ALAMITOS BEACH CONCESSION STAND PROJECT
SEA LEVEL RISE ASSESSMENT

FINAL

Prepared For:

LSA

Prepared By:

Everest International Consultants, Inc.

EVEREST

July 2017

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1. INTRODUCTION

The City of Long Beach (City) is conducting environmental review under the California Environmental Quality Act (CEQA) for a proposed project to be located at the western end of Alamitos Beach in Long Beach, California. The proposed project (Project), known as the Alamitos Beach Concession Stand, includes a combination of new development and redevelopment across an area of 1.22 acres located within Assessor's Parcel No. 7265-021-901. There is currently a bike path and pedestrian path at the project site as well as a small café (Alamitos Café), beach rental facility (Alfredo's Beach Rentals), on-site parking lot, and supporting facilities (e.g., bike racks, outdoor patio, automated teller machine). The project site is located on the landward side of a wide sandy beach that is the result of a sand fillet that was formed against the rubblemound (rock) jetty constructed as part of the Downtown Shoreline Marina. The location of the proposed project is shown in Figure 1.

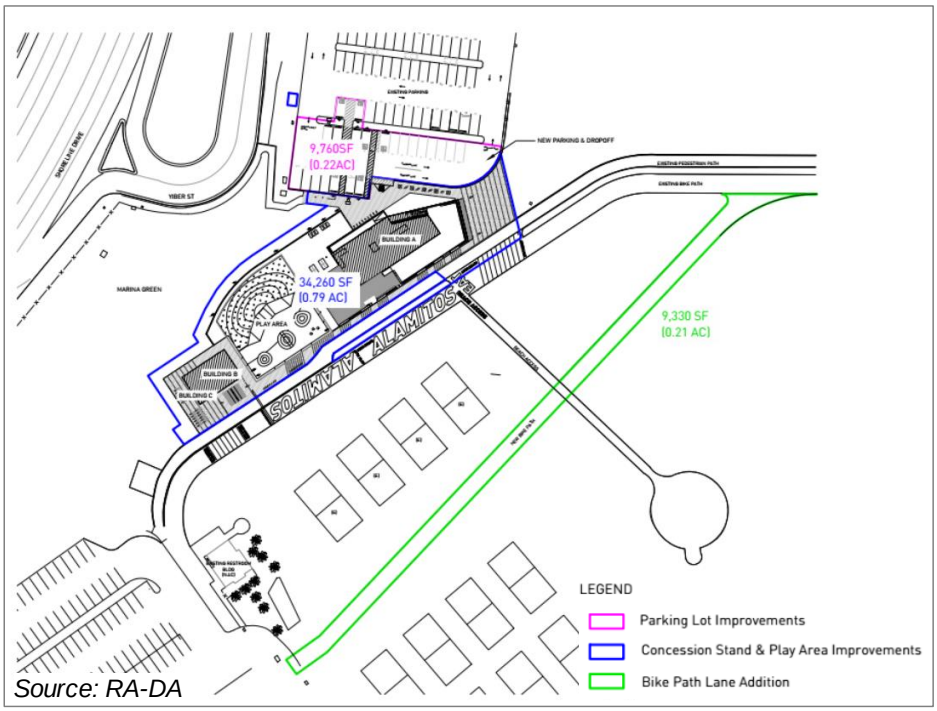
Figure 1. Project Location Map

The proposed project includes the demolition of the existing structures and subsequent replacement of those structures with three buildings, an outdoor recreational area, and improvements to the southern portion of the existing on-site parking lot. The Project would be aligned with the existing bike and pedestrian paths east of the project site, creating a promenade area in front of the project site facing the beach. In addition, the Project includes the addition of a new bike path that would improve pedestrian safety via repositioning of the sharp curve in the alignment of the existing bike path. The proposed conceptual project site plan and an artistic rendering are shown in Figure 2.

The City has retained LSA to conduct an Initial Study/Mitigated Negative Declaration (IS/MND) for CEQA compliance. In identifying the issues and associated analyses that would be needed for the IS/MND, LSA identified sea level rise as an issue of concern. LSA retained Everest International Consultants (Everest) to perform a sea level rise (SLR) assessment for use in evaluating the potential environmental impacts associated with the Project.

