Appendix A
Vulnerability Studies Completed for Santa Barbara

VULNERABILITY STUDIES COMPLETED FOR SANTA BARBARA

Multiple coastal hazard assessments have already been completed at both a local and regional level that provide vulnerability data for the Santa Barbara study area (updated from ESA, 2015). As a Vulnerability Assessment Update, the current study leans heavily on previous studies and aims to refine and augment them based on newer data available from the City and studies they have commissioned. These studies served as the baseline from which the Vulnerability Assessment Update was prepared.

- FEMA flood hazard maps, which are used for the National Flood Insurance Program, present coastal (from the ocean) and fluvial (from rivers and creeks) flood hazards. New coastal flood studies were recently completed and updated maps are available and included in this report (see Appendix D and Section 2.3). These maps assess existing hazards and do not consider erosion or projected sea-level rise. See Section 3.10 for further discussion of the differences between the FEMA flood hazard maps and Coastal Hazard Mapping.

- In 2012, the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center created the Digital Coast Sea-level Rise and Coastal Flooding Impact Viewer ("NOAA SLR Viewer," available at http://coast.noaa.gov/slr/) for the entire U.S. coastline. The viewer allows users to see how existing high-tide inundation areas will change with 1-ft increments of sea-level rise.

- Tsunami inundation maps, developed by CalEMA, the University of Southern California, and the California Geological Survey, are also available for the entire state of California.

- In 2009, Philip William and Associates, Ltd. (PWA, now ESA) was funded by the Ocean Protection Council to provide the technical hazards analysis in support of the Pacific Institute report on the "Impacts of Sea-level Rise on the California Coast" ("The Pacific Institute study," PWA 2009). In the course of this work, PWA projected future coastal flooding hazards for the entire state based on a review of existing FEMA hazard maps. In addition, PWA projected future coastal erosion hazard zones for the northern and central California coastline. These hazard zones were used in the Pacific Institute study, which evaluated potential socioeconomic impacts of sea-level rise. The maps completed as part of the Pacific Institute study used statewide datasets and were not to be used for local planning purposes, but the modeling methods (Revell et al 2011) were developed to be readily re-applied as improved regional and local data became available. These "Pacific Institute study" maps were used in the City of Santa Barbara General Plan Update Environmental Impact Report (EIR) prepared by AMEC in 2010. The "Pacific Institute study" maps did not extend beyond the Santa Barbara Harbor, and while additional maps were developed for the General Plan EIR, they only used elevation to show inundation from sea-level rise, without considering where water is actually expected to flow.

- Griggs and Russell (2012) completed a preliminary assessment of the City of Santa Barbara's vulnerability to sea-level rise. This project used the exposure maps in the General Plan Update EIR (AMEC, 2010) described previously, as well as best practices and available data for sea-level rise vulnerability being used that that time. The study provided an assessment highlighting the risks that wave damage, flooding and inundation, and erosion pose to shoreline development and infrastructure in Santa Barbara into the future. It also addressed opportunities for the adaptive capacity for these hazards, but acknowledged that a more detailed understanding of the hazards and of the sensitivity of assets would improve future analyses.

- The UCSB Bren School 2015 master's project, titled City of Santa Barbara Sea-level Rise Vulnerability Assessment (Denka et al. 2015), identified vulnerabilities within human populations, critical infrastructure, recreation and public access, and ecological resources, as well as identified adaptation strategies that the City could consider for their Local Coastal Program update. It builds on the work of Griggs and Russell (2012) and pre-dates coastal resilience modeling by others that refined the flood and erosion hazards associated with various amounts of sea-level rise.

- The Goleta Slough Areas Sea-level Rise and Management Plan, was prepared by ESA for the Goleta Slough Management Committee in 2015. This study focused on the ecological resources at Goleta Slough near the Santa Barbara Airport and the implications of sea-level rise for them. The study concluded with a set of goals for the area and policies and planning steps that could be used to reach those goals.

- Coastal Resilience modeling of coastal hazards was completed by ESA under contract to the County of Santa Barbara with funding from the State of California in 2016. The report is called Coastal Resilience Santa Barbara and is available on the Coastal Resilience website operated by The Nature Conservancy[1]. The study included two phases: south County from Jalama Beach County Park to Rincon Point which is approximately 70 miles of coast (ESA, 2015), and north County from Jalama Beach to the San Luis Obispo County line (ESA,2016). The study is similar to those completed for the counties of Santa Cruz, Monterey (Monterey Bay), Ventura, and Los Angeles. The methodology and approach were more refined than the approach used in the Pacific Institute Study and were intended to inform local coastal planning. The hazard information provided in the Coastal Resilience Santa Barbara report was used to inform a vulnerability assessment prepared by the County of Santa Barbara. The County-wide work was also informed by a separate focused study prepared for the City of Santa Barbara (ESA, 2016b), which inventoried existing structures along the coast, developed and applied methods to account for coastal structures, and updated hazard maps "with armoring" for the City. The inventory method used in the focused City of Santa Barbara study was subsequently applied to the countywide study (ESA, 2016b).

- Coastal Storm Modeling System (CoSMoS) version 3.0 was applied by the United States Geological Survey (USGS) to the southern California Bight,[2]~~,~~ which includes the City of Santa Barbara (Erickson et al, 2017). This version of CoSMoS addresses coastal erosion and flooding hazards included in the prior Coastal Resilience Project (County of Santa Barbara), but applies different methods and assumptions. Technical reports, maps and data are available on-line at the CoSMoS 3.0 weblink.[3]

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1 http://maps.coastalresilience.org/california/#

2 The southern California Bight is the curved coastline of Southern California from Point Conception to San Diego.

3 https://www.sciencebase.gov/catalog/item/589ccbf1e4b0efcedb772583

Appendix B

Sea-Level Rise Scenario Preliminary Recommendations and Summary of Policy Guidance (ESA, April 2, 2018)

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memorandum

date March 26, 2018 (revised April 2, 2018)

to Melissa Hetrick, City of Santa Barbara

from Louis White, PE

subject Sea-Level Rise Scenario Preliminary Recommendations and Summary of Policy Guidance: City of Santa Barbara Sea-Level Rise Adaptation Plan for the Local Coastal Program Update

The purpose of this memorandum is to facilitate selection of sea-level rise scenarios for the City of Santa Barbara Sea-Level Rise Adaptation Plan for the Local Coastal Program Update project. It is Environmental Science Associate's (ESA) understanding that the City of Santa Barbara (City) and the California Coastal Commission (CCC) staff will review this memo and select the scenarios for the project. Therefore, ESA has recommended sea-level rise scenarios (Section 4, Table 5) and documented the reasons for the recommended scenarios in this memo. ESA has also included a summary of State and Federal policy guidance and other relevant information. ESA is available to discuss this document based on direction from the City including comments from the CCC staff. This document is not authorized for public release except at the discretion of the City of Santa Barbara.

1. Introduction

This memo includes recommendations for selecting sea-level rise amounts and time horizons based on different projections of sea-level rise over time as a function of greenhouse gas emissions. This memo also relates the sea-level rise scenarios used in prior work by ESA and the United States Geological Survey (USGS) to the recently updated California sea-level rise guidance. Based on this information, ESA will assist the City to select the sea-level rise scenarios to be used in the project. ESA recommends two planning horizon timeframes (i.e., 2060, 2100) and two sea-level rise scenarios that account for variable greenhouse gas emissions and risk aversion, and a third extreme emission scenario for one timeframe (H++ scenario). See Section 4 for details on the recommended scenarios. Note that a subsequent memo will be prepared that discusses the hazard map products, including assumptions on storms, shore protection, and other issues such as beach nourishment; this memo is focused on sea-level rise scenarios.

2. Summary of Prior Sea-Level Rise Hazard Mapping Studies in Santa Barbara

ESA and USGS have previously assessed the impacts of sea-level rise on the Santa Barbara coast. ESA conducted sea-level rise hazard mapping, including the erosion and flooding hazards, in collaboration with Santa Barbara County, as well as the City of Santa Barbara (ESA 2015; 2016a; 2016b). The USGS also recently released the Coastal Storm Modeling System (CoSMoS) 3.0 study (Phase 2), which includes similar hazard mapping along the Southern California coast, including the city of Santa Barbara. Although the methods used in the studies differ, both studies predict increased areas impacted by erosion and flooding with sea-level rise as compared to existing conditions. The approach in integrating sea-level rise policy differs, however, where the ESA studies present scenario-based hazard maps informed by the recommended sea-level rise policy guidance, and the USGS study presents results for a discrete range of sea-level rise amounts independent of time. How each of these studies incorporated sea-level rise is described in the following sections.

2.1 Santa Barbara County and City Coastal Hazard Mapping by ESA

ESA worked with Santa Barbara County to prepare coastal hazard maps with sea-level rise to inform the County's Local Coastal Program (LCP) update (ESA 2015; 2016b). The process involved several stakeholders and local science advisors. The sea-level rise scenarios were based on those presented in National Research Council's report *Sea-Level Rise for the Coasts of California, Oregon, and Washington* (NRC 2012), with modified rates of vertical land motion to account for the variable geology along the Santa Barbara coastline. In areas mapped within the limits of the city of Santa Barbara, a single value of vertical land motion of -1.5 mm per year (the negative value indicates subsidence) was used, which conforms with the values reported in NRC (2012), OPC (2013), and CCC (2015). Based on ESA's interpretation of the new OPC (2018) guidance described in Section 3, the prior work is also consistent with the new sea-level rise projections of OPC (2018).

The planning horizons for the project were selected by the stakeholder process, which recommended presenting hazard data for the years 2030, 2060 and 2100. The basis for selecting 2060 was that it represents a mid-century horizon that occurs prior to years where the uncertainty in the projections becomes more evident. The selection of the years 2030 and 2100 were consistent with state guidance at the time of the study (OPC 2013; see section 3.2).

Based on feedback from the City of Santa Barbara, ESA refined the hazard maps to include the effects that existing shore protection would have on the hazard extents (ESA 2016a). ESA developed a methodology for considering the protective nature of coastal structures, and assumed that the structures would be maintained throughout the forecasting period. This resulted in hazard areas that were reduced, but not eliminated, owing to overtopping of the structures that increases with the rise in sea-level.

2.2 CoSMoS Southern California 3.0

As part of the USGS effort to expand the CoSMoS along the west coast, the recent 3.0 Phase 2 study was completed for the Southern California coast, which includes the extents of the city of Santa Barbara (Barnard et al. 2015). Rather than computing the hazard extents for sea-level rise based on the current policy guidance, the CoSMoS approach computes the hazard extents for several discrete values of sea-level rise, independent of time. Sea-level rise amounts from 0 to 2 meters were used, at 0.25 meter increments. Table 1 presents a conversion of the sea-level rise amounts from metric to English units.

TABLE 1
METRIC-ENGLISH CONVERSION OF SEA-LEVEL RISE AMOUNTS SIMULATED BY COSMOS

Case	1	2	3	4	5	6	7	8	9
Meters	0	0.25	0.5	0.75	1	1.25	1.5	1.75	2
Feet	0	0.8	1.6	2.5	3.3	4.1	4.9	5.7	6.6

3. Sea-Level Rise Policy Guidance

The sections below present State and Federal guidance on sea-level rise.

3.1 State Guidance on Sea-Level Rise

The California Ocean Protection Council (OPC) first released a statewide sea-level rise guidance document in 2010 following Governor Schwarzenegger's executive order S-13-08. This interim guidance document informed and assisted state agencies to develop approaches for incorporating sea-level rise into planning decisions. The document was updated in 2013 (OPC 2013) after the NRC released its final report *Sea-Level Rise for the Coasts of California, Oregon, and Washington* (NRC 2012), which provided three projections of future sea-level rise associated with low, mid, and high greenhouse gas emissions scenarios, respectively.

The CCC adopted sea-level rise policy guidance in 2015 (CCC 2015). The document recommends using a range of climate change scenarios (i.e., emissions scenarios) at multiple planning horizons for vulnerability and adaptation planning. The guidance presents a step-by-step process for addressing sea-level rise and adaptation planning in updated LCPs (CCC 2015, p 18). This memo focuses on the first step of the CCC recommended process: Determine a range of sea-level rise projections relevant to LCP planning area/segment using best-available science. At the time of the CCC (2015) report, NRC (2012) was included in State policy by OPC (2013). Since then, California commissioned an update (Griggs et al. 2017) and released an update to the sea-level rise policy in March 2018. Consequently, a key question is how to select the "best available science" and incorporate changes in the State Policy update. Additional information is provided in the following sections of this document.

3.1.1 Guidance on Climate Change and Sea-Level Rise Scenarios

The accumulation of greenhouse gases in the Earth's atmosphere is causing and will continue to cause global warming and resultant climate change. For the coastal setting, the primary exposure will be an increase in mean sea-level rise due to thermal expansion of the ocean's waters and melting of ice sheets.

State planning guidance for coastal flood vulnerability assessments call for considering a range of emission scenarios (OPC 2013; CCC 2015). These scenarios bracket the likely ranges of future greenhouse gas emissions and ice sheet loss, two key determinants of climate whose future values cannot be precisely predicted. Scenario-based analysis promotes the understanding of impacts from a range of emission scenarios and identifies the amounts of climate change that would cause impacts.

The state guidance recommends using emission scenarios that represent low, medium, and high rates of climate change. Recent studies of current greenhouse gas emissions and projections of future loss of ice sheet indicate that the low scenario probably underrepresents future sea-level rise (Rahmstorf et al. 2012; Horton et al. 2014). Also, note that even if sea-level rise does not increase as fast as projected for the high scenario, sea-level rise is projected to continue beyond 2100 under all emission scenarios. The assumptions that form the basis for the NRC (2012) scenarios are as follows:

Low Emissions Scenario – The low scenario assumes population growth that peaks mid-century, high economic growth, and assumes a global economic shift to less energy-intensive industries, significant reduction in fossil fuel use, and development of clean technologies.

Medium Emissions Scenario – The medium scenario assumes population growth that peaks mid-century, high economic growth, and development of more efficient technologies, but also assumes that energy would be derived from a balance of sources (e.g., fossil-fuel, renewable sources), thereby reducing greenhouse gas emissions.

High Emissions Scenario – The high scenario assumes population growth that peaks mid-century, high economic growth, and development of more efficient technologies. The associated energy demands would be met primarily with fossil-fuel intensive sources.

Table 2 presents sea-level rise projections for prior State guidance of OPC (2013) based on NRC (2012). The values for relative sea-level rise[1] at 2030, 2050 and 2100 for Los Angeles[2] are relative to 2000 and includes regional projections of both mean sea-level rise and vertical land motion of -1.5 millimeters per year for the San Andreas region south of Cape Mendocino.

TABLE 2
OPC (2013) STATE GUIDANCE: SEA-LEVEL RISE PROJECTIONS FOR SOUTHERN CALIFORNIA

Scenario	2030	2050	2100
Low Range	0.2 feet	0.4 feet	1.5 feet
Mid Curve	0.5 feet	0.9 feet	3.1 feet
High Range	1.0 feet	2.0 feet	5.5 feet

Source: Table 5.3, NRC (2012)

3.1.2 Sea-Level Rise Guidance Update of 2018

The California Natural Resource Agency and OPC released 2018 guidance update (OPC 2018) to the 2013 State of California guidance document (OPC 2013). The updated guidance provides a synthesis of the best available science on sea-level rise in California, a step-by-step approach for state agencies and local governments to evaluate sea-level rise projections, and preferred coastal adaptation strategies. The key scientific basis for this update was developed by the working group of the California OPC Science Advisory Team titled *Rising Seas in California: An Update on Sea-Level Rise Science* (Griggs et al. 2017). The above mentioned studies and guidance documents are shown in Figure 1 to illustrate the relationship between these documents.

[1] The term “relative sea-level rise” indicates that the local effects of vertical land motion are included in the sea-level rise projection,
[2] Los Angeles relative sea-level rise amounts are in closest proximity to city of Santa Barbara

Figure 1
California Sea-level Rise Guidance Documents and Scientific Basis for Each

The 2018 guidance update includes the following key changes and additions to the OPC (2013) guidance:

- **For years before 2050, sea-level rise projections are provided only for the high emissions scenario (RCP 8.5).** The world is currently on the RCP 8.5 trajectory, and differences in sea-level rise projections under different scenarios are minor before 2050.

- **Includes new "extreme" sea-level rise projections associated with rapid melting of the West Antarctic ice sheet.**

- **Shifts from scenario-based (deterministic) projections to probabilistic projections of sea-level rise.** The guidance update recommends a range of probabilistic projections for decision makers to select given their acceptable level of risk aversion for a given project.

- **Provides estimated probabilities of when a particular sea-level rise amount will occur.** In addition to sea-level rise projections that are tied to risk acceptability, updated guidance provides information on the likelihood that sea-level rise will meet or exceed a specific height (1 foot increments from 1 to 10 feet) over various timescales.

The guidance update includes significant advances in the scientific understanding of sea-level rise. Compared to the ***scenario-based*** sea-level rise projections in the 2013 version of state guidance, the updated guidance incorporates ***probabilistic*** sea-level rise projections, which associate a likelihood of occurrence (or probability) with various sea-level rise heights and rates into the future and are directly tied to a range of emissions scenarios (described below). Using probabilistic sea-level rise projections is currently the most appropriate scientific approach for policy setting in California, providing decision makers with increased understanding of potential sea-level rise impacts and consequences. The guidance update also includes an extreme sea-level rise scenario that is based on rapid melting of the West Antarctic ice sheet.

The guidance update now provides a range of probabilistic projections of sea-level rise that are based on two Intergovernmental Panel on Climate Change (IPCC) emissions scenarios called representative concentration pathways (RCPs[3]), as well as a non-probabilistic projection associated with rapid West Antarctic ice sheet mass loss. These three climate scenarios are explained below:

RCP 2.6 *Scenario* – This scenario corresponds closely to the aspirational goals of the 2015 Paris Agreement, which calls for limiting mean global warming to 2 degrees Celsius and achieving net-zero greenhouse gas emissions in the second half of the century. This scenario is considered very challenging to achieve, and is analogous to the low emissions scenario in NRC (2012).

RCP 8.5 *Scenario* – This scenario is consistent with a future where there are no significant global efforts to limit or reduce emissions. This emission scenario is consistent with that used to develop the high emissions scenario in NRC (2012).

H++ Scenario – This extreme scenario was proposed by the OPC Science Advisory Team in response to recent scientific studies that have projected higher rates of sea-level rise due to the possibility of more rapid melting of ice sheets.

Table 3 presents the probabilistic projections of sea-level rise for Santa Barbara with additional probabilities for the RCPs and the non-probabilistic H++ scenario (depicted in blue on the right-hand side). High emissions scenario represents RCP 8.5; low emissions scenario represents RCP 2.6. Because differences in sea-level rise projections under the various emissions scenarios are minor before 2050, the update only provides RCP 8.5 projections of sea-level rise up to 2050. **State-recommended projections for use in low, medium-high and extreme risk aversion decisions are outlined by dark blue boxes in Table 3.** The State suggests that decision makers take a precautionary, risk-averse approach of using the medium-high sea-level rise projections across the range of emissions scenarios for longer lasting projects with low adaptive capacity[4] and high consequences[5]. The State further recommends incorporating the H++ scenario in planning and adaptation strategies for projects that could result in threats to public health and safety, natural resources and critical infrastructure such as large power plants, wastewater treatment, and toxic storage sites. The probabilities included in Table 3 do not represent the actual probabilities of occurrence of sea-level rise, but provide probabilities that the ensemble of climate models used to estimate the contributions of sea-level rise will predict a certain amount of sea-level rise (OPC 2018).

[3] Named for the associated radiative forcing (heat trapping capacity of the atmosphere) level in 2100 relative to pre-industrial levels.
[4] Adaptive capacity is the ability of a system or community to evolve in response to, or cope with the impacts of sea-level rise.
[5] Consequences are a measure of the impact resulting from sea level rise, typically quantitative.

TABLE 3
OPC (2018) STATE GUIDANCE: PROJECTED SEA-LEVEL RISE FOR SANTA BARBARA IN FEET

		Probabilistic Projections (in feet) (based on Kopp et al. 2014)					H++ scenario (Sweet et al. 2017) *Single scenario
		MEDIAN	LIKELY RANGE		1-IN-20 CHANCE	1-IN-200 CHANCE	
		50% probability sea-level rise meets or exceeds...	66% probability sea-level rise is between...		5% probability sea-level rise meets or exceeds...	0.5% probability sea-level rise meets or exceeds...	
				Low Risk Aversion		Medium - High Risk Aversion	Extreme Risk Aversion
High emissions	2030	0.3	0.2 -	0.4	0.5	0.7	1.0
	2040	0.5	0.3 -	0.7	0.8	1.1	1.6
	2050	0.7	0.4 -	1.0	1.2	1.8	2.5
Low emissions	2060	0.7	0.4 -	1.0	1.4	2.2	
High emissions	2060	0.9	0.6 -	1.3	1.6	2.5	3.6
Low emissions	2070	0.9	0.5 -	1.3	1.7	2.8	
High emissions	2070	1.1	0.7 -	1.7	2.1	3.3	4.9
Low emissions	2080	1.0	0.5 -	1.5	2.0	3.6	
High emissions	2080	1.4	0.9 -	2.1	2.7	4.3	6.3
Low emissions	2090	1.1	0.6 -	1.8	2.4	4.4	
High emissions	2090	1.7	1.1 -	2.6	3.3	5.3	7.9
Low emissions	2100	1.2	0.6 -	2.0	2.9	5.3	
High emissions	2100	2.1	1.2 -	3.1	4.1	6.6	9.8
Low emissions	2110*	1.3	0.7 -	2.1	3.0	5.9	
High emissions	2110*	2.2	1.4 -	3.2	4.2	6.9	11.5
Low emissions	2120	1.4	0.7 -	2.4	3.5	7.0	
High emissions	2120	2.5	1.7 -	3.7	4.9	8.2	13.7
Low emissions	2130	1.5	0.8 -	2.6	3.9	8.0	
High emissions	2130	2.9	1.8 -	4.2	5.6	9.5	16.0
Low emissions	2140	1.6	0.8 -	2.9	4.4	9.1	
High emissions	2140	3.1	2.0 -	4.8	6.4	11.0	18.6
Low emissions	2150	1.8	0.7 -	3.2	5.0	10.5	
High emissions	2150	3.5	2.2 -	5.3	7.2	12.6	21.4

**Most of the available climate model experiments do not extend beyond 2100. The resulting reduction in model availability causes a small dip in projections between 2100 and 2110, as well as a shift in uncertainty estimates (see Kopp et al. 2014). Use of 2110 projections should be done with caution and with acknowledgement of increased uncertainty around these projections.*

Source: OPC (2018)

The H++ projection is a single scenario and does not have an associated likelihood of occurrence as do the probabilistic projections. Probabilistic projections are with respect to a baseline of the year 2000, or more specifically the average relative sea level over 1991 - 2009.

3.2 Federal Guidance

The US Army Corps of Engineers (USACE) issued circular EC 1100-2-8162 in December 2013, which provides guidance for the incorporation of direct and indirect physical effects of projected future sea-level rise (USACE 2013). This circular superseded all previous USACE-issued guidance on the subject, including the prior guidance issued (USACE 2011). According to the circular, planning studies and engineering designs should evaluate alternatives against a range of local sea-level rise projections defined by "low," "intermediate" and "high" rates of local sea-level rise. The USACE circular suggests using three sea level curves (historic and NRC-I and NRC-III from NRC 1987) modified to reflect the increase in the present rate of global sea-level rise to 1.7 mm per year. USACE (2013) provided guidance on how to incorporate local vertical land motion into the "intermediate" and "high" projections of sea-level rise. Additional guidance can be found in USACE (2014).

In comparison to the State guidance described above, the USACE recommended curves are slightly lower for the respective emissions scenarios. Table 4 presents a summary of the sea-level rise projections at 2030, 2060, and 2100 using the USACE (2013) guidance for values associated with Santa Barbara.[6] For purposes of this study, we recommend using sea-level rise projections that comply with the State guidance. However, consideration should also be given to the Federal guidance owing to the possibility of a USACE participation in adaptation of the Santa Barbara Harbor as well as the sand management plan which includes maintenance dredging and sand bypassing by the USACE.

TABLE 4
SEA-LEVEL RISE PROJECTIONS FOR SANTA BARBARA USING USACE (2013) GUIDANCE

Scenario	2030	2060	2100
Low	0.1 feet	0.2 feet	0.4 feet
Intermediate	0.4 feet	1.0 feet	2.1 feet
High	0.8 feet	2.3 feet	5.4 feet

Note: Values computed using methods described in USACE (2013) with parameters specific to Santa Barbara area. See footnote #6 below.

3.3 Comparison and Combination of Federal and State Guidance

Sea-level rise scenarios for projects similar to the Santa Barbara Sea-Level Rise Adaptation Plan have been based on a combination of State and Federal guidance. The Coastal Resilience Ventura project used three sea-level rise projections to represent the high, medium, and low scenarios: NRC (2012) high, NRC (2012) medium, and USACE (2011) medium, respectively. The sea-level rise hazard mapping conducted in Santa Barbara was similar to the work completed for the Coastal Resilience Ventura project, but the high, medium, and low sea-level rise curves were all derived from the NRC (2012) values and adjusted for local vertical land motion to conform to the OPC (2013) guidance, which was in effect at the time of the study.

Figure 2 presents a comparison of the updated OPC (2018) sea-level rise guidance to the federal USACE (2013) guidance. The solid, colored lines represent the projections of the new OPC (2018) guidance, and the dashed, colored lines represent the USACE (2013) sea-level rise scenarios for Santa Barbara. The low curve for USACE (2013) is not shown. Figure 2 illustrates that the USACE (2013) high sea-level rise curve generally falls within the range of values for the medium-high risk aversion from the OPC (2018) guidance, while the USACE (2013) intermediate sea-level rise curve falls within the range of values for the low risk aversion from the OPC (2018). The low scenario for the USACE (2013) is lower than the recommended projections described by the current State guidance, and not recommended for evaluation in this study (see Section 4). However, the USACE often

[6] Sea-level rise projections using the USACE (2013) guidance assume a project start at 2000 to facilitate comparison to State guidance; a subsidence rate of -1.5 mm/yr based on NRC (2012); and a historic sea-level rise rate of 1.11 mm/yr based on NOAA values for Santa Barbara NOS station 9411340.

considers the USACE (2013) low curve for evaluating federal navigation channel dredging projects, and so could be used for project-specific purposes.

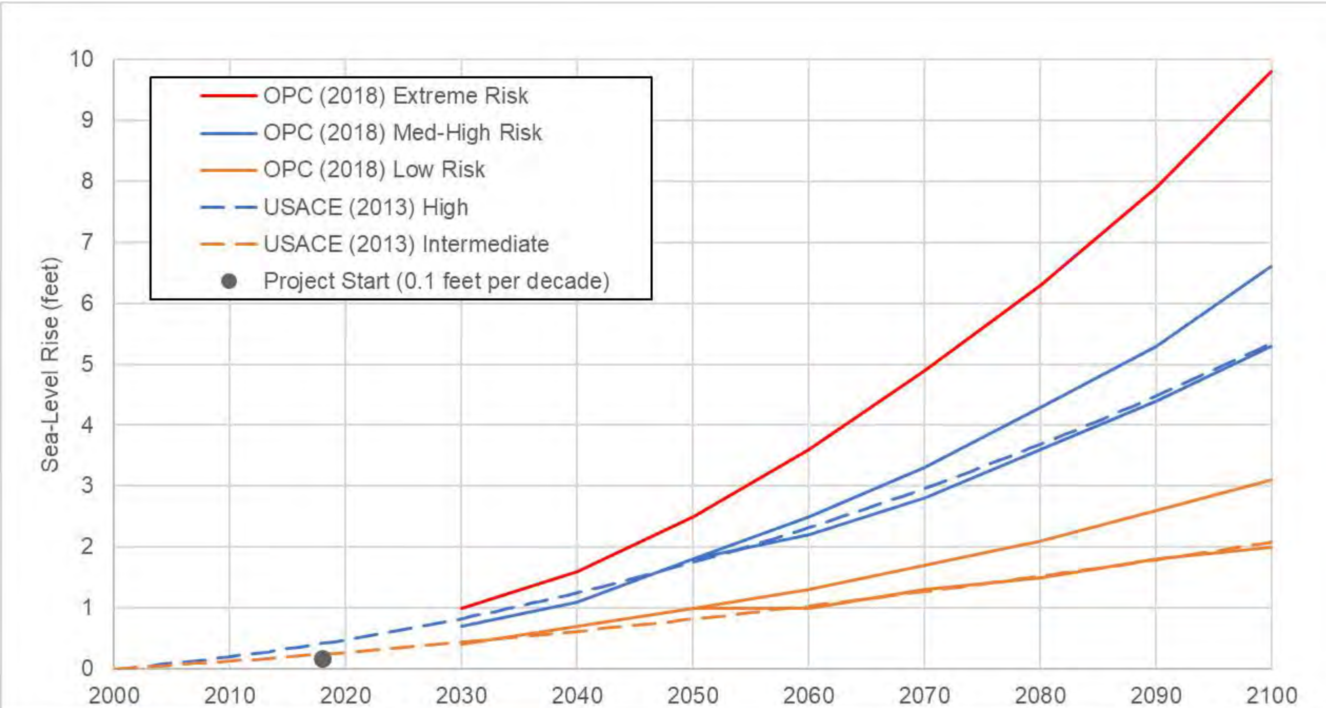

Figure 2
Comparison of Federal (USACE 2013) and State (OPC 2018) Sea-Level Rise Projections

4. Sea-Level Rise Scenarios for Santa Barbara Vulnerability Assessment

Considering the updated guidance discussed above, public webinars on the guidance update process[7], the latest science on sea-level rise and the need to use existing sea-level rise hazard data for Santa Barbara, the following planning horizons and sea-level rise scenarios are proposed for the Santa Barbara Sea-Level Rise Adaptation Plan.

4.1 Planning Horizons

ESA proposes the planning horizons of 2030, 2060, and 2100 for the purposes of the project. ESA's recommendation is based on the need to plan for short- and long-term impacts related to sea-level rise, as well as the fact that available coastal hazard maps were developed for these planning horizons (ESA 2015; ESA 2016a). Most climate models show strong agreement on the amount of sea-level rise that is likely to occur by 2050, and start to diverge after 2050 based on the range of potential emissions scenarios (OPC 2013). Therefore, it is important to consider a range of sea-level rise scenarios for future planning and projects with timeframes and to look beyond 2050.

[7] More information can be found here: http://www.opc.ca.gov/climate-change/updating-californias-sea-level-rise-guidance/

The proposed planning horizons are consistent with sea-level rise policy guidance documents and consistent with recent hazard mapping performed for Santa Barbara (ESA 2015; ESA 2016a). Years 2060 and 2100 will be used to evaluate vulnerability, adaptation, and associated economic impacts, while the year 2030 will be assessed in a qualitative manner without an economic and asset-level impact analysis. An extreme sea-level rise scenario will be assessed by considering the impacts associated with the medium-high risk level occur earlier, approximately between 2075 and 2080. The updated guidance introduces planning horizons beyond 2100 but these projections are presented with caution by the authors. As described in OPC (2018), most climate model experiments do not extend beyond 2100, which results in a large increase in uncertainty. Therefore, ESA has not presented sea-level rise amounts projected beyond 2100.

The 2060 and 2100 planning horizons are recommended so that decisions about land use can be matched to the timeframe for project lifespans and to facilitate the identification of triggers for adaptation measures. By using the planning horizons of 2060 and 2100, we can assess a range of sea-level rise that could occur at Santa Barbara in the mid and long-term whether or not the amounts of sea-level rise are realized at, before or after these years. These planning horizons (years) will determine the amounts of sea-level rise that are used to assess vulnerability to coastal flooding hazards and the timeframes over which coastal erosion hazards and consequent impacts are evaluated. These dates also correspond to existing hazard mapping products prepared for the city of Santa Barbara.

4.2 Sea-level Rise Scenarios

The sea-level rise scenarios proposed for this study were selected to be consistent with the latest guidance and to utilize available coastal hazard maps for Santa Barbara. Recent studies conducted for Santa Barbara County (ESA 2015) and the City of Santa Barbara (ESA 2016) applied the regional sea-level rise projections from NRC (2012), which were modified to incorporate local rates of vertical land motion (see Section 2). As shown in Section 3, these scenarios are consistent with the new OPC (2018) guidance.

Now that the State guidance update is in-effect, ESA proposes that this study consider the probabilistic projections of sea-level rise for low risk and medium-high risk aversion scenarios, as well as consideration of the H++ scenario. For comparison, the low and medium-high risk categories relate to the medium and high scenarios of NRC (2012), respectively, and therefore the low curve of NRC (2012) is not considered. To account for uncertainties in sea-level rise over time, and a range of assets at risk (e.g., high risk assets include critical community facilities, such as a wastewater treatment plant; low risk assets could include recreational assets and non-critical assets), ESA proposes to utilize the probabilistic projections for each Risk Aversion level from Table 3. A total of six sea-level rise scenarios are proposed to perform the vulnerability assessment and adaptation plan, including existing conditions (no sea-level rise) as well as future sea-level rise at 2060 and 2100. Table 5 below presents the proposed future sea-level rise scenarios based on the State-recommended projections for each Risk Aversion level. The implications of sea-level rise impacts to assets and possible adaptation for the 2030 timeframe will be considered at a high level without conducting an asset inventory and economic analysis, but will be described to provide context and for completion.

TABLE 5
PROPOSED SEA-LEVEL RISE SCENARIOS FOR PROJECT

Scenario	2030	2060	2075	2100
Low Risk Aversion[1]	0.4 feet	1.0 to 1.3 feet	--	2.0 to 3.1 feet
Med-High Risk Aversion[2]	0.7 feet	2.2 to 2.5 feet	--	5.3 to 6.6 feet
Extreme Risk Aversion	--	--	5.3 to 6.6 feet	--

1 Low Risk Aversion approximately equal to NRC (2012) Medium Curve
2 Med-High Risk Aversion approximately equal to NRC (2012) High Curve

In order to conduct the vulnerability assessment, ESA will rely on the available coastal hazard maps from the USGS CoSMoS effort and ESA's prior work for the County and City of Santa Barbara. Hazard maps will be selected that best match the sea-level rise scenarios presented in Table 5 above. While the CoSMoS and ESA coastal hazards selected for the vulnerability assessment do not exactly match the proposed sea-level rise scenarios in Table 5, the differences are acceptable given the uncertainties associated with sea-level rise. A subsequent memo will present the hazard mapping information and facilitate a decision by the City for how to consider erosion and flood hazards.

Figure 3 presents a chart of the sea-level rise projections based on the current OPC (2018) guidance and the available hazard maps that can be used for vulnerability and adaptation planning. The available maps were produced by ESA for the City and County of Santa Barbara, and by USGS as part of the CoSMoS 3.0. Although maps were not evaluated at the exact sea-level rise amounts of OPC (2018) tabulated in Table 3, they are representative of the new guidance within a reasonable amount of uncertainty.

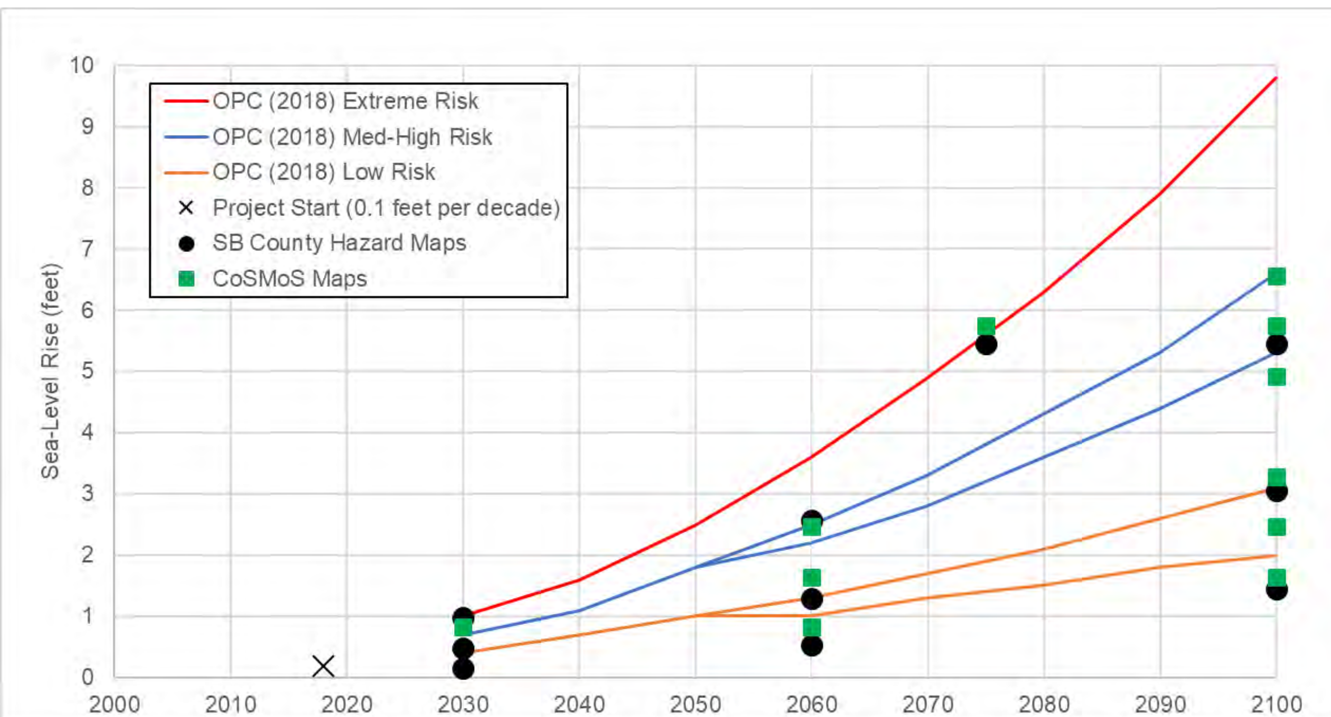

Figure 3
Comparison of Available Hazard Maps to Updated OPC (2018) Sea-Level Rise Guidance Curves

The Extreme Risk sea-level rise scenario of 9.8 feet at 2100 is not well represented in the available coastal hazard maps. This scenario will be evaluated by considering that the highest sea-level rise scenario modeled will occur at the time indicated in the Extreme Risk Aversion sea-level rise projection shown in Figure 3. Table 5 summarizes the potential sea level rise scenarios to be modeled, including the extreme H++ scenario that occurs at approximately 2075. These values can be modified based on review by the City and the CCC.

