormwater runoff changes associated with urbanization.

Fundamentally, the baylands – the low-lying areas surrounding the bay shoreline – serve as a geographic and physical buffer between the aquatic habitats of the Bay and areas of urban, rural, and suburban development. Over the last 150 years, almost all of the baylands surrounding San Francisco Bay have been fundamentally altered by human activities. Former tidal marshes were diked and drained for farmland, or filled to facilitate urban development. Huge swaths of baylands in the South and North Bays were converted to salt production ponds; while many of these ponds are in the process of being restored to tidal marsh, significant acreages remain in production. The flood protection afforded shoreline communities by their baylands is dependent on the configurations of those baylands, particularly whether or not they include tidal marsh. Indeed, the presence, absence, and condition of tidal marshes are among the primary factors that determine the vulnerability of developed baylands to flooding from rising sea levels.

1.1 Purpose of This Study

The purpose of this study is to examine the function and value of tidal marshes as an adaptation strategy to help bayshore communities manage the impacts of sea level rise. Its intended audience is the planners, politicians, regulators, and other stakeholders with the authority to make or affect decisions that influence the configuration and use of the San Francisco Bay shoreline. This report examines the current functions of San Francisco Bay tidal marshes as well as existing flood risk management strategies. It considers how environmental conditions are likely to change in the future, and how we can adapt our marshes and our flood risk management practices to accommodate these changes. The report is organized into nine chapters, as follows:

- **Executive Summary**
- **Chapter 1: Introduction**
- **Chapter 2: The Problem: Impacts of Sea Level Rise on the Bay's Shoreline.** A description of the threat posed by sea level rise to the developed shoreline community and to the Bay's tidal marsh ecosystem.
- **Chapter 3: Ecosystem Services of San Francisco Bay Tidal Marshes.** A description of a "complete" marsh, its various habitat components, and how the components work together to achieve a broad range of physical and biological processes.

- **Chapter 4: Economic Value of Services Performed by Bay Tidal Marshes.** A description of the various ecological benefits provided by tidal marshes in San Francisco Bay - both direct and indirect – that tidal marshes provide to both local communities and the Bay Area region.
- **Chapter 5: Flood Risk Management**. This chapter discusses adaptation strategies for levees and marshes that can help to decrease the vulnerability of shoreline communities to flooding.
- **Chapter 6: Tidal Wetland Restoration and Flood Risk Management Scenarios.** We present a case study for the Hayward Shoreline with examples of adaptation strategies that incorporate the natural shore.
- **Chapter 7: Using Tidal Wetlands to Reduce Shoreline Protection Costs**. This chapter describes relative costs of implementing different adaptation strategies.
- **Chapter 8: A Shoreline Flood Management Approach During an Era of Sea Level Rise.** Based upon the findings of Chapters 2-7, we outline a flood risk management approach for parts of the San Francisco Bay that reduces the flood risk for bayland communities while maintaining and enhancing ecosystem services.
- **Chapter 9: Key Findings.**

2 The Problem: Impacts of Sea Level Rise on the Bay's Shoreline

San Francisco Bay and its shoreline have existed in a relatively stable form for about the past 2,000 years. Rapid sea level rise that had been occurring since the end of the last ice age had slowed by that time, allowing the formation of a large complex of tidal marshes adjacent to the shore. Beginning with colonization of the region by Europeans in the 19th century, most of those tidal marshes were destroyed and converted to non-wetland uses. The heavily altered marsh ecosystem landscape now lies below sea level, protected from flooding by an aging network of earthen dikes.

In general, previous periods of global sea level rise occurred slowly, in ways that facilitated the graduation evolution, transformation, and persistence of shoreline ecosystems such as wetlands, beaches, and other features. However, climate change is causing sea levels to rise at accelerated rates that threaten to drown remaining and restored tidal marshes and to flood low-lying developed shoreline areas. Shoreline land managers are seeking new ways to protect the ecological and social resources of the shoreline during this new era of sea level rise.

2.1 Historic and Present Landscape

Modern San Francisco Bay as we know it began to form with rising sea levels at the end of the most recent glacial period, approximately 15,000-18,000 years ago. Early in the Holocene epoch, about 10,000 years ago, rising seas flooded the inland valleys that formed the precursors to the modern Bay (Goals Project 1999). Decreasing rates of sea level rise, beginning approximately 5,000-6,000 years ago, facilitated the development of extensive marshes and mudflats (Atwater 1979, Goman et al. 2008).

While the footprints of the modern marshes were generally established by 2,000-3,000 years ago, varying rates of relative sea level rise and sedimentation coupled with changes in estuary-wide salinity have affected the extents and elevations of the marshes and mudflats (Goman et al. 2008). Figure 1, from Atwater 1979, displays estimated shoreline evolution in San Francisco Bay over the past 15,000 years.

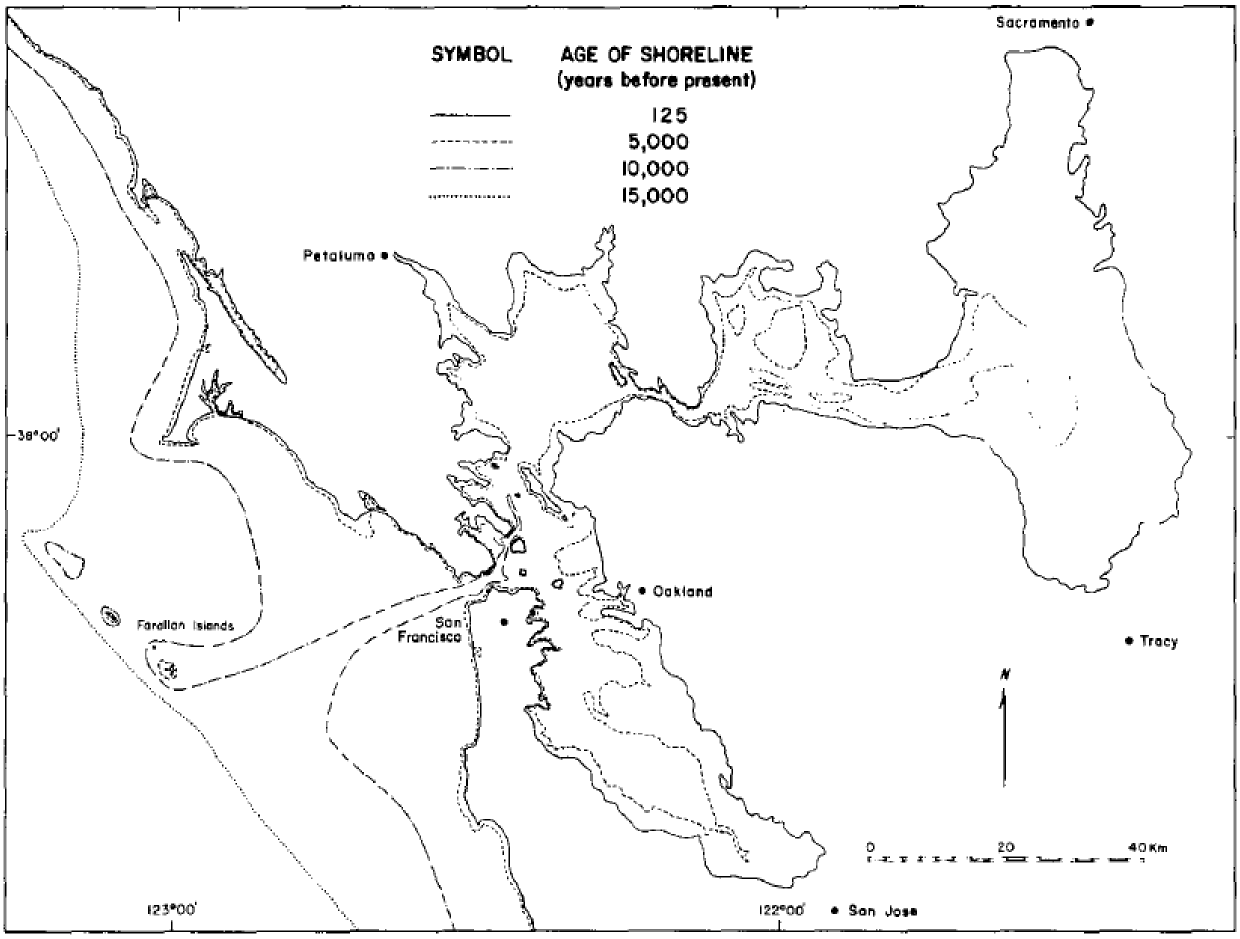


Figure 1. Approximate high-tide shorelines in San Francisco Bay over the past 15,000 years. The shoreline for 125 years ago does not consider human-induced changes such as the diking, draining, and/or filling of tidal marshes and mudflats, nor the effects of hydraulic mining in the Sierra Nevada during the mid-1800s. From Atwater 1979.

Western colonization of the Bay Area began in the 1700s, and by the early 1800s, Spanish missions had become established throughout the area. Given the area's hilly and often challenging topography, the tidal marshes fringing the Bay contained the most extensive areas of flat land on which infrastructure such as roads and railroads could be built. This fact, coupled with the perception of the marshes as "nuisance" lands that should be reclaimed for purposes such as agriculture and industry, led to the large-scale diking and draining of tidal marshes from the mid-1800s through early 1900s. In general, marsh reclamation moved from west to east, with most marshes of the Sacramento – San Joaquin Delta reclaimed by 1920. Much of this reclamation work was done by immigrant Chinese laborers, who hand-constructed levees with shovels and wheelbarrows for as little as 90 cents a day (Lee 2008, Figure 2).

Figure 2. An illustration of Chinese laborers constructing levees in the San Francisco Estuary. From Family Water Alliance 2012.

At the same time that the tidal marshes were being reclaimed, hydraulic gold mining had begun in earnest in the Sierra Nevada Mountains. The massive quantities of sediment released by this mining moved rapidly downstream to the Bay, where they accumulated on mudflats that were outboard of the levees that now surrounded the former tidal marshes (Jaffe et al. 1998, Figure 3). The rapid accretion of these sediments prevented much of these marshes from forming extensive dendritic channel networks, a prominent morphological and habitat feature of older, more mature marshes. Instead, channels in these marshes tended to be short and linear.

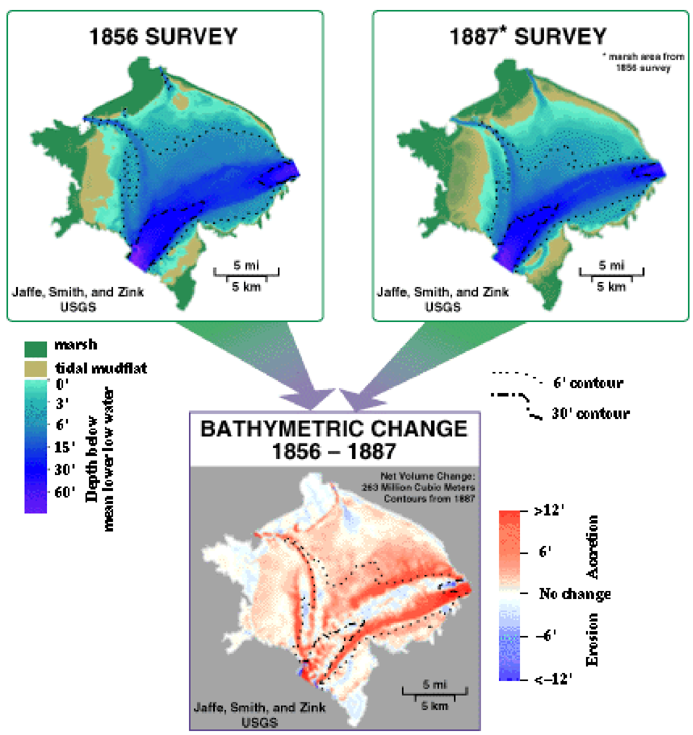


Figure 3. Bathymetric changes in San Pablo Bay due to the accretion of sediment mobilized by hydraulic gold mining. Some portions of the Bay accreted more than 12 feet of sediment during the late 1800s, particularly in areas that bordered the thalweg. From Jaffe et al. 1998, modified by SFSU.

Efforts to manage floods, develop hydropower, and deliver water supplies led to the construction of dams throughout the Sierra Nevada in the early to mid-1900s. The construction of these dams cut off the supply of hydraulically-mined sediment to the Estuary, changing the spatial distribution of accretive versus erosive areas (ibid). By this time, much of the Estuary's margins had taken the form of broad reclaimed and developed baylands fronted by levees, narrow strips of outboard tidal marsh, and extensive mudflats (Figure 4).

Figure 4. The northern shoreline of San Pablo Bay in the vicinity of Tolay Creek, where agricultural fields (former tidal marsh) lay behind levees and fringing marsh that grew on accreted sediments from hydraulic gold mining. Accretion has shrunk the mouth of Tolay Creek from a formerly broad channel to a narrow slough.

The passing of the pulse of sediment associated with hydraulic mining, increased flood management, and damn construction on large Sierra Nevada tributaries has decreased sediment delivery to the estuary from the Delta by about half (Schoellhamer 2011). This has been observed as a rapid 36% decrease in observed suspended sediment concentrations throughout San Francisco Bay between the 1990s and the first decade of the present century (ibid). As a result, an estuary that once experienced net accretion is now experiencing net erosion, and suspended sediment supply has become a limiting factor for marsh development and restoration (**Figure 5**).

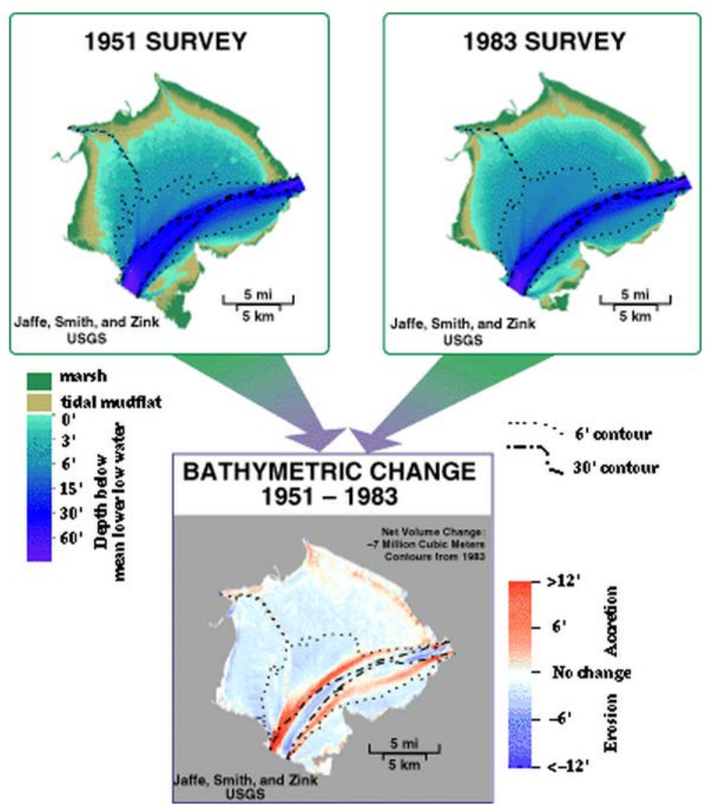


Figure 5. Bathymetric changes in San Pablo Bay due to the depletion of its sediment pool in the late 20th century. During this time period, about 7 million cubic meters of sediment was eroded from the Bay, causing widespread elevation decreases except along the main navigation channel. From Jaffe et al. 1998.

Not surprisingly, the destruction of ninety-two percent of its tidal marshes inflicted enormous damage on the Bay's aquatic ecosystem. The populations of wildlife species that relied on tidal marshes during a part or all of their life cycle declined, in some cases to the brink of extinction. Since tidal marshes served as the nursery ground for many estuarine fish, those populations experienced permanent damage. Among other species, salmon and steelhead numbers fell, California clapper rail and salt marsh harvest mice were declared to be endangered, and migratory shorebird and waterfowl species abundance and diversity dropped as suitable winter habitat was severely diminished.

Most of the 180,000 acres of tidal marshes that were converted to other uses were not intensively developed. Almost 40,000 acres were operated as solar salt evaporation ponds, while roughly 50,000 acres became farmlands. About 55,000 acres of tidal marshes near Suisun Bay were converted to managed freshwater/brackish wetlands to serve as private duck hunting clubs (Figure 6).

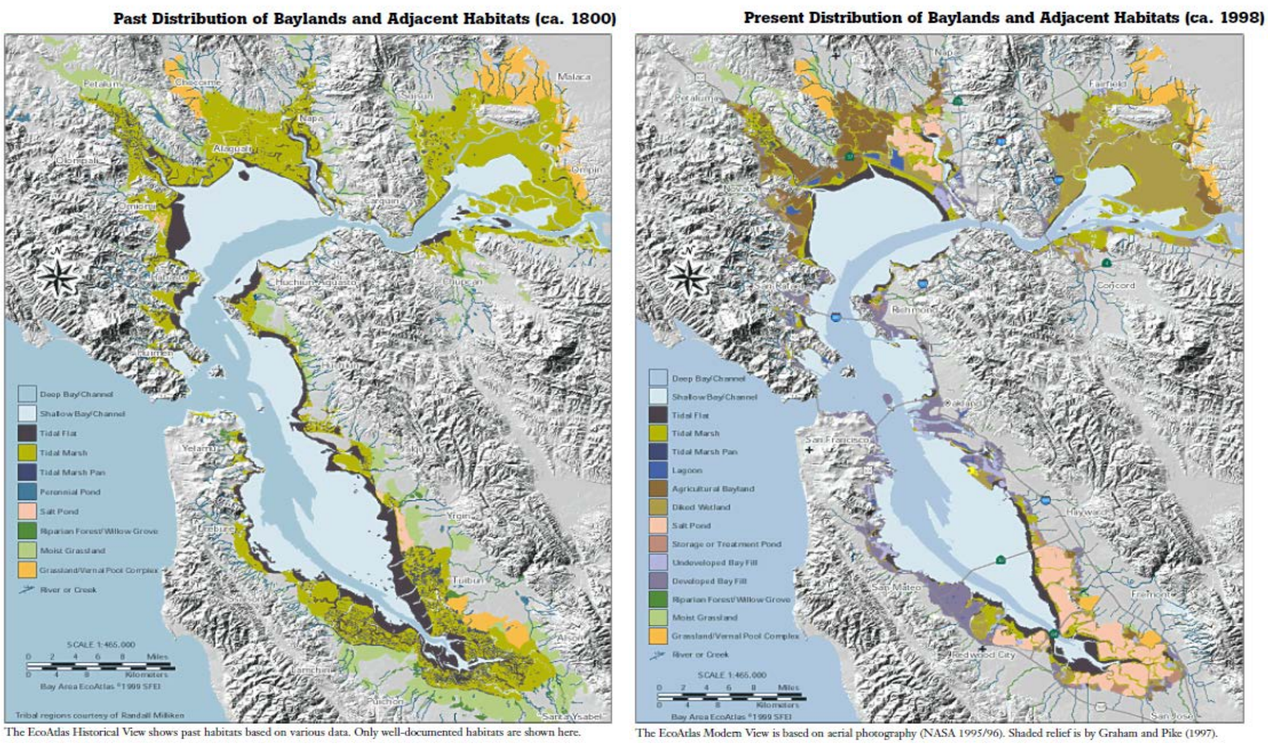


Figure 6. Historic and existing baylands habitats throughout San Francisco Bay. Most baylands in the North Bay were converted to agricultural fields, while baylands in the South Bay were largely converted to commercial salt ponds and other industrial uses. Baylands in the Suisun region were converted into managed wetlands used primarily for duck hunting; much if this continues to this day. From the Goals Project 1999.