The purpose of the sea level rise assessment (SLR Assessment) is to determine the potential for coastal hazards to impact the proposed project in the future as sea level rises. Knowing the level and extent of potential coastal hazard impacts that the proposed project might be exposed to in the future will help inform the level of environmental analysis required for the Project. The following objectives were developed to achieve the purpose of the SLR Assessment.

- Obtain relevant project data and information including existing project site topography, proposed project site topography, proposed building pad elevations, and SLR hazard model results.
- Identify relevant sea-level rise policy guidance (e.g., City, California Coastal Commission (CCC)) and decide on the appropriate set of sea-level rise projections and associated timeframes.
- Conduct an analysis for the selected SLR projections and associated SLR timeframes via comparison of projected water levels to existing and proposed ground elevations as well as the proposed building pad elevations. This analysis should include consideration of future hazards due to higher mean sea levels (tidal flooding), coastal storms (wave storms), and tsunamis.



Source: RA-DA

a) Conceptual Site Plan

Source: LSA

b) Conceptual Renderings

Figure 2. Conceptual Project Site Plan and Renderings

2. METHODS

2.1 Relevant Project Data and Information

LSA was contacted for project data and information including existing and proposed project site topography as well as proposed building pad elevation data. In cases where such data/information was lacking, LSA contacted City staff who then provided the requested data/information in time to conduct the SLR Assessment.

2.2 Relevant Sea-Level Rise Policy Guidance

The City website was searched for information regarding relevant sea-level rise policy. In addition, City staff was contacted via LSA to obtain recent City sea-level rise policy information. It was determined that the City did not have specific, relevant SLR policy guidance so state policy guidance from the CCC would be the most relevant information applicable to the Project. The CCC website was searched for recent information regarding SLR policy guidance and the most relevant policy guidance was downloaded for use in conducting the SLR Assessment. That guidance was found in the August 12, 2015 document titled, "California Coastal Commission Sea Level Rise Policy Guidance, Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs and Coastal Development Permits" prepared by the California Coastal Commission. The SLR projections presented in that document are summarized in Table 1 below with the original source (NRC 2012) indicated in the table title.

Table 1. Sea Level Rise Projections for California (NRC 2012)

TIME PERIOD*	NORTH OF CAPE MENDOCINO	SOUTH OF CAPE MENDOCINO
By 2030	-4 cm to +23 cm	+4 cm to +30 cm
By 2050	-3 cm to +48 cm	+12cm to +61 cm
By 2100	+10 cm to +143 cm	+42 cm to +167 cm

**Baseline was Year 2000.*

2.3 SLR Analysis

In recent years, the U.S. Geological Survey (USGS) has been developing a numerical modeling system capable of simulating various coastal hazards under existing mean sea level and future mean sea level conditions (i.e., SLR projections). This modeling system, known as the Coastal Storm Modeling System or CoSMoS (Erikson, et al. 2017), has been updated several times to better simulate the complex processes that affect the accuracy of the results. Results from the most recent version of CoSMoS (Version 3.0, Phase 2) were accessed from the "Our Coast, Our Future" website (http://data.pointblue.org/apps/ocof/cms/)

in the form of flood hazard area maps. The maps were printed and used to analyze tidal flooding and coastal storm flooding under the three SLR projection timeframes identified in the 2015 CCC SLR Policy Guidance as shown in Table 1 above (South of Cape Mendocino). The CoSMoS provides results for various amounts of SLR (ranging from 0 cm to 500 cm) with no consideration of year or timeframe. Since the CCC SLR Policy Guidance requires analysis of various SLR projections associated with timeframes, the CoSMoS results closest to the SLR projections associated with the CCC SLR timeframes were used to conduct the analysis presented herein. For example, the top end of the SLR projection for Year 2100 is 167 cm (Table 1, South of Mendocino) while the closest two CoSMoS results were for 150 cm and 175 cm. For this analysis, the CoSMoS results for the SLR projection of 175 cm were used and the result was assumed to be associated with Year 2100. In addition, GIS data of the studied scenarios were downloaded from the USGS Science Base-Catalog website for CoSMoS v3.0 Phase 2 – Los Angeles County (https://www.sciencebase.gov/catalog/item/5845d431e4b04fc80e52356c). These data provided water elevation projections for different SLR scenarios.