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Appendix C
Coastal Hydrology

1 COASTAL HYDROLOGY

The City of Santa Barbara lies along the Pacific coast of California, at the north end of the Southern California Bight. It is exposed to regular tidal variation and wave action from local and distant storms. The following sections summarize the tidal elevations, wave climate, typical wave runup conditions, and extreme water levels that have been reported for the project area in existing studies.

1.1 Tides

The tides in Santa Barbara exhibit mixed semi-diurnal characteristics, with two high tides and two low tides of unequal height occurring approximately every 24 hours. The tide range along the project site varies from approximately 4 feet during neap tides to approximately 9 feet during spring tides. Table 1 presents the published tidal datums for the Santa Barbara tide gage (NOAA NOS Station 9411340), located at the end of the City Pier in the Santa Barbara harbor.

TABLE 1
TIDAL DATUMS FOR SANTA BARBARA AND OTHER RELEVANT WATER LEVELS

Datum	Description	feet NAVD
Max	Highest Observed Tide (12/13/12)	7.54
HAT	Highest Astronomical Tide (12/2/90)	7.14
SHT	Spring High Tide (11/6/10)	6.80
MHHW	Mean Higher High Water	5.31
MHW	Mean High Water	4.55
MTL	Mean Tide Level	2.72
MSL	Mean Sea Level	2.70
MLW	Mean Low Water	0.89
MLLW	Mean Lower Low Water	-0.09
LAT	Lowest Astronomical Tide (1/1/87)	-2.09

Source: NOAA NOS Sta.9411340

Typical "high tide" flooding is projected using the monthly Extreme Monthly High Water (EMHW). This value was computed by averaging the maximum monthly water level for every month recorded at the Santa Barbara tide gauge (EMHW = 2.0 meters (6.6 ft) NAVD88) (ESA, 2016, ESA, 2015). This water level can therefore be thought of as the "monthly return period" ocean water level. This water level is identified as a frequency of inundation (about 12 times a year) that would impact land use: Similar thresholds but with different elevations and frequencies have become prevalent in recent years (e.g. about 26 times a year "high tide" [1] and once to twice a year "King Tide"[2]).

1.2 Waves

The incident wave climate at the City of Santa Barbara is highly seasonal, with the greatest exposure to long-period winter swells from the west. The Santa Barbara coast is generally sheltered by the summer south swells generated in the South Pacific. Shorter period storm waves from the southeast have caused significant impacts, particularly when combined with elevated water levels typical of El Niño winters.

The shore orientation and sheltering by the Channel Islands results in a narrow primary swell window from the west, and a second window from the southeast that can be occasionally quite damaging due to strong winds (e.g. March, 1983) and rare nearby tropical storm (Hurricane Marie, August 2014) Additional information can be found in the Coastal Resilience Santa Barbara technical reports (ESA, 2015; 2016; 2016b).

1.3 Extreme Water Levels

Santa Barbara is exposed to extreme water levels during storms, which can cause extensive if temporary flooding in the city. The Rincon Island tide gauge[3], an offshore gauge maintained by NOAA, is between the city of Santa Barbara and Ventura. Based on recorded water levels from this gauge, NOAA estimates an offshore still water level of 8.13 feet NAVD88. While this value is not identical to the CoSMoS data, the "storm" data reported by CoSMoS is described as the "near 100-year" event and is thus similar. More information can be found in the memo titled "Summary of Selected Methodology for Hazard Mapping – City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update" (ESA, 2018). Additional information can be found in the Coastal Resilience Santa Barbara technical reports (ESA, 2015; ESA, 2016; ESA, 2016b).

1.4 Relevant Features of FEMA Hazard Mapping

The FEMA map shows flooding due to rainfall and ocean sources that recur on average about once in 100 years. However, the extent of flooding shown is not expected to occur all at once because the 100-year rainfall event and the 100 –year ocean event do not occur at the same time. Also, a particular location may be exposed to flooding by multiple 100-year events: For example, Andree Clark Reserve can flood when high rainfall results in the 100-year flowrate on Sycamore Creek and water flows overland, with flooding also projected on US 101. The Andree Clark area can also flood when large ocean waves break during high ocean levels and the residual wave runup overtops the road and deposits water into the wetland basin. When an area is projected to flood from more than one source, the more extreme flood depth or elevation is mapped.

Another nuance in flood mapping is that each creek and each section of shore may flood differently and during different events. For example, the Mission Creek watershed is much larger than the Arroyo Burro

[1] https://tidesandcurrents.noaa.gov/publications/techrpt86_PaP_of_HTFlooding.pdf
[2] https://oceanservice.noaa.gov/facts/kingtide.html
[3] Rincon Island tide gage NOAA Sta. 9411270: http://tidesandcurrents.noaa.gov/est/est_station.shtml?stnid=9411270

watershed, requiring different rainfall durations and intensities to achieve the 100-year flowrate. Hence it is possible to have one drainage experience a 100-year flowrate and flood while a nearby drainage experiences a flowrate with a lower or higher recurrence interval (e.g. 50-year or 150-year). Similarly, shores in Santa Barbara are more or less exposed to particular wave events. The primary wave exposure is from westerly swell albeit reduced in intensity due to the oblique angle between westerly waves and the south-facing Santa Barbara shore. The western and eastern portions of Santa Barbara are more exposed to these west swells due to their more westerly shore orientation, while Leadbetter Beach and West Beach are more exposed to waves from the southeast which are typically generated by local storms (Moffatt & Nichol, 1987).

Flood and erosion events are partly correlated with storms that occur during the El Nino phase of the El Nino – Southern Oscillation (ENSO) climatic fluctuation which occurs about every five to seven years with widely ranging intensity: High intensity El Nino conditions occurred in 1982-83 and 1997-98, with moderate intensity more recently in 2010 and 2016 (Seymour, 1983; Barnard et al, 2017). El Nino intensity may be elevated during the "warm" phase of the Pacific Decadal Oscillation (PDO) that is estimated to have a periodicity of about 30 to 50 years, also with varying intensity (Bromirski et al, 2012). During strong El Nino conditions, the storm tracks drop to lower latitudes closer to southern California, resulting in high precipitation, larger breaking waves and storm surge (NRC, 1984). El Nino also temporarily perturbs the circulation in the Pacific Ocean which results in higher ocean levels on the entire west coast (OPC, 2015). Therefore, Santa Barbara is more likely to flood from both rainfall and ocean sources during El Nino conditions. However, the timing of high rainfall and high ocean levels and waves are not completely correlated, and their "joint probability" of simultaneous occurrence at the 100-year or other extreme level is low. From an engineering perspective, the partial correlation is often represented by assuming a peak river flowrate occurs during a moderately elevated ocean level: For example, a 100-year creek flowrate may be modeled with an ocean level with a 1 year to 10-year recurrence, and a 100-year coastal event may be modeled with a 1 year to 10 year creek flowrate where pertinent. The treatment of partial correlation and joint probability in flood mapping is further explained in Garrity et al, 2016 and FEMA, 2015.

In summary, the FEMA flood map shown in Appendix D is a compilation of 100-year flood events computed for Arroyo Burro Creek, Mission Creek, Laguna Channel, Sycamore Creek and the Pacific Ocean for the dominant flood source and worst conditions. Additional information can be found in the Flood Insurance Study (FIS) reports that accompany the Flood Insurance Rate Map (FIRM).

Appendix D

Geologic Review of Seacliff Areas (Campbell Geo, Inc.)

CAMPBELL GEO, INC.
ENGINEERING AND ENVIRONMENTAL GEOSCIENCE

Sea Level Rise Adaption Plan for the LCP Update
Geologic Review of Seacliff Areas
City of Santa Barbara, California

August 17, 2018

Submitted to

Environmental Science Associates
550 Kearny Street, Suite 800
San Francisco, CA

Prepared by

CAMPBELL·GEO, INC.
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C A M P B E L L G E O, I N C.
ENGINEERING AND ENVIRONMENTAL GEOSCIENCE

August 17, 2018

Environmental Science Associates
550 Kearny Street, Suite 800
San Francisco, CA

Attention: Mr. Louis White, PE

Subject: Sea Level Rise Adaption Plan
for the LCP Update – Geologic Review of Seacliff Areas
City of Santa Barbara, California

Dear Louis:

INTRODUCTION

This letter report summarizes the results of our geologic review of the sea level rise (SLR) hazard information provided by ESA, including the projected erosion resulting under various SLR scenarios in two current sets of hazard maps: the USGS Coastal Storm Modelling System (CoSMoS 3.0; Erikson et al. 2017) and the Santa Barbara County Coastal Resilience (ESA, 2015). The purpose of our work was to evaluate the geologic and seacliff conditions in the City of Santa Barbara relative to the future bluff top erosion or retreat predicted by the two approaches. We have reviewed and photo documented evidence of active or dormant erosion, relative exposure to wave runup and wave attack, and current (spring/summer 2018) beach sand profiles.

Our comments draw on Campbell·Geo's experience and site specific investigations of numerous coastal bluff properties in the City and County of Santa Barbara. In addition, regional geologic maps (Dibblee, 1966 and 1986; Hoover, 1978; Gurrola, 2002; Minor, 2009; and City of Santa Barbara General Plan, 2013) were reviewed during the course of this evaluation. Among the regional geologic maps we reviewed, the 1999 USGS Landslide Hazard Map (Bezore and Wills) also noted the existence of some landslides at the coastal bluffs, including at El Camino de la Luz and at Sea Ledge Lane.

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GEOLOGY

Regional Setting

The south coast of Santa Barbara County is located on the southern flank of the Santa Ynez Mountains, which make up a portion of the Transverse Range Province of California. The regional geologic structure consists of generally south dipping sedimentary rocks uplifted from the north by tectonic movement, including regional tectonic compression of the Santa Barbara Channel. In the coastal area of the City of Santa Barbara, tectonic movement is evident along the Mesa Fault and the Lavigia Fault, among other east to west trending structures. The uplifted Tertiary age rocks underlying the Mesa area of Santa Barbara are moderately to highly deformed by folding and faulting in the seacliff exposures between Leadbetter Beach and Hope Ranch. The coastal bluff at the Bellosguardo property (the former Clark Estate) is underlain by a Pleistocene debris flow deposit that shows some stratigraphy and is gently folded.

Site Geology: Lithology

The geologic units exposed is the coastal bluff areas are described by Dibblee (1966 and 1986) and Minor (2009), and include the Miocene-age Monterey formation and the Quaternary-age Casitas and marine terrace deposits. Holocene landslides and beach sand is also mapped. Artificial fill was not mapped by Dibblee or Minor, due to the regional nature of their work. Each geologic unit is described below from oldest to youngest.

Monterey Formation (Tm)

The Monterey formation is a white to gray marine siltstone and mudstone that is locally siliceous or cherty, diatomaceous and/or petroliferous. Some sections are moderately to highly fractured and con be accompanied by weathered material. The Monterey outcrop is well exposed at most areas of the seacliff.

Casitas Formation (Qca)

The Pleistocene-age Casitas formation is a moderately consolidated terrestrial alluvial fan (debris flow) deposit composed of pebbles, cobbles and boulders in a matrix of sand, silt and clay (minor). The unit is matrix supported in most locations exposed at the site but some areas are clast supported or are more indurated (hard) due to cementation of the matrix. The Casitas crops out along the lower portion of the seacliff near the Bellosguardo (former Clark Estate) property.

Marine Terrace Deposits (Qmt)

Unconsolidated sand and silt deposits are identified collectively as the marine terrace deposits, which unconformably overlie the Monterey and Casitas formations in roughly 10 to 20-foot thick sections.

Landslide Deposits (Qls)

This unit typically consists of fractured shale, sand, and sticky silt. Many of the shale fragments within the slide masses are relatively soft. Some of the slides are massive failures along daylighted bedding planes (such as the El Camino de la Luz landslide) and deep seated rotational slides. The slope failures at the coastal bluff adjacent to Bellosguardo are rather shallow erosional features.

Artificial Fill (Qaf)

Various amounts of artificial fill are found in the coastal bluff areas, typically associated with leveling building pads. A significant amount of artificial fill was noted at the area seaward of El Camino de la Luz, consisting of broken and regraded shale fragments. That fill is associated with grading of the landslide area that occurred after the 1978 landslide.

Beach Sand (Qbs)

Transitory deposits of beach sand are located from the toe of the seacliffs, typically in areas that extend 20 to as much as 150 feet oceanward. The amount of coverage varies by season and by wave and tidal conditions and is sometimes absent during winter months after high surf and tide events. Beach sand deposits near the eastern edge of the area (at the Bellosguardo revetment and jetties) are currently more stable, based on our observations over the last 15 to 20 years and as evidenced by the development of vegetation near the beach house.

Geologic Structure

The key feature of the seacliffs west of Leadbetter and Santa Barbara Point is the structurally complex folding of the Monterey formation that has resulted exposed sedimentary rock bedding planes with various orientations and angles of dip. In some portions of the coastal bluff in the Santa Barbara area, beds are dipping toward the ocean at an angle that is flatter or less steep than the angle of the slope face. This is called "daylighted" bedding, where the unsupported bedding plane surfaces can form landslides. Where daylighted bedding plane angles are relatively uniform and extensive, slope failures have developed, such as the 1978 landslide at El Camino de la Luz, located to the east of Edgewater Way. At that location, the bedding dips toward the ocean at angles measured to be from 10 to 35 degrees (PML/Weaver, 1978), resulting in a significant daylight condition since those angles are flatter (less steep) than the coastal slope. The western and eastern limits of the 1978 landslide are coincident with geometric changes in the bedding orientation of the Monterey formation planes.

Where the bedding is steeper, and does not exhibit a daylight condition in the bluff face, the slopes are generally more stable over the short term, with wave attack at the toe creating relatively steep slope angles. Bedding angle changes inland of the cliff face, for example where the bedding appears to flatten towards the hinge of an anticline in some areas, may result in daylighted bedding and an increased risk of slope failure and accelerated rate of erosion as the seacliff retreats.

The structure of the Casitas formation in the seacliff at Bellosguardo is a gently folded monocline where the sediments do not exhibit significant stratigraphic differentiation and do not present a significant hazard by failure from translational landslides along bedding planes.

The contact between the Monterey formation, the Casitas formation and the overlying terrace deposits is an angular unconformity. This term means that, in the time period between the deposition of the Monterey and the deposition of the terrace unit, tectonic deformation and erosion of the Monterey occurred before the terrace materials were deposited.

REVIEW OF CURRENT CONDITIONS AND THE SLR HAZARD MAPS

A reconnaissance level examination of current coastal bluff/seacliff conditions was made in May and June, 2018. Selected site photographs annotated with location and the location of the closest CoSMoS model transect number are appended to this letter. The purpose of this field effort was to review current geologic conditions, wave exposure and beach width, and, in combination with previous site specific geologic evaluations, assess the range in projections of future erosion and seacliff retreat presented in the CoSMoS and Coastal Resilience hazard maps.

Our comments are provided on Table I, organized by five separate lateral segments of the seacliff in the City of Santa Barbara from Sea Ledge Lane at the western edge of the city to the Bellosguardo (former Clark Estate) on the east.

The Coastal Resilience bluff erosion hazard maps were based on modeling the interaction of the wave runup elevation with the bluff morphology (ESA 2015). The approach utilizes a threshold approach, where the bluff toe is considered the elevation threshold for wave runup impacts on the bluff. The model estimates the increase in the erosion rate using the following steps: (1) correlate the historic erosion rate to the cumulative occurrence that wave runup elevations (i.e., total water level) exceeds the bluff toe threshold, (2) compute the increase in cumulative occurrence that the wave runup elevations exceed the bluff toe threshold for future conditions with sea level rise, (3) estimate the future erosion rate by scaling the historic erosion rate by the ratio of the future cumulative wave runup exceedance of bluff toe to the existing cumulative wave runup exceedance of the bluff toe. The model generally results in greater increases in the erosion rate for bluffs that are likely to be impacted by waves in the future, but may be less exposed to waves for existing conditions. The model is less sensitive to conditions where the relative change of bluff exposure to waves is small (e.g., bluffs impacted by waves for existing and future conditions). The Coastal Resilience model block-averages transects over sections of shore to account for variations of the erosion rates resulting from locations in different phases of bluff morphology (i.e., steep bluffs prone to erosion, or flatter bluffs that are less prone to erosion – see Young 2017).

In the areas immediately west and east of Arroyo Burro Beach County Park, based on our observations, and reported wave modeling and runup, it appears that the area to the west is less exposed to wave attack under current conditions, where the beach is somewhat wider. On the east, the beach is narrower and there is more wave contact with the toe of the seacliff. As sea level rise accelerates, the seacliff on the west, which now only occasionally is subject to wave attack, will be exposed to a greater change in conditions than the seacliff to the east, which is more frequently contacted by wave runup. In theory, the erosion rate on the west will, therefore, accelerate faster, resulting in a greater response and retreat of the seacliff. This variation is evident in the erosion maps.

Based on our discussions with one of the authors of the USGS CoSMoS model (Dr. Patrick Limber), the CoSMoS bluff recession model is very sensitive to the input parameter of the historic retreat rate. The CoSMoS bluff erosion projections are based on calculations of five different models that are dependent on historic erosion rates, water levels from tides and wave runup, and the shore and bluff morphology (Limber et al. 2018). These models range from simple Bruun-type calculations to more detailed interactions of these parameters. The CoSMoS modeling includes a wave exposure approach that is similar to that used for the Coastal Resilience bluff modeling. Where historic estimated erosion rates are high, the model predicts a much higher future rate and total erosion distance. Conversely, where historic erosion rates are low, the model predicts a relatively low future rate and lower total erosion distance. However, the historic retreat rates are estimated over a large number of locations in Southern California and there is a significant level of uncertainty as would be expected for a regional study. Site specific historic retreat rates (discussed below) are considered to be more accurate.

THREE CASE STUDIES – SITE SPECIFIC INVESTIGATIONSAND COMPARISON TO CURRENT SLR MODELS

We have reviewed the analysis and determination of structure foot print setbacks conducted at three selected sites in the city, based on site specific investigations conducted at various times by Campbell Geo between 2002 and 2012. The investigations were conducted in general conformance with the California Coastal Commission guideline (Johnsson, 2002) and made use of the analysis of historical/current aerial photographs, historical/current surveys, subsurface investigation, geotechnical lab analysis of soil and rock samples and slope stability modelling. The purpose of these studies was to evaluate seacliff retreat and slope stability to determine an appropriate development setback line to accommodate 75 years of retreat. The increase in future retreat rates from the measured historical retreat rate was, at the time of these studies, assumed to be insignificant for the 75 year (or less) project design life. Two of the site specific studies prepared by this office were submitted by private property owners to the City of Santa Barbara to support residential remodeling projects (Medcliff Road and Edgewater Way), both of which were reviewed and approved by the city. We have compared the results of the site specific investigations with the projections of seacliff erosion derived by the CoSMoS and Coastal Resilience models. A summary of the comparison is presented on Table II.

In general, the site specific measurement of seacliff retreat at the toe or the top of the bluffs are lower at the two seacliff areas (Medcliff and Edgewater sites) described above than the CoSMoS top pf bluff historic retreat estimates. At the Bellosguerdo site, the historic rate of retreat based on survey data at the top of the bluff is still significantly higher than the CoSMoS estimate.

CONCLUSIONS

Although the projected future coastal bluff erosion is subject to a great deal of variation based on a wide range of Sea Level Rise scenarios, it is clear that in response to an accelerated rate of rising sea level, the rate of seacliff erosion (retreat) will also increase as the seacliff is exposed to higher wave energies for longer periods of time. The USGS CoSMoS model and the Coastal Resilience Model are sensitive to estimated historical rate of retreat. The CoSMoS model determines the historical rate using regionally mapped shoreline and bluff edge locations, with data that is only accurate to 10 meters (33 feet). That analysis may generate a conservatively high future rate of retreat, and thereby generate unrealistically high future total erosion and retreat of the seacliff edge. Where historic retreat rates are low, the model may generate a lower future rate of retreat. For example, at the Bellosguardo site, the CoSMoS model has used a historic retreat rate that is lower than site specific measurement made after the construction of the rock revetment in the 1980's, which has greatly reduced erosion at the toe temporarily since that time. The top of the bluff has retreated, primarily due to erosional "flattening" of the slope angle, rather than erosion at the toe of the slope, as shown on one of the photos in the appendix to this report.

The variation between site specific historic retreat and the same parameter used in the CoSMoS and Coastal Resilience Models indicates they are useful tools for adaption planning at the regional to community scale. Sea level rise hazard mapping, such as the CoSMoS or Coastal Resilience products, should be periodically updated as actual sea level rise data is measured in the future to check the assumptions of low, medium, and worst case scenarios. To track actual seacliff retreat at the top and the toe, the city may wish to consider establishing a monitoring program based on a handful of survey transect locations (for example at city owned properties such as the Douglas Family Preserve/Wilcox property, Shoreline Park and the

Bellosguardo site) to have a licensed surveyor create detailed profiles on an annual basis or some other interval at the same location(s).

If you have any questions concerning this report, please do not hesitate to contact us.

Sincerely,
Campbell·Geo, Inc.

PROFESSIONAL GEOLOGIST
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Attachments: Tables (2)
Appendices

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TABLE I
SUMMARY AND COMMENTS FOR SEACLIFF EROSION PROJECTIONS
USGS COSMOS AND SB COUNTY RESILIENCE MODELS
City of Santa Barbara, California – August 2018

SEACLIFF AREA	**1. West of Arroyo Burro to Sea Ledge Lane**	**2. East of Arroyo Burro to Loyola Drive**	**3. East of Loyola Drive to Santa Barbara Point**	**4. Leadbetter Seacliff and Beach**	**5. Clark Estate / Bellosguardo**
Geologic Units and Structure	Monterey formation (Tm) overlain by thin marine terrace (Qmt); Tm bedding is daylighted in some areas; large ancient landslide at Sea Ledge Lane	Monterey formation (Tm) overlain by thin marine terrace (Qmt); Tm bedding is daylighted in some areas; large modern landslide at El Camino de la Luz	Monterey formation (Tm) overlain by thin marine terrace (Qmt); Tm bedding is daylighted in limited areas	Monterey formation (Tm) overlain by thin marine terrace (Qmt); Tm bedding is daylighted in some areas; rock revetment and artificial fill slope on east side protecting Shoreline Drive	Casitas formation (Qca) overlain by thin marine terrace (Qmt); rock revetment at toe of slope and two old sheet pile groins trapping beach sand
Wave Exposure at Toe	HIGH	HIGH	HIGH	LOW TO MODERATE	LOW
Beach Width	MODERATE TO NARROW	NARROW	NARROW	NARROW TO WIDE	MODERATE TO WIDE
CoSMoS to SB County Projected Erosion Model Comparisons for the Years 2060 and 2100	2060 - Projections are in fairly good agreement for both models with and w/out armoring	2060 - Projections are in fairly good agreement for both models (except between SB Lighthouse and Loyola Drive)	2060 - Projections are in fairly good agreement for both models with and w/out armoring	2060 - Projections are in fairly good agreement for both models with and w/out armoring	2060 - Projections are in fairly good agreement for both models with and w/out armoring
	2100 - Coastal Resilience hazard maps show greater erosion than CoSMoS	2100 - Coastal Resilience hazard maps show greater erosion between Arroyo Burro and SB Lighthouse but CoSMoS shows greater erosion between Lighthouse and Loyola	2100 - Projections are in fairly good agreement for both models with and w/out armoring	2100 - Projections are in fairly good agreement for both models with and w/out armoring; erosion boundaries east of La Marina Drive need to be considered for accuracy	2100- Projections show zero erosion for both models with armoring, which may not be accurate; the projection without armoring shows higher erosion with Coastal Resilience, but that prediction looks fairly reasonable with removal of the rock revetment/sheet piles

TABLE I
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USGS COSMOS AND SB COUNTY RESILIENCE MODELS
City of Santa Barbara, California – August 2018

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Additional Comments	CoSMoS transects 4030, 4031, and 4032 show the 2010 cliff edge at locations on ancient landslide at Sea Ledge Lane. The CoSMoS predicts zero erosion with armoring at Sea Ledge Lane. Area just west of Arroyo Burro showing very high future total erosion may be due to high historic rate estimated in CoSMoS model and the the absence of the Coastal Resilience block averaging method	Predicted retreat inland of Mesa Lane steps by CoSMoS may be high due to high historic rate estimated in CoSMoS model and the the absence of the block averaging method		Top of pre-SB Harbor seacliff, inland of Leadbetter Beach, Shoreline Drive, and two parking lots needs to be considered for accuracy at CoSMoS transects 3973 and 3975. Much of this area is not subject to wave attack under current conditions, but SLR will cause increased wave contact and accelerated erosion rates	Most of this area is not subject to wave attack under current conditions, but SLR will cause increased wave contact and accelerated erosion rates

TABLE II
COMPARISION OF SEACLIFF EROSION PROJECTIONS
SITE SPECIFIC INVESTIGATIONS, USGS COSMOS, AND COASTAL RESILIENCE MODELS
City of Santa Barbara, California – August 2018

LOCATION AND CLOSEST COSMOS TRANSECT NUMBER	**Medcliff Road – Transect No. 4010**	**Edgewater Way – Transect No. 4002**	**Clark Estate / Bellosguardo – Transect No. 3932**
Historical Erosion Rate (CoSMoS)	0.51 ft/yr	1.06 ft/yr	0.24 ft/yr
Historical Erosion Rate (Coastal Resilience)	1.02 ft/yr	1.02 ft/yr	0.43 ft/yr
Historical Erosion Rate (site specific investigation survey/aerial photos)	0.17 ft/yr (average retreat at toe from 1953 to 2011)	0.2 ft/yr (average retreat at toe from 1953 to 2012)	1.02 ft/yr (top of bluff – 1929 to 1983)(1) 0.36 ft/yr (top of bluff – 1986 to 2001)(2)
Total Future Erosion (Rate) Projected from CoSMoS (4) **2060 – 2.5 ft. SLR; 2100 – 5.5 ft. SLR**	2060 – 58 ft (1.2 ft/yr) 2100 – 102 ft (1.1 ft/yr)	2060 – 110 ft (2.2 ft/yr) 2100 – 187 ft (2.1 ft/yr)	2060 – 27 ft (0.54 ft/yr) (3) 2100 – 44 ft/ (0.49 ft/yr)(3)
Total Erosion from Projected from Coastal Resilience (4) **2060 - 2.6 ft. SLR; 2100 – 5.5 ft. SLR**	2060 – 87 ft (1.7 ft/yr) 2100 – 317 ft/ (3.5 ft/yr)	2060 – 86 ft (1.7 ft/yr) 2100 – 311 ft (3.5 ft/yr)	2060 – 41 ft (0.8 ft/yr) 2100 – 240 ft (2.7 ft/yr)
Recommended 75 Year Setback from Top of Bluff by Site Specific Study Completed in Year Noted (includes geotechnical F.S. analysis)	7 feet (2011, Campbell Geo, Inc.)	59 feet (2012, Campbell Geo, Inc.)	57 feet (2002, Campbell Geo, Inc.)

Notes: (1) rates estimated from aerial photographs in period prior to revetment installation at toe of seacliff at Bellosguardo
(2) rates estimated from site specific survey data after construction of revetment at Bellosguardo
(3) both CoSMoS projections at Bellosguardo are without armoring; the model projects zero erosion with armoring at this site
(4) Future erosion rates for CoSMoS and Coastal Resilience computed relative to year 2010

SEACLIFF FEATURES
CLARK ESTATE/BELLOSGUARDO
Santa Barbara, California
August, 2018

Seacliff Showing Revetment at Toe – View to West
(near CoSMoS Transect 3932)

Seacliff Showing Non-Marine Erosion – View to North

(near CoSMoS Transect 3932)

SEACLIFF FEATURES BETWEEN
SB CITY COLLEGE AND MESA LANE
Santa Barbara, California
May 28, 2018

- Top of Bluff at SB City College West Campus; View to Southwest toward Leadbetter Beach
(near CoSMoS Transect 3973)

- Revetment and Fill Slope at Leadbetter Beach near Santa Barbara Point; View to Southwest
(near CoSMoS Transect 3977)

SEACLIFF FEATURES BETWEEN
SB CITY COLLEGE AND MESA LANE
Santa Barbara, California
May 28, 2018

- Location of 2008 Bedding Plane Landslide at Shoreline Park (near CoSMoS Transect 3982)

- Seacliff Adjacent to West End of Shoreline Park (near CoSMoS Transect 3987)

SEACLIFF FEATURES BETWEEN
SB CITY COLLEGE AND MESA LANE
Santa Barbara, California
May 28, 2018

- Seacliff Adjacent to Thousand Steps at Santa Cruz Boulevard (near CoSMoS Transect 3990)

- Seacliff and Residential Structure West of Thousand Steps and East of SB Lighthouse (West of CoSMoS Transect 3992)

SEACLIFF FEATURES BETWEEN
SB CITY COLLEGE AND MESA LANE
Santa Barbara, California
May 28, 2018

- Seacliff Area East of SB Lighthouse
(near CoSMoS Transect 3997)

- Daylighted Monterey Shale Bedding on East Side of El Camino de la Luz Landslide
(near CoSMoS Transect 4000)

SEACLIFF FEATURES BETWEEN
SB CITY COLLEGE AND MESA LANE
Santa Barbara, California
May 28, 2018

- Ruptured Shale at Toe of 1978 El Camino de la Luz Landslide
(near CoSMoS Transect 4001)

- Landslide located East of Mesa Lane Staircase
(near CoSMoS Transect 4005)

SEACLIFF FEATURES BETWEEN
MESA LANE AND SEA LEDGE
Santa Barbara, California
May 27, 2018

Top of Bluff Showing Daylighted Monterey shale Beds – View to East of from Mesa Lane Staircase
(near CoSMoS Transect 4007)

Sea Cliff West of Mesa Lane Staircase
(near CoSMoS Transect 4007)

SEACLIFF FEATURES BETWEEN
MESA LANE AND SEA LEDGE
Santa Barbara, California
May 27, 2018

Anticline in Monterey shale West of Mesa Lane / East of Arroyo Burro (near CoSMoS Transect 4008)

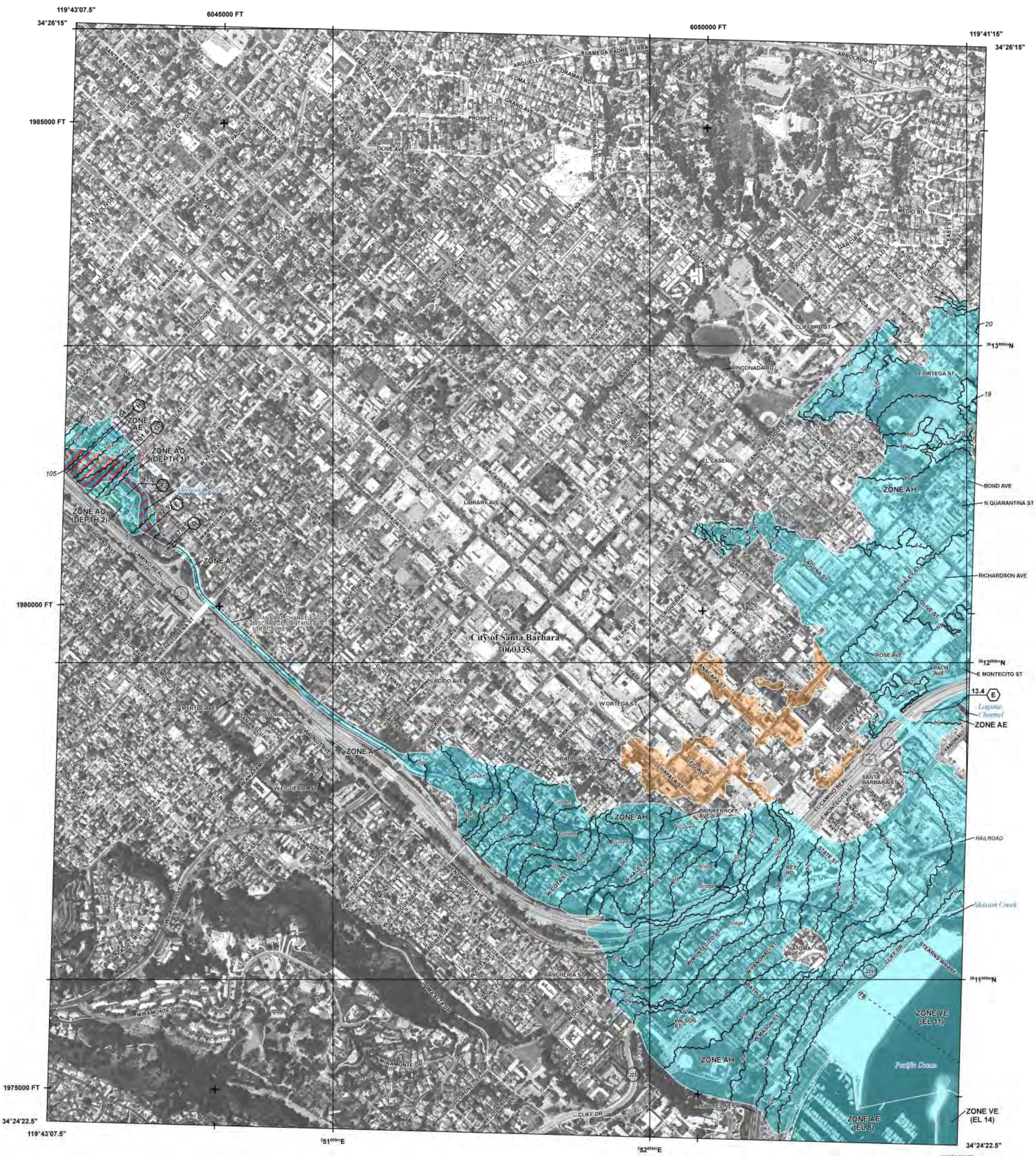
Bedding Dip Slope Adjacent to Douglas Family Preserve (near CoSMoS Transect 4014)

SEACLIFF FEATURES BETWEEN
MESA LANE AND SEA LEDGE
Santa Barbara, California
May 27, 2018

Revetment Adjacent to Pre-Historic
Landslide – Sea Ledge Lane
(near CoSMoS Transect 4031)

Appendix E

FEMA FIRM Panels for City of Santa Barbara



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT HTTP://MSC.FEMA.GOV

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A, V, A99*
	With BFE or Depth *Zone AE, AO, AH, VE, AR*
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	Area with Reduced Flood Risk due to Levee See Notes *Zone X*
OTHER AREAS	NO SCREEN Areas of Minimal Flood Hazard *Zone X*
	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	Channel, Culvert or Storm Sewer
	Levee, Dike or Floodwall
OTHER FEATURES	(E) 18.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
	(8) Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
	512 Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at http://msc.fema.gov/. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

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To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was derived from digital orthophotography collected by the Coastal Service Center and U.S. Department of Agriculture Farm Service Agency. Coastal Service Center imagery was flown in 2011 and was produced with a sub-meter ground sample distance. Department of Agriculture imagery was flown in 2014 and was produced with a 1-meter ground sample distance.

