MEMORANDUM

To:	Simon A. Poulter, Padre Associates, Inc.	Date:	July 12, 2021
From:	Wenkai Qin, Ph.D., P.E., NV5, Inc.		
Project:	**PRC 421 Decommissioning Project, Goleta, California**		
Subject:	**Coastal Impact Assessment for Decommission of PRC 421 Caissons**		
CC:	Jennifer Leighton, Padre Associates, Inc.		

1 INTRODUCTION

1.1 Project background and Location

The existing facilities at the former Oil and Gas Lease PRC 421 include two piers and caissons, PRC 421-1 and PRC 421-2, on State tidelands and submerged lands as well as the upland access road and revetment below the bluffs marking the southern limit of the Sandpiper Golf Course in the city of Goleta, California. The location of PRC 421 is shown in Figure 1 and Figure 2.

Figure 1. Vicinity of PRC 421

Figure 2. Location of PRC 421

The PRC 421 piers and facilities were installed approximately nine decades ago for the purpose of oil and gas development of the Ellwood Oil Field (EOF). The original oil and gas lease (Lease No. 89) was issued in 1929, terminated and renewed under PRC 421 in 1949, and subsequently reassigned several times with the last assignment to Venoco, Inc. in 1997, but later quitclaimed to the State of California in 2017. The two existing PRC 421 piers and associated access road and pipelines are the last remaining structures associated with the prolific oil development of the EOF.

With the plugging of the last two wells in 2019, the PRC 421 piers and caissons have no further use. These deteriorating structures now represent a physical coastal obstruction, a potential public safety hazard, and a potential environmental hazard. The California State Lands Commission (CSLC), as the representative owner of PRC 421, is seeking approval to decommission the remaining pier infrastructures. The removal of these structures is anticipated to be a significant public benefit, allowing full use of the beach coastline by the public and eliminating an existing threat to public safety and the environment.

1.2 Study Purpose and Scope of Services

As a subconsultant to Padre Associates, Inc., NV5, Inc. was retained by CSLC to perform a preliminary coastal engineering analysis to assist in the preparation of the EIR for the decommissioning of the PRC 421 piers and caissons. The caissons sitting on the beach have provided a wave sheltering effect for the areas behind (landward of) the caissons during high tides and thus have provided erosion protection for the beach and the shoreline behind these caissons.

The access roadway that runs along the bluff is currently armored with riprap revetment for most portions. This revetment provides erosion protection for the access roadway and protects the coastal bluff behind the roadway from wave-induced erosion.

The purpose of NV5's coastal engineering analysis is to evaluate the impact of the removal of PRC 421 caissons and piers on the beach and shoreline behind the caissons and the impact of the removal of the access road with riprap on the bluff face. These impacts were evaluated based on qualitative assessments and limited engineering analyses. NV5's proposed scope of services consists of the following:

Task 1 Data Review

Consultant will review oceanographic data near the project site. The data includes the NOAA tide record, CDIP wave data, and future Sea Level Rise (SLR) projections.

Task 2 Qualitative Coastal Impact Assessment for Removal of Caissons and Piers

Consultant will perform the following work:

- Estimation of the wave sheltering effect of the existing caissons for the beach areas behind these caissons.
- Qualitative assessment of the wave condition on the beach after removal of the caissons and piers.
- Qualitative assessment of the existing beach and shoreline conditions based on historical Google Earth aerial images.
- Qualitative assessment of the future beach and shoreline evolution trend after removal of the caissons and piers.
- Recommendation of alternative(s) for shoreline protection after removal of caissons and piers.

Task 3 Qualitative Coastal Impact Assessment for Removal of Access Road with Riprap

Consultant will estimate the water depth and wave condition at the bluff toe after the removal of the access roadway with riprap and qualitatively assess the implications to bluff toe erosion.

Task 4 Project Memorandum

Consultant will prepare a brief project memorandum to summarize the results of the qualitative impact analyses for the removal of the caissons, piers, access roadway and riprap.

2 NEARSHORE OCEANOGRAPHIC CONDITION

2.1 Still Water Levels

Variations of the still water level (SWL) along the California shoreline are primarily caused by astronomical tides with secondary contributions from storm surge, wave setup, and El Niños. The National Oceanic and Atmospheric Administration (NOAA) Santa Barbara Station (Station ID: 9410840) is the closest NOAA tidal station to the PRC 421 site and thus was used to represent the SWL characteristics for the project site. The tidal datum at Santa Barbara is summarized in Table 1.

Table 1. Tidal Characteristics at Santa Barbara (1983-2001 Tidal Epoch)

Tidal datum	Water level (ft, NAVD88)
Highest Observed Water Level	+7.51
Mean Higher High Water (MHHW)	+5.25
Mean High Water (MHW)	+4.50
Mean Sea Level (MSL)	+2.65
Mean Low Water (MLW)	+0.94
Mean Lower Low Water (MLLW)	-0.14
Lowest Observed Water Level	-3.01

The still water levels have been measured at the NOAA Santa Barbara Station since 1991 but with a data gap from 1998 to 2004. To cover a longer period of data record, the water levels measured at the NOAA Santa Monica Station, which is the second closest station to the project site, between 1998 and 2004 was added to the data gap of the Santa Barbara Station. As such, the measured water levels cover a 30-year period from 1991 to 2020. It is noted that measured still water levels not only include the contribution from astronomical tides, but also contributions from historical storm surge, wave setup, and El Niños.

Based on the annual maximum SWL derived from the 30-year data record, a statistical analysis was conducted to determine the annual maximum SWL for various return periods. The annual maximum SWL data and the curve-fitting of the data using the Weibull distribution are shown in Figure 3. As listed in Table 2, the 1-year SWL is +6.8 ft, NAVD88 and the 100-year SWL is +7.8 ft, NAVD88.

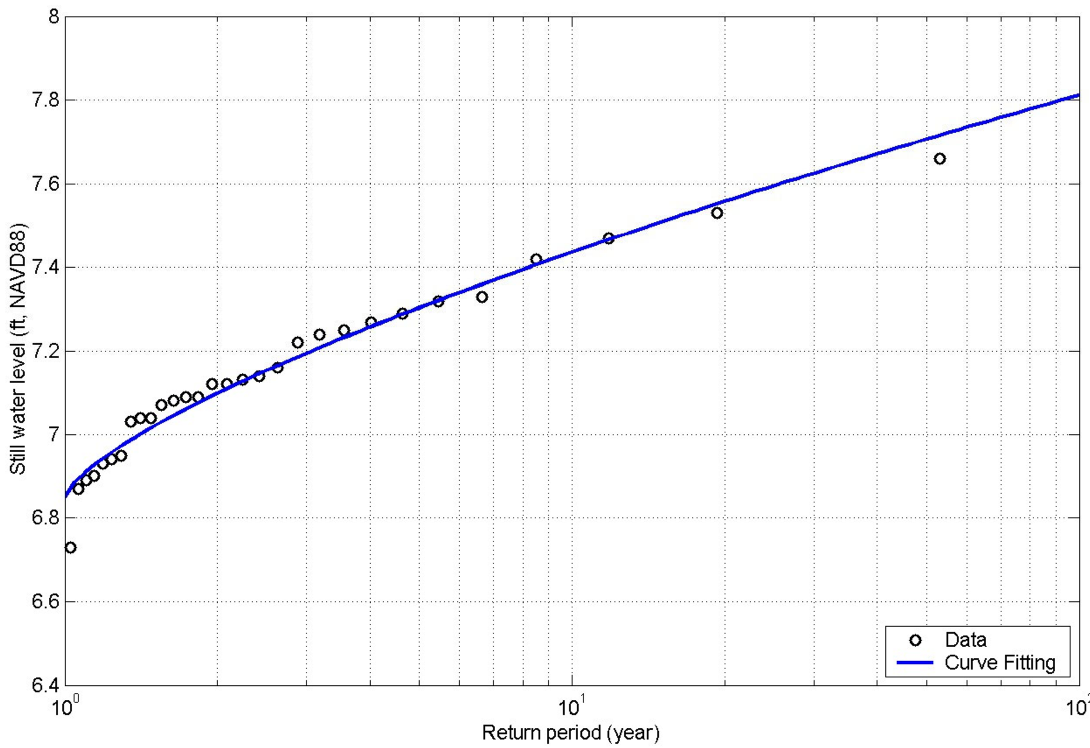


Figure 3. Return Frequency of Annual Maximum Still Water Levels

Table 2. Return Frequency of Annual Maximum Still Water Levels

Return period	Still Water Level (ft, NAVD88)
1-year	+6.8
10-year	+7.4
50-year	+7.7
100-year	+7.8

