4.5 Geology, Soils, and Seismicity

This section describes the geology, soils, and seismicity conditions in the vicinity of the proposed project and evaluates the extent to which the project could expose people or structures to potential seismic, liquefaction, landslide, and expansive soil impacts, and the extent to which the project could result in substantial soil erosion or loss of topsoil. This section summarizes the results of the *Feasibility Geotechnical Investigation* prepared for the project by Pacific Geotechnical Engineering (2013), the *Carmel River Lagoon Restoration Scenic Road Protection Options* prepared by Moffatt & Nichol (2013a) and *Coastal Engineering Analysis* prepared by Moffatt & Nichol (2013b), and the *Littoral Processes and River Breachings at Carmel River Beach* prepared by Thornton (2005); each of these reports are contained in **Appendix F** of this EIR.

Public and agency comments related to geology, soils, and seismicity conditions were received during the public scoping period, and are summarized below:

- Evaluate scour and erosion impacts as a result of proposed EPB and SRPS project components structures;
- Evaluate potential impacts to local sand supply; and
- Evaluate potential impacts associated with wave energy.

To the extent that issues identified in public comments involve potentially significant effects on the environment according to the CEQA and/or are raised by responsible agencies, they are identified and addressed within this EIR. For a complete list of public comments received during the public scoping period, please refer to **Appendix A**, **NOP and Public Comment Letters.**

4.5.1 Environmental Setting

Geologic structure in central California is primarily the result of tectonic events that have occurred during the past 30 million years. It is widely believed that the numerous faults in this area are related to movements along the boundary between the Pacific and North American tectonic plates. The relative motion between these two tectonic plates is taken up largely along the northwest-trending San Andreas Fault system, which defines the regional boundary between the two plates. Changes in sea level and tectonic uplift resulted in a complicated depositional environment that produced the complex geology of the Monterey Bay region. Faulting and folding have deformed and displaced the geologic units in the region, and the granitic basement and overlying Tertiary deposits have been juxtaposed along many of the northwest/southeast-trending faults. The project site lies within the Coast Ranges Geomorphic Province, a discontinuous series of northwest-southeast trending mountain ranges, ridges and intervening valleys characterized by complex folding and faulting.

4.5.1.1 Regional Geologic Setting

The geologic and soils study area extends from the Lagoon to the beach. The geology of the site vicinity is dominated by two factors: offset across the Cypress Point fault and alluvial sediments of the Carmel River.

The Cypress Point Fault is a northwest-trending normal fault that skirts and parallels the elevated ridge of ground between Scenic Road and Carmelo Street; the fault is mapped just east of and parallel to Carmelo Road. In the project vicinity, this fault is entirely concealed by sediment, and is inferred on the basis of different bedrock types east and west of the fault. The dominant rock type west of the fault (underlying Abalone Point and Stewart's Cove) is granitic. The dominant rock type east of the fault is much younger basaltic andesite. Although the fault is mapped as a single strand, it may be a more complex fault zone. This may have resulted in some differential offset of the top-of-rock bedrock surface. The Cypress Point Fault is not considered to be active.

The project reach is within a crenulate-shaped bay, anchored by the rocky Carmel Point headland (south of Stewart's Cove) to the north and a bedrock outcrop to the south. Consistent with typical headland-bay beaches, the shoreline shape is oriented parallel to the wave crests as they refract and diffract around the headland. There is also a wave energy gradient along the beach such that during the winter, when waves are predominantly from the northwest direction, the energy decreases from south to north.

Rocky granodiorite underlying the north and south end of the beach, separated by approximately 600 feet of sand, constrains where the lagoon reaches the beach (MPWMD, 2007). The beach is confined to the north and the south by bedrock outcrops, and is comprised of sand. The beach forms a seasonal barrier between the mouth of the Lagoon and the Pacific Ocean. The barrier beach is seasonally breached (either naturally or artificially) when high rainfall events increase the water level in the lagoon. Because the Carmel River is ephemeral and the beach is subjected to swell for most of the year, wave run-up rebuilds the berm and closes off the barrier beach when river outflows are low or absent.

The beach at Carmel River State Beach is steep, reflective, and composed of fairly coarse sand delivered to the beach by the river. The slope of the beach progressively becomes flatter from the south to the north. Field observations by Professor Ed Thornton of the Naval Postgraduate School show that the beach slope varies from about 8H:1V (12%) at the north end of the beach, to about 3.6H:1V (28%) at the south end of the beach (Thornton, 2005). Sand grain size, and therefore wave energy, also increases from the north to the south end of the beach. Sand is deposited on the beach berm by wave action, and at high tides, waves overtop the berm depositing sand and debris on the back beach (nearest the lagoon). Thornton also determined that the beach is relatively stable and has not migrated over the past 130 years.

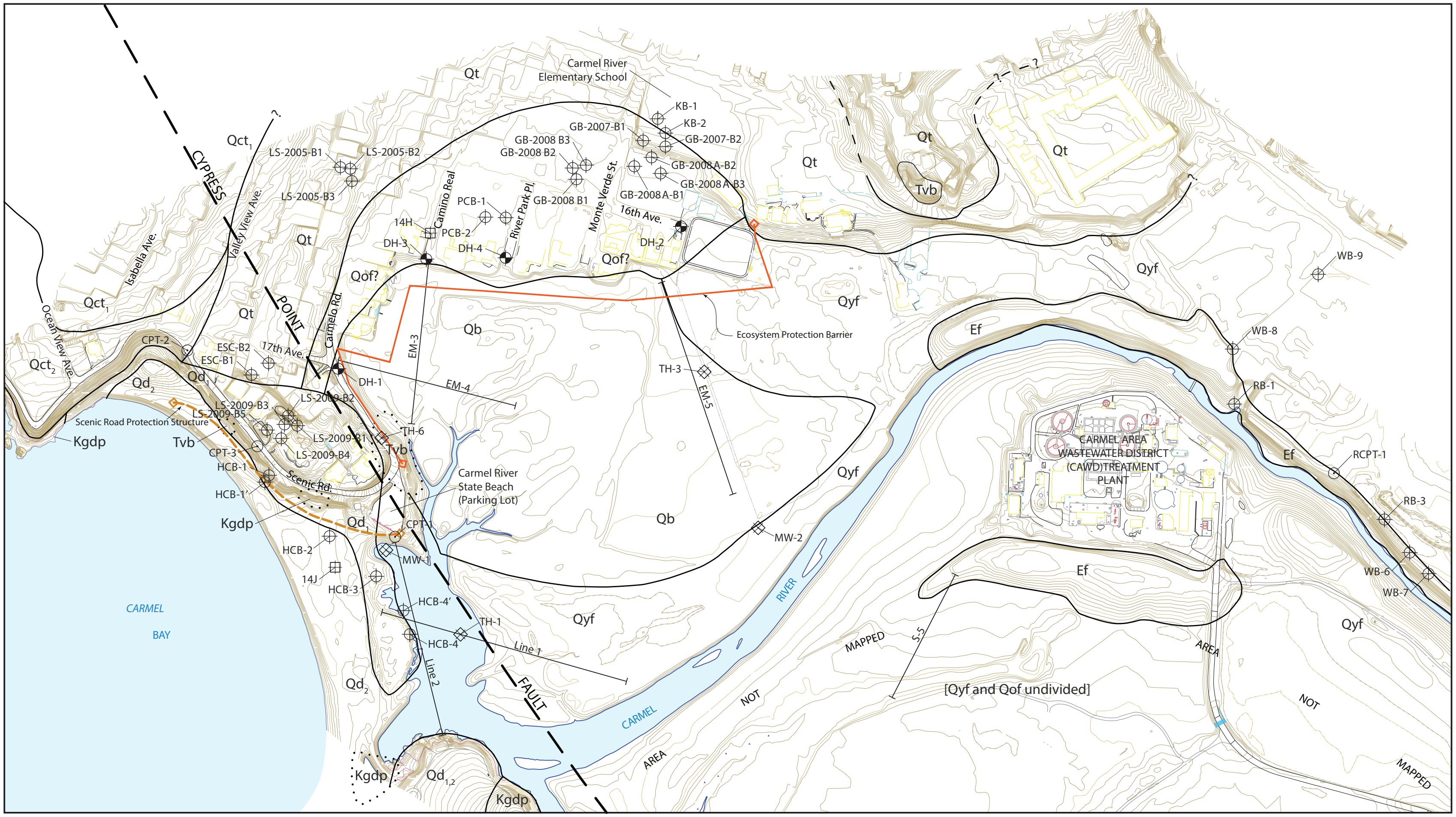
The beach topography is seasonally variable and dependent on numerous factors including river flow, wave height, period and direction, tide, mechanical or natural breaching, wind direction and strength, and river sediment deposition. The beach has been heavily managed and mechanical breaching has significantly altered the beach topography. By mechanically breaching in different locations each year, the beach to the north, south, and middle of the river mouth are unnaturally modified, eliminating the ability to determine the "natural" beach topography and breaching process.

4.5.1.2 Geologic Units

Based on the Geotechnical Report, the geologic units anticipated within the project study area include coastal terrace deposits, coastal dunes, beach sand, floodplain deposits, basin deposits, and earth fill. The distribution of the various geologic units is shown on the geologic site plan (**Figure 4.5-1**.). A brief summary of these geologic units and characteristics are presented below.

COASTAL TERRACE DEPOSITS

Coastal terrace deposits are deposited across wave-cut platforms that have undergone subsequent uplift. Sediments on these terraces are described as generally "semiconsolidated, moderately well sorted marine sand containing thin, discontinuous gravel-rich layers." Thickness of these deposits is



EXPLANATION

Earth Materials

- **Ef** Earth fill - various textures. Fill prisms along roads not mapped for legibility
- **Qd** Dune sand - locally subdivided into Qd_1 (older) and Qd_2 (younger)
- **Qb** Basin deposits - plastic clay and silty clay
- **Qyf** Younger floodplain deposits - fine sand and silt, minor discontinuous clay layers
- **Qof** Older floodplain deposits - fine sand and silt, minor discontinuous clay layers
- **Qt** Alluvial terrace deposits - silt, silty clay, sand and gravel; locally subdivided
- **Qct** Coastal terrace deposits - sand with thin, discontinuous gravelly layers
- **Tvb** Volcanic rocks - basaltic andesite flows and flow breccia
- **Kgdp** Granodiorite (porphyritic granodiorite of Monterey of Ross (1976))

Symbols

- Geologic contact, dashed where approximate, queried where uncertain, dotted where concealed
- Inferred, buried fault
- DH-4 — Exploratory drill hole (this investigation)
- CPT-2 — CPT sounding (this investigation)
- Exploratory drill hole (investigations by others)

KB-2	(Kleinfelder, 2011)
GB-2008A-B3	(Grice, 2008A)
GB-2008 B3	(Grice, 2008B)
PCB-2	(Pacific Crest, 2008)
LS-2009-B5	(Landset, 2009)
LS-2005-B5	(Landset 2005)
ESC-B2	(Earth Systems Consultants, 2010)
HCB-4	(Hydro-Search, 1981)
WB-9	(Wahler, 1989; compiled in Raas [2000])
RB-3	(Raas, 2000)
MW-3 / MW-2	(Staal, Gardner, Dunne, 1989b)
TH-6 / TH-6	(Staal, Gardner, Dunne, 1989b)
14H	(Previous borings compiled by Staal, Gardner, Dunne, 1989b)
RCPT-3 / CPT sounding	(Raas, 2000)

- Geophysical transects (Staal, Gardner, Dunne, 1989)
- Proposed Ecosystem Protection Barrier
- Scenic Road Protection Structure

Notes:

1. Base provided by Whitson Engineers
2. Geologic interpretation modified from Clark, Dupre and Rosenberg (1997), with additions
3. Scenic Road Protection Structure preliminary alignment provided by Moffat & Nichol
4. Ecosystem Protection Barrier preliminary alignment provided by Whitson Engineers

N

100 0 100 200

Scale in feet

Source: Pacific Geotechnical Engineers, 2013

Geologic Site Plan

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Planning and Environmental Consulting

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variable, but typically less than about 20 feet. The coastal terrace in the vicinity of the proposed SRPS project component site is mapped as the "Lighthouse terrace."