SCALE

Map Projection:
Universal Transverse Mercator Zone 11N; North American Datum 1983;
Western Hemisphere; Vertical Datum: NAVD 88

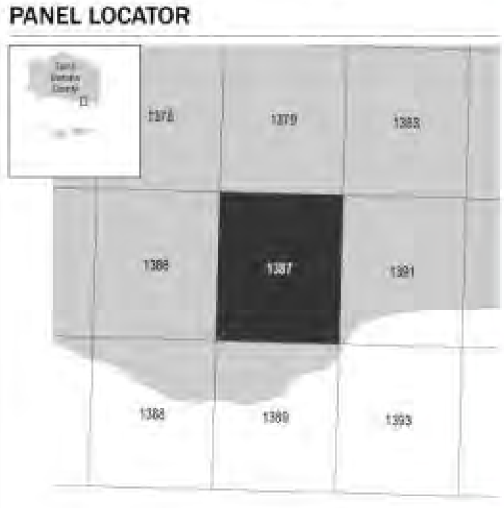
N

1 inch = 500 feet 1:6,000

0 250 500 750 1,000 2,000 feet

0 125 250 500 meters

PANEL LOCATOR



FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

SANTA BARBARA COUNTY, CALIFORNIA

and Incorporated Areas

PANEL **1387** OF **1835**

FEMA

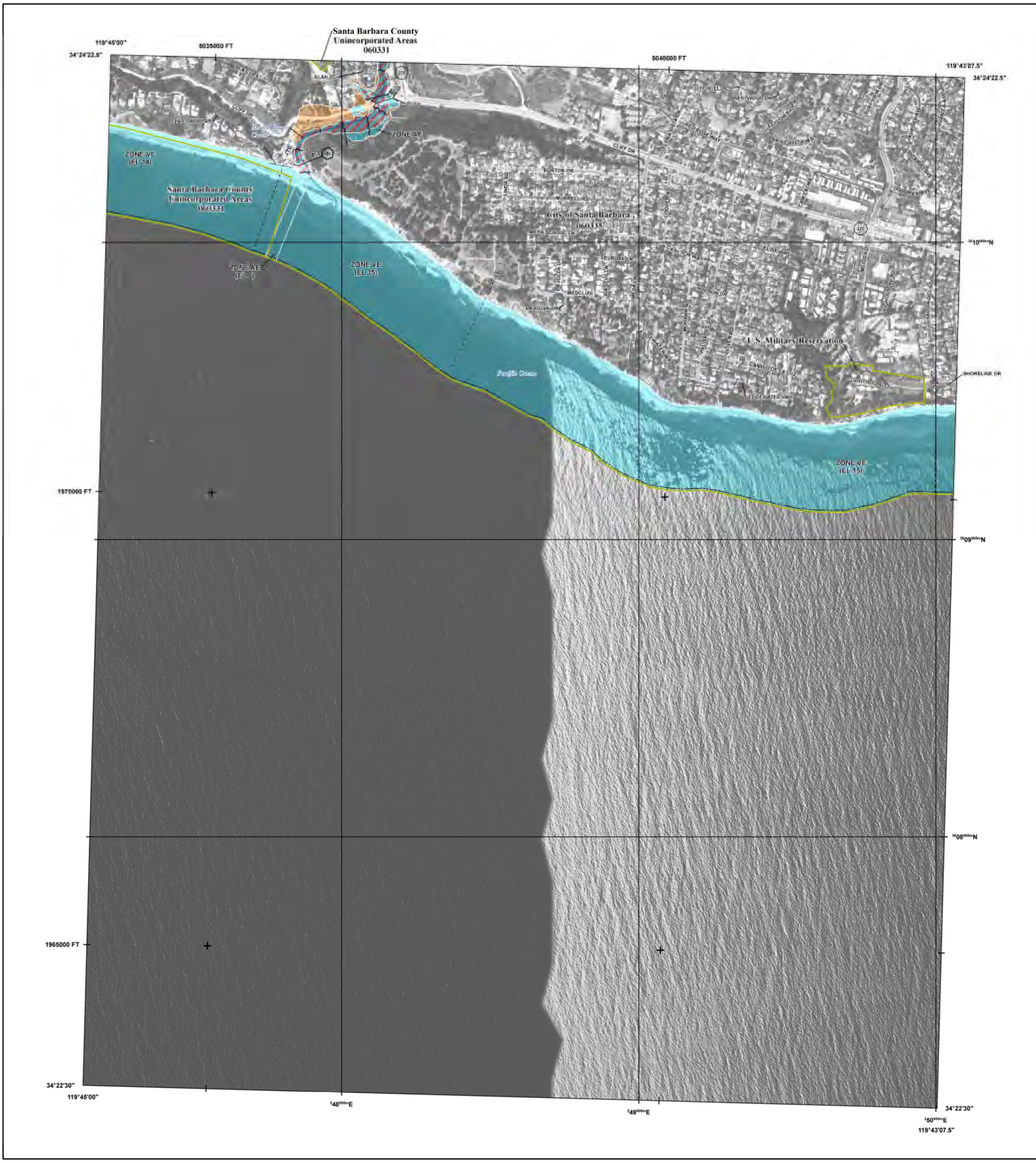
Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
SANTA BARBARA, CITY OF	060335	1387	J

VERSION NUMBER
2.3.3.3

MAP NUMBER
06083C1387J

MAP REVISED
September 28, 2018



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A, V, A99*
	With BFE or Depth *Zone AE, AO, AH, VE, AR*
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	Area with Reduced Flood Risk due to Levee See Notes *Zone X*
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GENERAL STRUCTURES	Channel, Culvert or Storm Sewer
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	Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
	512 Base Flood Elevation Line (BFE)
OTHER FEATURES	Limit of Study
	Jurisdiction Boundary

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SCALE

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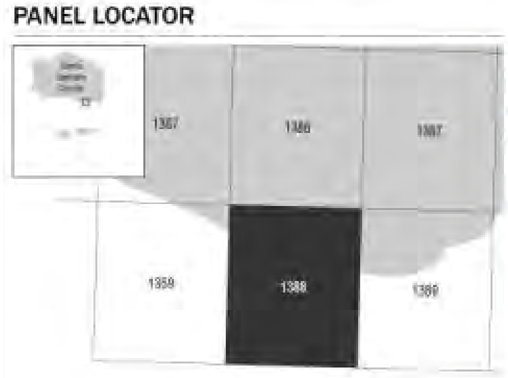
Universal Transverse Mercator Zone 11N; North American Datum 1983; Western Hemisphere; Vertical Datum: NAVD 88

1 inch = 500 feet 1:6,000

0 250 500 750 1,000 2,000 feet

0 125 250 500 meters

PANEL LOCATOR



National Flood Insurance Program

FEMA

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

SANTA BARBARA COUNTY, CALIFORNIA

and Incorporated Areas

PANEL 1388 OF 1835

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
SANTA BARBARA, CITY OF	060335	1388	H
SANTA BARBARA COUNTY	060331	1388	H

VERSION NUMBER
2.3.3.3

MAP NUMBER
06083C1388H

MAP REVISED
September 28, 2018

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A, V, A99*
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	Regulatory Floodway
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	Area with Reduced Flood Risk due to Levee See Notes *Zone X*
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	18.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
	Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
	512 Base Flood Elevation Line (BFE)
OTHER FEATURES	Limit of Study
	Jurisdiction Boundary

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SCALE

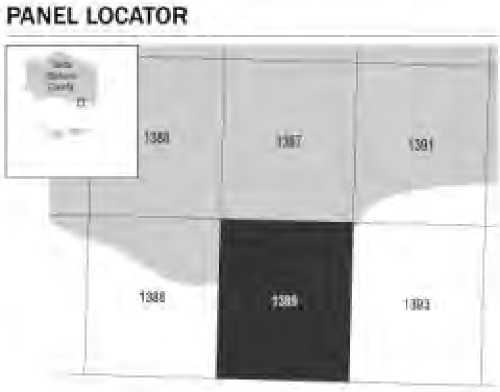
Map Projection:
Universal Transverse Mercator Zone 11N; North American Datum 1983; Western Hemisphere; Vertical Datum: NAVD 88

1 inch = 500 feet 1:6,000

0 250 500 750 1,000 2,000 feet

0 125 250 500 meters

PANEL LOCATOR



FEMA
National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

SANTA BARBARA
COUNTY, CALIFORNIA
and Incorporated Areas

PANEL 1389 OF 1835

FEMA

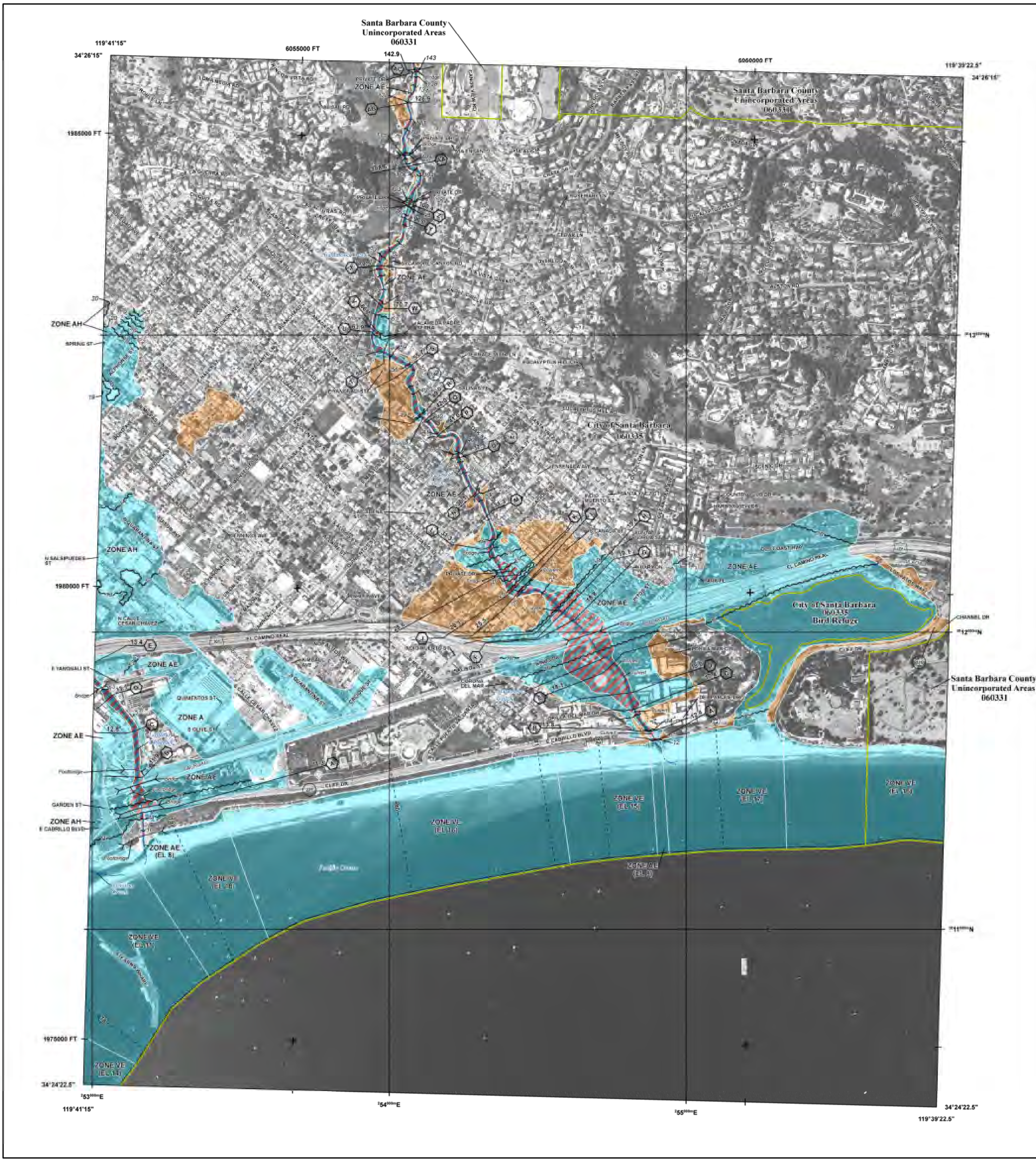
Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
SANTA BARBARA, CITY OF	060335	1389	H

VERSION NUMBER
2.3.3.3

MAP NUMBER
06083C1389H

MAP REVISED
September 28, 2018



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was derived from digital orthophotography collected by the Coastal Service Center and U.S. Department of Agriculture Farm Service Agency. Coastal Service Center imagery was flown in 2011 and was produced with a sub-meter ground sample distance. Department of Agriculture imagery was flown in 2016 and was produced with a 1-meter ground sample distance.

SCALE

Map Projection:
Universal Transverse Mercator Zone 11N; North American Datum 1983; Western Hemisphere; Vertical Datum: NAVD 88

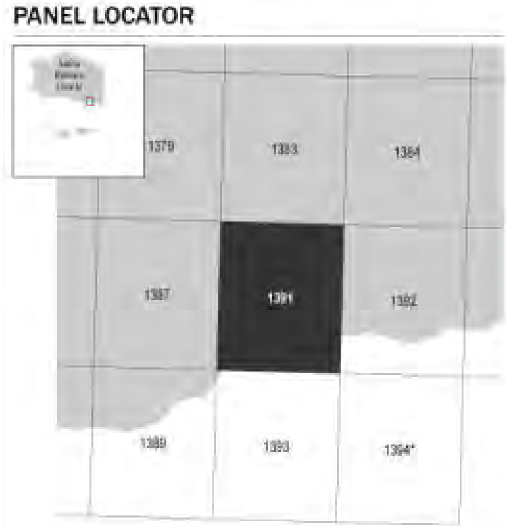
N

1 inch = 500 feet 1:6,000

0 250 500 750 1,000 2,000 feet

0 125 250 500 meters

PANEL LOCATOR



*PANEL NOT PRINTED

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

SANTA BARBARA COUNTY, CALIFORNIA
and Incorporated Areas

PANEL 1391 OF 1835

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
SANTA BARBARA, CITY OF	060335	1391	J
SANTA BARBARA COUNTY	060331	1391	J

VERSION NUMBER
2.3.3.3

MAP NUMBER
06083C1391J

MAP REVISED
September 28, 2018

Appendix F
Sea-Level Rise Hazard Maps by Hazard Type

SOURCE: USGS, ESA

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update / D171018.00

ESA

Figure F-1
Erosion Hazards

SOURCE: USGS, ESA

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update / D171018.00

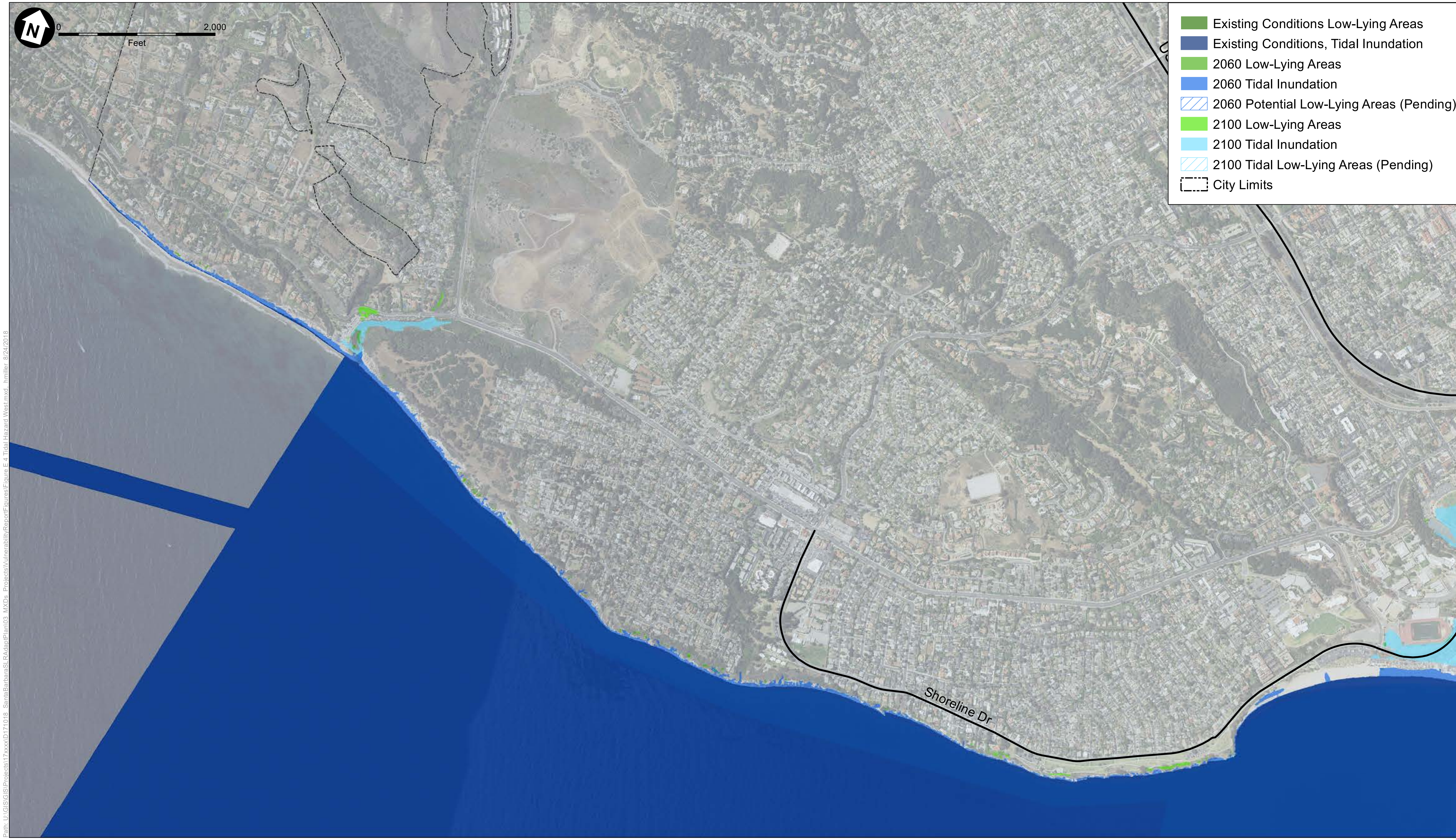
Figure F-2
Erosion Hazards

ESA

SOURCE: USGS, ESA

Figure F-3
Tidal Inundation Hazards

ESA



SOURCE: USGS, ESA

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update / D171018.00

ESA

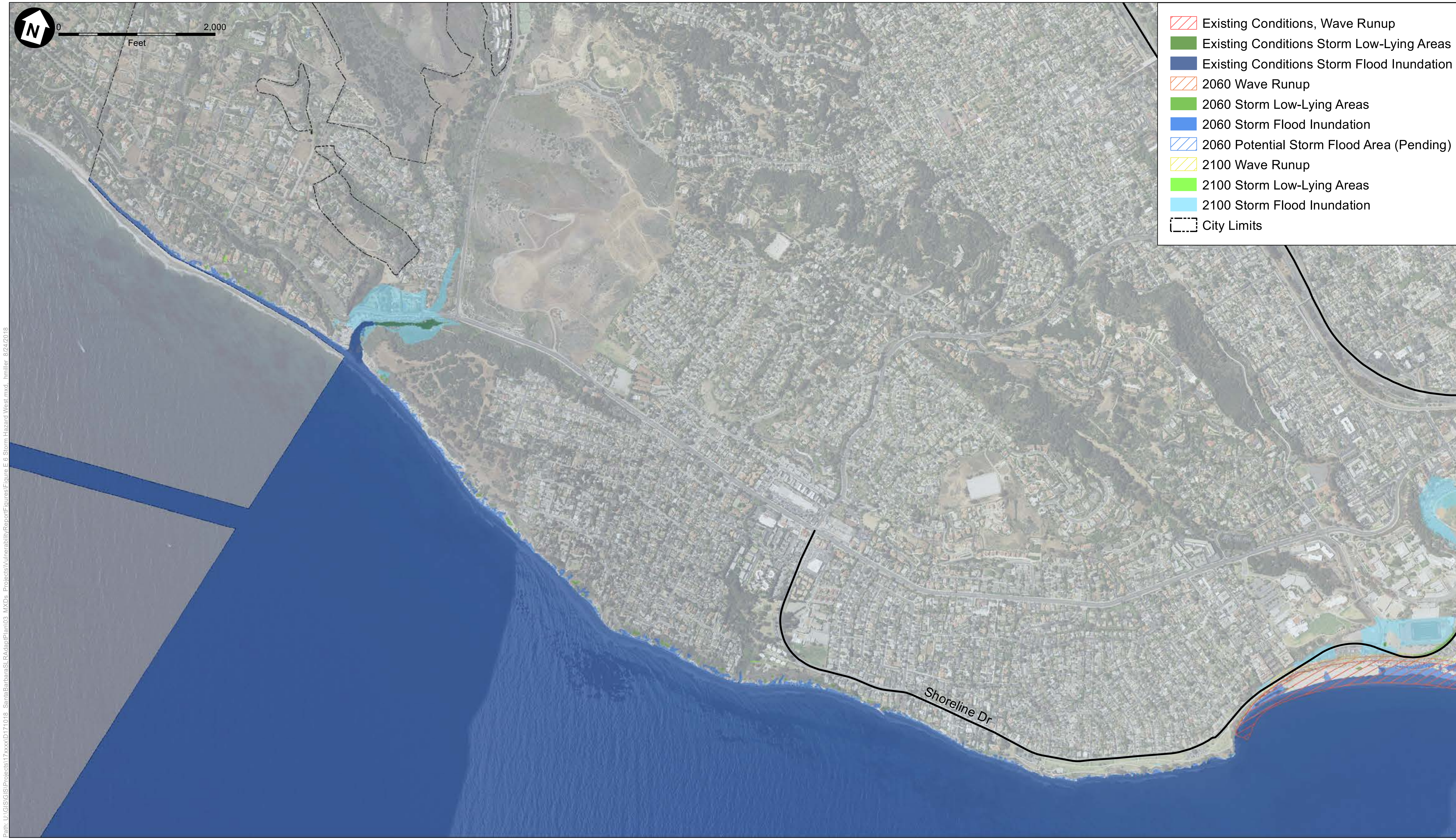
Figure F-4
Tidal Inundation Hazards

SOURCE: USGS, ESA

SCity of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update / D171018.00

ESA

Figure F-5
Storm Inundation Hazards



SOURCE: USGS, ESA

ESA

Figure F-6
Storm Inundation Hazards

Appendix G
Upland Hazards

Upland Hazards

This appendix describes the source of the upland hazards mapping used in this Vulnerability Assessment (VA). Upland hazards in the vicinity of coastal bluffs were added to this VA at the request of the City of Santa Barbara. The upland hazards were added to represent the instability of the upper bluffs and adjacent inland areas for the purposes of land use planning and policy. The upland hazards are associated with geologic and geotechnical stability of coastal cliffs, including consideration of landslides and other terrestrial erosion processes. The Upland Hazards are mapped in addition to the Coastal Storm Modeling System (CoSMoS) which, as explained in the main body of the VA, addresses the exposure to coastal flooding and erosion under existing conditions and with higher sea levels projected for the future.

The City's Draft Local Coastal Program Land Use Plan has an Interim Shoreline Hazards Screening Area that includes coastal erosion and flooding, as well as areas of upland hazards associated with landslide and erosion of bluff tops (Figure I-1 copied from Figure 5.1-1, City of Santa Barbara, 2018). The upland hazards in this VA consist of the Bluff Face and Bluff Top zones in Figure I-1. These zones are based on focused study by URS (2009) on behalf of the City of Santa Barbara. Figure I-2 shows landslide and other slope failure hazard zonation 1 through 4: Several historical landslides are mapped and most of the bluff tops in Santa Barbara have the most severe risk rating of 4 (Source: Map 6, URS (2009)). A bluff top hazard zone was established 75 feet inland of landslide scarps and bluff edges, as shown in Figure I-3 (Source: Map 10, URS (2009)). Mapped landslides include the ancient Sea Ledge Lane vicinity, El Camino de la Luz (occurred 1978) and Shoreline Park (occurred 2008) which incurred a bluff top loss of approximately 38 feet (City of Santa Barbara, 2018; Campbell Geo, 2018 Appendix C).

The upland hazards and coastal hazards mapped in this VA are not completely independent, but rather, are based on different analyses that are complementary. The coastal hazards address erosion by waves and wave runup at the base (or "toe") of the bluffs, which results in bluff recession (landward erosion) that may extend to the top of the bluff or only to an intermediate location on the face. Over time, the erosion at the base of a bluff can be expected to result in failure at the top of the bluff. However, the bluff top recession can lag the erosion at the bluff base, and bluff top recession is also affected by terrestrial erosion processes (e.g. driven by rain and wind). Terrestrial bluff erosion can take the form of landslides or other erosion events, for example when an over-steepened bluff is saturated from rainfall and drainage causing the weight of the bluff to exceed its strength. The slope failure risk depends on other factors, such as the bluff layering and faulting, and groundwater flows which are not modeled explicitly in the coastal hazard modeling. While the historic erosion rates derived from historical maps and aerial photographs include terrestrial erosion processes, the use of long-term average bluff erosion rates does not necessarily convey the potential for a mass failure in any given year. For this reason, the Coastal Resilience Santa Barbara (CRSB) mapping includes a "safety buffer" of upland erosion hazards based on an approximate estimate of the dimensions of historical bluff failures plus the calculated uncertainty in long-term bluff erosion rates for a given time frame. An example is shown in Figure I-4 (ESA, 2015). For existing conditions, a block-failure width of 5 to 120 meters was used depending on the location and geology. For future conditions, an additional buffer distance was computed as the elapsed number of years multiplied by the standard deviation of the historic erosion rates. Note that the CRSB bluff-top safety buffer is not analyzed in the VA, but may be considered to approximately indicate higher risks and uncertainty with future conditions.

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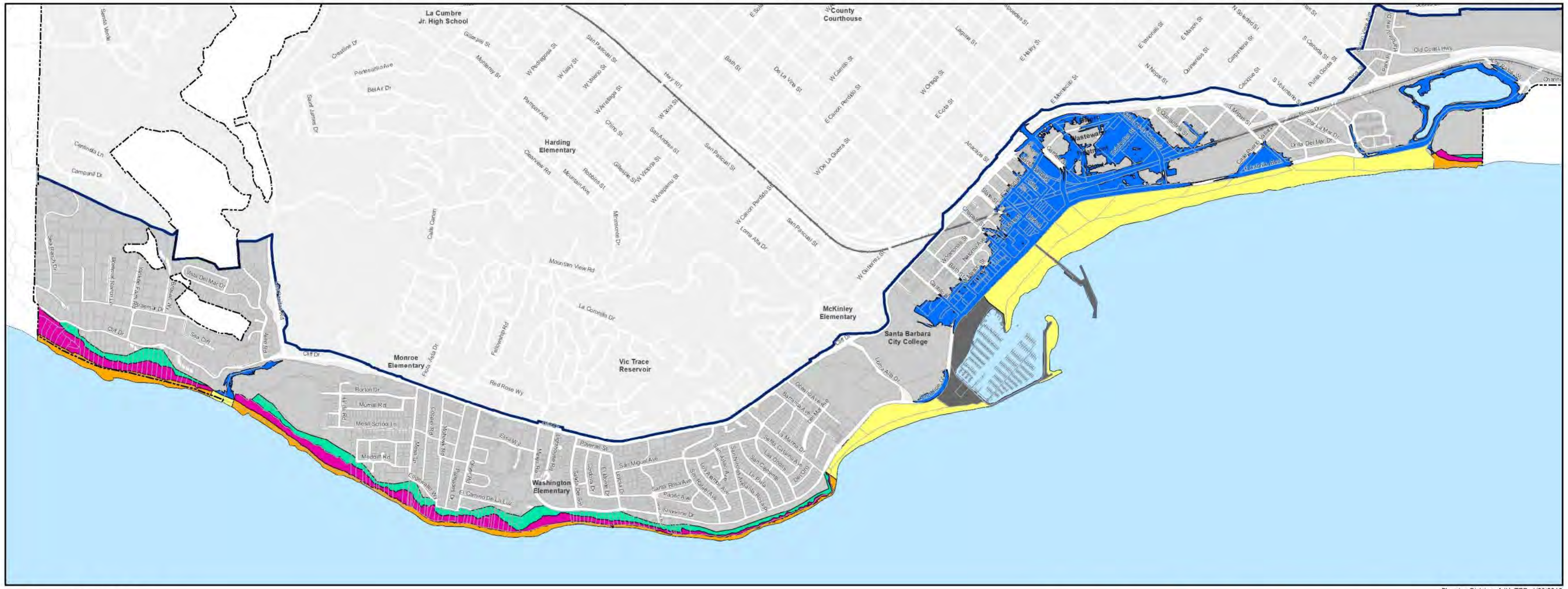
FIGURE 5.1-1 INTERIM SHORELINE HAZARDS SCREENING AREAS



Planning Division, AJN, TRB, 1/29/2018

NAD 1983 State Plane
California V FIPS 0405 (Feet)

1:24,000

BOUNDARIES

- Coastal Zone
- City Limits

SHORELINE HAZARDS SCREENING AREAS

- Area 1 - City-Owned Low-Lying Beach and Backshore Areas
- Area 2 - Bluff-Backed Beaches
- Area 3 - Coastal Bluff Faces
- Area 4 - Coastal Bluff-Tops
- Area 5 - Stearns Wharf and Harbor
- Area 6 - Inland Coastal Flooding Area

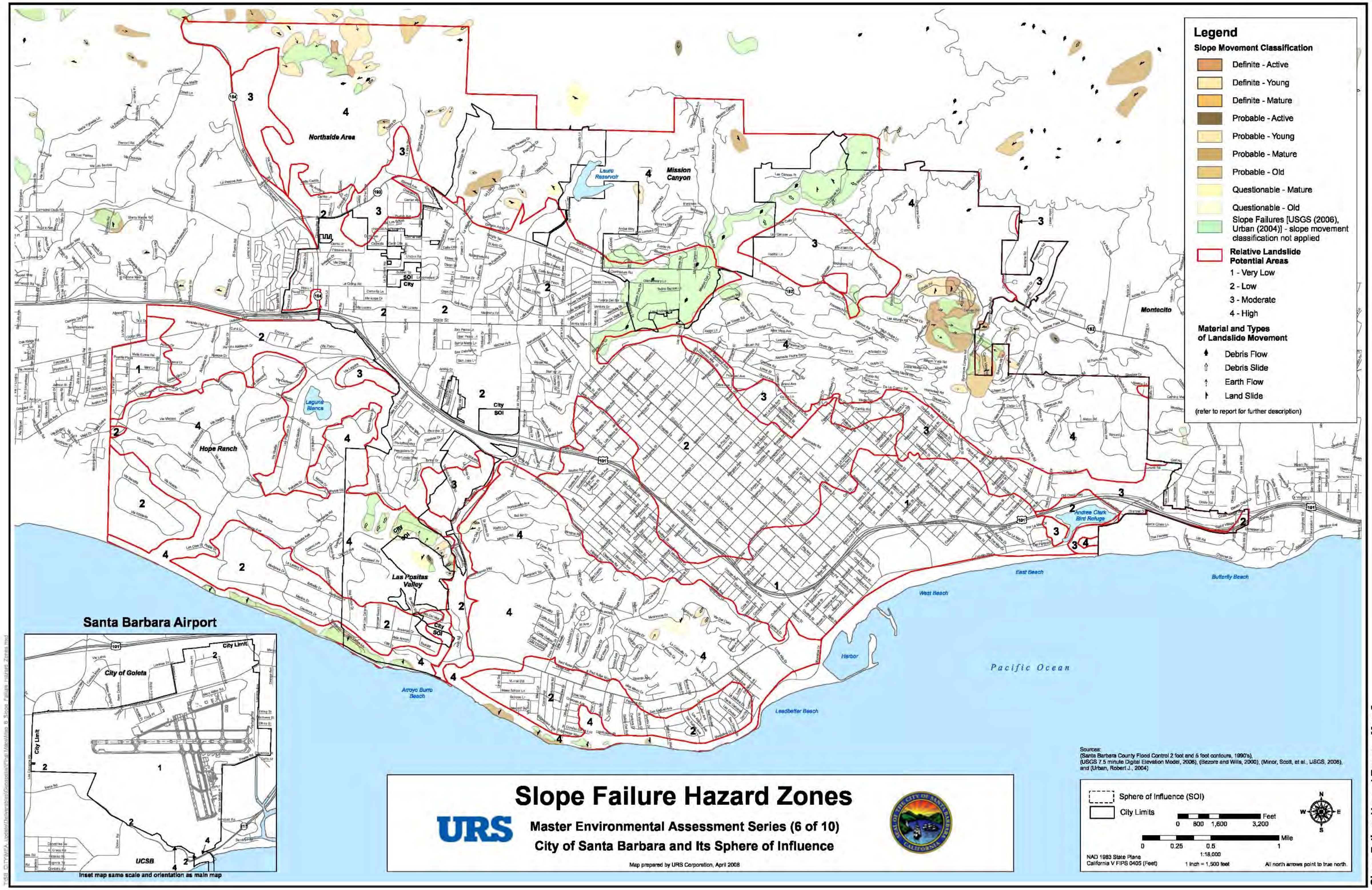
Note: This map was created using the middle confidence bound of the USGS CoSMoS 3.0 model outputs for the 150cm SLR scenario with a 100 year storm event, no beach nurishment, and no consideration of existing coastal protective structures. This is an illustrative tool used to depict hazard screening areas potentially subject to shoreline hazards including: beach erosion; coastal bluff erosion; coastal bluff slope failure or instability; coastal flooding; and wave impacts, now and in the future and factoring in the anticipated effects of sea level rise. This map is based on model outputs and does not account for all of the complex and dynamic geologic conditions and coastal processes that could occur at any given site, future construction, shoreline protection upgrades, or other changes to the City or region that may occur in response to sea level rise. This map provides a screening-level tool for when site specific technical evaluations may be required and when development standards pertaining to shoreline hazard areas may be applied. Any areas subject to beach erosion, coastal bluff erosion, coastal bluff slope failure, coastal flooding, and/or wave impacts that are not depicted on the Map, shall also be subject to the policies of this Coastal LUP. This map shall be used in the interim period between Coastal Commission certification of this Coastal LUP and when new shoreline hazard screening procedures and maps are certified as part of a future Sea Level Rise Adaptation Plan process. Further information on the Shoreline Hazards Screening Areas can be found in Policy 5.1-28 Interim Shoreline Hazards Screening Areas Map.

2018 City Council Review Draft

Sources: California Coastal Commission GIS/Mapping Unit (2017), USGS CoSMoS 3.0 (2017), City of Santa Barbara (2017), URS (2009)

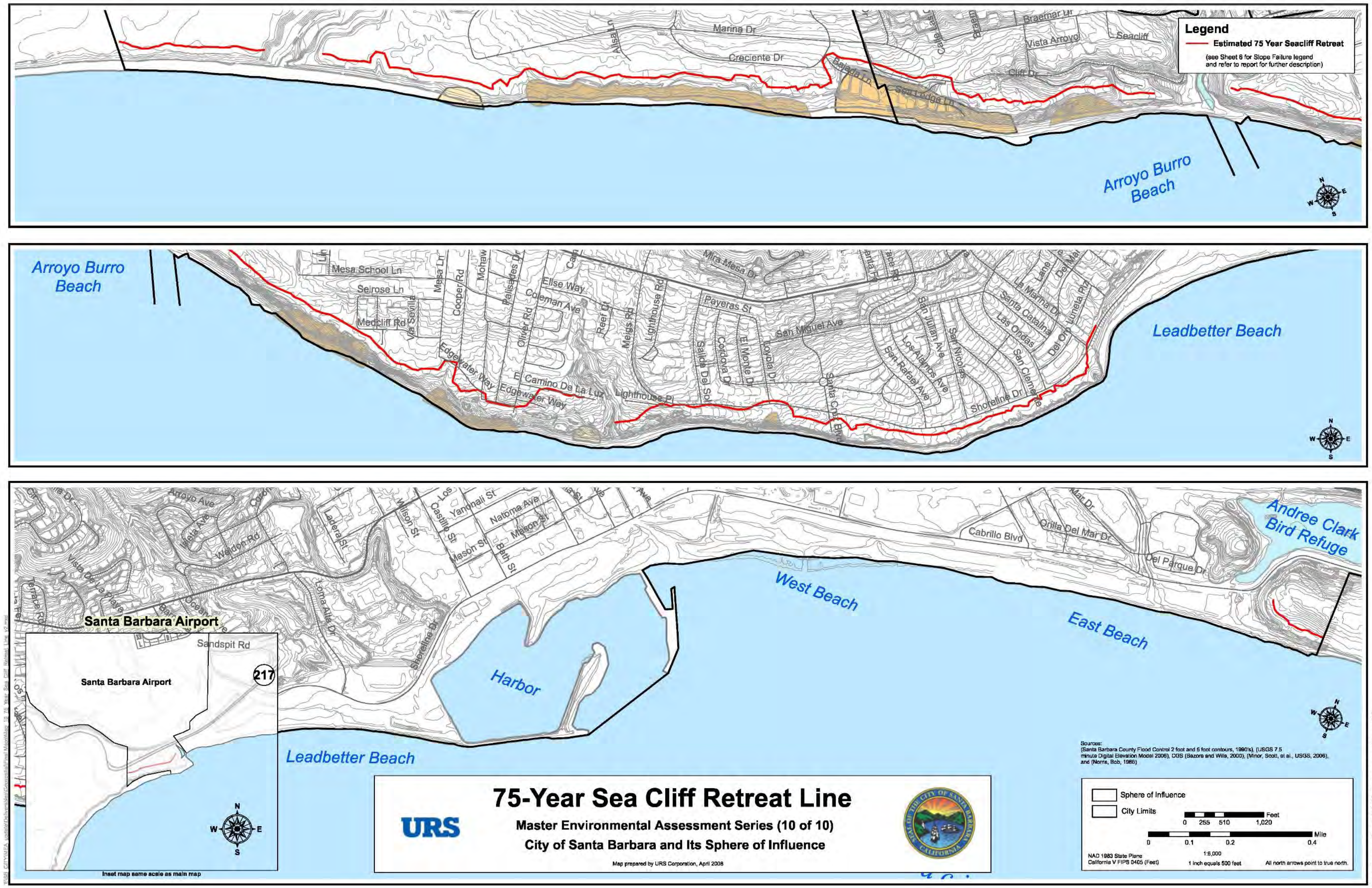
SOURCE: Santa Barbara Draft Land Use Plan, 2018

Figure I-1
Interim Shoreline Hazards Screening Areas



SOURCE: URS, 2009

Figure I-2
URS Slope Failure Hazard Zones



SOURCE: URS, 2009.