2.2 Sea Level Rise

The California Ocean Protection Council (OPC) adopted the 2018 update of the State of California Sea-Level Rise (SLR) Guidance, which provides science-based guidance to help state and local governments analyze the risks associated with SLR and incorporate SLR into planning, permitting, and investing decisions. In this 2018 SLR Guidance, a range of potential SLR projections were developed for a subset of active California tide gauges based on emission trajectories, acknowledging that projected SLR has a significant range of variation as a result of uncertainty in future greenhouse gas emissions and their geophysical effects, such as the rate of land ice melt.

The probabilistic projections for the height of SLR over different time frames and emission scenarios for the Santa Barbara tide gauge, the closest gauge to the project site, are summarized in Table 3.

Table 3. Sea Level Rise Projections (Feet, from 2000)

Time Period		Likely Range (66% probability)	Medium-High Rise Aversion (0.5% probability)
2050	High Emissions	0.4 – 1.0	1.8
2070	Low Emissions	0.5 – 1.3	2.8
	High Emissions	0.7 – 1.7	3.3
2100	Low Emissions	0.6 – 2.0	5.3
	High Emissions	1.2 – 3.1	6.6

2.3 Waves Offshore of PRC 421

Waves (ocean swell and wind waves) along the southern California coast are mainly produced by six basic meteorological weather patterns. These include extratropical storm swells in the Northern Hemisphere (north or northwest swell), wind swells generated by northwest winds in the outer coastal waters (wind swell), westerly (west sea) and southeasterly (southeast sea) local seas, storm swells of tropical storms and hurricanes off the Mexican coast, and southerly swells originating in the Southern Hemisphere (southerly swell).

Because of Point Conception and Coal Oil Point, PRC 421 is only exposed to waves coming from the southeast and then clockwise to approximately the west, as shown in Figure 4. Furthermore, the offshore Channel Islands provide some sheltering for waves coming from the Pacific Ocean within this exposure angle and reduce the energy of many ocean swells before they reach Santa Barbara Channel.

Figure 4. PRC 421 Exposure Angle to Pacific Storms

The NOAA National Data Buoy Center (NDBC) maintains a buoy station (NDBC 46053) inside Santa Barbara Channel. The location of this station is shown in Figure 4. Deployed at a water depth of approximately 1,300 feet, this buoy has collected the wave data since 1994. Because this buoy is located within the Channel, the sheltering effect of the offshore Channel Islands is already reflected in the measured data. As waves propagate from the deep water to nearshore coastal areas, they will be further altered by shoaling, refraction, diffraction, and breaking processes because of the variations in local bathymetry. By considering wave shoaling, refraction, and breaking, the hourly wave data measured at the NDBC 46053 buoy was transformed to a nearshore location at approximately -6 feet, NAVD88, which is approximately 300 feet offshore from the PRC 421 caissons. Figure 5 shows the joint distribution of significant wave heights and wave directions at this location. As shown in this figure, the wave direction is from the southwest (SW) direction during approximately 40% of the time and from the west southwest (WSW) direction during approximately 58% of the time. The waves from other directions are negligible. The dominant SW to WSW wave directions is a combined result of the specific wave exposure angle, the sheltering effect of the Channel Islands, and the local nearshore plain/contour orientation that faces SW.

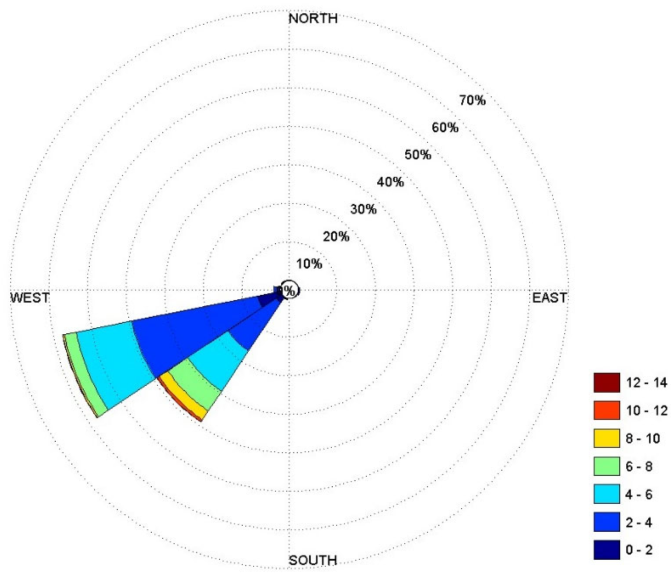


Figure 5. Joint Distribution of Wave Heights and Directions at -6' MLLW

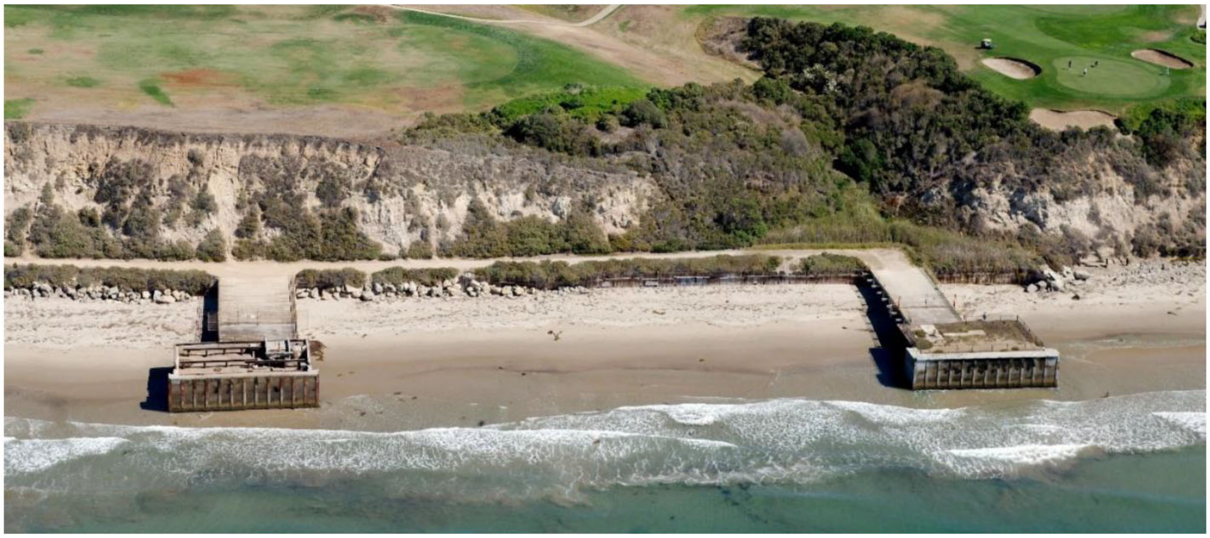
3 QUALITATIVE COASTAL IMPACT ASSESSMENT FOR REMOVAL OF PRC 421 CAISSONS AND PIERS

The primary facilities associated with PRC 421 occupy approximately 11,600 square feet of pier space and include two piers on State tide and submerged lands below the bluffs at the southern limit of Sandpiper Golf Course, as shown in Figure 6 and Figure 7. The two piers, Pier 421-1 and Pier 421-2, were built with vertical steel piles with overlying horizontal steel I-beams and wood timber decking and are approximately 325 feet apart. Each caisson is approximately 80 feet in length (in the alongshore direction). The PRC 421-1 caisson is approximately 40 feet wide (in the cross-shore direction), and the PRC 421-2 caisson is approximately 30 feet wide. The piers provide access and support for two wells on separate concrete caissons. Both PRC 421 wells have been plugged to the surface with concrete.