COASTAL DUNES

Younger (Pleistocene and Holocene) coastal dunes locally lap across and overlie the coastal terrace deposits in the vicinity of the proposed SRPS project component. Dune deposits consist of "unconsolidated, well-sorted fine- to medium-grained sand" up to about 75 feet thick.

BEACH SAND

Beach sand is mapped along the shore of Stewart's Cove,[1] and makes up the seasonal barrier across the mouth of the Carmel River. Texturally, beach sand is typically "unconsolidated, well-sorted, medium- to coarse-grained sand with local layers of pebbles and cobbles and thin discontinuous lenses of silt in back-beach areas."

FLOODPLAIN DEPOSITS

Floodplain deposits occur to the north and south of the Carmel River. The oldest of these floodplain deposits is mapped along a swath a few hundred feet north of, and roughly paralleling, the proposed EPB project component alignment. Texturally, these sediments consist of "unconsolidated, relatively fine-grained, heterogeneous deposits of sand and silt commonly including relatively thin layers of clay." Inset into these older floodplain deposits are younger floodplain deposits, which generally underlie the proposed EPB project component alignment. Texturally, these are very similar to older floodplain deposits with variable gravel content. These younger floodplain deposits are generally less than about 20 feet thick.

BASIN DEPOSITS

Basin deposits are mapped in the area of the Lagoon. Basin deposits are described as "unconsolidated, plastic clay and silty clay containing much organic materials, and locally containing interbedded thin layers of silt and silty sand."

EARTH FILL

Earth fill is present in many more localities than is shown in **Figure 4.5-1** (for clarity reasons). Developed and graded sites typically have discontinuous fill deposits, particularly at the outboard edges of graded pads on sloping ground, and the outboard shoulders of roads on sloping ground. The southern extent of fill at the interface between developed properties and State Parks land could strongly affect the ease with which any sort of driven floodwall can be constructed, especially if fill contains rubble or larger clasts.

The outboard edge of Scenic Road currently has a sloping sandy ramp that descends to the beach, which is underlain by a prism of rip-rap.

4.5.1.3 Bathymetry and Coastal Processes

The sea floor offshore of the Carmel River Beach is relatively steep, quickly dropping off to depths greater than 100 feet in the Carmel Canyon; however, very little detailed information exists on the nearshore bathymetry within the surf zone. **Figure 4.5-2** provides a detail from the NOAA navigation

[1] Stewart's Cove is located west of the proposed SRPS project component; please refer to the map shown in **Figure 3-3**.

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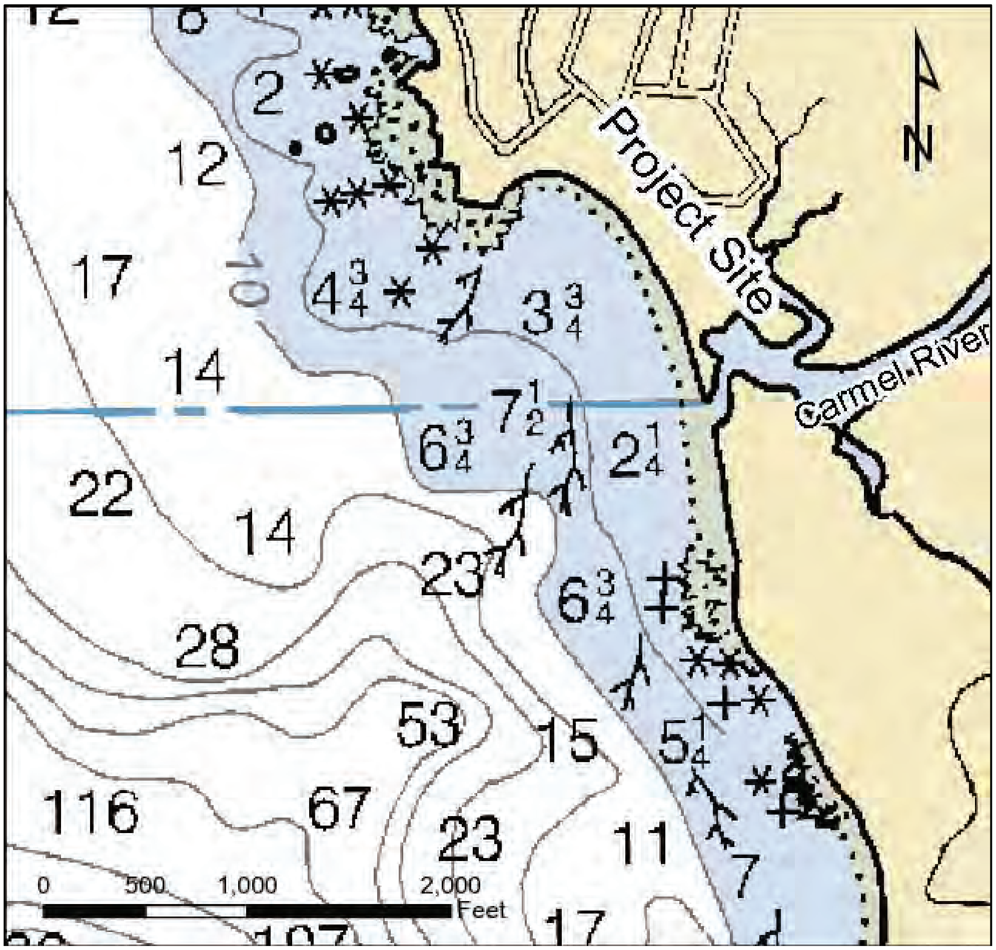
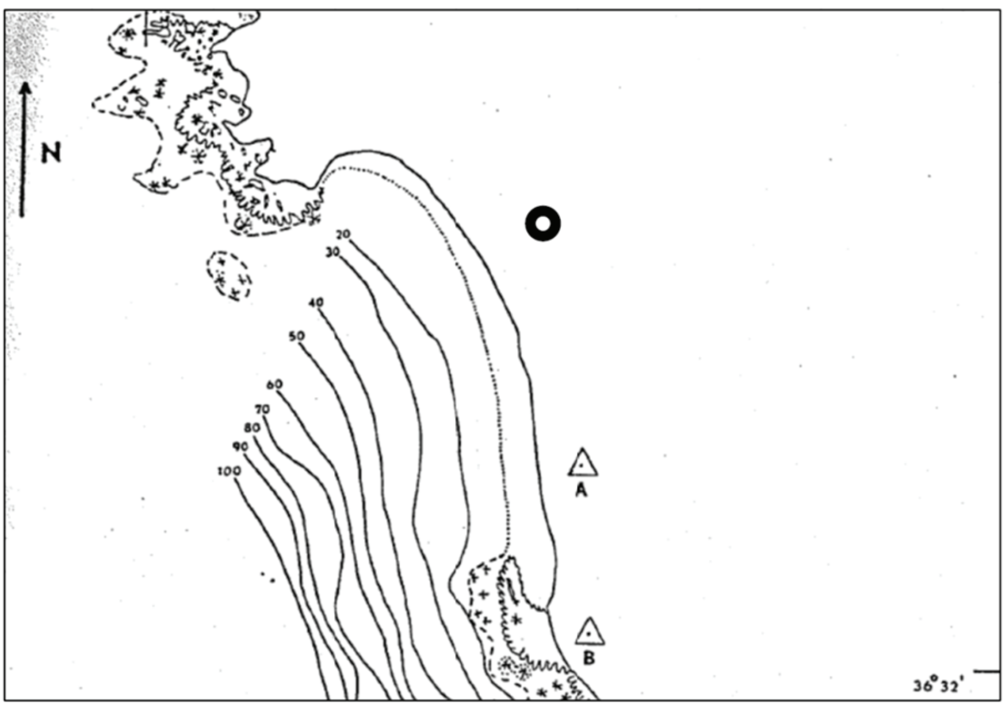


A.) Depths (in fathoms, MLLW) near project site (NOAA Chart)



B.) Nearshore Bathymetry (in ft, MLLW)
(Howell, 1972)

Bathymetry in Project Area

DD&A	Denise Duffy and Associates, Inc. Planning and Environmental Consulting	Date 10-12-2016 Scale	Figure 4.5-2

Source: Moffatt & Nichol, August 2013

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chart of the area, but survey dates are unknown and there is still a lack of detail in the direct project vicinity. A bathymetric survey performed in the early 1970's, with the locations of 20 to 100 feet depth contours, is provided in **Figure 4.5-2** (Howell, 1972). Rock outcroppings at the northern and southern headlands are evident in the figure, with the sea floor between the two headlands reported to be mantled by over five feet of fine to coarse sand.

LITTORAL TRANSPORT

Cross-Shore Transport

The periodic, orbital motion of water under waves is important in transporting sediment up and down the beach profile (cross-shore direction). Seasonal changes in wave climate, especially in locations that have a distinct winter storm season, induce corresponding changes in the state of a beach, where sediment is transported offshore during storm events and the beach slowly recovers during less energetic events. **Figure 4.5-3** depicts sediment transport in the Carmel Bay.

Because the Carmel River Beach is sheltered from the predominant wave direction, very little wave energy in the form of large, storm waves reaches the northern portions of the beach; instead, swell impacts the beach for most of the year, transporting sediment shoreward and building up the beach berm (Thornton, 2005). The high seasonal variability in shoreline position common for other area beaches is not observed here, with an estimated position variation of only +/- 10 m (Thornton, 2005).

Long-Shore Transport

Waves approaching a beach at some angle away from the perpendicular induce a small mean current parallel to the shoreline as they break across the surf zone. This current drives the corresponding transport of suspended sediment parallel to the beach, and gradients in this transport rate due to differences in nearshore wave height or wave incidence angle promote erosion or accretion of the beach face in different areas. The incident-angle driven transport gradients often alter the shoreline so that it tends to align with the predominant incident wave angle, diminishing transport rates so that an equilibrium condition exists.

Due to the shape of the Carmel River Beach system, long-shore transport is most likely northward in the north portion of the beach and southward in the south portion of the beach, serving to distribute sediment brought to the coast by the river along the length of the beach. This hypothesis was also verified in studies performed for Carmel Beach (Howell, 1972). The concave shape of the beach is largely aligned with the crests of the refracted and diffracted breaking waves, suggesting the beach is close to an equilibrium shape and transport magnitudes are relatively low (Thornton, 2005).

An additional mechanism other than oblique wave incidence may drive long-shore transport northwards toward the anchoring headland. Waves breaking across the surf zone induce a heightening of the mean water level known as wave setup, and larger waves produce setup of greater magnitude. Because of the sheltering effect of the northern headland, wave heights decrease northward along the beach resulting in a water level gradient that drives a northward flowing current (Thornton, 2005). While the magnitude of the transport due to this gradient is unknown, research at the more-exposed Ocean Beach in San Francisco shows that a setup-gradient induced long-shore current can greatly exceed that produced by oblique incidence or tide.