Figure I-1
URS 75-Year Sea Cliff Retreat Line

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SOURCE: TNC, et al. 2015; ESA, 2015

Figure I-4
Bluff-top Safety Buffer for Existing Conditions

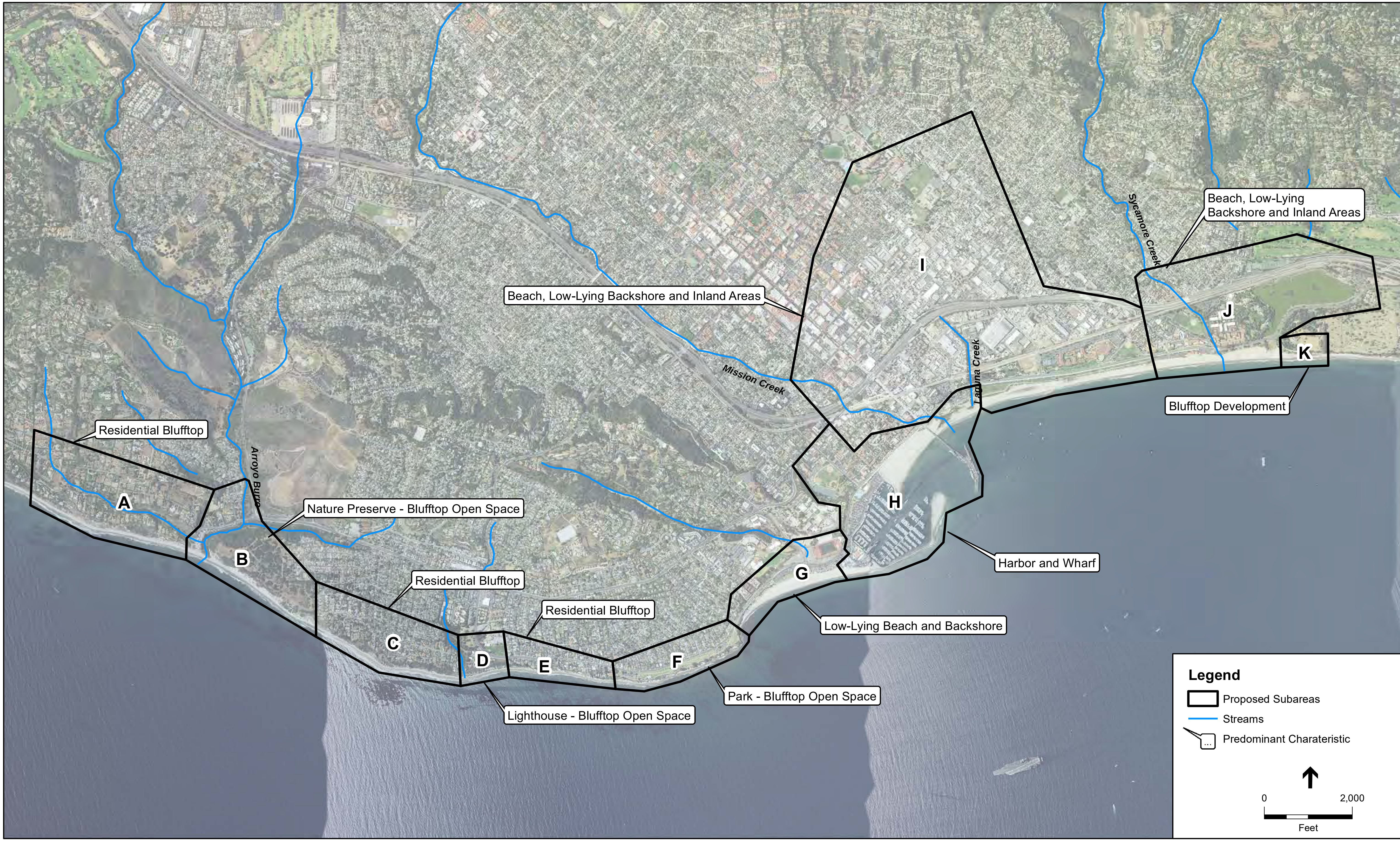
References

City of Santa Barabara draft land use plan, draft for City Council, April 2018

ESA 2015, Santa Barbara County Coastal Hazzard Modeling and Vulnerability Assessment, Technical Methods Report. November, 2015

URS (2009) Geology and Geohazards Master Environmental Assessment, Technical Report and Evaluation Guidelines. Prepared by URS Corporation. 2009.

Appendix H
Asset Exposure Tables for City and Each Subarea



SOURCE:

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update. 171018

Figure H-1

Shoreline HazardPlanning Subareas

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Table H-1. Santa Barbara Exposed Public Works Assets

All Subareas

			Existing Conditions						
Category	**Assets**	**Units**	**Bluff Erosion***	**Shore Erosion***	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying***	**Flood Prone***
Tansportation	Railroads	ft	0	0	0	0	176	0	0
	Roads	ft	0	0	1,360	478	73	0	0
	Public Parking	sq ft	0	0	66,282	122,980	1,771	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	67	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	4,064	67	0	0
	Parks	sq ft	0	0	804,596	3,384,008	186,805	0	0
Parcels	Parcels	ct	0	0	62	17	100	0	0
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	142	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	1,215	2,052	168	0	0
Stormwater	Drainage Pipes	ft	0	0	26	835	206	0	0
	Drainage Channels	ft	0	0	499	1,309	2,359	0	0
	Water Control Structures	ct	0	0	0	2	1	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	3,516	27	0	0
	Recycled Laterals	ft	0	0	0	21	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	1,298	572	1,049	0	0
	Breakwater (Rip-Rap)	ft	0	0	10,168	62	408	0	0
	Launch Ramps	ft	0	0	452	0	6	0	0
	Rock Groins	ft	0	0	0	316	17	0	0
	Rock Groins (Rip-Rap)	ft	0	0	658	61	233	0	0
	Waterfront Street Parking	ft	0	0	0	533	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

** Bluff Erosion, Shore Erosion, Low-Lying Areas, and Flood Prone Areas were not considered for Existing Conditions*

Table H-2. Santa Barbara Exposed Public Works Assets

All Subareas

			Year 2060, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	176	0	43	0	1,480
	Roads	ft	1,985	0	1,506	3,409	533	2,397	4,011
	Public Parking	sq ft	817	5,527	250,955	312,449	95,898	0	16,726
Communications	Fiber Optic Cabinets	ct	0	0	0	1	0	0	2
	Fiber Optic Cables	ft	0	0	67	3,838	1,120	0	870
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	15	0	0	12
Recreation	CA Coastal Trail	ft	6,425	1,102	1,867	8,253	577	0	306
	Parks	sq ft	1,036,626	1,537,190	1,610,215	2,400,287	340,593	0	303,561
Parcels	Parcels	ct	135	15	44	31	35	26	135
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	676	0	253	321	646	1,609	1,533
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	3,278	1,335	2,073	4,477	3,465	1,976	2,986
Stormwater	Drainage Pipes	ft	2,476	193	716	2,911	859	3,049	4,112
	Drainage Channels	ft	236	719	2,607	275	3,451	0	1,318
	Water Control Structures	ct	0	1	1	1	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	25	0	0	0
	Recycled Mains	ft	1,641	1,430	1,316	4,959	570	0	1,294
	Recycled Laterals	ft	6	15	6	120	47	27	29
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	3,753	551	732	0	0
	Breakwater (Rip-Rap)	ft	0	0	11,480	24	89	0	0
	Launch Ramps	ft	0	0	458	0	0	0	0
	Rock Groins	ft	0	0	480	396	482	0	0
	Rock Groins (Rip-Rap)	ft	0	0	1,204	66	57	0	0
	Waterfront Street Parking	ft	0	0	0	2,332	1,737	0	1,807
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	2	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-3. Santa Barbara Exposed Public Works Assets

All Subareas

			Year 2100, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	24,127	0	13,483	0	0
	Roads	ft	6,888	0	35,918	1,805	57,939	425	19,498
	Public Parking	sq ft	13,522	131,517	794,216	131,277	311,037	10,799	0
Communications	Fiber Optic Cabinets	ct	0	0	9	1	7	0	3
	Fiber Optic Cables	ft	0	1,421	9,746	1,268	6,685	23	2,536
Critical Facilities	Fire Stations	ct	0	0	0	0	1	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	257	0	827	0	2,220	243	0
Recreation	CA Coastal Trail	ft	9,945	4,597	9,790	1,797	1,561	1,736	0
	Parks	sq ft	1,370,379	2,986,008	6,039,160	429,423	1,078,202	172,756	72,286
Parcels	Parcels	ct	184	15	328	49	1,153	260	278
Sewer	Lift Stations	ct	0	0	0	0	2	0	0
	Laterals	ft	2,304	98	10,219	279	27,998	62	13,204
	Force Mains	ft	0	0	0	0	474	0	0
	Gravity Mains	ft	7,951	2,962	30,393	1,120	56,459	460	18,401
Stormwater	Drainage Pipes	ft	4,299	791	22,308	882	42,779	419	16,282
	Drainage Channels	ft	874	1,244	10,865	246	5,598	774	2
	Water Control Structures	ct	0	1	2	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	1,571	0	424
	Water Mains	ft	0	0	25	0	0	0	0
	Recycled Mains	ft	2,768	4,305	9,458	501	9,054	65	1,171
	Recycled Laterals	ft	26	70	768	5	1,729	46	117
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	9,518	3	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	12,042	0	0	0	0
	Launch Ramps	ft	0	0	458	0	0	0	0
	Rock Groins	ft	0	0	1,361	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	1,327	0	0	0	0
	Waterfront Street Parking	ft	0	478	16,030	251	11,203	29	150
Wells	Groundwater Wells	ct	0	0	0	0	1	0	0
	Monitoring Wells	ct	0	2	5	0	6	0	3
	Production Wells	ct	0	0	0	0	1	0	0

Table H-4. Santa Barbara Exposed Public Works Assets

Subarea A

			Existing Conditions						
Category	**Assets**	**Units**	**Bluff Erosion***	**Shore Erosion***	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying***	**Flood Prone***
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	0	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	0	0	0	0
	Parks	sq ft	0	0	2,738	10,252	2,926	0	0
Parcels	Parcels	ct	0	0	19	1	32	0	0
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	0	0	0	0	0	0	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

** Bluff Erosion, Shore Erosion, Low-Lying Areas, and Flood Prone Areas were not considered for Existing Conditions*

Table H-5. Santa Barbara Exposed Public Works Assets

Subarea A

			Year 2060, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	518	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	0	0	0	0
	Parks	sq ft	0	13,961	1,767	1,087	200	0	0
Parcels	Parcels	ct	32	3	21	1	3	8	14
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	0	0	0	0	0	0	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-6. Santa Barbara Exposed Public Works Assets
Subarea A

			Year 2100, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	1,527	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	257	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	273	0	0	0	0	0	0
	Parks	sq ft	0	42,439	0	0	0	0	0
Parcels	Parcels	ct	35	3	1	0	0	3	7
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	0	0	0	0	0	0	0
	Drainage Channels	ft	535	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-7. Santa Barbara Exposed Public Works Assets
Subarea B

Category	Assets	Units	Existing Conditions						
			Bluff Erosion*	Shore Erosion*	Tidal Inundation	Storm Waves	Storm Flooding	Low-Lying*	Flood Prone*
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	0	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	0	0	0	0
	Parks	sq ft	0	0	41,066	44,959	103,281	0	0
Parcels	Parcels	ct	0	0	3	2	4	0	0
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	0	0	0	0	8	0	0
	Drainage Channels	ft	0	0	296	131	713	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

** Bluff Erosion, Shore Erosion, Low-Lying Areas, and Flood Prone Areas were not considered for Existing Conditions*

Table H-8. Santa Barbara Exposed Public Works Assets

Subarea B

			Year 2060, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	61	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	2,280	0	0	0	14	0	0
	Parks	sq ft	640,440	19,219	64,337	12,750	89,750	17,164	7,349
Parcels	Parcels	ct	4	2	2	2	3	3	2
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	57	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	0	0	0	0	15	0	0
	Drainage Channels	ft	99	148	431	0	1,299	1	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-9. Santa Barbara Exposed Public Works Assets
Subarea B

			Year 2100, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	61	0	0	0	1,464	251	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	1,162	243	0
Recreation	CA Coastal Trail	ft	2,416	0	37	0	1,274	281	0
	Parks	sq ft	834,089	134,358	103,708	64,524	172,158	12,635	0
Parcels	Parcels	ct	6	2	3	2	25	11	6
Sewer	Lift Stations	ct	0	0	0	0	1	0	0
	Laterals	ft	0	0	0	0	167	47	0
	Force Mains	ft	0	0	0	0	432	0	0
	Gravity Mains	ft	57	0	0	0	1,807	258	0
Stormwater	Drainage Pipes	ft	0	0	39	0	826	171	0
	Drainage Channels	ft	202	455	1,254	246	1,389	291	240
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	793	38	0
	Recycled Laterals	ft	0	0	0	0	180	46	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-10. Santa Barbara Exposed Public Works Assets

Subarea C

			Existing Conditions						
Category	**Assets**	**Units**	**Bluff Erosion***	**Shore Erosion***	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying***	**Flood Prone***
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	0	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	0	0	0	0
	Parks	sq ft	0	0	0	0	0	0	0
Parcels	Parcels	ct	0	0	13	0	23	0	0
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	0	0	0	0	0	0	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

** Bluff Erosion, Shore Erosion, Low-Lying Areas, and Flood Prone Areas were not considered for Existing Conditions*

Table H-11. Santa Barbara Exposed Public Works Assets
Subarea C

			Year 2060, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	383	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	480	0	0	0	0	0	0
	Parks	sq ft	4,388	0	0	0	0	0	17
Parcels	Parcels	ct	56	0	1	0	0	26	25
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	219	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	1,267	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	1,049	0	0	0	0	4	0
	Drainage Channels	ft	137	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-12. Santa Barbara Exposed Public Works Assets

Subarea C

			Year 2100, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	1,955	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	1,339	0	0	0	0	0	0
	Parks	sq ft	4,388	0	0	0	0	0	27
Parcels	Parcels	ct	82	0	2	0	0	19	11
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	933	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	2,938	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	2,035	0	0	0	0	0	0
	Drainage Channels	ft	137	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-13. Santa Barbara Exposed Public Works Assets
Subarea D

			Existing Conditions						
Category	**Assets**	**Units**	**Bluff Erosion***	**Shore Erosion***	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying***	**Flood Prone***
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	0	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	0	0	0	0
	Parks	sq ft	0	0	0	0	0	0	0
Parcels	Parcels	ct	0	0	1	0	2	0	0
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	0	0	0	0	0	0	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

** Bluff Erosion, Shore Erosion, Low-Lying Areas, and Flood Prone Areas were not considered for Existing Conditions*

Table H-14. Santa Barbara Exposed Public Works Assets
Subarea D

Category	Assets	Units	Year 2060, LIG						
			Bluff Erosion	Shore Erosion	Tidal Inundation	Storm Waves	Storm Flooding	Low-Lying	Flood Prone
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	281	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	322	0	0	0	0	0	0
	Parks	sq ft	0	0	0	0	0	0	0
Parcels	Parcels	ct	4	0	0	0	0	1	1
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	605	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	200	0	0	0	0	0	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	298	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-15. Santa Barbara Exposed Public Works Assets
Subarea D

Category	Assets	Units	Year 2100, LIG Bluff Erosion	Shore Erosion	Tidal Inundation	Storm Waves	Storm Flooding	Low-Lying	Flood Prone
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	1,058	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	603	0	0	0	0	0	0
	Parks	sq ft	0	0	0	0	0	0	0
Parcels	Parcels	ct	6	0	0	0	0	1	2
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	72	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	1,581	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	396	0	0	0	0	0	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	591	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-16. Santa Barbara Exposed Public Works Assets

Subarea E

			Existing Conditions						
Category	**Assets**	**Units**	**Bluff Erosion***	**Shore Erosion***	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying***	**Flood Prone***
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	0	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	0	0	0	0
	Parks	sq ft	0	0	0	0	9	0	0
Parcels	Parcels	ct	0	0	19	0	26	0	0
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	0	0	0	0	0	0	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

** Bluff Erosion, Shore Erosion, Low-Lying Areas, and Flood Prone Areas were not considered for Existing Conditions*

Table H-17. Santa Barbara Exposed Public Works Assets

Subarea E

			Year 2060, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	273	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	328	0	0	0	0	0	0
	Parks	sq ft	1,255	0	0	0	0	0	0
Parcels	Parcels	ct	32	0	0	0	0	8	19
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	186	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	705	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	484	0	0	0	0	0	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	268	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-18. Santa Barbara Exposed Public Works Assets
Subarea E

Category	Assets	Units	Year 2100, LIG						
			Bluff Erosion	Shore Erosion	Tidal Inundation	Storm Waves	Storm Flooding	Low-Lying	Flood Prone
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	1,180	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	1,081	0	0	0	0	0	0
	Parks	sq ft	1,255	0	0	0	0	0	0
Parcels	Parcels	ct	47	0	0	0	0	11	1
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	948	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	1,888	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	662	0	0	0	0	13	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	1,067	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-19. Santa Barbara Exposed Public Works Assets

Subarea F

			Existing Conditions						
Category	**Assets**	**Units**	**Bluff Erosion***	**Shore Erosion***	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying***	**Flood Prone***
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	0	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	0	0	0	0
	Parks	sq ft	0	0	999	793	2,506	0	0
Parcels	Parcels	ct	0	0	1	1	1	0	0
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	0	0	0	0	4	0	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

** Bluff Erosion, Shore Erosion, Low-Lying Areas, and Flood Prone Areas were not considered for Existing Conditions*

Table H-20. Santa Barbara Exposed Public Works Assets
Subarea F

			Year 2060, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	9	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	1,969	0	0	0	0	0	0
	Parks	sq ft	228,470	0	1,097	0	330	344	645
Parcels	Parcels	ct	2	0	1	0	1	2	1
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	9	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	339	0	0	0	0	0	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	30	0	0	0	0	0	0
	Recycled Laterals	ft	6	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-21. Santa Barbara Exposed Public Works Assets
Subarea F

Category	Assets	Units	Year 2100, LIG						
			Bluff Erosion	Shore Erosion	Tidal Inundation	Storm Waves	Storm Flooding	Low-Lying	Flood Prone
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	68	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	3,199	0	0	0	22	233	0
	Parks	sq ft	361,415	0	1,399	0	2,083	20,845	0
Parcels	Parcels	ct	4	0	1	0	1	2	0
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	99	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	592	0	0	0	0	65	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	76	0	0	0	0	0	0
	Recycled Laterals	ft	26	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-22. Santa Barbara Exposed Public Works Assets
Subarea G

Category	Assets	Units	Existing Conditions						
			Bluff Erosion*	Shore Erosion*	Tidal Inundation	Storm Waves	Storm Flooding	Low-Lying*	Flood Prone*
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	0	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	822	0	0	0
	Parks	sq ft	0	0	55,211	454,925	0	0	0
Parcels	Parcels	ct	0	0	1	5	0	0	0
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	53	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	0	223	0	0	0
Stormwater	Drainage Pipes	ft	0	0	0	292	0	0	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

** Bluff Erosion, Shore Erosion, Low-Lying Areas, and Flood Prone Areas were not considered for Existing Conditions*

Table H-23. Santa Barbara Exposed Public Works Assets
Subarea G

			Year 2060, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	461	0	0	99	34	0	98
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	465	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	1,045	332	45	967	0	0	0
	Parks	sq ft	119,372	231,190	3,731	253,521	0	0	731
Parcels	Parcels	ct	19	2	1	3	1	0	2
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	271	0	0	71	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	636	0	0	290	33	0	74
Stormwater	Drainage Pipes	ft	404	45	0	424	0	20	136
	Drainage Channels	ft	0	0	0	0	0	96	2
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	1,045	0	0	760	0	0	12
	Recycled Laterals	ft	0	0	0	0	0	0	7
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-24. Santa Barbara Exposed Public Works Assets
Subarea G

			Year 2100, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	1,039	0	1,204	202	1,247	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	1	0	1	0	0
	Fiber Optic Cables	ft	0	158	505	332	191	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	1,034	1,039	5	941	0	0	0
	Parks	sq ft	118,109	435,632	40,683	79,146	27,318	258	0
Parcels	Parcels	ct	30	3	4	4	10	2	4
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	351	71	0	0	73	0	68
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	1,389	263	876	209	1,542	0	33
Stormwater	Drainage Pipes	ft	614	321	526	364	737	8	23
	Drainage Channels	ft	0	0	105	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	1,034	432	606	453	498	0	0
	Recycled Laterals	ft	0	0	120	5	34	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-25. Santa Barbara Exposed Public Works Assets
Subarea H

Category	Assets	Units	Existing Conditions						
			Bluff Erosion*	Shore Erosion*	Tidal Inundation	Storm Waves	Storm Flooding	Low-Lying*	Flood Prone*
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	0	0	1,360	277	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	35	67	0	0
	Parks	sq ft	0	0	554,607	1,077,546	62,319	0	0
Parcels	Parcels	ct	0	0	3	8	4	0	0
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	89	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	0	534	0	0	0
Stormwater	Drainage Pipes	ft	0	0	26	82	24	0	0
	Drainage Channels	ft	0	0	116	788	313	0	0
	Water Control Structures	ct	0	0	0	1	1	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	1,058	27	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	1,298	572	1,049	0	0
	Breakwater (Rip-Rap)	ft	0	0	5,401	61	298	0	0
	Launch Ramps	ft	0	0	452	0	6	0	0
	Rock Groins	ft	0	0	0	316	17	0	0
	Rock Groins (Rip-Rap)	ft	0	0	658	61	227	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

** Bluff Erosion, Shore Erosion, Low-Lying Areas, and Flood Prone Areas were not considered for Existing Conditions*

Table H-26. Santa Barbara Exposed Public Works Assets
Subarea H

			Year 2060, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	0	0	1,432	1,243	450	267	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	1
	Fiber Optic Cables	ft	0	0	0	314	1,107	0	102
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	15	0	0	0
Recreation	CA Coastal Trail	ft	0	0	1,798	1,859	563	29	0
	Parks	sq ft	0	202,648	1,418,209	737,604	248,337	47,451	11,964
Parcels	Parcels	ct	0	5	8	8	13	5	9
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	253	237	646	127	8
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	931	2,929	3,260	571	7
Stormwater	Drainage Pipes	ft	0	58	538	1,089	651	411	129
	Drainage Channels	ft	0	273	879	66	0	20	127
	Water Control Structures	ct	0	1	1	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	25	0	0	0
	Recycled Mains	ft	0	0	900	2,587	536	65	72
	Recycled Laterals	ft	0	0	0	103	47	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	3,753	551	732	0	0
	Breakwater (Rip-Rap)	ft	0	0	6,067	23	89	0	0
	Launch Ramps	ft	0	0	458	0	0	0	0
	Rock Groins	ft	0	0	480	396	482	0	0
	Rock Groins (Rip-Rap)	ft	0	0	1,178	66	53	0	0
	Waterfront Street Parking	ft	0	0	0	29	1,737	0	22
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-27. Santa Barbara Exposed Public Works Assets
Subarea H

Category	Assets	Units	Year 2100, LIG						
			Bluff Erosion	Shore Erosion	Tidal Inundation	Storm Waves	Storm Flooding	Low-Lying	Flood Prone
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	0	0	8,922	0	1,784	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	3	0	0	0	0
	Fiber Optic Cables	ft	0	0	3,948	0	803	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	27	0	0	0	0
Recreation	CA Coastal Trail	ft	0	739	4,554	0	0	0	0
	Parks	sq ft	0	376,028	3,019,731	10,454	216,454	43	2,860
Parcels	Parcels	ct	0	5	59	5	48	6	6
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	5	3,258	0	562	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	30	11,898	50	1,845	0	0
Stormwater	Drainage Pipes	ft	0	204	3,450	0	678	4	0
	Drainage Channels	ft	0	406	1,312	0	365	39	0
	Water Control Structures	ct	0	1	1	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	25	0	0	0	0
	Recycled Mains	ft	0	750	4,823	0	161	0	0
	Recycled Laterals	ft	0	31	354	0	135	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	9,518	3	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	6,338	0	0	0	0
	Launch Ramps	ft	0	0	458	0	0	0	0
	Rock Groins	ft	0	0	1,361	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	1,297	0	0	0	0
	Waterfront Street Parking	ft	0	0	4,753	0	939	0	4
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-28. Santa Barbara Exposed Public Works Assets

Subarea I

			Existing Conditions						
Category	**Assets**	**Units**	**Bluff Erosion***	**Shore Erosion***	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying***	**Flood Prone***
Tansportation	Railroads	ft	0	0	0	0	176	0	0
	Roads	ft	0	0	0	0	73	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	67	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	2,734	0	0	0
	Parks	sq ft	0	0	74,392	905,590	7,250	0	0
Parcels	Parcels	ct	0	0	0	4	6	0	0
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	546	1,295	168	0	0
Stormwater	Drainage Pipes	ft	0	0	0	164	170	0	0
	Drainage Channels	ft	0	0	0	0	1,333	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	2,458	0	0	0
	Recycled Laterals	ft	0	0	0	21	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

** Bluff Erosion, Shore Erosion, Low-Lying Areas, and Flood Prone Areas were not considered for Existing Conditions*

Table H-29. Santa Barbara Exposed Public Works Assets
Subarea I

			Year 2060, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	176	0	43	0	1,480
	Roads	ft	0	0	73	610	49	3,305	13,271
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	1	0	0	2
	Fiber Optic Cables	ft	0	0	67	2,696	13	217	1,993
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	12
Recreation	CA Coastal Trail	ft	0	770	24	3,543	0	0	0
	Parks	sq ft	0	708,259	56,087	734,044	1,977	112,068	127,214
Parcels	Parcels	ct	0	4	10	4	15	50	237
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	14	0	1,645	7,959
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	1,335	473	1,215	172	2,051	11,293
Stormwater	Drainage Pipes	ft	0	90	178	564	193	3,883	12,698
	Drainage Channels	ft	0	0	1,265	0	2,151	1,431	635
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	1,430	416	1,612	35	14	1,524
	Recycled Laterals	ft	0	15	6	17	0	27	60
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	1,186	0	60	1,926
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	2	0	2	3
	Production Wells	ct	0	0	0	0	0	0	0

Table H-30. Santa Barbara Exposed Public Works Assets
Subarea I

Category	Assets	Units	Year 2100, LIG						
			Bluff Erosion	Shore Erosion	Tidal Inundation	Storm Waves	Storm Flooding	Low-Lying	Flood Prone
Tansportation	Railroads	ft	0	0	23,454	0	9,060	0	48
	Roads	ft	0	0	19,138	504	38,878	20	19,661
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	5	0	6	0	3
	Fiber Optic Cables	ft	0	1,262	5,293	307	5,154	23	2,536
Critical Facilities	Fire Stations	ct	0	0	0	0	1	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	800	0	1,059	0	0
Recreation	CA Coastal Trail	ft	0	2,819	1,394	124	0	0	0
	Parks	sq ft	0	1,353,368	934,683	44,852	261,054	3,859	72,286
Parcels	Parcels	ct	0	4	208	0	737	23	334
Sewer	Lift Stations	ct	0	0	0	0	1	0	0
	Laterals	ft	0	22	6,639	0	23,601	7	13,224
	Force Mains	ft	0	0	0	0	41	0	0
	Gravity Mains	ft	0	2,669	15,060	163	40,986	48	18,431
Stormwater	Drainage Pipes	ft	0	267	14,943	205	36,820	86	16,628
	Drainage Channels	ft	0	0	5,823	0	32	0	985
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	1,571	0	424
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	3,123	3,395	48	3,301	0	1,171
	Recycled Laterals	ft	0	39	249	0	1,084	0	117
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	471	10,166	251	7,834	29	236
Wells	Groundwater Wells	ct	0	0	0	0	1	0	0
	Monitoring Wells	ct	0	2	5	0	6	0	3
	Production Wells	ct	0	0	0	0	1	0	0

Table H-31. Santa Barbara Exposed Public Works Assets
Subarea J

			Existing Conditions						
Category	**Assets**	**Units**	**Bluff Erosion***	**Shore Erosion***	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying***	**Flood Prone***
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	0	0	0	201	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	472	0	0	0
	Parks	sq ft	0	0	53,139	844,027	0	0	0
Parcels	Parcels	ct	0	0	2	4	0	0	0
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	0	0	0	298	0	0	0
	Drainage Channels	ft	0	0	87	390	0	0	0
	Water Control Structures	ct	0	0	0	1	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	533	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

** Bluff Erosion, Shore Erosion, Low-Lying Areas, and Flood Prone Areas were not considered for Existing Conditions*

Table H-32. Santa Barbara Exposed Public Works Assets
Subarea J

Category	Assets	Units	Year 2060, LIG						
			Bluff Erosion	Shore Erosion	Tidal Inundation	Storm Waves	Storm Flooding	Low-Lying	Flood Prone
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	0	0	0	1,457	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	363	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	1,885	0	0	306
	Parks	sq ft	0	326,161	64,987	641,100	0	1,177,912	164,279
Parcels	Parcels	ct	0	3	2	18	0	3	9
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	0	43	0	0	0
Stormwater	Drainage Pipes	ft	0	0	0	833	0	23	413
	Drainage Channels	ft	0	298	32	209	0	48	556
	Water Control Structures	ct	0	0	0	1	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	1,111	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-33. Santa Barbara Exposed Public Works Assets
Subarea J

Category	Assets	Units	Year 2100, LIG						
			Bluff Erosion	Shore Erosion	Tidal Inundation	Storm Waves	Storm Flooding	Low-Lying	Flood Prone
Tansportation	Railroads	ft	0	0	672	0	4,423	0	0
	Roads	ft	0	0	6,654	1,099	14,566	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	1	0	0	0
	Fiber Optic Cables	ft	0	0	0	630	537	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	3,771	731	264	0	0
	Parks	sq ft	0	590,410	1,938,957	230,447	399,135	134,959	0
Parcels	Parcels	ct	0	3	30	0	802	10	16
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	323	279	3,595	8	7
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	1,890	698	10,280	154	7
Stormwater	Drainage Pipes	ft	0	0	3,349	314	3,718	74	6
	Drainage Channels	ft	0	383	2,372	0	3,812	444	396
	Water Control Structures	ct	0	0	1	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	634	0	4,300	28	0
	Recycled Laterals	ft	0	0	45	0	296	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	1,111	0	2,430	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-34. Santa Barbara Exposed Public Works Assets
Subarea K

Category	Assets	Units	Existing Conditions: Bluff Erosion*	Shore Erosion*	Tidal Inundation	Storm Waves	Storm Flooding	Low-Lying*	Flood Prone*
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	0	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	0	0	0	0
	Parks	sq ft	0	0	20,932	45,542	8,515	0	0
Parcels	Parcels	ct	0	0	2	1	2	0	0
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	0	0	0	0	0	0	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

** Bluff Erosion, Shore Erosion, Low-Lying Areas, and Flood Prone Areas were not considered for Existing Conditions*

Table H-35. Santa Barbara Exposed Public Works Assets

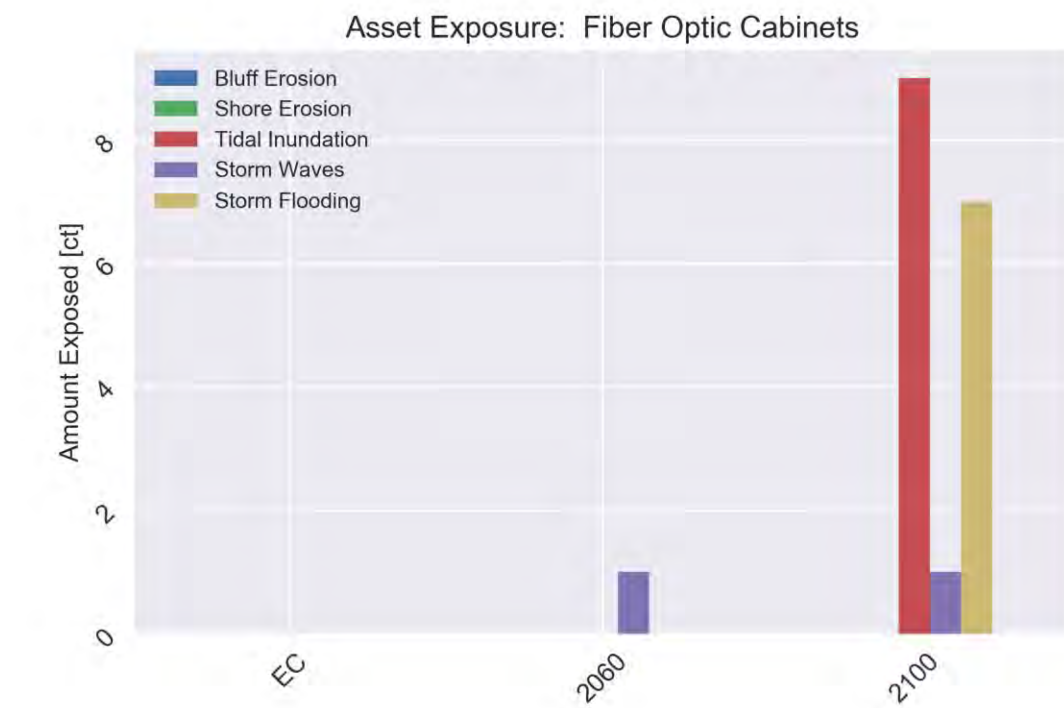
Subarea K

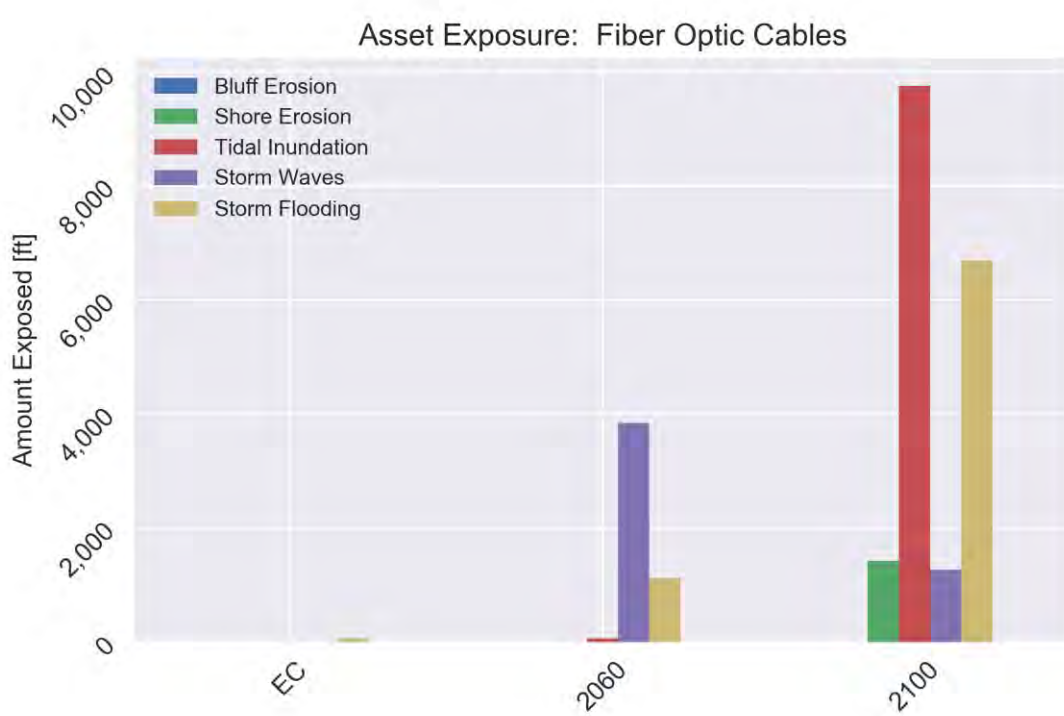
			Year 2060, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	0	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	0	0	0	0
	Parks	sq ft	42,703	33,867	0	20,182	0	0	0
Parcels	Parcels	ct	2	1	0	1	0	0	0
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	0	0	0	0	0	0	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Table H-36. Santa Barbara Exposed Public Works Assets
Subarea K

