moffatt & nichol

SLR-VA REPORT
Prepared for California State Parks
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DRAFT

SEACLIFF STATE BEACH AND NEW BRIGHTON STATE BEACH

Sea Level Rise Vulnerability Assessment

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Prepared by:
Moffatt & Nichol
2185 N. California Blvd., Suite 500
Walnut Creek, CA 94596-3500
T 925.944.5411
www.moffattnichol.com

DRAFT

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List of Acronyms

#	Number
ac	acres
ADA	Americans with Disabilities Act
AP	Adaptation Planning
CCRP	California Coastal Records Project
CEM	{USACE} Coastal Engineering Manual
CoSMoS	{USGS} Coastal Storm Modeling System
DG	Decomposed granite
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
ft	feet
GW	Groundwater
Inund.	Inundation
IPCC	International Panel on Climate Change
KT	King Tide
M&N	Moffatt & Nichol
MRLC	Multi-Resolution Land Characteristics Consortium
MSL	Mean Sea Level
NLCD	{USGS} National Land Cover Database
NOAA	National Oceanic and Atmospheric Administration
OCOF	{USGS} Our Coast Our Future
OPC	{California} Ocean Protection Council
PD	Present Day
SB	State Beach
SLR	Sea Level Rise
spp	species plurimae (several species)
SPR	State Parks and Recreation
SS	Steamship
TWL	Total Water Level
USACE	US Army Corps of Engineers
USGS	United States Geological Survey
VA	Vulnerability Assessment
WW I	World War I

Executive Summary

Project Background

Waves and storm surge during winter storms in January 2023 produced severe beach erosion along the Seacliff State Beach and New Brighton State Beach shorelines. Seacliff State Beach was especially impacted, including the campground, day-use, and Rio Del Mar beach areas. The exposure to coastal hazards and the current erosion has placed public structures and resources at risk of further damage and loss if measures are not taken to reduce the exposure.

This report provides an assessment of coastal hazards and vulnerability of California Department of Parks and Recreation (Parks) assets[1] to these hazards in the light of projected sea level rise (SLR). This sea level rise vulnerability assessment (SLR-VA) serves as the basis for the development of short- and long-term shoreline adaptation alternatives.

Work conducted in this phase of the report preparation included:

- Site investigation and inventory of Parks assets in collaboration with Parks staff.
- Public outreach and engagement, including development of outreach and engagement materials and online and in-person activities.
- Preparation of a coastal hazards vulnerability assessment for Seacliff State Beach and New Brighton State Beach assets including increasing vulnerability due to projected SLR.

SLR-VA Findings

Table E-1 summarizes the overall findings of the SLR-VA, organized by Seacliff SB and New Brighton SB subareas. The VA assigns vulnerability ratings ranging from Low (yellow) to Severe (dark red) as a function of SLR ranging from 1 to 6 feet. In terms of timeline, 1 foot of SLR was taken as representative of the projected potential near-term conditions by 2050; 2 feet was adopted to support mid-term planning by around 2070, and 4 feet of SLR was considered for long-term planning looking towards the end of the century. An additional scenario of 6 feet of SLR was as a worst-case scenario based on the higher-end of projected SLR.

The right side of Table E-1 provides a breakdown of the range of coastal processes contributing to exposure of the respective subareas. The coastal processes include: wave runup (WR), wave overtopping (OT), beach erosion (BE), shoreline retreat (SR), and cliff retreat (CR). Wave runup, wave overtopping, and beach erosion denote temporary exposure conditions, while shoreline and cliff retreat represent permanent impacts. SLR and tides were also considered as permanent exposures as these will exacerbate flood hazards and coastal processes over time.

At the Seacliff SB Campground and Day Use Area, the primary coastal processes that drive vulnerability are wave overtopping and beach erosion. Along Rio Del Mar, the governing driver is beach erosion and secondarily wave overtopping. With SLR, these areas will increasingly become

[1] Existing visitor serving infrastructure including natural and cultural resources.

affected by shoreline retreat and wave runup. Across these areas, the potential for cliff retreat is projected to have a moderate influence on the vulnerability of Parks assets.

At New Brighton Beach, the coastal processes that primarily drive vulnerability include beach erosion and shoreline retreat. Vulnerability at Potbelly Beach is mainly influenced by shoreline retreat (permanent impact) and secondarily beach erosion (temporary impact). With SLR and projected loss of beach, wave runup will become more of an influencing factor. Vulnerability of the clifftop areas at the Campground and Porter-Sesnon is primarily associated with potential cliff retreat.

Table E-1: Summary of SLR-VA vulnerability ratings by subarea.

Asset	Sea Level Rise (ft) 1’	2’	4’	6’	WR	OT	BE	SR	CR
Seacliff SB									
Campground	H	S	S	S		◉	◉	○	●
Day Use Area	M	H	S	S	○	◉	◉	○	●
Upper Lot	L	M	S	S					●
Rio Del Mar	M	H	S	S	○	●	◉	○	●
New Brighton SB									
Campground	M	S	S	S					●
New Brighton Beach	M	H	S	S	○	●	◉	◉	○
Porter-Senon	M	H	H	H					●
Potbelly Beach	L	L	M	H	○		●	◉	

Vulnerability Rating:

L	Low
M	Moderate
H	High
S	Severe

Legend:

WR	Wave Runup
OT	Wave Overtopping
BE	Beach Erosion
SR	Shoreline Retreat
CR	Cliff Retreat

Influence of Coastal Processes:

○	Slight influence
●	Moderate influence
◉	High influence
◉	Very high influence

1. Introduction

1.1. Project Location

Figure 1-1 shows the location of Seacliff State Beach and New Brighton State Beach at the northern end of Monterey Bay.

In the following, Seacliff State Beach (SB) refers to all Parks assets included in this 85-acre Parks facility. Similarly, New Brighton SB encompasses all Parks assets at the 95-acre New Brighton State Beach.

1.1.1. Seacliff SB

Refer to Figure 1-2 for an overview of Seacliff SB, which provides public access to recreational vehicle (RV) camping, picnic sites, ramadas, and Americans with Disabilities Act (ADA) accessible parking and restroom facilities. Beach wheelchairs are available, free of charge via reservations at the Friends of Santa Cruz State Parks Beach Wheelchairs website.

The Seacliff Visitor Center and Park Store enables visitors to learn about the historic setting of the site, cultural resources, the geology of the site and fossils, and features a tide pool and aquarium where the public can observe some of the marine life that exists at the site.

The Seacliff area was historically occupied by Native people up until the Spanish colonization around 1833.

The pier and cement ship SS Palo Alto are central features of the site and important historic and cultural resources from this century. The ship is a World War I tanker with a hull constructed from concrete as the steel supply became scarce towards the end of the war. The ship was built at the U.S. Naval Shipyard in Oakland and underwent sea trials, but did not serve in the war, which ended November 1918.

In 1929, the SS Palo Alto was intentionally grounded off Seacliff Beach as part of the development of a pleasure pier entertainment complex, completed in 1930. Seacliff was inaugurated as a state beach in 1931.

A promenade trail provides access to the beach at the base of the cliff. The beach is a popular swimming spot. Fishing from the beach is permitted with a license from the Department of Fish and Wildlife limits. Dogs on leash are permitted throughout the park.

1.1.2. New Brighton SB

Refer to Figure 1-3 for an overview of New Brighton SB. The Pacific Migrations Visitor Center at New Brighton enables visitors to learn about the diversity of marine life on the coast, and delve into the cultural resources of the site, which includes Chinese immigrants who occupied a fishing village in the area in the 1870's and 1880's, when it was known as China Beach. New Brighton became a state beach in 1933.

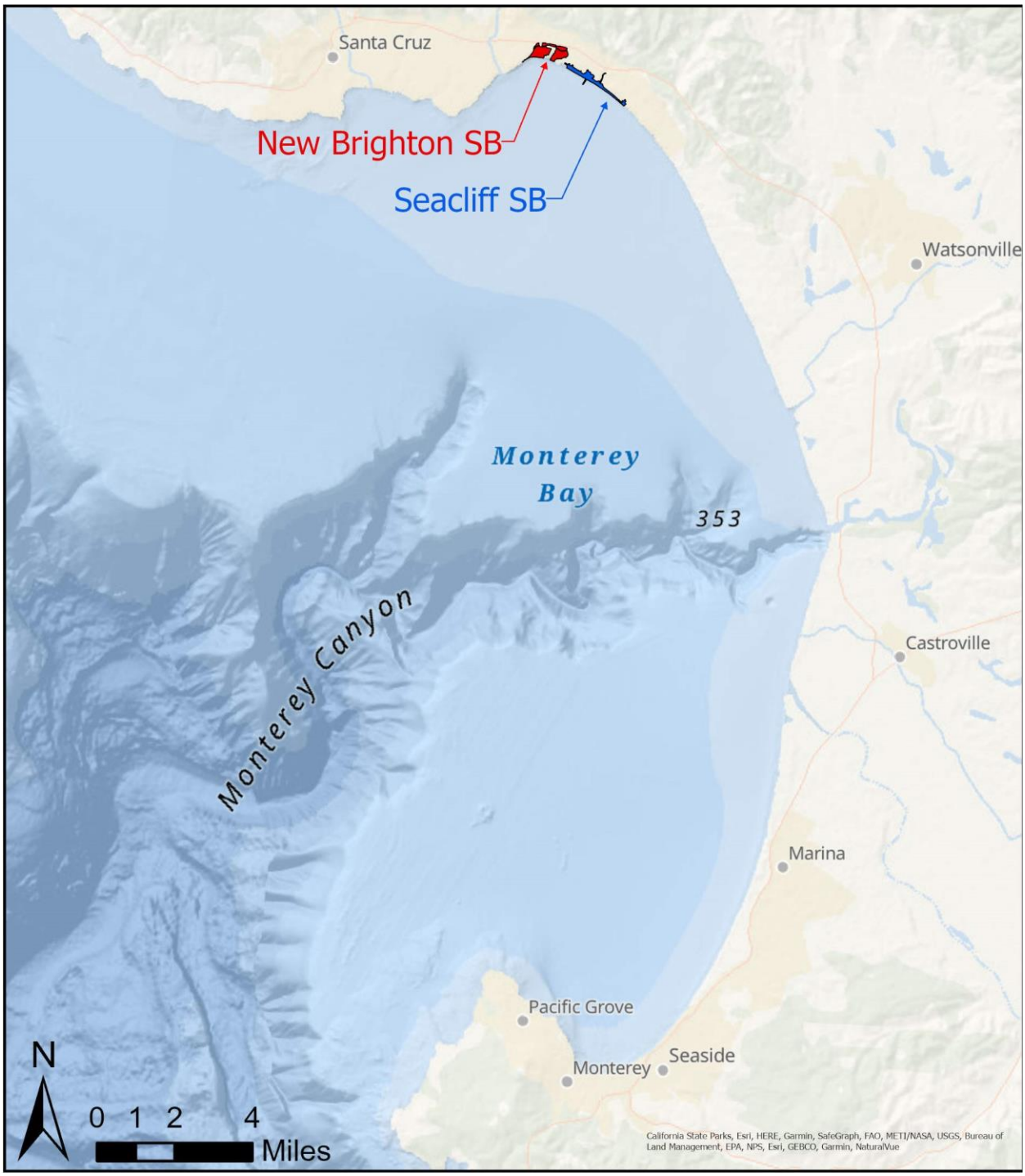

Figure 1-1: Location of Seacliff SB and New Brighton SB.

Figure 1-2: Subareas at Seacliff SB.

Figure 1-3: Subareas at New Brighton SB.

Today, the New Brighton SB offers campfire and Junior Ranger programs, hiking trails, and more than one hundred family, group, bicycle, and RV campsites, including lifeguard access, restroom and shower facilities. Beach wheelchairs are available for ADA accessibility to the park area. Popular activities on the beach include fishing, swimming, and beach combing.

The Seacliff SB and New Brighton SB alternatives development subareas are shown in Figure 1-2 and Figure 1-3 and include the subareas listed in Table 1-1.

Table 1-1: Seacliff SB and New Brighton SB alternatives development project areas.

Alternatives Development Project Areas	Subareas	Acreage (ac)	Elevation Range (feet NAVD88)
Seacliff SB	Upper Lot	9.1	95 – 108’
	Campground	11.2	0 – 20’
	Day Use	14.1	0 – 20’
	Rio Del Mar	28.0	0 – 15’
New Brighton SB	Campground	77.7	20 – 150’
	Porter-Sesnon	70.9	20 – 150’
	New Brighton Beach	2.6	0 – 17’
	Potbelly Beach	1.9	0 – 20’

Protective shoreline infrastructure has been in place at Seacliff SB since 1926 and later at New Brighton SB. Table 2-1 summarizes the type and extent of shoreline structures (linear feet) at Seacliff SB and New Brighton SB.

Table 1-2: Seacliff SB and New Brighton SB Distribution of Shoreline Structures (feet).

Shoreline Structure Types	Seacliff SB			New Brighton SB	
	Seacliff Campground	Day Use Area	Rio Del Mar	New Brighton Beach	Potbelly Beach
Rock Armoring	-	-	979’	1,693’	-
Timber Bulkhead	2,563’	2,465’	471’	-	-
Concrete Seawall	-	-	2,953’	-	-
No Structures	-	-	-	1,256’	563’
Total Length (feet)	2,563’	2,465’	4,403’	2,949’	563’
Shoreline Structures (%)	100%	100%	100%	57%	0%

The data illustrates that 100% of the Seacliff SB shoreline is protected with shoreline structures in the form of rock armoring, timber bulkhead or concrete seawall. 57% of the New Brighton SB shoreline is protected with shoreline structures and Potbelly Beach remains fully unprotected.

2. Coastal Processes

2.1. Setting

Seacliff SB and New Brighton SB are located in the northern portion of Monterey Bay. The shoreline along this northern portion of Monterey Bay is oriented in a predominantly west-southwest direction, with an increasingly southern orientation in the far northern portions of the Bay. The typical coastal setting across the two state beach areas consists of sandy beaches fronting a seacliff composed of Purisima Formation overlain by terrace deposits. Beach width narrows along upcoast portions of New Brighton SB.

Despite seasonal winter-summer beach width variations that are common along the California coastline, the overall beach alignment in northern Monterey Bay is in equilibrium with the dominant northwest wave direction (Griggs & Fulton-Bennet, 1987). This is primarily due to the influence of nearby headlands, which cause waves from the northwest to refract or bend and eventually break in a direction parallel to the beach. Storm damage is more common when waves arrive from a west or southwest direction. Waves from these directions arrive with very little loss of energy and result in sand being scoured off of the beach, increasing the potential for damage and coastal cliff impacts as the protective barrier provided by a wider beach is reduced. Specific factors related to the coastal processes at Seacliff SB and New Brighton SB can be found in the Coastal Processes Report provided in Appendix A.

2.2. Total Water Level and Beach Width

The National Oceanographic Atmospheric Administration (NOAA) operates tide stations that record water levels. The Monterey tide station (Station 9413450) has been collecting data since 1973 and is used to record historic sea level and extreme high waters in Monterey Bay. The left side of Figure 2-1 summarizes water levels at Monterey, ranging from Mean Lower Low Water (MLLW) to Mean Higher High Water (MHHW). High and low tides vary from the Mean Sea Level (MSL). The tide range is 5.4 feet from MLLW to MHHW.

Monthly, there will be tides that reach elevations above the regular MHHW tides. These are termed spring tides and occur at full or new moon when the sun, moon and earth are in alignment. The highest tides that occur each year are termed King Tides (KT). King Tides can reach 1.6 feet higher than MHHW tides, significantly reducing beach width and reaching elevations not commonly inundated by tides. These tidal cycles are driven by the motion of the earth and the moon in relation to the sun and follow a 19-year cycle termed a tidal epoch.

A number of effects can cause the water level to rise, which include low barometric pressure associated with the passage of storm systems, wind shear pushing water up against shoreline areas, and El Niño effects, which produce a rise of the ocean level due to warming and thermal expansion of the water. These effects occur independently of the astronomical tide cycles. In addition, wave runup can limit the extent of available beach width. These factors are considered under one as the Total Water Level (TWL). Refer to Figure 2-2 for information on each of the components that contribute to the TWL.

The most damaging storms in the historical record have occurred as a combination of El Niño effects, storm surge, and high tides.

The right side of Figure 2-1 shows how water levels and wave runup affect the beach width at Seacliff and New Brighton Beach, where yellow indicates the beach width, dark blue indicates the extent of wave runup, light blue is representative of tidal inundation, and dark grey signifies beach erosion.

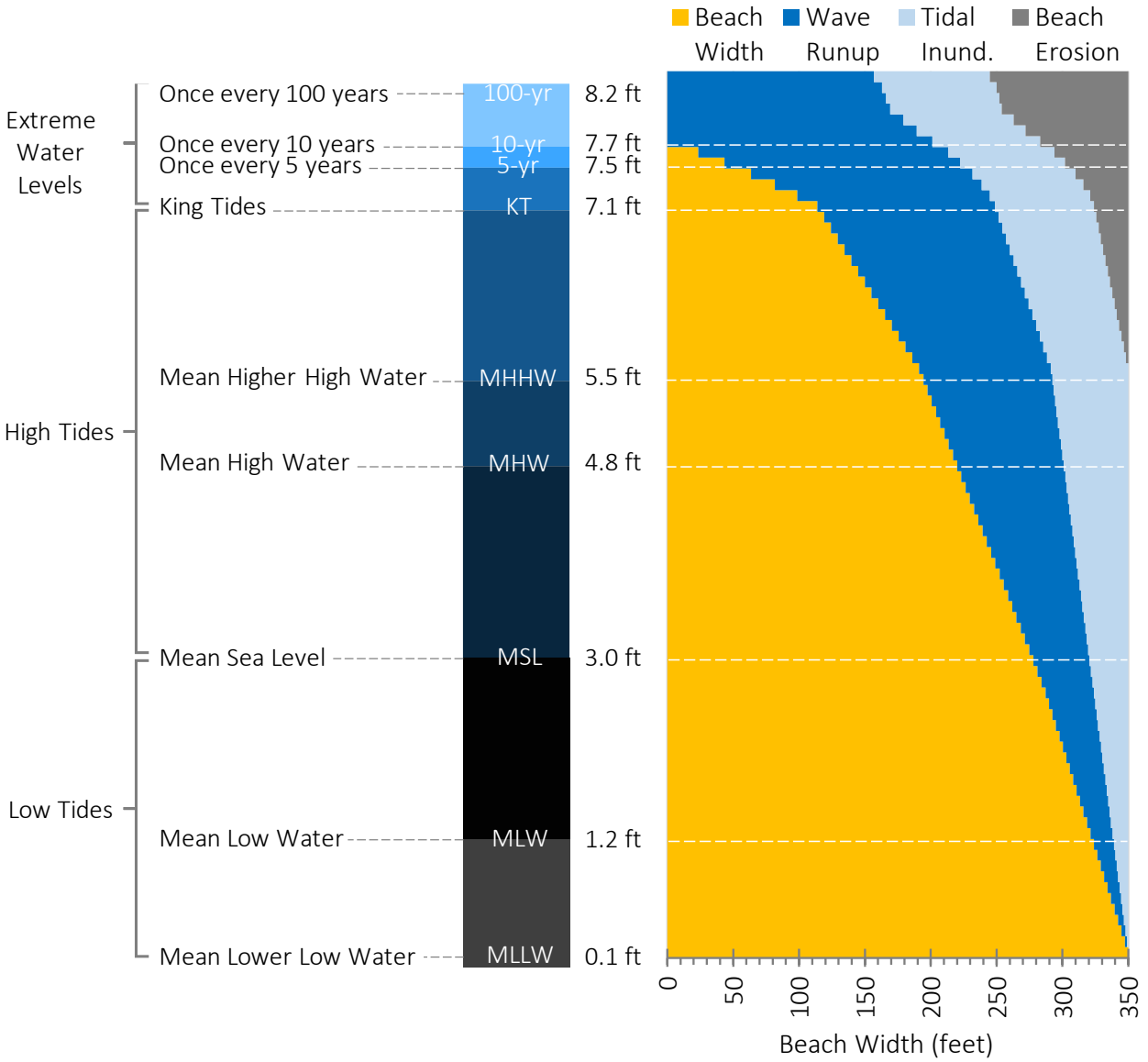

Figure 2-1: Tidal and extreme water levels, beach response at Monterey.

At low tide, the beach can be up to 350 feet wide (bottom of figure) if there is no wave action of significance. Comparing with the MHHW level, it can be seen that the inundation attributed to the normal tide range can cause a reduction in beach width of about 60 feet. During King Tides, about 100 feet of the beach can be subject to tidal inundation.

Wave runup can be responsible for a significant reduction in beach width as well. Under typical wave conditions at MHHW, the beach width can be reduced by about 160 feet, and during king tides and heavy surf reduced by 240 feet.

Above these levels of inundation, beach erosion starts to play a role when storm systems and El Nino conditions increase the water level above the astronomical tide range. As an example, a 5-year storm event may cause about 50 feet of beach erosion and can reduce the beach width to about 40 feet. Similarly, a 10-year storm can reduce the beach width to just a few feet. It is estimated that wave runup associated with 20 to 100-year storms can reach the base of the cliff. Under these conditions there would be no accessible beach width.

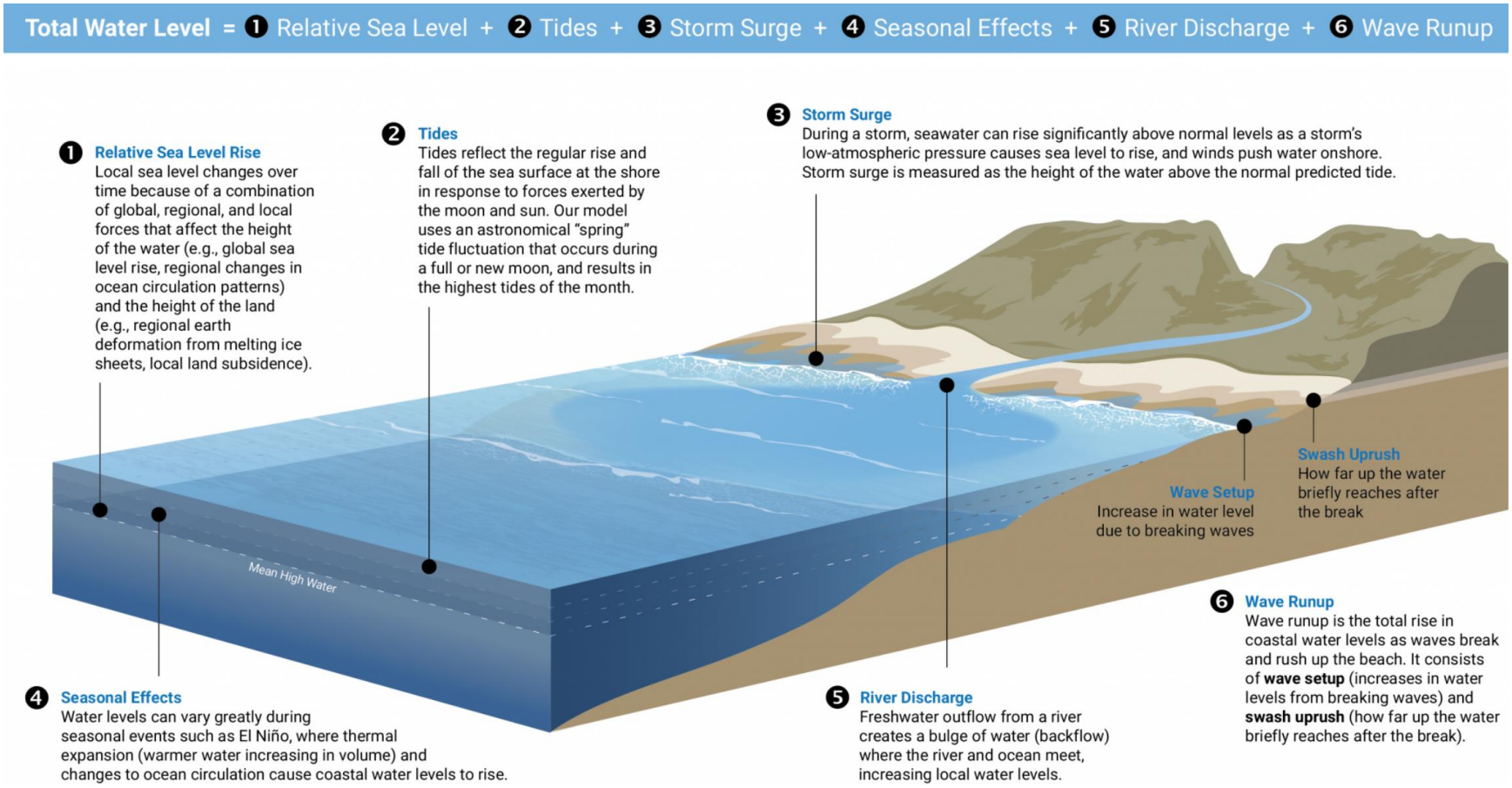

Figure 2-2: Factors affecting the Total Water Level, OCOF (2023).

2.3. SLR Projections

Current guidance for California recommends evaluation of SLR impacts using a scenario-based analysis. This method is founded on the approach by the Intergovernmental Panel on Climate Change (IPCC) to understand how SLR and other drivers interact to threaten health, safety, and resources of coastal communities.

The best available science and most recent guidance is summarized in OPC (2024), which has been adopted as the guidance for the State of California. Table 2-1 summarizes SLR projections adopted for the project based on OPC (2024) in consultation with regulatory agencies. The Intermediate-High SLR scenario reflects rapid ice sheet loss contributing to sea level rise and is representative of a plausible high-end projection. The High SLR scenario assumes high future emissions and high warming with large potential contributions from rapid ice sheet loss, and representative of a worst-case scenario.

Table 2-1: SLR projections.

Scenario	Projected SLR in feet by:			
	PD	2050	2070	2100
Intermediate-high SLR scenario	0.1’	1.0’	2.0’	4.0’
High SLR scenario	-	-	-	6.0’

PD – Present-day

The project-adopted SLR projections can be characterized as follows:

- 1 foot of SLR by ~2050. Intermediate-high SLR scenario for near-term actions.
- 2 feet of SLR by ~2070. Intermediate-high SLR scenario for mid-term planning.
- 4 feet of SLR by ~2100. Intermediate-high SLR scenario for long-term planning.
- 6 feet of SLR by ~2100. High SLR scenario to evaluate higher-end of possibilities for highly risk-averse facilities for long-term planning.

3. Asset Inventory

The methodology adopted for the typology of Parks assets follows the San Diego Coast District Sea Level Rise Adaptation Pathways Report and Statewide Toolkit, Final Statewide Methodology Memo, AECOM (2022).

This framework includes typologies for shoreline types, Parks assets, natural resources, and cultural resources, categorized by the sensitivity of these assets to Temporary Exposure and Permanent Exposure, defined as follows:

- Temporary Exposure. Temporary flooding due to coastal storm flooding.
- Permanent Exposure. Permanent tidal inundation from SLR, emergent groundwater, and/or shoreline change and cliff retreat.