Source: InterAct PMTI, Inc. (2021)

Figure 6. PRC 421 Facilities

One project alternative consists of a full removal of the piers, pier caissons and well portions above the bedrock, back to the wooden seawall abutments at the intersection of the access road. The caissons, sitting on the beach, and the piles that support the piers have provided a wave sheltering effect for the areas behind (landward of) the caissons during high tides and thus have provided erosion protection for the beach and the shoreline behind these caissons. Removal of pier caissons and piles may impact the local coastal processes in the area adjacent to PRC 421. The sizes of the pier piles are negligible compared to the wavelength and the dimensions of the caissons. Therefore, the impact of pier pile removal on coastal processes is negligible and our coastal impact assessment focuses on the removal of the two pier caissons.



Source: InterAct PMTI, Inc. (2021)

Figure 7. PRC 421 Caissons and Piers

3.1 Wave Sheltering Effect of Existing Caissons

The wave sheltering effect of the existing PRC 421 caissons and the wave impact of caisson removal are investigated using the STWAVE (STeady-state spectral WAVE) model that was developed by the U.S. Army Corps of Engineers (Smith et al., 2001). STWAVE is capable of simulating wave shoaling, refraction, diffraction and breaking, wind-wave growth due to local sea breeze, and wave-wave interaction. The STWAVE model domain covers a rectangular area that is 150 meters (approximately 500 feet) cross-shore and 300 meters (approximately 1,000 feet) alongshore, with a cell size of 0.5 meters by 0.5 meters. The offshore boundary is located along the approximate -6 feet, NAVD88 contour, which is approximately 300 feet offshore from the PRC 421 caissons. The 2018 USGS 1-meter DEM combined with the NOAA navigational chart (Chart ID 18721) was used to approximate the bathymetry of the modeled domain.

As discussed in Section 2.3, the wave direction at the offshore boundary (-6 feet, NAVD88) is from the SW during approximately 40% of the time and from the WSW during approximately 58% of the time. The waves from other directions are negligible. Thus, two synthetic wave events, both with a wave height of one meter and coincident with a 100-year tide at +7.8 feet, NAVD88, were specified at the offshore boundary in the STWAVE model simulations. One wave event is from SW, and the other is from WSW. The computed spatial variation of wave heights is shown in Figure 8 for an incident wave coming from SW at the offshore boundary and in Figure 9 for an incident wave from WSW. Since the incident wave height is one meter, the results shown in these two figures can also be interpreted as the wave transformation coefficients, which are defined as the ratios of local wave heights to the incident wave height.

As shown in Figure 8 and Figure 9, the PRC 421 caissons have provided significant wave sheltering effect behind the caissons, all the way back to the wooden seawall abutments at the intersection of the access road. The wave height and resulting wave energy behind the caissons are much lower than other beach areas without sheltering of the caissons.

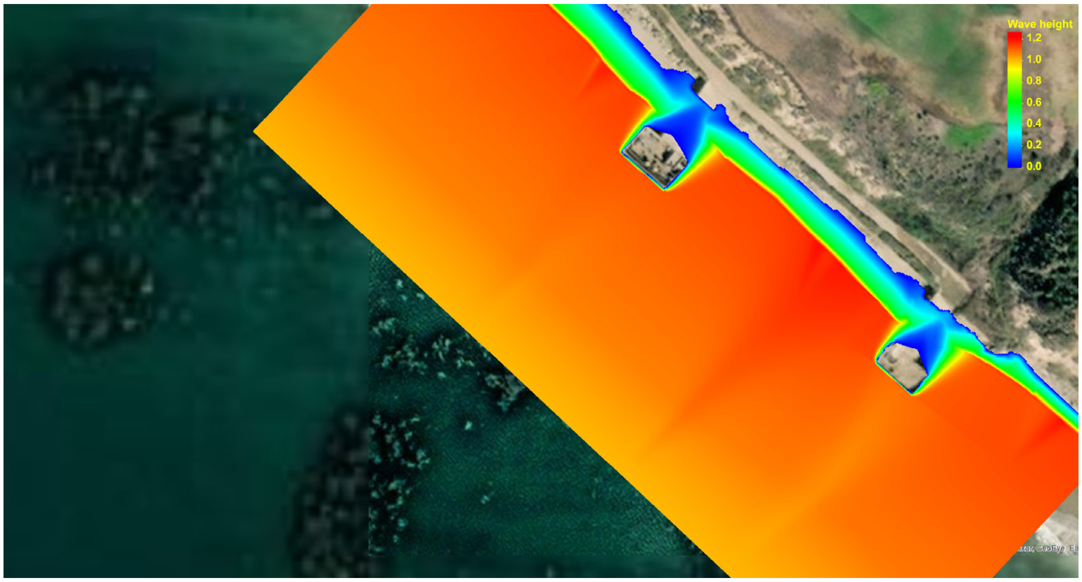


Figure 8. Wave Height Transformation Coefficients for SW Waves (Existing Condition)

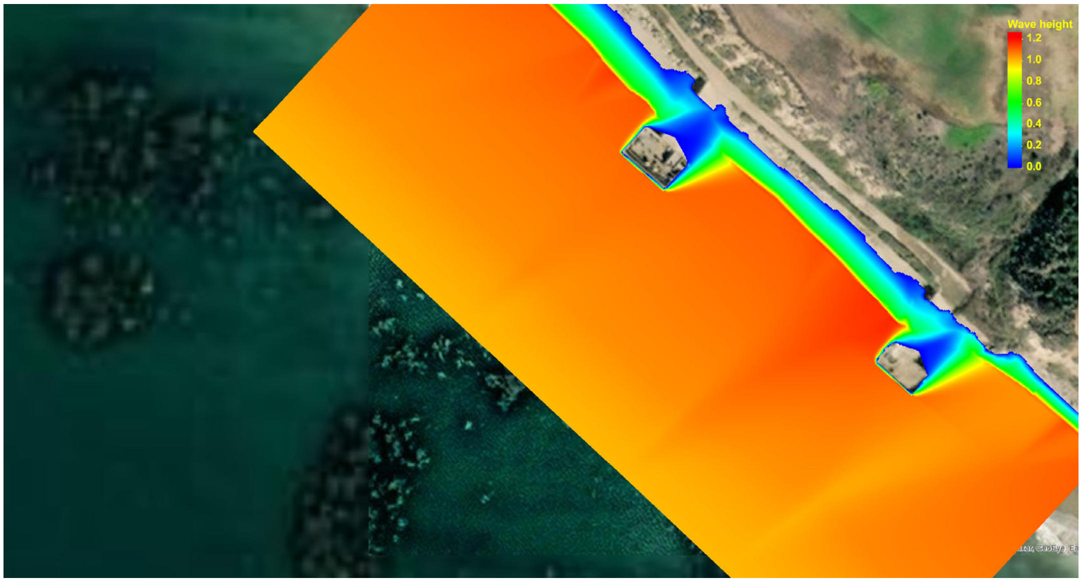


Figure 9. Wave Height Transformation Coefficients for WSW Waves (Existing Condition)

3.2 Impact of PRC421 Removal on Wave Climate

Figure 10 and Figure 11 show the wave transformation coefficients for incident waves coming from SW and WSW, respectively. After removal of PRC 421, the wave climate in the areas that are currently sheltered by the caissons will be similar to other adjacent beach areas.