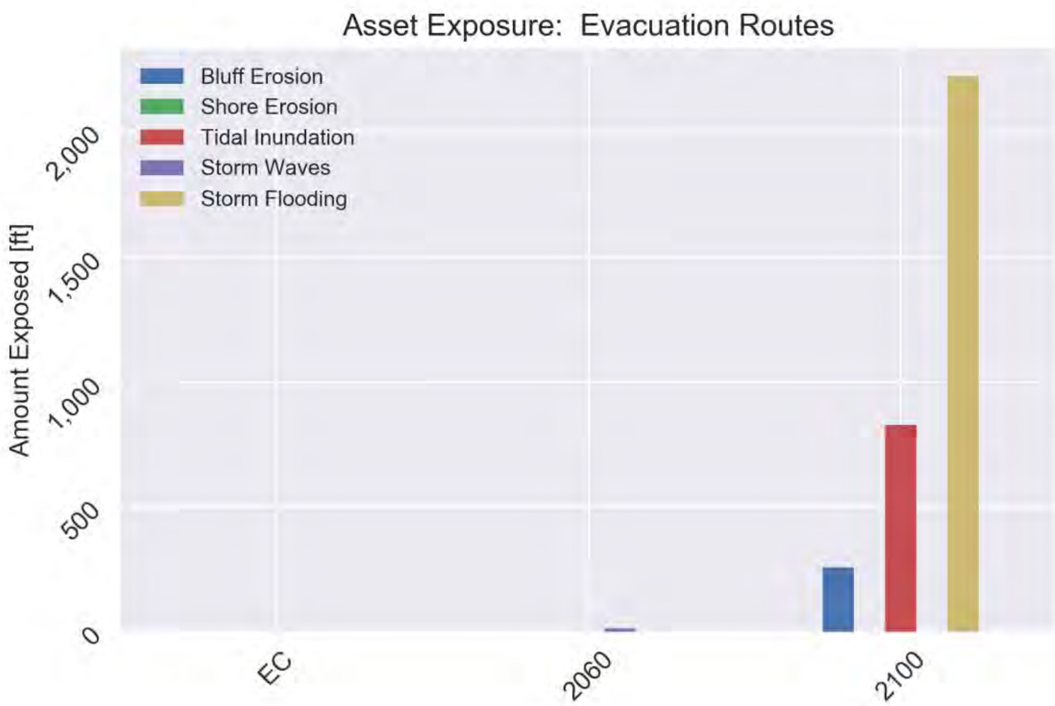
			Year 2100, LIG						
Category	**Assets**	**Units**	**Bluff Erosion**	**Shore Erosion**	**Tidal Inundation**	**Storm Waves**	**Storm Flooding**	**Low-Lying**	**Flood Prone**
Tansportation	Railroads	ft	0	0	0	0	0	0	0
	Roads	ft	0	0	0	0	0	0	0
	Public Parking	sq ft	0	0	0	0	0	0	0
Communications	Fiber Optic Cabinets	ct	0	0	0	0	0	0	0
	Fiber Optic Cables	ft	0	0	0	0	0	0	0
Critical Facilities	Fire Stations	ct	0	0	0	0	0	0	0
	Police Stations	ct	0	0	0	0	0	0	0
	Evacuation Routes	ft	0	0	0	0	0	0	0
Recreation	CA Coastal Trail	ft	0	0	0	0	0	0	0
	Parks	sq ft	51,124	51,886	0	0	0	157	0
Parcels	Parcels	ct	2	1	1	0	1	2	0
Sewer	Lift Stations	ct	0	0	0	0	0	0	0
	Laterals	ft	0	0	0	0	0	0	0
	Force Mains	ft	0	0	0	0	0	0	0
	Gravity Mains	ft	0	0	0	0	0	0	0
Stormwater	Drainage Pipes	ft	0	0	0	0	0	0	0
	Drainage Channels	ft	0	0	0	0	0	0	0
	Water Control Structures	ct	0	0	0	0	0	0	0
Water Supply	Raw Water Mains	ft	0	0	0	0	0	0	0
	Water Mains	ft	0	0	0	0	0	0	0
	Recycled Mains	ft	0	0	0	0	0	0	0
	Recycled Laterals	ft	0	0	0	0	0	0	0
Harbor Infrastructu	Breakwater (Concrete)	ft	0	0	0	0	0	0	0
	Breakwater (Rip-Rap)	ft	0	0	0	0	0	0	0
	Launch Ramps	ft	0	0	0	0	0	0	0
	Rock Groins	ft	0	0	0	0	0	0	0
	Rock Groins (Rip-Rap)	ft	0	0	0	0	0	0	0
	Waterfront Street Parking	ft	0	0	0	0	0	0	0
Wells	Groundwater Wells	ct	0	0	0	0	0	0	0
	Monitoring Wells	ct	0	0	0	0	0	0	0
	Production Wells	ct	0	0	0	0	0	0	0

Communications

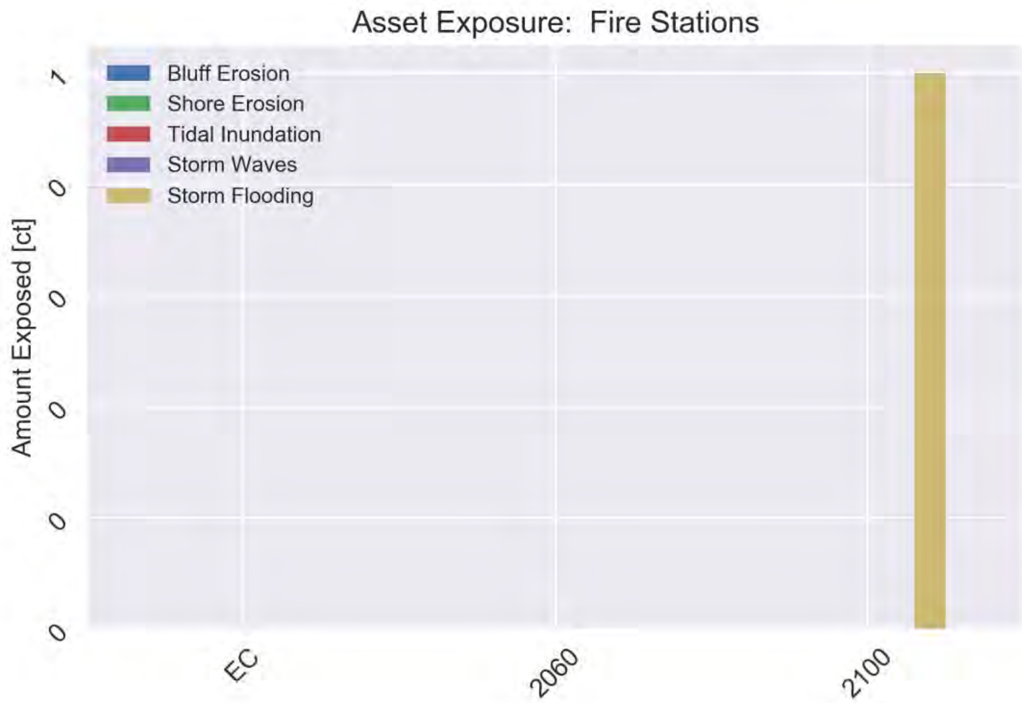




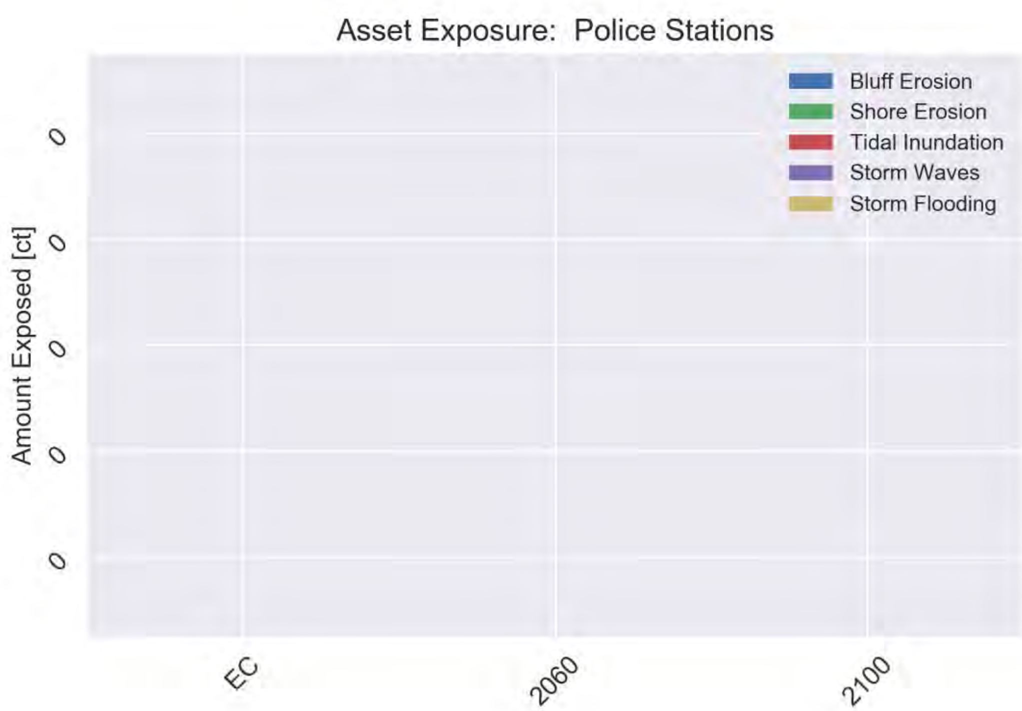
Critical Facilities



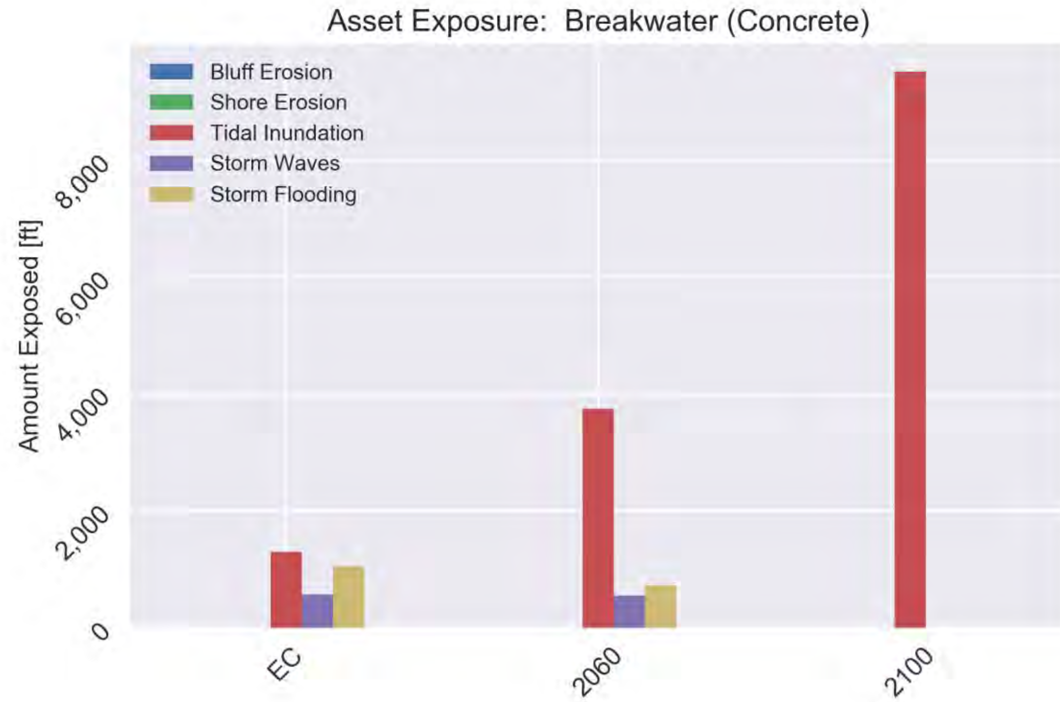
Asset Exposure: Fire Stations

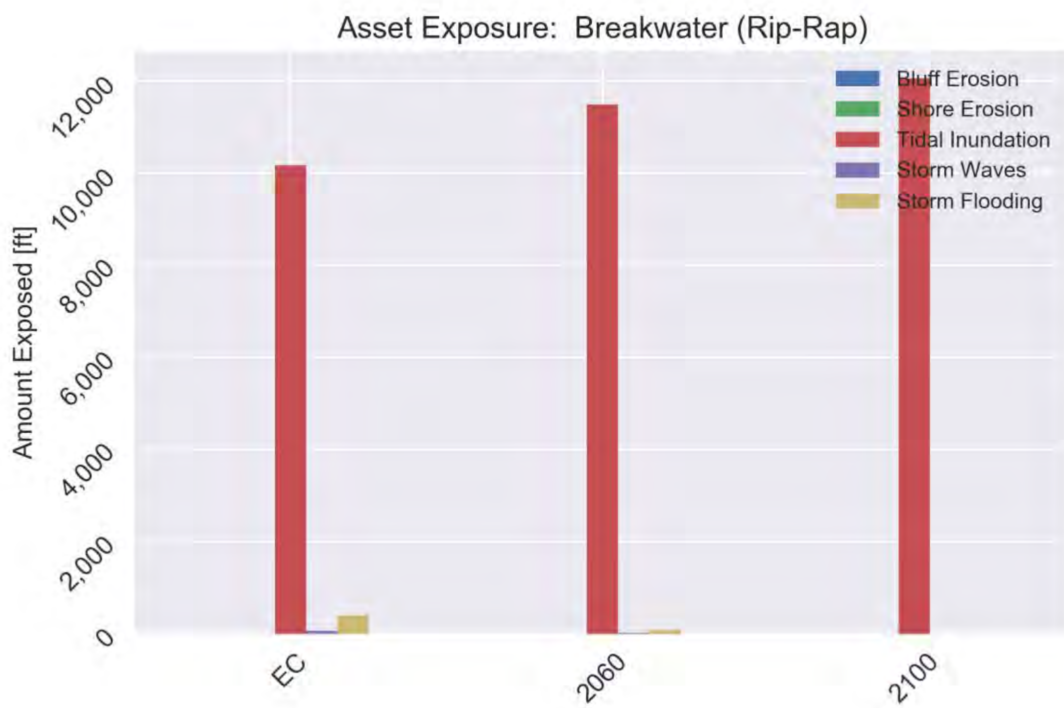


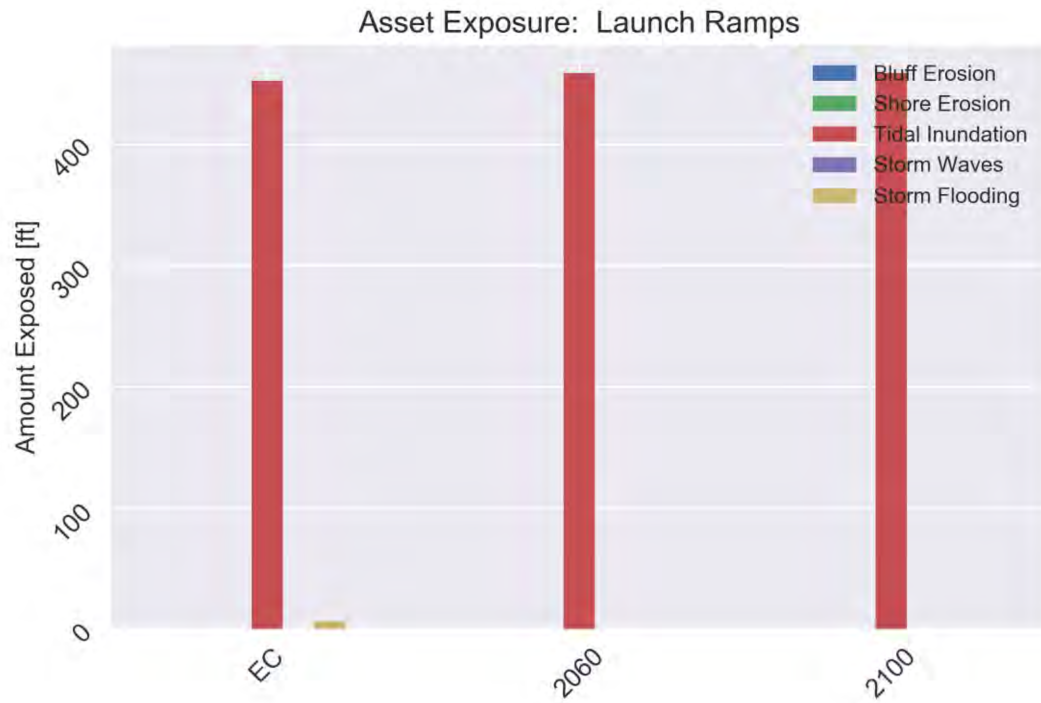
Asset Exposure: Police Stations

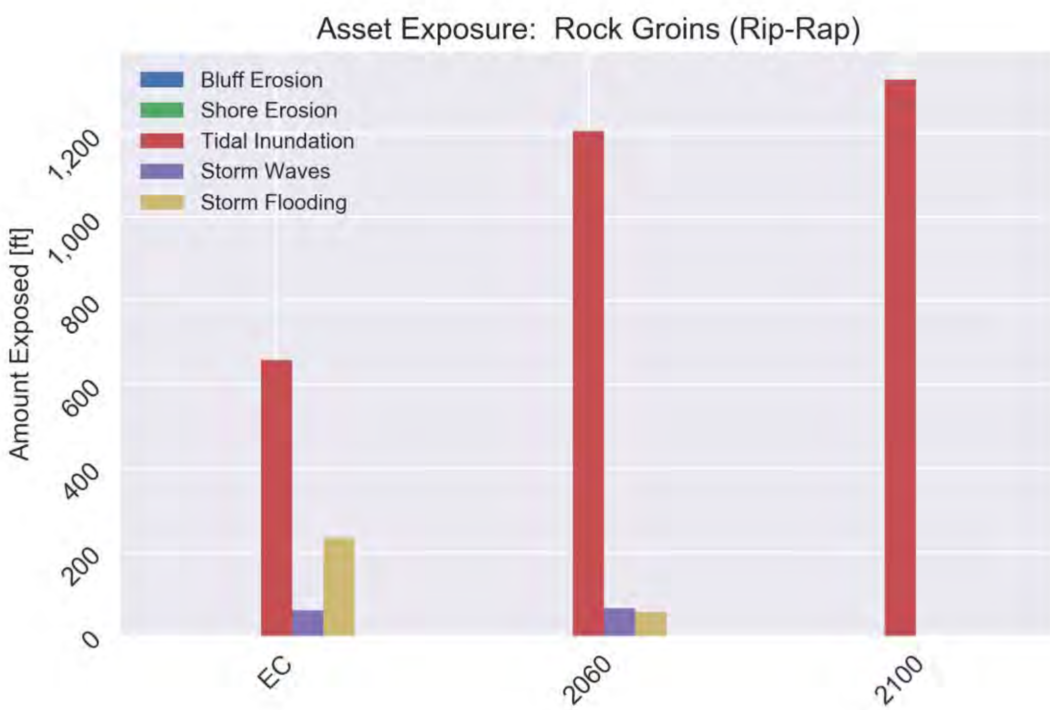


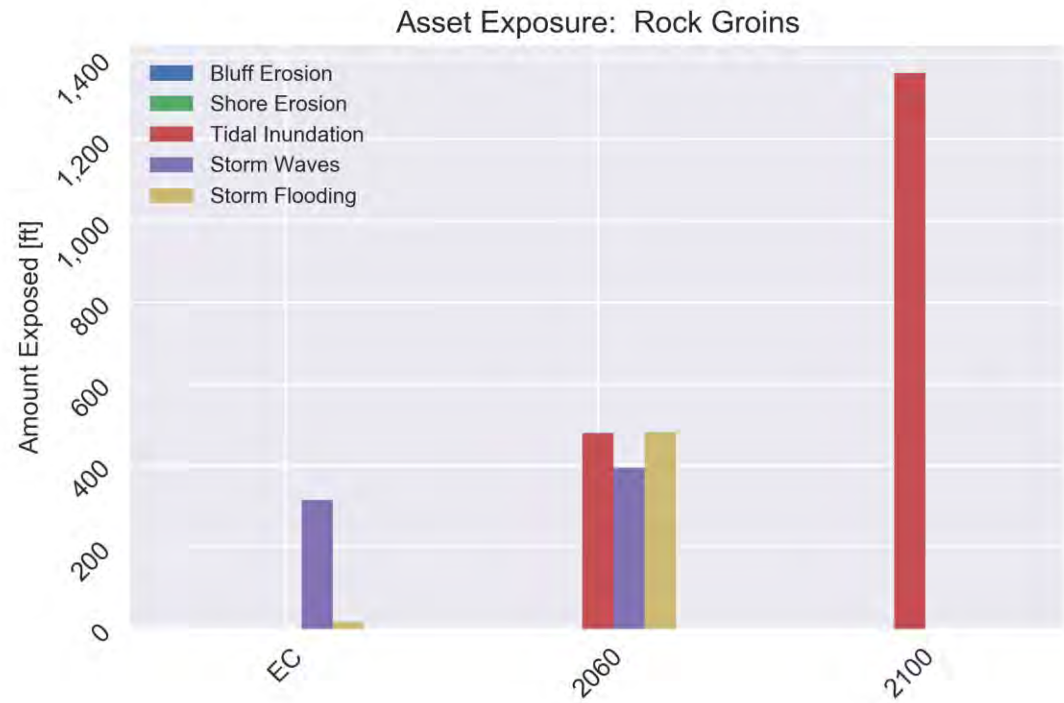
Harbor Infrastructure





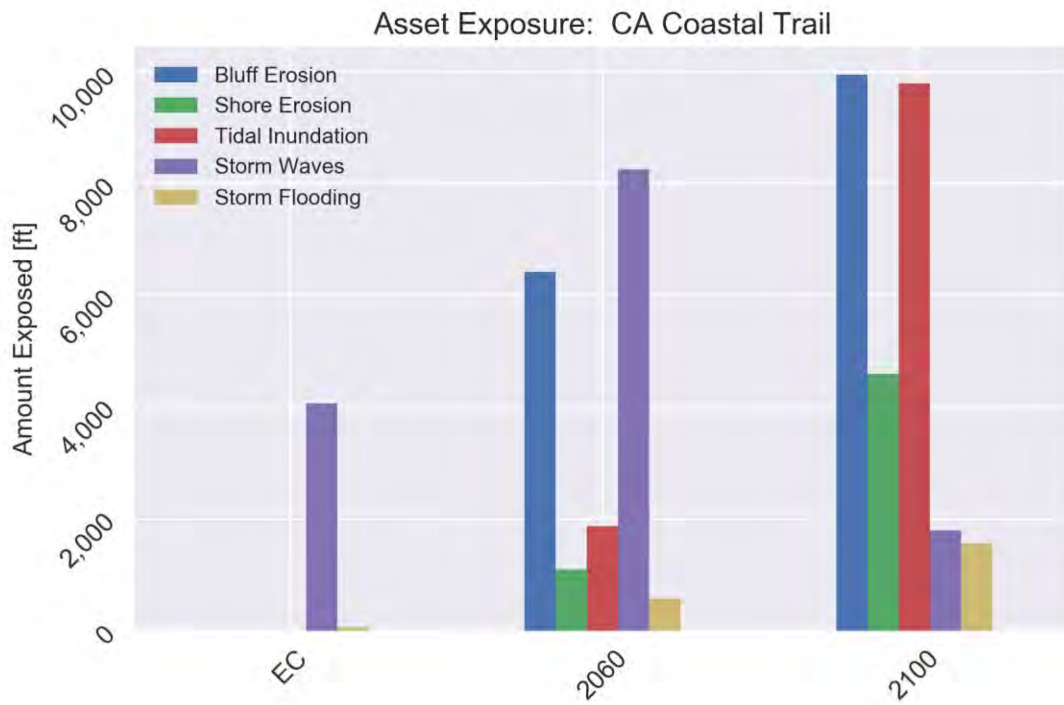

Asset Exposure: Launch Ramps
Amount Exposed [ft]
0
100
200
300
400
EC
2060
2100
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding


Asset Exposure: Rock Groins (Rip-Rap)
Amount Exposed [ft]
0
200
400
600
800
1,000
1,200
EC
2060
2100
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding

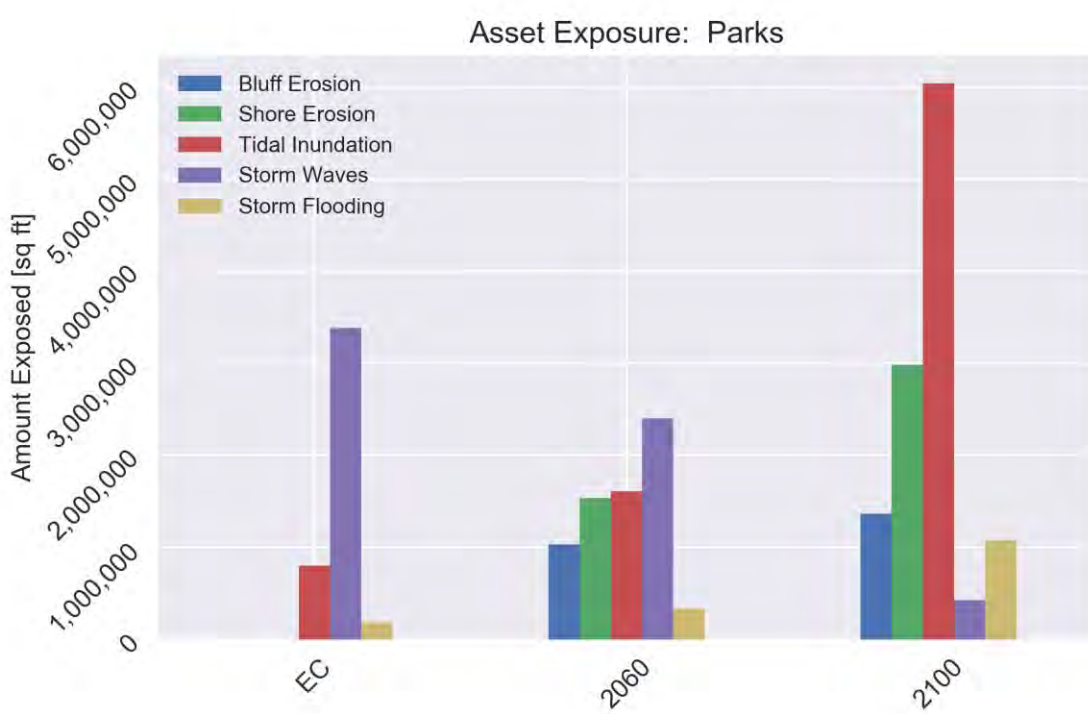

Asset Exposure: Rock Groins
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ft]
0
200
400
600
800
1,000
1,200
1,400
EC
2060
2100


Asset Exposure: Waterfront Street Parking
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ft]
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
EC
2060
2100

Recreation

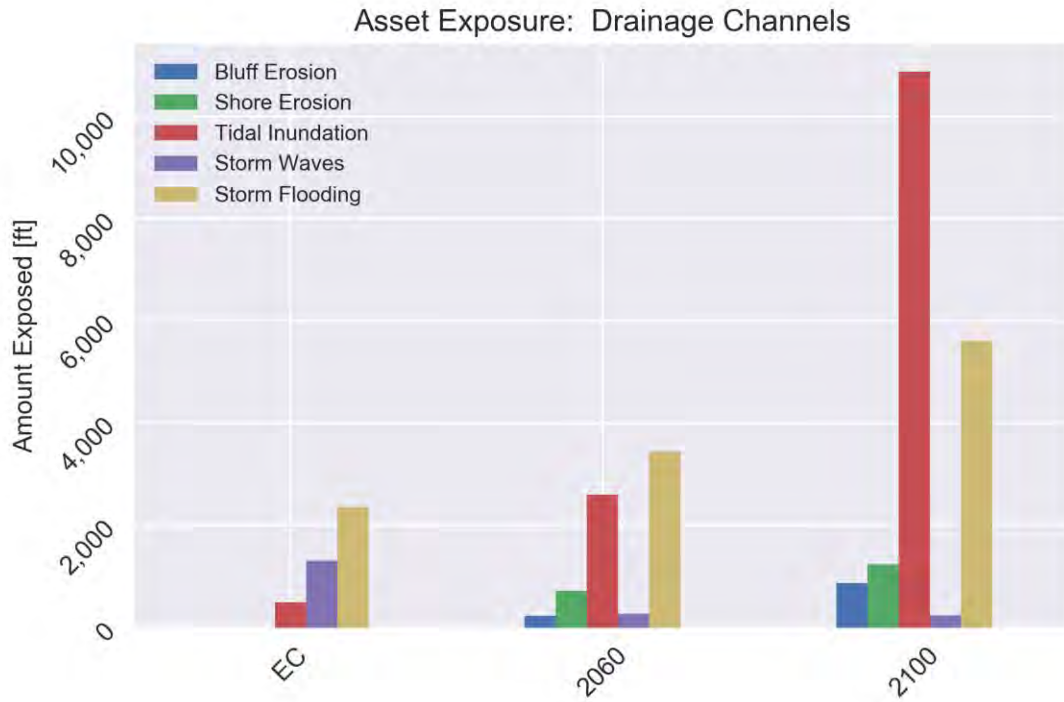


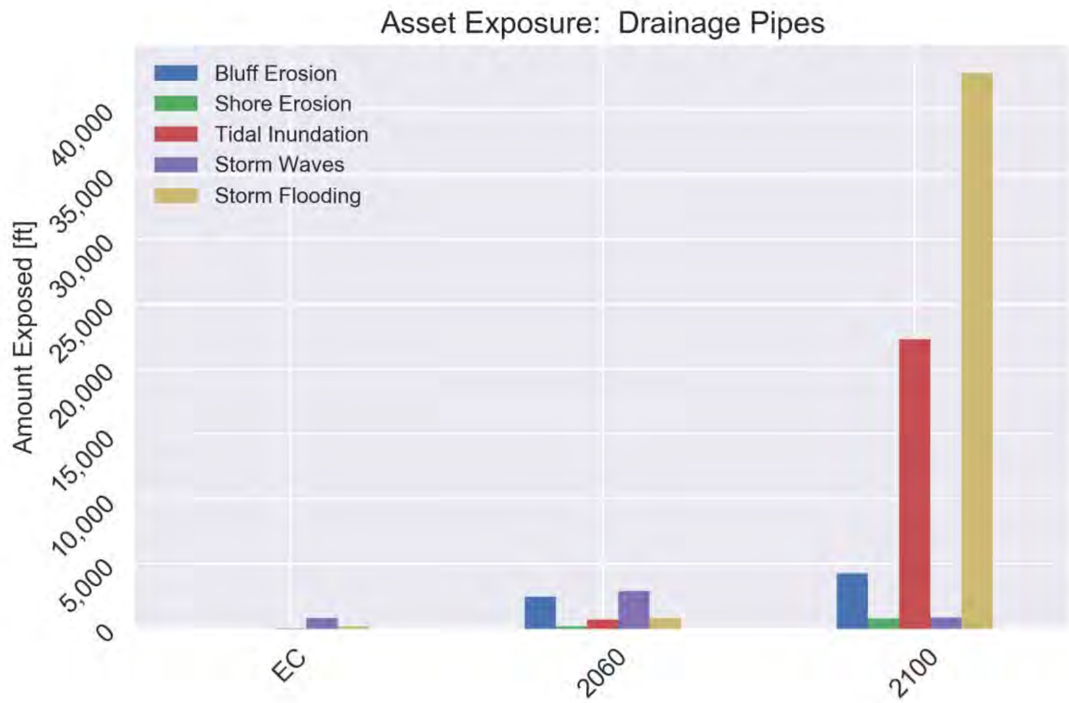
Asset Exposure: CA Coastal Trail
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ft]
0
2,000
4,000
6,000
8,000
10,000
EC
2060
2100



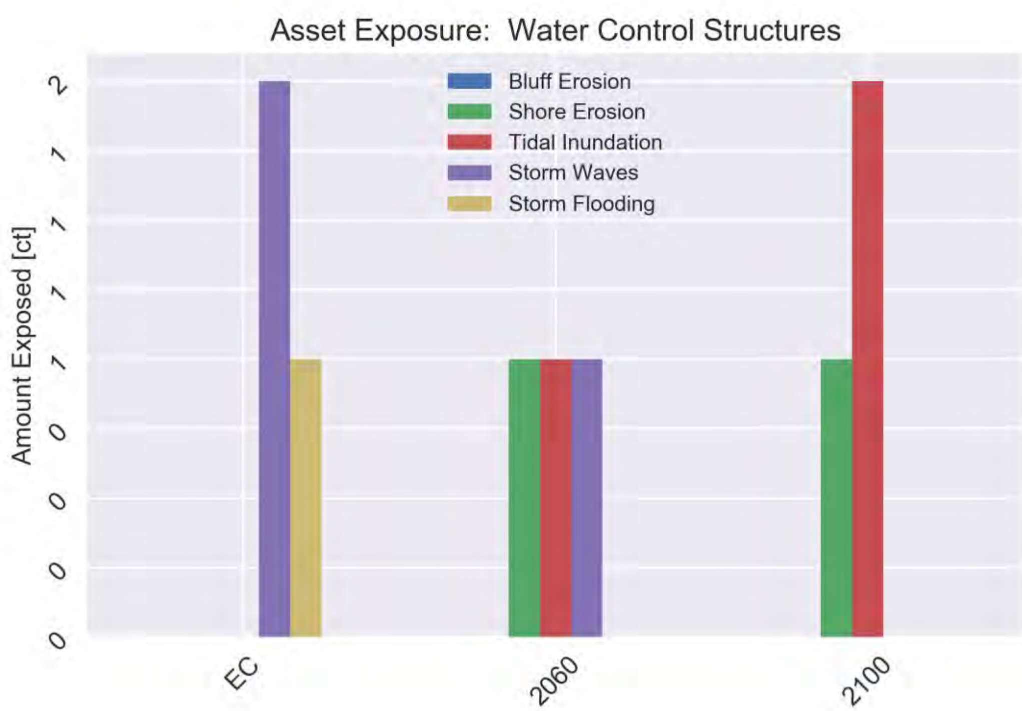
Asset Exposure: Parks
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [sq ft]
0
1,000,000
2,000,000
3,000,000
4,000,000
5,000,000
6,000,000
EC
2060
2100

Stormwater


Asset Exposure: Drainage Channels
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ft]
0
2,000
4,000
6,000
8,000
10,000
EC
2060
2100

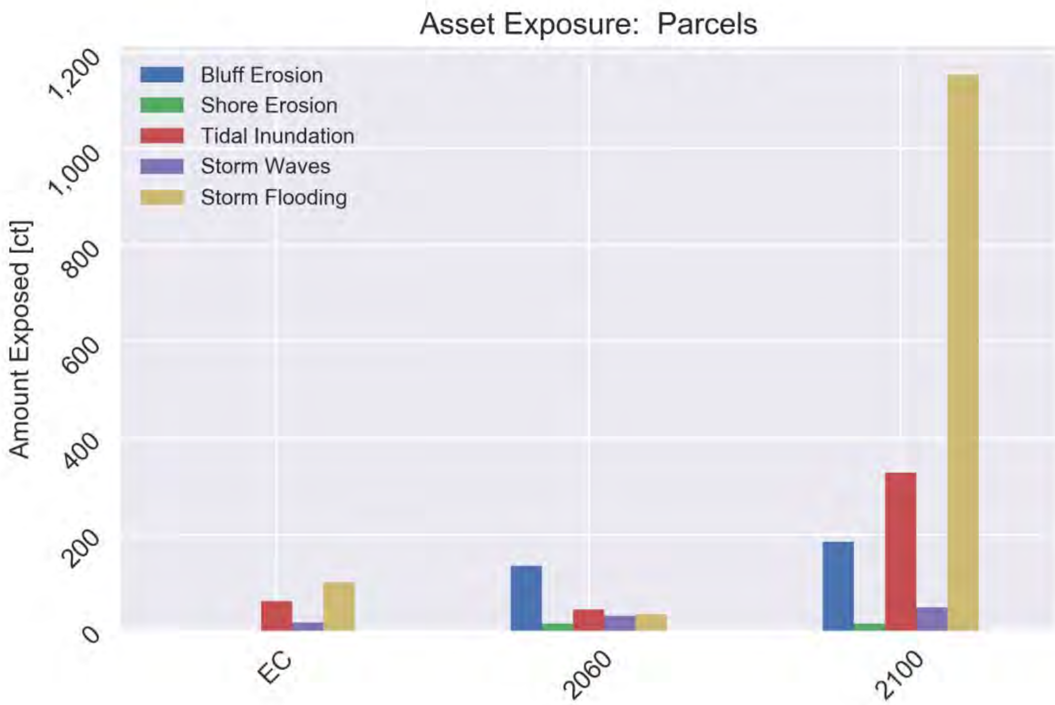


Asset Exposure: Drainage Pipes
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ft]
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
EC
2060
2100