To analyze potential coastal hazards associated with tsunamis the California Department of Conservation website was searched for relevant information. Tsunami inundation maps for the California coastline prepared by the California Emergency Management Agency, California Geological Survey, and University of Southern California were found on this website and the most relevant map (Long Beach Quadrangle) was downloaded for use in conducting the SLR Assessment. The downloaded tsunami inundation map, which was dated March 1, 2009, does not include consideration of SLR so the inundation mapping represents inundation under existing (2009) mean sea level.

3. RESULTS

3.1 Tidal Flooding with SLR

The results of the CoSMoS 3.0 sea level rise hazard mapping analysis for Year 2016, Year 2030, Year 2050, and Year 2100 are shown in Figures 3, 4, 5, and 6, respectively. The Year 2016 results represent current (i.e., existing) conditions with no rise in sea level (i.e., 0 cm SLR). The Year 2030, Year 2050, and Year 2100 maps depict flood hazards associated with a 25 cm, 75 cm, and 175 cm rise in sea level, respectively (i.e., 25 cm SLR, 75 cm SLR, 175 cm SLR). There are two images shown in each figure with the top ('a' panel) and bottom ('b' panel) images depicting the results without and with 100-year return period coastal (wave) storms, respectively.

The mapped results for the conditions without coastal wave storms (Figures 3a, 4a, 5a, & 6a) were reviewed to assess the vulnerability of the project site to tidal flooding now and in the future with SLR. In general, the results indicated that the project site would not be