BEACH MORPHOLOGY

The slope of the beach progressively becomes flatter from the south to the north. Field observations by Professor Thornton of the Naval Postgraduate School show that the beach slope varies from about 12%

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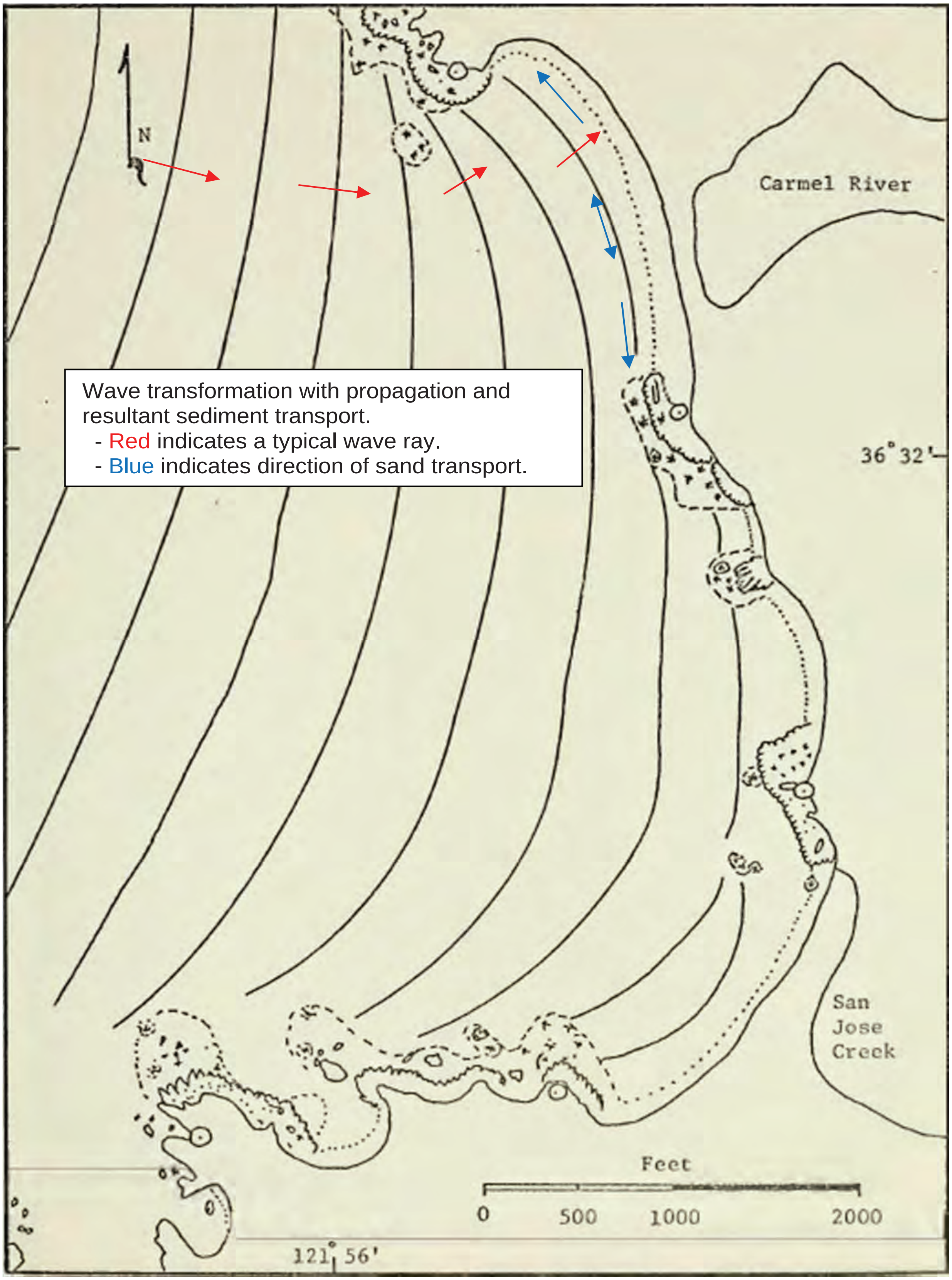

Wave Refraction Diagram for WNW, 11-second Swell (Howell, 1972)

Sediment Transport in Carmel Bay

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Scale	

Source: As cited in Moffatt & Nichol, August 2013

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at the north end of the beach to about 28% on the south end of the beach (Thornton, 2005). Sand grain size, and therefore wave energy, also increases from the north to the south end of the beach. Sand is deposited on the beach berm by wave action, and at high tides, waves overtop the berm depositing sand and debris on the back beach (nearest the Lagoon) (**Figure 4.5-4**). Thornton also determined that the beach is relatively stable and has not migrated over the past 130 years.

The beach topography is seasonally variable and dependent on numerous factors including river flow, wave height, period and direction, tide, mechanical or natural breaching, wind direction and strength, and river sediment deposition. After review of the surveys and data, it is evident that the beach is heavily managed and mechanical breaching significantly alters the beach topography. By mechanically breaching in different locations each year, the beach to the north, south, and middle of the river mouth are unnaturally modified, eliminating the ability to decipher the "natural" beach topography and breaching process.

A preliminary analysis of beach berm elevations for the 2003 to 2012 period indicates the following:

- The *low point* of the beach berm is generally about +14 feet and is to the south of the river mouth in most of the surveys (5 out of 7 surveys reviewed). The highest elevation of this low point was about 15.5 feet in December 2004.
- The *high point* is generally in the middle of the beach, and ranges from +16 to +17 feet (5 out of 7 surveys reviewed).
- The beach immediately north of the entrance is generally between the above two ranges of elevations and was as low as the southern portion in 2 of the 7 surveys reviewed, and actually was the high point in 2 of the 7 surveys reviewed.

WAVES

The wave climate offshore of the project site is characterized by long-period, energetic swell that typically approaches from the west through northwest (clockwise) directions. The location of the two closest wave measurement buoys are approximately 50 miles northwest and 30 miles south. The wave climate varies seasonally to a high degree. During the fall and winter seasons, North Pacific storms generate long period swells that propagate from the west through northwest directions, though infrequently southerly swells can occur as well. During the summer months, shorter period (local seas) waves predominate from the northwest; infrequent southern hemisphere swells are also present.

Carmel River Beach is largely protected from the predominant wave directions by both the southern end of the Monterey Peninsula and the rocky headland directly north of the beach. As long period, northwest waves propagate towards the shore, they undergo refraction due to changes in the bathymetry and diffract to a large degree by the protecting headlands, filtering out higher-frequency wave energy so that mostly low-frequency swell impacts the beach. Waves must be severely refracted in order to reach the beach. The beach is exposed to the rare, westerly storms, where wave focusing can amplify approaching waves (Thornton, 2005). At the northern portion of the beach, diffraction of wave energy from the sheltering headland results in further diminished waved that approach the curved portion of the beach at a northerly direction. Consequently, the waves arriving at the beach for most of the year, are swell waves, which act to move sand onto the beach and build the berm.

ASTRONOMICAL TIDES

Typical tidal water levels at the site was characterized using measurements from the Monterey, CA tide gage, located approximately seven miles north of the project site on the opposite side of the Monterey Peninsula. The lag time between water levels of this distance is less than five minutes, and differences

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A.) Photo taken 30 September 2005 showing evidence of overtopping of berm (rack line back of berm and water in the back beach) and the narrow distance between lagoon and ocean.

B.) 2003 aerial poto showing the rock basement of the south channel.

Source: Littoral Processes and River Breachings at Carmel River Beach, Thorton, 2005

Beach Morphology in Project Area

Denise Duffy and Associates, Inc.

Planning and Environmental Consulting

Date 10-12-2016

Scale

Figure 4.5-4

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in water levels are negligible. **Table 4.5-1** below gives the tidal datums at the proposed project site reference to Mean Lower Low Water (MLLW) and NAVD88 datums.

Table 4.5-1 Tidal Datums at the Proposed Project Site

Tidal Plane	Elevation (feet)	
	MLLW Datum	NAVD88 Datum
Mean Higher High Water (MHHW)	5.34	5.48
Mean High Water (MHW)	4.64	4.78
Mean Tide Level (MTL)	2.87	3.01
Mean Low Water (MLW)	1.1	1.24
Mean Lower Low Water (MLLW)	0	0.14
National Geodetic Vertical Datum 1988 (NAVD88)	-0.14	0

4.5.1.4 Soils

On-site soils are classified in the Monterey County Soil Survey (USDA, 1978). Soil is generally defined as the unconsolidated mixture of mineral grains and organic material that covers the land surfaces of the earth. Soils can develop on unconsolidated sediments and weathered bedrock. Soils at the site vary based upon the topography of the site. Soils at the site consist of mostly disturbed soils. Sources of current and historic ground disturbance are due mostly to agricultural activities. As shown on **Figure 4.5-5**, the Web Soil Survey (USDA-NRCS, 2013) identifies 14 map units within the project area: Alviso silty clay loam (Ac), Aquic xerofluvents, Coastal beaches (Cm), Elder very fine sandy loam, 2-9 % slopes (EbC), Metz fine sandy loam (Mf), Narlon loamy fine sand, 2-9% slopes (NcC), Oceano loamy sand, 2-15% slopes (OaD), Pacheco clay loam (Pa), Pico fine sandy loam (Pf), Salinas clay loam, 0-2% slopes (SbA), Santa Ynez fine sandy loam, 9-15% slopes (ShD), Sheridan coarse sandy loam, 15-30% slopes (SoE), Water (W), and Xerothents, dissected (Xd).

4.5.1.5 Faulting and Seismicity

<u>REGIONAL FAULTS</u>

The greater San Francisco/Monterey Bay Area is seismically dominated by the active San Andreas Fault system, the tectonic boundary between the northward moving Pacific Plate (west of the fault) and the North American Plate (east of the fault). This movement is distributed across a complex system of generally strike-slip, right-lateral, subparallel faults, as depicted in **Figure 4.5-6**.

Regional faults that have a potential to generate large magnitude earthquakes and significant ground shaking at the site are listed below in **Table 4.5-2**, and selected faults are described in detail in **Appendix F**. Map distances are derived from the USGS Quaternary Fault and Fold database (USGS and California Geological Survey, 2006).

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Soils Map

Figure 4.5-5

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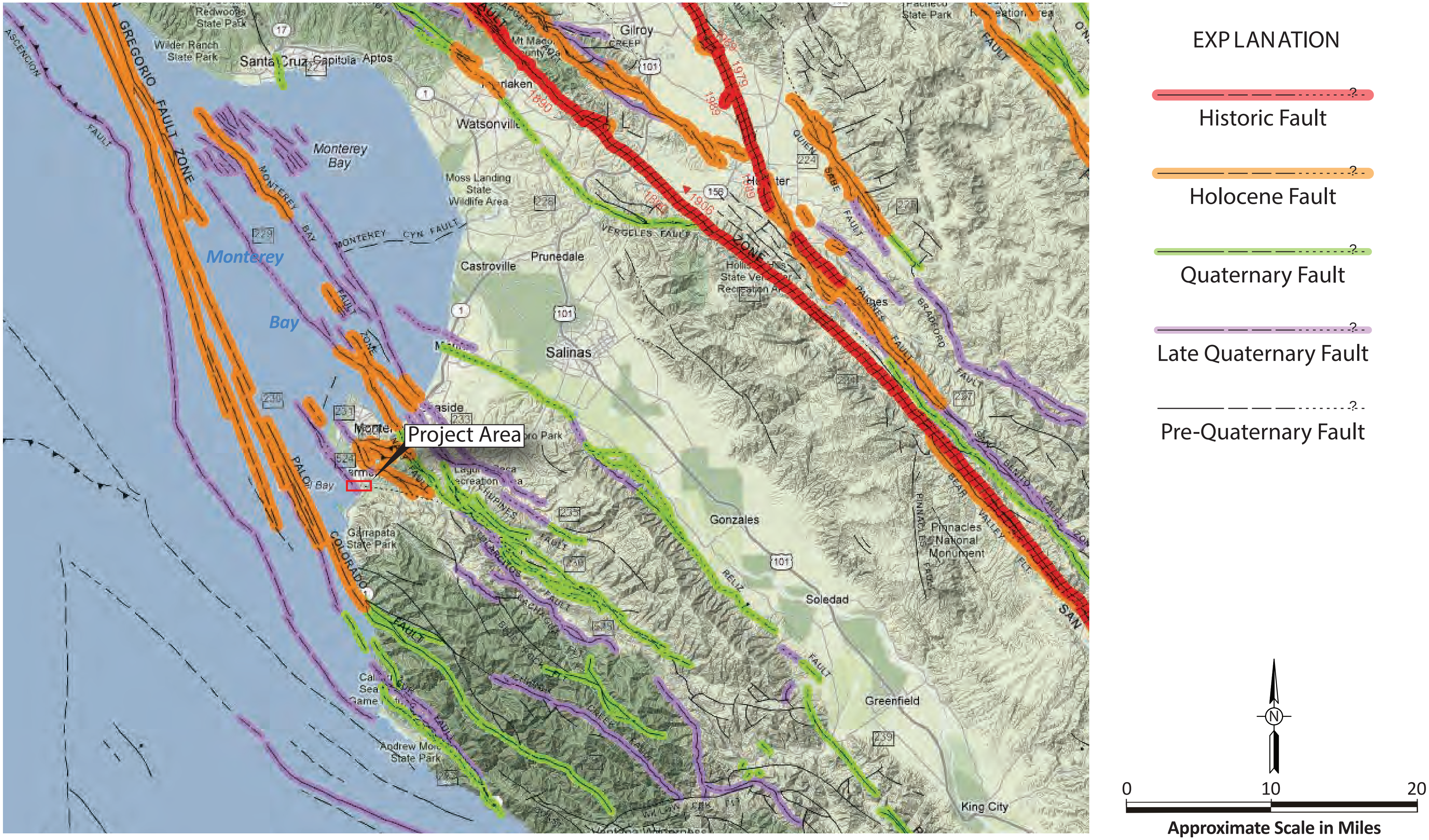