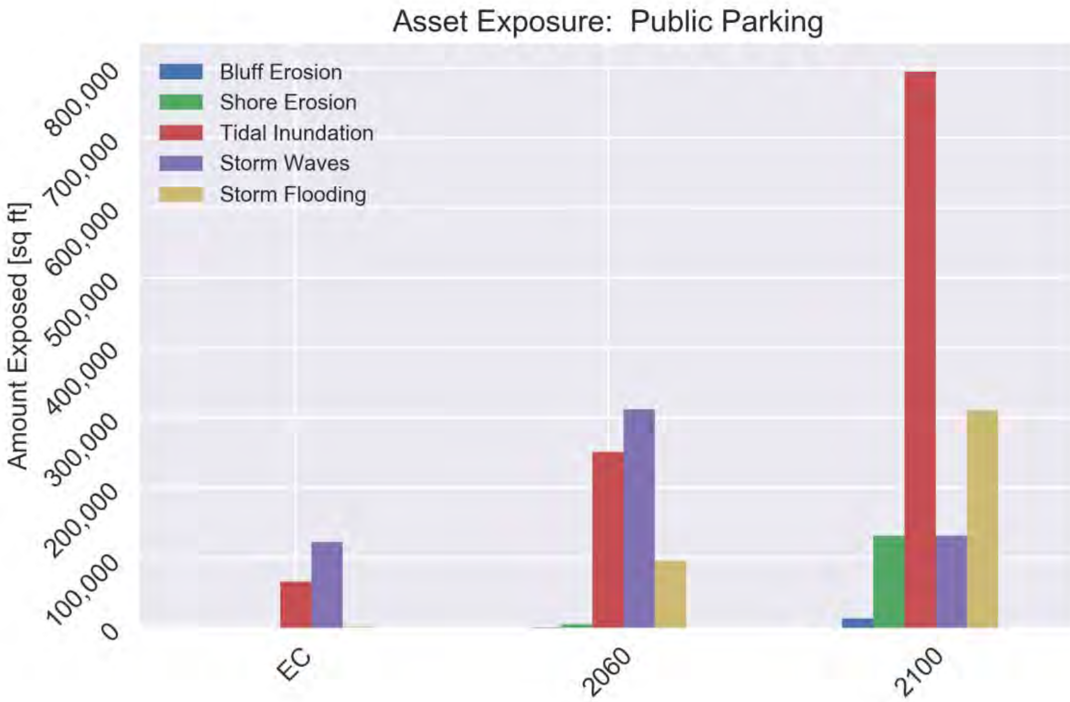


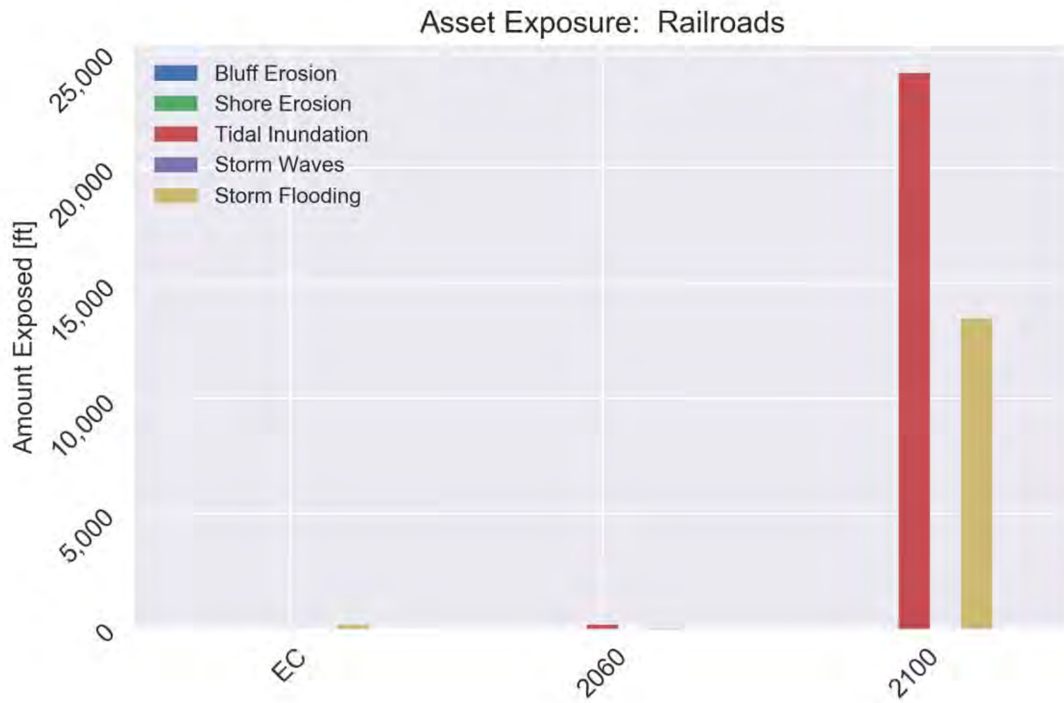
Asset Exposure: Water Control Structures
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ct]
2
1
1
1
1
0
0
0
0
EC
2060
2100

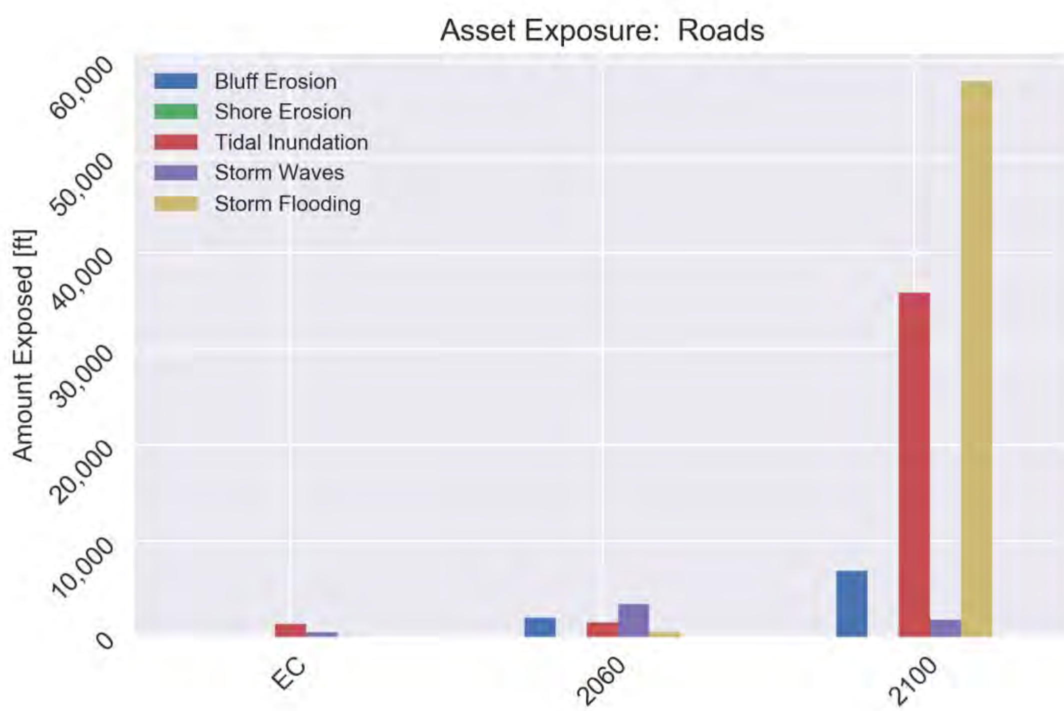
Public and Private Properties (Parcels)



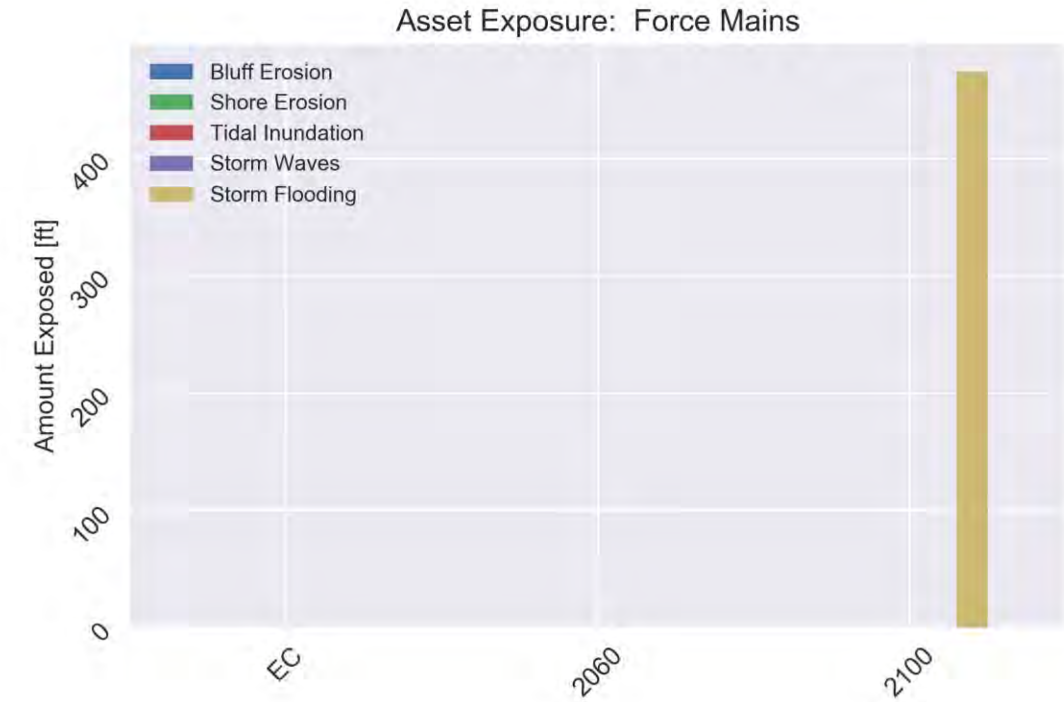
Transportation



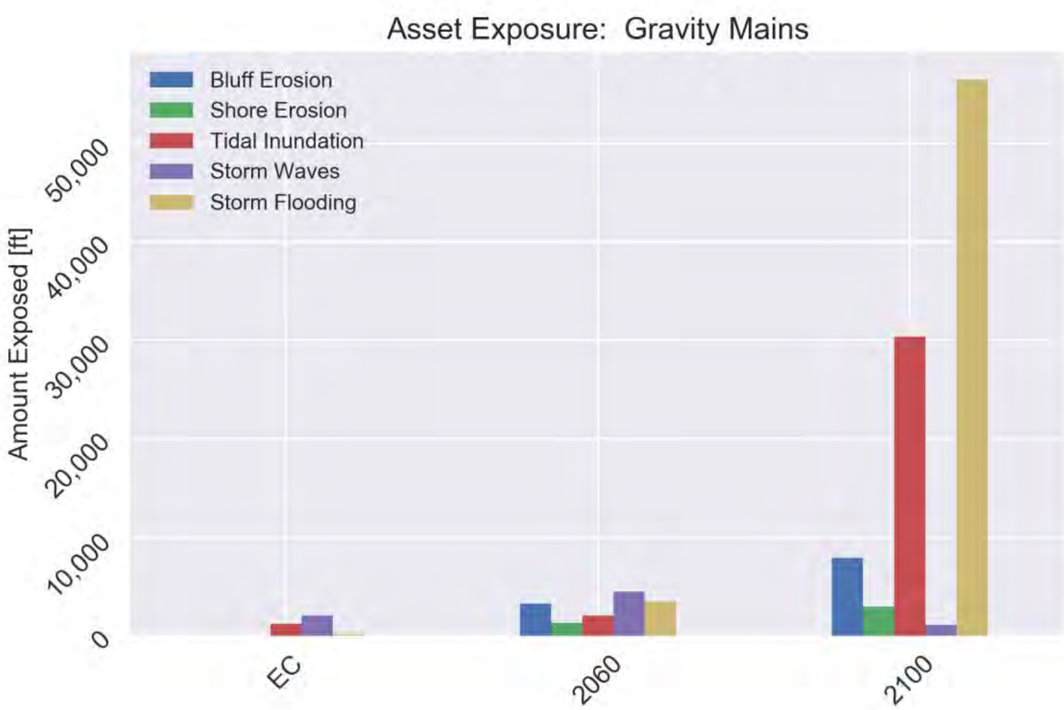

Asset Exposure: Railroads
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ft]
25,000
20,000
15,000
10,000
5,000
0
EC
2060
2100


Asset Exposure: Roads
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ft]
60,000
50,000
40,000
30,000
20,000
10,000
0
EC
2060
2100

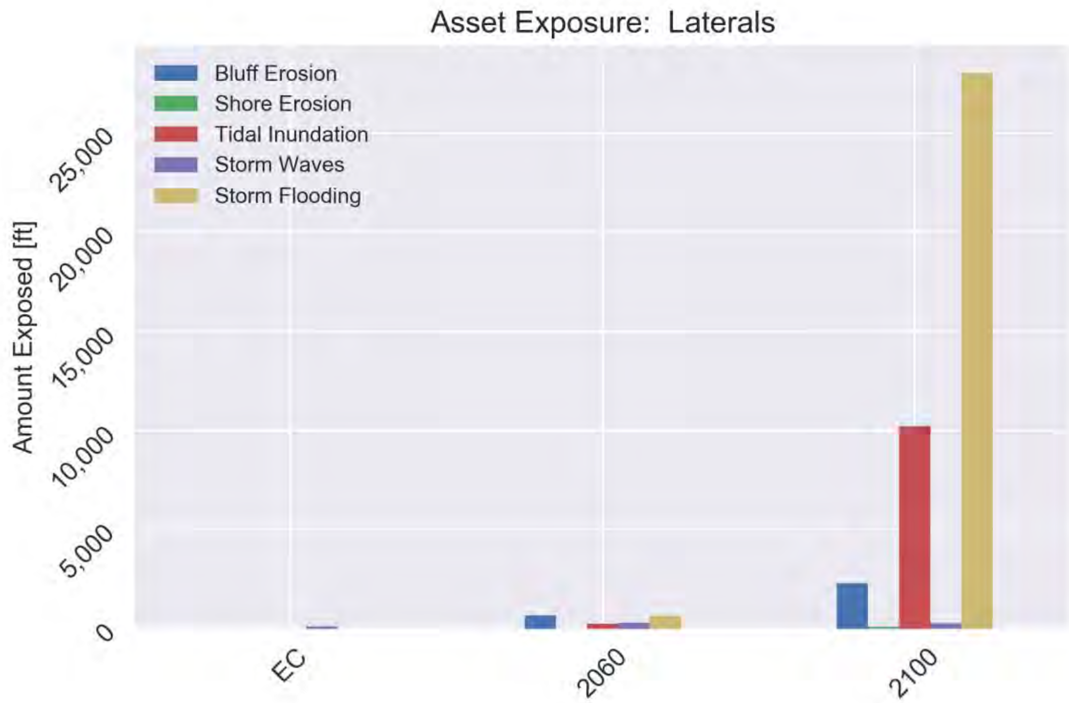
Wastewater



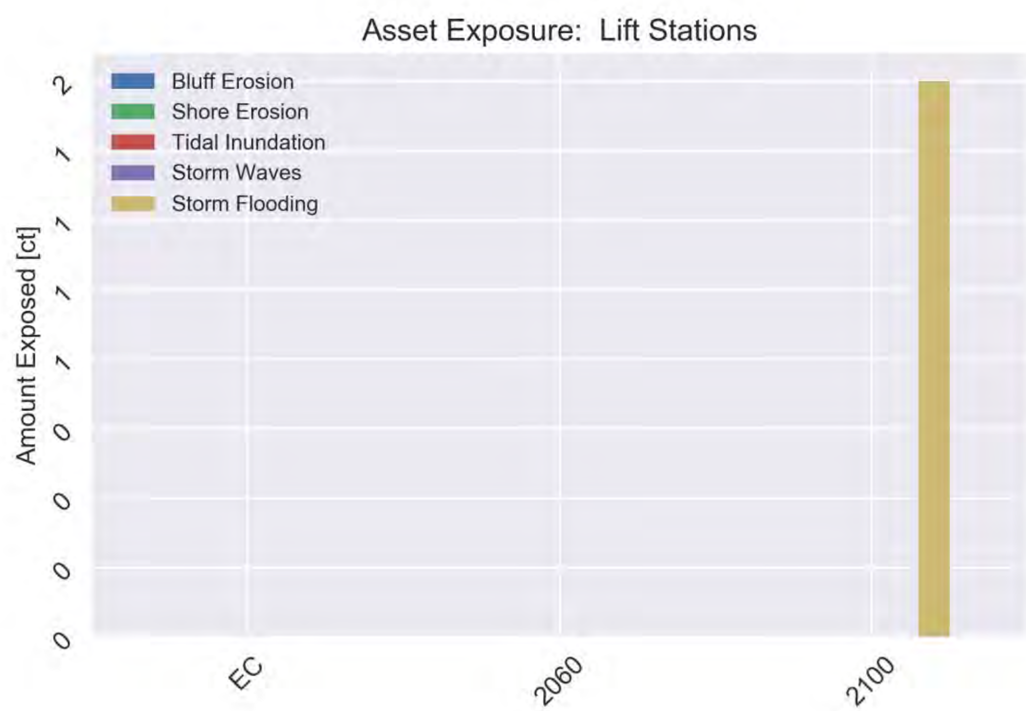
Asset Exposure: Force Mains
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ft]
0
100
200
300
400
EC
2060
2100



Asset Exposure: Gravity Mains
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ft]
0
10,000
20,000
30,000
40,000
50,000
EC
2060
2100

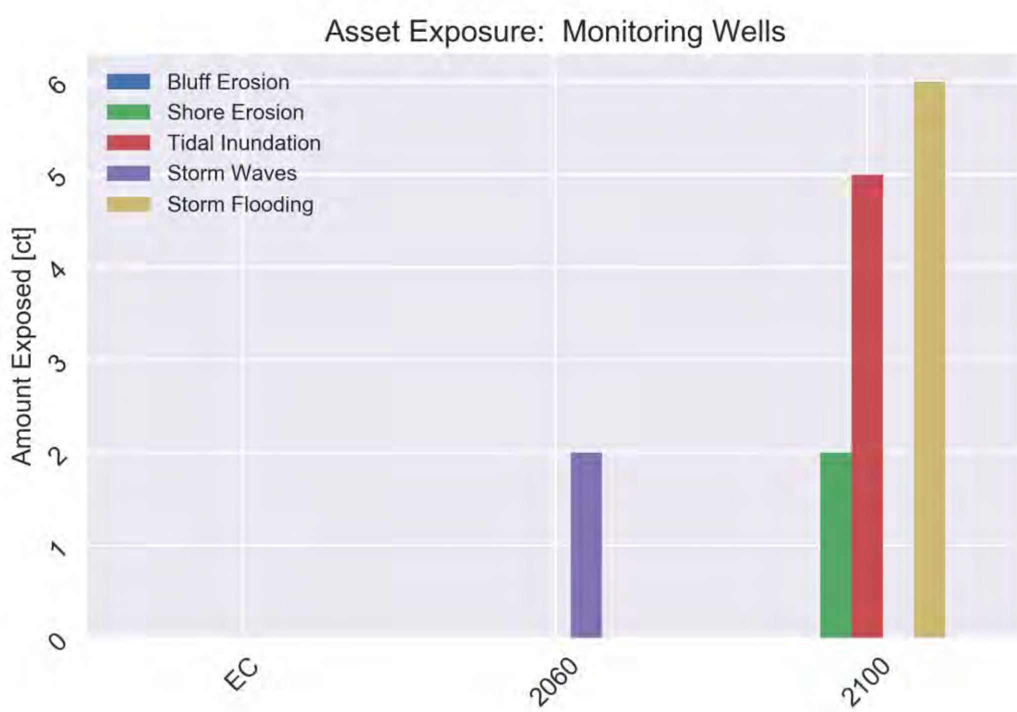


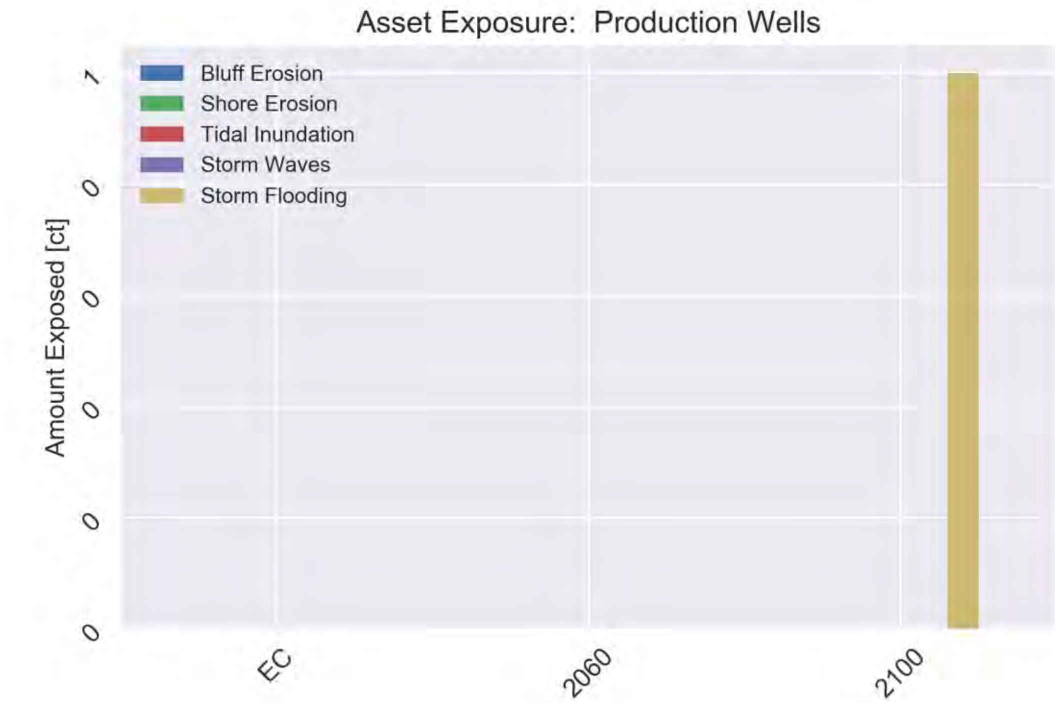
Asset Exposure: Laterals
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ft]
0
5,000
10,000
15,000
20,000
25,000
EC
2060
2100



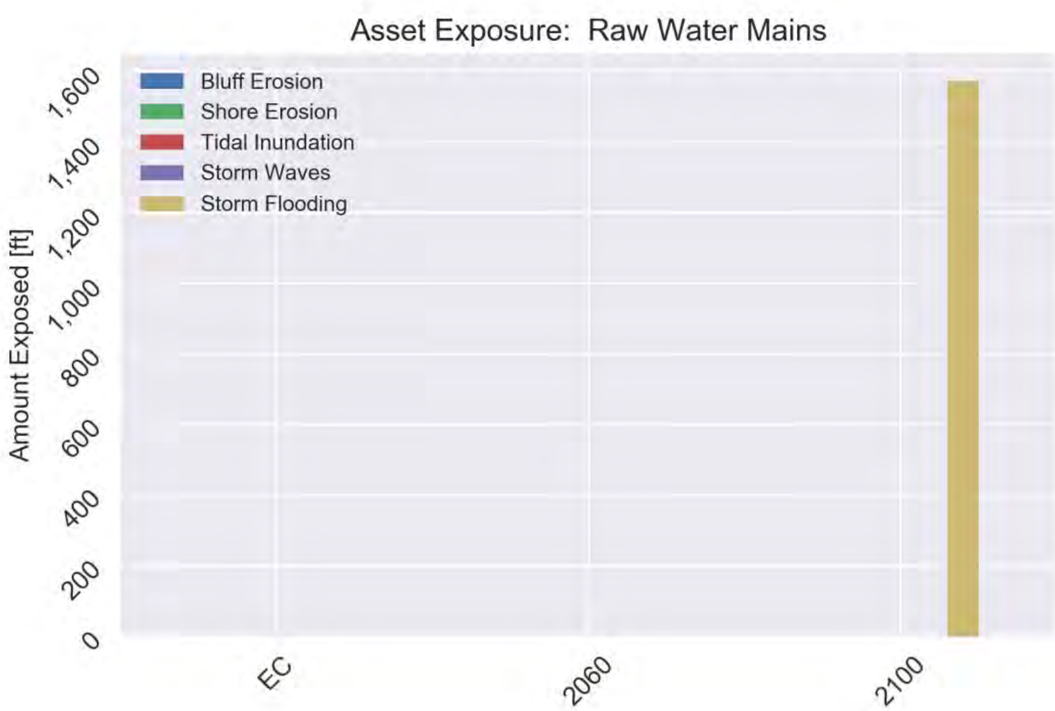
Asset Exposure: Lift Stations
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ct]
0
0
0
0
1
1
1
1
2
EC
2060
2100

Water Supply

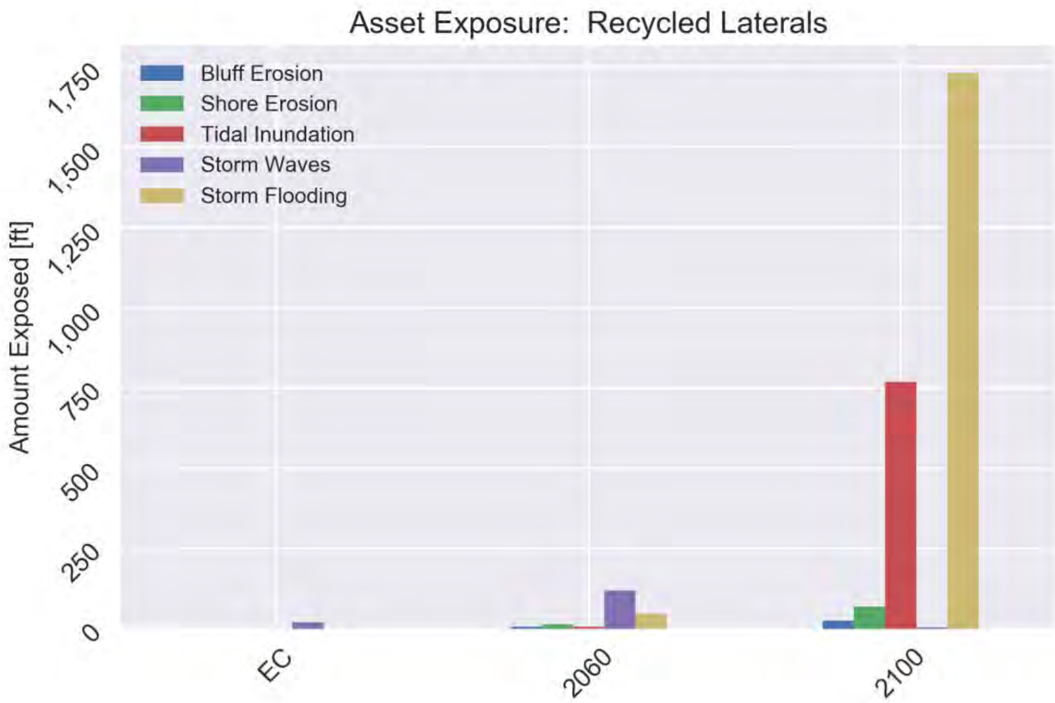




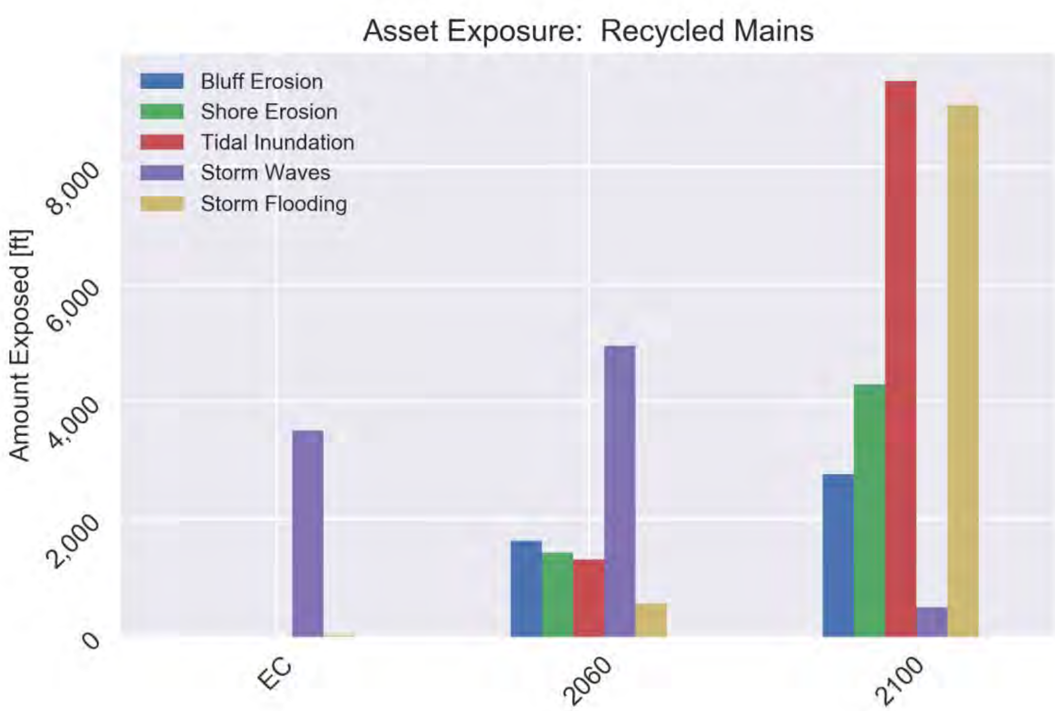
Asset Exposure: Production Wells
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ct]
1
0
0
0
0
0
EC
2060
2100



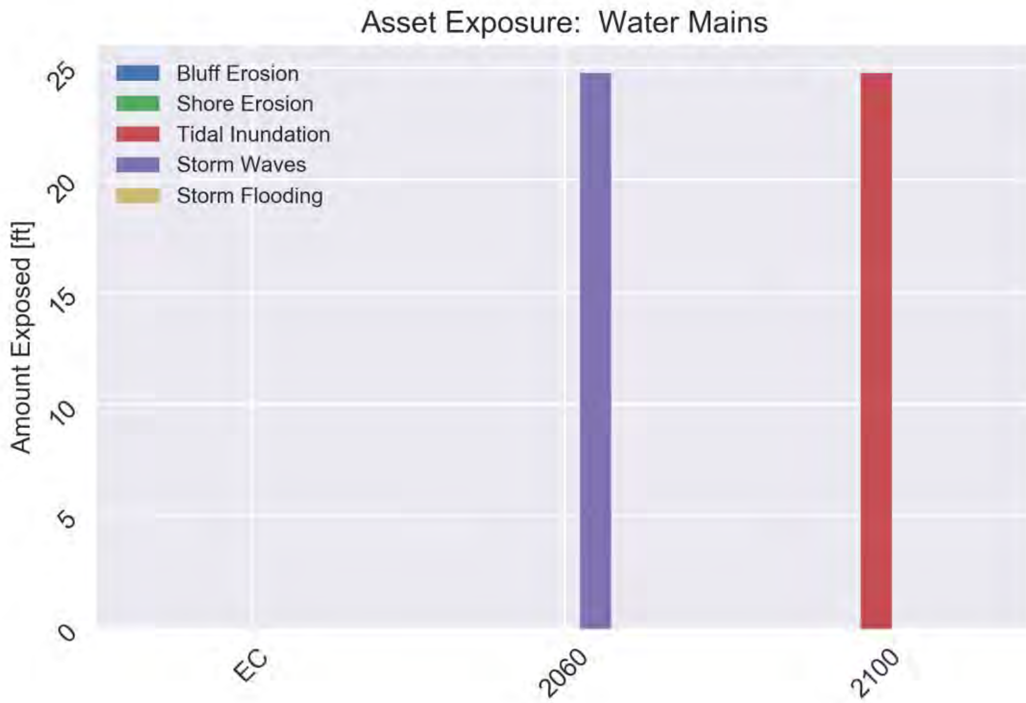
Asset Exposure: Raw Water Mains
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ft]
1,600
1,400
1,200
1,000
800
600
400
200
0
EC
2060
2100



Asset Exposure: Recycled Laterals
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ft]
0
250
500
750
1,000
1,250
1,500
1,750
EC
2060
2100



Asset Exposure: Recycled Mains
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ft]
0
2,000
4,000
6,000
8,000
EC
2060
2100


Asset Exposure: Water Mains
Bluff Erosion
Shore Erosion
Tidal Inundation
Storm Waves
Storm Flooding
Amount Exposed [ft]
0
5
10
15
20
25
EC
2060
2100

ASSET DATA SOURCES

Category	Asset	Geometry	Source
Communications	Fiber Optic Communication Cabinets	Point	City of Santa Barbara
Communications	Fiber Optic Cables	Line	City of Santa Barbara
Critical Facilities	Fire Stations	Point	City of Santa Barbara
Critical Facilities	Police Stations	Point	City of Santa Barbara
Critical Facilities	Evacuation Routes	Line	City of Santa Barbara
Harbor Infrastructure	Concrete Breakwaters	Line	City of Santa Barbara
Harbor Infrastructure	Rip-rap Breakwaters	Line	City of Santa Barbara
Harbor Infrastructure	Boat Launch Ramps	Line	City of Santa Barbara
Harbor Infrastructure	Solid Groins	Line	City of Santa Barbara
Harbor Infrastructure	Rip-Rap Groins	Line	City of Santa Barbara
Harbor Infrastructure	Street Parking	Line	City of Santa Barbara
Recreation	Recreational Areas[1]	Polygon	BREN[2]
Recreation	CA Coastal Trail	Line	City of Santa Barbara
Stormwater	Stormwater Pipes	Line	City of Santa Barbara
Stormwater	Stormwater Channels	Line	City of Santa Barbara
Stormwater	Water Control Structures	Point	ESA[3]
Structures/Parcels	Parcels	Polygon	City of Santa Barbara
Transportation	Railroads	Line	City of Santa Barbara
Transportation	Roads	Line	City of Santa Barbara
Transportation	Public Parking Lots	Polygon	City of Santa Barbara
Wastewater	Sewer Lift Stations[4]	Point	City of Santa Barbara
Wastewater	Sewer Laterals	Line	City of Santa Barbara
Wastewater	Sewer Force Mains	Line	City of Santa Barbara
Wastewater	Sewer Gravity Mains	Line	City of Santa Barbara
Water Supply	Groundwater Wells	Point	City of Santa Barbara
Water Supply	Monitoring Wells	Point	City of Santa Barbara
Water Supply	Production Wells	Point	City of Santa Barbara
Water Supply	Water Pumps	Point	City of Santa Barbara
Water Supply	Raw Water Mains	Line	City of Santa Barbara
Water Supply	Water Mains	Line	City of Santa Barbara
Water Supply	Recycled Water Mains	Line	City of Santa Barbara
Water Supply	Recycled Water Laterals	Line	City of Santa Barbara

NOTES:

1 Recreation Areas include Stearns Wharf, though this asset is in the harbor area. The harbor and Stearns Wharf are addressed in more detail in Section 4.4.1 and 4.4.2.