Legend
Project Site Flood Hazard Area

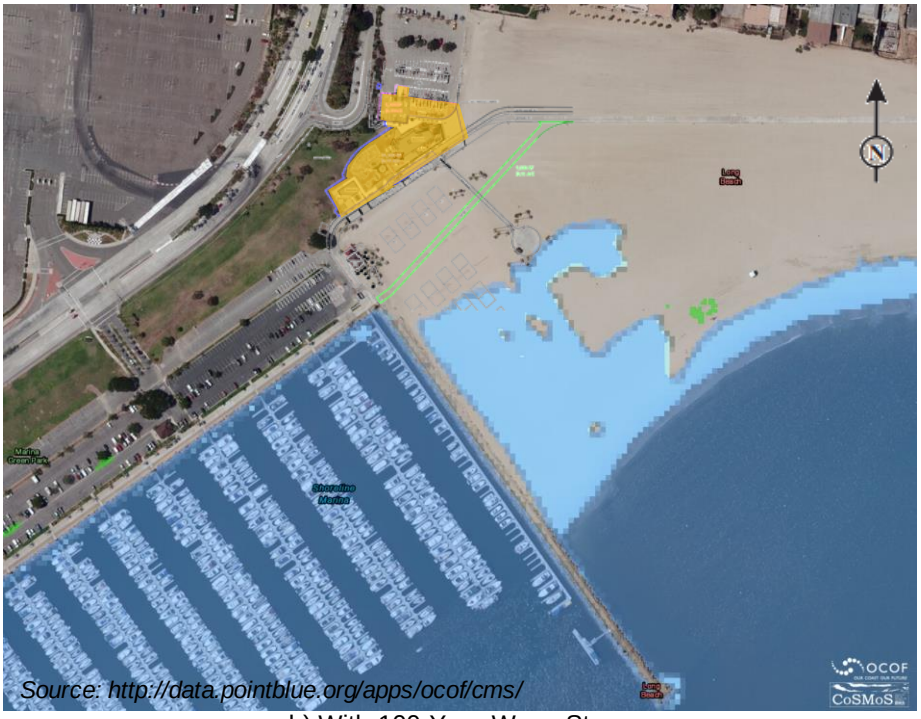
a) Without Wave Storm

b) With 100-Year Wave Storm

Figure 3. CoSMoS 3.0 Flood Hazard Map
Current Sea Level Scenarios

Legend
Project Site | Flood Hazard Area | Flood-prone Low Lying Areas

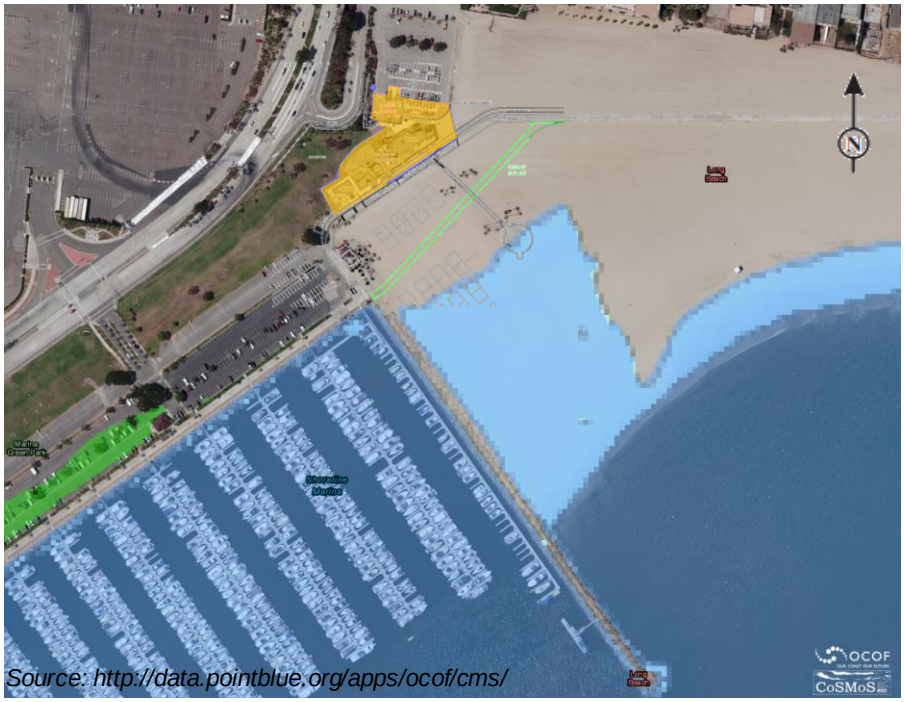
a) Without Wave Storm



b) With 100-Year Wave Storm

Figure 4. CoSMoS 3.0 Flood Hazard Map
25 cm Sea Level Rise Scenarios
Selected to Represent CCC SLR Policy Guidance Projection for Year 2030