2.2 Future Landscape

After 3,000 years of relatively stable sea level and 150 years of a turbid estuary, the Bay is returning to the norm of the Holocene period with rapid sea level rise and clearer water. In response, the baylands will evolve to accommodate higher sea levels and less sediment. Existing tidal marshes will be more dynamic than we have experienced in the recent historic past. There may be downshifting and drowning of high marsh to low marsh and mudflat over the next century; there may be landward movement or transgression of the tidal marshes and mudflats inland; there may be the need to actively manage tidal marshes more than in the past to maintain their ecological integrity.

Existing tidal marshes accommodate moderate sea level rise by a combination of vertical accretion and a gradual landward shift in position of the shoreline and landward edge. The vertical and horizontal movement of these marshes are dependent on three rates:

1. *Vertical accretion rates*, which depend upon the rates of sea level rise, sediment supply, and the rate of organic production,
2. *Horizontal erosion rates*, which depend upon the rate of sea level rise, sediment supply, and incident wave energy, and
3. *Horizontal transgression rates*, which depend upon the rate of sea level rise and the slope of the upland transition zone or barriers.

The factors that govern these rates are described below.

Sea Level Rise. There have been significant advances in the scientific recognition of the risk of abrupt climate change and accelerating sea level rise (OPC 2011). Sea level has risen by about 7 inches on the California coast in the past century. Present sea level rise projections suggest that global sea levels in the 21st century can be expected to be much higher. These projections are summarized in the recent National Research Council Report on West coast sea level rise (NRC 2012) which provided estimates of regional sea level rise for San Francisco (Table 1).

Table 1. San Francisco Bay Regional Projections of Sea Level Rise (NRC 2011)

Year	Intermediate Projection (in) A1B scenario	High and Low Range (in) B1 and A1F1 scenario
2030	5.5	1.7-11.7
2050	11.0	4.8-23.9
2100	36.2	16.7-65.5

Notes:

- The projected global sea level is dependent upon the emission scenario.
- Local steric and wind-driven contributions were estimated from global climate change models (GCMs); the land ice contributions included an adjustment for gravitational and crustal deformation effects; and an estimate was made of regional vertical land movement.

Sediment Supply and Organic Peat Production. As discussed above in Section 2.1, the estuary is currently experiencing a risk of reduced fine sediment availability as the erodible sediment pool is depleted (Schoellhamer 2011). Wetlands build elevation through two main processes: accretion of suspended sediment, and production of organic peat within the plants' root systems. The salt marshes of San Francisco Bay do not produce as much peat as their more brackish and freshwater analogues upstream in Suisun Marsh and the Delta, so their ability to keep up with sea level rise is governed by the amount of available suspended sediment present. Therefore, whether observed declines continue or abate will have a much greater effect on the future trajectory of SSC than climate change. This trajectory has important ecological implications because further reductions in sediment supply will increase the vulnerability of tidal marshes and mudflats to sea level rise (Cloern et al 2011).

Local Topography. Tidal marshes have responded to low/moderate rates of sea level rise in different ways according to local topography. Marshes adjacent to gentle, continuous slopes accommodate sea level rise by accreting vertically with only minor long-term or progressive conversion of tidal habitat types, and by a gradual landward shift (horizontal displacement or landward estuarine “transgression”) in position. Most natural bay margins have this type of topography (Figure 7.).

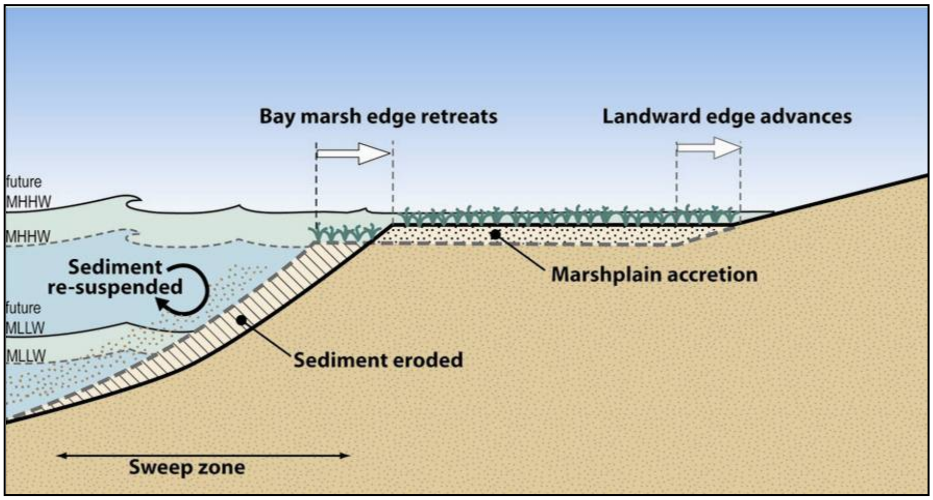


Figure 7. Landscape evolution along a natural bayshore edge.

Conversely, marshes bounded by a steep slope (such as an inboard levee) have a reduced width of transition zone available for transgression; mudflat and marsh habitat will narrow as it is ‘squeezed’ against the levee. Historic diking has steepened coastal gradients around much of the Bay, converting gently sloping baylands edges into steep linear borders backed by subsided basins (**Figure 8**).

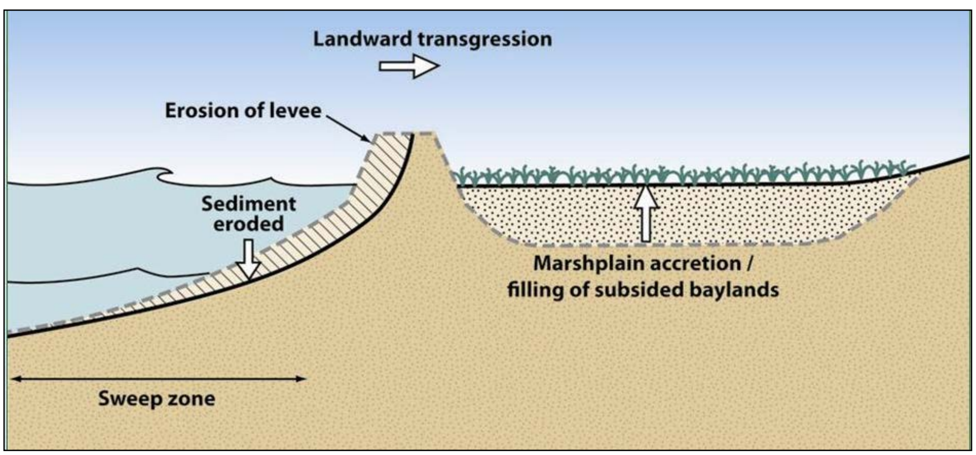


Figure 8. Landscape evolution along a developed bayland edge.

In both scenarios, as sea level rise continues to accelerate, it will eventually outstrip the rate of accretion, and tidal marshes will start to "drown". If the vertical accretion (mineral and organic) of marshes cannot keep pace with sea level rise, marsh habitats will tend to migrate (or "transgress") landward. Gradual submergence of tidal marshes increases the period and frequency of tidal inundation, leading to "downshifting" of habitat zones (high marsh to middle marsh, middle to low, low marsh to mudflat). There will also be expansion of tidal marsh pannes and enlargement of tidal channels due to the increased tidal prism.

Wave Energy. Wave energy can further exacerbate habitat conversions along shorelines by depleting mudflats and causing the progressive landward erosion of the marsh edge. Wave erosion (from natural waves, or human activities such as boating) can create wave-cut marsh "cliffs" or scarps in exposed areas. Marshes with robust, healthy vegetation communities are able to dissipate wave energy, and reduce the amount of erosive energy that reaches the shoreline. The vegetation also traps and stabilizes suspended sediment, and produces organic matter in the soil profile. However, marshes that are already stressed from submergence have less rigorous vegetation growth, and are less able to dissipate wave energy, trap suspended sediment, and produce organic peat. Rising sea levels will increase the amount of wave energy along the baylands, further reinforcing the likelihood of habitat conversion.

Landscape Evolution. It is optimistic to project that existing marsh areas around the Bay will not experience varying degrees of habitat conversion. The combination of rising sea levels, suspended sediment supply, peat production, local topography, and wave energy will likely result in the estuary-wide "downshifting" of bayland habitats. The degrees to which particular areas downshift will depend on local conditions and the degree of management that is or is not directed at the area. In a worst-case scenario, accelerated sea level rise at the upper end of projected rates could result in the widespread drowning of marshes. Rapid marsh vegetation dieback could lead to the development of extensive pans (ponds) on the marsh plain that will increasingly fragment marshes, expanding them into tidal flats. Rapid marsh edge and levee erosion and increased flooding of baylands would be likely components of this scenario.

Considering the present projected rates of sea level rise, the most likely outcome for the baylands will be a mix of the above-referenced scenarios until 2050-2070. This reflects the variation of marshes and governing physical processes around the Bay as well as likely temporal variations in sea level. Even in "gradual" sea level rise scenarios, the resulting rates and magnitudes of habitat conversions will not be uniformly gradual. There are significant episodic fluctuations in sea level during strong El Niño events of up to approximately 8 inches above average levels during intense storms. Thus habitat change and biological responses to habitat change caused by sea level rise may occur in pulses.

3 Ecosystem Services of San Francisco Bay Tidal Marshes

Major tidal marsh restoration projects have commenced in San Francisco Bay over the past twenty years. The goals of these *ad hoc* initiatives are to restore at least 100,000 of wetlands within the footprint of the Bay's original tidal marshes, thereby restoring the multiple benefits provided by Bay wetlands. Restoration projects were undertaken primarily to restore critical wildlife habitat, as well as to provide important recreational and flood risk management benefits. But as climate change science continues to advance, restoration managers have realized that rising sea levels threaten to overwhelm restoration efforts by drowning restored marshes. Managers and other stakeholders are therefore increasingly considering restoration strategies that could enable marshes to persist in the face of sea level rise.

At the same time that rising sea level threatens the viability of Bay tidal marshes, it also increased the threat of flooding low-lying developed areas along the shore. Tidal marshes are known to perform important flood risk management functions. They act as a buffer between the shoreline and deeper open waters. They reduce the wave height and velocity of water as it encounters friction from marsh vegetation and shallow bottom surfaces. Had San Francisco Bay's original 196,000-acre tidal marsh system been left intact, shoreline flooding would most certainly be less frequent and severe than it is today. It is possible to determine the amount of flood protection benefit that marshes provide by quantifying their wave attenuation attributes using standard engineering formulas. To address the flooding risks associated with sea level rise, shoreline land managers are evaluating the merits of a variety of shoreline flood risk management strategies.

In this section, we discuss the multiple services performed by San Francisco Bay tidal marshes and examine the features of healthy tidal marsh ecosystems.

3.1 The Complete Marsh

The economic benefits to society provided by marshes are directly dependent upon the maturity and morphology of the marshes in question. "Complete" marshes, or those that express the broadest possible range of marsh and associated estuarine and upland habitats, tend to provide higher ecological and economic benefits than marshes with a narrower range of habitats.

Within San Francisco Bay, complete marshes include the following habitat types:

Low, mid, and high marsh are inundated at depths, frequencies, and durations that are determined by marsh plain elevations, the movement of tides, and the distance of the plains from tidal channels. High marsh is typically defined as marsh within a foot of MHHW, low marsh the area within a foot of MTL, and mid-marsh the transition between the two (Figure 9). High marsh areas tend to be inundated less often, at lower depths, and for shorter periods of time than lower marshes. As such, the dominant vegetation communities in the marsh types are different: within San Francisco Bay, high marsh is typically dominated by pickleweed (*Sarcocornia* spp.) while low marsh is dominated by *Spartina foliosa* (mid-marsh typically contains varying gradients of both species). Due to tidal inundation dynamics, very small changes in topography can result in considerable changes in associated vegetation and wildlife use. Aquatic organisms such as fish will move with the tides back and forth between low and high marsh areas to maximize their ability to forage. Some terrestrial animals, such as salt marsh harvest mice, primarily stay in one zone (in the case of the mouse, high marsh) while others such as the California clapper rail will move back and forth between high and low marsh, depending on the tides.

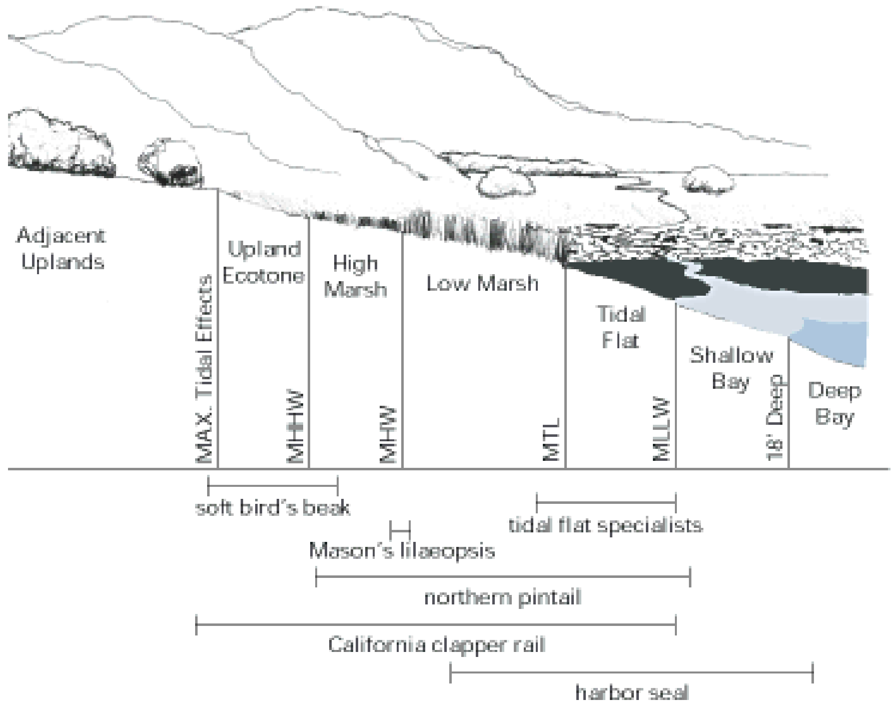


Figure 9. Different organisms utilize different portions of the intertidal zone, though many, such as the California clapper rail, move back and forth between zones. Graphic from the 1999 Baylands Ecosystem Habitat Goals Report.

Dendritic tidal channel networks are the complex systems that link the marsh plain with the open tidal waters of the Bay (Figure 10). These networks are generally only found in mature, ancient marshes such as Petaluma River Marsh and the marshes at China Camp State Park, as their long, branching morphology was formed by the gradual stabilization of local sea levels during the Holocene (Baye 2012). Tidal channels transport flood and ebb tides in and out of the marsh along with tidally-transported constituents such as suspended sediment and nutrients, and provide access for fish and wildlife. Along many tidal channels natural levees provide topographic heterogeneity and are often the preferred habitat of special-status plants such as Mason's lileaopsis. Marshes with more complex tidal channel networks, have more varied topography, higher levels of marsh biodiversity and are more resilient to disturbance (Baye 2012).

Figure 10. An aerial photograph of diked salt ponds in southern San Francisco Bay, displaying the complex, remnant, dendritic tidal channel networks that once flooded and drained the marshes.

Mudflats, which generally exist outboard of marshes between MTL and MLLW (between the marshes and subtidal open water, Figure 11), are the source of most of the suspended sediment that is available to accrete in tidal marshes and play an important role in attenuating waves. Winds and tidal action suspend sediment off of mudflats, which is then transported into marsh interiors via tidal channels. As mentioned earlier, regional decreases in suspended sediment have eroded local mudflats, limiting the volume of sediment that is available for re-suspension and accretion in tidal marshes. Mudflats also provide critical foraging habitat for the Bay's ample resident and migratory shorebird populations. Many shorebirds will move into tidal marshes and forage there (particularly in tidal pannes) when mudflats become inundated by rising tides.

Figure 11. Mudflats within the Palo Alto Baylands are bisected by a channel that is submerged at higher tides.

Ponds/pannes are open-water areas found in poorly drained areas of the mature high marsh plain or the wetland-upland edge, separate from tidal channels (Figure 12). Ponds are usually less than a foot deep, and flood only during extreme tide events. Pannes become hypersaline in late summer due to evapotranspiration. Because they generally lack emergent vegetation, some pannes support submerged aquatic vegetation such as wigeon grass, sago pondweed, and macroalgae, which in turn attract invertebrates such as insects. As a result, pannes are often important foraging areas for waterfowl and wading birds (Goals Report 1999) and are important structural features of mature tidal marshes.

Figure 12. Tidal pannes within salt marsh at the Emeryville Crescent, part of Eastshore Regional Park (pannes appear dark green)**.**

The **upland – estuarine transition** is generally considered to be the area between MHHW and the reach of the highest extreme tide events. This highly dynamic ecotone (transition between the wetland and upland habitats) is critical to tidal marsh biodiversity, as it is home to a broad range of special-status plant species and provides high-tide refugia for terrestrial marsh wildlife such as salt marsh harvest mouse and Suisun shrew. The upland-estuarine transition is a habitat type that has largely vanished from most of the San Francisco baylands due to infill development and the construction of berms and levees. Where tidal marshes would previously form broad ecotones adjacent to gently sloped uplands, most present day upland-estuarine transitional habitats are now compressed into narrow bands of habitat along levees that are less resilient to disturbance. As sea levels rise, tidal marsh will transgress over the upland-estuarine transition, forcing the ecotone itself to move upslope into whatever limited space is available.

Occasionally, in areas where creeks and seasonally drainages feed directly into tidal marsh, the alluvial fans formed by these drainages can form on top of tidal marsh. Tidal marsh can then transgress over these alluvial fans, forming complex, spatially variable "layer cakes" of tidal marsh and alluvial sediments. These systems often support regionally rare plant species that are adapted to these highly variable conditions. While such systems were once plentiful around San Francisco Bay, they now only exist in a few limited places, including China Camp State Park, Rush Ranch Open Space Preserve in Suisun Marsh (Figure 13), and Petaluma River Marsh.