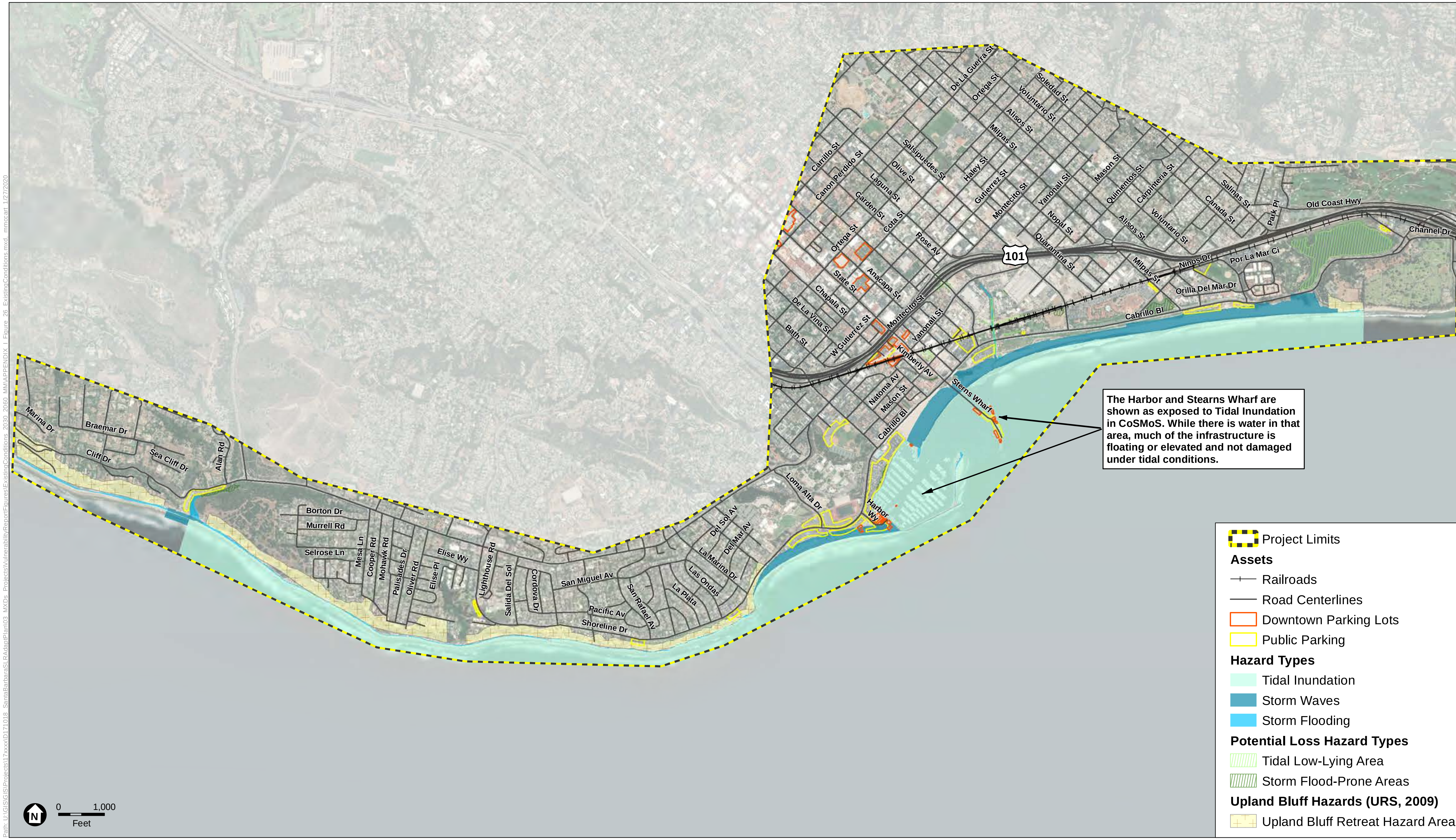
2 The recreational areas dataset from Bren provides more data than the layer provided by the city, but covers fewer areas. This dataset was augmented with any areas in the city-provided dataset that were exposed to one or more of the hazard layers.

3 ESA identified two tide gates and one pump station that were not in the data provided by the City and created a layer to identify these in the analysis.

4 The “lift station” identified by the City represents the El Estero Wastewater Treatment Plant.

Appendix I

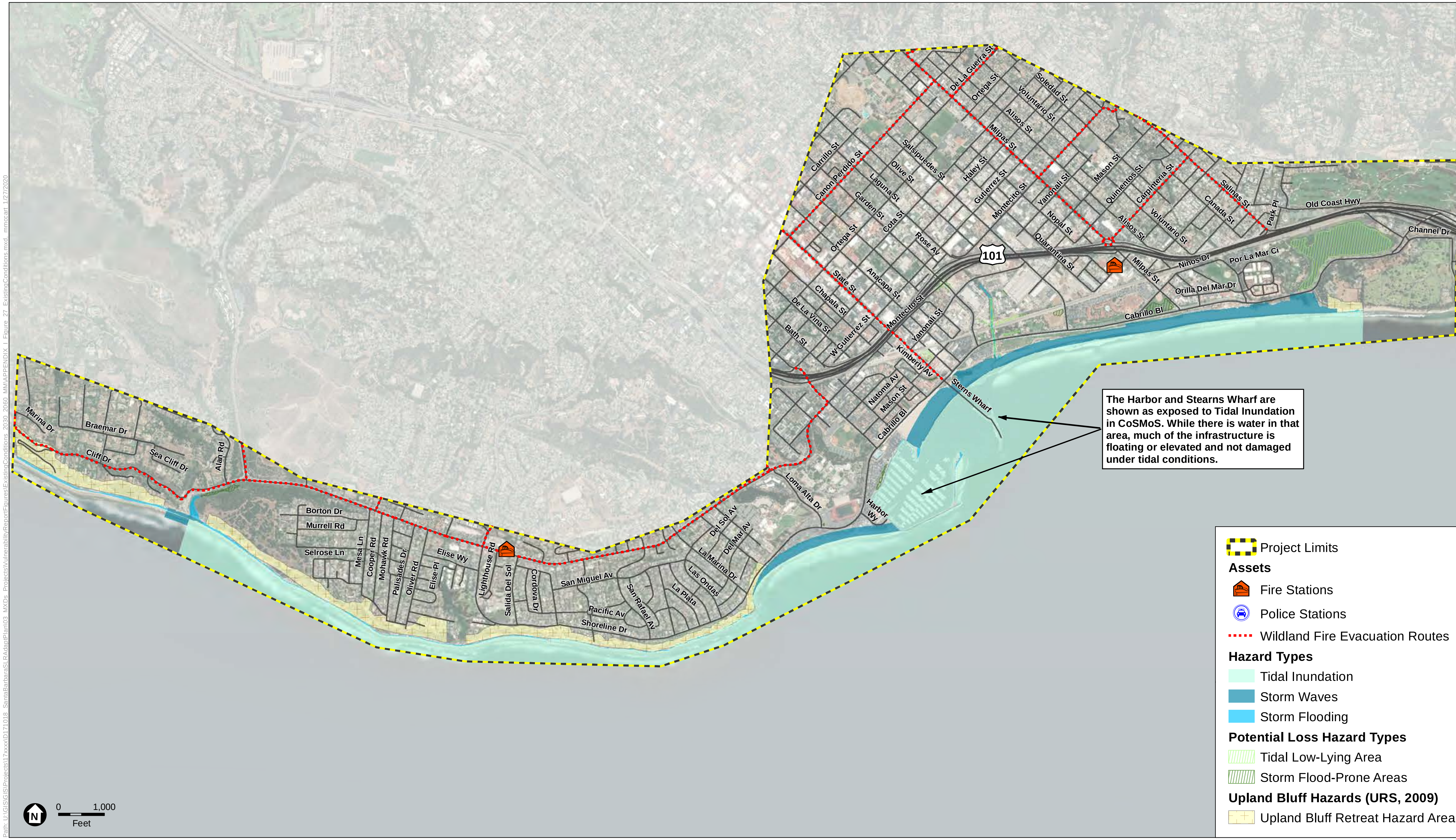
Asset Exposure Maps for 0.8 Feet and 2.5 Feet of Sea-Level Rise



SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbra, 2018.

Figure I-1
Asset Hazard Map:
Transportation Hazards Existing Conditions

ESA

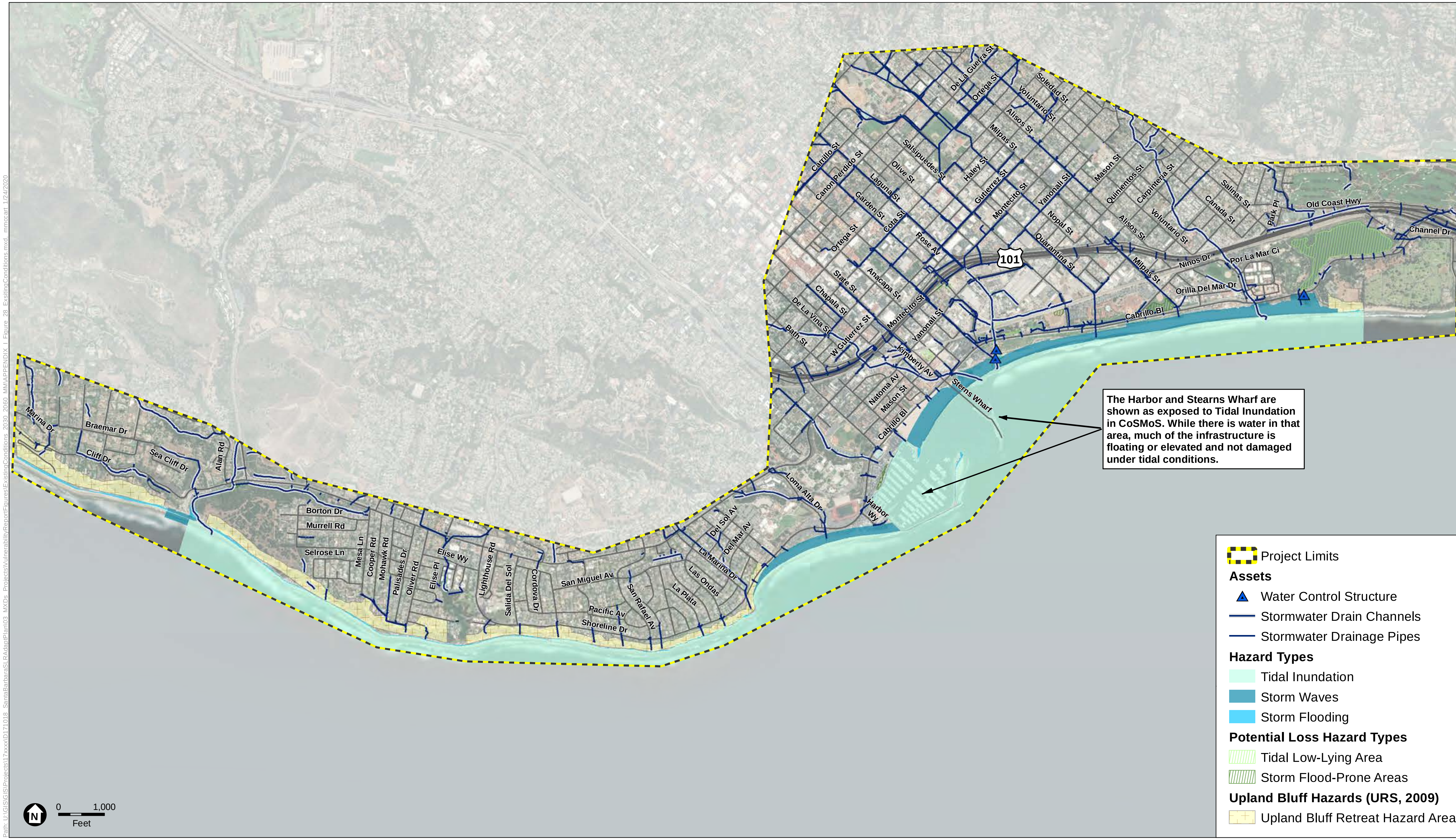


SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbara, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

Figure I-2
Asset Hazard Map:
Fire Stations, Police Stations, and Evacuation Routes
Existing Conditions

ESA

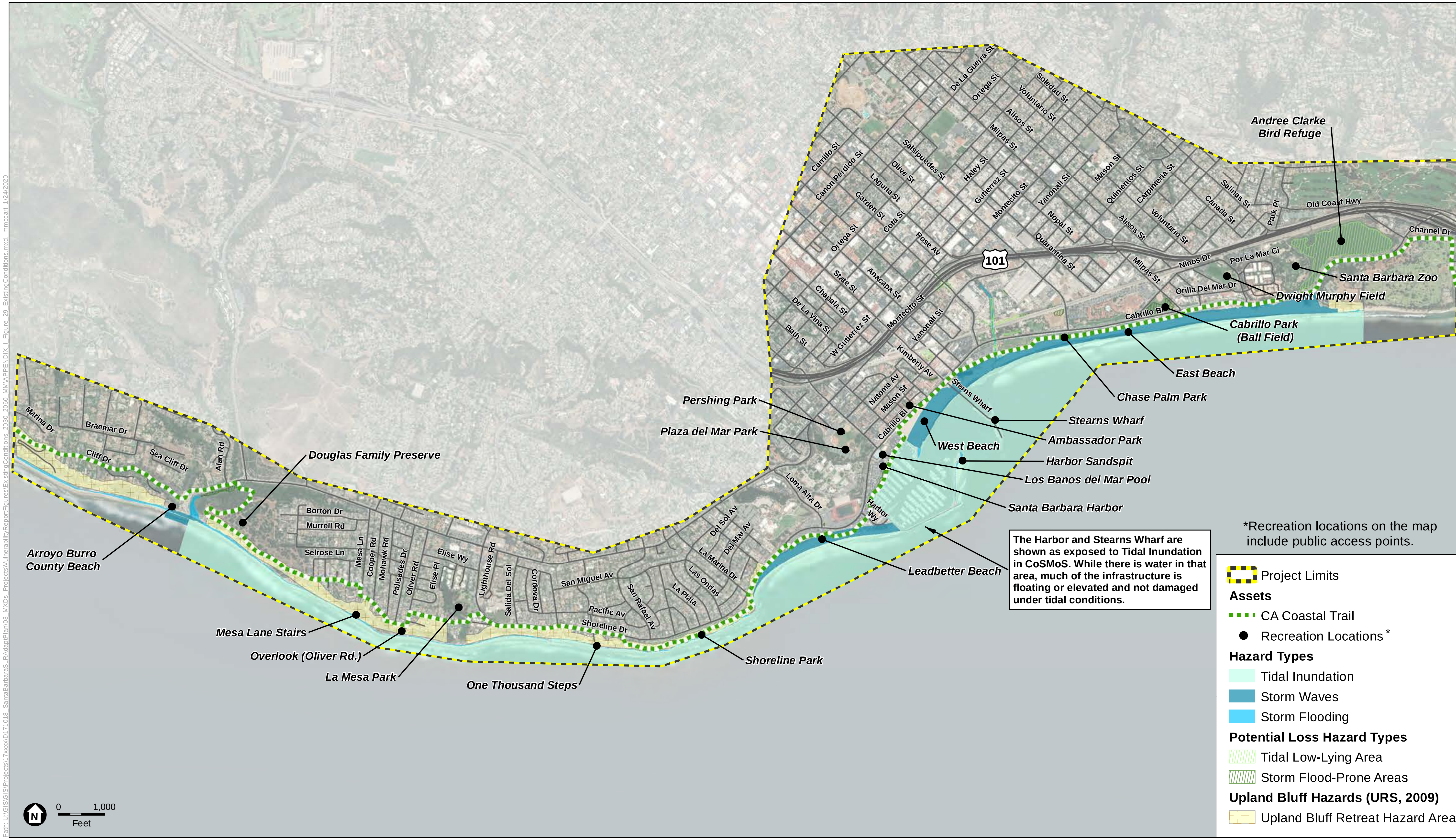


SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbara, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

Figure I-3
Asset Hazard Map:
Stormwater Hazards Existing Conditions

ESA



SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbra, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

Figure I-4
Asset Hazard Map:
Recreation Areas Hazards Existing Conditions

ESA

SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbra, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

Figure I-5
Asset Hazard Map:
Harbor Assets Hazards Existing Conditions

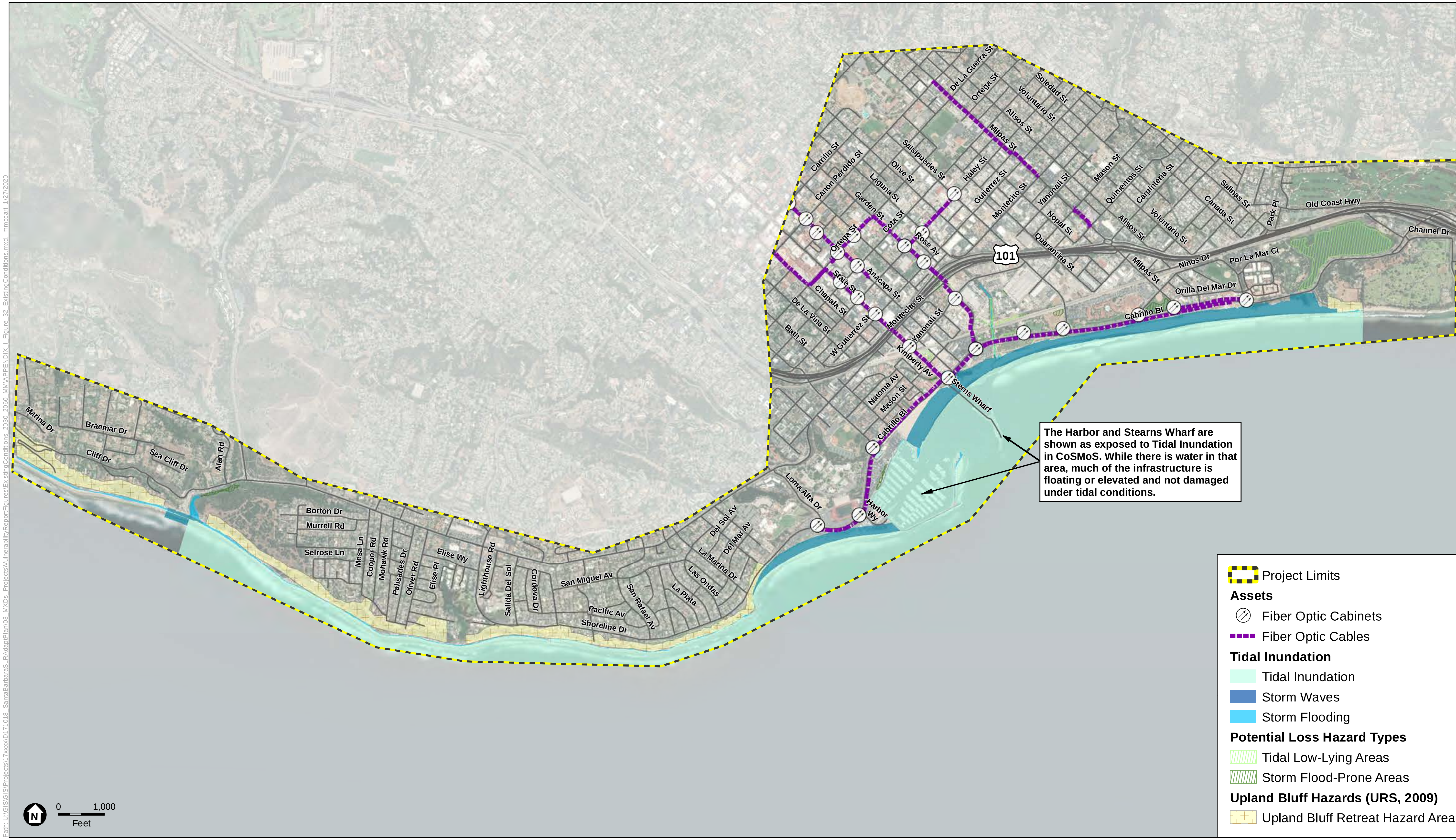
ESA

SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbra, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

Figure I-6
Asset Hazard Map:
Public and Private Properties
Hazards Existing Conditions

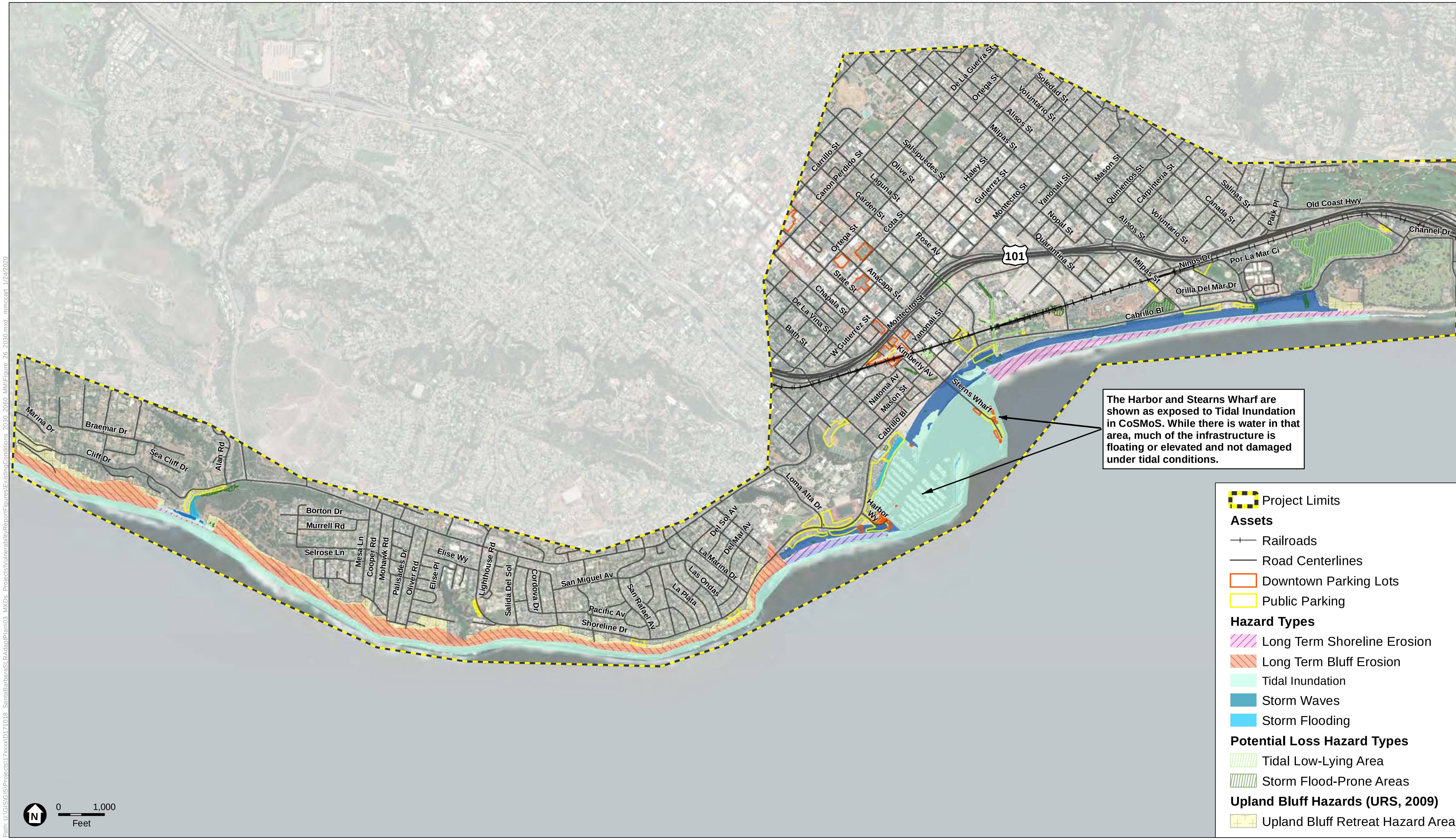
ESA



SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbra, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

Figure I-7
Asset Hazard Map: Communications
Hazards Existing Conditions

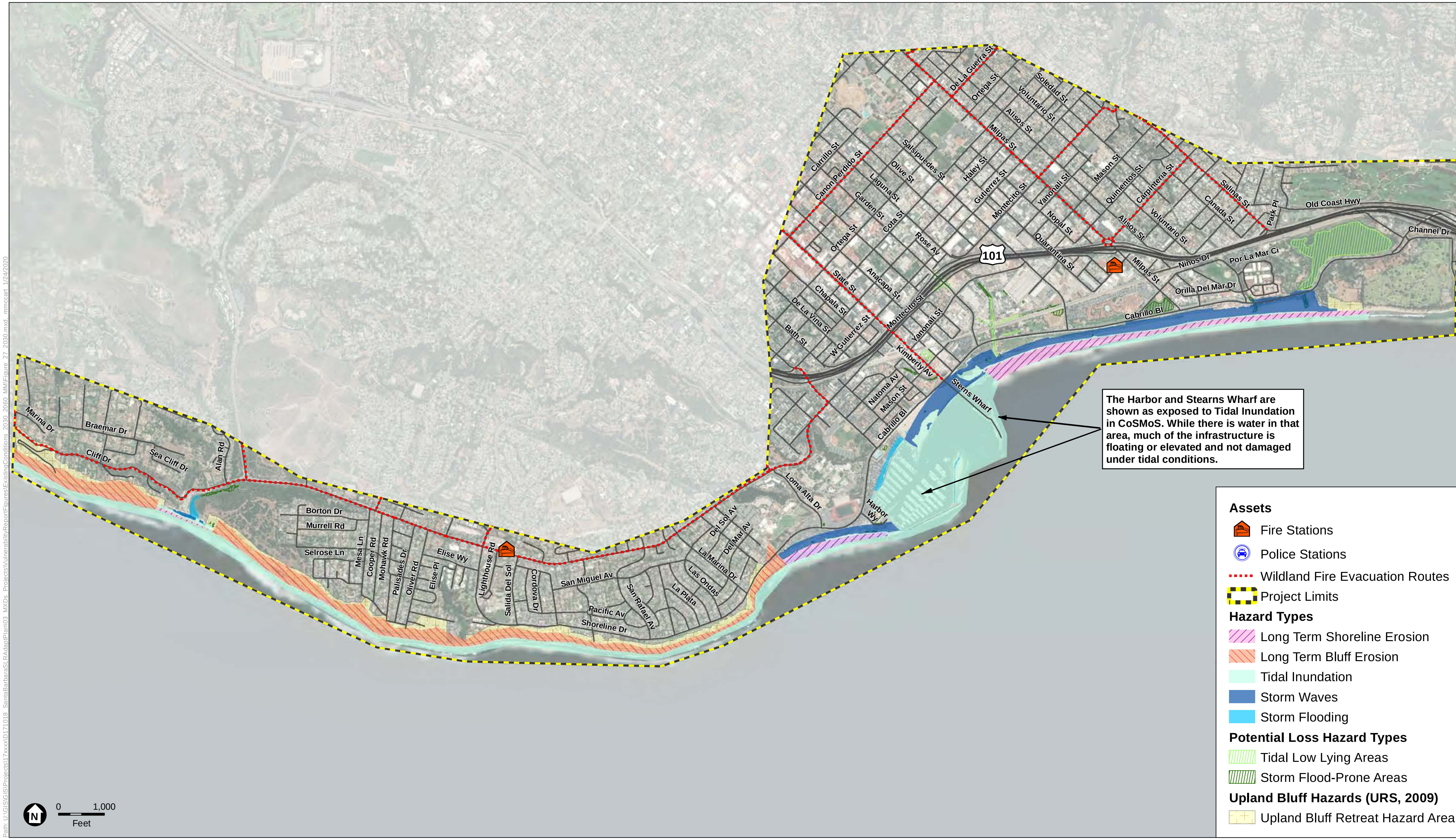


SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbra, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

Figure I-8
Asset Hazard Map:
Transportation Hazards 2030

ESA

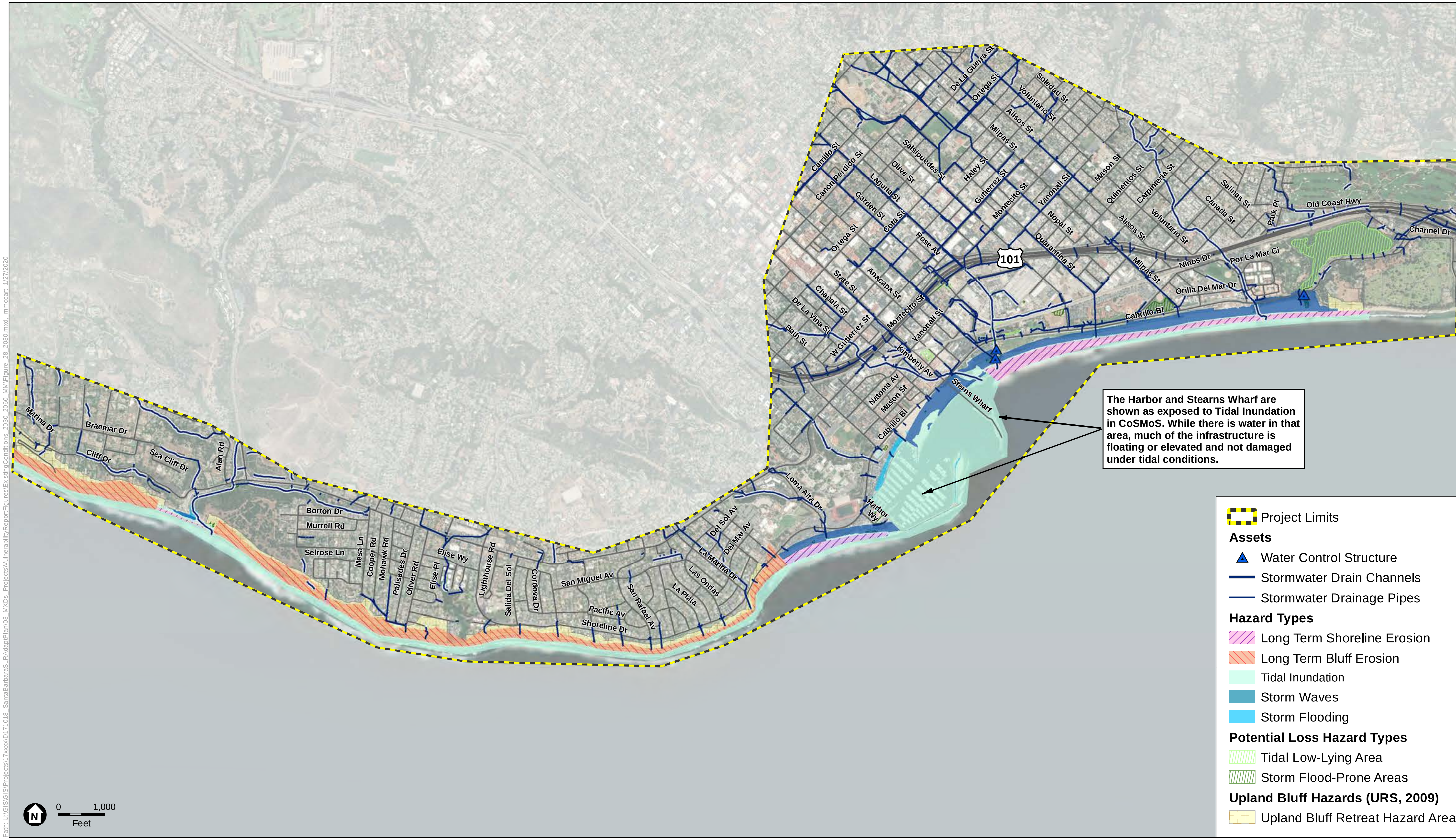


SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbara, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

Figure I-9
Asset Hazard Map:
Fire Stations, Police Stations, and Evacuation Routes
2030

ESA

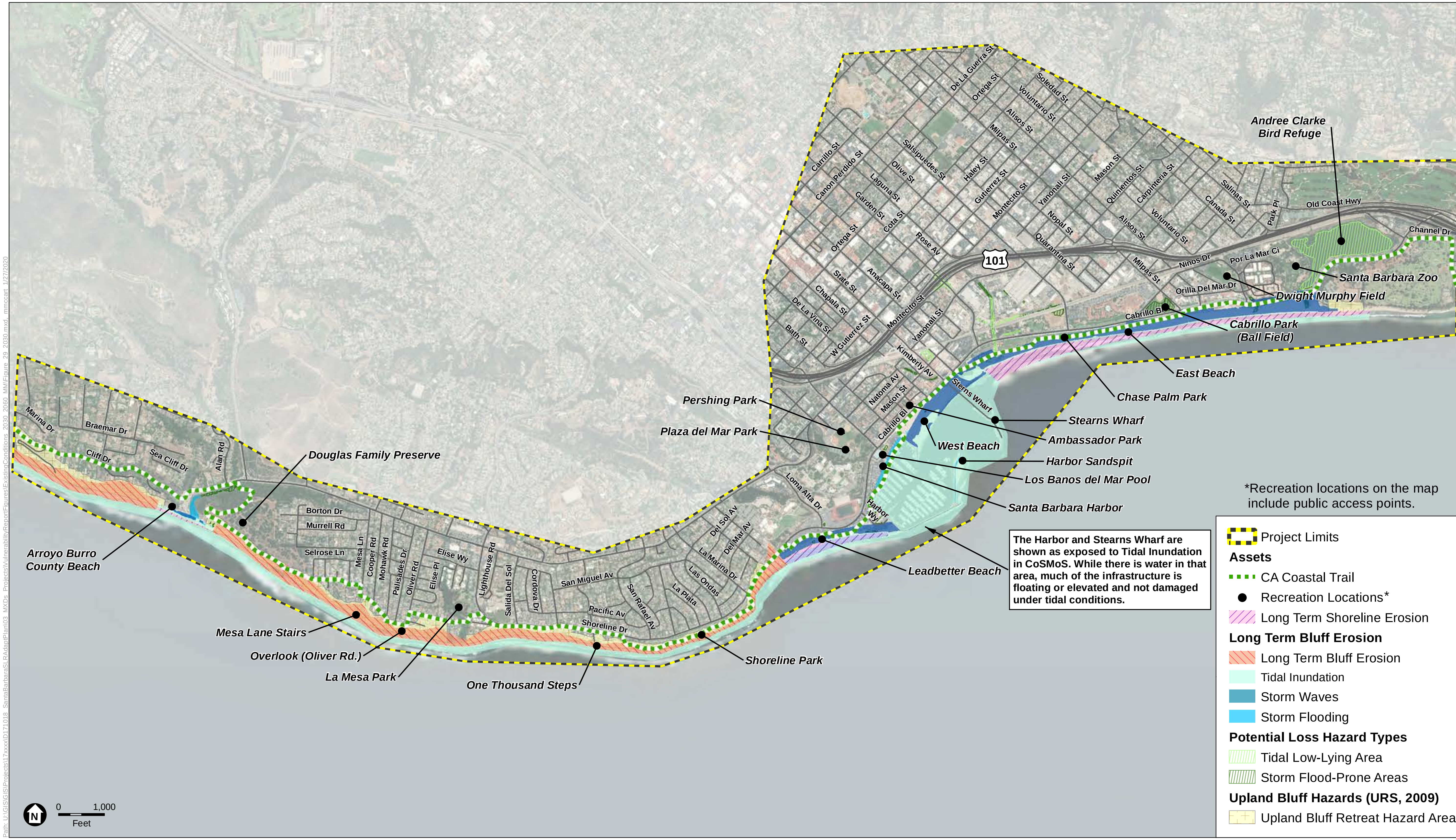


SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbara, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

Figure I-10
Asset Hazard Map:
Stormwater Hazards 2030

ESA



SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbra, 2018.

Figure I-11
Asset Hazard Map:
Recreation Areas Hazards 2030

ESA

SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbra, 2018.