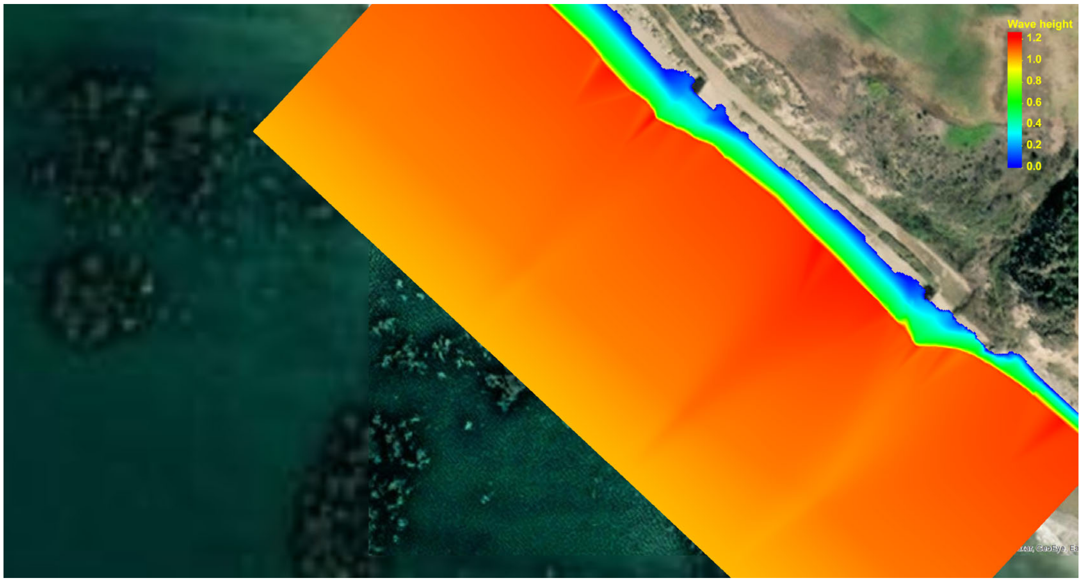


Figure 10. Wave Height Transformation Coefficients for SW Waves (PRC 421 Removal)

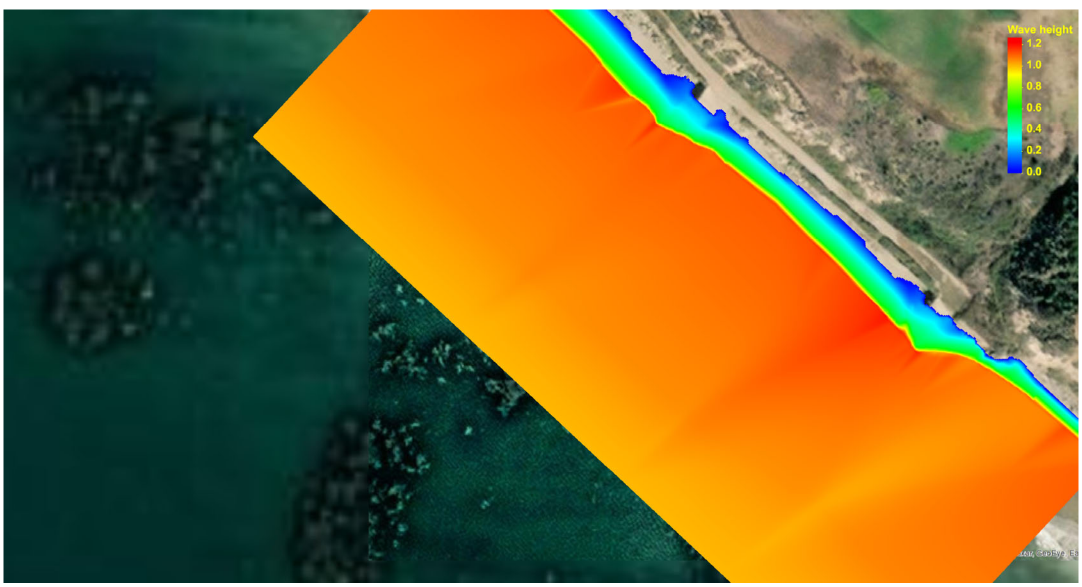
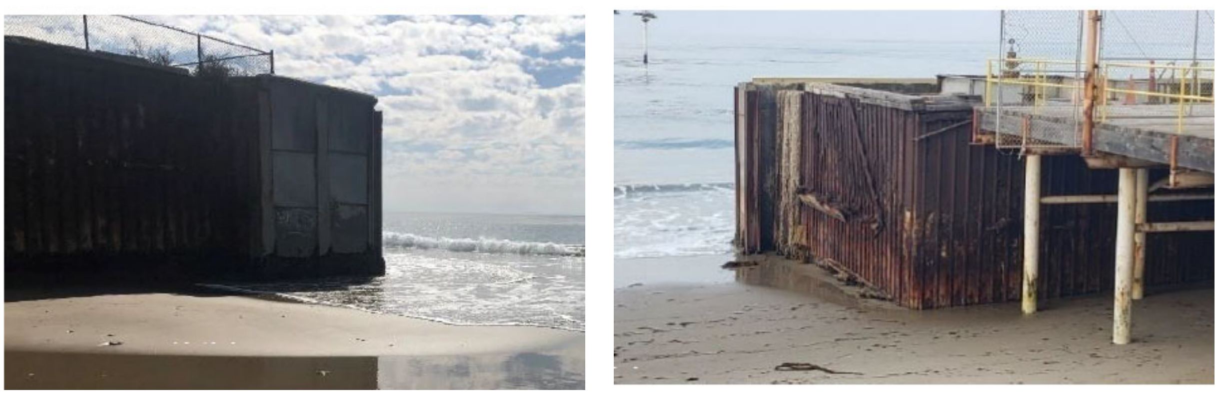


Figure 11. Wave Height Transformation Coefficients for WSW Waves (PRC 421 Removal)

3.3 Impacts of PRC421 Removal on Long-term Shoreline and Beach Evolution

Waves that propagate to the nearshore region where PRC 421 is located mainly come from SW to WSW. Alongshore currents form and alongshore sediment transport occurs as these waves sweep into the shoreline at an oblique angle and push water down in one direction along the shoreline. This drives along-shore currents and a net sediment transport toward the southeast along the shoreline.

The alongshore sediment transport capacity mainly depends on the wave height and the wave angle at the wave breaking point, as shown in the "CERC formula" (USACE, 1984). The PRC 421 caissons and piers sit on the beach. Depending on the surf condition, the sand level at the caisson varies from approximately MLLW to MHHW, as shown in Figure 12. As a result, medium to large waves already break further offshore of the caisson, and removal of PRC 421 will not impact the breaking wave condition and thus is not expected to impact the alongshore sediment transport capacity associated with the medium to large waves. These caissons may impact the small waves that break on the beach during high tides, reducing breaking wave energy and thus reducing the alongshore sediment transport potential for the area behind the caissons. But this impact is limited to the small areas just behind the caissons and is small compared to the total annual sediment transport capacity which is contributed mainly by medium to large waves.



Low sand level – Mar 2020 at 0' to 3' tides ***High sand level – Sept 2020 at 2' to 6' tides***

Source: InterAct PMTI, Inc. (2021)

Figure 12. Sand Level at PRC 421

PRC caissons may act as a short sand-retention structure during high tides that will help prevent sand from moving southeast in the beach area and thus help retain more sand on the upcoast. However, because of the limited width (30 to 40 feet) of the caissons and the relative high sand level, this impact is expected to be insignificant.