Legend
Project Site | Flood Hazard Area | Flood-prone Low Lying Areas

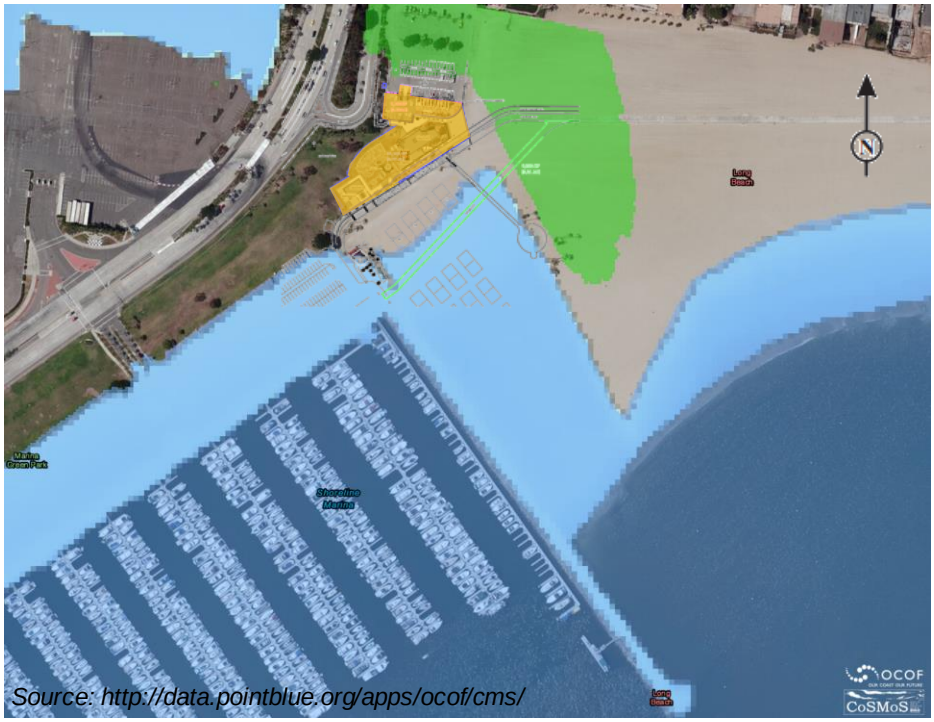


a) Without Wave Storm

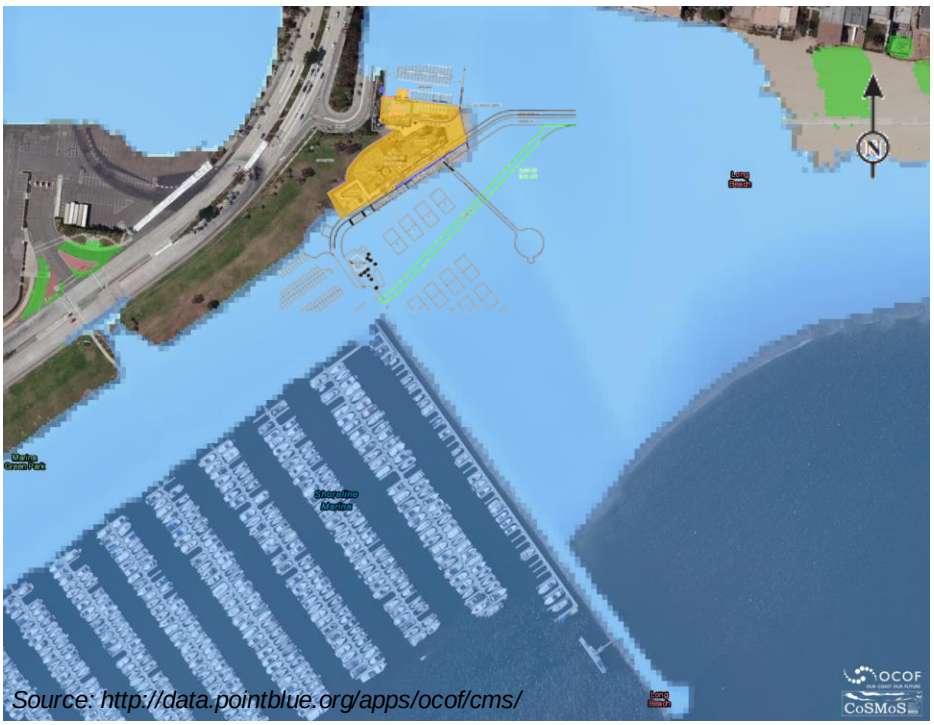
b) With 100-Year Wave Storm

Figure 5. CoSMoS 3.0 Flood Hazard Map
75 cm Sea Level Rise Scenarios
Selected to Represent CCC SLR Policy Guidance Projection for Year 2050

Legend
Project Site | Flood Hazard Area | Flood-prone Low Lying Areas



a) Without Wave Storm



b) With 100-Year Wave Storm

Figure 6. CoSMoS 3.0 Flood Hazard Map
175 cm Sea Level Rise Scenarios
Selected to Represent CCC SLR Policy Guidance Projection for Year 2100

subject to coastal hazards associated with tidal flooding now or in the future under all SLR projections (25 cm, 75 cm, and 175 cm) and through all timeframes (Year 2016, Year 2030, Year 2050, and Year 2100). The one exception is the proposed bike path that may be subject to tidal flooding with 175 cm of SLR (Year 2100) but not with lower levels of SLR (25 cm & 50 cm) estimated to occur in earlier years (Year 2030 & Year 2050). This assumes that the finished ground elevation of the proposed bike path is at the same ground elevation modeled in CoSMoS 3.0, which is likely the existing ground elevation.