Figure 13. The upland-estuarine transition near the Spring Branch Creek drainage at Rush Ranch in Suisun Marsh. Changes in vegetation communities make it easy to observe the highest extreme tide level.

The five habitats described above are the primary components of a "complete" tidal marsh. Due to geographic variation, not all "complete marshes" will have these features (for example, the tidal marshes of Brown's Island in the western Sacramento – San Joaquin Delta have no adjacent uplands), but in general they are positive indicators of ecosystem service and tidal marsh resiliency.

3.2 Characteristics of a "Complete Marsh"

The characteristics of the various habitat components of a marsh will to a large degree govern its health and ability to function as a "complete marsh". The California Rapid Assessment Method (CRAM) is a tool developed by researchers to facilitate the rapid assessment of marsh health (Collins 2008). The CRAM systems considers a broad range of biotic and abiotic factors, such as vegetation communities, geomorphology, location within a watershed, surrounding landscape use, and much more. Habitats with good scores are likely to provide high levels of ecological and hydrologic function, while those with low scores provide less. The CRAM system has been used as a part of a comprehensive survey of the condition of San Francisco tidal marshes by comparing the local marshes' CRAM score for physical structure to that for the relatively less impacted tidal marshes along the north coast of California (SFEP 2011).

A number of interesting findings from this study help define what makes a marsh "healthy", and provides guidance for the development of restoration objectives:

- **Marsh size.** Historically, tidal marshes in the estuary tended to be much larger than they are today. The existing proportion of small marshes (1-100 acres) has increased, and there are fewer very large (500-5,000 acre) marshes. The significance of this in consideration of historic and future environmental change is that large marshes tend to be more resilient to disturbance (such as sea level rise) than smaller marshes because they generally contain more heterogenic habitats as well as enough room for these habitats to move across the landscape (Collins 2011).

- **Landscape space.** Accommodating the full complement of marsh features and functions requires space – not just for the wetland itself, but critical adjacent habitats such as upland-wetland ecotones and subtidal areas. Mudflats , marshes, subtidal channels, and upland buffers all have characteristic dimensions set by physical processes which, coupled with ecological requirements such as individual species requirements, help define a minimum functional marsh patch size.

- **Marsh dynamics.** As noted in the previous chapter, the shoreline is dynamic, and will be increasingly so with accelerated sea level rise. Providing space and removing constraints to movement will become increasingly important. In particular, the upland-estuarine transition is critical to future marsh transgression, yet this habitat that has suffered some of the greatest losses throughout the estuary (Bayland Goals 1999).

- **Complexity and heterogeneity.** Many existing marshes around the Bay lack complexity in either their topography or channel network due to their young age. Many of the ancient marshes were diked and filled, leaving only a few examples in the Bay (e.g. China Camp, Petaluma River Marsh). With a few exceptions (e.g. Carl's Marsh along the Petaluma River), more recent tidal marsh restoration sites have not yet had time to develop natural complexity.

The more "complete" a marsh, the better its ability to provide a broad range of ecosystem and economic services. These services are discussed in greater detail below.

3.3 Ecosystem Services

The Bay's tidal wetlands have economic value because they provide services that increase the quality of life for humans and improve the productivity of businesses and communities. Figure 14 demonstrates the core conceptual framework for understanding these ecosystem services. The diagram shows that the ecosystem services stem from three factors: natural capital, ecosystem processes, and socioeconomic demands.

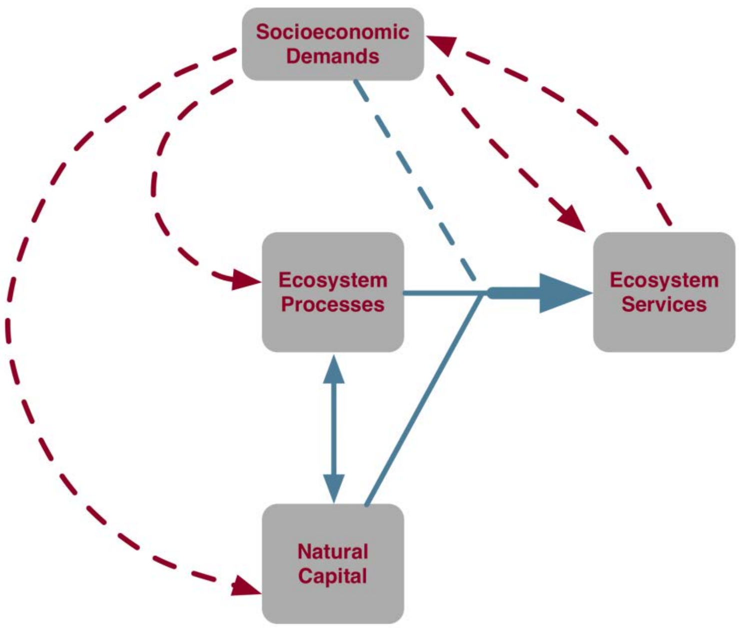


Figure 14. Conceptual Framework for Understanding Ecosystem Services (Source: ECONorthwest)

At the base of the framework lies *natural capital*. This term describes nature's basic building blocks, such as the water, vegetation, wildlife, and soils of the Bay's tidal wetlands. Some types of natural capital, such as an edible fish, may have value as stand-alone goods. Most units of natural capital, though, have value only through symbiotic relationships with other units that, through the complex workings of an ecosystem, provide goods and services of value to society.

These workings, called *ecosystem processes*, lie at the center of the framework. They "are the characteristic physical, chemical, and biological activities that influence the flows, storage, and transformation of materials and energy within and through ecosystems" (USEPA Science Advisory Board 2009, p. 12). The ecosystem processes of tidal wetlands include the cycling and chemical transformation, of nutrients and other substances, the movement and storage of water, and biological activities that convert the sun's energy and carbon dioxide into vegetation, build new soil by removing sediment from the water, absorb energy from tides and waves, and more. Natural capital and ecosystem processes are difficult to consider in isolation. Both are necessary to produce and maintain a viable wetland ecosystem capable of producing valuable ecosystem services.

The product from ecosystem processes and natural capital is considered an *ecosystem service* only if humans derive a benefit from it and have a demand for it. Thus, the top of the framework in Figure 14 displays socioeconomic demands. The interaction between natural capital and socioeconomic demands means that the economic importance of the ecosystem services derived from the Bay's tidal wetlands can vary both in response to changes in the ecosystem's ability to produce them, and also in response to changes in society's demands for them. Changes in productivity might occur as sea level rises and alters the depth of water covering the wetlands. Changes in demand might arise from changes in human preferences, as might occur, for example, when research and education enable humans to understand more clearly that the tidal wetlands can mediate the adverse effects of higher sea levels in the Bay.

3.4 Ecosystem Services Provided by the Bay's Wetlands

Wetlands provide a broad array of physical and ecological functions that benefit ecosystems, including the human component of the ecosystem (eftec 2005). Four of the most significant ecosystem services of wetlands are:

1. Flood risk management and erosion control,
2. Pollution control and improvement of water quality,
3. Carbon sequestration, and
4. Habitat for target wildlife species.

These services are discussed below.

3.4.1 Flood Risk Management and Erosion Control

Since tidal wetlands are typically located between the shore and infrastructure within the baylands (*e.g.* roads, railroads, and utility transmission lines), they often provide the first line of defense against waves and flooding. Wetlands attenuate the energy of incoming waves, reducing their height, erosive force, and ability to inflict damage on shoreline infrastructure. This attenuation reduces (1) the likelihood that shoreline protection may be overtopped during an extreme weather event and (2) the maintenance costs, due to damage by erosion, of shoreline protection structures. Additional information about how wetlands mitigate flood risk is discussed in Sections 5 and 6 below.

While wetlands can provide protection from short-term flooding and erosion events, they can also provide protection from the long-term flooding impacts of sea level rise. When allowed to persist as broad areas of low topographic relief adjacent to upland "buffer" areas, wetlands can provide accommodation space for rising sea levels by transgressing over formerly upland areas (areas that were formerly above the tidal frame). The adjacent wetland and upland areas can buy planners the time to move critical baylands infrastructure to higher ground, or to construct engineered shoreline protection such as levees or seawalls.

3.4.2 Pollution Control and Water Quality

Wetlands remove pollutants from water through a variety of physical, chemical, and biological processes. They function as the estuary's "kidneys" capable of efficiently removing a broad range of pollutants emitted from both point and non-point sources. Some pollutants adsorb to organic or mineral particles within wetland soils, or form particulates or salts that settle out of the water column. For example, heavy metals such as copper and lead can adsorb to complex wetland molecules such as humic acids, or can precipitate out of the water column as sulfide salts. Due to wetlands' unique redox chemistry (combination of reduced and oxidized soils), other pollutants can be converted into less harmful chemical forms. For example, the coupling of oxidized soils around a wetland plant's root zone with adjacent reduced soils can result in the conversion of nitrate (a common nutrient that acts as a pollutant above certain concentrations) to inert nitrogen gas.

The ultimate fates of pollutants in wetlands are dependent upon the pollutants, their biogeochemistry, and the disturbance regime in the wetland. Typically, pollutants that are removed through adsorption or sedimentation, such as some metals and complex molecules, are buried in accreting wetland sediments. If these sediments are disturbed, or if the wetland's chemistry is significantly changed (e.g. change in pH or redox regime), the pollutants can in some cases be re-introduced to the water column. Other pollutants can be taken up by wetland organisms and integrated into their biological structures.

3.4.3 Carbon Sequestration

Wetlands can sequester carbon through the production of both above-ground and below-ground biomass; however, it is the latter that sequesters carbon in the long-term. Most wetland plants have large subsurface structures called rhizomes that function to (1) transmit oxygen from the above-surface parts of the plant to its roots, (2) store energy, and (3) anchor the plant in saturated soils. In most wetland soils, the roots and rhizomes of living and dead wetland plants comprise a majority of the soil volume. As wetland plants die, the lack of oxygen in saturated soils (reduced conditions) prevents the decomposition of the roots and rhizomes, leading to the development of organic peat soils. These soils, and their associated sequestered carbon, can persist for thousands of years as long as they are maintained in a saturated, anoxic environment. In this way, wetland restoration is one of the most cost-effective and efficient ways to sequester excess atmospheric carbon.

The draining and diking of most of the Bay's tidal wetlands in the 19th and 20th centuries resulted in the drying and compaction of wetland soils in these areas. No longer saturated and anoxic, their organic peats oxidized, releasing massive quantities of CO_2 into the atmosphere and resulting in the subsidence of the diked, drained lands (in extreme cases, to below tidal elevations). Restoring these marshes will effectively reverse that process, though the buildup of peat soils and their concomitant sequestration of carbon will take much longer than their oxidation and loss.

3.4.4 Wildlife Habitat

Since mature, healthy tidal wetlands often include multiple different types of habitats (see Section 3), they can host an impressively broad range of plant and wildlife species. Approximately 500 species of fish and wildlife can be found in and around San Francisco Bay. Almost 300 of these species are resident and migratory birds. For the latter group, the Bay is one of the largest and most critical resting and foraging sites along the Pacific Flyway. Almost all shorebird species and a quarter of the waterfowl that utilize the Pacific Flyway spend some time in the Bay's wetland and associated mudflat habitats (Goals Project 1999). Scientists have estimated that over 75% of commercially important fish/invertebrate species, and 95% of recreationally important species, have a life stage that is dependent upon wetlands for survival and/or reproduction (Feierabend and Zelazny 1987). Within San Francisco Bay, dozens of fish species rear in tidal wetlands and associated habitats, including critical threatened and endangered species such as steelhead and Chinook salmon. The loss of tidal wetland habitats throughout the SF Estuary has resulted in significant impacts to populations of these species, particularly ones such as the California clapper rail and the salt marsh harvest mouse that spend most of their life cycle in tidal marshes. The Baylands Ecosystem Habitat Goals Report describes in depth how tidal wetland loss around the Bay impacted its many dependent communities and species (Goals Project 1999).

4 Economic Value of Services Performed by Bay Marshes

The economic value of the ecosystem services provided by the Bay's tidal wetlands is a measure of their contribution to the quality of life of humans or to the productivity of businesses and communities. Economists have long recognized the economic importance of wetlands and many studies conducted in California and elsewhere confirm that wetlands provide ecosystem services with the components of value described in this section (Woodward and Wui 2001; Boyer and Polasky 2004). Most of this research, however, has focused on freshwater wetlands. This section summarizes the few studies that have specifically examined saltwater wetlands, focusing on three types of wetland ecosystem services: (a) protection of shoreline properties from storms and flooding, (b) sequestration of carbon, and (c) other ecosystem services provided by tidal wetlands. The results from these studies provide the basis for the subsequent sections to estimate the potential value of protecting and restoring tidal wetlands in San Francisco Bay.

4.1 Components of the Total Value of Ecosystem Services

Figure 15 demonstrates how the total economic value of all the services derived from an ecosystem has several components. The left side of Figure 15 shows values associated with demands that involve human use of an ecosystem. Sometimes the use occurs directly, as when humans go into a wetland to watch or hunt waterfowl. Other times use of the ecosystem occurs indirectly, for example, when less damage is incurred because the existence of a tidal wetland attenuated wave overtopping waves during a storm. Use values often are indicated by market prices, such as the amount birders pay to view wildfowl, the reduction in the storm damage, or the increase in values for homes located near wetlands. However, it is important to note that there are imperfections in markets that can result in all benefits/costs not being reflected by market prices.

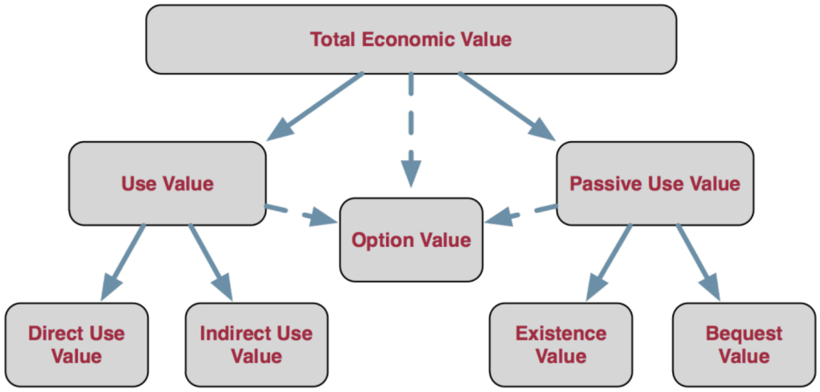


Figure 15. Components of the Total Economic Value of Ecosystem Services (**Source:** ECONorthwest)

The right side of Figure 15 represents nature's values that exist when there is a passive use of an ecosystem. Passive use value falls into two categories. Existence value, comes from people's desire for the continued existence of a species, landscape, or some other aspect of an ecosystem, or of the overall ecosystem as a whole. Bequest value, arises because people desire to ensure that the ecosystem will be available to be enjoyed by future generations. Typically, these passive use values are described in terms of an individual's willingness to pay for an object's current or future existence. For example, if an individual is willing to pay a given sum to prevent the elimination of a tidal wetland, then this amount represents the existence value they place on the wetland. People generally do not satisfy their passive use demands by buying something and, hence, one generally cannot point to a price as a reliable indicator of the value of the associated ecosystem service.

The middle of Figure 15 shows another component of the total value, called option value. An option value refers to the benefit of maintaining an opportunity to derive services from tidal wetlands in the future. It can originate from either side of Figure 15. Use-related option value might exist, for example, if owners of shoreline properties currently feel that the levee in front of their properties provides adequate protection against storm erosion, but they are willing to pay extra on their tax bills to ensure that tidal wetlands in front of the levee remain intact to provide additional protection in the future as sea levels rise.

4.2 The Value of Flood Risk Management and Erosion Control

A search of literature specific to San Francisco Bay did not find any research results estimating the value of storm-protection services provided by the Bay's tidal wetlands. The results of research elsewhere, however, confirms that tidal wetlands in similar settings provide valuable storm-protection services and provide an initial basis for estimating the value of these services in the Bay. Table 2 shows the results from three studies that estimated the value of the storm-protection services provided by tidal wetlands. One recent study examined the ecosystem services derived from the low marsh, salt flat, and high marsh zones of wetlands near Galveston Island, Texas (Feagin et al. 2010). The authors were able to quantify the annual value for five types of services: recreational opportunities associated with birding and hunting; sequestration of carbon; storm protection; habitat and other support for fisheries; and contribution to the value of nearby private property. Table 2 shows their findings suggest the value of storm-protection services, reported as the average value per acre per year, was about $5,700.

Table 2. Estimates from Past Studies of the Value of Storm-Protection Services Provided by Tidal Wetlands

Study	Value of Storm Protection Provided by Wetlands (2010 dollars)		
Feagin et al. (2010)	Different zones of wetlands near Galveston Island, Texas provide storm protection and reduce damage to shoreline private property:		
	Low Marsh	$5,000	per acre per year
	Salt Flat	$170	per acre per year
	High Marsh	$500	per acre per year
Möller (2001)	A salt marsh extending 250 feet in front of a sea wall in the U.K. would reduce the costs of constructing and maintaining the sea wall by about 90 percent, or $3,025 per foot.		
King and Lester (1995)	A salt marsh extending 250 feet in front of a sea wall in the U.K. would reduce construction and maintenance costs by $1,800-3,200 per foot or about $300,000–$500,000 per acre of salt marsh.		

Source: ECONorthwest, with data from indicated sources.

Research in the U.K. estimated the potential cost savings that could materialize when salt marsh, by absorbing the erosive energy of waves, lower the height and, hence, the cost of the sea wall required to protect inland property (Möller et al. 2001). The authors found that, if the cost of building and maintaining a sea wall without a salt marsh would cost about $3,400 per linear foot, then a salt marsh extending 80 meters in front of the sea wall would reduce the size of the sea wall required to achieve the same level of protection and decrease the cost of the sea wall by about 90 percent, or $3,000 per linear foot of sea wall.

A similar study found that, with no salt marsh, a sea wall 40 feet high would be required but, with a salt marsh extending 250 feet in front of it, a sea wall only 10 feet high would provide commensurate levels of protection, and the reduction in construction and maintenance costs for the sea wall would be about $300,000–$500,000 per acre of salt marsh (King and Lester 1995). Most of these savings could be realized with a narrower salt marsh. A marsh extending only 20 feet in front of a sea wall, for example, would yield about 50–75 percent of the savings attainable with an 250 foot salt marsh, and one extending 100 feet would provide about 80–90 percent of the savings. A global review of data found a similar relationship between the breadth of salt marshes and their effect on the height of waves reaching shore. The review found that the initial, narrow strip of salt marsh, next to the upland area, attenuates wave height the most, and the incremental effect on wave height diminishes with each additional increase in the breadth of the sea marsh (Barbier et al. 2008).