Historical Google Earth images were also analyzed to assist in our long-term shoreline impact assessment. Figure 13 through Figure 18 shows the wide beach condition in the summer or fall season in 1994, 2002, 2007, 2012, 2017, and 2019, respectively. No noticeable beach accretion or erosion trend is observed from these historical images. In other words, the beach or shoreline near PRC 421 is relatively stable without a significant long-term retreat or advance trend. It is also observed that the width of the beach upcoast (northwest) of PRC 421-2 is relatively uniform, except for June 2017 and August 2019 when the beach widths behind the PRC 421 caissons are slightly wider than the adjacent beaches.

The long-term shoreline and beach evolution mainly depends on alongshore sediment transport. It is concluded that the beach and shoreline near PRC 421 is relatively stable without a significant long-term retreat or advance trend. PRC 421 piers and caissons have insignificant impact on the alongshore currents, alongshore sediment transport, or long-term beach and shoreline evolution trend. Removal of PRC 421 is anticipated to have a negligible impact on the long-term beach and shoreline evolution in adjacent beaches. If there is any impact, the impact will be limited to the local areas behind the caissons and the impact is considered insignificant.

Figure 13. Wide Beach Condition in May 1994

Figure 14. Wide Beach Condition in June 2002

Figure 15. Wide Beach Condition in September 2007

Figure 16. Wide Beach Condition in August 2012

Figure 17. Wide Beach Condition in June 2017

Figure 18. Wide Beach Condition in August 2019

3.4 Impact of PRC421 Removal on Seasonal Shoreline and Beach Evolution

While beaches near the PRC 421 site are relatively stable without a noticeable long-term retreat or advance trend, it undergoes a significant seasonal variation between a wider “summer” beach and a narrower "winter" beach. Figure 19 shows the narrow “winter” beach in February 2016, and Figure 20 shows the wide beach in the subsequent summer/fall season. Figure 21 and Figure 22 show the seasonal variation of beach from a narrow “winter” beach to a wide “summer” beach in 2018. While the beaches near PRC 421 are wider in summer, it is much narrower (Figure 19 and Figure 21) or can be completely depleted, as shown in Figure 23 and Figure 24, in winter.

The seasonal variation of beach width is mainly caused by the cross-shore sediment transport that depends on cross-shore currents and wave motions. Calmer waves in the summer generally move sand from offshore towards the beach, resulting in a wider beach with a mild slope. Waves are typically larger during winter months, and sediment tends to move towards offshore, resulting in beach and shoreline erosion during the stormy winter months. When winter storms coincide with high tides, the beach can be completely depleted (Figure 23 and Figure 24) and storm damage can occur. For example, El Niño conditions in 1983 caused extensive damage along normally calm sections of the coastline within the Santa Barbara Channel. It is also noted that a certain amount of sand and beach did remain in place behind the two PRC 421 caissons while the adjacent beaches were severely eroded (Figure 19 and Figure 21) or depleted (Figure 23 and Figure 24) during the winter storms. This indicates that the PRC 421 caissons have provided erosion protection for the beach and shoreline behind the caissons during the stormy winter months.

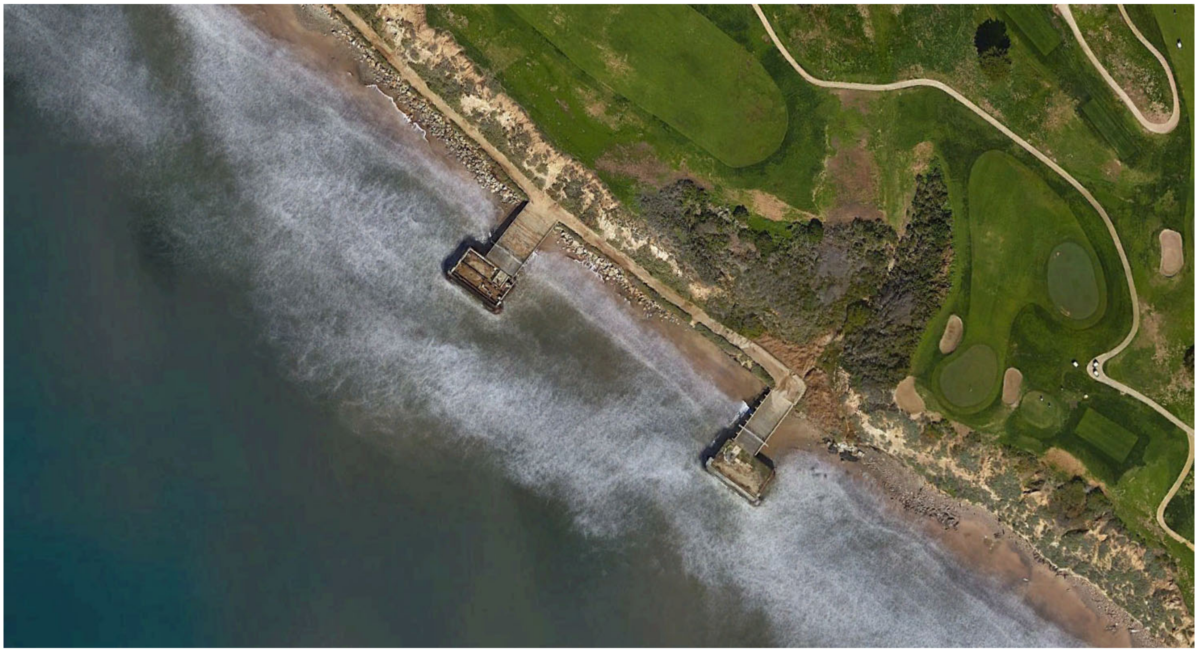


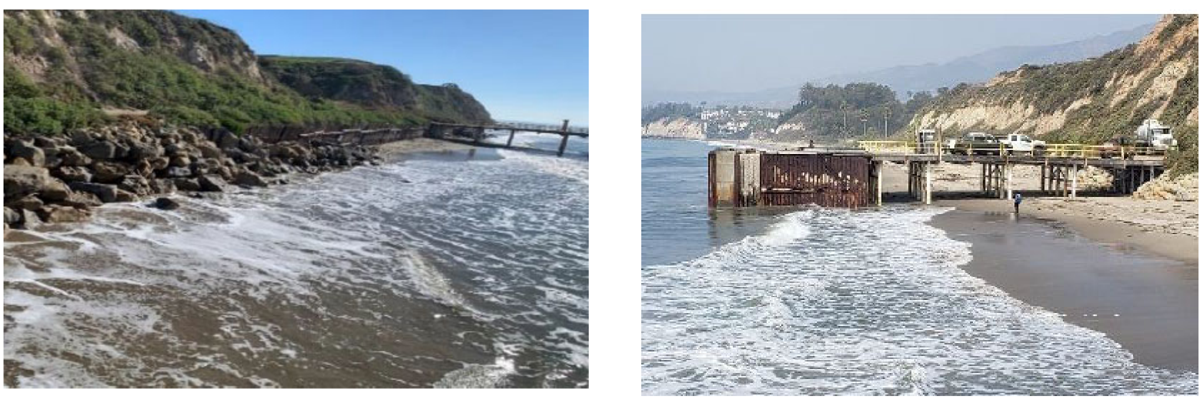
Figure 19. Narrower "Winter" Beach in February 2016

Figure 20. Wider "Summer" Beach in October 2016

Figure 21. Narrower "Winter" Beach in February 2018

Figure 22. Wider "Summer" Beach in August 2018

Figure 23. Depleted Beach Condition in February 2021



Depleted Beach – Mar 2020 at 0' to 3' Tides ***Wider Beach – Sept 2020 at 2' to 6' Tides***

Source: InterAct PMTI, Inc. (2021)

Figure 24. Beach Sand Level at PRC 421

In conclusion, beaches near the PRC 421 site have undergone a significant seasonal variation between a wider "summer" beach and a narrower "winter" beach. The winter storms have caused severe beach erosion near PRC 421. But the PRC 421 caissons have provided erosion protection for the beach and shoreline immediately behind these caissons. Removal of PRC 421 caissons will expose these sheltered areas to storm-induced erosion during the winter months, like what has happened to adjacent beaches.