3.1. Land Use

Figure 3-1 provides an overview of the distribution of land cover at Seacliff SB and New Brighton SB, based on CONUS satellite altimetry data from the National Land Cover Database (NLCD), MRLC (2021).

Figure 3-1: Seacliff SB and New Brighton SB Land Cover, NLCD (2021).

Seacliff SB includes areas of developed open space, and medium to high density development. New Brighton SB classifies as developed open space interspersed with evergreen forest and isolated areas

of wooded wetlands and low to medium density development. Seacliff SB and New Brighton SB also contain areas of non-native forest, non-native herbaceous, non-native shrub, and forest fragments. The Porter-Sesnon area consists of mixed forest, evergreen forest, scrub, and grasslands with isolated areas of emergent herbaceous wetlands.

The distribution of natural resources was assessed based on the Santa Cruz and Santa Clara Fine Scale Vegetation Map, Tukman (2023). The fine-scale vegetation map identifies 121 classes of vegetation communities and agricultural land cover types, including forests, grasslands, riparian vegetation, wetlands, and croplands. Common plant species identified at Seacliff SB and New Brighton SB are listed in Table 3-1.

Table 3-1: Plant species at Seacliff SB and New Brighton SB.

Common Name	Scientific Name	Status
Box elder	*Acer negundo*	Native
Bigleaf maple	*Acer macrophyllum*	Native, in decline
Coyote brush	*Baccharis pilularis*	Native, invasive
Coast live oak	*Quercus agrifolia*	Native
Arroyo willow	*Salix lasiolepis*	Native
Tasmanian bluegum, red gum	*Eucalyptus (globulus, camaldulensis)*	Non-native, invasive
Monterey cypress	*Hesperocyparis macrocarpa*	Non-native, moderately invasive
Monterey pine	*Pinus radiata*	Non-native
Himalayan blackberry	*Rubus armeniacus*	Non-native, invasive
Ice plant	*Mesembryanthemum spp. – Carpobrotus spp.*	Non-native, invasive

Table 3-2 categorizes land use at Seacliff SB based on the NLCD Data, MRLC (2021). The upper portion of the table indicates land cover types by acreage (ac). The acreages are divided into three groups representative of the inland area, clifftop edge, and beach area as follows:

- **Row 1:** Acreage of inland area, not vulnerable to SLR, coastal hazards or cliff retreat.
- **Row 2:** Acreage of clifftop area, approximately within 100 feet of the cliff edge, potentially vulnerable to cliff retreat.
- **Row 3:** Acreage of beach area potentially vulnerable to SLR and coastal hazards.
- **Row 4:** Total SB acreage, total of rows 1 to 3.

Acreages are provided for the NLCD land cover types across the columns from left to right, including total acreages provided in the rightmost column.

The lower portion of the table indicates the acreages as percentages of the total as follows:

- **Row a:** Percent inland area not vulnerable to SLR, calculated as row 1 divided by row 4.
- **Row b:** Percent clifftop area potentially vulnerable to cliff retreat, calculated as row 2 divided by row 4.
- **Row c:** Percent beach area potentially vulnerable to SLR and coastal hazards, calculated as row 3 divided by row 4.

- **Row d:** Percent total SB area, calculated as the sum of rows a to c and should equal 100% to verify all SB area has been accounted for within the respective subgroups (columns left to right).

Table 3-2: Land use at Seacliff SB.

	Seacliff SB								
			Developed						
#	Land Use by Location	Open Water	Open Space	Low Intensity	Medium Intensity	High Intensity	Barren Land	Shrub/Scrub	Total
1	Inland (ac)	0.0	3.6	3.5	7.2	1.4	0.0	0.3	15.8
2	Clifftop (ac)	0.0	6.4	10.7	4.2	0.2	0.0	0.4	22.0
3	Beach (ac)	10.9	0.9	4.0	29.1	13.1	19.3	0.0	77.4
4	Group Total (ac)	10.9	10.9	18.2	40.5	14.7	19.3	0.7	115.2
a	Inland (%)	0%	33%	19%	18%	10%	0%	43%	14%
b	Clifftop (%)	0%	59%	59%	10%	1%	0%	57%	19%
c	Beach (%)	100%	8%	22%	72%	89%	100%	0%	67%
d	Group Total (%)	100%	100%	100%	100%	100%	100%	100%	100%

Key indicators are highlighted, which show that:

- 59% of the open space at Seacliff SB is potentially vulnerable to cliff retreat.
- 59% of low intensity development is potentially vulnerable to cliff retreat.
- 72% of medium intensity development is potentially vulnerable to SLR and coastal hazards.
- 89% of high intensity development is potentially vulnerable to SLR and coastal hazards.
- 19% of the land use at Seacliff SB is potentially vulnerable to cliff retreat.
- 67% of the land is potentially vulnerable to SLR and coastal hazards.

The data shows that the majority of land at Seacliff SB (19% + 67% = 86%) is potentially at risk of SLR related impacts, and highlights that the majority of medium and high intensity development is located in beach areas with risk of exposure to coastal hazards exacerbated by SLR.

Table 3-3 summarizes NCLD land use data for New Brighton SB. The data shows that the majority of land use at New Brighton (83%) is not at risk of SLR related impacts, but also reveals that the majority of medium and high intensity development is located in beach areas where there is a risk of exposure to coastal hazards exacerbated by SLR.

Table 3-3: Land use at New Brighton SB.

New Brighton SB													
		Developed									Wetlands		
Land Use By Location	Open Water	Open Space	Low Intensity	Medium Intensity	High Intensity	Barren Land	Evergreen Forest	Mixed Forest	Shrub/Scrub	Herbaceous	Hay/Pasture	Woody	Emergent Herbaceous	Total
Inland (ac)	0	38.9	14.8	2.1	0	0	30.2	9.8	14	16.7	2	4.2	1.4	134.2
Clifftop (ac)	0.0	6.2	2.7	0.4	0.2	0.0	2.0	0.0	1.1	0.0	0.0	0.2	0.2	13.1
Beach (ac)	0.4	0.0	3.6	6.2	2.9	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.2
Group Total (ac)	0.4	45.1	21.1	8.7	3.1	1.1	32.2	9.8	15.1	16.7	2.0	4.4	1.6	161.5
Inland (%)	0%	86%	70%	24%	0%	0%	94%	100%	93%	100%	100%	95%	88%	83%
Clifftop (%)	0%	14%	13%	5%	6%	0%	6%	0%	7%	0%	0%	5%	13%	8%
Beach (%)	100%	0%	17%	71%	94%	100%	0%	0%	0%	0%	0%	0%	0%	9%
Group Total (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Key indicators are highlighted, which show that:

- 71% of medium intensity development at New Brighton SB is potentially vulnerable to SLR and coastal hazards.
- 94% of high intensity development is potentially vulnerable to SLR and coastal hazards.
- 8% of the land use at New Brighton SB is potentially vulnerable to cliff retreat.
- 9% of the land is potentially vulnerable to SLR and coastal hazards.

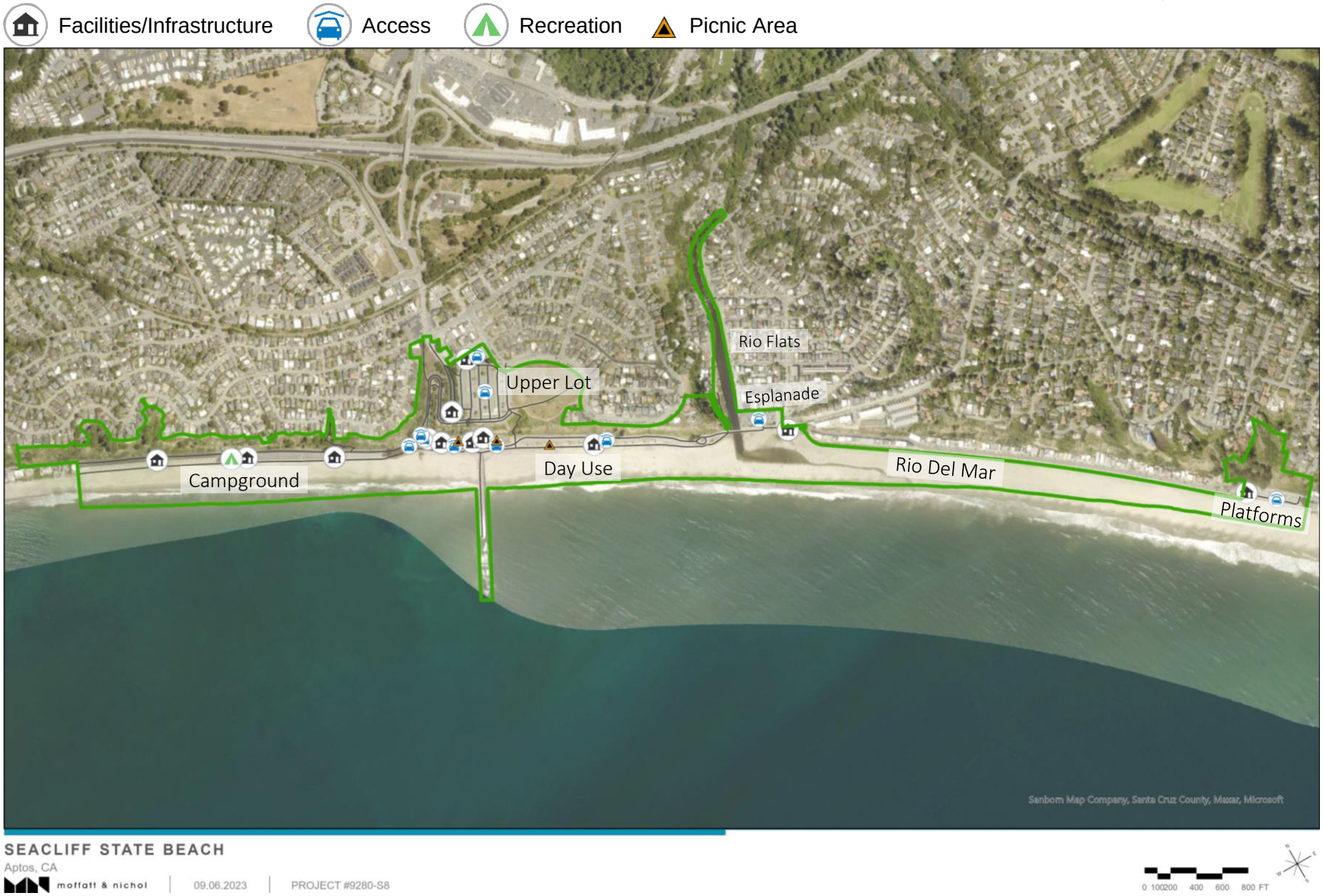

Figure 3-2: Overview of Parks Assets at Seacliff SB.

Details of Parks Assets at Seacliff SB subareas are provided in the following. Refer to Figure 3-2 for the general locations of Assets.

3.2. Seacliff Campground

Figure 3-3 shows the Campground located west of the Seacliff Visitor Center. Prior to the January 5, 2023 storm, this area featured a paved pedestrian walkway, 64 RV parking spaces, and 3 ADA accessible restroom facilities with shower facilities, protected by a timber bulkhead fronted by sandy beach. The January storm is estimated to have had a 20-year recurrence interval and caused extensive damage to the RV parking and hookups, and the Seacliff Pier to the point where these facilities had to be demolished and removed. Public access has since been restored and now consists of the roadway at the base of the cliff, fronted by a gently sloping sand fill with a line of rock placed along the toe. Near the entrance to the campground there is access to the Seacliff Visitor Center and Beach Gate Trail.

The shoreline consists of sandy beach backed by road, parking, and other infrastructure. This shoreline type has a high sensitivity to shoreline change as the hard backshore features do not allow the beach to migrate landward, resulting in permanent loss of beach.

Figure 3-3: Seacliff Campground, sandy beach backed by road, parking lot, CCRP (2023).

3.2.1. Land Use

Land use and land cover at the Seacliff Campground is summarized in Table 3-4. Approximately 70% of the area consists of developed land, including 2.2 acres of open space; 24 acres of low, medium, and high intensity development; and 5.1 acres of beach (categorized as barren land). The low intensity development typically categorizes the talus deposits at the base of the cliff, medium intensity development is representative of the parking areas, and high intensity development representative of buildings and facilities. The open water area of Seacliff Campground is part of the Monterey Bay National Marine Sanctuary.

It is worth noting that a significant portion of facilities and recreational elements at the Seacliff Campground are located in clifftop areas (27%), leaving these facilities potentially vulnerable to cliff retreat, SLR and coastal hazards.

Table 3-4: Land use at Seacliff Campground.

Seacliff Campground							
		Developed					
Land Use By Location	Open Water	Open Space	Low Intensity	Medium Intensity	High Intensity	Barren Land	Total
Inland (ac)	0.0	0.0	0.9	1.3	0.0	0.0	2.2
Clifftop (ac)	0.0	2.0	6.0	1.6	0.2	0.0	9.8
Beach (ac)	5.6	0.2	1.6	10.2	2.2	5.1	24.9
Group Total (ac)	5.6	2.2	8.5	13.1	2.4	5.1	36.9
Inland (%)	0%	0%	11%	10%	0%	0%	6%
Clifftop (%)	0%	90%	71%	12%	9%	0%	27%
Beach (%)	100%	10%	18%	78%	91%	100%	67%
Group Total (%)	100%	100%	100%	100%	100%	100%	100%

3.2.2. Natural Resources

Plant species and vegetation types found at Seacliff Campground are listed in Table 3-5. In areas where the data supports identification of specific species, these are indicated, e.g. Tasmanian bluegum, redgum, and Monterey cypress. In areas where the data does not support identification of specific species, generalized land cover categories are provided, such as: forest fragment, grassland, and non-native shrub.

The upper portion of the table indicates plant species and vegetation types by acreages, divided into regions located inland, along the clifftop, and on the beach. The lower half of the table indicates the

size of the respective areas as a percentage of the plant category total. The rightmost column of the table indicates the total acreage for Seacliff Campground overall (natural resources plus developed areas).

The table highlights that the majority of natural resources at Seacliff Campground (89%) are located along the clifftop (78%) and on the beach (11%), making these resources potentially vulnerable to cliff retreat and SLR and coastal hazards. Vegetation impacted by cliff retreat would be lost and species on the beach do not tolerate saltwater exposure and wave action.

Table 3-5: Natural resources at Seacliff Campground.

Seacliff Campground						
Natural Resource By Location	**Tasmanian bluegum, red gum**	**Forest fragment**	**Grassland**	**Monterey cypress**	**Non-native shrub**	**Total**
Inland (ac)	0.6	0.0	0.3	0.2	0.1	1.2
Clifftop (ac)	0.3	0.3	0.0	2.1	5.8	8.5
Beach (ac)	0.5	0.0	0.0	0.1	0.6	1.2
Group Total (ac)	1.4	0.3	0.3	2.4	6.5	10.9
Inland (%)	45%	0%	100%	8%	1%	11%
Clifftop (%)	18%	98%	0%	86%	89%	78%
Beach (%)	36%	8%	0%	5%	10%	11%
Group Total (%)	100%	100%	100%	100%	100%	100%

3.3. Seacliff Day Use Area

Figure 3-4 shows the Day Use area, located east of the Visitor Center. In addition to the visitor center, facilities include ADA accessible restroom and shower facilities, picnic areas and parking. The Day Use area extends east along the base of the cliff, terminating at a turning circle near Aptos Creek. From this area the Moosehead Trail provides access between the beach and the clifftop area. A separate trail connects to the bridge across Aptos Creek with access to shops, stores, and restaurants in Rio Del Mar and Aptos.

The Day Use facilities include 12 picnic ramadas, 146 tables, 47 stoves, two comfort stations and 100 parking spaces adjacent to the beach.

The shoreline at the Day Use area consists of sandy beach backed by road, parking, and other infrastructure. This shoreline type has a high sensitivity to shoreline change as the hard backshore features do not allow the beach to migrate landward, resulting in permanent loss of beach.

Figure 3-4: Seacliff Day Use, sandy beach backed by seawall, CCRP (2023).

3.3.1. Land Use

Land use and land cover at the Seacliff Day Use area is summarized in Table 3-6. Approximately 60% of the area is developed, including 0.7 acres of open space and 15.8 acres of low, medium, and high intensity development. The extent of beach fronting the Day Use facilities is approximately 6.2 acres (categorized as barren land). A 4.7-acre area of open water is part of the Monterey Bay National Marine Sanctuary.

It is worth noting that the majority of facilities and recreational elements at the Seacliff Day Use area (67%) are located at the base of the cliff, leaving these facilities potentially vulnerable to SLR and coastal hazards.

The percentage totals in Table 3-6 indicate that virtually all of the facilities and recreational elements at the Day Use area are located along the clifftop (16%) or on the beach (83%) at heightened exposure to cliff retreat, SLR and coastal hazards.

Table 3-6: Land use at Seacliff Day Use Area.

Seacliff Day Use								
		Developed						
Land Use By Location	Open Water	Open Space	Low Intensity	Medium Intensity	High Intensity	Barren Land	Shrub/Scrub	Total
Inland (ac)	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.7
Clifftop (ac)	0.0	0.4	2.2	1.3	0.0	0.0	0.4	4.4
Beach (ac)	4.7	0.0	2.0	8.2	2.0	6.2	0.0	23.1
Group Total (ac)	4.7	0.6	4.2	9.7	2.0	6.2	0.6	28.2
Inland (%)	0%	33%	0%	2%	0%	0%	33%	2%
Clifftop (%)	0%	67%	56%	14%	0%	0%	67%	16%
Beach (%)	100%	0%	50%	84%	100%	100%	0%	83%
Group Total (%)	100%	100%	100%	100%	100%	100%	100%	100%

3.3.2. Natural Resources

Plant species and vegetation types found at the Seacliff Day Use area are summarized in Table 3-7. The data highlights that the majority of natural resources at Seacliff Campground (90%) are located along the clifftop (75%) and on the beach (15%), leaving these resources potentially vulnerable to cliff retreat, SLR, and coastal hazards.

The beach is home to many types of birds and marine life, including mussels, ocean worms, sea stars, sea anemones, barnacles, and rock crabs.

The wreck of the SS Palo Alto World War I steamship is located a distance from the shoreline. Fish populations around the ship include flounder, mackerel, halibut, lingcod, perch, cabezon, jacksmelt, steelhead, anchovy, tomcod, and kingfish. Additional species seen in the area include seabirds, sea otters, harbor seals, sea lions, dolphins, and whales. Although the wreck is a manmade structure, it now provides valuable habitat that is relatively rare to find along the coast.

Table 3-7: Natural resources at Seacliff Day Use.

Seacliff Day Use							
Natural Resource By Location	**Coyote brush**	**Tasmanian bluegum, red gum**	**Grassland**	**Ice plant**	**Non-native forest**	**Non-native shrub**	**Total**
Inland (ac)	0.0	0.01	0.0	0.0	0.6	0.0	0.6
Clifftop (ac)	1.5	0.0	0.3	0.8	0.8	1.2	4.6
Beach (ac)	0.03	0.0	0.01	0.3	0.3	0.3	0.9
Group Total (ac)	1.5	0.0	0.3	1.1	1.7	1.5	6.1
Inland (%)	0%	100%	0%	0%	35%	0%	10%
Clifftop (%)	98%	0%	97%	73%	47%	80%	75%
Beach (%)	2%	0%	3%	27%	18%	20%	15%
Group Total (%)	100%	100%	100%	100%	100%	100%	100%

3.4. Seacliff Upper Lot

The Seacliff Upper Lot serves as an overflow parking area when the Campground and Day Use areas fill up, providing paved parking for 365 cars and unpaved overflow parking for 250 cars. Additional facilities at the Upper Lot include a service yard and five employee residences. The area is also used for open space recreation, and at times for storage of Parks equipment, material, and vehicles needing to be serviced. A stairway provides access down to the beach.

The shoreline at the base of the Upper Lot consists of a sandy foreshore backed by road, parking, and other infrastructure. This shoreline type has a high sensitivity to shoreline change as the hard backshore features do not allow the beach to migrate landward, resulting in permanent loss of beach. However, the structures at the base of the cliff limit cliff retreat, reducing the rate of retreat to the base rate.

Figure 3-5: Seacliff Upper Lot, CCRP (2023).

3.4.1. Land Use

Table 3-8 summarizes land use categories at the Upper Lot, indicating that the majority of the area (95%) is located inland and not vulnerable to SLR and cliff retreat. A limited portion of the site (5%) is located along the cliff edge and potentially vulnerable to cliff retreat. However, infrastructure and facilities located at the base of the cliff and walls incorporated to retain slide would be anticipated to limit cliff retreat associated with SLR and wave exposure.

Table 3-8: Land use at Seacliff Upper Lot.

Seacliff Upper Lot					
	Developed				
Land Use By Location	Open Space	Low Intensity	Medium Intensity	High Intensity	Total
Inland (ac)	3.6	2.2	6.2	1.3	13.3
Clifftop (ac)	0.2	0.4	0.0	0.0	0.7
Beach (ac)	See Day Use, Table 3-6				-
Group Total (ac)	3.8	2.6	6.2	1.3	14.0
Inland (%)	94%	83%	100%	100%	95%
Clifftop (%)	6%	17%	0%	0%	5%
Group Total (%)	100%	100%	100%	100%	100%

3.4.2. Natural Resources

The Upper Lot mostly consists of developed land and contains limited natural resources. Plant species and vegetation types found at the Upper Lot include Coyote brush, grassland, Monterey cypress, and areas of non-native forest.

Table 3-9 summarizes plant species and vegetation types by region, which shows that 93% of natural resources are located inland and not vulnerable to SLR and cliff retreat. About 7% of the vegetation is located in proximity to the cliff edge and potentially vulnerable to cliff retreat. However, walls and infrastructure located at the base of the cliff serve to limit cliff retreat in this area.

Table 3-9: Natural resources at Seacliff Upper Lot.

Seacliff Upper Lot					
Natural Resource By Location	**Coyote Brush**	**Grassland**	**Monterey cypress**	**Non-native forest**	**Total**
Inland (ac)	0.5	4.8	1.1	0.3	6.7
Clifftop (ac)	0.3	0.1	0.0	0.1	0.5
Beach (ac)	See Day Use, Table 3-7				-
Group Total (ac)	0.8	4.9	1.1	0.4	7.2
Inland (%)	62%	98%	99%	75%	93%
Clifftop (%)	38%	2%	1%	25%	7%
Group Total (%)	100%	100%	100%	100%	100%

3.5. Rio Del Mar

Rio Del Mar is located east of Aptos Creek and consist of a wide beach backed by a mix of paved walkways, roadway and parking areas, with restroom facilities, lifeguard towers, and private residences. About 88% of the shoreline is backed by seacliff. A mix of rock armoring and seawalls are in place to protect facilities along the shoreline.

The beach provides a long expanse of clean beach interspersed with segments of sand dune vegetated with Pink Sand Verbena (*Abronia umbellata*). Popular activities at the beach include walking, volleyball, kite flying, and sunbathing.

The shoreline at Rio Del Mar consists of sandy beach backed by a seawall[2] (Figure 3-7), road, parking, and other infrastructure (Figure 3-9). This shoreline type has a high sensitivity to shoreline change as the hard backshore features do not allow the beach to migrate landward, resulting in permanent loss of beach.

[2] Note: Seawall and road not owned by State Parks.

Figure 3-6: Rio Del Mar shoreline at Aptos Creek (left), sandy beach backed by seawall, CCRP (2023).

Figure 3-7: Parking area at Rio Del Mar Platforms, sandy beach backed by road, parking, CCRP (2023).

3.5.1. Land Use

Table 3-10 summarizes land use at Rio Del Mar, which is for the most part concentrated in the beach areas (88%). These facilities are potentially vulnerable to SLR, shoreline retreat and coastal hazards.

About 12% of developed areas are located along the cliff edge and potentially vulnerable to cliff retreat. A low-profile wall has been installed at the base of the cliff to control slide debris and will to some extent limit cliff retreat driven by future SLR.

Table 3-10: Land use at Rio Del Mar.

Rio Del Mar							
		Developed					
Land Use By Location	Open Water	Open Space	Low Intensity	Medium Intensity	High Intensity	Barren Land	Total
Inland (ac)	0.0	1.6	0.2	0.0	0.0	0.0	1.8
Clifftop (ac)	0.0	1.6	0.9	1.1	0.9	0.0	4.4
Beach (ac)	0.7	1.1	2.0	11.3	8.9	8.0	32.0
Group Total (ac)	0.7	4.3	3.1	12.4	9.8	8.0	38.2
Inland (%)	0%	37%	7%	0%	0%	0%	5%
Clifftop (%)	0%	37%	29%	10%	10%	0%	12%
Beach (%)	100%	26%	64%	100%	100%	100%	88%
Group Total (%)	100%	100%	100%	100%	100%	100%	100%

3.5.2. Natural Resources

A variety of plant species and vegetation types can be found along Rio Del Mar, primarily in the beach areas as indicated in Table 3-11. These resources are potentially vulnerable to SLR, shoreline retreat and coastal hazards. None of the listed species are tolerant to saltwater exposure and wave action.

Table 3-11: Natural resources at Rio Del Mar.