Source: Pacific Geotechnical Engineers, 2013

Regional Fault Map

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Table 4.5-2 Regional Faults

Fault	Approximate Distance (miles)	Direction from Project Site to Fault
Monterey Bay/Tularcitos	4.6	Northeast
Reliz	11.7	Northeast
Zayante-Vergeles	26	Northeast
San Andreas	30	Northeast
Sargent	34	Northeast
Calaveras	35	Northeast
Ortigalita	56	Northeast
Hayward	63	North

LOCAL FAULTS

The proposed project vicinity is transected by the Cypress Point Fault, which is not considered active. The proposed project site is not located within an Alquist-Priolo Earthquake Fault Zone and no mapped active faults are known to cross the proposed project site. The nearest fault is the Monterey Bay/Tularcitos Fault approximately 4.6 miles to the northeast. The probability of ground surface rupture at the proposed project site due to displacement is considered low. However, the proposed project site is located in a region of high seismicity. It is anticipated that during the useful life of the proposed project, the proposed project area will be subject to strong ground shaking. It is also anticipated that the area will periodically experience small to moderate magnitude earthquakes.

4.5.1.6 Events and Processes

FAULT RUPTURE

Evaluation of fault rupture hazard is based on the historic activity and recurrence of faulting along existing faults. Faults of known historic activity during the last 200 years, as a class, have a greater probability for future activity than faults classified as Holocene age (last 11,000 years), and a much greater probability of future activity than faults classified as Quaternary age (last 1.6 million years). However, certain faults have recurrent activity measured in tens or hundreds of years whereas other faults may be inactive for thousands of years before being reactivated. The magnitude, sense, and nature of fault rupture also vary for different faults or along different strands of the same fault.

As described above, the project vicinity is transected by the Cypress Point Fault, which is not considered active. The proposed project components are located in a seismically active region and a number of potentially active and active faults are located within proximity of the site. Current estimates suggest that there is a 62% probability of a large magnitude (6.7 or greater) earthquake in the San Francisco Bay Region as a whole in the 30-year period ending in 2031. The proposed project site is not, however, located within an Alquist-Priolo Earthquake Fault Zone. No active faults are known to transect the site.

GROUND SHAKING

Strong ground shaking may occur due to earthquake events along active faults nearby or distant to the proposed project site. Disregarding local variations in ground conditions, the intensity of shaking at different locations within the area can generally be expected to decrease with distance away from an earthquake source. Small to moderate earthquakes (magnitude less than 5.0 on the Richter Scale) are common in Monterey County. The most significant quakes affecting the County during the last century have included the 1906 San Francisco earthquake and the 1989 Loma Prieta earthquake. Research has shown that areas underlain by layers of unconsolidated, recent alluvium, and unconsolidated soil materials with high ground water have an increased risk of experiencing the damaging effects of ground shaking.

Due to its proximity to a number of major earthquake faults, it is reasonable to assume that the proposed project site would be exposed to seismically-induced ground shaking.

<u>SOIL LIQUEFACTION AND DYNAMIC SETTLEMENT</u>

Liquefaction is the transformation of soil from a solid to a liquid state as a consequence of increased pore-water pressures, usually in response to strong ground shaking, such as those generated during a seismic event. Loose, granular soils are most susceptible to these effects while more stable, silty clay and clay materials are generally somewhat less affected. The potential damaging effects of liquefaction include differential settlement, loss of ground support for foundations, ground cracking, heaving and cracking of structure slabs due to sand boiling, and buckling of deep foundations due to liquefaction-induced ground settlement. Dynamic settlement may also occur in loose, dry sands above the water table. In general, a relatively high potential for liquefaction exists in loose, sandy soils that are within 50 feet of the ground surface and are saturated (below the groundwater table).

The Holocene alluvium has a “high” liquefaction susceptibility, while the older (Pleistocene) alluvium has a “moderate” liquefaction susceptibility. Bedrock and upland areas are mapped has having a “low” liquefaction susceptibility. There are no known historic liquefaction sites from the 1906 and 1989 earthquakes. The proposed EPB alignment lies within zones to have moderate to high liquefaction susceptibility. Hazard mapping is unclear regarding the liquefaction susceptibility of the proposed SRPS project component alignment.

Lateral spreading is horizontal movement of soil toward a free face, such as a creek bank, typically associated with liquefaction. Lateral spreading is a failure within weaker soil material that causes the soil mass to move towards a free face or down a gentle slope. Lateral spreading generally occurs in shallow groundwater areas with unsupported embankments including natural creek banks, fill slopes, levees, etc. Areas that have a potential for lateral spreading within the study area are low-lying areas near river channels, sloughs, or other drainages. Liquefaction-induced lateral spreading can also occur on mild sloped (flatter than 5%) underlain by loose sands and a shallow groundwater table. If liquefaction occurs, the unsaturated overburden soil can slide as intact blocks over the lower, liquefied deposits, creating fissures and scarps.

<u>LANDSLIDES</u>

The occurrence of landslides is influenced by a number of factors, including slope angle, soil moisture content, vegetative cover, and the physical nature of the underlying strata. Landslides can be triggered by one or more specific events, including development-related construction, seismic activity, soil saturation, and fires. The primary factor in determining landslide potential is an unstable slope condition.

The landslide potential on the project site is considered to be low, as indicated by Monterey County’s Landslide Hazard Map.

<u>TSUNAMI</u>

Tsunamis are open sea tidal waves generated by earthquakes. Tsunami damage is typically confined to low-lying coastal areas. The proposed project site is located within the mapped tsunami inundation area (California Emergency Management Agency et al., 2009). According to the Monterey County Operational Area Tsunami Incident Response Plan (Monterey County Office of Emergency Services, 2007) a locally generated tsunami may occur if a large enough earthquake occurs in or near Monterey

Bay region. Such an earthquake could produce a tsunami that reaches shore in a matter of minutes. The plan states that, within Monterey County, there is a low likelihood of experiencing a tsunami. The most likely tsunami cause, though still relatively unlikely compared to other hazards, is a distant event, where there would be more than one hour to respond to a tsunami warning (Monterey County Office of Emergency Services, 2007).

EROSION POTENTIAL AND SEA LEVEL RISE

Surface soils tend to erode under the wearing action of flowing water, waves, wind, and gravity. Factors influencing erosion include topography, soil type, precipitation and other environmental conditions. Erosion is capable of having a large impact on shaping and changing the landscape, and may incidentally be accelerated by anthropogenic activities. Non-point sources, including impervious surfaces, construction activities, and road construction, can all accelerate the rate that soils are removed from hillsides. In general, granular soils with relatively low cohesion and soils located on relatively steep topography have relatively high erosion potential.

The proposed project site is identified to have a moderate to high erosion hazard. The sandy bluffs adjacent to the mouth of the Lagoon are at risk of erosion. These bluffs have been developed and erosion of these features threatens homes, roads, and other infrastructure. Severe erosion can undermine stability of natural and man-made slopes, foundations, and roadways. In past years, erosion has removed the seasonal beach from the water side of Scenic Road, reducing support for the road, surface drainage elements, protected Monterey Cypress trees, and beach access steps.

Coastal shoreline retreat is affected by long-term erosion, sea level rise, and storm events, and is forecast to worsen based on some projections of global warming causing the sea level to rise (ESA-PWA, 2014). Sea level rise is a complex and dynamic process ultimately controlled by levels of heat-trapping greenhouse gases in the atmosphere.[2] Globally, sea level rise is driven by two primary factors – global ice melt and thermal expansion of seawater – but locally there are numerous processes that can alter the rate, extent, and duration of changes in sea level. As such, accurately predicting sea level of the coming centuries for specific locations is very challenging.

Sea level rose approximately seven inches over the past century (1900-2005) along most of the California coast. The local tide gauge at Monterey dates back to 1973, but even during this short time period, a trend of sea level rise is evident at the rate of approximately 0.05 inches per year. Due to local oceanographic conditions, sea level in central California has been relatively stable or even declining over the past several decades. However, when the regional climate change patterns that drive local sea level trends shift, the Central Coast will very likely experience a rise in sea level that will correspond to, or may even exceed, the mean global rate of sea level rise.

In October 2010, the Coastal Ocean Working Group of the California Climate Action Team (CO-CAT) finalized the *State of California Sea-Level Rise Interim Guidance Document* (CO-CAT, 2010), which provided guidance for incorporating sea-level rise projections into planning and decision making for projects in California in response to Executive Order S-13-08, issued on November 14, 2008, that directed state agencies to plan for sea level rise and coastal impacts. The executive order also requested that the National Research Council (NRC) to issue a report on sea-level rise to advise California on planning efforts. The *Interim Guidance Document* was considered interim because it was expected that the document would be updated when the NRC report was completed. The final report

[2] This discussion on sea level rise has been excerpted from the Monterey Peninsula, Carmel Bay and Southern Monterey Bay Integrated Regional Water Management Plan (Monterey Peninsula Water Management District and DD&A, Inc., 2014) http://www.mpirwm.org/IRWM%20Library/IRWMPlan%20Final_whole.pdf

from NRC was released in June 2012 and the *Interim Guidance Document* has been updated; the *State of California Sea-Level Rise Guidance Document* (CO-CAT, 2013). Based on the NRC report, the *Sea-Level Rise Guidance Document* (2012) updated ranges of sea-level rise predicted for the years 2030, 2050, and 2100. These predictions are similar to the ones presented in the Interim Guidance Document, but have a wider range. In addition, the Sea-Level Rise Guidance Document acknowledges different rates of sea-level rise for regions north and south of Cape Mendocino, which is highlighted because the differences in tectonic activity north and south of Cape Mendocino (**Table 4.5-3**). According to this document, sea level rise south of Cape Mendocino is projected (using the year 2000 as a baseline) as: 0.13-0.98 feet between 2000 and 2030; 0.39-2.0 feet between 2000 and 2050; and 1.38-5.48 feet between 2000 and 2100 (CO-CAT, 2013). Coastal erosion and flooding, ongoing issues in the area, are also expected to increase with accelerating sea level rise.