3.5 Shoreline Protection Recommendation after PRC421 Removal

As discussed in Section 3.4, larger winter storms have caused severe beach erosions near the PRC 421 site. Removal of PRC 421 will expose the areas behind the caissons to storm-induced erosion in winter. The storm-induced erosion can significantly lower the sand level or even completely deplete the beach in front of the access road, as shown in Figure 23 and Figure 24.

Figure 26 through Figure 29 show beach profiles at four transects near the PRC 421 site. The locations of these four transects are shown in Figure 25. Transect 1 is approximately 600 feet upcoast of PRC 421-1, Transect 2 is along the upcoast face of PRC 421-1, Transect 3 is at the approximately middle point between two caissons, and Transect 4 is approximately 600 feet downcoast of PRC 421-2. The beach profiles were developed based on the USGS 1-meter DEM (collected in summer 2018) and the NOAA nautical chart.

Figure 25. Location of Beach Transects

The beach sand elevation along the base of the access road is at approximately +10 feet, NAVD88 in the summer. However, this sand level can be eroded down to MLLW or lower during winter storm events (Figure 24). This will expose the earthen bank of the access road to direct wave attacks, leading to a failure of the bank if no erosion protection structure was installed. As an example, the bank of the access road failed during the winter of 2000/2001, and the previously buried pipelines were exposed beneath the access road. While the eroded beach might be restored in the subsequent summer with calmer waves, the loss of the high grounds (such as the access road and coastal bluff) is considered a permanent loss and is not anticipated to naturally recover during the summer because these high grounds are above the wave action zones.