Rio Del Mar									
Natural Resource By Location	**Bigleaf maple**	**Tasmanian bluegum, red gum**	**Monterey cypress**	**Ice plant**	**Coastal scrub**	**Non-native forest**	**Coast live oak**	**Arroyo willow**	**Total**
Inland (ac)	0.0	0.1	0.1	0.0	1.4	0.0	0.01	0.0	1.7
Clifftop (ac)	0.0	1.0	0.2	0.6	0.5	0.0	0.0	0.0	4.2
Beach (ac)	0.002	0.1	0.1	0.8	0.0	0.1	0.02	1.0	31.5
Group Total (ac)	0.002	1.2	0.4	1.4	1.9	0.1	0.03	1.0	37.4
Inland (%)	0%	11%	20%	3%	73%	0%	33%	0%	5%
Clifftop (%)	0%	79%	57%	42%	27%	0%	0%	0%	12%
Beach (%)	100%	10%	23%	54%	0%	100%	67%	100%	88%
Group Total (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%

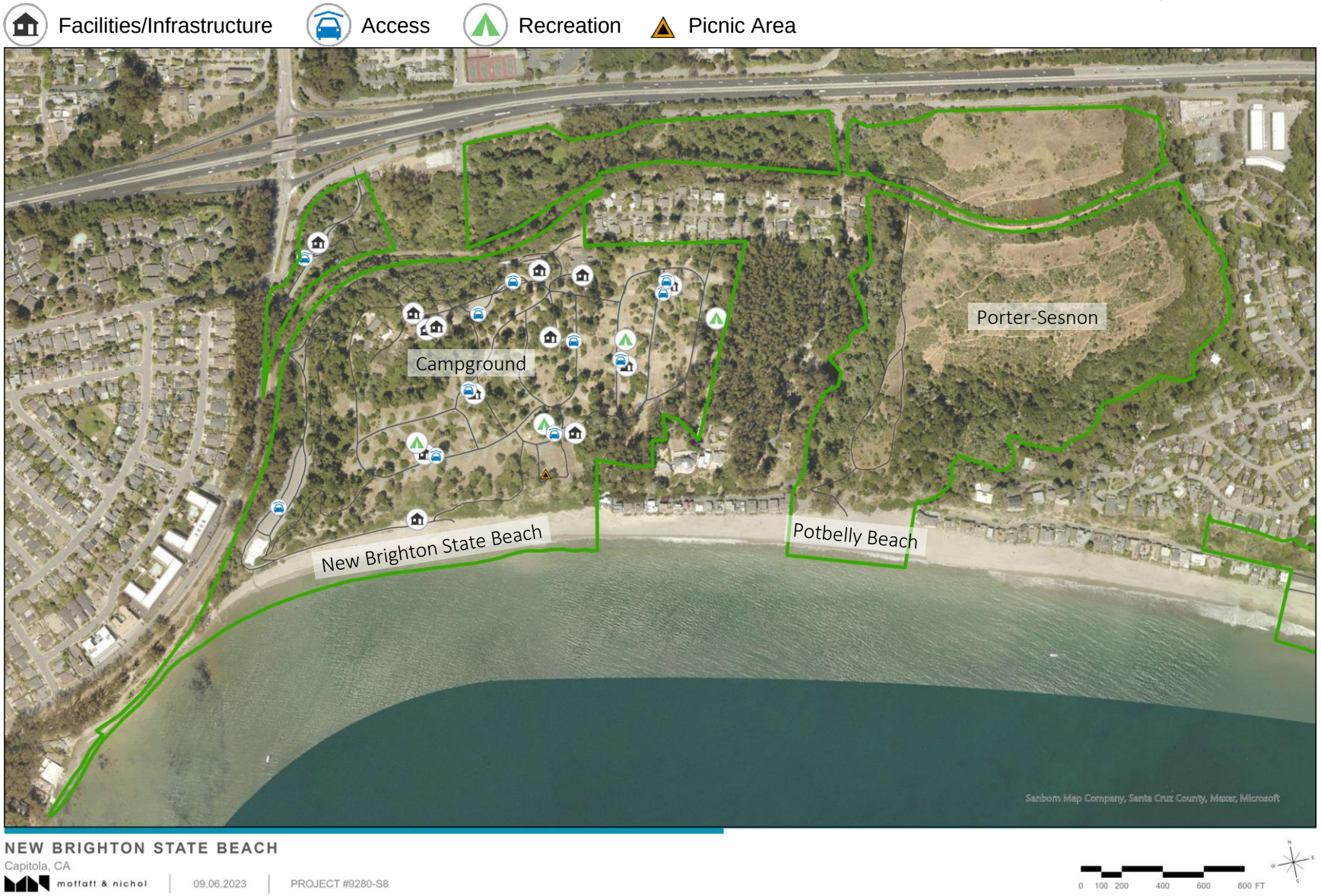

Figure 3-8: Overview of Parks Assets at New Brighton SB.

Details of Parks Assets at New Brighton SB subareas are provided in the following. Refer to Figure 3-8 for the general location of assets.

3.6. New Brighton Campground

The New Brighton Campground consists of a wooded area located on the bluff by New Brighton Beach. The campground contains 109 family (8-person) campsites, including ADA accessible sites, 9 premium sites, 11 sites with RV hookup, 1 bike-in site, and 3 group sites. The premium sites are located along the edge of the bluff overlooking New Brighton Beach.

Natural resources found at New Brighton Campground include Coast live oak, coffeeberry, coast blue-blossom, blackberry and other plants native to the region. Invasive species French broom, fennel, periwinkle, jubata, English ivy, and Cape ivy are managed with the goal of maintaining 50 to 80% Coast live oak canopy cover in the Campground.

Tannery Gulch runs along the west side of the campground with an outlet to New Brighton Beach. A range of plant species in Tannery Gulch serve as refugia for resident and migrating songbirds, including Arroyo willow and Coast live oak overstory, and understory dominated by California blackberry, poison oak, small-headed bull rush, hedge nettle, cape ivy, eucalyptus, and periwinkle.

Figure 3-9: New Brighton Campground, Nearmap (2023).

Two shoreline types front the new Brighton Campground area. From the parking area to the west to about midway along the base of the cliffs, the shoreline is sandy beach backed by rock revetment which prevents landward migration of the beach, resulting in gradual loss of beach. The remaining shoreline consists of sandy beach backed by natural bluff, which has moderate sensitivity to shoreline change. Erosion of slide debris talus deposits at the base of the bluff may initially provide a supply of

material to the beach. As these talus deposits are depleted, the shoreline is expected to transition to sandy to rocky beach backed by hard cliff preventing landward migration and permanent loss of beach. Refer to Section 3.7 for photos of the respective shoreline types.

3.6.1. Land Use

Land use and land cover at New Brighton Campground is summarized in Table 3-12, which shows that the majority of the campground facilities (90%) are located inland and not vulnerable to SLR related hazards. A smaller portion of facilities (10%) are located along the edge of the cliff and potentially vulnerable to cliff retreat. This includes the premium campsites.

Table 3-12: Land use at New Brighton Campground.

New Brighton Campground									
	Developed						Wetlands		
Land Use By Location	Open Space	Low Intensity	Medium Intensity	Evergreen Forest	Shrub/Scrub	Hay/Pasture	Woody Wetlands	Emergent Herbaceous	Total
Inland (ac)	33.8	13.8	1.8	16.7	0.9	2.0	2.2	0.4	71.6
Clifftop (ac)	5.3	1.6	0.2	0.4	0.2	0.0	0.2	0.2	8.2
Beach (ac)	Refer to New Brighton Beach, Table 3-14								-
Group Total (ac)	39.1	15.4	2.0	17.1	1.1	2.0	2.4	0.6	79.8
Inland (%)	86%	90%	89%	97%	80%	100%	91%	67%	90%
Clifftop (%)	14%	10%	11%	3%	20%	0%	9%	33%	10%
Group Total (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.6.2. Natural Resources

Natural resources found at New Brighton Campground are indicated in Table 3-13, categorized by location inland, along the cliff edge, or on the beach. The data shows that the majority of natural resources (89%) are located inland and not vulnerable to SLR and cliff retreat.

About 80% of species found in this area are native, and 20% non-native species. About 11% of the vegetation is located in proximity to the clifftop edge and potentially vulnerable to cliff retreat.

Table 3-13: Natural resources at New Brighton Campground.

New Brighton Campground										
Natural Resource By Location	**Box elder**	**Tasmanian bluegum, red gum**	**Grassland**	**Monterey cypress**	**Non-native herbaceous**	**Non-native shrub**	**Monterey pine**	**Coast live oak**	**Arroyo willow**	**Total**
Inland (ac)	0.1	10.7	9.4	15.2	0.0	0.0	17.2	9.5	2.6	64.7
Clifftop (ac)	0.0	0.8	0.5	1.6	0.1	2.1	2.1	0.0	0.4	7.6
Beach (ac)	Refer to New Brighton Beach, Table 3-15.									-
Group Total (ac)	0.1	11.5	9.9	16.8	0.1	2.1	19.3	9.5	3.0	72.3
Inland (%)	100%	93%	95%	90%	0%	0%	89%	100%	87%	89%
Clifftop (%)	0%	7%	5%	10%	100%	100%	11%	0%	13%	11%
Group Total (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.7. New Brighton Beach

New Brighton Beach is accessible from the Tannery Gulch parking lot near the west end of the beach. A beach trail provides access to Potbelly Beach via a compacted DG pathway along the base of the cliff, providing lifeguard access and access to restroom facilities. On the east side of the lower parking lot, the Sunset Trail leads up the bluff to the New Brighton Campground.

At low tide, it's possible to walk west about 1 mile along the bay to Capitola Beach, and about 1 to 2 miles east along the bay to the beach at Seacliff SB. Beach areas are maintained for public recreational use, leaving a portion of kelp wrack and driftwood to support shorebird habitat.

Popular recreational activities at New Brighton Beach include swimming, kayaking, and skimboarding.

Three shoreline types exist at New Brighton Beach. West of the parking area, the shoreline consists of a rocky shore backed by seacliff (Figure 3-10), interspersed by sections of sandy shore. This shoreline type has low sensitivity to shoreline change and the vulnerability is dependent on the erosion potential of the bluff. Approximately 386 feet of rock armoring has been placed to protect the base of the cliff against wave exposure.

East of the parking area, the shoreline transitions to sandy beach backed by riprap armoring (Figure 3-11 left). The sensitivity of this shoreline type to shoreline change is high as the hard backshore features prevent landward migration of the beach, resulting in gradual loss of beach.

Further east, the shoreline consists of sandy beach backed by natural bluff (Figure 3-11 right). This shoreline has moderate sensitivity to shoreline change. If the bluff consists primarily of soft material,

erosion of the bluff may contribute to accretion of the beach. If the bluff consists of harder material, the beach may erode at a higher rate than the bluff, resulting in reduction in the beach width. The composition of the bluff at this location is presumably talus deposits of loose slide debris backed by harder seacliff (Purisima Formation). The projected shoreline response is therefore that the shoreline will initially respond as a sandy beach backed by soft natural bluff and over time transition to a sandy to rocky beach backed by hard cliff limiting landward migration and resulting in permanent loss of beach.

Figure 3-10: New Brighton Beach, rocky shoreline backed by cliff, CCRP (2023).

Figure 3-11: New Brighton Beach, sandy beach backed by bluff, CCRP (2023).

3.7.1. Land Use

Land use at New Brighton Beach is summarized in Table 3-14, which highlights that natural resources at this location are located on the beach (89%) or lower part of the bluff face (11%), leaving these resources potentially vulnerable to cliff retreat, SLR, and coastal hazards.

Table 3-14: Land use at New Brighton Beach.

New Brighton Beach					
		Developed			
Land Use By Location	Open Water	Low Intensity	Medium Intensity	High Intensity	Total
Inland (ac)	New Brighton Campground, Table 3-12				-
Clifftop (ac)	0.0	0.7	0.7	0.0	1.4
Beach (ac)	0.4	3.3	4.7	2.7	11.1
Group Total (ac)	0.4	4.0	5.4	2.7	12.5
Clifftop (%)	0%	18%	13%	0%	11%
Beach (%)	100%	83%	87%	100%	89%
Group Total (%)	100%	100%	100%	100%	100%

3.7.2. Natural Resources

Table 3-15 summarizes natural resources at New Brighton Beach. The plant species and vegetation types found in this area are non-native apart from Arroyo willow.

Natural resources in this area are located on the beach and bluff face and potentially vulnerable to SLR and coastal hazards, having a low tolerance to saltwater and wave exposure.

The rocky shores at the base of the cliff west of the parking area serve as habitat for mussels, sea stars, barnacles, rock crabs, sea anemones, and marine worms.

Fish populations in the area include flounder, sole, halibut, mackerel, lingcod, jacksmelt, cabezon, anchovy, perch, kingfish, steelhead, and salmon. Additional species seen in the area include pelicans, seabirds, dolphins, sea otters, sea lions, and migrating whales.

Table 3-15: Natural resources at New Brighton Beach.

New Brighton Beach							
Natural Resource By Location	**Tasmanian bluegum, red gum**	**Monterey cypress**	**Non-native herbaceous**	**Non-native shrub**	**Monterey pine**	**Arroyo willow**	**Total**
Inland (ac)	Refer to New Brighton Campground, Table 3-13						-
Bluff face (ac)	0.1	0.0	0.002	0.0	0.00	0.01	0.1
Beach (ac)	0.2	0.1	0.002	0.2	0.01	0.14	0.7
Group Total (ac)	0.3	0.1	0.004	0.2	0.01	0.15	0.8
Bluff face (%)	33%	0%	33%	0%	0%	7%	15%
Beach (%)	67%	100%	33%	100%	100%	93%	85%
Group Total (%)	100%	100%	100%	100%	100%	100%	100%

3.8. Porter-Sesnon

The Porter-Sesnon property consists of 66 acres of undeveloped land. There is vehicular access to the site via McGregor Drive and a trail connection to Potbelly Beach at the base of the bluff.

The Southern Pacific railroad line intersects the property, dividing it into a North Field and South Field.

The North Field is colonized by native perennial grasses, including California oat grass (*Danthonia californica*) and purple needle grass (*Nassella pulchra*) and other native species. There is a limited number of woody plants, such as coyote brush (*Baccharis pillularis*). Invasive species include French broom, cotoneaster, and ivy species. Woody species are managed to maintain coastal grassland.

The South Field has been colonized by cotoneaster, Monterey pine, California blackberry, coffeeberry, French broom, coyote brush, and coast live oak. Colonization by woody shrubs is transitioning the area to woodland. Monterey pine, Monterey cypress, cotoneaster, eucalyptus, french broom and jubata are actively controlled to promote transition to Coast live oak woodland.

The shoreline fronting the Porter-Sesnon property is Potbelly Beach. Refer to Section 3.9. The shoreline type consists of sandy beach backed by soft natural bluff, assumed to consist of slide debris talus deposits backed by the harder Purisima Formation.

Figure 3-12: Porter-Sesnon, Nearmap (2023).

3.8.1. Land Use

Table 3-16 summarizes land use and land cover types at Porter-Sesnon categorized by location inland, along the clifftop, or on the beach. The data shows that the majority of developed land and natural resources at Porter-Sesnon are located inland (95%) and therefore not vulnerable to SLR and shoreline retreat. A limited portion of assets (5%) are located in proximity to the clifftop edge, consisting

of 0.4 acres of medium intensity development, 0.7 acres of shrub/scrub, and 2 acres of evergreen forest.

Table 3-16: Land use at Porter-Sesnon.

Porter-Sesnon										
	Developed							Wetlands		
Land Use By Location	Low Intensity	Medium Intensity	High Intensity	Evergreen Forest	Mixed Forest	Shrub/scrub	Herbaceous	Woody	Emergent Herbaceous	Total
Inland (ac)	5.6	0.9	0.2	13.1	9.8	13.3	16.7	2.0	0.9	62.5
Clifftop (ac)	0.2	0.4	0.0	2.0	0.0	0.7	0.0	0.0	0.0	3.3
Beach (ac)	Refer to Potbelly Beach, Table 3-18									-
Group Total (ac)	5.8	1.3	0.2	15.1	9.8	14.0	16.7	2.0	0.9	65.8
Inland (%)	96%	67%	100%	87%	100%	95%	100%	100%	100%	95%
Clifftop (%)	4%	33%	0%	13%	0%	5%	0%	0%	0%	5%
Group Total (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.8.2. Natural Resources

Natural resources at Porter-Sesnon are summarized in Table 3-17 categorized by location in terms of proximity to the coast. 94% of natural resources are located inland and not vulnerable to cliff and shoreline retreat. 6% of natural resources are located along the clifftop and potentially vulnerable to cliff retreat.

In this group, a smaller portion are grassland, non-native shrub and Monterey pine. Gum plants (Eucalyptus) are non-native and an invasive species. Coast live oak is a native species, and there would be a potential for loss of up to 0.6 acres of this habitat to cliff retreat, SLR and coastal hazards.

Table 3-17: Natural resources at Porter-Sesnon.

Porter-Sesnon									
Natural Resource By Location	**Coyote brush**	**Tasmanian bluegum, red gum**	**Grassland**	**Non-native forest**	**Non-native shrub**	**Monterey pine**	**Coast live oak**	**Himalayan blackberry**	**Total**
Inland (ac)	12.4	2.7	10.7	0.5	0.6	4.4	27.1	1.0	59.4
Clifftop (ac)	0.0	0.7	0.3	0.0	0.8	1.1	0.6	0.0	3.6
Beach (ac)	Refer to Potbelly Beach, Table 3-19								-
Group Total (ac)	12.4	3.4	11.0	0.5	1.4	5.5	27.7	1.0	63.0
Inland (%)	100%	80%	97%	100%	36%	80%	98%	100%	94%
Clifftop (%)	0%	20%	3%	0%	54%	20%	2%	0%	6%
Group Total (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.9. Potbelly Beach

Potbelly Beach is located between private residences at the base of the bluff (Figure 3-13). There is access to Potbelly Beach along the shoreline from New Brighton Beach below mean high tide. Higher tides and wave runup periodically limit access along the beach. From Potbelly Beach, there is a trail connection to the clifftop Porter-Sesnon area. A ravine on the west side of Potbelly Beach carries Old Woman Creek, which seasonally and intermittently outlets onto Potbelly Beach. The residences to the west of Potbelly Beach are protected with rock armoring. Borregas Creek is located in the ravine at the east end of Potbelly Beach. The residences to the east by the Borregas Creek outlet are located on pile foundations, and the private residences further east are protected with rock armoring.

The shoreline type at Potbelly Beach consists of sand backed by soft natural bluff. The sensitivity of this shoreline type to shoreline change is moderate, given that the bluff may erode and contribute to accretion of the beach. However, if the beach is eroding at a faster pace than the bluff, loss of beach and reduced beach width will result.

Figure 3-13: Potbelly Beach, CCRP (2023).

3.9.1. Land Use

Land use categories in the vicinity of Potbelly Beach are summarized in Table 3-18. The main area consists of 0.2 acres of open space and 1.1 acres of beach (barren land). The 2.8 acres of low, medium, and high intensity development reflect the primary use of Potbelly Beach for recreational purposes.

Table 3-18: Land use at Potbelly Beach.

Potbelly Beach						
	Developed					
Land Use By Location	Open Space	Low Intensity	Medium Intensity	High Intensity	Barren Land	Total
Inland (ac)	Refer to Porter-Sesnon, Table 3-16					-
Bluff face (ac)	0.2	0.0	0.0	0.0	0.0	0.2
Beach (ac)	0.2	1.1	1.3	0.4	1.1	4.2
Group Total (ac)	0.4	1.1	1.3	0.4	1.1	4.4
Bluff face (%)	100%	0%	0%	0%	0%	5%
Beach (%)	100%	100%	100%	100%	100%	100%
Group Total (%)	100%	100%	100%	100%	100%	100%

3.9.2. Natural Resources

Natural resources at Potbelly Beach are indicated in Table 3-19, consisting mainly of gum trees (Eucalyptus), non-native shrub and a small stand of Coast live oak. Eucalyptus is a non-native, invasive species. Coast live oak is a native species.

Table 3-19: Natural resources at Potbelly Beach.

	Potbelly Beach			
Natural Resource By Location	**Tasmanian bluegum, red gum**	**Non-native shrub**	**Coast live oak**	**Total**
Inland (ac)	Porter-Sesnon, Table 3-17			-
Bluff face (ac)	0.01	0.02	0.002	0.03
Beach (ac)	0.3	0.1	0.04	0.4
Group Total (ac)	0.3	0.1	0.04	0.4
Bluff face (%)	3%	17%	5%	7%
Beach (%)	97%	83%	95%	93%
Group Total (%)	100%	100%	100%	100%

Borregas Gulch and Old Woman Gulch contain a number of species that support and serve as refugia for resident and migrating songbirds. Plant species found at these two locations include Arroyo willow and Coast live oak overstory, and understory dominated by California blackberry, poison oak, small-headed bull rush, hedge nettle, cape ivy, eucalyptus, and periwinkle.

3.10. Cultural Resources

The Seacliff SB and New Brighton SB area has a rich cultural history, located within the unceded homelands of the Awaswas-speaking Tribe known as the Aptos, who stewarded these lands since time immemorial. Centuries of colonial violence beginning with the Spanish Mission Period and subsequent Mexican and American Periods led to the disruption of Native lifeways and traditional resource management in this area. Despite this legacy of colonial disruption, local tribal descendant communities persist in restoring Indigenous stewardship to the land and sea in this region.

Native people thrived for thousands of years, living in tribal communities led by a chief and council elders. Indigenous groups living in the area of Santa Cruz and the northern part of Monterey Bay included the Awaswas and Mutsun. Two distinct tribes lived in the area of Seacliff SB and New Brighton SB, which included the Aptos tribe “The People” and the Cajastaca “Jackrabbit” tribe. The Aptos tribe was one of the larger Awaswas groups in the region. The Cajastaca were a sub-group of the larger Aptos tribe, Milliken (1991, 1995).

Native people in this area developed sophisticated resource management practices, including selective hunting, fishing, gathering, and trapping for mammals, reptiles, waterfowl and other birds, along with the use of prescribed burns to increase the productivity of important ethnobotanical resources such as acorns, nuts, seeds, berries, roots, and shoots. Resources from the sea included

whales, sea otters, sea lions, mussels and abalone. Marine resources were traded with inland tribes in the region, in return for pine nuts and obsidian. They lived in sizable dome shaped houses constructed of poles and thatched with tule, capable of accommodating 10-15 people. The utilized animal skins for clothing, and as blankets and bedding combined with tule mats.

The arrival of missionaries and Spanish colonizers in the mid-1700s had a negative impact on Indigenous people throughout California. Numbering approximately fifty individual tribes at the time, their numbers were severely reduced by the introduction of disease and cultural genocide brought to California by European settlers, yet Native people persist into the present and are working to revitalize traditional stewardship and cultural practices to heal from historic trauma from successive waves of Euro-American colonization.

The Spanish colonization led to the establishment of Mission Santa Cruz. After Mexico broke away from Spain in 1821, the land was subdivided into Mexican land grants (ranchos). By 1833 it was known as Rancho Aptos.

Seacliff developed into a bustling shipping port with the building of the Castro-Spreckels wharf. During the mid-1920's, landowners constructed summer homes on the cliffs above Seacliff and the area to its south, Rio Del Mar. On the north side of Seacliff, 1920's tourists enjoyed upscale camping facilities.

In 1930 the Seacliff Amusement Corporation bought the SS Palo Alto, a concrete steamship (SS) built during WW I. It was brought to the site and grounded on the seafloor in shallow water near the beach, and a pier was built leading to the ship's main deck. It was turned into an elaborate amusement center with dining rooms and entertainment. The Seacliff Amusement Corporation went bankrupt after only two seasons of dining and dancing.

Thereafter, Seacliff Beach and the SS Palo Alto became one of California's first state beaches in 1931. For more than 80 years, beachfront camping, picnicking, fishing, and interpretive walks have been among the park's most popular activities.

3.10.1. Buildings and Historic Structures at Seacliff SB

Seacliff SB contains the following historic structures listed in Table 3-20. The exposure to coastal processes is indicated in the center column, and the sensitivity to temporary and permanent exposure in the two rightmost columns.

Table 3-20: Historic structures at Seacliff SB.

Structure	Usage	Coastal Processes	Sensitivity to:	
			Temporary Exposure	Permanent Exposure
Picnic Ramada	Covered picnic area	SLR and wave action	High	High
Building #1	State Parks	Cliff retreat	High	High
Building #2	State Parks	Not vulnerable	None	None
SS Palo Alto	Bird and marine habitat	SLR and Wave Action	Low	Moderate
Seacliff Pier	Demolished following Jan. 5, 2023 storm damage.	N/A	N/A	N/A

The Seacliff Picnic Ramada was erected in the 1930's by the Civilian Conservation Corps, constructed from peeled pine log posts and hipped shingle roof. Eight rock walls that encompass the picnic area were constructed from stacked sandstone and mortar. The ramada burned and its remains torn down in 2005, SPR (2023).

The SS Palo Alto, a 435-ft long World War I concrete steam ship, was grounded off Seacliff SB in 1929 as part of the development of a pleasure pier entertainment complex. The remains of the ship serves as a platform for a range of bird species and marine life.

The Seacliff Pier consisted of a 660-ft long timer structure, terminating at a viewing area at the SS Palo Alto location.

3.10.2. Buildings and Historic Structures at New Brighton SB

Historic structures at New Brighton SB are listed in Table 3-2.

Table 3-21: Historic structures at New Brighton SB.

Structure	Usage	Coastal Processes	Sensitivity to:	
			Temporary Exposure	Permanent Exposure
Picnic Ramada	Covered picnic area	Cliff retreat	High	High
Building #1	State Parks	Not vulnerable	-	-
Southern Pacific Line and New Trestle	Historic rail line	Not vulnerable	-	-
1880 Chinese fishing village	No longer in existence.	N/A	N/A	N/A

- Not impacted by SLR.
N/A Not Applicable.

The New Brighton Ramada and associated stoves were constructed by the Civilian Conservation Corps in the late 1930's. Several of the mortared rock stoves associated with the post and beam ramada are in deteriorating condition, either through vandalism or lack of maintenance, SPR (1990b).

The Southern Pacific Line and New Trestle which crosses over the entrance road is noted as an historic rail line dating from 1881 in Santa Cruz County. The earlier bridge trestle was replaced in 1961, SPR (1990b).

The fishing village was sited by Chinese immigrants in the mid-1850's. The U.S. Census of 1880 indicated that 29 fishermen were living there at the beginning of the decade, aged 16 to 48.

3.10.3. Paleontological Resources

The coastal cliff in the Capitola to Seacliff region is named the Purisima Formation, which is a deposit of grey-blue sandstone formed from sediment deposited from rivers in the Pliocene Era. This sedimentary rock deposit was uplifted over time to create the seacliff witnessed present-day.

The Purisima Formation features bands of fossils of marine life, including seashells, snails and bone fragments from whales and seals.

4. Coastal Hazards & SLR Vulnerability Assessment

4.1. Study Approach

The Coastal Hazard and SLR Vulnerability Assessment and Shoreline Adaptation Planning (SLR-VA+AP) Alternatives for Seacliff SB and New Brighton SB assesses potential impacts to State Parks resources and infrastructure across multiple SLR scenarios and prepares adaptation alternatives to mitigate these impacts. Key questions that guided the overall study to inform future coastal hazard adaptation measures and their implementation at each location are illustrated in Figure 4-1.

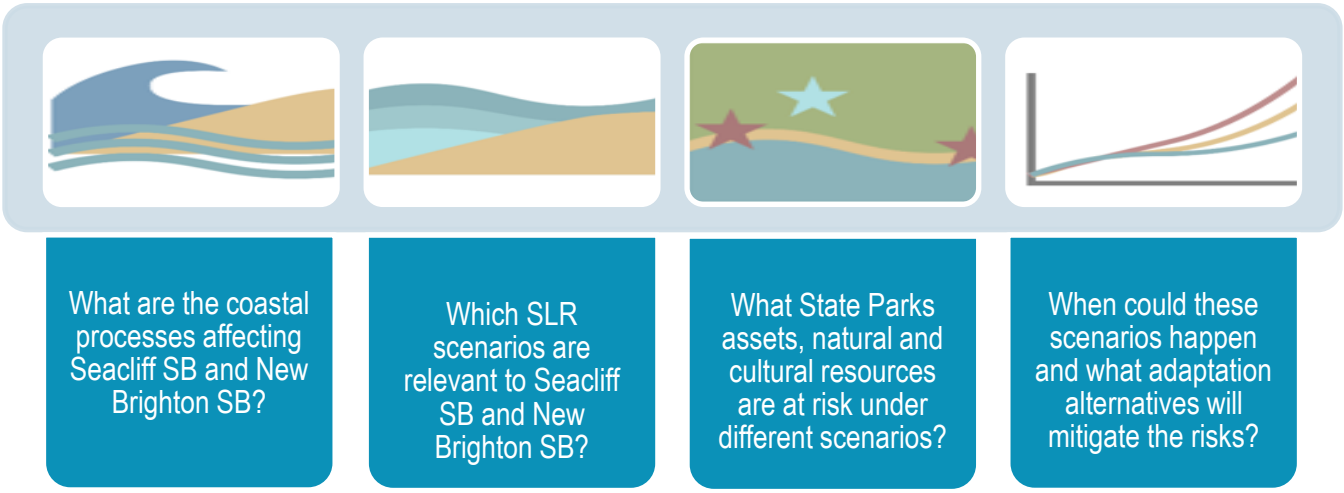

Figure 4-1: Key questions used to guide the SLR-VA+AP.