These research results provide an initial basis for estimating the value of storm-protection services provided by tidal wetlands in San Francisco Bay. They strongly suggest that tidal wetlands in front of a levee will likely reduce the size of the levee required to provide a given level of storm protection, and the cost savings represents the value of the wetland's services. These values quoted above provide a basis for making initial, rough estimates of the value of storm-protection services provided by tidal wetlands in San Francisco Bay which will be further investigated in section 7. Their utility is limited, however, because they reflect the specific characteristics—water and storm patterns, geologic configuration, shoreline property values, etc.—of the research sites in the U.K. Their applicability to a tidal wetland in San Francisco Bay must be determined on a case-specific basis and will depend on the extent to which it exhibits similar characteristics and any differences affect the value of storm-protection services in a predictable manner. If everything is similar to the underlying characteristics of the U.K. research, for example, then it a site-specific assessment might indicate it is reasonable to assume that a wetland in San Francisco Bay would reduce the costs of a levee or sea wall by a percentage similar to what was found in the U.K.

4.3 The Value of Carbon Sequestration Services

When tidal wetlands sequester carbon by removing carbon dioxide from the atmosphere, they lower these future damages, and this reduction represents the value of the carbon-sequestration services. The value of carbon-sequestration services depends on two factors: the number of tons of carbon sequestered and the value per ton. The amount of carbon sequestered by tidal wetlands will be site-specific, however review of studies from around the world suggests that, as a first approximation, tidal wetlands sequester about 0.9 tons of carbon per acre per year (Chmura and Anisfeld 2003). Many studies have attempted to estimate the value of sequestered carbon. This analysis uses the results from a recent study by several federal agencies, which estimated that reducing emissions of carbon dioxide reduces costs associated with the impacts on climate change by about \$5–\$67, in 2010 dollars, per ton of carbon dioxide (WGSCC 2010). This range is equivalent to about \$20–\$250 per ton of carbon stored. Combined, these results indicate that tidal wetlands can sequester carbon with a value of about \$20–\$220 per acre per year.

Another estimate of the value of carbon sequestered by tidal wetlands comes from a study of a coastal area of about 9,500 acres near Galveston Island, Texas (Feagin et al. 2010 and Table 3). The authors estimated that low marsh would sequester about 27 tons of carbon per acre per year, and high marsh would sequester about 25 tons of carbon per acre per year, but algal salt flat would experience a loss of about 0.2 tons of carbon per acre per year. The larger numbers are about ten times the global average sequestration rate found by Chmura and Anisfeld (2003), but the rate for salt flat shows a loss rather than a gain. Feagin et al (2010) used \$21 per ton of carbon, in 2010 dollars, which is about the same as the lower bound of the range estimated by the WGSCC (2010). Their analysis produced the values shown in the middle column of Table 3. The right-hand column shows what the values would have been if the authors had used \$250 per ton of carbon, the upper bound of the range of estimates for the value of sequestered carbon from the U.S. Interagency Working Group on Social Cost of Carbon (2010).

Table 3. Estimated Value of Carbon-Sequestration Services Provided by Tidal Wetlands near Galveston Island, Texas (2010 dollars)

	Value of Carbon Sequestered per Acre per Year	
Wetland Zone	**@$20 per Ton of Carbon[a]**	**@$250 per Ton of Carbon[b]**
Low Marsh	$540	$6,800
Salt Flat	-$4	-$50
High Marsh	$500	$6,200

Source: ECONorthwest, with data from Feagin et al. (2010).

[a] Value per ton of carbon used by Feagin et al. (2010); also the lower end of the range of values estimated by the WGSCC (2010).
[b] Value per ton of carbon represents the upper end of the range of values estimated by the WGSCC (2010).

These research results provide a basis for making initial, rough estimates of the value of the carbon-sequestration services provided by tidal wetlands in San Francisco Bay. The data from Chmura and Anisfield (2003) support an initial estimate: $20 –$220 per acre of tidal wetland. Higher values per acre may be warranted if site-specific examination shows that a tidal wetland in the Bay sequesters more rapidly than the rate, 0.9 tons of carbon per acre per year, reported by Chmura and Anisfield (2003).

4.4 The Aggregate Value of Multiple Ecosystem Services

Some researchers have estimated the value of bundles of ecosystem services provided by tidal wetlands. Feagin, et al. (2010) provides estimates of the overall value of multiple ecosystem services provided by tidal wetlands near Galveston Island. Table 4 summarizes the findings for six categories of ecosystem services: storm protection, carbon sequestration, recreational opportunities for birding and hunting, support for fisheries, and amenities that increase the value of nearby private property. The authors report their findings as the average annual value of the services provided by the three wetland zones described above: low marsh, salt flat, and high marsh. The low estimates shown in Table 4 reflect the base-case scenario examined by the authors and incorporate assumptions that the value of sequestered carbon is $21 per ton and the value of nearby private properties affected by wetland amenities grows 3 percent per year. The high estimates assume that the value of properties increases 6 percent per year, and the value of sequestered carbon is $250 per ton.

Table 4. The Overall Quantifiable Value of Six Ecosystem Services Provided by Tidal Wetlands near Galveston Island, Texas (2010 dollars)

	Value per Acre per Year, 2010 Dollars	
Wetland Zone	**Low Estimate**	**High Estimate**
Low Marsh	$9,000	$14,000
Salt Flat	$2,000	$5,000
High Marsh	$3,000	$10,000

Source: ECONorthwest, with data from Feagin et al. (2010).

The low marsh zone provides services with the greatest value, with its support for fisheries, storm protection, and carbon sequestration accounting for most of the difference. Recreational opportunities for birding and hunting are valuable services provided by the salt flat and high marsh zones, with the latter also providing storm protection and carbon sequestration services with considerable value.

Feagin, et al. (2010) also examined the potential impact of anticipated rises in sea level on the overall value of the ecosystem services provided by the wetlands. They considered several scenarios, involving low, medium, and high levels of sea-level rise; with and without sea walls that prevent migration of the wetlands inland as the sea level rises; and with different rates of increase in the value of private property. They found that the total, quantifiable value of the six categories of ecosystem services derived from the three zones likely would exhibit these patterns:

- Low marsh: the value likely would rise is marsh accretion or transgression could keep pace with sea level rise, but fall if the marsh began to drown.
- Salt flat: the value likely would increase in all scenarios.
- High marsh: the value likely would increase except with rapid sea level rise and the presence of barriers such as levees that prevent the wetland from migrating landward.

Other research has estimated the value of multiple ecosystem services provided by salt marshes using the replacement-cost method, i.e., by determining the cost of replacing them once they have been destroyed or seriously degraded. This method relies on an assumption that the services provided by a tidal wetland are worth at least what it would cost to replace the wetland if it were destroyed or severely degraded. A summary of the research (Spurgeon 1998) reports that restoration efforts on the East Coast and in Louisiana have experienced replacement costs of $54,000 – $87,000 per acre. Experiments in the U.K., which involve creating new salt marsh by opening agricultural land behind a sea wall to flooding by the sea incurred much lower replacement costs of about $1,000 – $26,000 per acre.

These research results provide a basis for making initial, rough estimates of the value of multiple services provided by tidal wetlands in San Francisco Bay. This range of values stems from the specific characteristics of the study site, however, and the set of services considered by the researchers. Its applicability to a tidal wetland in the Bay depends on the extent to which it exhibits similar characteristics and any differences affect the value of storm-protection services in a predictable manner. Further investigation is required to determine the applicability to specific sites in the Bay or to develop an estimate of value tailored to the site's characteristics.

4.5 Applying the Estimates of Value to Tidal Wetlands in San Francisco Bay

Though the results from the studies described above are not specific to San Francisco Bay, they include some of the best available data describing the economic values of tidal wetlands. As such, they provide valuable context that demonstrates the likely significant values of the ecosystem services provided by tidal wetlands in the Bay. Households, businesses, and communities realize considerable benefits by the presence of even limited tidal wetland habitats throughout the estuary; these benefits can only increase with the continued implementation of tidal wetland restoration projects.

Some of the most immediately tangible benefits to developed shoreline areas from tidal wetlands are the role these habitats play in flood risk management. Tidal wetlands can provide flood risk management services more economically than more typical infrastructure such as levees or sea walls. These services are described more in Section 5 below.

5 Flood Risk Management

The ability of tidal marshes to reduce flood risk by attenuating wave action, mitigating shoreline erosion, and conveying flood flows is one of the more tangible illustrations of the value of their ecosystem services. These services are relatively straightforward to quantify, and their benefits are becoming well understood and can be translated into economic terms.

5.1 Managing Risk

The risk of damage to San Francisco Bay shoreline infrastructure is likely to increase over the next century due to both climate change (and attendant rising sea levels) and continued development within the shoreline's floodplains. Though this risk cannot be entirely eliminated, it can be managed so that it is reduced to acceptable levels. The definition of "acceptable risk" is dependent upon a wide range of factors – societal, economic, technological – which also leads to questions about who pays for, and who benefits from, risk management. There are different ways of achieving the same level of risk that reflect our society's priorities and attitudes about the environment.

Risk can be defined a number of ways. One common definition of risk is as product of likelihood and consequence. Likelihood is the probability of failure of the *flood risk management* (FRM) scheme to prevent flooding. It is often expressed as a frequency of flooding (= events/year). The consequence of the resultant flooding varies depending not only on the nature of the flood (depth, duration, timing, etc.), but also on the location where flooding occurs (population, property, etc). Consequence itself is the product of potential damages (the value of the asset) and its vulnerability to damage. Consequence can be expressed as the amount of damage caused by the flood (= $/event). In this way risk can be expressed as the amount of damage per year (=$/year):

Risk = Likelihood x Consequence

So how can an acceptable level of risk be achieved? Table 5 and Figure 16 demonstrates how it is possible to achieve the same level of risk with different likelihoods and consequences, which can affect the choice of a risk management strategy. If the likelihood is high and the consequence low, then risk would be better addressed by reducing likelihood (and vice versa).

Table 5. The relationships between likelihood, consequence, and risk.

Risk	Likelihood	Consequence
Moderate	Moderate	Moderate
Moderate	High	Low
Moderate	Low	High

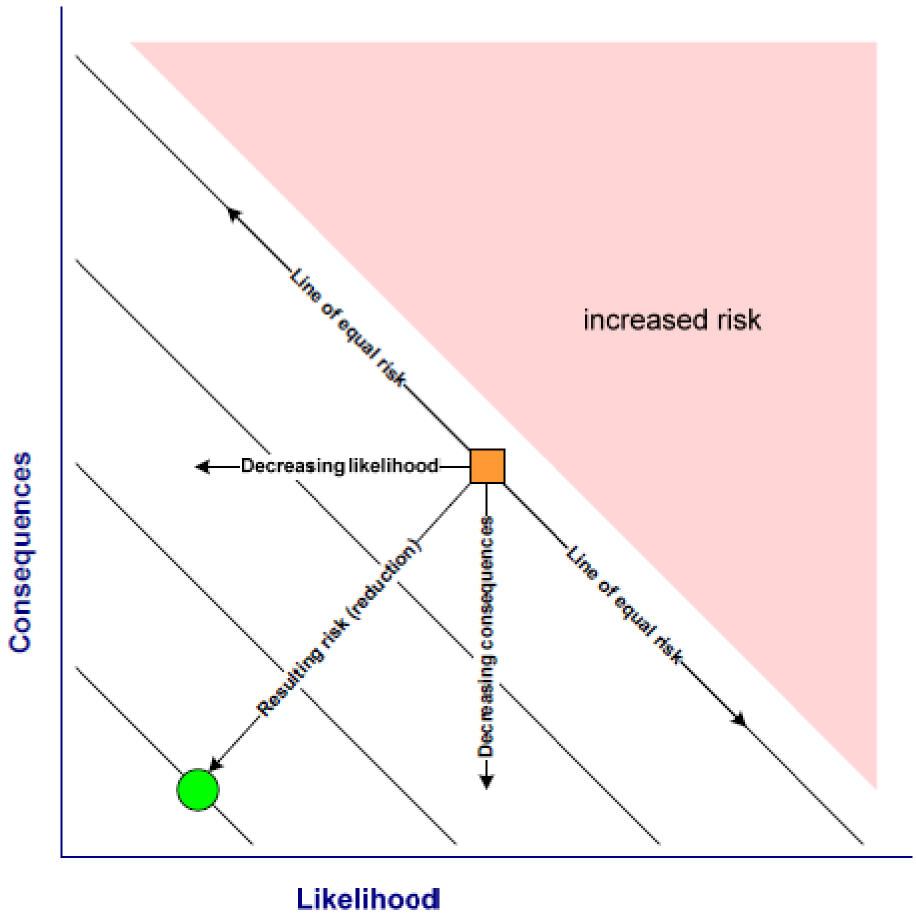


Figure 16. Graphical representation of the relationships between likelihood, consequence, and risk. From SafeCoast (2008)

Within San Francisco Bay, the likelihood and consequences of flooding are likely to change over time even without changes in flood risk management practices. Each asset (such as a road, pipeline, or transmission line) is likely to have its own risk trajectory as both environmental stressors and the nature of the asset change over time. An obvious change in environmental stressors would be the projected higher sea levels and more intense wave action resulting from climate change. The likelihood of flooding will increase as the extreme water surface elevations occur more frequently above the design elevation of levees, seawalls, and other shoreline protection. The consequences of flooding will increase as the depths and extents of inundation increase. Economic development will also change the potential consequences of flooding by changing the value of assets in the flood hazard zone.

We can influence the risk trajectory by choosing an appropriate risk management strategy as illustrated in Figure 17:

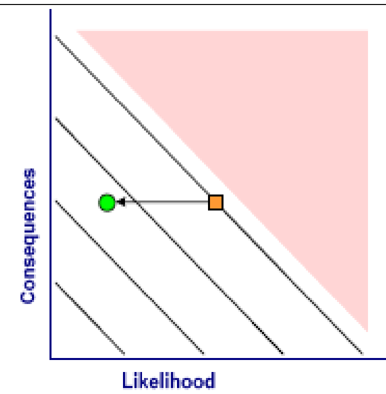
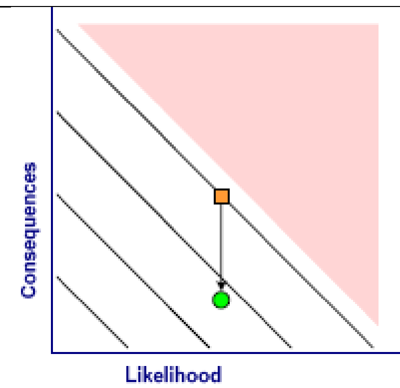
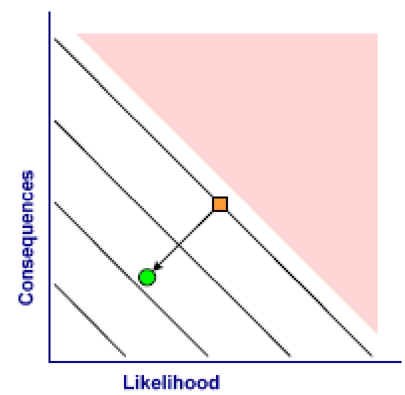
For instance, if a levee is raised, then the likelihood of a flood event occurring is reduced. This may be a temporary respite from risk, though, as the likelihood of flooding may increase with sea level.	
The consequence of flooding may be decreased. If it is assumed the asset retains the same value over time (and hence the same potential for damage), then measures such as insurance, flood proofing, and raising the elevation of the asset may reduce the actual damage.	
The likelihood and consequences of flooding may be reduced simultaneously if the asset is moved out of the flood hazard zone. Moving the asset upslope, away from the Bay, would decrease the frequency of flooding and reduce the depth of flood inundation at the same time.	

Figure 17. Risk trajectories for shoreline flood management.

The choices faced by society in considering various approaches to risk management can be illustrated by comparing the Dutch and American approaches to FRM. In the case of the Dutch, their emphasis has been on reducing the likelihood of flooding to a very low probability. Legal safety standards are set by the Dutch for each levee, with standards ranging from 1:2,000 to 1:10,000 years. This level of protection is achieved through a significant investment in levees estimated to cost 0.2% of annual GDP per year, or $1.7B per year into the next century. The resulting low likelihood of flooding is partnered with the potential for severe consequences if flooding should occur, as 20% and over 50% of Dutch land is below mean sea level or less than three feet above mean sea level, respectively. This flat, low-lying land is home to 60% of the population, which produces approximately 70% of the Dutch GDP ($542B) every year (Tomkiewicz 2013).

The San Francisco Bay Area has a more heterogeneous topography, with considerable developed areas outside the flood hazard zone. Heberger et al. (2012) suggest that about 13% of the population and 13% of GDP ($62B) is at risk of flooding, and estimates the costs of raising and constructing new levees to maintain the present level of protection to be a total of $5.7B. Over 20 years, that averages to an annual cost of about $0.1M per year.

It is instructive to consider the costs of defending GDP and people in terms of unit costs. Table 6 below demonstrates that for every dollar spent each year in the Netherlands, $319 of GDP is protected. In the Bay Area, $235 of GDP would be protected for the same cost. In terms of protecting people, it costs $170 to protect one person in the Netherlands each year while in the Bay Area the cost closer to $900 per year. There are several reasons for these differences:

- The length of defense relative to the population is shorter in the Netherlands. The Bay Area hazard zone is a relatively narrow band around the Bay.

- The density of people in the hazard zone is higher in the Netherlands than in the Bay Area. Conversely, relatively more GDP is generated in the Bay Area hazard zone, perhaps reflecting the local preference of locating industrial and office space close to the Bay, particularly in the South and East Bays.

Table 6. The consequences and costs of flood risk management in the Netherlands and the Bay Area.

	Netherlands	**Bay Area**
GDP	$774B	S479B
GDP at Risk	$542B 70%	$62B 13%
Population	16.7M	7.2M
Population at Risk	10.0M 60%	0.3M 3.8%
Cost to defend per yr	$1.7B/yr 0.2%	$0.3B 0.06%
GDP defended per $1 per yr	$319	$235
$ to defend one person per year	$170	$976

Source: Dutch figures from Vellinga et al/Katsman et al, for the Netherlands Delta Committee (2008); Bay Area figures from (Heberger et al 2012)

Different national approaches to flood risk management have been examined in a European study and are summarized in Table 7 (Safecoast 2008). The Dutch, being risk adverse, focus on measures such as primary levee defenses to increase flood protection, thereby lowering the frequency of inundation. The

English, on the other hand , focus more on limiting the potential consequences of flooding by emphasizing measurers such as restricting new development in flood prone areas, providing warning and evacuation plans, and relying on flood insurance. The English also emphasize managed realignment to create a shorter, more defensible shoreline, and create habitat (salt marsh) in front of levees to attenuate waves.