Table 4.5-3. Sea Level Rise Projections using 2000 as the Baseline

Time Period	North of Cape Mendocino	South of Cape Mendocino
2000 – 2030	-4 to 23 centimeters (-.013 to 0.75 feet)	4 to 30 centimeters (0.13 to 0.98 feet)
2000 – 2050	-3 to 48 centimeters (-.01 to 1.57 feet)	12 to 61 centimeters (0.39 to 2.0 feet)
2000 – 2100	10 to 143 centimeters (0.3 to 4.69 feet)	42 to 167 centimeters (1.38 to 5.48 feet)

Source: CO-CAT, 2013

The NRC report identified the projected sea level rise for San Francisco (the nearest location included in the report to the proposed project site) for the year 2050 (using 2000 as a baseline) is 11 inches ±4 inches, with total range of estimates of 5 to 24 inches. A graphic showing the NRC's projected sea level rise to the year 2100 is provided in **Figure 4.5-7** below.

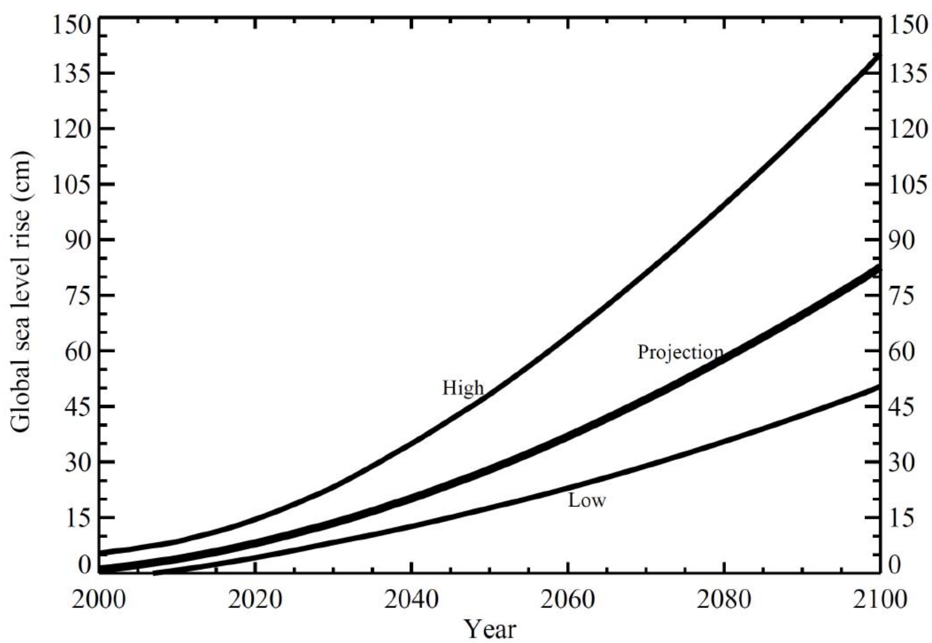

Figure 4.5-7. Range of projections of global sea level rise (NRC, 2012).

The NRC's study also notes that "changes in regional meteorological and climate patterns, including El Niños, coupled with rising sea level, are predicted to result in increasing extremes in sea levels. Models suggest that sea-level extremes will become more common by the end of the 21st century. Waves riding on these higher water levels will cause increased coastal damage and erosion—more than that expected by sea-level rise alone."

Coastal erosion in the proposed project area is expected to increase with accelerating sea level rise. The proposed SRPS project component is located within the 100-year Coastal Erosion Hazard Zones as mapped by the Pacific Institute (2009). The proposed EPB project component is located outside the identified coastal erosion hazard area, specifically outside the year 2100 envelope for coastal erosion.

EXPANSIVE SOILS

Expansive soils shrink and swell as a result of moisture changes. This can cause heaving and cracking of slabs-on-grade, pavements, and structures founded on shallow foundations. Structures or improvements built atop expansive soils may be subject to damage from soil shrinkage and swelling, associated with wetting and drying. A soil with a higher plasticity index is generally more prone to shrinkage or swelling in response to seasonal rainfall.

The near-surface soils at the proposed project site are generally low plasticity silts and sand that have low expansion potential.

SOIL COLLAPSE POTENTIAL

Collapsible soil is broadly defined as loose and cemented soil with low moisture content that is susceptible to a large and sudden reduction in volume upon wetting, with no increase in vertical stress. The process of soil collapse upon wetting is referred to as hydro-collapse. Another type of collapse can occur in saturated soil bearing soluble minerals when subjected to continuous leaching. Some common soluble soil minerals include calcium chloride, magnesium chloride, sodium chloride, potassium chloride, gypsum, anhydrite, dolomite, and calcium carbonate. The composition of minerals dissolved in leaching water will affect the soil mineral dissolution rate.

The most common types of collapsible soil include alluvial soils, eolian deposits, and residual soils formed by extensive weathering of parent materials such as granitic rock. Within the proposed project area alluvial materials, and residual soil over granodiorite are present. Settlement may occur where these materials are loose, relatively dry, and subjected to a significant increase in moisture content.

4.5.2 Regulatory Environment

4.5.2.1 Federal

The Federal Disaster Mitigation Act of 2000 (Public Law 106-390), which was adopted by Congress in October 2000, requires state and local governments to develop hazard mitigation plans in order to apply for federal grant assistance for disaster relief. The County, in coordination with all of its incorporated municipalities, is preparing a comprehensive update to its Multi-Jurisdictional Hazard Mitigation Plan. The plan, which was initially developed and adopted in 2007, is intended to identify local policies and actions to reduce the risk and future losses from natural hazards such as flooding, severe storms, earthquakes, and wildland fires. The plan also serves to meet key federal planning regulations which require local governments to develop a hazard mitigation plan as a condition for receiving certain types of non-emergency disaster assistance, including funding for hazard mitigation projects. The County and the cities of Carmel-by-the-Sea, Del Rey Oaks, Gonzales, Greenfield, King City, Marina, Monterey, Pacific Grove, Salinas, Sand City, and Soledad have each adopted the plan by resolution. A revised draft Multi-

Jurisdictional Hazard Mitigation Plan was prepared in 2014 (Monterey County Hazard Mitigation Planning Team and AECOM, 2014).

4.5.2.2 State

CALIFORNIA ALQUIST-PRIOLO EARTHQUAKE FAULT ZONING ACT AND SEISMIC HAZARD MAPPING ACT

The Alquist-Priolo Earthquake Fault Zoning Act was enacted in 1972 to minimize hazards from fault rupture by prohibiting structures for human occupancy across the trace of an active fault (within 50 feet). The Act requires delineation of "Earthquake Fault Zones," in which cities and counties cannot issue development permits until geologic investigation shows that development within such zones is not threatened by future faulting. The Seismic Hazards Mapping Act was adopted in 1990 to protect the public from earthquake hazards including ground shaking, liquefaction, seismically induced landslides, and other related ground failure. Maps showing seismic hazard zones, prepared by the California Geological Survey, identify areas susceptible to seismic hazards that may have special requirements, including additional geotechnical analysis (California Geological Survey, 2007, 2014).

SEISMIC HAZARDS MAPPING ACT

Like the Alquist-Priolo Act, the Seismic Hazards Mapping Act of 1990 (PRC Sections 2690 to 2699.6) is intended to reduce damage resulting from earthquakes. While the Alquist-Priolo Act addresses surface fault rupture, the Seismic Hazards Mapping Act addresses other earthquake-related hazards, including strong groundshaking, liquefaction and seismically induced landslides. Its provisions are similar in concept to those of the Alquist-Priolo Act. The State is charged with identifying and mapping areas at risk of strong groundshaking, liquefaction, landslides, and other corollary hazards. Cities and counties are required to regulate development within mapped Seismic Hazard Zones.

Under the Seismic Hazards Mapping Act, permit review is the primary mechanism for local regulation of development. Specifically, cities and counties are prohibited from issuing development permits for sites within Seismic Hazard Zones until appropriate site-specific geologic and/or geotechnical investigations have been conducted and measures to reduce potential damage have been incorporated into the development plans. There are no jurisdictions within Monterey County that are included within the State Seismic Hazards Mapping Act.

BUILDING CODES

The California Building Code (CBC), which is codified in CCR Title 24, Part 2, was promulgated to safeguard the public health, safety, and general welfare by establishing minimum standards related to structural strength, egress facilities, and general building stability. The purpose of the CBC is to regulate and control the design, construction, quality of materials, use/occupancy, location, and maintenance of all building and structures within its jurisdiction. Title 24 is administered by the California Building Standards Commission, which, by law, is responsible for coordinating all building standards. The 2013 CBC is based on the 2006 International Building Code (IBC) published by the International Code Conference. In addition, the CBC contains necessary California amendments that are based on the American Society of Civil Engineers (ASCE) Minimum Design Standards 7-05. ASCE 7-05 provides requirements for general structural design and includes means for determining earthquake loads, as well as other loads (e.g., flood, snow, wind) for inclusion in building codes. The provisions of the CBC apply to the construction, alteration, movement, replacement, and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures throughout California.

The earthquake design requirements take into account the occupancy category of the structure, site class, soil classifications, and various seismic coefficients, all of which are used to determine a Seismic Design Category (SDC) for a project. The SDC is a classification system that combines the occupancy categories with the level of expected ground motions at the site and ranges from SDC A (very small seismic vulnerability) to SDC E/F (very high seismic vulnerability and near a major fault). Design specifications are then determined according to the SDC.

STORM WATER POLLUTION PREVENTION PLAN

Construction activity that disturbs one or more acres of soil, or less than one acre but is part of a larger common plan of development that in total disturbs one or more acres, must obtain coverage under the General Permit for Discharges of Storm Water Associated with Construction Activity (Construction General Permit, 99-08-DWQ). Construction activity subject to this permit includes clearing, grading, and disturbances to the ground such as stockpiling or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of a facility. The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Program (SWPPP). The SWPPP includes construction mitigation measures such as desilting basins, silt fences, hydroseeding of slopes, and monitoring and clean-up requirements.

4.5.2.3 Regional/Local

RELEVANT PLANNING DOCUMENTS

The 1982 Monterey County General Plan, Carmel Area Land Use Plan, Carmel Area Coastal Implementation Plan, Point Lobos State Reserve and Carmel River State Beach General Plan, California Coastal Act, and California PRC contain a variety of policies related to the protection from geologic and soil hazards. Please refer to **Section 4.9, Land Use and Planning** for a description of these regulations and plans, and **Appendix C, Applicable Land Use Plans, Policies, and Regulations Consistency Analysis for the Carmel Lagoon Project** for a list of relevant policies and the consistency analysis.

MONTEREY COUNTY CODE

Chapter 16.08 of the Monterey County Code identifies rules and regulations to control all grading, including excavations, fills and embankments, and establishes the procedures for the issuances of grading permits. Chapter 16.08 is intended to minimize erosion as a result of ground disturbing activities.

Chapter 16.12 (Erosion Control) of the Monterey County Code sets forth required provisions for project planning, preparation of erosion control plans, runoff control, land clearing, and winter operations; and establishes procedures for administering those provisions. The code requires that specific design considerations be incorporated into projects to reduce the potential of erosion and that an erosion control plan be approved by the County prior to initiation of grading activities.

Hazardous area development standards identified in the regulations for development in the Carmel Area (Chapter 20.146, Monterey County Coastal Implementation Plan) requires that a geological report be prepared for projects in a number of cases, including projects located within 50 feet of the face of a cliff or bluff. The report shall be prepared by registered geologist or engineering geologist, as deemed appropriate by the County. The report shall be consistent with the "Guidelines for Geologic/Seismic Reports" of the California Division of Mines and Geology, and is required to include specific elements, as applicable to the site and proposed structure.