Important steps of the study approach are to:

- Understand current conditions and coastal processes.
- Assess how coastal processes evolve with SLR.
- Identify exposure and sensitivity of State Parks assets.
- Develop adaptation alternatives to mitigate risks (upcoming).
- Select a preferred adaptation pathway (upcoming).

4.2. Assessment Methodology

Figure 4-2 depicts the coastal zone at Seacliff SB and New Brighton SB, which is characterized by a tall seacliff consisting of marine terrace deposits overlying the Purisima Formation. The beach profile at the base of the cliff is characterized by a sloping foreshore profile and a flatter backshore profile at the base of the cliff. The foreshore is subject to daily tides and wave runup and active coastal processes. The backshore is located above the high tide level and dry under most conditions and consists of material placed during swell wave events.

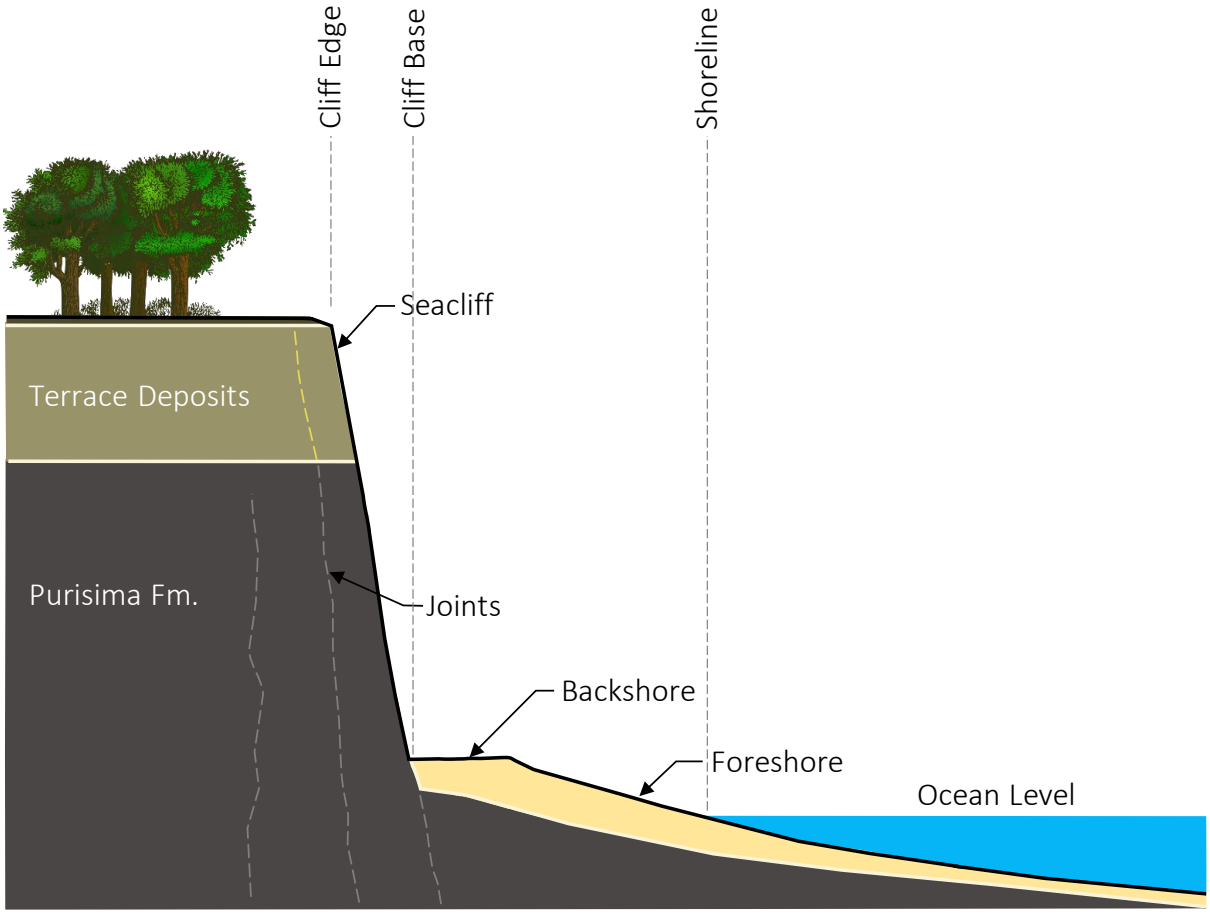

Figure 4-2: Beach and cliff profile at Seacliff SB and New Brighton SB.

The categorization of the coastal zone depicted in Figure 4-2 was an important step as part of the SLR vulnerability assessment methodology, which is described in the following. Coastal processes associated with waves revolve around the ocean level and include wave action, wave runup, beach profile changes, and shoreline retreat. These processes are affected by changes in the ocean level associated with tides, storm surge, El Niño effects, and SLR. The tide level changes every minute and goes through two cycles each day ranging from low to high tide. Storm surge is associated with the passage of storm systems typically occurring over the winter months. The El Niño southern oscillation is an ocean warming/cooling cycle that occurs at 5 to 6 year intervals. Warming of the ocean can increase the water level by over a foot due to thermal expansion of the ocean water. SLR constitutes a gradual rise of the ocean level over time due to global warming. Higher water levels bring the wave runup further up on the beach, typically up to the backshore area. In isolated wave events, the wave runup can reach the base of the cliffs. Shaped by these processes, the foreshore represents a highly dynamic environment, while designated public access areas are typically located in the backshore area with a bulkhead, seawall or other shore protection located at the dividing line between the foreshore and backshore. Cliff retreat is governed by weathering and stormwater runoff, but also sensitive to wave erosion at the base of the cliff, which can cause larger sections of the cliff face to shear off along joints in the cliff formation. The assessment methodology for these effects is described further in the following.

Parks assets, natural and cultural resources located in areas with potential exposure to coastal processes were evaluated per the following exposure categories:

- **Temporary Exposure.** Temporary impacts due to coastal storm flooding, wave runup and beach erosion.
- **Permanent Exposure.** Permanent tidal inundation from SLR, groundwater rise, shoreline retreat and cliff retreat.

The AECOM (2022) asset typology matrices adapted to Seacliff SB and New Brighton SB are provided in Appendix B.

The sensitivities of assets to temporary exposure are summarized in Appendix C, and the sensitivities to permanent exposure in Appendix D.

Figure 4-3 provides an overview of the asset exposure categories considered in the SLR-VA+AP.

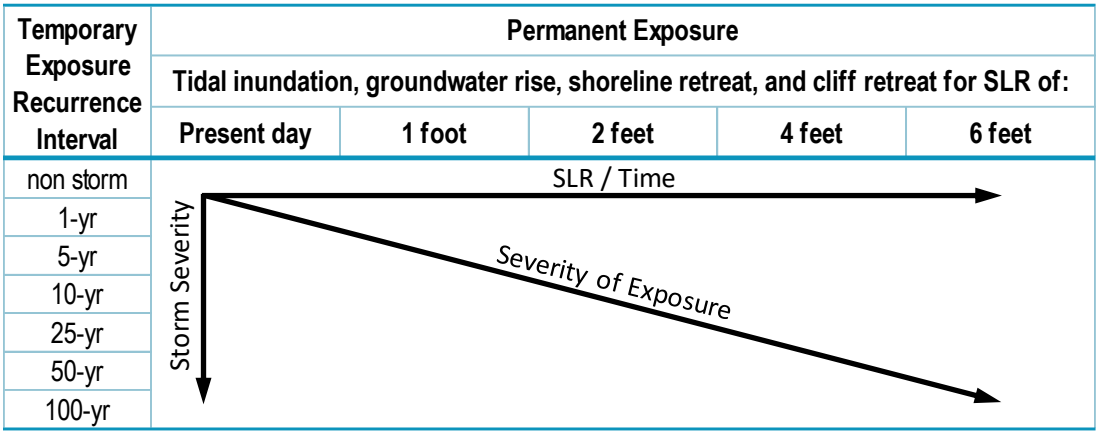

Figure 4-3: Asset exposure categories.

The left side of Figure 4-3 indicates the recurrence interval and increasing storm severity of temporary exposures ranging from non-storm to 100-year storm conditions. The top portion of the figure represents permanent exposure with SLR over time, from present day up to 6 feet of SLR. The arrow down across the figure illustrates the increasing severity of exposure resulting from increasing permanent and temporary exposure. Evaluation of coastal processes associated with these exposure categories were assessed as described in the following:

4.2.1. Permanent Exposure

Permanent exposure of assets as a result of SLR include: tidal inundation, shoreline retreat, and cliff retreat.

Figure 4-4 depicts tidal inundation of a beach as a result of SLR. At a typical beach slope, approximately 20 feet of beach is inundated for every foot rise of the water level.

The change in water level due to tidal variation will cause areas to become inundated on rising tides, which will reappear during low tide. It takes about 6 hours and 12.5 minutes for tides to go from high to low, or from low to high, and for this reason the impact is considered permanent.

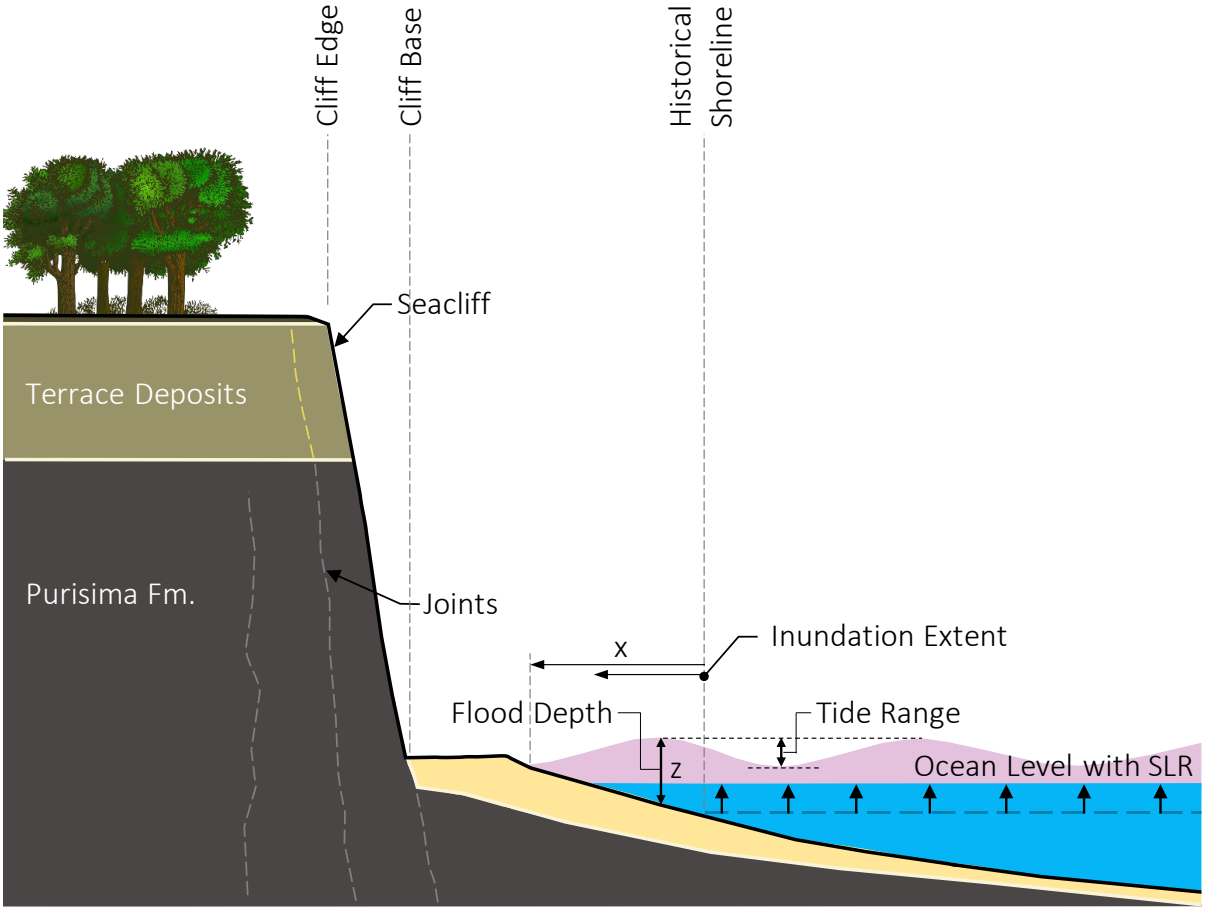

Figure 4-4: Inundation due to SLR and tides.

With SLR, a portion of the beach will become inundated due to the rise in water level (blue). The tidal variation (pink) also contributes a time-varying component termed tidal flooding. For any assets located in beach areas and subject to inundation, z characterizes the flood depth at the respective asset location(s).

Figure 4-5 depicts the process of shoreline retreat due to SLR, which will manifest as gradual narrowing of the beach. Assets located on the beach may consequently become exposed to erosion and undermining. The methodology adopted for the vulnerability analysis evaluated the physical location of assets in relation to the projected shoreline location with SLR to determine if assets were exposed to beach erosion. The winter beach profile was taken as the baseline for the historical (initial) shoreline location.

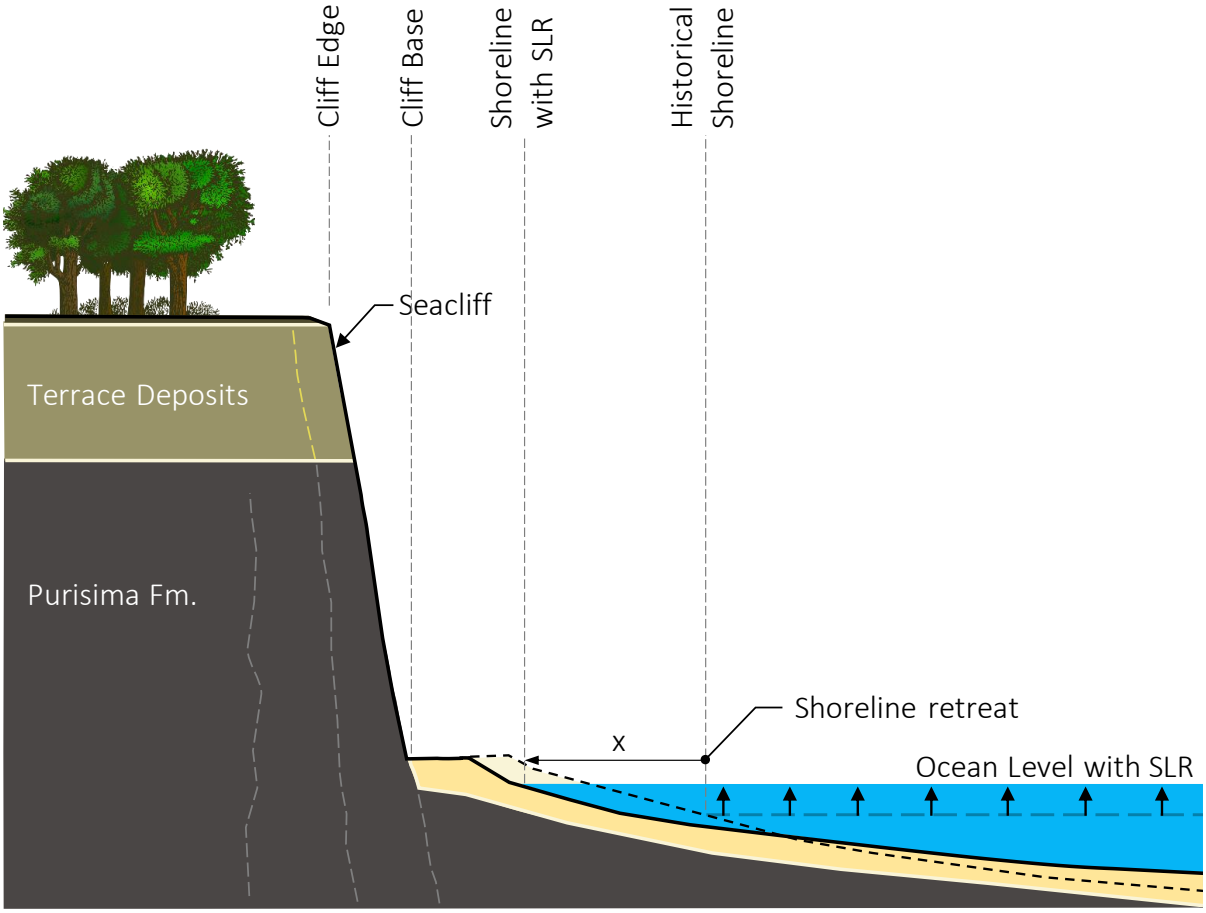

Figure 4-5: Shoreline retreat due to SLR.

This form of shoreline retreat is the result of an imbalance in the morphological processes at the shoreline caused by SLR. The phenomenon was documented by Per Bruun in 1962 and termed the Bruun Rule. Figure 4-6 depicts the relationship between SLR and shoreline retreat per Bruun (1962), JCR (1991). The rise in sea level produces an imbalance in the morphological processes of the beach profile. The active zone of the beach profile extends from the limit of wave runup to the closure depth, which is the water depth beyond which sediment movement is limited. SLR drives a process by which sand is eroded from the shoreline to build up the seabed by an amount equal to the rise in sea level.

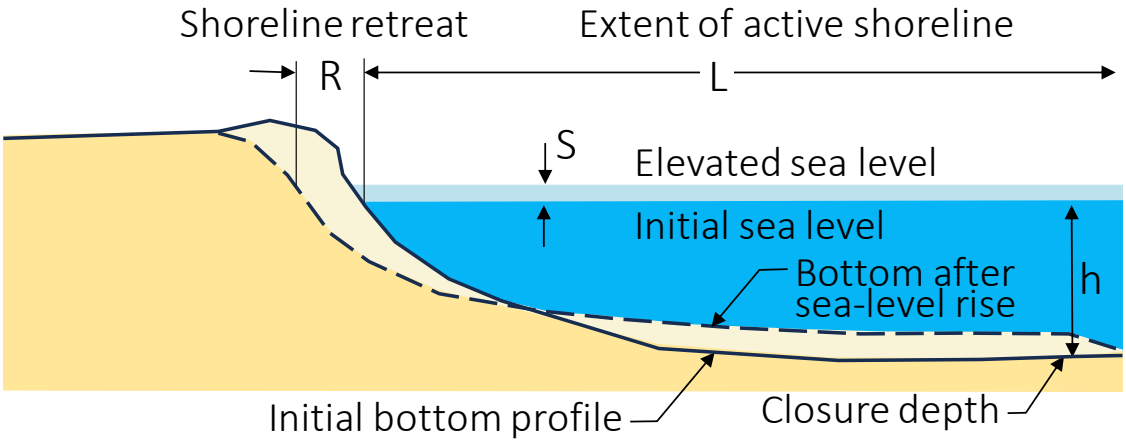

Figure 4-6: Shoreline retreat as a result of SLR.

The following equation describes the process:

$$R = \frac{S\,L}{h + B} = \frac{S}{\tan\beta}$$

Where R is the amount of shoreline retreat, S is the amount of SLR, L is the horizontal extent of the active shoreline (beach and seabed) where significant sediment transport occurs, h is the closure depth, B is the beach elevation above mean sea level, and β is the average slope of the active profile.

In this study, the extent of shoreline retreat associated with projected SLR was based on shoreline change data for Monterey Bay developed by USGS, depicted in Figure 4-7 based on OCOF (2023).

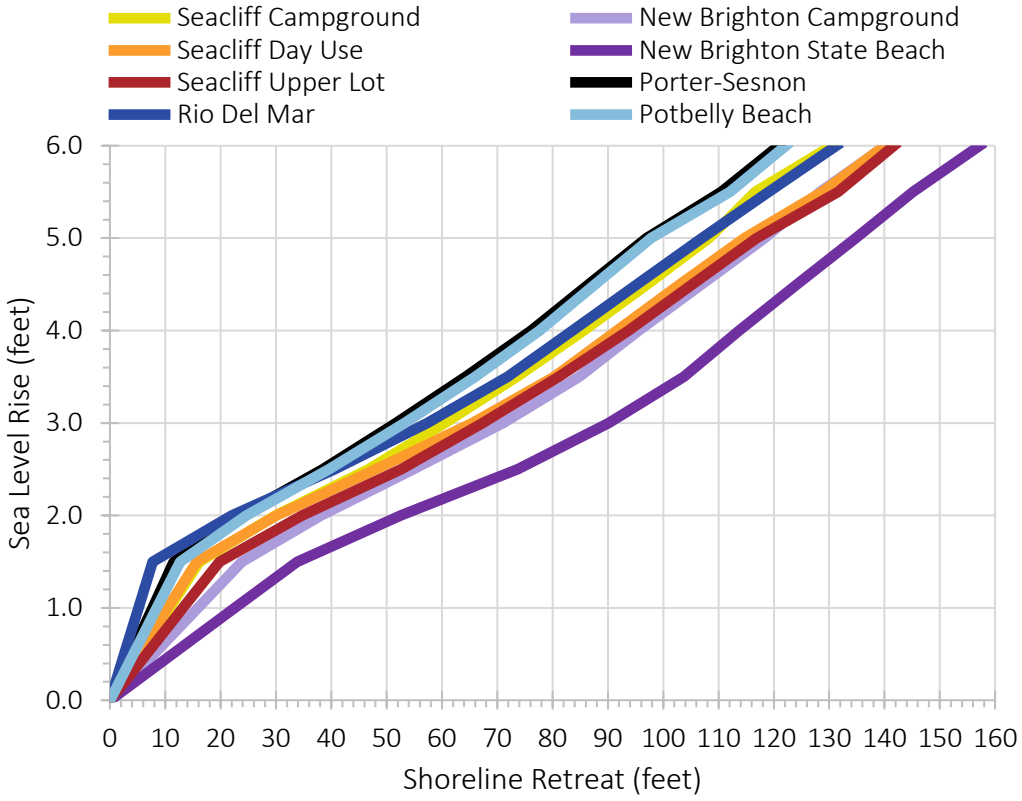

Figure 4-7: Shoreline retreat with SLR, OCOF (2023).

Figure 4-8 illustrates the process of cliff retreat, where the historical (existing) cliff edge retreats inland by the extent shaded in light gray. The extent of cliff retreat is characterized by the distance x indicated in the figure. Assets located within the zone of cliff retreat would be permanently impacted. Assets located at the base of the cliff could also be impacted by slide debris.

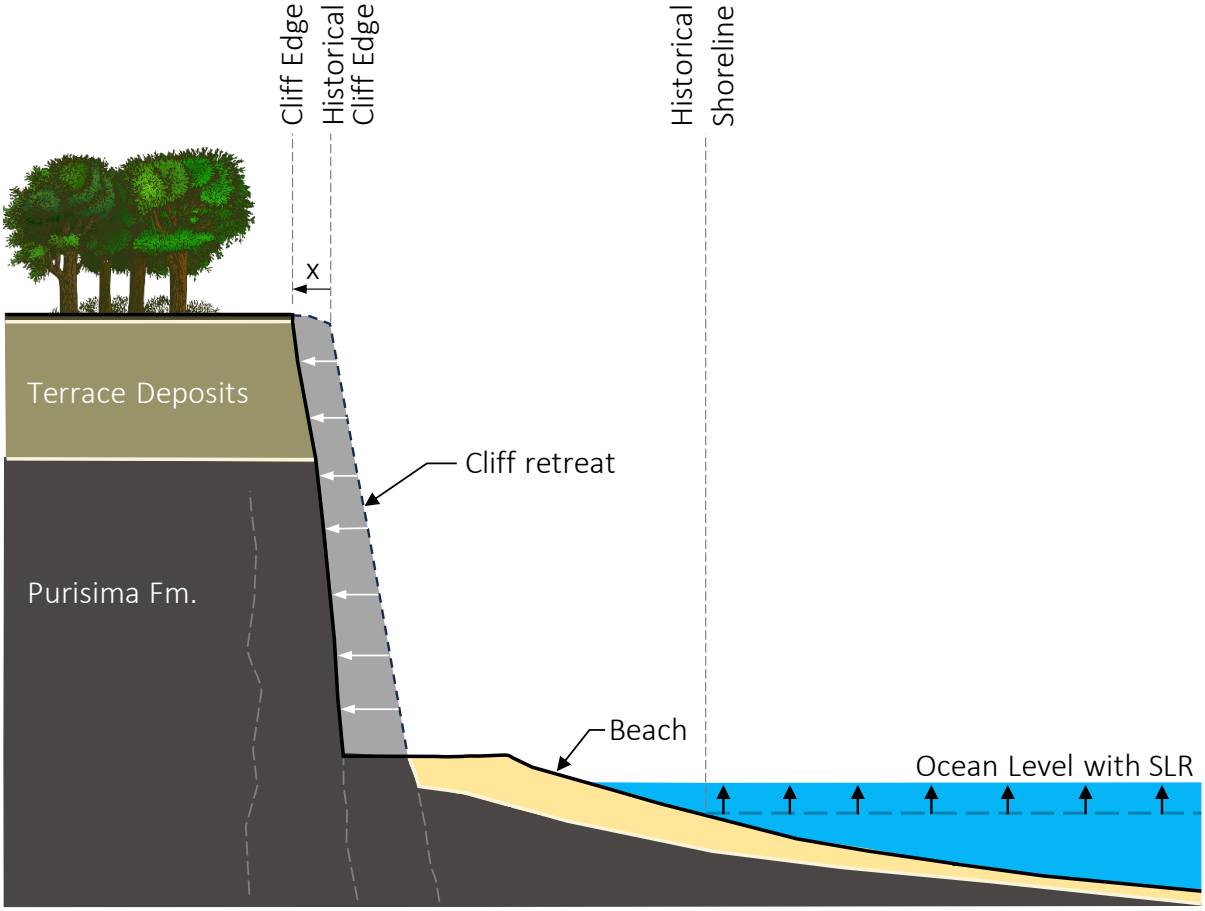

Figure 4-8: Cliff retreat.

Rates of cliff retreat adopted for this study were based on USGS data as summarized in Figure 4-9 based on data from OCOF (2023). These rates of cliff retreat are a function of SLR and assume that the base of the cliff is exposed to coastal hazards and part of the active shoreline processes.

In reality, the cliff retreat is limited by the presence of structures and coastal armoring at the base of the cliff. In the USGS CoSMoS model, this is treated as a toggle to either “hold the line” (prevent cliff retreat) or “not” (permit cliff retreat as a function of SLR). This study considered the intermediate condition where structures at the base of the cliff provide protection up their wall/structure crest elevation, and the portion of the cliff above that subject to retreat if exposed to SLR.