The tidal flooding elevation projections in the vicinity of the project site are presented in Table 2, along with relevant proposed project site elevations (top of existing pedestrian path, proposed concession deck of Building A, proposed café finished floor & deck of Building A, and proposed finished floor of Buildings B & C). It can be seen that the proposed project site elevations are above the highest tidal flooding elevation projection of 12.5 ft, NAVD88, indicating that the proposed project would not be subject to tidal flooding under all SLR projections (25 cm, 75 cm, 175 cm) and through all timeframes (Year 2016, Year 2030, Year 2050, and Year 2100).

Table 2. CoSMoS 3.0 Water Elevation Projections for Conditions Without Coastal (Wave) Storm Compared with Project Site Elevations

Sea Level Rise Scenario	Water Elevation	
	Meter, NAVD88*	Feet, NAVD88
Current Sea Level	2.0	6.6
25 cm SLR	2.3	7.5
75 cm SLR	2.8	9.2
175 cm SLR	3.8	12.5
Project Site Elevation (Feet, NAVD88)**		
Top of Existing Pedestrian Path (Low to High)		14.35 to 16.03
Proposed Concession Deck of Building A		16.97
Proposed Café Finished Floor and Deck of Building A (Concession Building)		17.47
Proposed Finished Floor of Buildings B and C (Rental and Restroom Building)		15.00

*Source: * CoSMoS 3.0 GIS Data*
*** City of Long Beach*

3.2 Coastal (Wave) Storm Flooding with SLR

The mapped results for the conditions with 100-year return period coastal (wave) storms (Figures 3b, 4b, 5b, & 6b) were reviewed to assess the vulnerability of the project site to coastal (wave) storm flooding now and in the future with SLR. In general, the results indicated that the project site would not be subject to coastal hazards associated with coastal (wave) storms now or in the future under all SLR projections (25 cm, 75 cm, 175 cm) and through all timeframes (Year 2016, Year 2030, Year 2050, Year 2100). Like with the tidal flooding coastal hazard, the one exception is the proposed bike path that would be subject to coastal (wave) storm flooding with 175 cm of SLR (Year 2100) but not with lower levels of SLR (25 cm & 50 cm) estimated to occur in earlier years (Year 2030 & Year 2050). This assumes that the finished ground elevation of the proposed bike path is at the same ground elevation modeled in CoSMoS 3.0, which is likely the existing ground elevation.

CoSMoS 3.0 includes the ability to estimate the increased erosion of beaches and erodible bluffs associated with sea level rise, including direct beach inundation and increased wave erosion due to more frequent and intense wave action. The CoSMoS 3.0 results for various coastal erosion scenarios (e.g., with & without beach nourishment) were reviewed for existing conditions (0 cm SLR and Year 2016), all SLR projections (25 cm, 50 cm, & 175 cm) and timeframes (Year 2030, Year 2050, & Year 2100) as part of this SLR Assessment. The results indicated that SLR-induced coastal erosion would not impact the project site now or in the future with SLR. The results do not indicate any SLR-induced beach erosion in the vicinity of the project site, although such erosion is observed on downcoast beaches located east/southeast of the project site. This finding is likely due to the stable nature of the beach in the vicinity of the project site.

The flood elevation projections with the 100-year coastal storm conditions in the vicinity of the project site are presented in Table 3, along with relevant proposed project site elevations (top of existing pedestrian path, proposed concession deck of Building A, proposed café finished floor & deck of Building A, and proposed finished floor of Buildings B & C). It can be seen that the proposed project site elevations are above the highest flood elevation projection of 14.8 ft, NAVD88, indicating that the buildings would not be subject to tidal flooding under all SLR projections (25 cm, 75 cm, 175 cm) and through all timeframes (Year 2016, Year 2030, Year 2050, and Year 2100) with one exception. The lower portions of the proposed bike path might be flooded in Year 2100.