Table 7. Approaches to flood risk management in the Bay Area, England, and the Netherlands.

Approach	Measures	Netherlands	England	Bay Area
Flood risk management	FRM Levees	●●●●	●●●	●●●
	Managed Realignment		●●●	●●
Limiting potential consequences of floods	Restricting new development in flood-prone areas	●	●●●	●●
	Construction of flood resistant buildings	●	●	●●●
	Storm surge warning	●●●	●●●	●●●
	Risk/crisis communication	●●	●●●	●●●
	Evacuation Planning	●●	●●●	●●
	Flood Insurance		●●●●	●●●●

● Limited importance, ●● Some Importance, ●●● Quite important, ●●●● Very important

Table 7 is based on a table in Safecoast (2008) with the addition of a column for the Bay Area. Like the Dutch and the English systems, Bay Area levees are used extensively to reduce the frequency of flooding; however, Bay Area managers also emphasize reducing the consequences of flooding.

The Dutch have chosen one route which will minimize the likelihood of flooding forced on them by the low-lying land they occupy and the severe consequences of not providing this level of protection. Because of their use of a large network of massive levees they have accelerated the erosion of remaining natural marshes. They have only recently begun to employ tidal marsh restoration as an element of their shoreline defense strategy.

San Francisco Bay enjoys a more favorable prognosis given its geography. San Francisco Bay is a relatively shallow, enclosed body of water that experience less ferocious storms than does Holland.

Further, there is upland away from the Bay – the whole area is not below sea level unlike Holland. We have the experience of managing a dynamic shoreline and we can point to successful tidal marsh restoration projects that continue to build in elevation and which are supporting expansion of vegetated marsh. There are significant opportunities for integrating wetlands into the management of the Bay shore through using the flood risk management benefits of tidal wetlands described below.

5.2 Flood Risk Management Benefits of Marshes

Most flood protection benefits of tidal wetlands can be placed into one of three categories: (1) wave attenuation, (2) mitigation of shoreline erosion, or (3) maintaining flood flow conveyance. These benefits are described below.

5.2.1 Wave Attenuation

Waves – whether generated by local winds or entering the Bay as oceanic swell – deliver significant energy to the shoreline which can lead to overtopping and erosion. Wave overtopping of levees can result in the rapid inundation of low-lying areas (particularly if levees or other water control structures are breached), resulting in local flooding and impacting public safety and wildlife communities.

Wave impacts are a function of multiple factors: the height, frequency, and duration of wave events, water levels, and the composition of the substrate upon which the waves are acting. Long periods of consistent, moderate wave action can do as much damage as short periods of large waves. The height of a wave approaching a shoreline is controlled by many factors, but primary among them are (1) the distance the wave has traveled (fetch), (2) the depth of water, and (3) the speed of the wind. The longer the fetch and the deeper the body of water, the higher the wave can grow. As waves approach a shoreline, they respond to local bathymetry.

When waves approach the shore, their energy is reduced, or attenuated, by the friction generated between the moving water and the underlying mudflat or vegetated wetland, resulting in a decrease in both the height of the wave and the speed at which it can travel. The farther the wave has to travel across a mudflat or wetland, the more its energy will be attenuated (Figure 18). The higher the water level above the marsh, the less waves are attenuated – so extreme events are attenuated less than typical spring tides. The amount of wave attenuation is governed by the water depth, bed roughness, marsh edge characteristics, and vegetation characteristics (height, density, shape of leaves). Salt marshes in particular are very efficient at reducing wave energy, achieving up to 70-80% reductions in wave height over 300 feet compared to 20-30% over mudflats of similar widths (Cooper 2005). Möller and Spencer (2002) measured 44% reductions in observed wave heights over narrow strips of salt marsh 30 feet wide.

Recent work in Corte Madera Bay (BCDC 2013) demonstrates a more complicated picture of wave attenuation over marshes. The relation of depth and wave height tends to limit wave elevations to a narrow height band at the back of the marsh. For a given water depth, high waves will break at the marsh edge such that the maximum wave height is 70% of the water depth and waves are further attenuated as they propagate over the marsh..

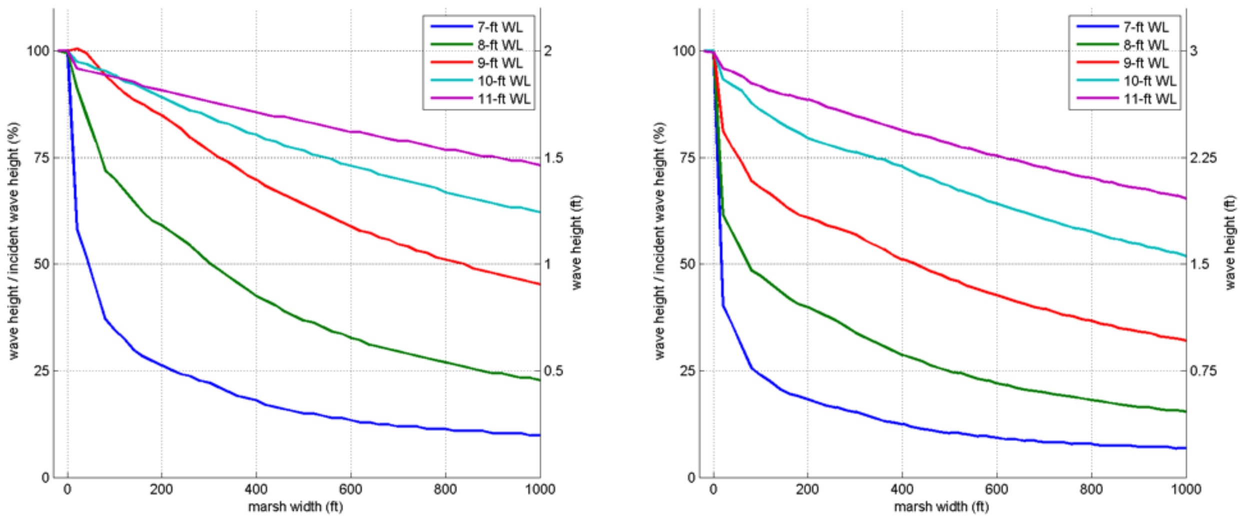


Figure 18. Predicted wave heights relative to incident wave height as a function of marsh width, from the WHAFIS model (see section 7).The incident wave height equals (a) 2 feet and (b) 3ft (BCDC 2013).

5.2.2 Mitigation of Shoreline Erosion

Waves can also damage coastal infrastructure such as roads, buildings, pipelines, and transmission lines by directly impacting infrastructure, or eroding the shoreline upon which the infrastructure is located.

If water depths leading up to the shoreline do not gradually decrease, as in the case of a levee or seawall (or vertical salt marsh scarp), the wave instead breaks suddenly when it meets the shoreline. This sudden deceleration results in most of the wave energy acting upon the local area instead of attenuating gradually over a longer distance. Breaking can damage the structure or erode the substrate, and increases the potential for structural failure and flooding. Maintaining tidal marsh outboard of levees and other engineered shoreline structures is therefore one of the most effective ways to reduce the likelihood of tidal flooding and decrease the maintenance costs for shoreline flood protection structures.

5.2.3 Maintaining Flood Flow Conveyance

Maintaining flood flow conveyance in tidal channels that drain urban areas is an important function of wetlands. Tidal channels in the Bay are prone to sedimentation due to the reduction of tidal prism following diking. Confinement by levees also reduces the bank full capacity of the channel. Wetlands adjacent to the tidal channels can increase the capacity of the channel in two ways. First, wetlands increase the tidal prism of the channel, which increases channel velocities and scours out accumulated sediments. The larger tidal prism creates and maintains a larger channel with increased conveyance.

Secondly, adjacent wetlands allow flood waters to escape from the channel into the wetlands, improving overall conveyance to the Bay and taking advantage of storage within the wetlands. Both tidal scour and flow diversion potential are maximized by placing the wetlands as far upstream as possible within the tidal zone.

6 Tidal Wetland Restoration and Flood Risk Management Scenarios

Given the multiple benefits that tidal wetlands provide to shoreline communities, particularly as part of an integrated flood risk management approach, how can they be utilized around San Francisco Bay to reduce shoreline protection costs? This chapter considers that question by using the example of the Hayward Shoreline, a typical developed Bay shore, to illustrate how tidal wetland restoration can provide flood risk management benefits. This analysis considers three potential approaches to integrated wetland restoration and flood risk management: (1) Holding the Line, (2) Marsh Restoration, and (3) Marsh and Upland Ecotone Slope Restoration. These have been developed from original ideas of ecologist Peter Baye, further developed with Jason Warner of Oro Loma Sanitary District and Mike Connor of East Bay Dischargers Authority and in a study for Hayward Area Shoreline Planning Agency (HASPA 2010).

6.1 The Hayward Shoreline

The Hayward Shoreline stretches along the East side of San Francisco Bay from San Leandro Creek in the north to the San Mateo Bridge (Figure 20). The shoreline is primarily comprised of levees surrounding diked baylands, many of which have been developed or otherwise heavily altered by historic or existing uses. The shoreline is typical of many shorelines along the East, South, and Central Bay, as its matrix of residential development, industrial/commercial development, and open space is criss-crossed with a variety of regionally critical infrastructure, including water treatment facilities, storm drainage channels, pipelines, high-voltage electrical transmission lines, railroads, and freeways.

The shoreline includes considerable frontage for the East Bay Regional Park District’s (EBRPD) Hayward Regional Shoreline and Coyote Hills Regional Park as well as property owned by the Hayward Area Recreation and Park District (HARD). Many of the open space areas are managed as fully tidal or managed tidal systems that provide a combination of wildlife habitat, flood flow storage, recreation, and wastewater treatment services. The Hayward shoreline is already vulnerable to inundation from coastal flooding – a combination of tides, storm surges, wave run-up and storm water runoff. With higher sea levels, storm surge conditions may combine to create short-term extremely high water levels that can inflict damage to areas that were not previously at risk. Figure 20 displays the potential area of inundation by 2050 and 2100. Within this area there are a large number of parcels owned by public and private entities which serve a number of different functions.

In addition to the residential and commercial properties that are threatened by potential inundation, the Hayward shoreline has important infrastructure close to the Bay shore. For example, the Oro Loma Wastewater Treatment Plant is vulnerable to both coastal and fluvial flooding as well as rising groundwater. Other vulnerable infrastructure includes the East Bay Dischargers Authority pipeline, Pacific Gas & Electric transmission lines, railroads, high pressure gas lines and fiber optic cables. All cross the area and will have to be considered in adaptation strategies. Landfills at the center of the shoreline will have to be protected from wave erosion and water infiltration that could compromise containment. Sea level rise could potentially impact groundwater plumes associated with former landfills.

The area's storm drainage channels are potential sources of fluvial flooding and are likely to be impacted by backwater effects due to rising sea levels. Storm drain systems, designed to flow by gravity, the tide gates on channels, and storm water pump stations will have to accommodate higher sea levels. Groundwater levels are affected by tidal fluctuations and sea level. Stormwater treatment measures which rely on infiltration may therefore be affected by higher groundwater elevations. Higher groundwater elevations may impact existing buildings and infrastructure such as cables, pipes and sewers.

Figure 19. The Hayward Shoreline is owned and operated by a broad range of public agencies, including the East Bay Regional Parks District (EBRPD), Hayward Area Recreation and Park District (HARD), Alameda County Flood Control and Water Conservation District (ACFCWCD), CalTrans, and the Department of Fish and Game (DFG). Source: City of Hayward.

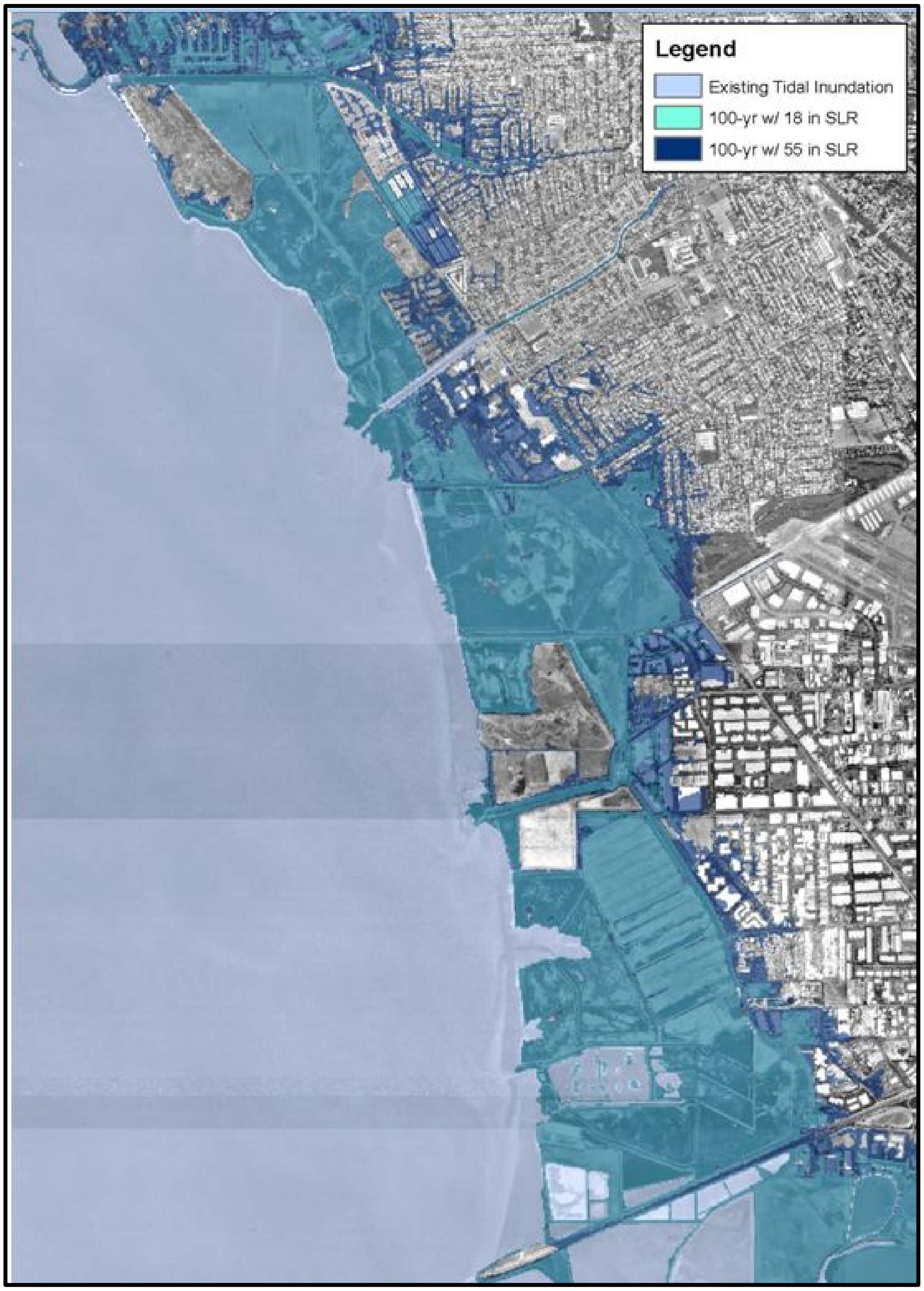


Figure 20. Vulnerability of the Hayward Shoreline to flooding from 16 inches (light blue) and 55 inches (dark blue) of sea level rise by 2050 and 2100, respectively. Modified from BCDC (2009).

6.2 Scenario 1: Holding the Line

This scenario is known as "holding the line" because it involves no realignment of existing levees or restoration of marsh outboard of the levees. Without wetland restoration, the combination of bayward levee erosion, accelerated sea level rise, and reduced local suspended sediment concentrations would continue to convert mid/high marsh habitats within the Hayward marshes to low marsh or even mudflat. Erosion of the outboard levee and conversion of mid/high marsh to low marsh will increase the likelihood that wave energy will impact the landward (eastern) levees, which will increase the need for levee maintenance. The crest elevation of the levees will have to be raised to keep pace with rising sea levels and increasing wave run-up elevations. As sea level rises and water depths at the toe of the structure increase so wave heights on the structure will increase. To maintain the stability of the levee with higher wave forces will require the use of larger armor rock. The larger waves combined with reflection of wave energy from the armored levee will result in erosion and lowering of the mudflat in front of the levee (Figure 21). Holding the line therefore results in an increasingly steep slope (up to 1:3) on the shoreline – the crest increases in height, the toe lowers, the armor increases and the levee stays in the same location. The increased wave energy is dissipated over a shorter distance, increasing the erosion of adjacent marsh/mudflats and increasing the forces on the levee. Existing mid/high salt marsh communities bayward of the levees will be increasingly squeezed against the steep slope. Tidal wetlands at locations such as Oro Loma and Cogswell Marshes will likely shrink and lose native species diversity as lower marsh zones expand and upper marsh zones contract.

Invasive plant species populations (such as brome and fennel) are likely to expand where levees are maintained more frequently or armored, potentially intensifying conflicts among trail users, levee maintenance, and marsh resource protection. With an increased likelihood of levee damage, subsided diked baylands landward of the Hayward marshes could experience more frequent overtopping, breaching, and/or failure (conversion to open water).

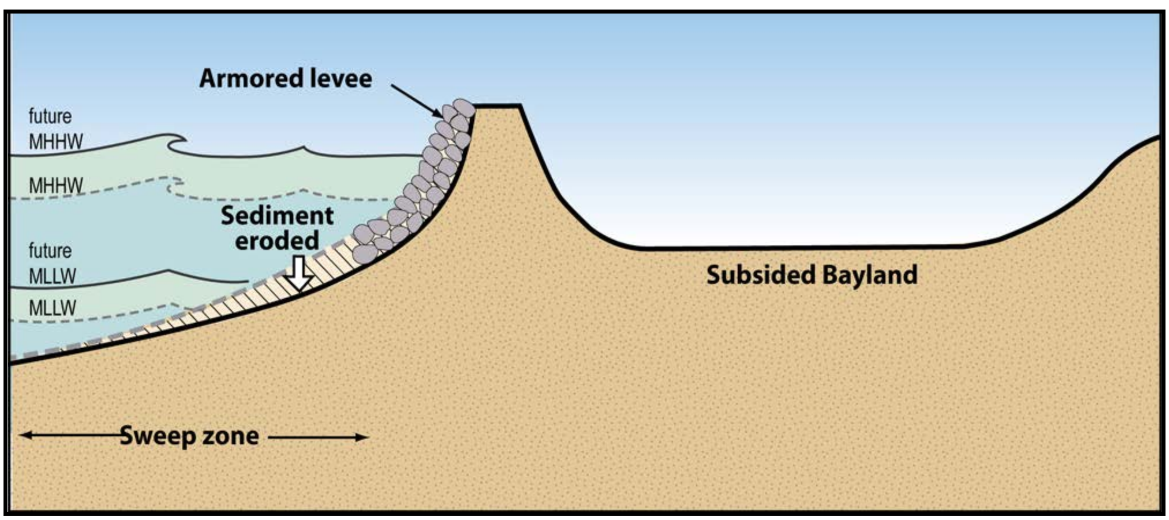


Figure 21. "Holding the line" results in the gradual erosion of the shoreline.