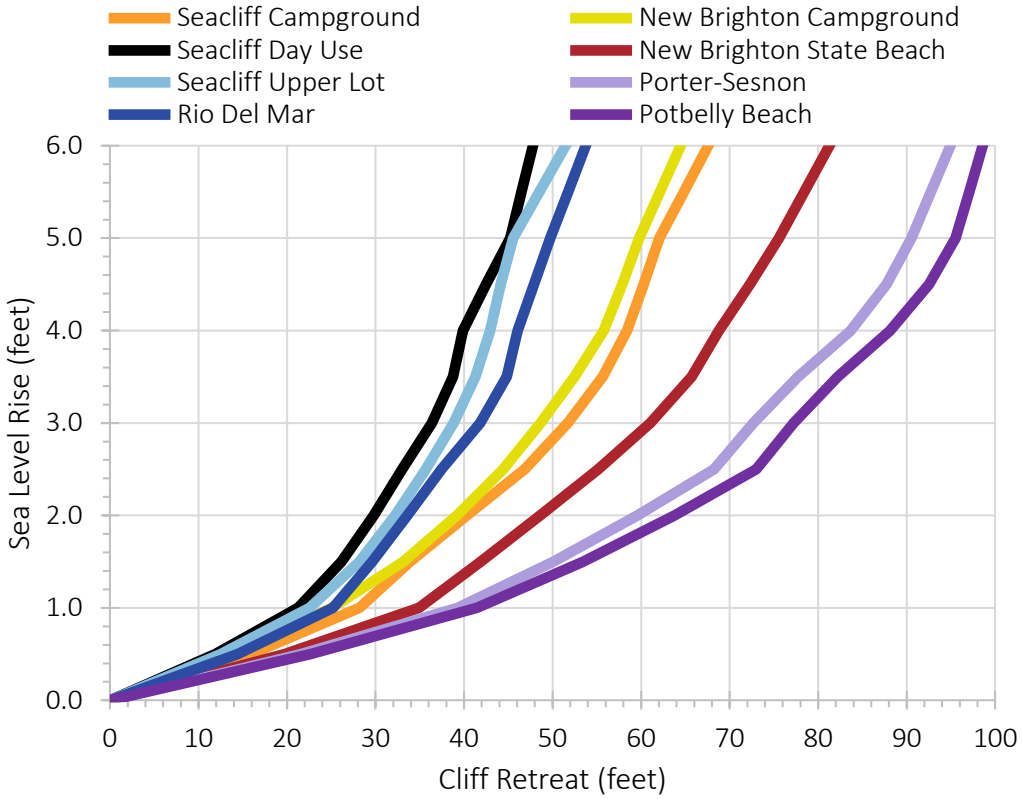

Figure 4-9: Cliff retreat with SLR, OCOF (2023).

The estimated groundwater (GW) level at Seacliff SB and New Brighton SB is shown in Figure 4-10, indicated by the dashed blue curve.

Groundwater levels in the Purisima Formation vary dependent on precipitation levels and infiltration. Based on well data, the general groundwater level at Seacliff SB and New Brighton SB is around El. +18 feet NAVD88, significantly above the mean sea level. Consequently, there is a downslope gradient that drives groundwater flow from the cliff formation to the ocean.

The groundwater elevation at the base of the cliff is generally at El. +12 feet NAVD88. In some areas along Las Olas Drive, the groundwater elevation is at the elevation of the roadway and groundwater seeps are at times visible.

In the vicinity of the shoreline, the groundwater level varies with the rise and fall of the tide. The groundwater elevation up on the beach is expected to be at approximately the Mean High Water level, on average around El. +4.8 feet NAVD88.

Based on the GW variation shown in Figure 4-10, GW rise driven by SLR is not anticipated to significantly impact below grade utilities and infrastructure more so than coastal hazards exacerbated by SLR such as wave runup, beach erosion, shoreline retreat and inundation due to SLR and tides.

However, SLR has the potential to impact groundwater by increasing the amount of saltwater infiltrating the groundwater aquifer and by pushing the freshwater lens further inland.

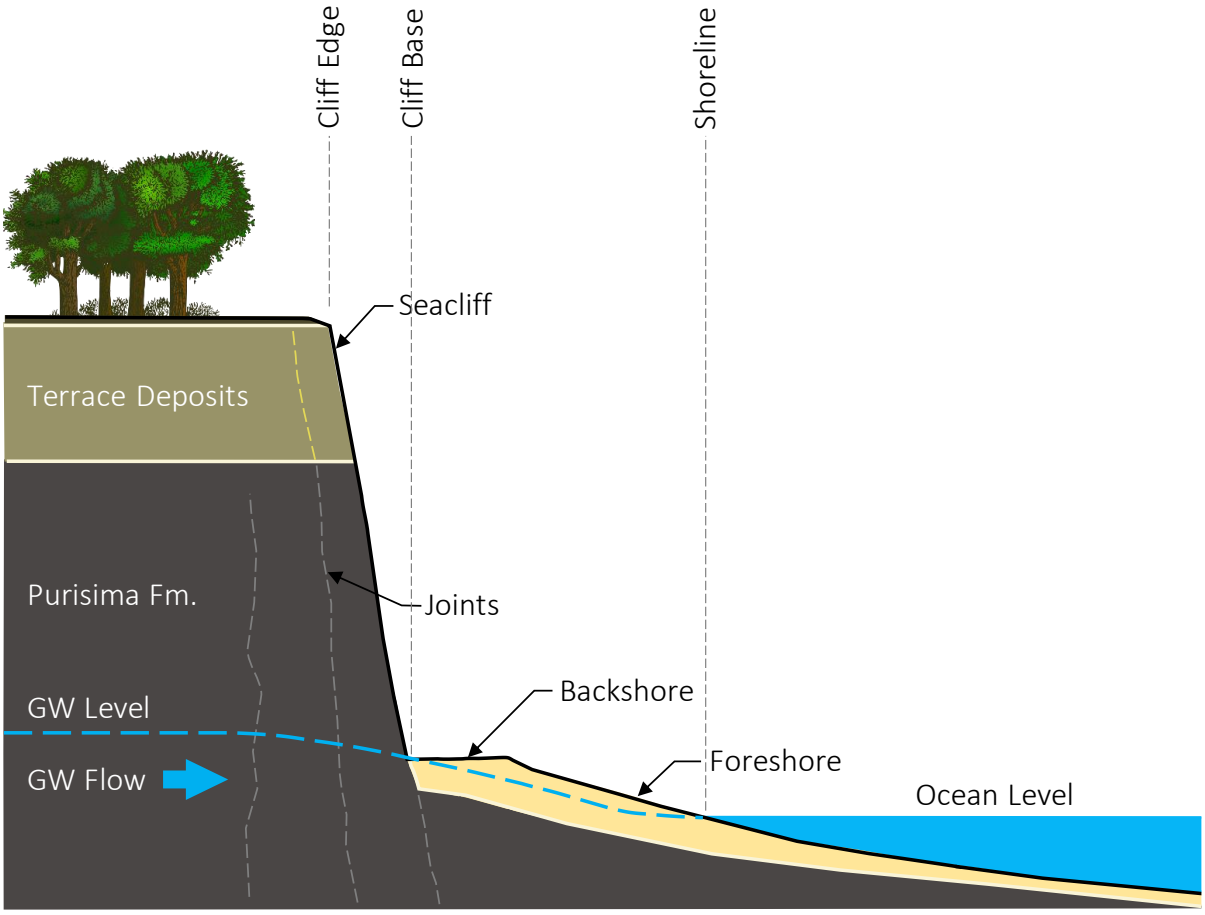

Figure 4-10: Estimated average groundwater level.

4.2.2. Temporary Exposure

Coastal flooding due to storm surge and wave action associated with the passage of storm systems constitutes temporary exposure of assets as these events are transitory. Figure 4-11 illustrates temporary exposure due to wave action and storm surge exacerbated by SLR.

The distance x in the figure indicates the extent of wave runup from the shoreline. Assets located within the zone of wave runup would be subject to flooding and wave impact.

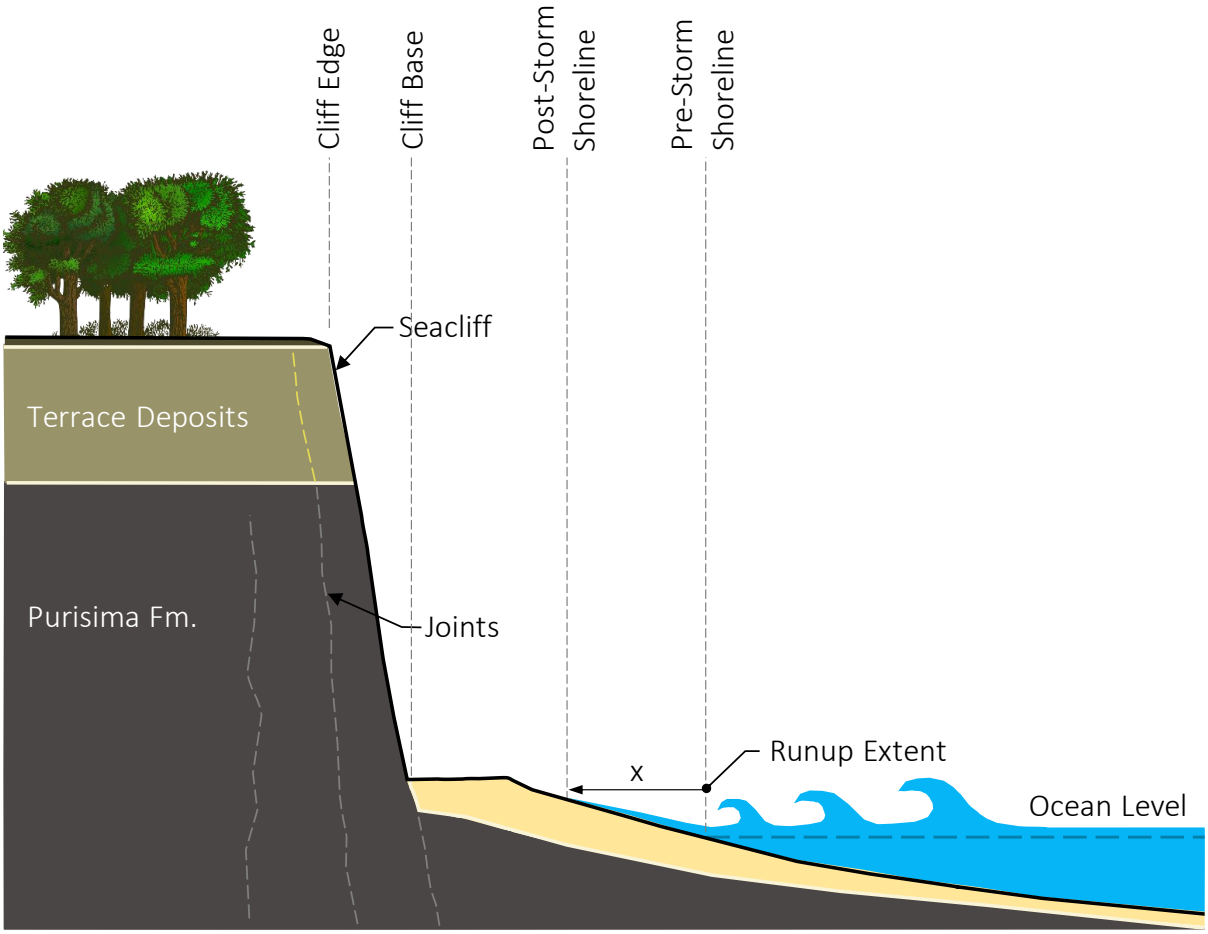

Figure 4-11: Temporary impacts associated with wave runup.

Flood depths and wave impacts were determined based on the methodology from the Coastal Engineering Manual depicted in Figure 4-12 from CEM (2011). The flood depth, H_w, at a structure located at a distance of X_1 from the waterline (SWL) is related to the breaking wave height, H_b, and wave runup R_a past the structure.

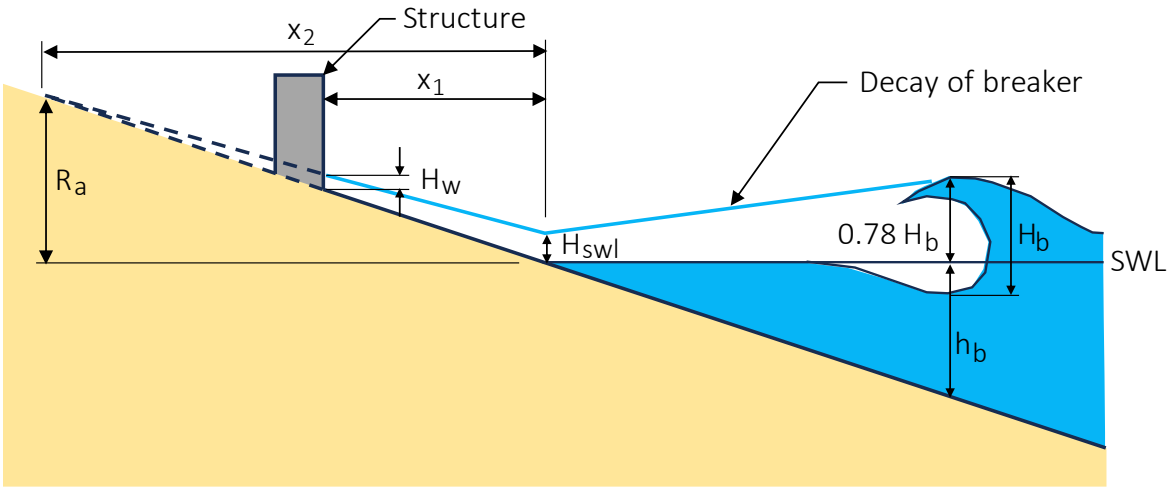

Figure 4-12: Exposure of structure to wave runup, CEM (2011).

The flood depth, H_w, can be described as:

$$H_w = 0.2H_b\left(1 - \frac{X_1 \tan\beta}{R_a}\right)$$

Where β is the slope of the beach measured in degrees from horizontal.

The wave impact force on the structure, F_w, can be approximated by:

$$F_w \approx 4.5\rho g H_w^2$$

Where ρ is the density of seawater and g is the gravitational acceleration.

The equation illustrates the damage associated with wave impact is proportional to the square of the flood depth.

Figure 4-13 illustrates the process of beach erosion typically associated with winter storm events. Storm waves are steeper and tend to pull sand off the beach into deeper water. The beach profile response to the storm wave exposure is essentially a flatter equilibrium profile. To build the flatter profile, sand is moved from the beach into deeper water. The result is lowering of the beach within the zone of wave runup and formation of a scarp. The height of the scarp, or scour depth, is indicated in the figure as z and is typically on the order of several feet, estimated to about 2 feet for 1-year storm events and up to 8 feet for a 100-year storm event.

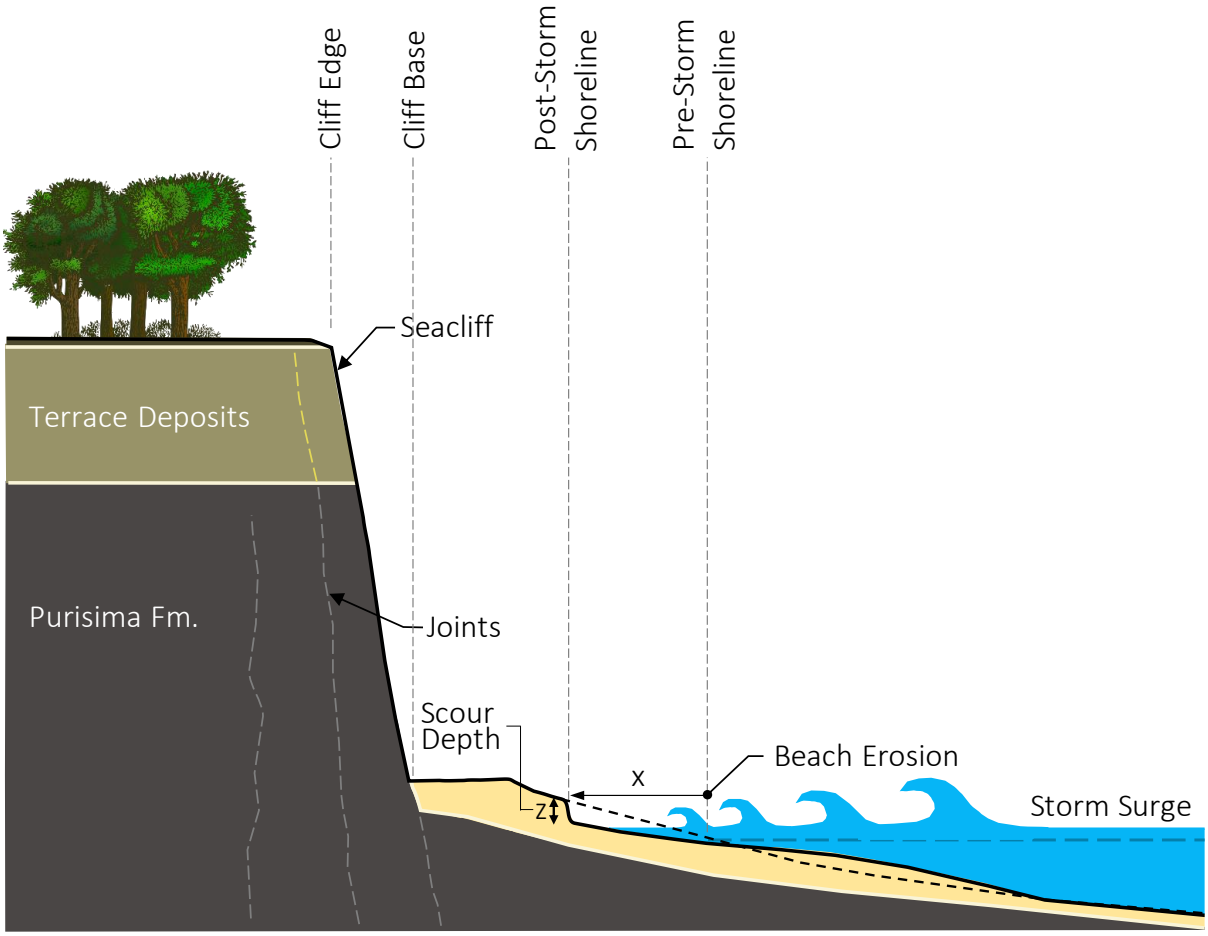

Figure 4-13: Beach erosion.

4.2.3. Asset Vulnerability

The vulnerability of individual assets was determined based on the following equation:

$$Vulnerability = \frac{Hazard \cdot Exposure \cdot Sensitivity}{Adaptive\ Capacity}$$

Where:

- Vulnerability is the extent to which an asset is susceptible to flooding and coastal processes stemming from sea level rise, in conjunction with its ability (or inability) to recover or adapt.
- Hazards embody SLR and coastal processes and include temporary and permanent inundation, wave action, shoreline retreat, beach erosion, cliff retreat, and groundwater rise.
- Exposure refers to the type, duration, and severity of coastal hazards an asset is subject to as a result of SLR.

- Sensitivity is the degree to which an asset is impaired by exposure to coastal hazards. The sensitivity of assets to permanent exposure is often higher than the sensitivity to temporary exposure, although short duration transitory coastal processes such as wave action, beach erosion and storm events can cause significant impacts. Refer to Appendix C for the sensitivity of assets to temporary exposure and Appendix D for sensitivity to permanent exposure. On a simple scale, asset sensitivity ratings can be categorized as follows, AECOM (2022):
    - Not sensitive. No impact to asset function.
    - Low sensitivity. Short-term, minor, or reversible damage to asset or function.
    - Moderate sensitivity. Substantial but reversible damage to asset or function.
    - High sensitivity. Irreversible damage to asset and permanent loss of function.
- Adaptive capacity is the ability of an asset to recover or adapt to changes in coastal hazards over time.

The above equation describes that the vulnerability of an asset to SLR related hazards can be reduced by reducing the hazard, sensitivity, and/or exposure of an asset, or increase its adaptive capacity.

An example of hazard reduction is incorporation of protective structures around assets, such as floodwalls and levees that physically reduce the hazard at the asset location. An example of reduction of sensitivity is floodproofing the base of a building making it more resilient to flood hazards. An example of hazard exposure reduction is to reduce flood depth by elevating assets. Increasing the adaptive capacity of an asset can be achieved by improving the mobility of the asset or its ability to be reinstated following impacts. An example of a natural asset with inherent adaptive capacity is a beach, which may experience erosion during storms and recover thereafter.

The above equation can be illustrated in a process diagram as depicted in Figure 4-14.

The blue box lists the permanent (P) and temporary (T) hazards. These are assigned a given probability. The occurrence of the permanent the hazard is either cyclical (tidal variation) and steady over time or increasing over time depending on projected SLR. The probability assigned to the permanent hazard is 100%, but time dependent or threshold dependent based on projected SLR.

The temporary hazards occur by random processes and are transient, reverting to an equilibrium state after the exposure event. For example, heightened wave exposure, storm surge and beach erosion are anticipated with the passage of winter storms, after which waves exposure falls back to a base level and eroded beach areas start to gradually recover, returning to the seasonal equilibrium beach width. As wave exposure is predominantly associated with winter storms, the base shoreline position is considered to be the winter beach profile. The level of wave exposure during a storm event is unknown and an outcome of a random process. Wave exposure and wave-driven beach erosion are therefore evaluated based on their probabilities of occurrence. As an example, winter storms occurring annually are assigned an annual probability of 100%. Storms with a recurrence interval of 5 years are assigned an annual probability of occurrence of 1/5 = 20% chance of occurrence. Storms having a 10-year recurrence interval have an annual probability of 1/10 = 10% chance of occurrence and so forth. A 100-year storm event could be highly damaging but has a limited chance of occurring of 1/100 = 1% each year.

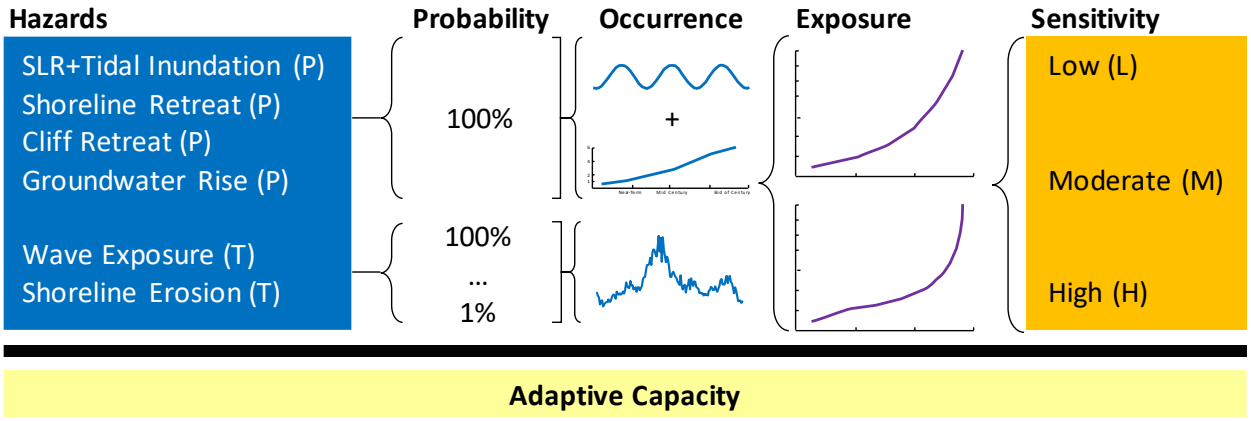

Figure 4-14: Asset vulnerability analysis.

Some of the incidental SLR and flood hazard related factors that can impact assets include:

- Depth of flooding.
- Susceptibility to increased depth and duration of flooding, for example damage to vegetation due to prolonged inundation.
- Wave impact.
- Asset foundation loss due to scour (temporary or permanent), beach erosion (temporary), shoreline retreat (permanent), or cliff retreat (permanent).
- Exposure of electrical systems to water, leading to operation malfunction or damage to the asset.
- Saltwater corrosion, damaging the surface or integrity of assets.
- Flood damage to building contents, components, or equipment stored within.

These factors are treated by the level of exposure of assets to temporary and permanent hazards, exemplified by the exposure curves shown in Figure 4-14. Curves of this type assign damage or impact to assets as a percentage (0-100%) dependent on the depth of flooding at the respective asset location. Hazard probabilities and flood depths were adopted from the flood maps included in Appendix E.

The sensitivity of assets in Figure 4-14 (orange box) were ranked low, moderate, or high based on the AECOM (2022) *Parks Sea Level Rise Adaptation Pathways Statewide Methodology Framework*. This framework is building on the Federal Highway Administration (FHWA) Vulnerability Assessment and Adaptation Framework, FHWA (2017), and the Federal Emergency Management Agency (FEMA) Multi-hazard Loss Estimation Methodology Flood Model, FEMA (2020).

Adaptive capacity is indicated in the denominator as it is inversely proportional to Vulnerability, i.e. a higher adaptive capacity reduces asset vulnerability, and a low adaptive capacity implies higher vulnerability.

4.3. Vulnerability of Assets and Resources by Subarea

The vulnerability assessment evaluated permanent impacts due to:

- **SLR and tidal inundation.** Assets are permanently inundated or exposed to prolonged or frequent periods of inundation.
- **Shoreline retreat.** Assets lose their foundation, accessibility is impacted.
- **Cliff retreat.** Assets lose their foundation, accessibility is impacted.

And temporary impacts associated with waves and storm surge:

- **Beach erosion.** Assets are exposed to scour, erosion and inundation associated with lowering of the beach profile during storms (beaches may recover thereafter).
- **Wave runup.** Assets are exposed to wave runup and associated flooding and wave impact.
- **Wave overtopping.** Assets are exposed to flooding associated with wave overtopping.

The vulnerabilities of impacted assets were ranked based on the categories listed in Table 4-1.

Table 4-1: Asset vulnerability categories.

	Vulnerability Category	Description
	Not impacted (blank)	No impact to asset function
L	Low (L)	Short-term, minor, or reversible damage to asset or function
M	Moderate (M)	Substantial but reversible damage to asset or function
H	High (H)	Irreversible damage to asset and permanent loss of function
S	Severe (S)	Catastrophic damage to asset and surroundings

Asset vulnerabilities for Seacliff SB and New Brighton SB subareas are summarized in the following.

4.3.1. Seacliff Campground

The Campground at Seacliff SB contains a wide range of infrastructure, assets, and above- and below-grade utilities. Vulnerabilities for facilities and resources are summarized in Table 4-2. The most immediate coastal hazard is wave overtopping which will be moderate to high with just one foot of SLR. Wave runup and beach erosion also have the potential to impact the coastal armoring in place. The beach has narrowed to a point where it is susceptible to beach erosion and wave runup present day. The Campground experienced widespread damage during the January 5, 2023 storm event, which is estimated to have an approximately 20-year recurrence interval. Impacts encountered included: 1) beach erosion and lowering of the beach face, 2) boards knocked out of timber bulkhead

with mostly just the upright posts remaining; 3) material behind timber bulkhead eroded and washed out; 4) RV parking areas undermined and collapsed; 5) doors at comfort stations knocked in; and 6) large quantities of sand deposited over the roadway. Wave runup during the storm event was observed to flow over the roadway and reach the base of the cliff.