Table 3. CoSMoS 3.0 Water Elevation Projections for 100-Year Coastal (Wave) Storm Conditions Compared with Project Site Elevations

Sea Level Rise Scenario	Water Elevation	
	Meter, NAVD88*	Feet, NAVD88
Current Sea Level	2.2	7.2
25 cm SLR	2.6	8.5
75 cm SLR	3.2	10.5
175 cm SLR	4.5	14.8
Project Site Elevation (Feet, NAVD88)**		
Top of Existing Pedestrian Path (Low to High)		14.35 to 16.03
Proposed Concession Deck of Building A		16.97
Proposed Café Finished Floor and Deck of Building A (Concession Building)		17.47
Proposed Finished Floor of Buildings B and C (Rental and Restroom Building)		15.00

*Source: * CoSMoS 3.0 GIS Data*
*** City of Long Beach*

3.3 Tsunami Inundation

The results of the tsunami inundation modeling conducted by the State of California are shown in Figure 7. The results indicate that the entire coast of Long Beach would likely be inundated by a tsunami of the magnitude and duration analyzed as part of the study conducted by the State of California. Specific to the proposed project, the results indicate that the project site would be vulnerable to tsunami inundation under existing conditions, including existing mean sea level (i.e., without sea level rise). As mentioned above, the tsunami hazard mapping analysis conducted by the State of California did not include an evaluation of tsunami hazards in the future with sea level rise. However, since the entire project site is in a tsunami hazard area under existing conditions it is reasonable to assume the entire area would be in a tsunami hazard area under future conditions with sea level rise, and the magnitude of inundation would likely be higher in the future for a given tsunami event due to the higher water elevations associated with sea level rise.