4.5.3 Impacts and Mitigation

4.5.3.1 Thresholds of Significance

Based on Appendix G of the State CEQA Guidelines, the project would result in significant impacts related to geology, soils, and seismicity if it would:

a. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
   - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault,
   - Strong seismic ground shaking,
   - Seismic-related ground failure, including liquefaction,
   - Landslides;

b. Result in substantial soil erosion or the loss of topsoil;

c. Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse;

d. Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property; or

e. Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewer are not available for the disposal of waste water.

4.5.3.2 Impact Analysis Overview

APPROACH TO ANALYSIS

The potential for impacts related to geology, soils, and seismicity are evaluated according to the significance criteria identified in **Section 4.5.3.1**. Each proposed project component site has been evaluated with respect to existing published data, mapping and research and the analysis of project effects is based upon the results of the Geotechnical Report prepared for the project by Pacific Geotechnical Engineering (2013) and the Coastal Analysis prepared by Moffatt & Nichol (2013b); both reports are contained in **Appendix F** of this EIR.

The Geotechnical Report identifies seismic, geologic and geotechnical hazards and constraints at the project sites and identifies the types of measures and engineering criteria that can be incorporated into project designs to prevent damages to facilities or properties or injury to people. The Geotechnical Report concluded that construction of the proposed EPB and SRPS project components is feasible from a geotechnical perspective provided that appropriate design, engineering, and construction considerations are incorporated into the projects once detailed design information is developed.

The County would have site-specific geotechnical investigations completed for the proposed EPB and SRPS project components, requiring foundations and specialized soils engineering work, as applicable to each component. Currently, preliminary (30%) design plans have been prepared for both the proposed EPB and SRPS project components. Site-specific geotechnical studies are essential for the final design of the proposed EPB and SRPS project components because they contain the information that informs the structural design of foundations and determines whether the geologic materials underlying the proposed facilities are capable of supporting the proposed uses without risk of detrimental effects from potential hazards associated with problematic soils, liquefaction, or excessive seismic shaking. Geotechnical investigations are required under the CBC for most structures as well as by the County. Based on field observation and laboratory testing, the geotechnical engineer can assess whether the soils are adequate to support the structure under static (non-earthquake) or seismic conditions. If corrective work is necessary to remedy the problem soils or otherwise unstable ground condition, the geotechnical engineer would recommend approaches to correct the condition. Geotechnical engineering recommendations are typically standard engineering practices that have been proven elsewhere to increase the geotechnical performance of an underlying soil or bedrock material. This impact analysis assumes that the County will incorporate all geotechnical recommendations set forth by the project geotechnical engineer.

PROPOSED ECOSYSTEM PROTECTION BARRIER AND SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENTS GEOTECHNICAL CONSIDERATIONS

The engineering consultants have prepared Preliminary 30% Plans for the proposed EPB and SRPS project components. The engineering consultants for the proposed project would incorporate the recommendations from the site-specific geotechnical investigations required by the County into final design. The analysis in this section incorporates the preliminary findings of the Geotechnical Report, as well as other referenced engineering studies, and takes into consideration that the finalized engineering design criteria for the proposed EPB and SRPS project components would be developed during the final stage of geotechnical evaluation.

The Geotechnical Report relied on subsurface data collected and published data available through federal and state agencies and previous local geotechnical investigations. The purpose of the preliminary investigation was to provide a characterization of the geologic, seismic, and subsurface conditions along the proposed component alignments. The preliminary investigation evaluated the potential geologic and seismic hazards as well as geotechnical engineering considerations. The information gathered through the preliminary investigation included geologic setting, subsurface soil and geologic conditions, general groundwater conditions, potential geologic hazards (i.e. ground motion, corrosive soils, and liquefaction), and construction considerations. The findings of the Geotechnical Report did not indicate that site conditions would preclude the construction and operation of the proposed EPB and SRPS project components.

Final geotechnical evaluations of the proposed EPB and SRPS project components would be completed following project approval and prior to obtaining final County building permits. The final geotechnical study would build off of the previously completed Geotechnical Report and focus on the specific geologic conditions along each alignment. The final study would involve additional soil sampling and soil laboratory analysis, field reconnaissance, and geotechnical engineering analysis to develop the final design criteria for the proposed EPB and SRPS project components. The recommendations developed under the final level of geotechnical study provides designers and construction contractors with necessary engineering details needed for all aspects of the final design such as seismic criteria considerations, maximum allowable displacements for settlement, excavation characteristics, trench stability, temporary shoring, dewatering, backfill requirement, and traffic surcharge loading. The County and project engineers would incorporate the recommendations developed by the final geotechnical study into the design. The recommendations could include soil conditioning, compaction, removal of problematic soils, installation of foundation piers, and special trench backfilling. These standard engineering practices are applied at construction sites throughout California.

SEISMIC CONSIDERATIONS

In California, an earthquake can cause injury or property damage by: (1) rupturing the ground surface, (2) violently shaking the ground, (3) causing the underlying ground to fail due to liquefaction, or (4) causing enough ground motion to initiate slope failures or landslides, any of which could damage or destroy structures. The checklist items in Appendix G of the State CEQA Guidelines, which provide the basis for most of the significance criteria in **Section 4.5.3.1**, above, reflect the potential for large earthquakes to occur in California and recommend analysis of the susceptibility of the proposed project sites to seismic hazards and the potential for the proposed project to exacerbate the effects of earthquake-induced ground motion at the proposed project sites and surrounding areas. Impacts associated with seismic hazards would be considered significant if the potential effects of an earthquake on a particular site could not be mitigated by an engineered solution. The significance criteria do not require elimination of the potential for structural damage from seismic hazards. Rather, the criteria require an evaluation of whether significant seismic hazards could be minimized through engineering design solutions that would reduce the associated risk of loss, injury, or death.

State and local code requirements ensure buildings and other structures are designed and constructed to withstand major earthquakes, thereby reducing the risk of collapse and the associated risks to human health and safety and private property. The code requirements have been developed through years of study of earthquake response and the observed performance of structures during significant local earthquakes (e.g. the 1989 Loma Prieta Earthquake) and others around the world. As discussed in **Section 4.5.2, Regulatory Environment**, the proposed project would comply with federal, state, and local laws regulating construction. The laws ensure that proposed development sites are adequately investigated and that seismic hazards are evaluated and addressed in the proposed project design and construction. These laws include the Seismic Hazards Mapping Act, the CBC, and County ordinances/codes pertaining to excavation, grading, and site development in geologic hazard zones (described in **Section 4.5.2.3**, above). The California Geological Survey Guidelines for Evaluating and Mitigating Seismic Hazards (Special Publication 117A) (California Geological Survey, 2008) provides guidance for evaluating and mitigating seismic hazards as required by PRC Section 2695(a).

As discussed above, site-specific geotechnical investigations are conducted to determine the presence of problematic soils and identify seismic hazards on a subject site. These investigations identify the geologic and seismic setting of a subject site and provide feasible engineering recommendations to remedy potentially adverse soil and seismic conditions. Site-specific geotechnical investigations also provide the necessary soil information required by structural engineers to ensure structures and buildings are designed appropriately to withstand earthquake ground motion. Grading plans, foundation designs, and structural designs are prepared based on the geotechnical recommendations presented in the site-specific geotechnical investigation and other pertinent requirements of the CBC.

AREAS OF NO IMPACT

Some of the significance criteria outlined above are not applicable to the proposed project or the proposed project would not result in impacts related to these criteria, as explained below.

(a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

- *Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault,*
- *Strong seismic ground shaking,*
- *Seismic-related ground failure, including liquefaction,*

- *Landslides;*

(No impact during the construction of the proposed project) Construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would be temporary and, as such, would not expose people or structures to a substantial risk due to fault rupture, seismic shaking or seismically-induced ground failure, liquefaction, or landslides. Operational effects of seismic hazards on people and structures after construction is evaluated below under **Impact GS-2**.

(d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property. (No impact during the construction or operation of the proposed project). The near-surface soils at the proposed project site are generally low plasticity silts and sand that have low expansion potential. Thus, the significance criterion (d) related to expansive soils is not applicable to the proposed project and is not discussed further.

(e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water. (No impact during construction or operation of the proposed project). The proposed project does not include the use of septic tanks or alternative waste water disposal systems. Thus, the significance criterion (e) related to septic tanks and alternative waste water disposal systems is not applicable to the proposed project and is not discussed further.

4.5.3.3 Impacts and Mitigation Measures

Impact GS-1: <u>Construction-Related Erosion and Loss of Topsoil</u>. Construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would not result in substantial erosion or loss of topsoil. (Criterion b) (EPB: Less-Than-Significant) (SRPS: Less-than-Significant) (ISMP: Less-than-Significant) (Project Overall: Less-than-Significant)

Construction at the proposed project sites would involve ground disturbance including site preparation, grading, and/or trenching. Most of the proposed project area is identified as being within areas of moderate to high erosion hazard. The potential for erosion or loss of topsoil impacts during construction at each of the proposed project sites is discussed below.

Potential erosion that may result from grading, trenching, and other soil disturbance during construction would generally be controlled during construction with implementation of erosion control plans as required by the County prior to issuance of easements, grading, and building permits. Additionally, standard construction practices to prevent and minimize construction-related erosion would be included in construction documents and SWPPP that are required pursuant to federal and state NPDES regulations and permits for construction on one acre or more (please refer to **Section 4.8, Hydrology and Water Quality** for further explanation of SWPPP requirements). The SWPPP would include BMPs to prevent erosion, such as: the use of silt fences or other physical barriers to prevent erosion and sedimentation into water bodies; use of desilting basins; limitations on work during storm events and control of runoff; and post-construction revegetation and drainage requirements, including low impact development standards.

A 401 Certification under Section 401 of the CWA (please refer to **Section 4.8, Hydrology and Water Quality** for additional information on Section 401 of the CWA) would be required prior to commencing construction. A dewatering or diversion plan as required under Section 401 Certification would be implemented to comply with water quality standards for turbidity and to dissipate the energy of the diverted or dewatering discharge to reduce erosive impacts. Additionally, the 401 Certification would require erosion control management practices, including protection of the excavated material from reentering the ocean or other waters of the state.

Proposed Ecosystem Protection Barrier Project Component

Excavations and grading required for the proposed EPB project component alignment are not anticipated to be any deeper than a few feet. As such, the proposed EPB project component would not result in substantial erosion or loss of topsoil. Furthermore, a 401 Certification would be required prior to commencing construction and would require the implementation of a dewatering or diversion plan and other measures to minimize impacts associated with erosion. Construction activities on one acre or more are subject to the permitting requirements of the NPDES General Permit for Discharges of Stormwater Runoff Associated with Construction Activity (General Construction Permit) (SWRCB Order No. 2009-09-DWQ; Modified 2010-0014-DWQ). Therefore, since the construction site would be greater than one acre in size, implementation of a SWPPP would also be required at this site as part of the General Construction Permit, which would insure erosion and loss of topsoil impacts would be less-than-significant.

Proposed Scenic Road Protection Structure Project Component

As presently planned, construction of the proposed SRPS project component would require excavations of up to about 25 feet for construction of the buried armor rock (rip-rap). The excavations would be predominantly in sand with little or no cohesion, with granitic rock anticipated at depth. The bottom portion of the excavations would also be likely under water. The excavations would require shoring or sloping the excavation sidewalls at a safe inclination. Dewatering would also be required to allow construction to proceed in a “dry” condition. A related consideration would also be the protection of excavations from ocean swell and waves.