Table 4-2: Vulnerability ratings for facilities and resources at Seacliff Campground.

Asset	Sea Level Rise (ft) 1’	2’	4’	6’	Hazard
Facilities/Infrastructure					
Comfort stations	M	H	S	S	Wave overtopping
A1 Pump Station	M	H	S	S	Wave overtopping
RV Electrical hookups (demolished)	H	S	S	S	Wave overtopping
Coastal armoring	H	S	S	S	Wave overtopping
Comfort stations		M	S	S	Beach erosion
Beach stormwater outlets	M	S	S	S	Beach erosion
Coastal Armoring	M	S	S	S	Beach erosion
Groundwater monitoring wells			M	S	Beach erosion
A1 Pump Station			M	S	Beach erosion
RV Electrical hookups (demolished)	L	M	S	S	Beach erosion
Stormwater conduits from clifftop to base of cliff	M	H	H	H	Cliff retreat
Access					
Las Olas Drive boom gate control point	M	H	S	S	Wave overtopping
Las Olas Drive	M	H	S	S	Wave overtopping
Campground Parking (demolished)	H	S	S	S	Wave overtopping
Beach access stairs	M	H	S	S	Wave overtopping
Las Olas Drive boom gate control point			M	S	Beach erosion
Las Olas Drive			M	S	Beach erosion
Campground Parking		L	S	S	Beach erosion
Beach access stairs	M	S	S	S	Beach erosion
Beachgate Trail	L	M	H	H	Cliff retreat
State Park Drive	L	M	M	M	Cliff retreat
Natural Resources (acres lost)					
Seacliff Campground Beach	4.7	5.3	8.5	11.1	Shoreline retreat
Tasmanian bluegum, red gum	0.2	0.2	0.2	0.3	Cliff retreat
Forest fragment	0.3	0.3	0.3	0.3	Cliff retreat
Monterey cypress	1.8	1.9	2.0	2.1	Cliff retreat
Non-native shrub	5.5	5.6	5.7	5.8	Cliff retreat

4.3.2. Seacliff Day Use

The Day Use area has a high concentration of infrastructure and assets. Vulnerability ratings for facilities and resources are summarized in Table 4-3. Near-term impacts are primarily in the form of wave overtopping and wave runup impacting shoreline armoring. Near-term impacts are mostly low

and gradually becoming moderate to severe mid- to long-term. Beach erosion is not estimated impact facilities in the near- to mid-term, although space on the beach will be lost gradually due to shoreline retreat associated with SLR.

Table 4-3: Vulnerability ratings for facilities and resources at Seacliff Day Use.

Asset	Sea Level Rise (ft) 1’	2’	4’	6’	Hazard
Facilities/Infrastructure					
Comfort Station by Visitor Center				M	Wave overtopping
The Beach Shack concession			M	H	Wave overtopping
Comfort Station by Picnic Area			M	H	Wave overtopping
Comfort Station by beach on State Park Dr.	L	M	S	S	Wave overtopping
Coastal armoring	L	M	S	S	Wave overtopping
Seacliff Visitor Center				L	Beach erosion
Comfort Station by Visitor Center				L	Beach erosion
The Beach Shack concession				H	Beach erosion
Comfort Station by Picnic Area				M	Beach erosion
Comfort Station by beach on State Park Dr.			M	S	Beach erosion
Coastal armoring		M	S	S	Beach erosion
Seacliff Pier (demolished)					N/A
Lifeguard tower on Seacliff Pier (demolished)					N/A
Covered picnic areas			M	S	Beach erosion
Drinking fountains			M	S	Beach erosion
Beach stormwater outlets			H	S	Beach erosion
Staff housing at 169, 171 Seacliff Dr.	S	S	S	S	Cliff retreat
Access					
Beach access stairs	M	H	S	S	Wave runup
Parking areas		L	S	S	Wave overtopping
Stairs to Upper Lot			S	S	Wave overtopping
Parking lot gate at Day Use entrance				L	Beach erosion
Parking areas				S	Beach erosion
Stairs to Upper Lot				L	Beach erosion
Beach access stairs			M	S	Beach erosion
Recreation					
Picnic trellis structures	L	M	S	S	Wave overtopping
BBQ grills	L	M	S	S	Wave overtopping
Park furnishings	L	M	S	S	Wave overtopping
Picnic areas and BBQ grills			S	S	Wave overtopping
Picnic areas and BBQ grills				L	Beach erosion
Picnic trellis structures			M	S	Beach erosion
BBQ grills			M	S	Beach erosion
Park furnishings			M	S	Beach erosion
Cultural Resources					

Asset	Sea Level Rise (ft) 1’	2’	4’	6’	Hazard
Building #1	S	S	S	S	Cliff retreat
Maintenance building			M	S	Cliff retreat
Natural Resources (acres lost)					
Day Use Beach	3.8	4.2	7.3	10.2	Shoreline retreat
Coyote brush	1.4	1.4	1.4	1.5	Cliff retreat
Grassland	0.3	0.3	0.3	0.3	Cliff retreat
Iceplant	0.8	0.8	0.8	0.8	Cliff retreat
Non-native forest	0.6	0.7	0.7	0.8	Cliff retreat
Non-native shrub	1.1	1.2	1.2	1.2	Cliff retreat

4.3.3. Seacliff Upper Lot

The Upper Lot has a high level of resiliency to SLR and cliff retreat. Only about 5% of the land is located along the cliff edge and potentially vulnerable to cliff retreat. The retaining wall at the base of the cliff helps hold back slide debris from localized cliff failures, but also prevents wave-erosion at the base of the cliff.

Vulnerability ratings for Parks facilities and natural resources at the Upper Lot are summarized in Table 4-4. Potentially vulnerable assets are located either in proximity to the cliff edge or on the cliff face such as the Upper Lot stairs and trail.

Table 4-4: Vulnerability ratings for facilities and resources at Seacliff Upper Lot.

Asset	Sea Level Rise (ft) 1’	2’	4’	6’	Hazard
Facilities/Infrastructure					
Entrance kiosk				M	Cliff retreat
Drinking fountain				M	Cliff retreat
Access					
State Park Drive	L	S	S	S	Cliff retreat
Upper Lot stairs and trail	M	M	M	M	Cliff retreat
Upper Lot			L	M	Cliff retreat
Recreational Assets					
Park furnishings		M	M	M	Cliff retreat
Natural Resources (acres lost)					
Coyote brush	0.1	0.1	0.2	0.3	Cliff retreat
Grassland				0.1	Cliff retreat
Non-native forest			0.1	0.1	Cliff retreat

4.3.4. Rio Del Mar

Rio Del Mar is characterized by having a wider beach extent, which works as a buffer against wave runup and temporary shoreline erosion. Vulnerability ratings for Parks facilities and natural resources are summarized in Table 4-5. The primary near-term hazards include wave runup and wave overtopping. Mid- to long-term the primary hazard will transition to beach erosion associated with storm event, which can undermine and erode the foundation under structures. A main feature of Rio Del Mar is Beach Dr. at the base of the cliff, which provides access to private residences and the Parks lot at Rio Del Mar Platforms.

Table 4-5: Vulnerability ratings for facilities and resources at Rio Del Mar.

Asset	Sea Level Rise (ft) 1’	2’	4’	6’	Hazard
Facilities/Infrastructure					
Comfort station, Aptos Creek	M	H	H	S	Wave runup
Comfort Station, Rio Del Mar Platforms	L	M	S	S	Wave overtopping
Coastal armoring	L	M	S	S	Wave overtopping
Signage by Aptos Creek Comfort Station				L	Beach erosion
Comfort Station, Rio Del Mar Platforms				H	Beach erosion
Coastal armoring			M	S	Beach erosion
Sewer line along Beach Dr.			L	H	Beach erosion
Electrical panel				L	Beach erosion
Stormwater beach outlets				H	Beach erosion
Stormwater outlet by 439 Beach Dr.	M	H	H	H	Cliff retreat
Access					
Beach Drive	M	H	S	S	Wave overtopping
Parking Lot, Rio Del Mar Platforms	M	H	S	S	Wave overtopping
Beach access stairs, Rio Del Mar Platforms	M	H	S	S	Wave runup
Beach access ADA Ramp, Rio Del Mar Platforms	M	H	S	S	Wave runup
Beach Drive				H	Beach erosion
Aptos Creek Bridge				L	Beach erosion
Parking Lot, Rio Del Mar Platforms				M	Beach erosion
Beach access stairs, Rio Del Mar Platforms				H	Beach erosion
Beach access ADA Ramp, Rio Del Mar Platforms				H	Beach erosion
Recreation					
Volleyball courts			L	L	Beach erosion
Natural Resources (acres lost)					
Rio Del Mar Beach	2.9	4.4	9.8	15.1	Shoreline retreat
Tasmanian bluegum, red gum	0.9	0.9	1.0	1.0	Cliff retreat
Monterey cypress	0.2	0.2	0.2	0.2	Cliff retreat
Ice plant	0.6	0.6	0.6	0.6	Cliff retreat
Coastal scrub	0.4	0.4	0.5	0.5	Cliff retreat

4.3.5. New Brighton Campground

The majority of New Brighton Campground (90%) is located inland and not at risk of SLR related hazards, refer to Table 3-12. The remaining 10% of the campground is located in proximity to the bluff edge and potentially vulnerable to bluff retreat. Vulnerability ratings for facilities and resources are summarized in Table 4-6. The results show that the facilities at most immediate risk include assets located close to the bluff edge and assets located on the face of the bluff such as the Sunset Trail and Beach Trail. Some of the premium campground sites could be impacted mid-term. Potential impacts to natural resources would encompass a range of non-native and native plant species, but none of these threatened or endangered.

Table 4-6: Vulnerability ratings for facilities and resources at New Brighton Campground.

Asset	Sea Level Rise (ft) 1’	2’	4’	6’	Hazard
Facilities/Infrastructure					
Interpretive exhibit by Sunset Trail	M	S	S	S	Cliff retreat
Drinking fountain Day-Use Lot south	M	S	S	S	Cliff retreat
Bike racks at Day-Use Lot		M	S	S	Cliff retreat
Drinking fountain by Special Event Ramada			M	S	Cliff retreat
Access					
Day-Use Beach Lot	M	M	M	M	Cliff retreat
Sunset Trail	M	S	S	S	Cliff retreat
Beach Trail	M	S	S	S	Cliff retreat
Recreation					
Premium Campground Sites 73, 75, 76, 78		H	S	S	Cliff retreat
Special Event Ramada			M	S	Cliff retreat
Park furnishings			M	S	Cliff retreat
Campfire center			H	S	Cliff retreat
BBQs			H	S	Cliff retreat
Natural Resources (acres lost)					
Tasmanian bluegum, red gum	0.6	0.7	0.7	0.8	Cliff retreat
Grassland	0.1	0.2	0.4	0.5	Cliff retreat
Monterey cypress	1.2	1.4	1.5	1.6	Cliff retreat
Non-native herbaceous	0.1	0.1	0.1	0.1	Cliff retreat
Non-native shrub	2.1	2.1	2.1	2.1	Cliff retreat
Monterey Pine	1.4	1.6	1.9	2.1	Cliff retreat
Arroyo willow	0.4	0.4	0.4	0.4	Cliff retreat

4.3.6. New Brighton Beach

Vulnerability ratings for Parks facilities and natural resources at New Brighton Beach are summarized in Table 4-7.

This area contains numerous Parks facilities, infrastructure, and amenities for public access and recreation. Beach width in this area is at times limited, in particular along the Beach Trail and below the Day-Use Lot. The shoreline to the west of the lot is rocky but at times accessible via patches of sandy foreshore emerging at low tide. Factors significantly impacting beach width at this location include wave runup, high tides, beach cusps[3], and wintertime conditions when the beach profile is narrow. Tide levels and wave runup will frequently reach the base of the rock revetment protecting the Beach Trail. Along the section of the beach to the east where the base of the bluff is unprotected, winter wave runup will typically extend up to the base of the bluff where considerable amounts of debris are deposited along the upper wrackline. Without protection, the bluff is potentially vulnerable to coastal hazards. The primary hazard in the near-term is beach erosion, transitioning to shoreline retreat in the mid- to long-term. The Beach Trail is potentially vulnerable to wave overtopping during major storm events present-day and lesser storm events with SLR. Although the rock revetment along the Beach Trail provides erosion protection for the trail, the typical response of an active shoreline fronting hard armoring is lowering of the beach face which enables larger waves to impact the protective structure to the point of failure when the design conditions are exceeded.

Table 4-7: Vulnerability ratings for facilities and resources at New Brighton Beach.

Asset	Sea Level Rise (ft) 1’	2’	4’	6’	Hazard
Facilities/Infrastructure					
Comfort Station	L	L	H	S	Wave overtopping
Coastal armoring	L	L	M	S	Wave runup
Comfort Station	L	H	S	S	Beach erosion
Showers	L	L	M	H	Beach erosion
Coastal armoring	L	M	S	S	Beach erosion
Sewer lines	L	H	S	S	Beach erosion
Stormwater outlet by Day-Use Lot	L	M	H	S	Beach erosion
Pumpout	M	M	M	M	Cliff retreat
Access					
Beach Trail		L	M	H	Wave overtopping
Beach Trail	M	S	S	S	Beach erosion
Beach access ramp by Day-Use Lot	M	S	S	S	Shoreline retreat
Beach access ramp by Comfort Station	M	S	S	S	Shoreline retreat
Natural Resources (acres lost)					
New Brighton Beach	4.0	5.1	5.8	5.8	Shoreline retreat
Tasmanian bluegum, red gum	0.1	0.1	0.1	0.1	Shoreline retreat
Monterey cypress			0.1	0.1	Shoreline retreat
Non-native shrub		0.1	0.2	0.2	Shoreline retreat
Arroyo willow	0.1	0.1	0.1	0.1	Shoreline retreat

[3] Beach cusps are regularly spaced embayments along the lower foreshore forming between protrusions referred to as horns. As the cusps form, they are subject to a filtering process, which deposits finer sediment within the embayments and coarser material along the horns. The typical spacing of the cusps is 150 feet and embayment depth is 40 feet.

4.3.7. Porter-Sesnon

The majority of the Porter-Sesnon property (95%) is located inland and not vulnerable to SLR related hazards, refer to Table 3-16.

Vulnerability ratings for Parks facilities and natural resources at Porter-Sesnon are summarized in Table 4-8. The primary vulnerability is to assets at risk of cliff retreat located in proximity to the cliff edge, which includes stormwater outlets and the trail from the clifftop down to Potbelly Beach. The estimated loss of natural resources potentially vulnerable to cliff retreat include 0.7 to 1.1 acres of Monterey pine (non-native) and 0.4 to 0.6 acres of Coast live oak (native). Remaining natural resources potentially vulnerable to cliff retreat are for the most part non-native species.

Table 4-8: Vulnerability ratings for facilities and resources at Porter-Sesnon.

Asset	Sea Level Rise (ft)				Hazard
	1’	2’	4’	6’	
Facilities/Infrastructure					
Stormwater outlet across from 120 New Brighton Rd.	M	H	H	H	Cliff retreat
Stormwater outlet, Old Woman Creek	M	M	M	M	Cliff retreat
Stormwater outlet, Borregas Creek	M	M	M	M	Cliff retreat
Access					
Stairway on Potbelly Beach Trail	M	H	H	H	Cliff retreat
Potbelly Beach Trail	M	H	H	H	Cliff retreat
Natural Resources (acres lost)					
Tasmanian bluegum, red gum	0.5	0.6	0.6	0.7	Cliff retreat
Grassland	0.2	0.3	0.3	0.3	Cliff retreat
Non-native shrub	0.8	0.8	0.8	0.8	Cliff retreat
Monterey pine	0.7	0.9	1.0	1.1	Cliff retreat
Coast live oak	0.4	0.5	0.6	0.6	Cliff retreat

A key element of the Porter-Sesnon property is trail access between the clifftop area and Potbelly Beach. Cliff retreat, having the ability to significantly impact this public access element, may manifest at relatively low levels of SLR. The highest rates of cliff retreat projected for Seacliff SB and New Brighton SB are for the Porter-Sesnon property and Potbelly Beach as the base of the bluff is unprotected at this location. Figure 4-9 projects 40 feet of bluff retreat for each foot of SLR near-term, and mid-term approximately 20 feet of bluff retreat for each foot of SLR thereafter. Rates of cliff retreat along the area of the Porter-Sesnon property located above Las Olas Dr. are expected to be limited in the near to mid-term due to the shoreline armoring protecting the beachfront residences along Las Olas Dr.

4.3.8. Potbelly Beach

Vulnerability ratings for Parks facilities and natural resources at Potbelly Beach are summarized in Table 4-9. Potbelly Beach is characterized by having very few assets on the beach and no shoreline armoring. This makes the beach more resilient and better at accommodating wave runup. However, without protection, assets located on the back beach and bluff face are potentially vulnerable when

exposed to coastal hazards. The primary hazard in the near-term is wave runup and the potential for scour at the base of structures and at the base of the bluff. Over the mid-term the exposure to wave runup will persist and beach erosion will become a significant hazard. In the long-term, the frequency and magnitude of wave exposure and beach erosion will continue to increase and permanent loss of beach due to SLR and shoreline retreat will become a key factor. Narrowing of the beach as the shoreline recedes will exacerbate wave runup and beach erosion.

Table 4-9: Vulnerability ratings for facilities and resources at Potbelly Beach.

Asset	Sea Level Rise (ft)				Hazard
	1’	2’	4’	6’	
Facilities/Infrastructure					
Stormwater outlet near 32 Potbelly Beach Rd.			M	H	Beach erosion
Stormwater outlet by 797 Las Olas Dr.			L	M	Shoreline retreat
Access					
Potbelly Beach Trail	L	L	M	M	Wave runup
Potbelly Beach Trail		L	H	H	Beach erosion
Natural Resources (acres lost)					
Potbelly Beach	0.7	1.1	1.8	2.4	Shoreline retreat
Tasmanian bluegum, red gum			0.1	0.3	Shoreline retreat
Non-native shrub				0.1	Shoreline retreat

5. Summary

This SLR-VA report provides an assessment of coastal hazards and vulnerability of State Park assets to these hazards in the light of projected SLR. The SLR-VA will serve as the basis for the development of short- and long-term shoreline adaptation alternatives.

Work conducted in this phase of the report preparation included:

- Site investigation and inventory of Parks assets in collaboration with Parks staff.
- Public outreach and engagement, including development of outreach and engagement materials and online and in-person activities.
- Preparation of the present coastal hazards vulnerability assessment for Seacliff SB and New Brighton SB to assess increasing vulnerability due to projected SLR.

Table 5-1 summarizes the overall findings of the SLR-VA, organized by Seacliff SB and New Brighton SB subareas. The VA assigns vulnerability ratings ranging from Low (yellow) to Severe (dark red) as a function of SLR ranging from 1 to 6 feet. In terms of timeline, 1 foot of SLR was taken as representative of the projected potential near-term conditions by 2050; 2 feet was adopted to support mid-term planning by around 2070, and 4 feet of SLR was considered for long-term planning looking towards the end of the century. An additional scenario of 6 feet of SLR was as a worst-case scenario based on the higher-end of projected SLR.

The right side of Table 5-1 provides a breakdown of the range of coastal processes contributing to exposure of the respective subareas. These coastal processes include: wave runup (WR), wave overtopping (OT), beach erosion (BE), shoreline retreat (SR), and cliff retreat (CR). Wave runup, wave overtopping, and beach erosion denote temporary exposure conditions, while shoreline and cliff retreat represent permanent impacts. SLR and tides were also considered as permanent exposures as these will exacerbate flood hazards and coastal processes over time.

At the Seacliff SB Campground and Day Use Area, the primary coastal processes that drive vulnerability are wave overtopping and beach erosion. Along Rio Del Mar, the governing driver is beach erosion and secondarily wave overtopping. With SLR, these areas will increasingly become affected by shoreline retreat and wave runup. Across these areas, the potential for cliff retreat is projected to have a moderate influence on the vulnerability of Parks assets.

At New Brighton Beach, the coastal processes that primarily drive vulnerability include beach erosion and shoreline retreat. Vulnerability at Potbelly Beach is mainly influenced by shoreline retreat (permanent impact) and secondarily beach erosion (temporary impact). With SLR and projected loss of beach, wave runup will become more of an influencing factor. Vulnerability of the clifftop areas at the Campground and Porter-Sesnon is primarily associated with potential cliff retreat.

Table 5-1: Summary of SLR-VA vulnerability ratings by subarea.

Asset	Sea Level Rise (ft) 1’	2’	4’	6’	WR	OT	BE	SR	CR
Seacliff SB									
Campground	H	S	S	S		◉	◉	○	●
Day Use Area	M	H	S	S	○	◉	◉	○	●
Upper Lot	L	M	S	S					●
Rio Del Mar	M	H	S	S	○	●	◉	○	●
New Brighton SB									
Campground	M	S	S	S					●
New Brighton Beach	M	H	S	S	○	●	◉	◉	○
Porter-Senon	M	H	H	H					●
Potbelly Beach	L	L	M	H	○		●	◉	

Vulnerability Rating:

L	Low
M	Moderate
H	High
S	Severe

Legend:

WR	Wave Runup
OT	Wave Overtopping
BE	Beach Erosion
SR	Shoreline Retreat
CR	Cliff Retreat

Influence of Coastal Processes:

○	Less influence
●	Moderate influence
●	High influence
◉	Very high influence

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Appendix A:

Coastal Processes

Enclosed: Coastal Processes Report, which provides a site characterization of Seacliff and New Brighton State Beaches, and an assessment of coastal processes and geomorphology relevant to the State Beach areas. This information formed the basis for the sea level rise vulnerability assessment.

Appendix B:

Asset Typology

Enclosed: Asset typology framework from AECOM (2022) San Diego Coast District Sea Level Rise Adaptation Pathways Report and Statewide Toolkit. This framework was adopted for categorization of State Park Assets.

Table B-1: Asset Typology Matrix.

Asset Category, Asset Subcategory	Asset Types
Facilities/Infrastructure	
Buildings	Kiosks, Restrooms Comfort Stations, Concessions, Staff Housing, Administration, Maintenance, Visitor Centers, Campfire Centers/Amphitheaters, Museums
Utilities	Sewer Lines, Potable Water Lines, Electric, Gas, RV Dumps, Stormwater
Park Assets	Flagpoles, Signage, Drinking Fountains, Bike Racks, Showers, Pay Stations, Interpretive Exhibits/Panels, Lifeguard Towers
Coastal Armoring	Seawall, Bulkheads, Revetments
Access	
Roads	State Parks Roads, Highways, Major Roads, Secondary Roads
Parking	Parking Lots, Parking Lot Gates
Trails	State Park Trails, California Coastal Trail, Non-System Routes, Bike Routes, Coastal Access
Structures	Bridges, Stairways, ADA Access
Recreation	
Recreational Amenities	Campgrounds, Fire Rings
Recreational Assets	Shelters/Ramadas, Park Furnishings, BBQs
Cultural Resources	
Historic-age Sites with Artifacts and Nonpermanent Features	Privy Pits/Trash Scatters/Dumps (AH4)
Indigenous Archeological Resources	Shell middens
Buildings, Structures, & Objects	Historic Buildings
Natural Resources	
Land Cover	Aquatic Bed, Beach, Cliff, Developed/Disturbed, Forest/Woodland, Freshwater Marsh, Grass/Herb, Nonnative Vegetation, Open Water, Riparian Scrub, Rocky Intertidal, Coastal Scrub, Swash Beach, Upper Beach
Vegetation	Vegetation Alliances, Vegetation Associations

Table B-2: Shoreline Typology Matrix for Coastal State Park Units.

		Foreshore	
		Sandy Beach	**Rocky Beach**
Backshore	Armor (Revetment or Riprap or Seawall)	X	--
	Road, Parking Lot, or Other Infrastructure	X	--
	Soft Natural Bluff	X	--
	Hard Natural Cliff	X	X

Table B-3: Sensitivity Rating Descriptions for Assets and Land Cover

Sensitivity Rating	Description
Not Sensitive	No impact to asset function
Low	Short-term, minor, or reversible damage to asset or function
Moderate	Substantial but reversible damage to asset or function
High	Irreversible damage to asset and permanent loss of function

Table B-4: Shoreline Sensitivity Ratings.

Shoreline Type	Sensitivity to Shoreline Change	Rationale
Sandy Beach Backed by Armor (Revetment or Riprap or Seawall)	High	Hard backshore features do not allow the beach to migrate landward, resulting in permanent loss of beach.
Sandy Beach Backed by Road, Parking Lot, or Other Infrastructure	High	Hard backshore features do not allow the beach to migrate landward, resulting in permanent loss of beach.
Sandy Beach Backed by Soft Natural Bluff	Moderate	Soft backshore bluffs may erode and contribute to accretion of the sandy beach (depending on bluff composition), although the beach may erode at a higher rate than the backing bluff, resulting in some reduction in beach width.
Sandy Beach Backed by Hard Natural Cliff	High	Hard backshore features do not allow the beach to migrate landward, resulting in permanent loss of beach.
Rocky or no beach Backed by Hard Natural Cliff	Low	With no existing beach, a rocky cliff's vulnerability is only based on the erosion potential of the cliff.

Table B-5: Adaptive Capacity Ratings.

Rating	Rationale
Low	The assets cannot be protected (e.g., they are located within an exposed area and would be difficult to move; there is no level of protection that can fully prevent damage; they are made of sensitive materials and cannot be upgraded; there are no backups available).
Moderate	The asset can be protected with some effort (e.g., there are potential protective measures, but they are not yet in place; the asset needs to be retrofitted or upgraded to withstand impacts; backups need to be acquired from other jurisdictions during an event).
High	The asset can easily be protected from impacts (e.g., there are already protective measures in place that adequately prevent impacts; assets can be moved during an event; there are backups available).

Appendix C:

Sensitivity to Temporary Exposure

Enclosed: Tables of sensitivity ratings adopted from AECOM (2022) San Diego Coast District Sea Level Rise Adaptation Pathways Report and Statewide Toolkit. These sensitivity ratings were adopted as a basis for assessment of the vulnerability of State Park assets in terms of their sensitivity to temporary exposure to coastal processes, including coastal storm flooding, wave runup and beach erosion.

Table C-1: Sensitivity Ratings to Temporary Exposure by Physical Asset Type.