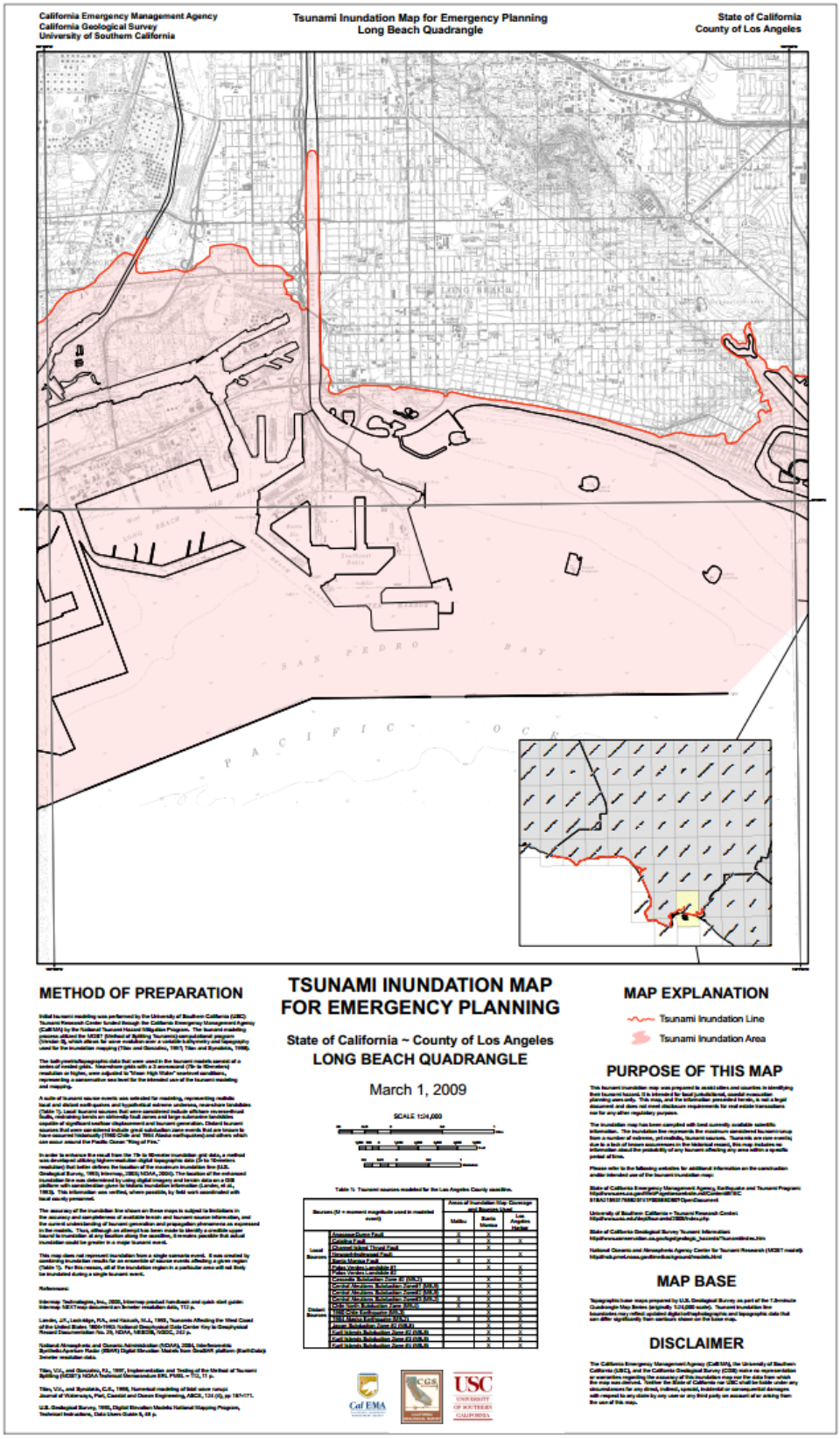


Figure 7. Tsunami Inundation Map

4. CONCLUSIONS

The CoSMoS 3.0 results reviewed for this SLR Assessment indicate that the proposed project site is not currently subject to coastal hazards associated with tidal flooding and coastal (wave) storms. In addition, the CoSMoS 3.0 results indicate that the proposed project site would not be subject to coastal hazards associated with tidal flooding and coastal (wave) storms until SLR reaches 175 cm, which is projected to occur sometime around Year 2100 according to the CCC's SLR policy guidance. These conclusions are based on the ground elevations used in the CoSMoS 3.0 simulations without regards to proposed project ground elevation changes and/or building pad elevation changes. Since the proposed project is not proposing any ground elevation reductions (i.e., excavation), the CoSMoS 3.0 results are directly applicable to assessing coastal hazard risk now and in the future with SLR. Consequently, with one exception, the proposed project would not be expected to be vulnerable to coastal hazards associated with tidal flooding and coastal (wave) storms now or in the future with SLR (25 cm in Year 2030, 75 cm in Year 2050, 175 cm in Year 2100). The one exception is the proposed bike path that would be expected to be vulnerable to coastal hazards associated with tidal flooding and coastal (wave) storms for a SLR of 175 cm, which is projected to occur sometime around Year 2100 according to the CCC's SLR policy guidance. This assumes that the finished ground elevation of the proposed bike path is at the same ground elevation modeled in CoSMoS 3.0, which is likely the existing ground elevation. If the finished ground elevation of the proposed bike path is designed to be higher than the existing ground and the flood elevations of the SLR projections, then this vulnerability would be alleviated.

In April 2017, the State of California, through the Ocean Protection Council (OPC) and Ocean Science Trust, released a report titled, "Rising Seas in California: An Update on Sea-Level Rise Science" (Griggs et al. 2017). It is the intent of this report to update sea level rise science applicable to the California coast. The State of California plans to use the information in the report to update the State's sea level rise policy. Public outreach for this effort started in May 2017 and the OPC anticipates that the updated State policy for SLR will be complete in January 2018. Once the State SLR policy is adopted it is anticipated that State resource (e.g., California Department of Fish & Wildlife) and regulatory agencies (e.g., California Coastal Commission) will update their SLR policy guidance. Under this approach and timeline, it is likely that the State resource and regulatory agencies will update their SLR policy guidance sometime in the spring or summer of 2018. Consequently, the SLR Assessment presented herein may have to be updated next year once the relevant State agencies (e.g., CCC) update their SLR policy guidance.

5. REFERENCES

California Coastal Commission. 2015. California Coastal Commission Sea Level Rise Policy Guidance, Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs and Coastal Development Permits. Published by the California Coastal Commission. Adopted August 12, 2015.

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