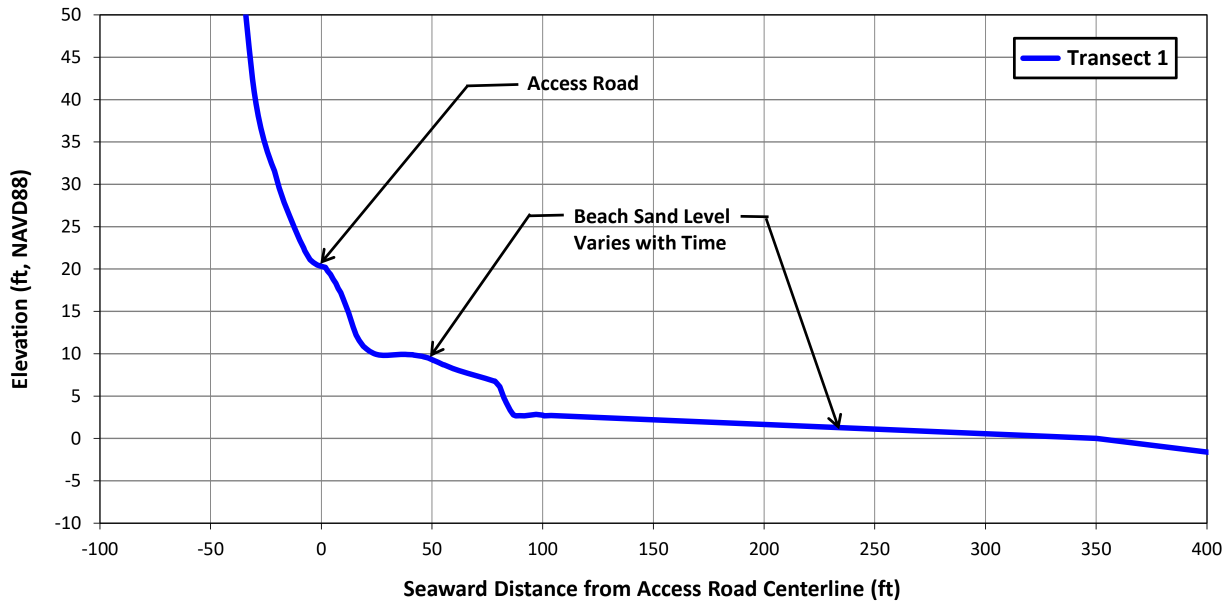


Figure 26. Approximate Beach Profile at Transect 1

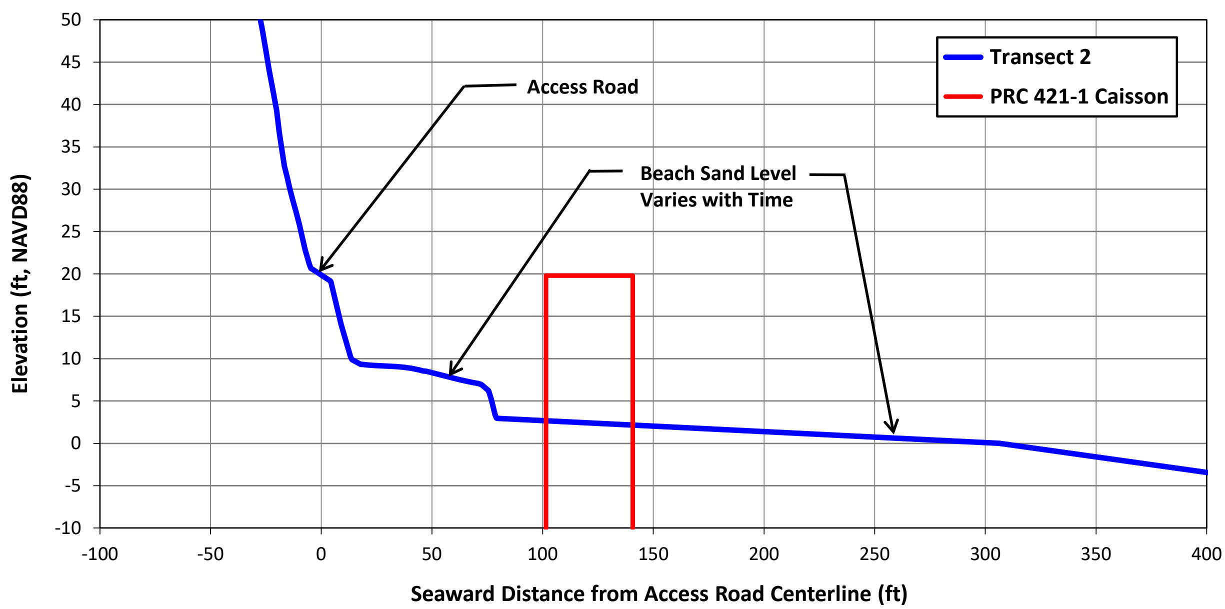


Figure 27. Approximate Beach Profile at Transect 2

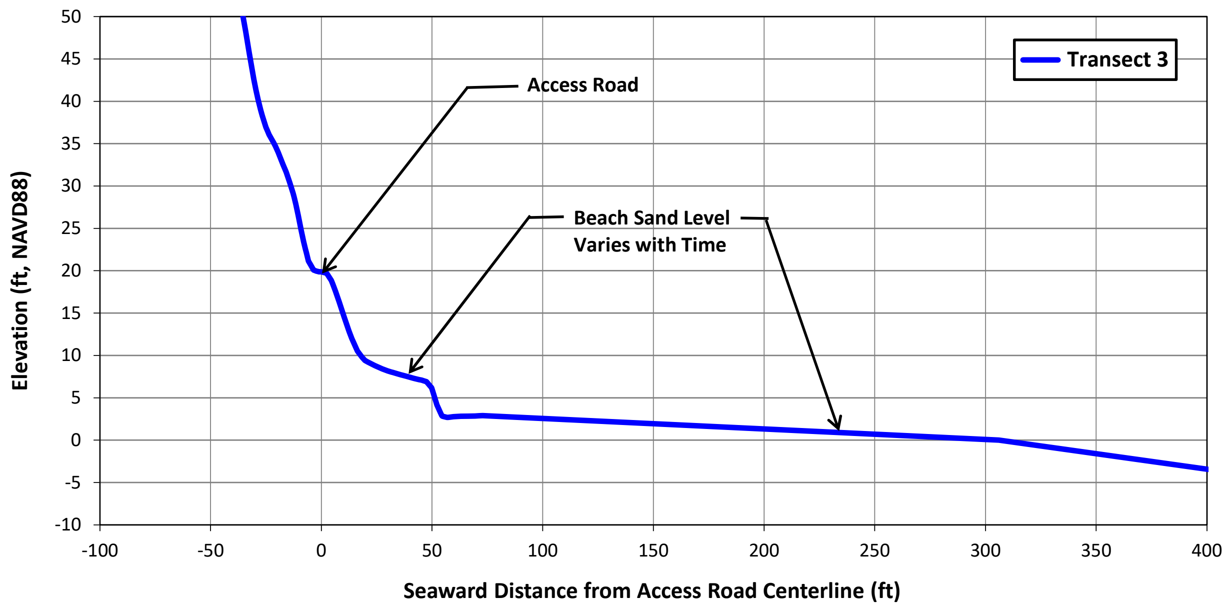


Figure 28. Approximate Beach Profile at Transect 3

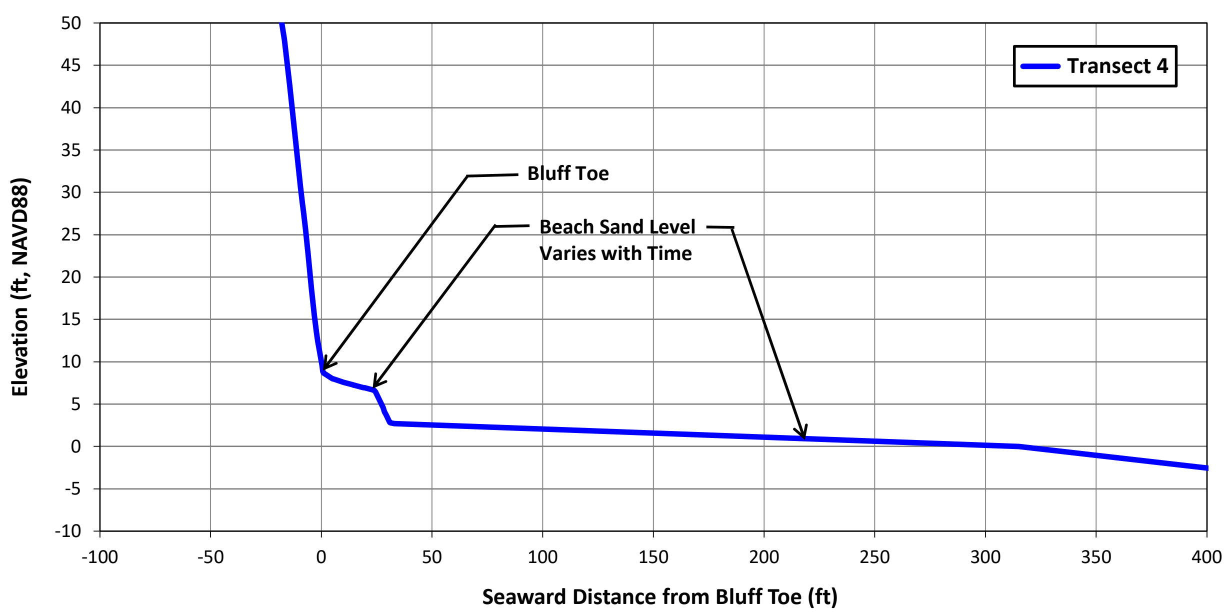


Figure 29. Approximate Beach Profile at Transect 4

Approximately 1,400 feet long riprap revetment has been placed at the base of the access road staring from the access road gate area to the approximate midpoint between the two PRC 421 pier structures. A wooden seawall runs behind both PRC 421 piers and from the midpoint between the two piers to approximately 75 feet to the east of PRC 421-2, as shown in Figure 7. Much of this wooden seawall has been compromised by storm and wave activity over many decades, as shown in Figure 30. Removal of PRC 421 will expose the beach behind the pier caissons to storm-induced erosion and expose the wooden seawall to direct and more intense wave attacks, further deteriorating or causing a failure of the wooden seawall. If the access road is to remain in place, a riprap revetment is recommended to replace the compromised wooden seawall after removal of PRC 421 structures in order to protect the access road and the land/costal bluff behind the road.

Source: InterAct PMTI, Inc. (2021)

Figure 30. Wooden Seawall Behind PRC 421-2 Pier

4 QUALITATIVE COASTAL IMPACT ASSESSMENT FOR REMOVAL OF THE ACCESS ROADWAY WITH RIPRAPS

A dirt and gravel road originating near the EOF provides vehicle access to the two PRC 421 piers. This access road currently extends in a southerly direction from the EOF for 600 feet across Sandpiper Golf Course and then turns southeast and extends approximately 1,300 feet along the base of the bluff to the PRC 421 piers. The 1,300-foot section of road along the bluff, along with existing riprap revetment, protects the Sandpiper Golf Course southern bluffs from wave action and erosion. One alternative of the PRC 421 decommissioning project includes the removal of the access road and existing riprap revetment along the base of road.

As discussed in Sections 3.4 and 3.5, the beach near the PRC 421 site undergoes a significant seasonal variation between a wider “summer” beach and a narrower "winter" beach. Larger waves have caused significant storm-induced erosion during winter months, and the beach can be completely depleted when large waves coincide with high tides. After removal of the access road with riprap revetment, the new ground or the bluffs behind the existing access road is anticipated to be exposed to direct wave action and/or coastal erosion hazard. If the material of the new grounds and the bluffs is erodible, the storm-induced erosion will evolve from the beach to the further inland areas, cutting the slope of high grounds and/or inducing erosion at the bluff toe, eventually leading to the failure (slope failures, collapses and landslides) of high grounds and bluffs. While the eroded beach might be restored in the subsequent summer with calmer waves, the failure of the high grounds and bluffs is considered a permanent loss and is not anticipated to be naturally recovered during the summer because these high grounds are above the active wave zones.

After removal of the access road and revetment, the erosion and failure of the high grounds and coastal bluffs is expected to continue for the foreseeable future. The resulting bluff retreat rate depends on the soil erodibility and intensity of future storms. In addition, future sea level rise will result in greater wave energy reaching higher on the shoreline and the face of bluffs with a longer duration of wave action. This will accelerate future shoreline and bluff retreat.

5 REFERENCES

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Appendix A: Historical Google Earth Images