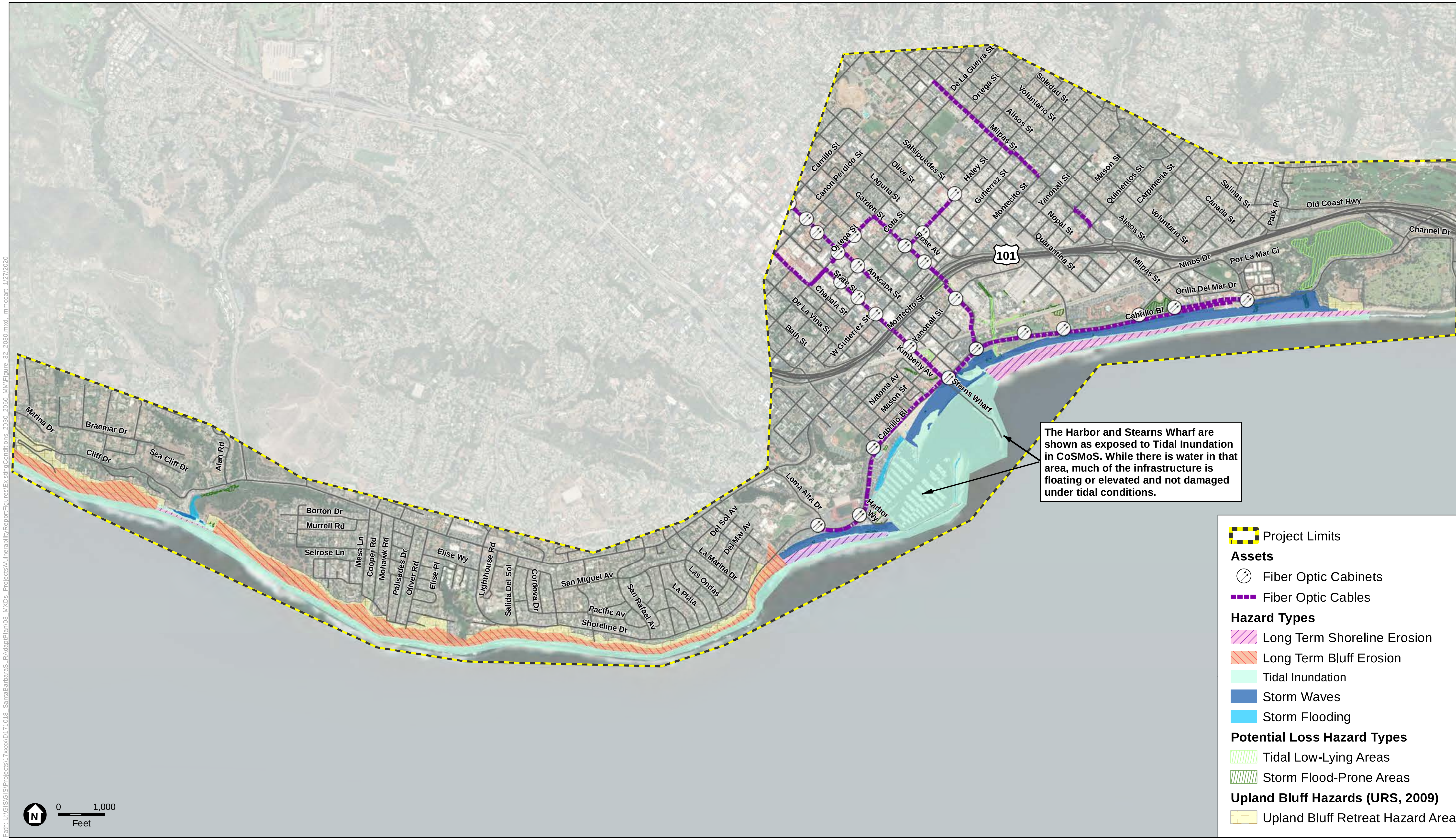
Figure I-12
Asset Hazard Map:
Harbor Assets Hazards 2030

SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbra, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

Figure I-13
Asset Hazard Map:
Public and Private Properties
Hazards 2030

ESA

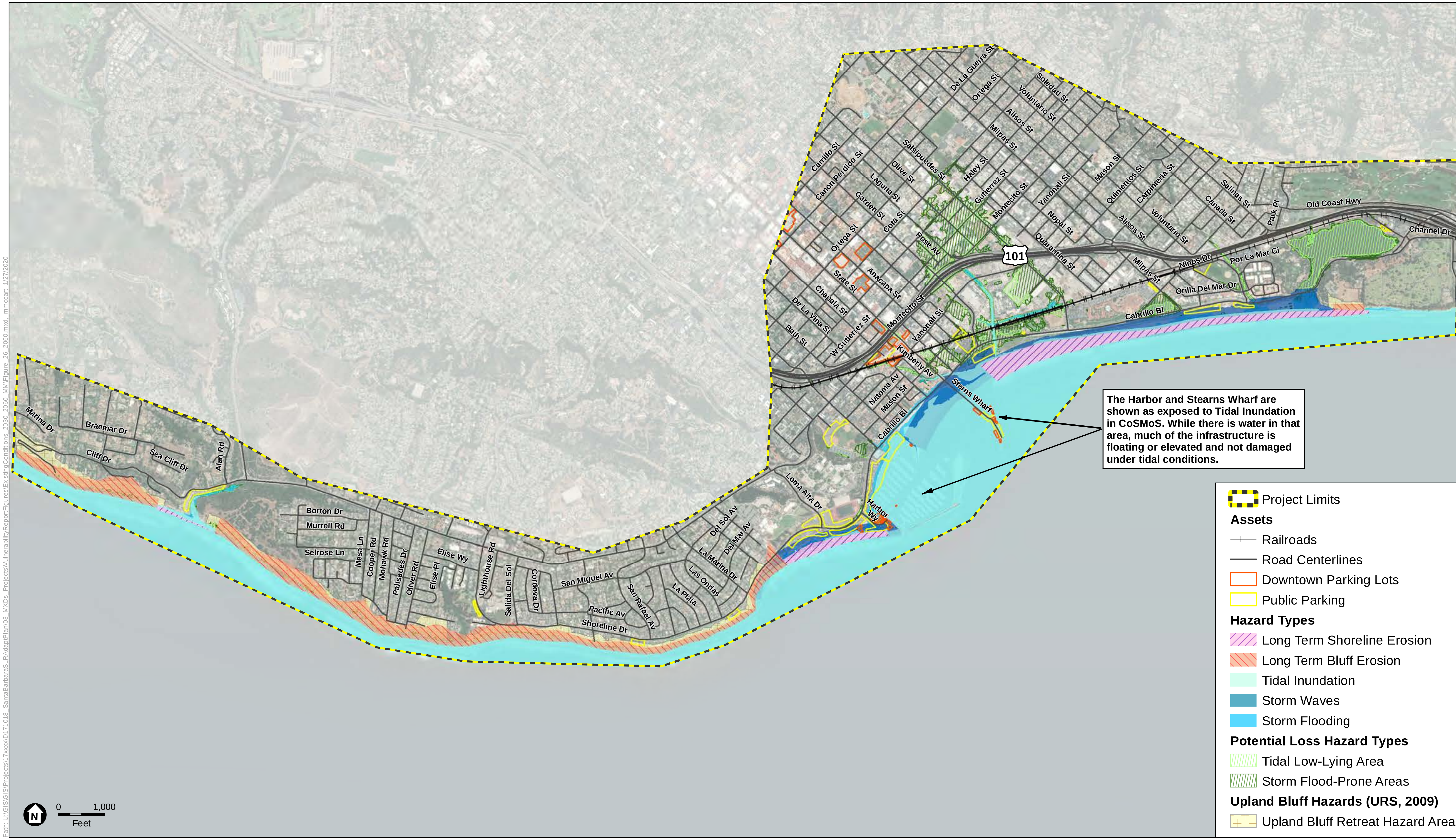


SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbra, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

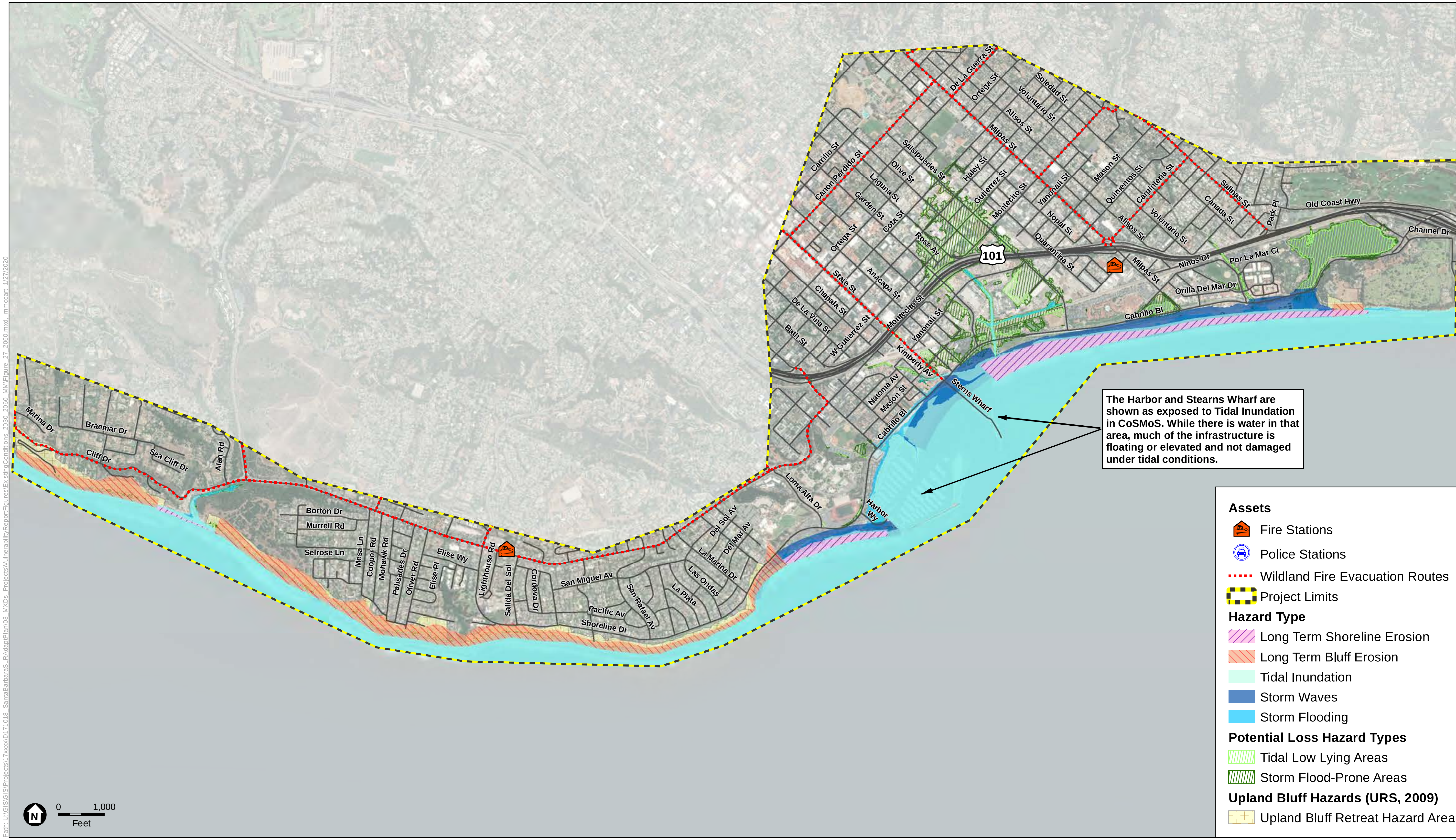
Figure I-14
Asset Hazard Map: Communications
Hazards 2030

ESA



SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbra, 2018.

Figure I-15
Asset Hazard Map:
Transportation Hazards 2060

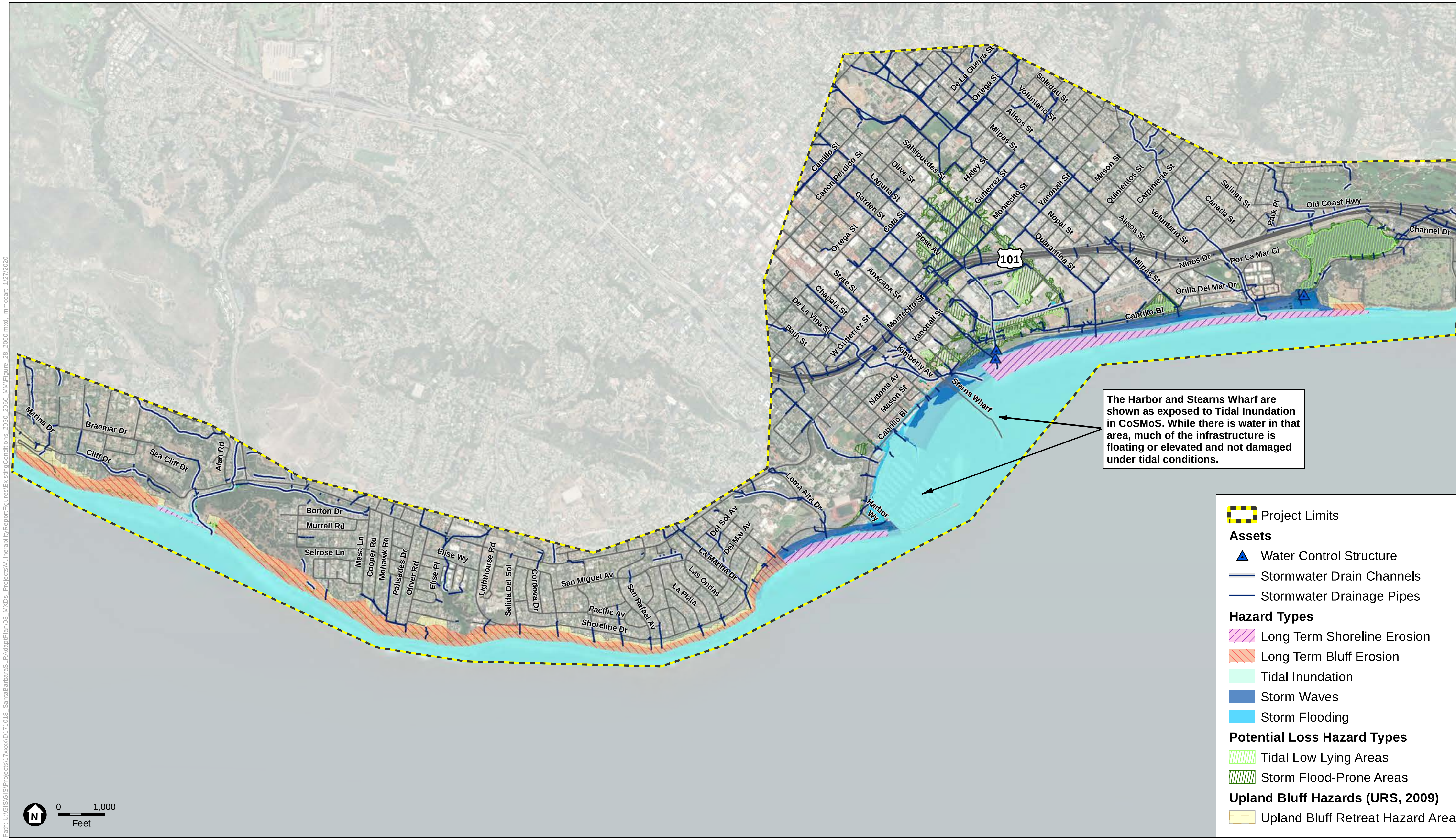


SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbara, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

Figure I-16
Asset Hazard Map:
Fire Stations, Police Stations, and Evacuation Routes
2060

ESA

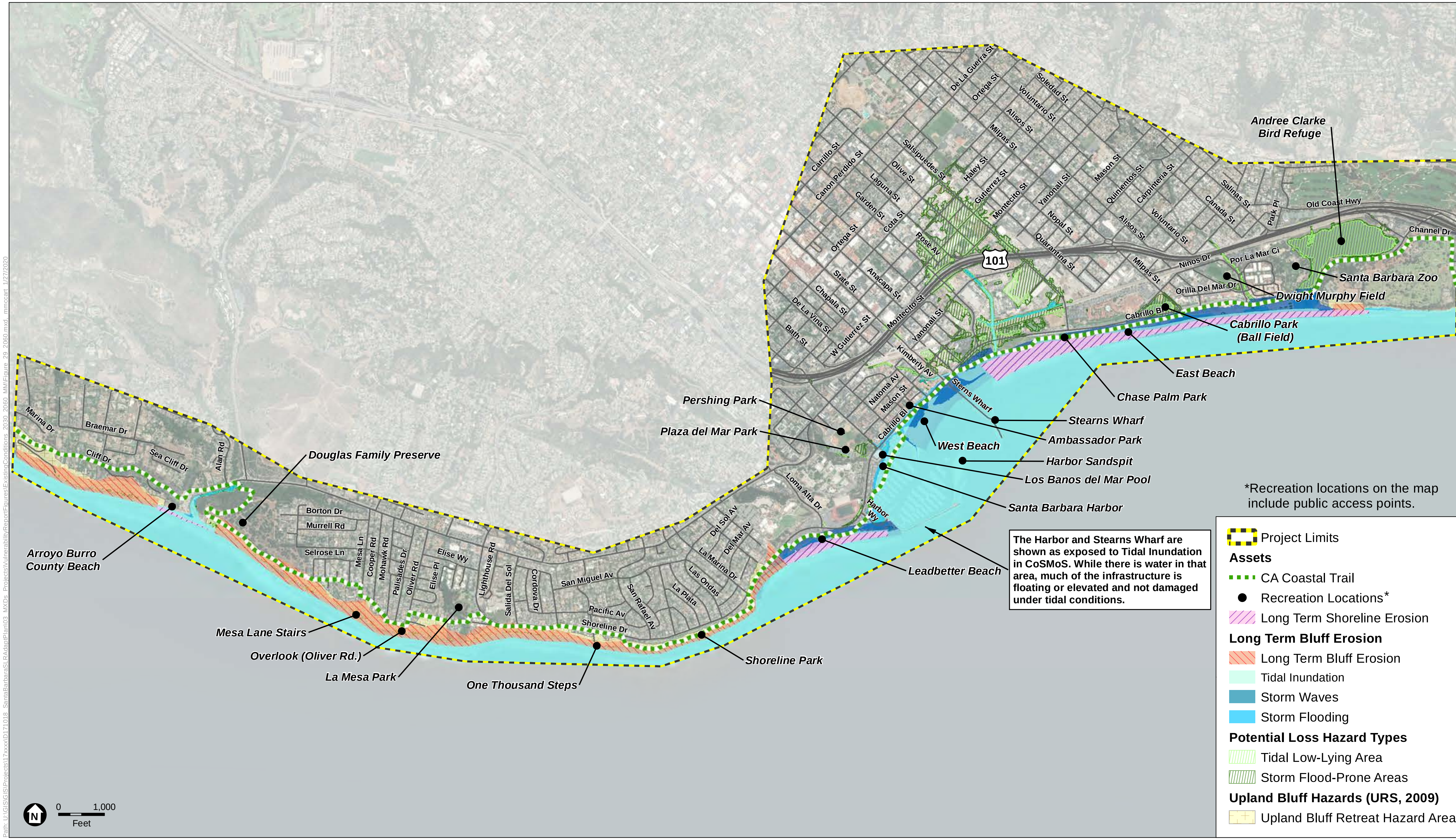


SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbara, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

Figure I-17
Asset Hazard Map:
Stormwater Hazards 2060

ESA



SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbra, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

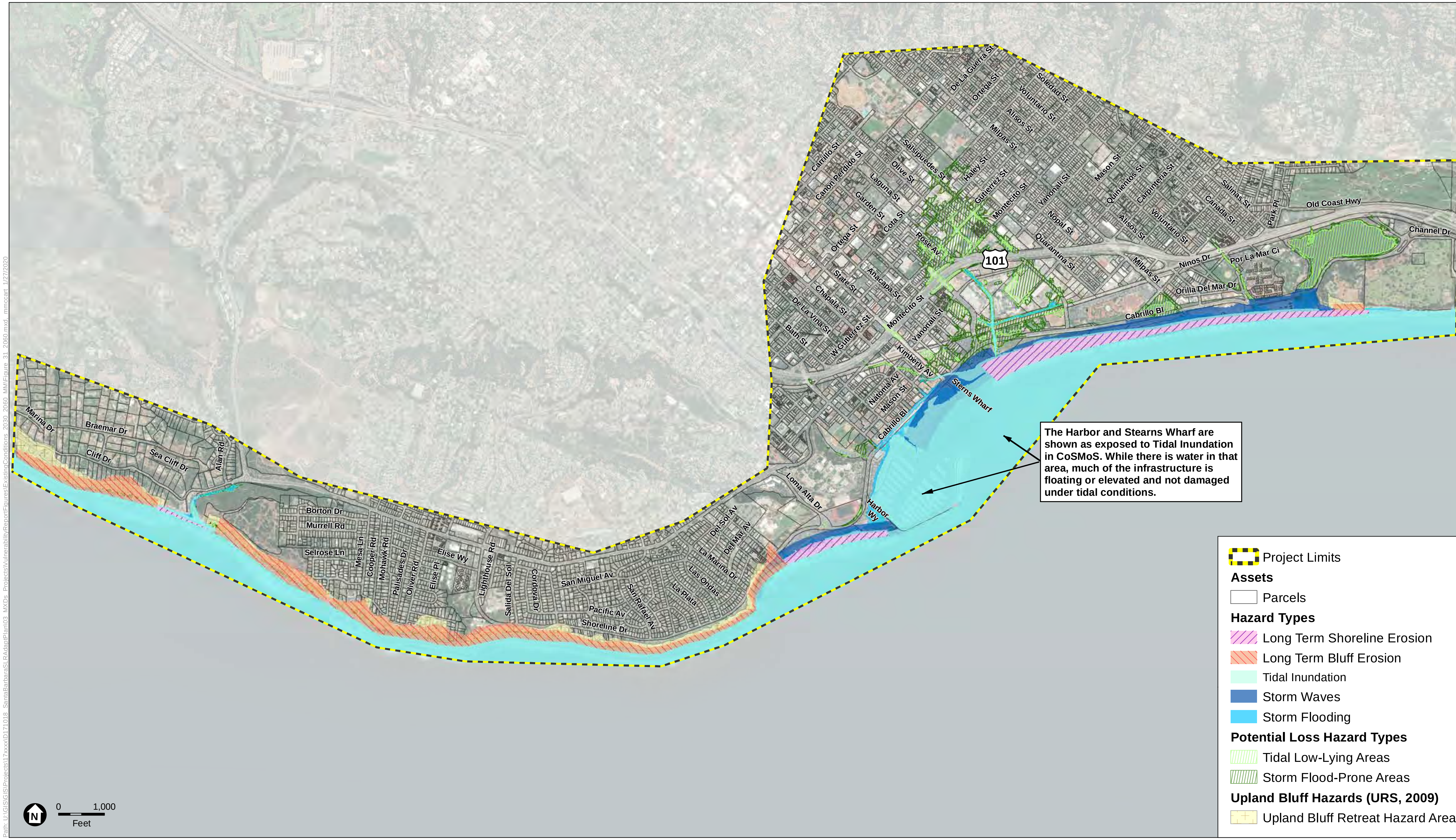
Figure I-18
Asset Hazard Map:
Recreation Areas Hazards 2060

ESA

SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbra, 2018.

Figure I-19
Asset Hazard Map:
Harbor Assets Hazards 2060

ESA

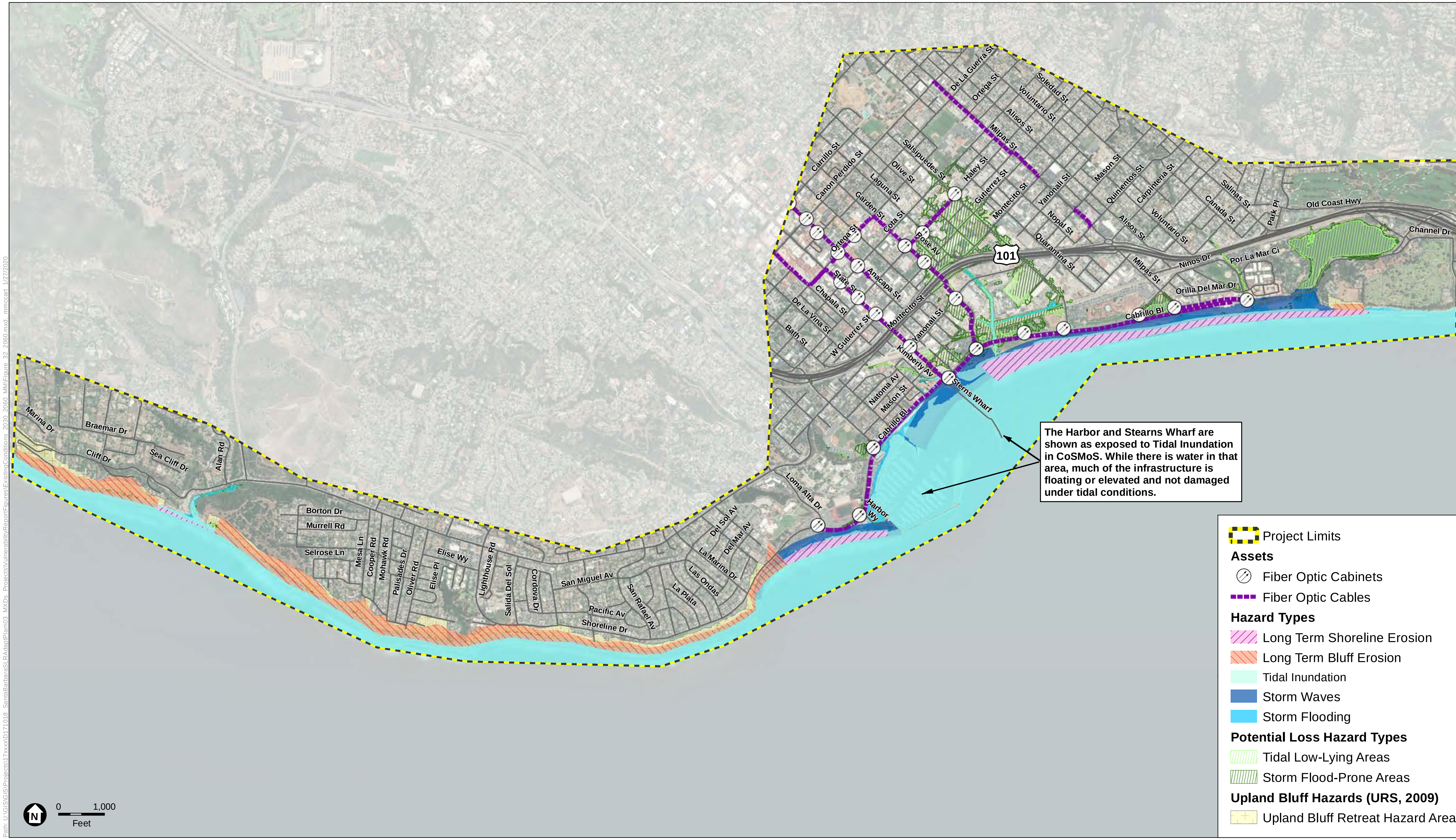


SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbra, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

Figure I-20
Asset Hazard Map:
Public and Private Properties
Hazards 2060

ESA



SOURCE: ESRI, 2018, ESA, 2018, City of Santa Barbra, 2018.

City of Santa Barbara Sea-Level Rise Adaptation Plan for the LCP Update

Figure I-21
Asset Hazard Map: Communications
Hazards 2060

Appendix J
Shoreline Response Model

ESA Shoreline Evolution Model

In order to project beach widths through time, ESA applied its shoreline evolution model that separately tracks shoreline and backshore erosion with beach width. The shoreline evolution model relies on historic shoreline and backshore erosion rates, shore geometry and SLR amount to calculate future erosion distances and beach width for each City sub-area. Historic erosion rates were determined from CoSMoS bluff erosion transects and Coastal Resilience Santa Barbara (CRSB) shoreline erosion rates. For bluff-backed beaches, the historic shoreline and bluff erosion rates was assumed to equal the CoSMoS bluff erosion rate and future bluff erosion distances were set to equal CoSMoS outputs for the 2m SLR @ 2100 scenario. For low backshores (Ledbetter Beach, West and East Beaches) the CRSB shoreline erosion rates were applied and the backshore was assumed to be held in place (at the development line). Existing beach widths were determined for each sub-area using the digital elevation model used for CoSMoS hazard modeling and mapping. Shore geometry (foreshore slope and shoreface slope) was determined from CRSB study data.

Beach Width

The beach width is the distance between the shoreline[1] and the backshore. A starting beach width was estimated for each reach using the representative distance between the mean high water line[2] and the backshore location as observed in the 2013 NOAA Coastal California TopoBathy Merge Project DEM. Subsequent beach widths are calculated based on the relative movement of the shoreline and backshore. If the shoreline erodes more quickly than the backshore, then the beach narrows, and vice versa.

Shoreline Movement

Three components contribute to shoreline movement in this quantified conceptual model: landward movement due to sea level rise (SLR), shoreline erosion caused by other coastal processes (e.g., waves, wind, changes in sediment supply), and seaward movement of the shore due to sand placement activities:

$$Shoreline\ Movement = SLR\ transgression + Ongoing\ erosion + Beach\ nourishment$$

Sea Level Rise Transgression

The impact of sea level rise on shoreline movement is incorporated by assuming that the shoreline will move inland based on the shape of the beach profile and the amount of sea level rise:

$$Sea\ Level\ Rise\ Transgression = \frac{increase\ in\ sea\ level}{shoreface\ slope}$$

The shoreface slope used in this equation depends on whether or not the backshore is eroding. A1 shows how the sea level rise erosion changes with beach width. When the backshore is not allowed to erode, or the beach is so wide that backshore erosion is not occurring (like when the beach is widened after beach nourishment), the

[1] Assumed to be located at Mean High Water (MHW=4.55 ft NAVD88, from NOAA Santa Barbara tide gage).
[2] The MHW line was extracted from the 2013 NOAA Coastal CA TopoBathy Merge Project

shoreline erodes according to a standard Bruun[3] slope, which is the slope between the depth of closure and the backshore toe location (shoreface height/active profile length).

However, if the backshore is allowed to erode, it will release sand into the system that will slow future erosion. In this case, a modified Bruun slope is used, which accounts for the eroding dune height. This slope is calculated as: (shoreface height + dune height)/(active profile length). Therefore, if the dune is very high, the slope increases and the sea level rise transgression is reduced. The taller the dune, the more the sea level rise transgression is reduced. In the beach nourishment scenarios, the shoreface slope is changed over time to reflect decreasing availability of beach-sized sediments. See the discussions about beach nourishment below for more detail.

The model assumes a linear transition between when a regular Bruun slope is used and when the modified Bruun slope is used (Figure A1Figure). When the beach is more than 2x wider than the stable beach slope, the Bruun slope is used. When the beach is narrower than the stable beach slope and the backshore is allowed to erode, the modified Bruun slope is used. In between these two beach widths, the erosion is linearly interpolated between the two methods.

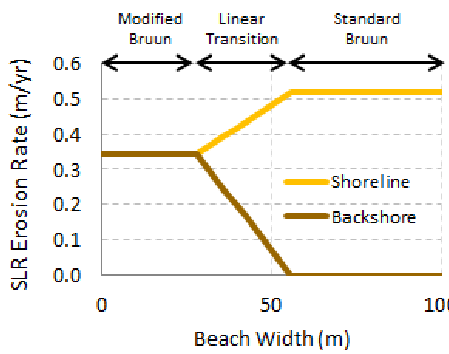


Figure A1: Example of empirical relationships between sea level rise-induced erosion rate and beach width. In this example the existing beach width is 28 meters. The sea level rise erosion rate for the standard Bruun slope is 0.52 m/yr, while the modified Bruun slope, which takes into account sediments released by the eroding dune, is 0.34 m/yr. In between the two conditions, a linear transition is assumed.

As the rate of sea level rise increases towards the end of the century, the contribution of sea level rise to shoreline movement will likely be greater than ongoing erosion in areas with a beach, while narrow beaches fronting bluffs or armoring structures may be lost entirely.

Background Erosion

All four reaches have a historic shoreline trend – either erosion or accretion. If no action is taken, and the beach and dunes are allowed to erode, this component of erosion will remain constant. However, if actions are taken that modify the beach's behavior (like beach nourishment or building a seawall), this component of erosion can increase or decrease. In this model, shoreline erosion is specified as a function of beach width. When the beach is nourished, the beach widens and the shoreline moves seaward. In this unusually wide beach configuration, the shoreline erosion rate is expected to increase (Dean 2002). If the beach narrows (either due to sea level rise or background erosion combined with holding the line), shoreline erosion decreases. An exponential empirical

[3] Bruun, P., 1962. Sea-level rise as a cause of shoreline erosion. Proceedings of the American Society of Engineers. Journal of the Waterways and Harbors Division 88, 117-130.

relationship was established between shoreline erosion rate and beach width for each reach that reflects this conceptual model.

$$E_{shoreline}(t) = \min(E_{shoreline,historic} * e^{a\left(\frac{BW(t)}{BW_{stable}} - 1\right)}, E_{shoreline,max})$$

Where:

$E_{shoreline}$ (t)	= Shoreline erosion at time t
$E_{shoreline,\ historic}$	= Historic shoreline erosion rate
$E_{shoreline,max}$	= Maximum shoreline erosion rate
BW (t)	= Beach width at time t
$BW_{ambient}$	= "Ambient" beach width
a	= calibration parameter for erosion rate responsive to beach width

Similar exponential relationships have been proposed for existing sand placement projects (Dean 2002). One assumption is that sand placements are self-similar. Previous studies have shown that an exponential relationship may overestimate the erosion rates (Dette et al. 1994). Because very little data exist related to response of shoreline erosion to sand placement, the decay parameter was selected based on wave exposure. Then, the value of (a) was increased in areas with higher wave exposure, like Manor, and decreased in reaches with lower wave exposure, like Pacifica State Beach. When a groin is implemented, the decay parameter is reduced by 50%, to account for the reduced potential sediment transport. In the beach nourishment scenarios, the decay parameter can be increased over time to reflect decreasing availability of beach-sized sediments (finer sediments are removed from the system more quickly). See the discussions about beach nourishment below for more detail.

An example of this relationship is plotted in Figure A2Figure. When the beach width is equal to the ambient beach width, the erosion rate is equal to the long-term historic erosion rate. The equation is capped with a maximum erosion rate to acknowledge that there is a limit to how quickly sand can be removed from the beach. A high value of the calibration parameter (a) leads to erosion rates being more responsive to beach width. A value of 0 would result in a constant erosion rate equal to the historic erosion rate, regardless of beach width.

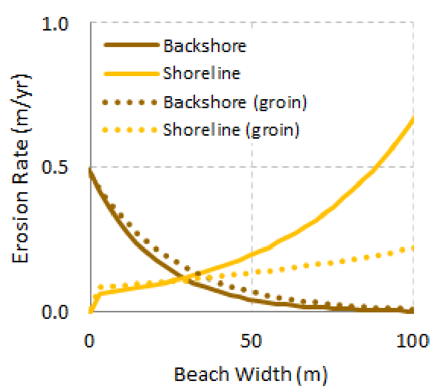


Figure A2: Example of empirical relationships between erosion rate and beach width. In this example, the existing beach width is 29 meters. The historic shoreline and backshore erosion rates are both 0.12 m/year. When a groin is added, the ambient beach width is assumed to widen by 25% to 36 meters; the shoreline erosion rates for beaches wider than the ambient beach with are reduced compared to no-groin conditions.

Beach Nourishment

This component of the equation applies during beach nourishment scenarios. Each time beach nourishment is implemented, it widens the beach by shifting the shoreline seaward. The amount the shoreline is shifted seaward depends on the volume of sand placed on the beach, the profile characteristics, and sand quality.

Backshore Erosion

The backshore location is tracked using a similar empirical relationship as the shoreline. The basic equation is similar except that the beach nourishment adjustment (which only changes the shoreline) is replaced with a placement loss distance (which only affects the backshore when armor is constructed).

$$Backshore\ Movement = SLR\ transgression + Ongoing\ erosion - Placement\ Loss$$

Sea Level Rise Transgression

As with the shoreline, the impact of sea level rise on backshore movement is incorporated by assuming that the backshore toe will move inland based on the shape of the beach profile and the amount of sea level rise:

$$Sea\ Level\ Rise\ Transgression = \frac{increase\ in\ sea\ level}{shoreface\ slope}\ or\ 0$$

The sea level rise component of backshore erosion is plotted on Figure A1 along with the shoreline erosion. If the backshore is allowed to erode and the beach is narrower than the stable beach width, a modified Bruun slope is used in this equation. This slope is calculated as:

$$Modified\ Bruun\ Slope = \frac{shoreface\ height + dune\ height}{active\ profile\ length}$$

If the scenario is to hold the line or the beach is wider than twice the stable beach width, the backshore does not erode. The backshore erosion is linear between 0 and the modified Bruun transgression when the beach is between the stable beach width and 2x the stable beach width.

Background Erosion

Bluff erosion is expected to have the opposite response to beach width: when the beach is wide, the backshore is expected to erode more slowly than if the beach is narrow, due to the additional protection from waves provided by the wide beach. When the beach becomes narrow, the backshore is expected to erode more quickly due to more frequent wave contact at the backshore toe. Once again, the erosion rate is capped by the maximum backshore erosion rate to acknowledge that the backshore (bluff/cliffs in particular) should have a maximum erosion rate which is a function of geology. This relationship is plotted, along with the similar relationship for shoreline erosion, in Figure A2.

$$E_{backshore}(t) = \min(E_{backshore,historic} * e^{-b\left(\frac{BW(t)}{BW_{stable}}-1\right)}, E_{backshore,max})$$

Where:

$E_{backshore}$ (t) = Backshore erosion at time t
$E_{backshore,\ historic}$ = Historic backshore erosion rate

$E_{backshore,max}$ = Maximum backshore erosion rate
BW (t) = Beach width at time t
$BW_{ambient}$ = "Ambient" beach width
b = calibration parameter for erosion rate responsive to beach width

In this case we calculate the decay parameter (b) using the ratio:

$$b = \frac{shoreface\ height + dune\ height}{shoreface\ height}$$

which is derived from a modified Bruun profile. This value could be modified in more detailed studies with additional information about how the backshore responds to narrower or wider beaches. Most reaches were relatively insensitive to this parameter.

It is important to note that this model does not address backshore erosion due to terrestrial processes (e.g., ground water levels, seismic forces, geology, land use, etc.) that are independent of coastal processes and outside the scope of this study.

Placement Loss

Placement loss refers to the space taken up by construction of a coastal protection structure like a revetment or seawall. These structures are usually placed at the back of the beach and cover part of the existing beach width, effectively shifting the backshore line seaward. For the current study, a placement loss of 7.6 meters (25 feet) is assumed for new armoring structures.