Management Strategy

Under this scenario, local stakeholders would have to agree on an alignment for "holding the line" that would (1) facilitate continued inundation of areas that are already intertidal and (2) protect areas behind levees that are not slated for long-term tidal restoration (e.g. landfill areas, and areas with critical infrastructure such as wastewater treatment facilities). A potential alignment is displayed in Figure 22. The development of a single alignment would help to avoid spending money to improve levees that would not be necessary in the long-term, so available funds are focused on protecting the highest-priority areas. Levees would have to be raised to provide adequate (at the very least, equal to existing) protection against the tidal flooding of developed baylands and infrastructure east of the levee. The required increase in levee crest elevations to maintain existing protection would be on the order of sea level rise, plus subsidence resulting from added fill. The stable rock size to prevent erosion would increase with the depth of water at the toe of the structure.

Figure 22. A potential alignment for "holding the line." (HASPA 2010)

Levees that might be lower priorities for raising include the existing bayfront levees along Oro Loma and Cogswell Marshes. These levees do not currently provide flood protection, but primarily serve to support the Bay Trail and dissipate wave energy that would otherwise threaten actual flood risk management levees that are farther landward. In the long-term, improving the bayward levees may not be cost-effective, as rising sea levels (and subsequent marsh drowning) would eventually result in the levees becoming "peninsulas" that would be surrounded on all sides by open water, leaving them vulnerable to damage from wind-wave erosion and subject to increased long-term maintenance costs. Therefore, it might be more cost-effective in the long-term to abandon these levees, and focus levee improvement efforts on an alignment that would strictly protect critical baylands infrastructure and areas such as landfills that cannot be tidally inundated.

6.3 Scenario 2: Levee and Wetland

An alternative to "Hold the Line" is to move the levee to a new location further inland, east of the alignment proposed in Scenario 1 above (Figure 23.). This allows existing marshes and mudflats to transgress landward naturally. This also requires relocating existing infrastructure out of the hazard zone while restricting new construction in vulnerable areas. Realignment takes advantage of the natural protection provided by marshes and mudflats to reduce the risk of flooding and erosion allowing smaller levees to be built. The restored tidal marshes will reduce wave heights, and reduce the height to which levees must be raised to provide adequate flood management.

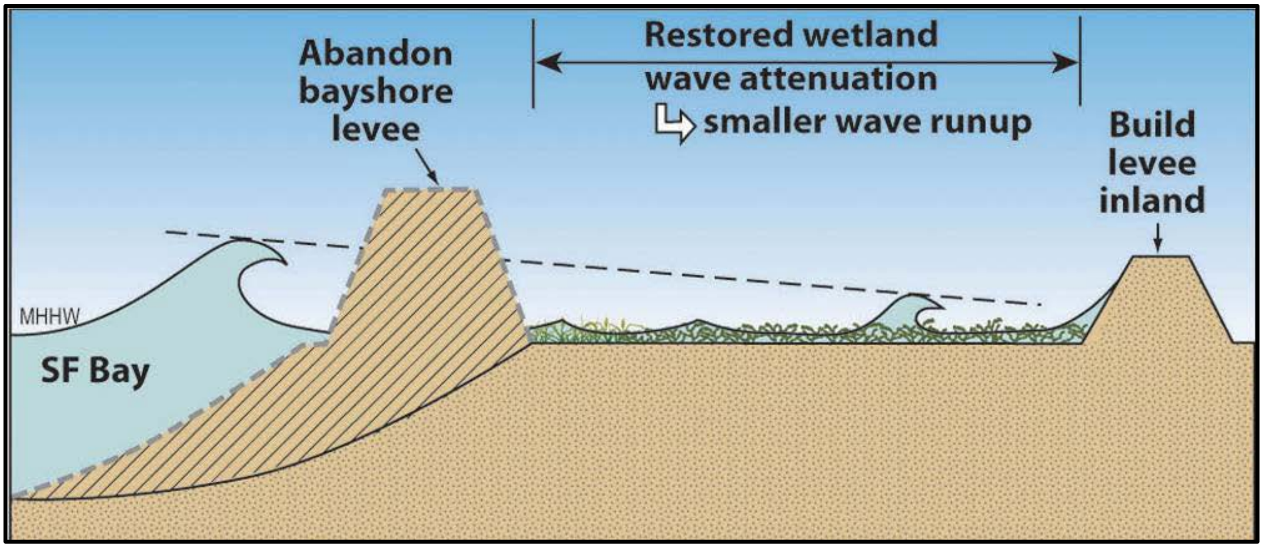


Figure 23. Wave attenuation over restored tidal wetlands limits how high realigned levees have to be in order to provide equivalent flood protection to larger, bayshore levees.

Management Strategy

On the Hayward shoreline, the levee line could be realigned to the landward edge of Oro Loma, Cogswell and Hayward marshes (Figure 24) allowing these marshes to transgress landward naturally. The existing bayshore levee would be maintained in front of the landfills and wastewater treatment plants. The realigned level could also be located east of the landfill, but the existing bayfront levee would have to be managed or reinforced in such a way as to prevent damage to the landfill. Realignment would decrease the slope of the shoreline; dissipating wave energy over distances of several hundred feet or more and allowing the construction of much lower levees.

Figure 24. A potential alignment for levee realignment. (HASPA 2010)

The alignment presented in Figure 24 would result in the conversion of significant amounts of diked baylands to tidal marsh. Some of these areas, such as the oxidation ponds landward of Cogswell Marsh, would require restoration so that they become suitable for tidal flooding and colonization by emergent tidal wetland plants. Likely activities include soil grading, substrate removal, excavation of tidal channels, and potential pre-vegetation to encourage the post-breach deposition of tidally transported suspended sediments. This option would also require Hayward Marsh to be re-engineered so that it could support tidal marsh instead of the brackish marsh that is currently fed by treated wastewater effluent from the EBDA line. The treatment capacity currently provided by Hayward Marsh would have to be relocated to a new position landward of the improved levee, or provided through alternate treatment technology. In addition, the habitat values provided by Hayward Marsh (foraging and breeding habitat for a broad range of waterfowl and shorebirds) would have to be mitigated for elsewhere in the vicinity. If the levee were instead constructed around Hayward Marsh, the marsh would no longer be able to gravity-drain to the Bay, and treated wastewater would have to be pumped over the levee to the Bay.

6.4 Scenario 3: Levee, Wetland and Upland Ecotone Slope

Even without the threat of sea level rise, the area of potential inundation on the Hayward shoreline is considerable. Looking ahead, the East Bay shore will become increasingly vulnerable to inundation by 2050. Ideally, any adaptation strategy to such changing conditions should:

- Dissipate wave energy over a long shallow slope;
- Provide a mechanism to increase the surface elevation at about the rate of sea level rise;
- Allow for adaptation to varying rates of rising sea levels;
- Slow down both habitat and hazard zone migration.

The Hayward shoreline has some space to realign, but also has two other opportunities to exploit as identified by ecologist Peter Baye.

Firstly, large amounts of treated fresh water pass through the Hayward shoreline in the EBDA pipeline, from treatment plants in the south and east to be discharged at the mid-bay outfall. This pipeline running north-south across the baylands severely constrains the realignment of the levees. Redirecting the output from the wastewater treatment plants to local treatment marshes and disconnecting the EBDA pipeline would remove a major constraint on the Hayward shoreline and improve the resiliency of the EBDA system. The input of fresh water at the inland edge of the tidal marshes would create more productive brackish marshes with higher accretion rates..

The second opportunity is the local availability of sediment. Sediment is at present being trapped at San Leandro Marina and along the flood channels leading to the Bay. In the past this sediment would have entered the Bay and accreted on mudflats and marshes; this connection has now been broken. Levees, flood control channels, and urban development have isolated the bayland marshes from natural pulses of watershed sediments along the tidal marsh edges. Natural sediment depositional landforms such as crevasse splays (delta-like overbank sediment deposits on marshes or floodplains) and alluvial fans (washes) no longer form in diked baylands to provide natural widening and sediment nourishment in the upper tidal elevation range of the bayland edges. The sediment presently trapped could be recovered and hydraulically placed on the bayland edges. Artificial high marsh berms on the outer marsh edges could be actively maintained or managed to keep pace with sea level rise and erosion by periodically raising their crests with thin deposits of sediment (berm capping), in phases or staggered patterns to ensure continuous mature vegetative cover.

Management Strategy

The Wetland and Ecotone Restoration scenario combines the EDBA outflows and local sediment availability to create a more sustainable shoreline that can accrete vertically and does not transgress landward so rapidly. It combines the virtues of the "Hold the Line" and "Levee and Wetland" options, but does not alleviate impacts to land uses and costs. Figure 26 displays a cross-section of the Hayward shoreline displaying the main elements:

- The existing bayshore levee line would be realigned further inland behind the marshes. An impermeable berm would be constructed, perhaps with a cut-off wall to limit saline groundwater intrusion. The crest elevation of the impermeable berm would be set by still water levels, and would be relatively low as it would not be subject to wave overtopping. If space was limited, then an impermeable wall could be used in place of the berm.
- A freshwater swale would run parallel to, and bayward of, the impermeable berm. This swale would act as a manifold, distributing freshwater from the wastewater treatment plants along the length of the shoreline.
- Forming the bayward bank of the freshwater swale would be a seepage berm. This would be a berm slightly lower than the impermeable berm with a long, shallow (1:100) bayward slope down to tidal marsh elevation. This berm would be constructed from a poorly sorted coarse and fine material dredged from the flood channels. Water from the swale would then seep through the berm as shallow groundwater discharge to the back of tidal marshes, above tidal elevation, where brackish marsh would form (Figure 26).

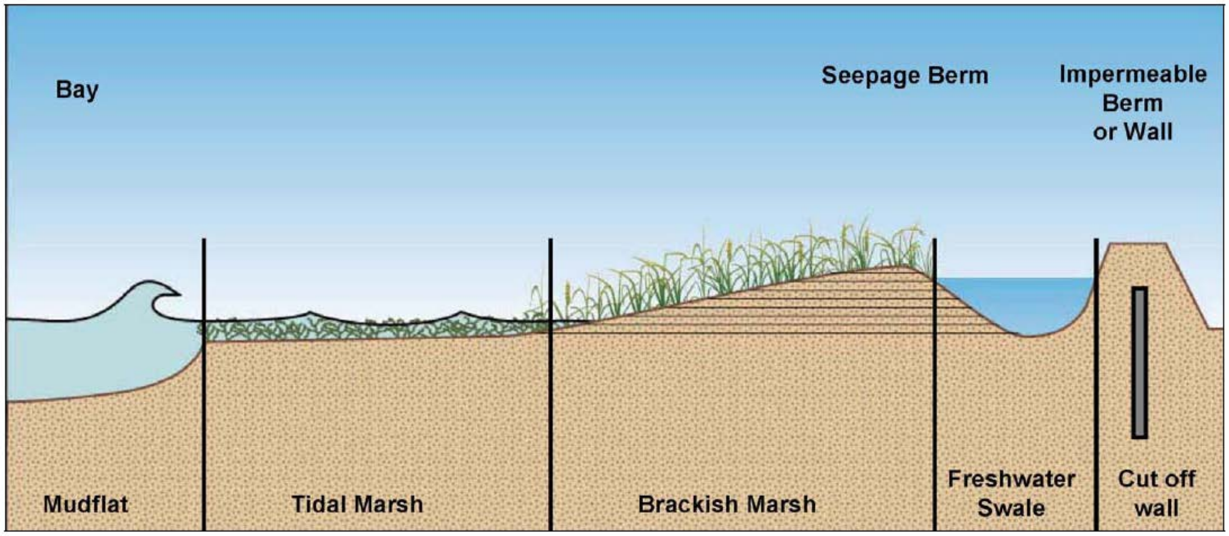


Figure 26. Design elements for a flood protection levee with upland-wetland ecotone.

Figure 27 displays the general arrangement of the marshes, swales and berms in plan view. The saline tidal marshes would accrete and transgress naturally up the 1:100 slope while the brackish marsh will accrete more rapidly due to the greater organic production. Over time, as sea level rises, the slope should gradually steepen rather than transgress landward. This will slow down the landward transgression of wetlands and “squeeze” some habitats, yet maintain the wave attenuation functions of the marshes.

Figure 27. A potential alignment flood risk management levee with upland-wetland ecotone. (HASPA 2010)

Sediment from the flood channels could be used not just to construct the original seepage berm, but also to periodically raise it. A pipe could be run on top of the berm through which would be pumped a sediment-water mixture. This mixture would be released on a regular basis in an alternating pattern of splays in small amounts so as not to bury the existing vegetation.

7 Using Tidal Wetlands to Reduce Shoreline Protection Costs

The scenarios above describe flood risk management regimes in which wetlands play a fundamental role. The integration of wetlands into a flood risk management strategy can lead to cost savings through three primary mechanisms:

1. A reduction in wave height due to the attenuation of waves over the marsh results in lower run-up elevations, lower crest height, and a smaller levee size.
2. The presence of a vegetated marsh results in a higher initial surface elevation upon which the levee is constructed; the toe of the levee is located at about MHHW rather than MTL. The height of the levee, and therefore overall size of the levee, is therefore reduced.
3. Wave attenuation is greater as depths over the marsh decrease. For lower, more frequent water levels (e.g spring tides), wave forces on the marsh-fronted levee will be significantly reduced. Without a marsh, waves will impact the levee on every tide. It is likely that maintenance requirements on the levee without marsh will be higher, and the levee may be in an eroded condition when an extreme event does occur.

The cost analysis below considers these factors, and demonstrates the flood risk management cost savings resulting from implementing the strategies that incorporate wetlands and upland ecotone slopes. All costs are relative, calculated per unit length or per unit area and are in 2010 US dollars.

7.1 Cost Analysis

Previous studies (such as King and Lester (1995) discussed in section 4.2) describe the potential cost savings associated with the presence of a marsh in front of a levee. In these studies, the cost of constructing a levee was calculated to provide a specified level of protection for the ‘no marsh case’. The width of marsh was varied in front of the levee, and the size and cost of levee was calculated to maintain the same level of protection.

This analysis utilizes a similar methodology and, in addition, calculates the cost of marsh restoration and marsh/levee maintenance over 50 years. The total cost of the combined marsh and levee for over 50 years was then compared for levees with different marsh widths per unit lengths of shoreline. The cost savings of having a marsh are expressed as savings per acre of restored marsh relative to the levee with no marsh. In addition to varying the width of the marsh, the cost of creating and maintaining an upland ecotone slope was also considered.

Cost Calculation Details

This analysis utilizes a number of simplifying assumptions to allow for a simple comparison of costs. The first is that the shoreline in question is a realistic representation of a developed Bay shoreline, with an aging outboard levee and the resulting choice to (1) maintain the levee in place or (2) realign the levee landward and restore a marsh. If levees are maintained in place, the analysis assumes that the new levees would be constructed along existing alignments. If levees are realigned, the analysis assumes that no new land has to be purchased for the levees or marsh; all new fill is on the bayward side of the levee. All costs are expressed in 2010 dollars.

Water Surface Elevations, Waves, and Wave Run-Up. Calculating the size of the levee requires specifying the total water level, or TWL. The total water level is defined as the combination of a high bay water level and wind-wave run-up. This preliminary analysis used the joint occurrence of a 100-year bay water level and a 100-year wind wave event to estimate the TWL and the required levee crest. The TWL analyses used in the cost estimate are preliminary, but provide a basis for approximate cost estimates.

Extreme water levels. Total water levels were based on a 100-year return elevation of 12 ft MLLW from the USACE San Francisco Bay flood analyses (USACE 1984) and are representative of the Central Bay. This analysis added an additional 14 inches of sea level rise by 2050, which is a relatively high projection (OPC 2011, NRC 2012).

Waves. Waves of 2 feet and 2.5 seconds were selected for the wave condition at the marsh edge. These were chosen as the depth-limited waves for 100-year return water level; higher waves would break at the marsh edge. Estimates and observations of significant wave height in the Bay suggest that typical 1% significant wave heights range from 2 ft to 4 ft at the mudflat edge for most of the Bay's marshes (DHI 2011, Lacy and Hoover 2011) although observations suggest higher waves may be experienced in part of the Bay. The actual extreme wave heights depend on local bathymetry, wind speed, wind direction, and fetch. Sites subject to local sheltering experience waves in the lower portion of this range. Areas just inside the Golden Gate, which are exposed to larger ocean swell, and portions of the South Bay with the longest fetches, experience waves at or above the high end of this range.

Wave attenuation. Wave attenuation across the marsh was calculated using WHAFIS, developed by FEMA to predict wave conditions associated with storm surge (FEMA 1988).with standard parameters derived for San Francisco Bay vegetation (BCDC 2013). The attenuation curves in Figure 1 were derived as part of the BCDC *Innovative Wetland Adaptation Techniques in Lower Corte Madera Creek Watershed* project (BCDC 2013).

Run-up. Wind wave run-up elevation was calculated using van der Meer (2003) as described in FEMA's *Guidelines for Coastal Flood Hazard Analysis and Mapping for the Pacific Coast* (FEMA 2005), and is a function of wave height, period, levee slope and construction. This was added to the extreme water level to define TWL for the scenario and to set the levee crest elevation.

Levees. The analysis assumed each levee is earthen, with a trapezoidal shape. The main factor affecting the cost estimates is the required height of the levee, which is the required crest elevation minus the approximate elevation of the existing grade. The existing grade was assumed to be MHHW if a tidal marsh was present, and MTL if not present. The conceptual design elevations are based on 100-year TWLs with an additional 1 ft allowance for freeboard. Levee cross-sections without a marsh are assumed to have inboard and outboard slopes of 3:1 (H:V), a crest width of 15 ft, and a foundation depth below grade of 2 ft. The approximate cost for engineered fill was $30/CY. The only difference for the levee cross-section with a marsh was to broaden the side slope to 7:1. To prevent levee erosion, new levees are assumed to be armored with rock. The armoring design used in the cost estimate is a rock revetment to be placed between the toe and the crest of the levee. For the levee without a marsh, 0.5 ton rock was used for armoring; for the levee with marsh, the rock size was reduced to 0.25 ton. The approximate cost for armoring was $110/cubic yard. Initial fill volumes will likely include an "over-build" to compensate for the initial subsidence. It is estimated that the subsidence on bay mud could be as much as 30 percent of the levee height. To account for this, an additional 30% of soil was added to the design cross-sections of all levees.