Figure A-1. Shoreline Condition in May 1994

Figure A-2. Shoreline Condition in June 2002

Figure A-3. Shoreline Condition in November 2003

Figure A-4. Shoreline Condition in November 2006

Figure A-5. Shoreline Condition in September 2007

Figure A-6. Shoreline Condition in June 2009

Figure A-7. Shoreline Condition in August 2010

Figure A-8. Shoreline Condition in April 2011

Figure A-9. Shoreline Condition in August 2012

Figure A-10. Shoreline Condition in April 2013

Figure A-11. Shoreline Condition in December 2013

Figure A-12. Shoreline Condition in August 2014

Figure A-13. Shoreline Condition in January 2015

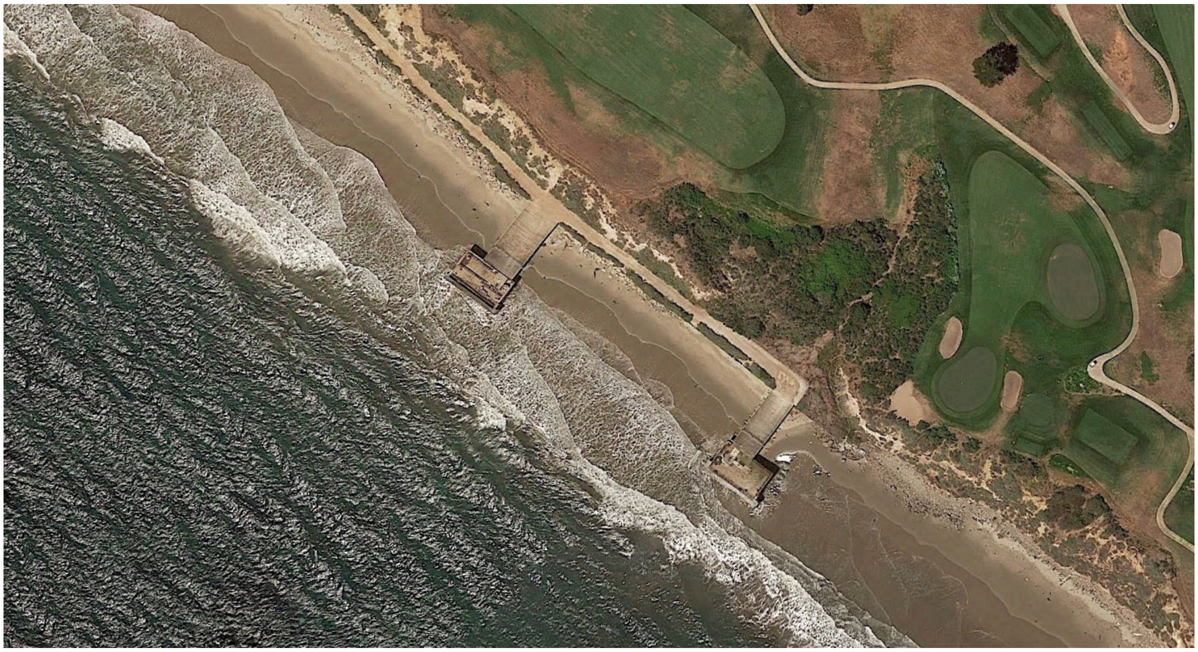

Figure A-14. Shoreline Condition in May 2015

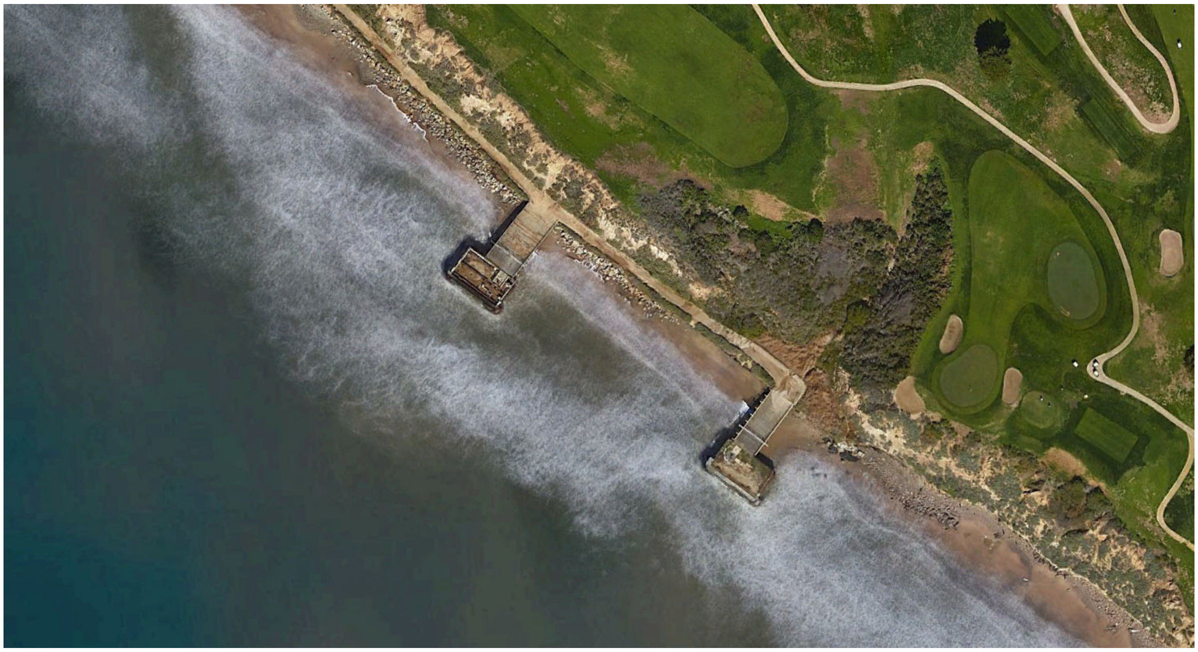

Figure A-15. Shoreline Condition in February 2016

Figure A-16. Shoreline Condition in October 2016

Figure A-17. Shoreline Condition in June 2017

Figure A-18. Shoreline Condition in December 2017

Figure A-19. Shoreline Condition in January 2018

Figure A-20. Shoreline Condition in February 2018

Figure A-21. Shoreline Condition in August 2018

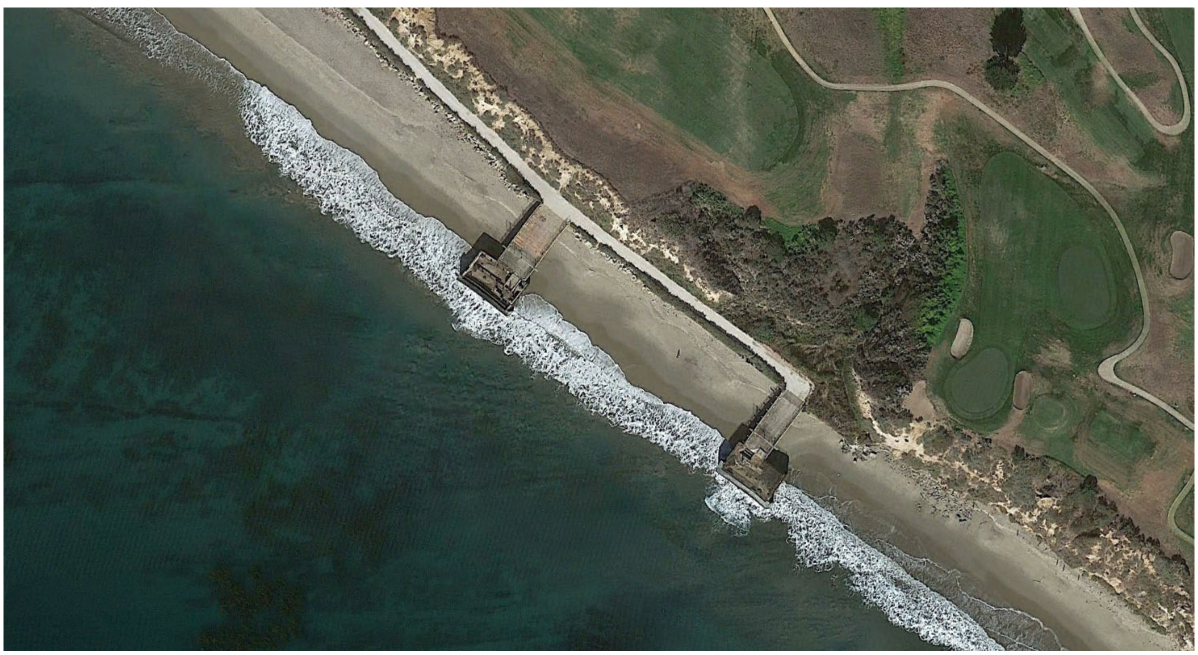

Figure A-22. Shoreline Condition in November 2018

Figure A-23. Shoreline Condition in August 2019

Figure A-24. Shoreline Condition in February 2021

Figure A-25. Shoreline Condition in July 2021