The depth to bedrock along the proposed SRPS project component alignment ranges from approximately 17 to 29 feet. Based on the available information, the top of bedrock throughout this area represents a (buried) wave-cut platform that likely does not have substantial relief. There is a potential for some topographic relief on this surface since the Cypress Point fault is an en-echelon (stepped) fault, which could result in a more complicated top-of-bedrock surface; the site-specific, design-level geotechnical investigation will need to more closely define variability in the top of bedrock elevation. All available information constrains the position of the main Carmel River channel axis since at least Pleistocene time to a location south of the proposed SRPS project component, as indicted by the southward deepening of the top-of-bedrock surface documented in borings.

The proposed SRPS project component alignment would require substantial grading and excavation. A 401 Certification would be required prior to commencing construction and would require the implementation of a dewatering or diversion plan and other measures to minimize impacts associated with erosion. Construction activities on one acre or more are subject to the permitting requirements of the General Construction Permit. Therefore, since the construction site would be greater than one acre in size, implementation of a SWPPP would also be required at this site as part of the General Construction Permit, which would insure erosion and loss of topsoil impacts would be less-than-significant.

Proposed Interim Sandbar Management Plan Project Component

Implementation of the proposed ISMP project component would require grading and other ground disturbing activities, when necessary, to mechanically breach the Lagoon in the short-term. By definition, the breaching of the Lagoon, naturally or mechanically, results in erosion and the loss of topsoil in the area. The mechanical breaching of the Lagoon would result in substantial erosion and loss of topsoil in the area; however, the MOU requires the implementation of management criteria that subsequent to the opening action and after high inflows from the river have receded, the Lagoon shall either be allowed to naturally close or remain with an open outlet channel flowing over the beach in a meandering channel that is designed to mute tidal influence and rapid draining of the Lagoon. If excessive scour is observed in the constructed outlet channel, the Lagoon shall immediately be closed by the placement of sand that is free of contaminants. As a result, potential substantial erosion and loss of topsoil impacts are reduced to a less-than-significant level with implementation of the MOU.

Impact Conclusion

The construction of the proposed project could result in soil erosion or loss of topsoil due to ground disturbance and construction at all proposed project sites. However, State requirements for implementation of a SWPPP as well as implementation of measures required by the 401 Certification and General Construction Permit would ensure this impact would be less-than-significant. In addition, implementation of the proposed ISMP project component includes measures to reduce the potential for substantial erosion and loss of topsoil and the impact would be less-than-significant. No mitigation measures are required.

Impact GS-2: <u>Construction-Related Soil Collapse and Soil Constraints</u>. Construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component would be located on geologic units or soils that are unstable, or that may become unstable during project construction, and potentially result in soil instability or collapse; however, this exposure would not result in a substantial risk to people or structures. (Criterion c) (EPB: Less-Than-Significant) (SRPS: Less-than-Significant) (ISMP: Less-than-Significant) (Project Overall: Less-than-Significant)

Construction of the proposed project components would be located on geologic units or soils that are considered unstable. Liquefaction is a phenomenon in which saturated, cohesion-less soils are subject to a temporary loss of shear strength during seismic shaking. Lateral spreading is a failure within a nearly horizontal soil zone, commonly associated with liquefaction, which causes the overlying soil mass to move towards a free face or down a gentle slope.

The proposed EPB and SRPS project components would be designed in accordance with recommendations of site-specific geotechnical investigations prepared by a California-licensed geotechnical engineer, or engineers. Design-level geotechnical investigation would be prepared for the proposed EPB and SRPS project components to inform final design and construction that address seismic hazards and expansive soils, and the best means for complying with all applicable state and local code requirements and other protective standards. The investigations would include soil sampling and laboratory testing of materials in order to provide design criteria and recommendations applicable to foundation design, earthwork, backfill, site preparation, trenching, dewatering, tunneling, materials, and other factors related to these proposed project components. All recommendations of the site-specific geotechnical investigations would be incorporated into the final design and construction specifications for each proposed project component, and would be implemented as specified by the construction contractors. Project construction would comply with applicable codes and requirements of the CBC with California additions (CCR Title 24), and applicable County construction and grading ordinances.

Temporary construction slopes may range up to 2:1 or 2.5:1 (horizontal:vertical) inclinations. In accordance with requirements of state and local agencies and professional engineering standards, the contractor would use continuous shoring as necessary to protect existing improvements, where temporary slopes are not feasible. Where flowing sand conditions warrant special excavation and shoring procedures, trench shields and limited open trench conditions would be used to protect adjacent improvements and existing utilities. Given these considerations, the construction of the proposed project components, as described in more detail below, would result in a less-than-significant impact due to soil instability or collapse.

PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT

Subsurface conditions along the proposed EPB project component alignment consist predominantly of sand and varying relative density and isolated layers of firm to hard clays and silts. The upper sand layers are generally loose to medium dense, whereas the deeper sands are generally dense to very dense. Gravels and cobbles have been reported generally below a depth of about 42 feet except in some areas where gravel-sized granitic fragments were reported as shallow as 13 feet. The presence of gravels and cobbles (especially boulders, if present) must be considered when selecting the type and size of the sheet piles and the driving equipment to be used (which needs to match the pile type). Pre-drilling may be considered to “loosen” the subsurface soils, thereby reducing resistance to pile driving.

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

The construction of the proposed SRPS project component may require excavations of up to about 25 feet. The excavations would be predominantly in sand with little or no cohesions, with granitic rock anticipated at depth. The bottom portion of the excavations would also likely be under water. The excavations would require shoring or sloping the excavation sidewalls at a safe inclination. Dewatering would also be required to allow construction to proceed in a “dry” condition. A related consideration would also be protection of excavations from ocean waves.

PROPOSED INTERIM SANDBAR MANAGEMENT PLAN PROJECT COMPONENT

The implementation of the proposed ISMP project component would occur in the same geologic area described above in the proposed SRPS project component discussions (i.e., sand). However, the implementation of the proposed ISMP project component does not require the construction of any structures that would be adversely affected by unstable soils or other geologic units.

Impact Conclusion

The construction of the proposed EPB and SRPS project components and implementation of the proposed ISMP project component could result in exposure to unstable soils due to presence of dune sands that may cave continuously in some areas. Construction at these sites may require temporary shoring to protect construction workers from injury due to potential soil collapse. Although there is the potential for soil collapse during trenching and excavation, compliance with the requirements of state and local agencies and professional engineering standards would ensure that this impact would be less-than-significant. No mitigation measures are required.

Impact GS-3: Exposure to Fault Rupture. The proposed EPB and SRPS project components would be located in a seismically active area, and these components may be affected by fault rupture from an earthquake on local faults; however, this exposure would not result in a substantial risk to people or structures. (Criterion a) (EPB: Less-Than-Significant) (SRPS: Less-than-Significant) (ISMP: No Impact) (Project Overall: Less-than-Significant)

The proposed project site is not located within the Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist, and there are no known active faults passing through the property. However, the proposed project is located in a region of high seismicity (**Figure 4.5-6**). Based on general knowledge of the local seismicity, it should be anticipated that, during the useful life of the proposed project, the proposed project area would be subject to strong ground shaking. It is also anticipated that the proposed project area would periodically experience small to moderate magnitude earthquakes.

The proposed EPB and SRPS project components would be designed accordingly and would incorporate sound engineering judgment and conform to the CBC requirements, which would minimize potential safety risks associated with seismic hazards to an acceptable and less-than-significant level.

Impact Conclusion

Although in a region of high seismic activity, the operation of the proposed EPB and SRPS project components would not expose people or structures to substantial risk of adverse effects due to fault rupture as the sites are not located on an active fault or within the Alquist-Priolo Earthquake Fault Zoning Map. The proposed EPB and SRPS project components would be designed accordingly and would incorporate sound engineering judgment and conform to the CBC requirements, which would minimize potential safety risks associated with seismic hazards to an acceptable and less-than-significant level. No mitigation measures are required.

Impact GS-4: <u>Exposure to Seismic Ground Shaking and Liquefaction.</u> The proposed EPB and SRPS project components would be located in a seismically active area; however, the proposed project operations would not expose people or structures to a substantial risk of loss, injury, or death involving exposure to seismic groundshaking and liquefaction. (Criteria a and c) (EPB: Less-Than-Significant) (SRPS: Less-than-Significant) (ISMP: No Impact) (Project Overall: Less-than-Significant)

The proposed EPB and SRPS project components would be located within a seismically active region. An earthquake on local or regional faults could result in damage to structures due to seismic shaking and/or liquefaction. The intensity would be dependent on the magnitude of the earthquake and distance of facilities from the earthquake epicenter. The primary effects of groundshaking would be potential damage to the proposed structures, including foundations. Structures would be designed in accordance with requirements of the CBC regarding seismic design criteria, which would help minimize damages and would not result in substantial adverse risks to people or structures.

<u>PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT</u>

The proposed EPB project component alignment lies within zones considered to have moderate to high liquefaction susceptibility. Effects of liquefaction in the site vicinity as a result of the 1906 San Francisco or 1989 Loma Prieta earthquakes have not been identified and not anticipated. The results of the liquefaction analysis in the Geotechnical Report suggest that some of the sand layers encountered in the drill holes and Cone Penetrometer Test (CPT) probes could liquefy when subject to the design peak ground acceleration. In general, the potential for liquefaction-induced lateral spreading along the proposed EPB alignment is low, due to the lack of a nearby free face.

<u>PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT</u>

In general, the potential for liquefaction-induced lateral spreading along the proposed SRPS project component alignment is higher than it is along the proposed EPB project component alignment, due to the drop in elevation as one descends from Scenic Road across the back beach to the surf zone. While the proposed SRPS project component alignment is located where there is potential for liquefaction and ground failure, the proposed SRPS project component alignment would likely have considerable positive effects on slope behavior during seismic events. The proposed SRPS project component alignment would likely protect against loss, injury, or death by stabilizing the Scenic Road and reducing the risk of liquefaction and related hazards.

Prior to the final design of the proposed EPB and SRPS project components, detailed geotechnical evaluations would be performed for specific project sites, with geology and soils hazards identified in order to develop and incorporate appropriate seismic design parameters into new structural development. Geotechnical evaluation of liquefaction potential and dynamic settlement, including subsurface exploration, would be performed during the design phase for project sites with planned new structural development constructed in accordance with local requirements and the CBC. Appropriate measures to protect structures and other improvements would be developed based on the site specific geotechnical conditions. Adherence to existing regulations and standards, including the CBC, would minimize harm to people and structures from adverse geologic events and conditions.

Impact Conclusion

Upon completion of construction, the proposed EPB and SRPS project components would be subject to seismic shaking during an earthquake and could be subject to liquefaction and/or lateral spreading. Generally, damages to facilities would be localized and minimized with adherence to local regulations, building codes, and recommendations of site-specific geotechnical reports. The application of proven seismic design criteria as standard engineering practices that are recommended in geotechnical reports would ensure that the facilities would be designed and built to minimize risk of damage. Damage from an earthquake could result in temporary cessation of proposed project operations until repairs are completed, but the effects of seismic groundshaking and liquefaction would not result in a substantial risk of loss, injury, or death resulting in a significant impact. No mitigation measures are required.

Impact GS-5: <u>Exposure to Coastal Erosion and Sea Level Rise.</u> The proposed EPB and SRPS project components would not be exposed to substantial soil erosion as a result of sea level rise. (Criterion b) (EPB: Less-than-Significant) (SRPS: Less-than-Significant) (ISMP: No Impact) (Project Overall: Less-than-Significant)

<u>PROPOSED ECOSYSTEM PROTECTION BARRIER AND SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENTS</u>

Coastal areas are subject to coastal erosion, which may be exacerbated by sea level rise which is predicted to occur throughout the century. It is possible that coastal erosion exacerbated by sea level rise may affect the proposed SRPS project component. The sea level along the central coast is projected to continue to rise over the next several decades, and the coastline is expected to retreat inland due to the rising sea level and the resulting erosion.