Marshes. The analysis assumes that marsh plain elevation is 9 ft MLLW, and that tidal marshes would be restored by breaching any outboard levees and relying on natural sedimentation for the accretion of a marsh. While relying on natural sedimentation for the accretion of a marsh plain, there are a number of restoration measures that can be added to a project accelerate the evolution and to enhance the habitat. Some common features are: levee breaches, pilot channels, starter channels, side cast natural levees, and ditch blocks. The average cost for these features in previous restoration projects in San Francisco Bay is about $10,000 per acre.

Cost Calculation Details (cont.)

Ecotone Slope. For the upland ecotone slope, the analysis assumed the top of the transitional-upland area would be sufficient to accommodate the extreme water level; the bottom of the upland-ecotone was assumed to be at marsh plain elevation. The analysis assumes an idealized side slope of 30:1 (H:V); during final design and construction, the slopes would include some variation both in planform to create a more natural shoreline and along the slope to create benches and shallow depressions to form pannes at a variety of elevations. The intent of this approach is to work within the overall idealized slope to create an upland transitional zone with some complexity. To reduce the initial fill requirements it may be possible to construct the ecotone slopes in stages. The approximate cost for poorly sorted, unengineered fill is $15/CY.

Maintenance. The analysis assumes that that the maintenance requirements for the levee, tidal marsh and ecotone slope are 1% of initial construction cost per year for 50 years. The analysis considers costs over 50 years, with construction costs of both levees and tidal marsh occurring at Year 1, and maintenance costs occurring at a constant rate over the next 49 years. Society generally places a greater weight on costs that would occur in the near future versus costs that would occur further in future, all else being equal. To account for this time preference, the stream of maintenance costs is converted to its equivalent present value using the discounting process and a discount rate of 4% per year.

7.1.1 Cost Savings: Levee With Wetland Restoration

Figure 28 displays the total cost per mile of constructing a levee without a marsh compared to the cost of a levee with varying widths of marsh for a 100 year water level with 14 inches of sea level rise. The total cost for the levee without a marsh over 50 years is just over $12M per mile. With a 200 foot wide marsh in front of the levee ,the cost of the levee is reduced to about $5.5M per mile. Restoring a 200 foot wide marsh costs about $0.8M per mile, for a total cost of about $6.3M.

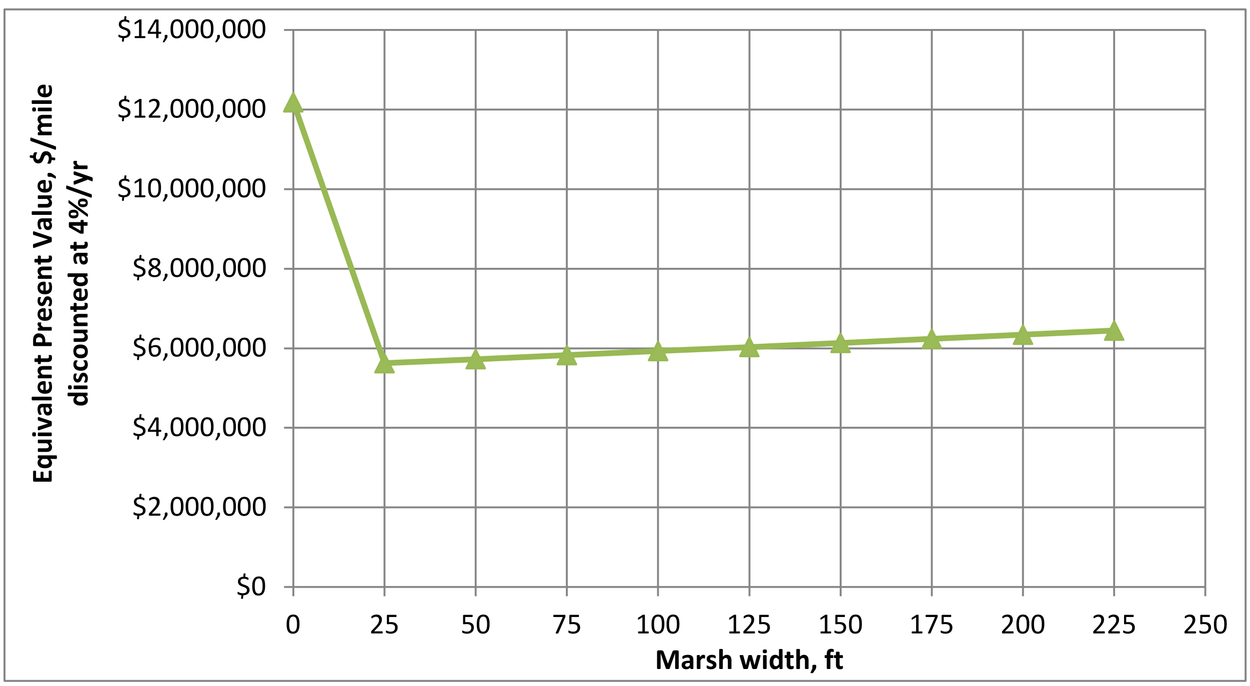


Figure 28. The total cost of levee construction over 50 years drops considerably when fronted by a marsh, due to the effects of wave attenuation.

In this example, there is a saving of about $6M per mile for a 200 foot wide marsh over 50 years. This would require creating about 80 acres of marsh per mile, so the value per acre of marsh in this scenario is approximately $75K (Figure 29). As the marsh width increases, the cost saving decreases. Most of the benefit from the marsh is realized in the close to the bay edge of the marsh where the reduction in wave height is greatest, a finding echoed in previous studies (King and Lester, 2001; Möller et al. 2001). For a marsh 100 feet wide, only 40 acres need be restored, and the value of each acre (equivalent reduction in levee costs) comes to about $160K per acre. However, many of the other ecosystem services described in section 3 benefit from much wider and larger areas of tidal marsh. These services benefit from larger acreages that are not confined to narrow bands close to the shoreline. Broader marshes would also serve as buffers for marsh edge erosion, which could otherwise cause the marsh to narrow over time. Wider marshes would therefore facilitate wave attenuation for relatively longer periods of time.

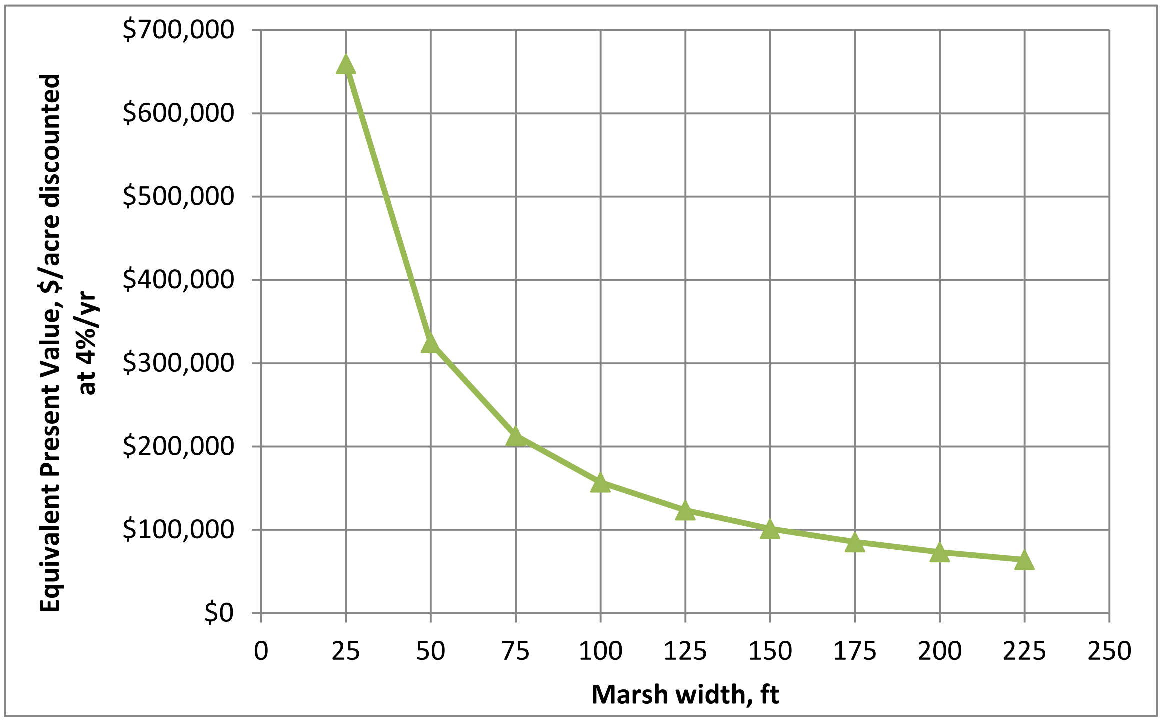


Figure 29. Cost savings per acre of wetland (averaged over 50 years) vs. marsh width.

7.1.2 Cost Savings: Levee With Wetland and Ecotone Restoration

The preceding scenario assumes that the marsh will accrete at a sufficient rate to keep up with sea level rise and maintain its wave attenuation function at least until the second half of the century. Accretion rates on marshes measured in the Bay show that this may be a reasonable assumption at least until 2060-2070 (Takekawa et al. 2012). However, at some point sea level rise may accelerate past the rate at which the marsh can accrete vertically, and the marsh may start to move landward. The construction of an upland-wetland ecotone slope could provide a buffer area into which the marsh could migrate landward, while maintaining sufficient width to attenuate waves. As discussed in the preceding sections, the presence of an ecotone slope provides additional ecological benefits to the marsh, contributing to the restoration of a "complete marsh". However, the construction of such a slope would require additional fill.

Figure 30 shows the total cost per mile of constructing a levee with a marsh and ecotone slope compared to the cost of a levee alone. As with Scenario 2, the total cost for the levee without a marsh for over 50 years is just over $12M per mile. With a 200 foot wide marsh and an upland ecotone slope in front of the levee, the cost of the levee is reduced to about $4.2M per mile as the ecotone slope also attenuates wave action. Restoration of an upland ecotone slope and a 200-foot-wide marsh costs about $2M per mile, for a total cost of about $6.3M per mile over 50 years.

The cost saving per mile is about the same for the scenarios with and without the ecotone slope. The ecotone slope does require more fill and maintenance; however, the additional reduction in wave run-up allows the crest elevation of the levee to be lower. For the scenarios discussed here, these two costs appear to balance each other out; while the upland ecotone slope has a larger volume, it is constructed from lower-cost unengineered fill and does not require armoring.

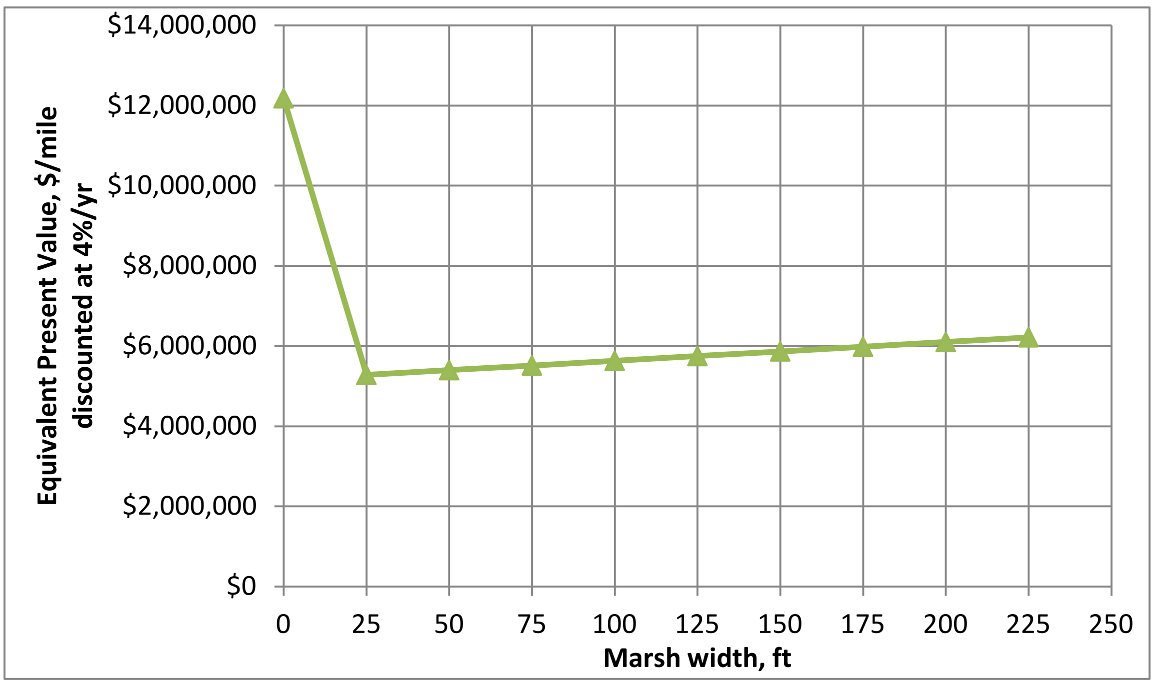


Figure 30. Marsh width versus equivalent present value per mile over 50 years for a levee with a marsh and upland ecotone slope.

Cost Savings Summary. Figure 31 summarizes the relative costs of the three scenarios (holding the line, levee realignment with marsh restoration, and levee realignment with marsh and ecotone restoration), shown in relation to each other for a 200-foot-wide marsh. It is important to note that the total economic benefits of incorporating tidal marsh restoration into flood risk management strategies would exceed the value estimated by this analysis, since it only considers flood risk management and not other ecosystem services such as wildlife habitat, carbon sequestration, and water quality improvements as described in section 3.

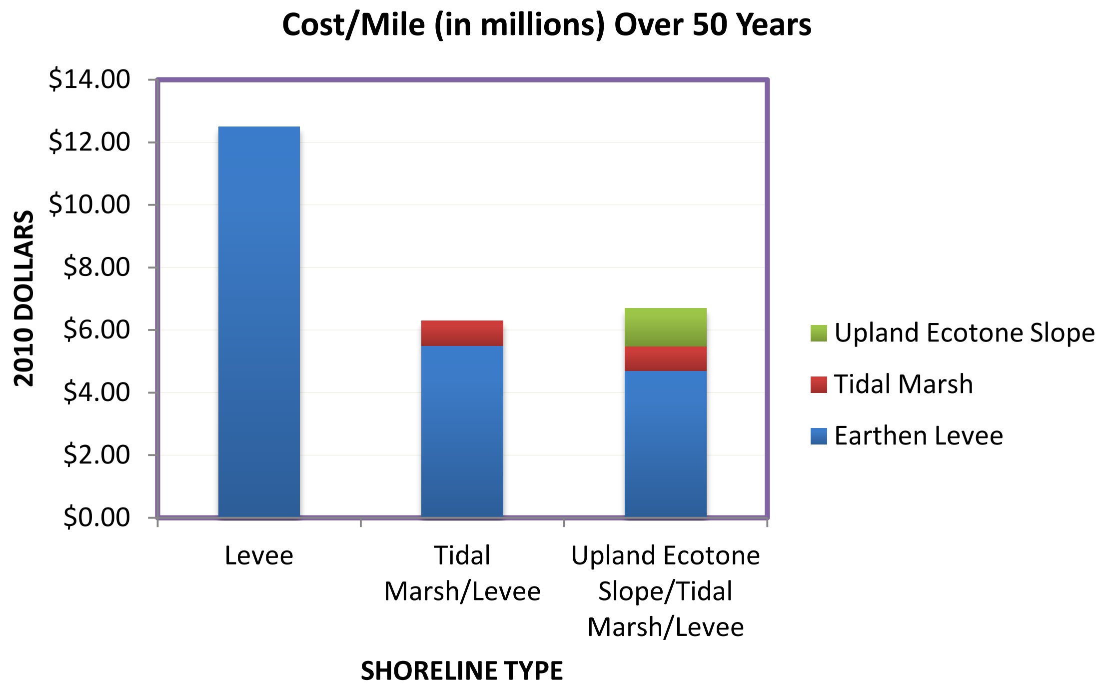


Figure 31. A comparison of the total potential costs of various flood risk management scenarios.

8 A Shoreline Flood Management Approach During an Era of Sea Level Rise

The response to sea level rise and flood risk management will vary around the Bay depending on the particular conditions of the site. There is no single strategy that will fit all locations. This study identifies a shoreline management approach that would take advantage of adjacent landscapes and land uses for particular locations to increase flood risk management benefits and reduce their costs. This approach is one that could have significant benefits beyond the flood risk management savings described here.

8.1 The Horizontal Levee

The significant flood risk management benefits that can be provided by vegetated tidal marshes, have been recognized in the Bay for a long time. Over the last two decades a number of restoration projects such as Warm Springs , Sonoma Baylands and Hamilton Airfield have made use of gentle slopes and benches which mimic marshes to attenuate waves. The Dutch have begun to integrate similar elements into their shoreline defense planning that they describe as “the horizontal levee.”

We expand and elaborate on the “horizontal levee” concept by modifying its design to include a dynamic ecotone slope, as suggested by ecologist Peter Baye; rendering it into an exaggerated version of a levee with restored tidal marsh and ecotone described in section 6 (Figure 32). The horizontal levee shoreline management system for San Francisco Bay includes a vegetated tidal marsh adjacent to the

Bay open waters, landward of which is constructed an ecotone marsh, followed by a fresh water swale and terminating in a smaller flood risk management levee (Figure 32).

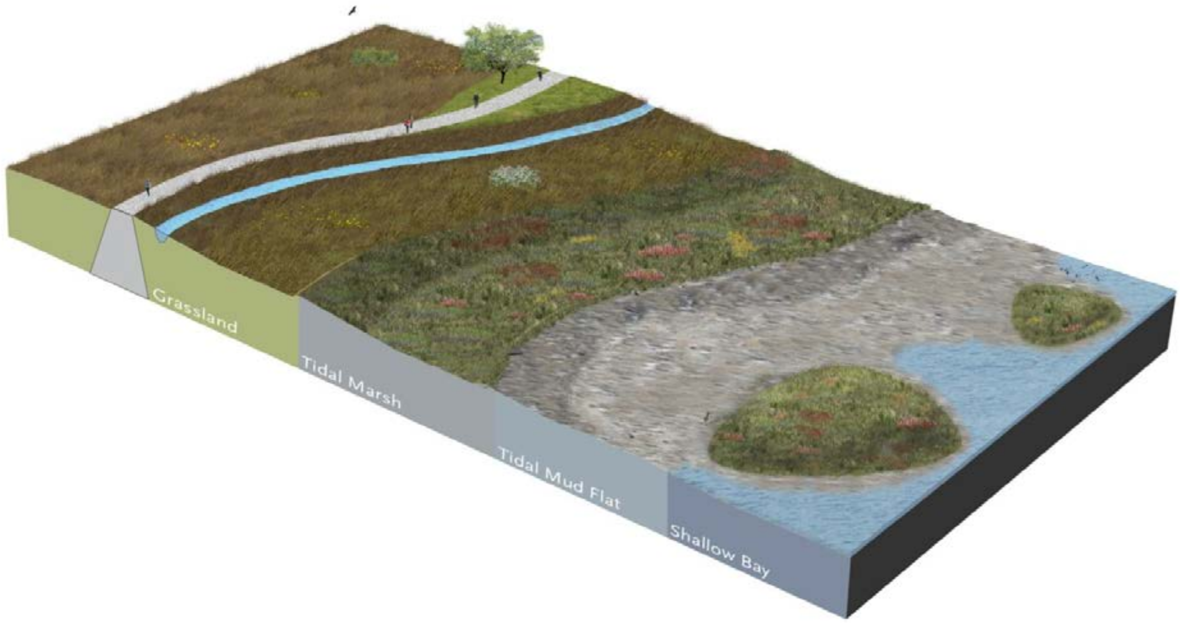


Figure 32. The “horizontal levee” design concept.