Asset Type	Sensitivity to Temporary Exposure	Rationale
Facilities/Infrastructure		
Piers	Moderate	Structure is elevated but may be structurally sensitive to changes in water levels, particularly during storm events when large waves may reach higher elevations of the pier. Access to piers will also be limited during and after temporary high storm events until deemed safe for the public.
Contact Station /Kiosk, Concessions, Staff Housing, Administration, Maintenance, Visitor's Center, Campfire Centers/Amphitheaters, Education Centers/Classrooms, Museums	High	Buildings may experience structural damage if exposed to temporary flooding or erosion. The extent and degree of damage is dependent on flood depths, duration, conformity of structure with modern building codes, and degree of floodproofing and site drainage. Buildings also often have electrical components that could experience damage and require replacement with even temporary flood exposure. Flooding will also temporarily limit building access.
Comfort Station/ Restroom	Moderate	Comfort stations/restrooms are typically simple cinder block structures with limited housed electrical, mechanical, or sensitive building materials (e.g., drywall) that could be damaged. However, flooding will temporarily limit building access.
Water Main	Low	Water pipe structures do not exhibit electrical or mechanical components, reducing their sensitivity. However, water pressure may be dependent on functionality of pumps, which may be sensitive to flood exposure.
RV Dumps	Moderate	A 100-year coastal storm flood event will result in temporary loss of access, but is unlikely to damage the underground dump station.
Storm Drain	Moderate	Storm drains have a moderate sensitivity to flooding. If flood waters exceed the design threshold of the network, it will lose its functionality.
Sewer Line	High	Sewer lines do not exhibit electrical or mechanical components, reducing their sensitivity. However, movement of sewage may be dependent on functionality of pumps, which may be sensitive to flood exposure.
Wastewater /Stormwater Outfall	High	Although outfalls are not structurally susceptible to flood damage, their functionality is highly sensitive. They are the lowest point of discharge and their function is limited when receiving waterbody levels are higher than the outfall elevation.
Signage	Low	Depending on the robustness of signage base support, temporary flooding may dislodge sign from existing location.

Asset Type	Sensitivity to Temporary Exposure	Rationale
Interpretive exhibits and panels	Medium	Depending on the robustness of exhibit base support, temporary flooding may dislodge exhibit from existing location. Depending on the exhibit material temporary inundation could affect degradation. Salt water rapidly degrades interpretive panels made of high-pressure laminate or fiberglass embedded.
Lifeguard Tower	Moderate	Structure is elevated but may be structurally sensitive to changes in water levels, particularly during storm events when large waves may reach higher elevations of the structure.
Seawall, Bulkheads, Revetments	Moderate	Coastal armoring is designed to be resilient to wave action but may experience wave overtopping. Severe storm events may degrade, damage or undermine these structures.
Access		
Paved Roads (State Parks Roads, Highways, Major Roads, Secondary Roads)	Low	Road materials are not sensitive to infrequent low velocity temporary flooding, but frequent floods may cause deterioration. Paved roads are hardened structures and may have low sensitivity to erosion during overwash events. If roads are submerged by a depth of more than a few inches, vehicle movement will stop, but should be able to resume quickly after waters recede. Wave action or high velocity flow may cause erosion of roadway foundation.
Unpaved Roads (State Parks Roads, Secondary Roads)	Moderate	Temporary flooding may require short-term closure and cleanup of minor debris after floodwaters recede. Frequent or major flooding may completely erode or wash out roads, prohibiting future use until repairs are made.
Parking Lot Gates	Low	Gates are manually operated and do not contain features that are sensitive to temporary changes in water level condition due to temporary storm events. However, temporary flooding may cause short-term access loss to the gate/fence.
Parking Lots	Low	Temporary flooding may cause short-term loss of parking lot use while flooded, but access can be resumed after floodwaters subside. Repeated flooding or wave action may cause surface lot deterioration.
Pedestrian Trails and Bike Routes (Unpaved)	Moderate	Temporary flooding may require short-term closure and cleanup of minor debris after floodwaters recede. Frequent or major flooding may completely erode or wash out trails, prohibiting future use until repairs are made.
Pedestrian Trails and Bike Routes (Paved)	Low	Temporary flooding may require short-term closure and cleanup of minor debris after floodwaters recede. Paved pedestrian trails and bike routes are hardened structures and may have low sensitivity to erosion during overwash events. Frequent or major flooding

Asset Type	Sensitivity to Temporary Exposure	Rationale
		may completely erode or wash out trails, prohibiting future use until repairs are made.
Bridge/ Crossing	Low	Temporary flooding may require short-term closure of bridge and clean-up of debris, but access can be resumed after floodwaters subside.
Stairways (wood)	Medium	Temporary flooding may require short-term closure of stairways and clean-up of debris, but access can be resumed after floodwaters subside. Structural integrity of wood stairways may be compromised by high velocity storm surges.
Recreation		
Sand Volleyball Courts, Ramp, Birding Locations, Special Event Area, Campgrounds, Fire Rings	Low	Temporary flooding may require short-term closure of recreation feature use and clean-up of debris, but access can be resumed after floodwaters subside.
Shelters/Ramadas	Low	Temporary flooding may require short-term closure of shelter and clean-up of debris, but access can be resumed after floodwaters subside.
Park Furnishing, Drinking Fountains, Bike Racks, Showers, Play Station	Low	Temporary flooding may require short-term loss of use of park feature use and clean-up of debris, but access can be resumed after floodwaters subside.

Table C-2: Sensitivity Ratings to Temporary Exposure by Cultural Resource Type.

Asset Type	Sensitivity to Temporary Exposure	Rationale
Historic-age Sites with Artifacts and Nonpermanent Features		
Privy Pit/Trash Scatter/Dump (AH4)	High	Temporary flooding could adversely impact the elements of a privy pit/trash scatter/dump. The artifacts found in these sites are made of organic material (wood, faunal bone, paper, shell, etc.), metal, and other items that could deteriorate when exposed to high velocity flow, wave action, water, or extreme weather. Flooding has the potential to move or relocate artifacts, destroying their provenience (in situ location). Provenience is crucially important information a cultural resource can provide.
Indigenous Archeological Resources		
Shell middens	High	Temporary flooding could adversely impact shell middens. The artifacts found at these sites are made of organic material that could deteriorate when exposed to high velocity flow, wave action, water, or extreme weather. Flooding has the potential to move or relocate artifacts, destroying their provenience (in situ location). Provenience is crucially important information a cultural resource can provide.
Other Historic-age Sites and Isolates		
Historic Buildings	High	Buildings may experience structural damage if exposed to temporary flooding or erosion. The extent and degree of damage is dependent on flood depths, duration, and degree of floodproofing and site drainage. Buildings also often have utility (electrical, water, and sewer) components that could experience damage and require replacement with even temporary flood exposure. Flooding will also temporarily limit building access.

Table C-3: Sensitivity Ratings to Temporary Exposure by Natural Resource Type.

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Temporary Exposure	Rationale
Aquatic Bed	For the purpose of this assessment, aquatic beds consist of various communities and include seagrass beds (a type of submerged aquatic vegetation [SAV]) and invertebrate (namely oyster) reefs. Seagrass beds are subtidal marine habitats found in bays, harbors, estuaries, and on the open coast. They are generally comprised of species such as *Zostera marina, Zostera pacifica,* and *Ruppia maritima* that supports a diversity of life, provides habitat in the form of foraging and nursery grounds, offers wave attenuation and other critical ecosystem services. Subtidal invertebrate reefs, (e.g. oyster reefs) are also important estuarine features that create habitat, act as water filtration mechanisms, and attenuate waves.	N/A	N/A	Low	Temporary flooding and tidal inundation won't decrease function of seagrass habitats and oyster reefs, though sustained sedimentation loads, and wave action may have result in state changes of each community.
Beach	Beaches are zones that occur at the land-sea interface and encompass the area between swash beach and upper beach. Beaches can be comprised of many	N/A	N/A	Low - Moderate	Beaches experience daily high tides in this region of the state, and even higher king tides throughout the year. Level of inundation depends on the local processes

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Temporary Exposure	Rationale
	different types of materials depending on the surrounding geologic formations and processes.				including slope of the beach, sedimentation, freshwater input, and wave action. Beaches backed by cliffs may experience less impacts from temporary flood impacts as they erode and increase sediment supply to keep pace with SLR.
Bluff	Coastal bluffs are escarpments or steep faces of rock, decomposed rock, or soil resulting from erosion, faulting, or folding of the land mass and are in the coastal zone	N/A	N/A	High	Large storm events and increased wave action can accelerate cliff erosion leading to retreat and/or failure. Bluff sensitivity is also related to the geologic rock type present and local processes including orientation, wave exposure, beach width, and terrestrial processes. El Nino events have historically caused as much change as expected over a 50- year period. Storm events can also cause runoff-based erosion and ground destabilization through saturation.
Forest/ Woodland	Terrestrial land cover dominated by trees, and in the case of this assessment, bluff-dwelling Torrey pines and eucalyptus.	Eucalyptus (globulus, camaldulensis) Semi-Natural Stands Pinus torreyana Special Stands	Eucalyptus (globulus, camaldulensis) Semi-Natural Stands Pinus torreyana Special Stands	Moderate	Temporary flooding would likely cause forested and woodland areas to lose significant ecological function from saltwater inundation.
Freshwater	Freshwater marshes are	Schoenoplectus	Schoenoplectus	High	Temporary flooding and

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Temporary Exposure	Rationale
Marsh	unique transitional habitats that occur at the interface between the terrestrial and freshwater aquatic environments. Freshwater marshes occur in drainages, seepages, and other perennially moist, low places often found along stream courses and near riparian wetland areas.	americanus Alliance Typha (angustifolia, domingensis, latifolia) Alliance	americanus Association Typha domingensis Association		salinity intrusion via tides and storms would result in state change of freshwater marshes due to the innately low salinity tolerance of associated endemic species.
Grass/Herb	The grassland land cover type comprises grasslands dominated by native grasses and grasslands that are dominated primarily by nonnative grasses and, to a lesser extent, nonnative forbs.	Abronia latifolia-Ambrosia chamissonis Alliance Brassica (nigra) and Other Mustards Semi-Natural Stands Bromus (diandrus, hordeaceus)-Brachypodium distachyon Semi-Natural Stands Cressa truxillensis-Distichlis spicata Alliance Deinandra fasciculata Provisional Alliance Distichlis spicata	Ambrosia chamissonis-Abronia maritima-Cakile maritima Association Brassica (nigra) and Other Mustards Semi-Natural Stands Bromus (diandrus, hordeaceus)-Brachypodium distachyon Semi-Natural Stands Cressa truxillensis-Distichlis spicata Provisional Association Deinandra fasciculata Association Distichlis spicata-	Moderate	Coastal herbs/grasslands would not likely lose all ecological function during extreme storm events and temporary flooding as herbs/grasslands probably receives some level of flooding, salinity intrusion, and spray due to its proximity to the coast.

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Temporary Exposure	Rationale
		Alliance Glebionis coronaria semi natural stands Mediterranean California Naturalized Annual and Perennial Grassland Semi-Natural Stands	Annual Grasses Association Glebionis coronaria semi natural stands Mediterranean California Naturalized Annual and Perennial Grassland Semi-Natural Stands		
Nonnative Vegetation	Land cover dominated by introduced vegetation that is not indigenous to a region.	Carpobrotus edulis or Other Ice Plants - Semi-Natural Stands	Carpobrotus edulis or Other Ice Plants - Semi-Natural Stands	Moderate	Temporary flooding would likely not change the functionality of nonnative and invasive species as they are adapted to a wide range of conditions. Flooding or erosion would reduce potential opportunities for high value restoration or retreat of facilities or sensitive native habitats.
Open Water	Open water is a body of ocean water that provides essential ecosystem services and habitat for a diverse suite of flora and fauna in San Diego County.	N/A	N/A	None	Temporary exposure and SLR is not likely to change the functionality of open water systems, rather expand its areal extent under future SLR conditions.
Riparian Forest	Riparian vegetation is found throughout California growing along streams, in floodplains, and in canyon bottoms. Many riparian plant species	Platanus racemosa Alliance Salix gooddingii Alliance	Platanus racemosa-Populus spp./Salix lasiolepis Association Salix lasiolepis Association	Low	Temporary flooding events from extreme storms could cause minor change to riparian ecosystems and associated vegetation, however the vegetation is

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Temporary Exposure	Rationale
	regenerate from seed following flood events. Riparian scrub is shrub dominated and dense.		Acacia - Semi- Natural Stands Salix gooddingii Association		adapted for dynamic conditions and are dependent upon flooding for regeneration or reproduction.
Riparian Scrub	Riparian vegetation is found throughout California growing along streams, in floodplains, and in canyon bottoms. Many riparian plant species regenerate from seed following flood events. Riparian forest is dominated by trees.	Arundo donax Semi-Natural Stands Baccharis salicifolia Alliance Naturalized Warm-Temperate Riparian and Wetland Semi- Natural Stands Pluchea sericea Alliance	Arundo donax Semi-Natural Stands Baccharis salicifolia Association Naturalized Warm-Temperate Riparian and Wetland Semi-Natural Stands Pluchea sericea Association	Low	Temporary flooding events from extreme storms could cause minor change to riparian ecosystem and associated vegetation, however the vegetation is adapted for dynamic conditions and are dependent upon flooding for regeneration or reproduction.
Rocky Intertidal	Marine intertidal ecosystems with rocky substrate are found predominantly between mean lower low water and mean higher high water along the outer coast.	N/A	N/A	Moderate	Rocky intertidal ecosystems are dynamic and productive transitory zones at the land-sea interface that experience a wide range of conditions daily due to changes in tidal regimes. Intertidal organisms are adapted to these extremes, though the upper and lower limits are determined by physical, chemical, and biological forces, all of which shape the ecology and persistence of this

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Temporary Exposure	Rationale
					ecosystem. Temporary exposure and subsequent changes are unique to each location and unlikely to cause irreversible change/loss of function. Given these adaptations to extreme conditions, rocky intertidal systems remain sensitive to small fluctuations in sea levels.
Coastal Scrub	Coastal Scrub is comprised of scattered or dense stands of locally native tree and shrub species.	Artemisia californica-Eriogonum fasciculatum Alliance Artemisia californica-Salvia mellifera Alliance Artemisia californica Alliance Artemisia dracunculus Alliance Bahiopsis laciniata Alliance Encelia californica Alliance	Artemisia californica-Eriogonum fasciculatum- Malosma laurina Association Artemisia californica-Salvia mellifera Association Artemisia californica Association Artemisia dracunculus Association Bahiopsis laciniata-Artemisia californica-Eriogonum fasciculatum Association Encelia californica-Artemisia californica	Moderate	Coastal scrub would not likely lose all ecological function during extreme storm events and temporary flooding as it probably receives some level of salinity intrusion and spray due to its proximity to the coast.

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Temporary Exposure	Rationale
			Association		
		Isocoma menziesii Alliance	Isocoma menziesii Provisional Association		
		Lycium californicum Provisional Alliance	Lycium californicum Provisional Association		
		Rhus integrifolia Alliance	Rhus integrifolia Association		
		Atriplex lentiformis Alliance			
		Baccharis sarothroides Provisional Alliance	Baccharis sarothroides Association		
		Carpobrotus edulis or Other Ice Plants - Semi-Natural Stands	Carpobrotus edulis or Other Ice Plants - Semi-Natural Stands		
		Salvia mellifera Alliance	Salvia mellifera-Malosma laurina Association		
Swash Beach	Swash beach is defined as sandy beach found between mean lower low water and mean higher high water.	N/A	N/A	Low	Beaches experience high tides daily in this region, and even higher king tides throughout the year. Level of inundation depends on the local processes including slope of the beach, sedimentation, freshwater input, wave

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Temporary Exposure	Rationale
					action. Beaches backed by cliffs may experience less changes from temporary flood impacts as they erode and increase sediment supply to keep pace with SLR.
Upper Beach	Upper beach habitat is sandy beach stretching from mean higher high water inland into dunes, cliffs, or other habitats. Upper beach habitat typically has drier sand than swash beach.	N/A	N/A	Moderate	Beaches experience high tides daily in this region, and even higher king tides throughout the year. Level of inundation depends on the local processes including slope of the beach, sedimentation, freshwater input, wave action. Beaches backed by cliffs may experience less impacts from temporary flood impacts as they erode and increase sediment supply to keep pace with SLR.

Appendix D:

Sensitivity to Permanent Exposure

Enclosed: Tables of sensitivity ratings adopted from AECOM (2022) San Diego Coast District Sea Level Rise Adaptation Pathways Report and Statewide Toolkit. These sensitivity ratings were adopted as a basis for assessment of the vulnerability of State Park assets in terms of their sensitivity to permanent exposure to permanent tidal inundation from SLR, groundwater rise, shoreline retreat and cliff retreat.

Table D-1: Sensitivity Ratings to Permanent Exposure by Physical Asset Type.

Asset Type	Sensitivity to Permanent Exposure	Rationale
Facilities/Infrastructure		
Piers	High	Permanently inundated structures will become inoperable. Erosion at the shore end of the pier may affect access and cause structural damage.
Contact Station /Kiosk, Concessions, Staff Housing, Administration, Maintenance, Visitor's Center, Campfire Centers/Amphitheaters, Education Centers/Classrooms, Museums	High	Buildings may experience significant damage and loss of access if exposed to permanent inundation. Erosion of building foundation may cause structural damage.
Comfort Station/ Restroom	High	Buildings may experience significant damage and loss of access if exposed to permanent inundation. Erosion of building foundation may cause structural damage.
Water Main	Moderate	Water pipe structures do not exhibit electrical or mechanical components, reducing their sensitivity. However, water pressure may be dependent on functionality of pumps, which are not designed for permanent inundation. Long-term erosion may also expose water pipeline and cause structural damage.
RV Dumps	High	Permanent inundation of the RV dump areas will inhibit their access and long- term functionality. As higher sea levels elevate groundwater, the unsaturated zone of soil underlying groundwater dump drain fields, which is critical for proper removal of pathogens and wastewater treatment, will be reduced.
Storm Drain	High	Permanent inundation of the storm drain network will inhibit its functionality to convey excess stormwater.
Sewer Line	High	Sewer lines do not exhibit electrical or mechanical components, reducing their sensitivity. However, movement of sewage may be dependent on functionality of pumps, which are not designed for permanent inundation. Long-term erosion may also expose sewer lines and cause structural damage.
Wastewater /Stormwater Outfall	High	Although outfalls are not structurally susceptible to inundation, their functionality is highly sensitive. They are the lowest point of discharge and their function is limited when receiving waterbody levels are higher than the outfall elevation. Long-term erosion may also remove supporting sediment from beneath the outfall pipeline and cause structural damage.
Signage	High	Asset may experience an increased rate of material degradation and loss of access

Asset Type	Sensitivity to Permanent Exposure	Rationale
		due to long-term inundation. Sign may become dislodged by erosion.
Interpretive exhibits and panels	High	Asset may experience an increased rate of material degradation and loss of access due to long-term inundation. Exhibit may become dislodged by erosion.
Lifeguard Tower	High	Permanently inundated structures will become inoperable.
Seawall, Bulkheads, Revetments	Moderate	Coastal armoring is designed to be resilient to water level changes but may lose efficiency when flooded.
Access		
Paved Roads (State Parks Roads, Highways, Major Roads, Secondary Roads)	High	Permanently inundated roadways will become inoperable. Long-term erosion may degrade roadway foundation.
Unpaved Roads (State Parks Roads, Secondary Roads)	High	Permanently inundated roadways will become inoperable. Long-term erosion may degrade roadway foundation.
Parking Lot Gates	High	Gate may experience an increased rate of corrosion or material deterioration due to saltwater exposure and a loss of access due to permanent inundation. Gates/fence posts may become dislodged by erosion.
Parking Lots	High	Permanent inundation will make parking lots inoperable. Long-term shoreline erosion may degrade or completely erode pavement in lot.
Pedestrian Trails and Bike Routes (Unpaved)	High	Permanent inundation will make unpaved trails unusable. Long-term shoreline erosion may degrade or completely erode trail.
Pedestrian Trails and Bike Routes (Paved)	High	Permanent inundation will make pedestrian trails and bike routes inoperable. Long-term shoreline erosion may degrade or completely erode trail.
Bridge/ Crossing	High	Permanently inundated park structures will become inoperable. Erosion of bridge touchdown points may affect access.
Stairways (wood)	High	Permanently inundated park structures will become inoperable. Erosion of stairway foundations may affect their structural integrity or access.
Recreation		
Sand Volleyball Courts, Ramp, Birding Locations, Special Event Area, Campgrounds, Fire Rings	High	Permanently inundated or eroded park feature will become inoperable.
Shelters/Ramadas	High	Permanently inundated park structures will become inoperable. Erosion of shelter

Asset Type	Sensitivity to Permanent Exposure	Rationale
		foundation may cause structural damage.
Park Furnishing, Drinking Fountains, Bike Racks, Showers, Play Station	High	Permanently inundated park feature will become inoperable. Long term erosion may affect functionality of existing park furnishings.

Table D-2: Sensitivity Ratings to Permanent Exposure by Cultural Resource Type.

Asset Type	Sensitivity to Permanent Exposure	Rationale
Historic-age Sites with Artifacts and Nonpermanent Features		
Privy Pit/Trash Scatter/Dump (AH4)	High	Permanent hazards could potentially cause the loss of access or complete destruction of a cultural resource. Inundation and erosion have the potential to alter the stratigraphy of a site if artifacts or features are buried.
Indigenous Archeological Resources		
Shell middens	High	Permanent hazards could potentially cause the loss of access or complete destruction of a shell midden. Inundation and erosion have the potential to alter the stratigraphy of a site if artifacts or features are buried.
Other Historic-age Sites and Isolates		
Historic Buildings	High	Permanent hazards could potentially cause the loss of access or complete destruction of a cultural resource. Inundation and erosion have the potential to alter the stratigraphy of a site if artifacts or features are buried.

Table D-3: Sensitivity Ratings to Permanent Exposure by Natural Resource Type.

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Permanent Exposure	Rationale
Aquatic Bed	For the purpose of this assessment, aquatic beds consist of various communities and include seagrass beds (a type of submerged aquatic vegetation [SAV]) and invertebrate (namely oyster) reefs. Seagrass beds are subtidal marine habitats found in bays, harbors, estuaries, and on the open coast. They are generally comprised of species such as *Zostera marina, Zostera pacifica,* and *Ruppia maritima* that supports a diversity of life, provides habitat in the form of foraging and nursery grounds, offers wave attenuation and other critical ecosystem services. Subtidal invertebrate reefs, (e.g. oyster reefs) are also important estuarine features that create habitat, act as water filtration mechanisms, and attenuate waves.	N/A	N/A	High	SLR is likely to decrease light penetration needed for optimal growing conditions and photosynthetic capacity of seagrasses. If areal extent allows, upslope migration may occur, though migration space may be limited in surrounding urban and developed areas. Invertebrate reefs won't likely be as sensitive to SLR, as they are to differing climate stressors including ocean acidification and warming.
Beach	Beaches are zones that occur at the land-sea interface and encompass the area between swash beach and upper beach. Beaches can be comprised of many	N/A	N/A	Moderate - High	SLR is likely to increase erosion rates and permanently inundate low-elevation and low-sloped beaches, depending on factors such

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Permanent Exposure	Rationale
	different types of materials depending on the surrounding geologic formations and processes.				as elevation, sediment supply, and adjacent land use. Sensitivity is unique to each beach, and if given the opportunity to migrate, beaches can be very resilient systems. In southern California, infrastructure and urbanization generally limit this possibility. Increased fragmentation (pocket beaches), narrower and steeper beaches will likely result with permanent SLR.
Cliff	Coastal cliffs are escarpments or steep faces of rock, decomposed rock, or soil resulting from erosion, faulting, or folding of the land mass and are in the coastal zone	N/A	N/A	High	SLR will act to reduce the extent of the protective beach width, thereby increasing the exposure of existing cliff faces to wave action causing greater rates of erosion. Peregrine falcons and other cliff-nesting bird habitat would change in addition to land loss and greater risk to the built environment.
Forest/ Woodland	Terrestrial land cover dominated by trees.	Eucalyptus (globulus, camaldulensis) Semi-Natural Stands Pinus torreyana Special Stands	Eucalyptus (globulus, camaldulensis) Semi-Natural Stands Pinus torreyana Special Stands	High	Permanent SLR would likely lead to cliff erosion and narrowing of the buffer beaches that protect the cliffs. Should forest/woodland be subjected to permanent flooding, it would be highly

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Permanent Exposure	Rationale
					sensitive to salinity inundation and flooding from SLR and would experience permanent loss of function over time and likely convert to subtidal habitat.
Freshwater Marsh	Freshwater marshes are unique transitional habitats that occur at the interface between the terrestrial and freshwater aquatic environments. Freshwater marshes occur in drainages, seepages, and other perennially moist, low places often found along stream courses and near riparian wetland areas.	Schoenoplectus americanus Alliance Typha (angustifolia, domingensis, latifolia) Alliance	Schoenoplectus americanus Association Typha domingensis Association	High	Increased salinity could result in reduced wetland productivity, function, shifts in species composition towards salt-tolerant species, potential for increase in invasive species, and ultimately loss of freshwater marsh.
Grass/Herb	The grassland land cover type comprises grasslands dominated by native grasses and grasslands that are dominated primarily by nonnative grasses and, to a lesser extent, nonnative forbs.	Abronia latifolia-Ambrosia chamissonis Alliance Brassica (nigra) and Other Mustards Semi-Natural Stands Bromus (diandrus, hordeaceus)-Brachypodium distachyon Semi-Natural Stands Cressa truxillensis-Distichlis spicata	Ambrosia chamissonis-Abronia maritima-Cakile maritima Association Brassica (nigra) and Other Mustards Semi-Natural Stands Bromus (diandrus, hordeaceus)-Brachypodium distachyon Semi-Natural Stands Cressa truxillensis-Distichlis spicata	High	Coastal herb/grasslands would likely lose all ecological function during permanent SLR, flooding and salinity intrusion, causing irreversible change.

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Permanent Exposure	Rationale
		Alliance Deinandra fasciculata Provisional Alliance Distichlis spicata Alliance Glebionis coronaria semi natural stands Mediterranean California Naturalized Annual and Perennial Grassland Semi-Natural Stands	Provisional Association Deinandra fasciculata Association Distichlis spicata-Annual Grasses Association Glebionis coronaria semi natural stands Mediterranean California Naturalized Annual and Perennial Grassland Semi-Natural Stands		
Nonnative Vegetation	Land cover dominated by introduced vegetation that is not indigenous to a region.	Carpobrotus edulis or Other Ice Plants - Semi-Natural Stands	Carpobrotus edulis or Other Ice Plants - Semi-Natural Stands	High	Nonnative and invasive species will likely be highly sensitive to permanent SLR due to total inundation, thereby leading to a loss of habitat. Non- native habitats sometimes support remnant native species and provide potential for habitat restoration sites in sensitive coastal areas where much of the native vegetation has been lost to development. Loss of this potential habitat represents a loss of opportunities for increasing or preserving

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Permanent Exposure	Rationale
					coastal habitats.
Open Water	Open water is a body of ocean water that provides essential ecosystem services and habitat for a diverse suite of flora and fauna in San Diego County.	N/A	N/A	None	Open water is not sensitive to SLR. Permanent SLR will likely act as a major habitat conversion, shifting estuarine fringing habitats (e.g., salt marshes and freshwater marshes) to open water with increasing sea levels.
Riparian Forest	Riparian vegetation is found throughout California growing along streams, in floodplains, and in canyon bottoms. Many riparian plant species regenerate from seed following flood events. Riparian scrub is shrub dominated and dense.	Platanus racemosa Alliance Salix gooddingii Alliance	Platanus racemosa-Populus spp./Salix lasiolepis Association Salix lasiolepis Association Acacia - Semi- Natural Stands Salix gooddingii Association	High	Ecologically, riparian corridors are likely to be highly sensitive to permanent SLR and salinity intrusion. Riparian ecosystems are dependent on groundwater and reliable fresh water sources, and hence would lose ecological function.
Riparian Scrub	Riparian vegetation is found throughout California growing along streams, in floodplains, and in canyon bottoms. Many riparian plant species regenerate from seed following flood events. Riparian forest is dominated by trees.	Arundo donax Semi-Natural Stands Baccharis salicifolia Alliance Naturalized Warm-Temperate Riparian and Wetland Semi- Natural Stands	Arundo donax Semi-Natural Stands Baccharis salicifolia Association Naturalized Warm-Temperate Riparian and Wetland Semi-Natural Stands	High	Ecologically, riparian corridors are likely to be highly sensitive to permanent SLR and salinity intrusion. Riparian ecosystems are dependent on groundwater and reliable fresh water sources, and hence would lose ecological function.