The planning and design of the proposed EPB and SRPS project components considered the impacts of sea-level rise. The proposed SRPS project component is located within the landward limit of the 2100 Erosion High Hazard Zone (Pacific Institute, 2009). As a result, there would be a potential for this structure to become undermined and exposed after a significant coastal storm event sometime around 2100. However, the *Carmel River Lagoon Scenic Road Protection Preliminary 30% Design Draft Report* identified using a 2-foot sea level rise, taking into consideration of the results of the NRC report, and assuming a 30-year project life as the basis for design. The preliminary design of the proposed SRPS project component includes the analysis of extreme water levels and events with a 2-foot rise in sea level. The proposed SRPS project component would be reevaluated and either rehabilitated or removed depending on future conditions toward the end of its life in approximately 30 years; this would occur prior to 2100. Therefore, potential impacts from coastal erosion as a result of sea level rise are less-than-significant.

The proposed EPB project component is located outside the identified coastal erosion hazard area, specifically outside the year 2100 envelope for coastal erosion (Pacific Institute, 2009). The *Feasibility Report* identified the EPB project design life to be 50 years and an increase in ocean levels of 0.5 to 2 feet anticipated over the life of the project. This increase is assumed to translate to an approximately parallel increase in statistical Lagoon levels of 0.5 to 2 feet. Elevation 16 feet is equal to the current FEMA 100-year flood elevation for the Lagoon and is 0.6 feet higher than the highest Lagoon level on record. When considering the elevation of the proposed EPB project component, the anticipated sea-level rise and impacts to the visual character of the area were considered. It was determined that a 1.5-foot freeboard (i.e., an EPB elevation of 17.5 feet) would account for anticipated sea-level rise while reducing visual impacts. Therefore, with the proposed EPB project component elevation at 17.5 feet and the proposed EPB project component located outside of the year 2100 envelope for coastal erosion, potential impacts from coastal erosion as a result of sea level rise are less-than-significant.

Impact Conclusion

The proposed EPB and SRPS project components could be subjected to sea level rise and associated coastal erosion during their 30-year and 50-year life spans, respectively. However, the preliminary design of the proposed EPB and SRPS project components have considered sea level rise, and within the life of the projects, potential impacts from coastal erosion as a result of sea level rise are less-than-significant impact.

Impact GS-6: Operation-Related Erosion and Loss of Topsoil/Sand. Operation of the proposed EPB and SRPS project components would not result in substantial erosion or loss of topsoil/sand. (Criterion b) (EPB: Less-Than-Significant) (SRPS: Less-than-Significant) (ISMP: No Impact) (Project Overall: Less-than-Significant)

PROPOSED ECOSYSTEM PROTECTION BARRIER PROJECT COMPONENT

The proposed EPB project component would result in a more naturally functioning lagoon ecosystem as the need to artificially breach the Lagoon to prevent flooding of the residential area to the north of the Lagoon would be reduced. The proposed EPB project component would allow an increased depth and duration of inundation within the Lagoon. While structures that constrict or confine river floodplains can induce erosion due to increased flood-flow velocities or through eddying effects at the obstruction, such a response would not be expected under the proposed project scenario. Although the proposed EPB project component would limit the extent of the Carmel River floodplain to some degree at high flows, the magnitude of the constriction is minimal relative to the full width of the floodplain corridor. Flow velocities, even during large floods, are low through the Lagoon, especially along the edges where the proposed EPB project component would be located. Given these conditions, scour effects due to constriction of the channel or as a result of hardscaping associated with the constructed proposed EPB project component would be unlikely, and, therefore, would have a less-than-significant impact.

PROPOSED SCENIC ROAD PROTECTION STRUCTURE PROJECT COMPONENT

Active Erosion/Scour

Undermining or scouring at the base of a bluff protection structure can be a common cause of structure failure. Scouring of sediment, whether the beach or a river, is the result of water current velocities that are high enough to move or erode the material in any particular location. Winter waves generate enough energy and have short enough periods that they erode or scour the beach. Longer period and less energetic summer waves move the sand back up the shoreface and rebuild the beach.

As described in **Chapter 3, Project Description**, the purpose of the proposed SRPS project component is to design a rock buttress to prevent erosion of the bluff fronting Scenic Road, which it does not experience under the current and historical management of the sandbar, and to the adjacent public parking lot, if the river breaches in a northerly direction. The proposed SRPS project component would anchor the bluff where it currently exists, preventing erosion that may occur from wave-run up. The existing toe of the bluff slope is typically at an elevation of approximately +20 feet. The proposed SRPS project component alignment would extend from the southern tip of the public parking lot toward the northwest. The rock revetment proposed along the parking lot would provide protection from erosion caused by wave run-up. There would be occasional flooding of the parking lot during large coastal storms and flooding would be possible when Lagoon water levels are at or near the base flood elevation. The outer rock layer would be sized to withstand extreme ocean wave and river current forces (e.g., 1 to 2-ton sized rock) with a layer of smaller rock and/or geotextile fabric underneath to prevent underlying soils from being eroded through the revetment. Conservative estimates of rock size and thickness have been utilized in the preliminary design; dimensions were generally selected from Caltrans and the Coastal Engineering Manual.

The northern terminus would be located between stations 5+00 and 6+00, between Valley View Avenue and Isabella Avenue. This terminus was determined based on where the wave energy is low enough (compared to locations further south) such that sand build-up is not a significant concern. The *Feasibility Geotechnical Analysis* indicted that this is the likely location of a natural breach, where river flow would overcome natural beach grades. The end of the rock revetment would be keyed into the slope. The proposed SRPS project component would be aligned to direct the riverine flow to turn west and breach at approximately station 6+00, which would be the northern limit of river migration. The reasoning for having a northern limit of migration is to ensure that the river does not swing all the way into the cove where Scenic Road turns to the west, where beach erosion could cause significant damage to the unprotected bluff and habitat.

The bottom of the revetment was set to roughly match mean higher high water (MHHW), which is also intended to correspond with the existing marine terrace (which is erosion-resistant). A determination of the marine terrace location and extent would be done as part of the final design; if the elevation of the marine terrace is higher or lower than expected, the rock buttress design would be revised accordingly.

As described above, the proposed SRPS project component has been preliminarily designed to reduce the potential impacts from scour to the structure, bluff, and parking lot if the river breaches to the north end. The engineering consultants would incorporate the recommendations from the site-specific geotechnical investigations as required by the County into final design. Therefore, potential impacts from scour are less-than-significant.

Passive Erosion

Whenever a hard structure, such as rip-rap or a seawall, is constructed along a shoreline to halt erosion, the shoreline is essentially fixed at that location. Adjacent landforms (e.g., beaches, cliffs, etc.) will continue to retreat landward, creating an artificial headland out of the armored segment of coast. If armor is placed at the base of a cliff that has a beach in front of it, the beach will continue to migrate landward on either side of the armored area, but there will be no beach in front of the armor. This is called passive erosion.

The purpose of the proposed SRPS project component would be to prevent erosion of the bluff below Scenic Road by preventing erosion at the bluff's toe of slope. Above the top of the revetment, the slope would be permanently planted with native species appropriate to the coastal strand and dune habitats, and maintained to control erosion. The proposed SRPS project component would be designed so as to be buried by beach sand under normal conditions, and exposed only during high-flow conditions, after which natural/seasonal beach processes would be allowed to rebury the structure. The northern terminus deflects river flows away from the very innermost (northerly) part of Stewart's Cove. As such, the passive erosion would be reduced as the revetment would not be permanently exposed and subjected to erosion. This is a less-than-significant impact.

Wave Overtopping

Wave overtopping is defined as the transport of significant quantities of ocean water over the top of a seawall, either as greenwater, splash, or spray. Overtopping can cause damage by exerting direct vertical and horizontal forces, and also by eroding materials from behind walls.

In most coastal areas, it is not practical or economical to build a protection structure that will not be overtopped during severe storm conditions. Standard run-up calculations for seawalls typically consider only the frequency of overtopping by greenwater. The height of the run-up is usually calculated using empirical or theoretical formulas based on specified water depth, beach slope and grain size, wave height, wave period, maximum expected sea level, and the type of slope of the structure involved. One of the limitations of run-up calculations is that they do not accommodate the local variations in the bluff profile, or the irregularities of the shoreline.

The Preliminary 30% Plans are based on protecting Scenic Road and the parking lot from erosion and scour if the river breaches to the north under various extreme ocean and riverine scenarios. As described above, the proposed SRPS rock buttress structure would anchor the bluff where it currently exists. The bottom of the revetment was set to roughly match MHHW, which is intended to correspond with the existing marine terrace (which is erosion-resistant) and avoid undermining of the structure.

The top of the bluff is already higher than the FEMA base flood elevation, and if the bluff is not allowed to retreat, wave run-up would not reach the top. Based on the available information reviewed for the preliminary design, wave run-up does not seem to pose a significant threat to the upper portions of the slop, and, therefore, the primary focus of the armoring is to protect the base of the bluff. The preliminary design is based on a number of parameters (please refer to Table 2-1 of the *Preliminary 30% Design Draft Report* in **Appendix G**), and in the run-up analysis, the wave was shown to break prior to reaching the toe of the revetment in each extreme event scenario. Therefore, it is unlikely that waves would overtop the structure and create scour and undermine Scenic Road and the parking lot. Therefore, potential erosion impacts from wave overtopping are less-than-significant.

Reduction in Sand Contribution

The breakdown of rocks and sediments in cliffs, bluffs, and dunes creates sand that constitutes some fraction of the littoral budget. Armoring coastal landforms covers up those erosion-prone surfaces and may, therefore, reduce sand supply. In cases where these reductions occur, they can make downcoast beaches narrower, allowing more wave energy to erode cliffs, bluffs, and dunes downcoast of the armored area. The relative contribution of cliff erosion to sediment budget will vary based on local geology and erosion rates. Thus, understanding the effect of coastal armoring on sand supply needs to be addressed on a littoral cell by littoral cell basis.

Historically and currently, the breach has been managed in order to avoid flooding of the existing development in the low-lying areas and eroding the bluff under Scenic Road. Damage to Scenic Road by actively managing or allowing a natural breach to the north could result in the loss of access to eight private residences, adverse environmental impacts (such as discharge of raw sewage into the ocean), and impairment to public access to important coastal resources. As a result, the bluff under Scenic Road has not been frequently exposed to riverine or wave erosion and thus, does not significantly contribute to the sand supply or littoral budget in the local or regional area. The proposed SRPS project component would maintain the existing conditions of directing the flow of the river away from the bluff to avoid damage to Scenic Road. Therefore, impacts to sand supply are less-than-significant.

Impact Conclusion

The operation of the proposed EPB and SRPS project components would not result in substantial erosion or loss of topsoil/sand as a result of active erosion/scour, passive erosion, wave overtopping, or a reduction in sand contribution. Flow velocities, even during large floods, are low through the Lagoon, especially along the edges where the proposed EPB would be located. Given these conditions, scour effects due to constriction of the channel or as a result of hardscaping associated with the constructed proposed EPB project component would be unlikely, and, therefore, it is a less-than-significant impact. The purpose of the proposed SRPS project component is to prevent erosion of the bluff fronting Scenic Road and parking lot, and the rock buttress has been designed to direct flow away from the bluff and parking lot, avoiding or reducing erosion. The northern terminus of the rock buttress deflects river flows away from the very innermost (northerly) part of Stewart’s Cove, reducing passive erosion as the revetment would not be permanently exposed and subjected to erosion. The preliminary design has evaluated wave-up under extreme conditions, and it is unlikely that waves would overtop the structure and create scour and undermine Scenic Road and the parking lot. Therefore, the proposed SRPS project component would not result in substantial erosion or loss of topsoil. This is a less-than-significant impact.

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