This horizontal levee system is partially self-maintaining, providing space for the marsh to transgress with rising sea level and enabling the ecotone marsh to build in elevation as sea level rises. This feature can extend the utility of the flood risk management system over time and significantly reduce operation and maintenance costs of the entire shoreline management system. It takes advantage of natural marsh processes that have been operating in the Bay for thousands of years.

The horizontal levee system can capitalize on the existence of a large-scale marsh program that is already underway in San Francisco Bay, and it can enhance the success of that initiative by providing a solution to the threat of rising sea levels. Absent the redesign, present marshes may not be able to keep up with accelerated sea level rise towards the end of the century and may inundate and drown. The horizontal levee offers an interim solution to critical problems facing the region over the coming decades as sea level increases.

The horizontal levee provides a vegetated buffer that reduces the destructive wind and wave energy associated with storms. The horizontal levee would increase in elevation over time, enhancing the ability of the flood risk management system to keep pace with sea level rise, reducing damage to the levee and reducing maintenance costs. Traditional flood risk management levees would need to be overbuilt or raised periodically as sea level increased. The horizontal levee would provide upland for adjacent tidal marshes as the system evolved. As suspended sediment concentrations in Bay waters are declining, depriving marshes of a key building material, transgression of the marsh is more likely.

8.2 An Integrated Shoreline Management System

Flood protection along the shoreline of San Francisco Bay has been accomplished almost exclusively by constructing engineered barriers and associated water control structures, such as tide gates and pumping stations. The vast majority of the engineered barriers are earthen levees, though seawalls have also been employed where conditions require. These structures have generally been designed for the sole purpose of providing flood protection, without consideration for accomplishing other shoreline management objectives.

By considering opportunities to accomplish related objectives, especially habitat restoration and water quality improvements, the horizontal levee offers significant advantages over conventional single-purpose design. By recognizing the flood risk management benefits provided by tidal marshes, the opportunity arises to build those benefits into the ongoing Bay wetland restoration program, something that has been done in an *ad hoc* fashion to date. Further, by considering marsh restoration needs when operating the flood risk management system, options present themselves to collaborate across programs that otherwise would not be considered.

The horizontal levee approach within a shoreline management paradigm includes an upland ecotone slope immediately adjacent to the landward edge. By considering this upland ecotone slope from the point of view of accomplishing multiple management objectives, it becomes clear that three objectives can be attained that at first appear unrelated.

First, construction of the ecotone slope restores a component of the historic wetland ecosystem that has been almost completely eliminated by development, thereby providing habitat for important plant and animal species. So, not only does it serve as a flood protection barrier, but it replicates a valuable component of the original marsh ecosystem, enhancing our existing marsh restorations. Second, if the upland ecotone slope is managed by using treated waste water from adjacent water treatment plants, it reduces the need for treatment plants to pump waste water long distances to discharge points. This reduces energy cost (electricity for pumping) and maintenance costs (for the buried discharge pipeline) to the treatment plant operator. Third, the upland ecotone slope is constructed using dredged sediment such as excavated from adjacent flood control channels, thereby increasing sediment volumes applied to the marsh and reducing costs to flood districts that currently excavate channel sediment and transport it to distant disposal sites.

There is however, a need for urgency if the value of wetlands is to be realized. The natural evolution of tidal marshes is a gradual process that occurs over years and decades. Sea level rise is projected to accelerate, sediment supply in the Bay is projected to decrease. The sooner that marsh restoration is initiated, the sooner the marsh will begin to build in elevation and for vegetation to establish.

9 Key Findings

Utilizing tidal wetlands in conjunction with more traditional hard-engineered flood risk management approaches such as levees is cheaper and more cost-effective than simply relying on traditional approaches alone. Unlike traditional approaches to flood risk management, tidal wetlands also confer a broad range of additional ecological and economic benefits to the landscape. They provide habitat for fish, birds, and wildlife which has been lost due to diking in the 19th and 20th centuries. They sequester carbon from the atmosphere and use it to build up organic peat soils. Finally, they help remove pollutants from a Bay severely impacted by runoff from developed areas.

The key findings of this study are as follows:

- Sea level is rising in San Francisco Bay at an accelerated rate. The California Ocean Protection Council estimates that sea level will rise to 14 inches by 2050 and to 55 inches by 2100.
- The existing shoreline flood risk management system in San Francisco Bay consists of an extensive network of earthen levees in varying degrees of repair, as well as sea walls and water control structures in select locations.
- The greatest flooding threat to developed areas along the shoreline of San Francisco Bay during the next several decades is from flooding caused by storms occurring during periods of high tides, not from elevated sea levels alone.
- Prior to the latter half of the 21st century it may be possible to adapt to increased sea level and protect existing land uses by employing strategic modifications of the current shoreline management paradigms.
- Later in the 21st century protection of low-lying developed areas along the Bay shoreline may not be sustainable without extensive modification of shoreline protection structures.
- Tidal marshes can provide significant flood risk management benefits by attenuating wave energy during storms, and at significantly lower cost than traditional flood risk management structures. Tidal marshes located adjacent to levees can significantly enhance flood risk management benefits compared to those provided by the levees alone.
- By combining current regional marsh restoration and regional flood risk management planning into a new shoreline management approach, costs could be significantly reduced while providing equivalent levels of protection.
- A "horizontal levee," a hybrid marsh-levee flood risk management system as described in this report, is one approach to help the Bay shoreline keep pace with sea level rise over the next century in critical locations.

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APPENDIX B

Follow-up correspondence with Native American Groups and Individuals

Carla Violet

From: Eileen Barrow <eileen@origer.com>
Sent: Wednesday, February 22, 2017 8:20 AM
To: Carla Violet
Cc: janine@origer.com
Subject: FW: Foster City Levees
Attachments: Foster City Amah Mutsun.pdf

From: Eileen Barrow [mailto:eileen@origer.com]
Sent: Monday, January 23, 2017 1:34 PM
To: 'amahmutsuntribal@gmail.com'
Cc: 'janine@origer.com'
Subject: Foster City Levees

Dear Ms. Zwierlein,

Attached is a copy of a letter we sent you in 2015 regarding the above referenced project. The Foster City is proposing to make improvements to a portion of the levee that protects the city from flooding. Please let me know if you have any questions or comments regarding this project.

Eileen

Eileen Barrow
Senior Associate

Tom Origer & Associates
P.O. Box 1531
Rohnert Park, CA 94927

(707) 584-8200 voice
(707) 584-8300 fax

Carla Violet

From: Eileen Barrow <eileen@origer.com>
Sent: Wednesday, February 22, 2017 8:20 AM
To: Carla Violet
Cc: janine@origer.com
Subject: FW: Foster City Levee Project
Attachments: Foster City Costanoan Rumsen.pdf

From: Eileen Barrow [mailto:eileen@origer.com]
Sent: Monday, January 23, 2017 1:38 PM
To: 'rumsen@aol.com'
Cc: 'janine@origer.com'
Subject: Foster City Levee Project

Dear Mr. Cerda

Attached is a copy of a letter we sent you in 2015 regarding the above referenced project. The Foster City is proposing to make improvements to a portion of the levee that protects the city from flooding. Please let me know if you have any questions or comments regarding this project.

Eileen

Eileen Barrow
Senior Associate

Tom Origer & Associates
P.O. Box 1531
Rohnert Park, CA 94927

(707) 584-8200 voice
(707) 584-8300 fax

Carla Violet

From: Eileen Barrow <eileen@origer.com>
Sent: Wednesday, February 22, 2017 8:20 AM
To: Carla Violet
Cc: janine@origer.com
Subject: FW: Foster City Levees Project
Attachments: Foster City Indian Canyon.pdf

From: Eileen Barrow [mailto:eileen@origer.com]
Sent: Monday, January 23, 2017 1:39 PM
To: 'ams@indiancanyon.org'
Cc: 'janine@origer.com'
Subject: Foster City Levees Project

Dear Ms. Sayers

Attached is a copy of a letter we sent you in 2015 regarding the above referenced project. The Foster City is proposing to make improvements to a portion of the levee that protects the city from flooding. Please let me know if you have any questions or comments regarding this project.

Eileen

Eileen Barrow
Senior Associate

Tom Origer & Associates
P.O. Box 1531
Rohnert Park, CA 94927

(707) 584-8200 voice
(707) 584-8300 fax

January 25, 2017

Jakki Kehl
720 North 2nd Street
Patterson, CA 95363

RE: Foster City Levee Protection Planning and Improvements Project, San Mateo County

Dear Ms. Kehl:

In December, 2015, we contacted you regarding the Foster City Levee Protection Planning and Improvements Project. The City of Foster City has asked us to follow-up on this letter to see if you have any questions or comments regarding this project.

Enclosed is copy of our 2015 letter and a portion of the San Mateo and Redwood Point, Calif. 7.5' USGS topographic quadrangles showing the project location.

Sincerely,

Eileen Barrow

Eileen Barrow
Senior Associate

Tom Origer & Associates
Archaeology / Historical Research

December 29, 2015

Jakki Kehl
720 North 2nd Street
Patterson, CA 95363

RE: Foster City Levee Protection Planning and Improvements Project, San Mateo County

Dear Ms. Kehl:

I write to notify you of a proposed project within San Mateo County, for which our firm is conducting a cultural resources study. The Foster City Levee Protection Planning and Improvements Project is designed to make improvements to the existing levee system in Foster City, San Mateo County, to prevent flooding. The study area is represented by the solid black line as shown on the map provided. The City of Foster City Planning Division is reviewing the project for CEQA compliance.

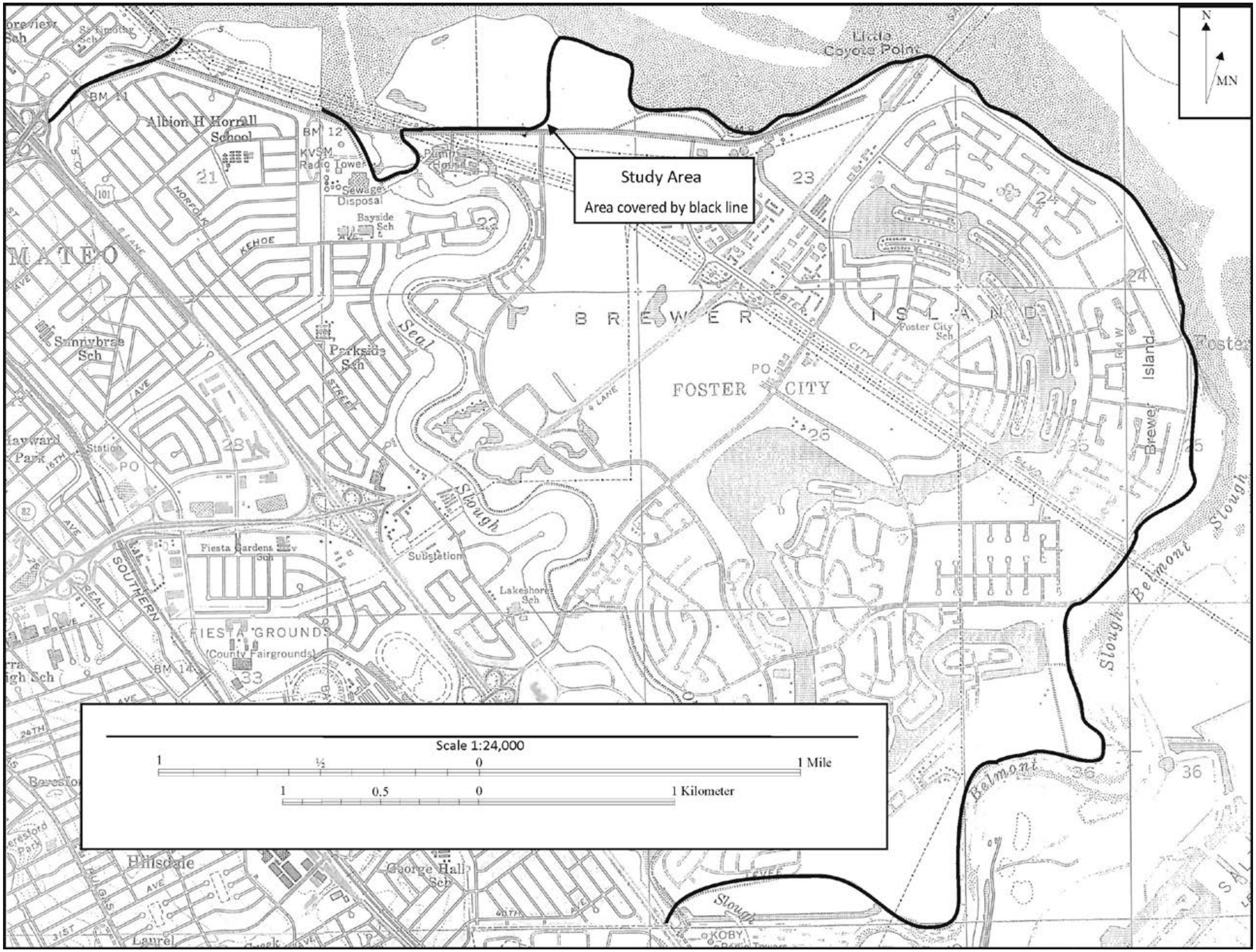
Enclosed is a portion of the San Mateo and Redwood Point, Calif. 7.5' USGS topographic quadrangles showing the project location.

Sincerely,

Taylor Alshuth

Taylor Alshuth
Associate

www.origer.com P.O. Box 1531, Rohnert Park, California 94927 (707) 584-8200



N
MN
Study Area
Area covered by black line
Little Coyote Point
Albion H Horrall School
KVSM Radio Tower
Sewage Disposal
Bayside Sch
Parkside Sch
Sunnybrae Sch
Seal Slough
Substation
Lakeshore Sch
Fiesta Gardens Sch
FIESTA GROUNDS
(County Fairgrounds)
BREWER ISLAND
Foster City Sch
FOSTER CITY
Brewer Island
Belmont Slough
Hillsdale
George Hall Sch
Scale 1:24,000
1 ½ 0 1 Mile
1 0.5 0 1 Kilometer

Carla Violet

From: Eileen Barrow <eileen@origer.com>
Sent: Wednesday, February 22, 2017 8:21 AM
To: Carla Violet
Cc: janine@origer.com
Subject: FW: Foster City Levees Project
Attachments: Foster City Muwekma Ohlone.pdf

From: Eileen Barrow [mailto:eileen@origer.com]
Sent: Monday, January 23, 2017 1:40 PM
To: 'muwekma@muwekma.org'
Cc: 'janine@origer.com'
Subject: Foster City Levees Project

Dear Ms. Cambra,

Attached is a copy of a letter we sent you in 2015 regarding the above referenced project. The Foster City is proposing to make improvements to a portion of the levee that protects the city from flooding. Please let me know if you have any questions or comments regarding this project.

Eileen

Eileen Barrow
Senior Associate

Tom Origer & Associates
P.O. Box 1531
Rohnert Park, CA 94927

(707) 584-8200 voice
(707) 584-8300 fax

Carla Violet

From: Eileen Barrow <eileen@origer.com>
Sent: Wednesday, February 22, 2017 8:21 AM
To: Carla Violet
Cc: janine@origer.com
Subject: FW: Foster City Levees Project
Attachments: Foster City The Ohlone.pdf

From: Eileen Barrow [mailto:eileen@origer.com]
Sent: Monday, January 23, 2017 1:41 PM
To: 'chochenyo@aol.com'
Cc: 'janine@origer.com'
Subject: Foster City Levees Project

Dear Mr. Galvan

Attached is a copy of a letter we sent you in 2015 regarding the above referenced project. The Foster City is proposing to make improvements to a portion of the levee that protects the city from flooding. Please let me know if you have any questions or comments regarding this project.

Eileen

Eileen Barrow
Senior Associate

Tom Origer & Associates
P.O. Box 1531
Rohnert Park, CA 94927

(707) 584-8200 voice
(707) 584-8300 fax

Carla Violet

From: Eileen Barrow <eileen@origer.com>
Sent: Wednesday, February 22, 2017 8:21 AM
To: Carla Violet
Cc: janine@origer.com
Subject: FW: Foster City Levee Project
Attachments: Foster City Trina Marine Ruano Family.pdf

From: Eileen Barrow [mailto:eileen@origer.com]
Sent: Monday, January 23, 2017 1:46 PM
To: 'soaprootmo@comcast.net'
Cc: 'janine@origer.com'
Subject: Foster City Levee Project

Dear Ms. Garibay,

Attached is a copy of a letter we sent you in 2015 regarding the above referenced project. The Foster City is proposing to make improvements to a portion of the levee that protects the city from flooding. Please let me know if you have any questions or comments regarding this project.

Eileen

Eileen Barrow
Senior Associate

Tom Origer & Associates
P.O. Box 1531
Rohnert Park, CA 94927

(707) 584-8200 voice
(707) 584-8300 fax

Carla Violet

From: Eileen Barrow <eileen@origer.com>
Sent: Wednesday, February 22, 2017 8:21 AM
To: Carla Violet
Cc: janine@origer.com
Subject: FW: Foster City Levee Project
Attachments: Foster City Yamane.pdf

From: Eileen Barrow [mailto:eileen@origer.com]
Sent: Monday, January 23, 2017 1:45 PM
To: 'rumsien123@yahoo.com'
Cc: 'janine@origer.com'
Subject: Foster City Levee Project

Dear Ms. Yamane,

Attached is a copy of a letter we sent you in 2015 regarding the above referenced project. The Foster City is proposing to make improvements to a portion of the levee that protects the city from flooding. Please let me know if you have any questions or comments regarding this project.

Eileen

Eileen Barrow
Senior Associate

Tom Origer & Associates
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Rohnert Park, CA 94927

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