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Permanent Exposure	Rationale
		Pluchea sericea Alliance	Pluchea sericea Association		
Rocky Intertidal	Marine intertidal ecosystems with rocky substrate are found predominantly between mean lower low water and mean higher high water along the outer coast.	N/A	N/A	High	SLR will likely reduce the extent of rocky intertidal ecosystems, shifting it upward in elevation to keep pace with rising sea levels. If there is migration space for expansion, the sensitivity to SLR would be moderate, however, most rocky intertidal nearshore areas do not have that migration capacity and therefore are highly sensitive to changes in sea levels and would shift to subtidal ecosystems.
Coastal Scrub	Coastal Scrub is comprised of scattered or dense stands of locally native tree and shrub species.	Artemisia californica-Eriogonum fasciculatum Alliance Artemisia californica-Salvia mellifera Alliance Artemisia californica Alliance Artemisia dracunculus Alliance Bahiopsis laciniata Alliance	Artemisia californica-Eriogonum fasciculatum- Malosma laurina Association Artemisia californica-Salvia mellifera Association Artemisia californica Association Artemisia dracunculus Association Bahiopsis laciniata-Artemisia californica-	High	Coastal scrub habitat would likely lose all ecological function during permanent SLR, flooding and salinity intrusion, causing irreversible change and habitat shifts.

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Permanent Exposure	Rationale
		Encelia californica Alliance Isocoma menziesii Alliance Lycium californicum Provisional Alliance Rhus integrifolia Alliance Atriplex lentiformis Alliance Baccharis sarothroides Provisional Alliance Carpobrotus edulis or Other Ice Plants - Semi-Natural Stands Salvia mellifera Alliance	Eriogonum fasciculatum Association Encelia californica-Artemisia californica Association Isocoma menziesii Provisional Association Lycium californicum Provisional Association Rhus integrifolia Association Baccharis sarothroides Association Carpobrotus edulis or Other Ice Plants - Semi-Natural Stands Salvia mellifera-Malosma laurina Association		
Swash Beach	Swash beach is defined as sandy beach found between mean lower low water and mean higher high water.	N/A	N/A	Moderate - High	SLR is likely to increase erosion rates and permanently inundate low-elevation and low-sloped beaches, depending on factors such as elevation, sediment supply,

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Permanent Exposure	Rationale
					and adjacent land use. Sensitivity is unique to each beach, and if given the opportunity to migrate, beaches can be very resilient systems. In southern California, infrastructure and urbanization generally limit this possibility. Increased fragmentation (pocket beaches), narrower and steeper beaches likely the result.
Upper Beach	Upper beach habitat is sandy beach stretching from mean higher high water inland into dunes, cliffs, or other habitats. Upper beach habitat typically has drier sand than swash beach.	N/A	N/A	Moderate - High	SLR is likely to increase erosion rates and permanently inundate low-elevation and low-sloped beaches, depending on factors such as elevation, sediment supply, and adjacent land use. Sensitivity is unique to each beach, and if given the opportunity to migrate, beaches can be very resilient systems. In southern California, infrastructure and urbanization generally limit this possibility. Increased fragmentation (pocket beaches), narrower and steeper beaches likely the result.

Natural Resource	Natural Resource Description	Vegetation Alliance	Vegetation Association	Sensitivity to Permanent Exposure	Rationale
Sources: Hutto et al. 2015; Largier et al 2010; Griggs and Russell 2012; Heady et al. 2018; Thorne et al. 2016; Uyeda et al. 2013; Herbert et al. 2013; Thorner et al. 2014; SDMMP and TNC 2017					

Appendix E:

Flood Hazard Maps

Enclosed: Flood hazard maps depicting:

Seacliff State Beach

1. Flood extent at Seacliff SB for non-storm, and 1 to 100-year flood hazards at present-day sea level.
2. Flood extent at Seacliff SB for 1-year storm events with 0 to 6 feet of sea level rise.
3. Flood extent at Seacliff SB for 5-year storm events with 0 to 6 feet of sea level rise.
4. Flood extent at Seacliff SB for 10-year storm events with 0 to 6 feet of sea level rise.
5. Flood extent at Seacliff SB for 25-year storm events with 0 to 6 feet of sea level rise.
6. Flood extent at Seacliff SB for 50-year storm events with 0 to 6 feet of sea level rise.
7. Flood extent at Seacliff SB for 100-year storm events with 0 to 6 feet of sea level rise.

New Brighton State Beach

1. Flood extent at New Brighton SB for non-storm, and 1 to 100-year flood hazards at present-day sea level.
2. Flood extent at New Brighton SB for 1-year storm events with 0 to 6 feet of sea level rise.
3. Flood extent at New Brighton SB for 5-year storm events with 0 to 6 feet of sea level rise.
4. Flood extent at New Brighton SB for 10-year storm events with 0 to 6 feet of sea level rise.
5. Flood extent at New Brighton SB for 25-year storm events with 0 to 6 feet of sea level rise.
6. Flood extent at New Brighton SB for 50-year storm events with 0 to 6 feet of sea level rise.
7. Flood extent at New Brighton SB for 100-year storm events with 0 to 6 feet of sea level rise.

SEACLIFF STATE BEACH
Aptos, CA
moffatt & nichol | 09.06.2023 | PROJECT #9280-S8


State Park Assets
Picnic Grounds
Parking Points
Campgrounds
Buildings
Recreational Routes
Park Boundaries
1-Year Storm Scenario
0ft SLR
1ft SLR
2ft SLR
4ft SLR
6ft SLR
SEACLIFF STATE BEACH
Aptos, CA
moffatt & nichol
09.06.2023
PROJECT #9280-S8
0 100200 400 600 800 FT


State Park Assets
Picnic Grounds
Parking Points
Campgrounds
Buildings
Recreational Routes
Park Boundaries
5-Year Storm Scenario
0ft SLR
1ft SLR
2ft SLR
4ft SLR
6ft SLR
Sanborn Map Company, Santa Cruz County, Maxar
SEACLIFF STATE BEACH
Aptos, CA
moffatt & nichol
09.06.2023
PROJECT #9280-S8
0 100200 400 600 800 FT


State Park Assets
Picnic Grounds
Parking Points
Campgrounds
Buildings
Recreational Routes
Park Boundaries
10-Year Storm Scenario
6ft SLR
4ft SLR
2ft SLR
1ft SLR
0ft SLR
SEACLIFF STATE BEACH
Aptos, CA
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PROJECT #9280-S8
0 100200 400 600 800 FT


State Park Assets
Picnic Grounds
Parking Points
Campgrounds
Buildings
Recreational Routes
Park Boundaries
25-Year Storm Scenario
0ft SLR
1ft SLR
2ft SLR
4ft SLR
6ft SLR
SEACLIFF STATE BEACH
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State Park Assets
Picnic Grounds
Parking Points
Campgrounds
Buildings
Recreational Routes
Park Boundaries
50-Year Storm Scenario
0ft SLR
1ft SLR
2ft SLR
4ft SLR
6ft SLR
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State Park Assets
PicnicGrounds
ParkingPoints
Campgrounds
Buildings
RecreationalRoutes
ParkBoundaries
100-Year Storm Scenario
0ft SLR
1ft SLR
2ft SLR
4ft SLR
6ft SLR
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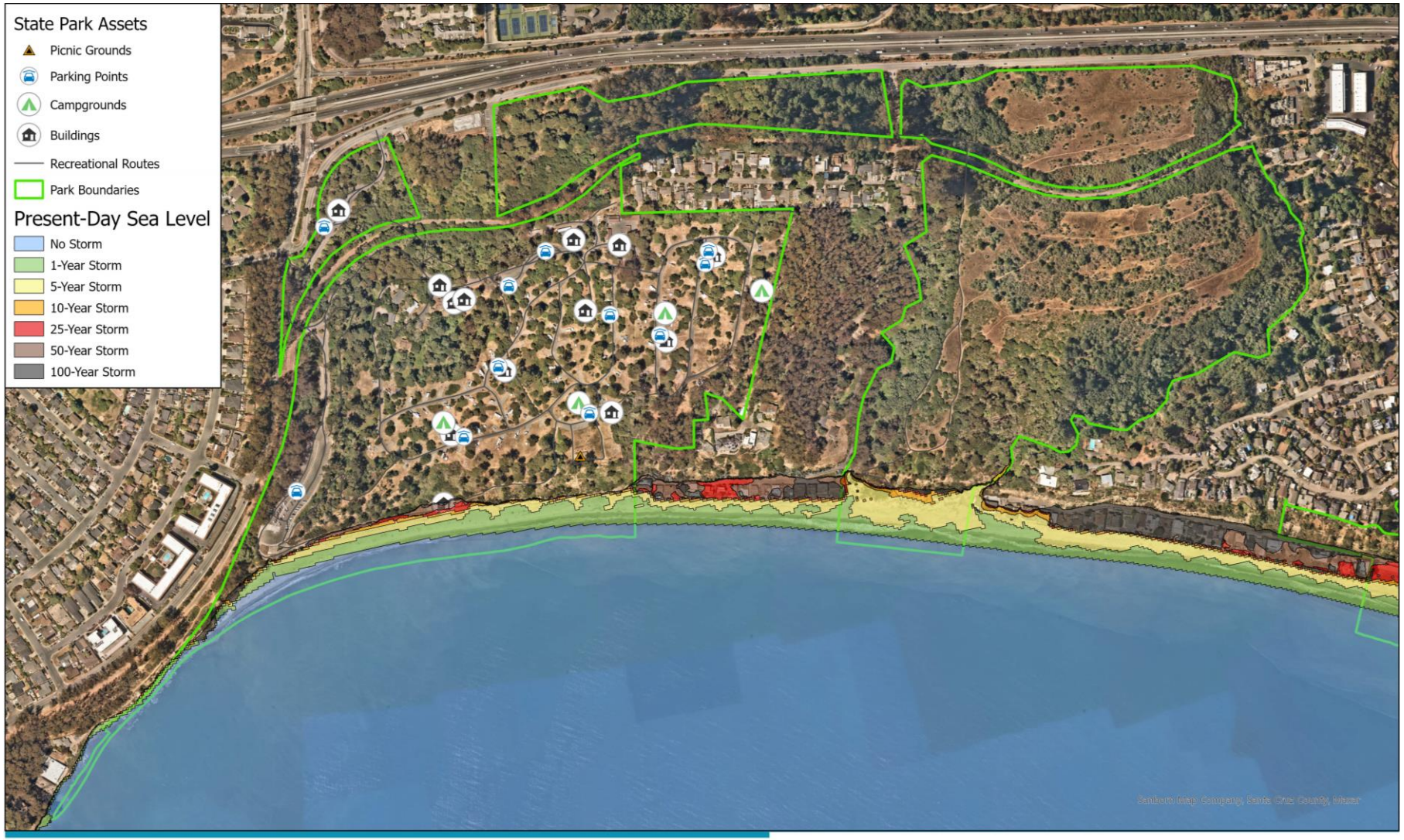
09.06.2023
PROJECT #9280-S8
0 100200 400 600 800 FT



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Capitola, CA
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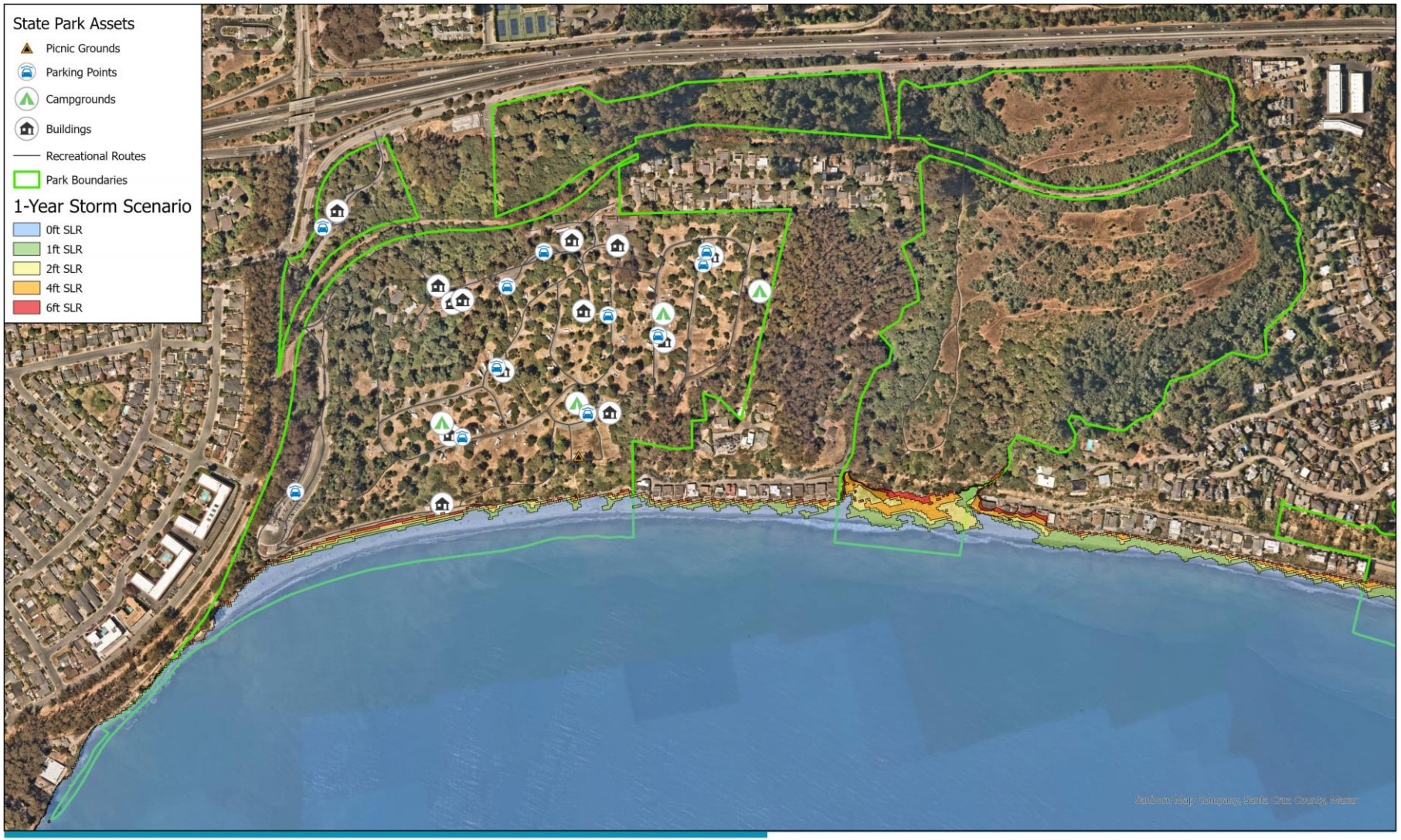
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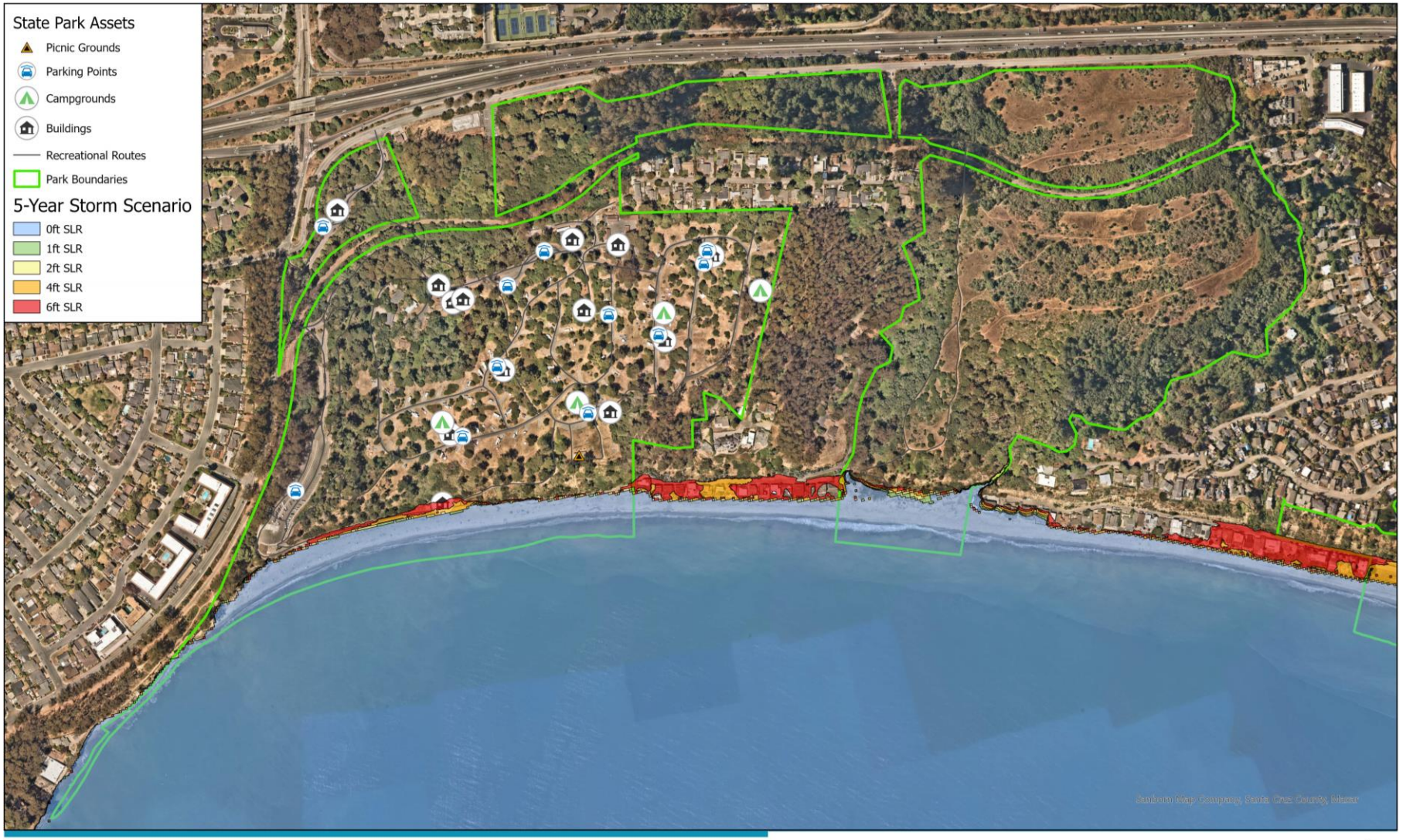
0 100 200 400 600 800 FT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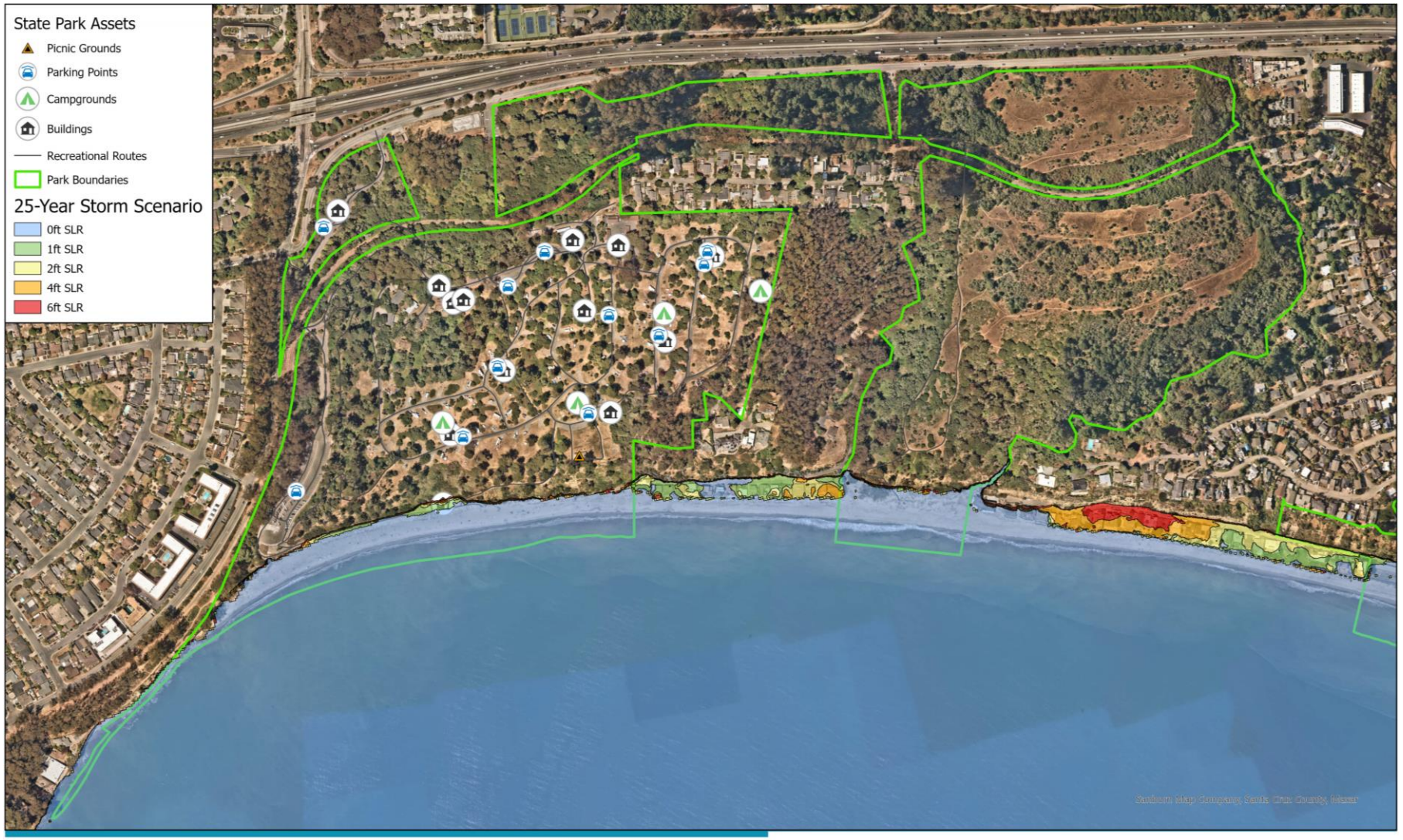
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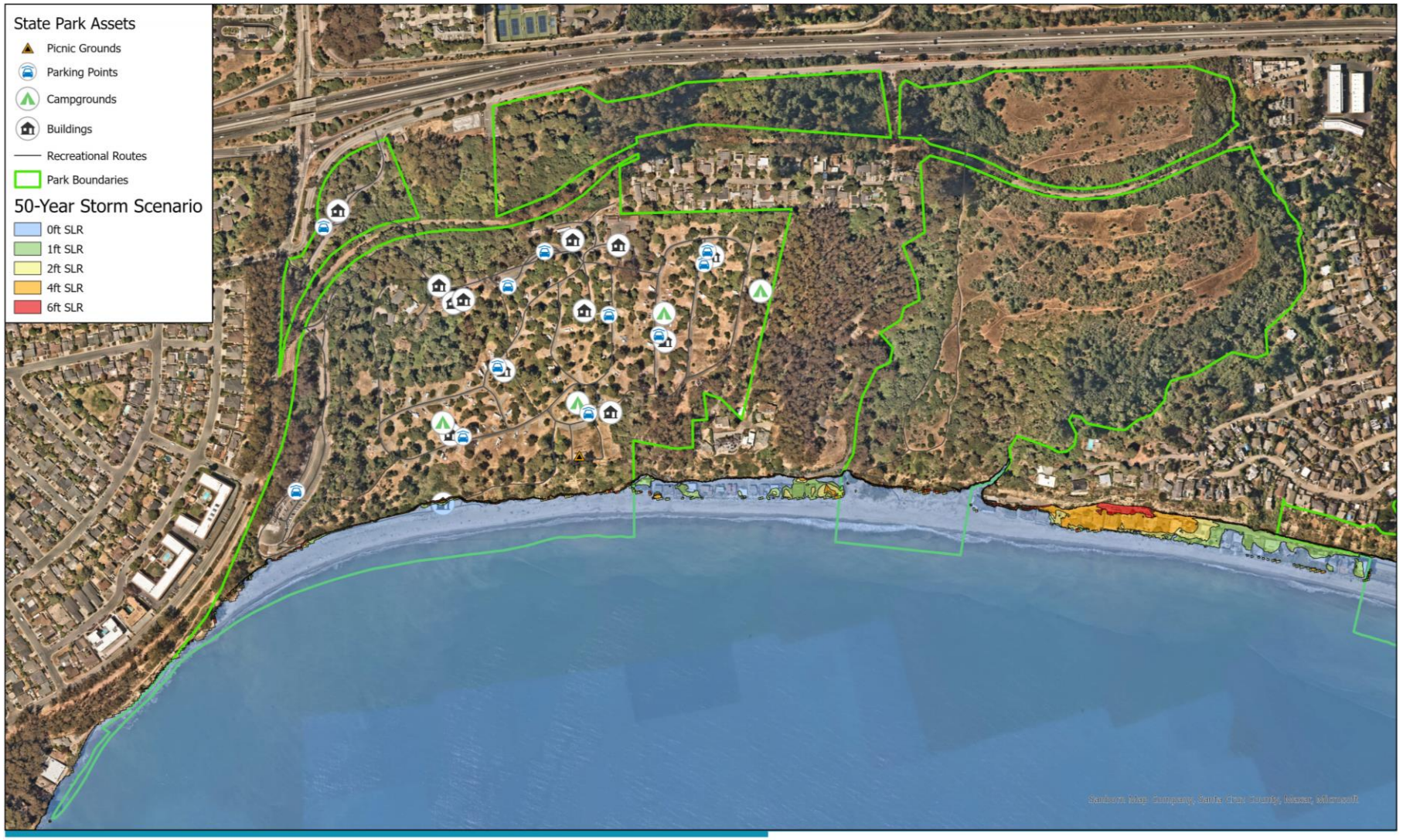
State Park Assets
Picnic Grounds
Parking Points
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Buildings
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50-Year Storm Scenario
0ft SLR
1ft SLR
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