Point Dume and Zuma Beach, Malibu, CA

COUNTY OF LOS ANGELES – DEPARTMENT OF BEACHES AND HARBORS

COASTAL RESILIENCE PROJECT IMPLEMENTATION

PHASE 1: FEASIBILITY STUDY – FINAL REPORT

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County of Los Angeles – Department of Beaches and Harbors

Coastal Resilience Project Implementation

Phase 1: Feasibility Study – Final Report

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Executive Summary

As part of the first phase of the Los Angeles County Department of Beaches and Harbors (LACDBH) Coastal Resilience Project Implementation, a feasibility study was conducted to evaluate projects proposed as part of the 2023 Coastal Resilience Study at three sites: Zuma Beach & Point Dume Beach in the City of Malibu, Dockweiler State Beach in the City of Los Angeles, and Redondo Beach in the City of Redondo Beach.

Project Development and Selection

The concepts outlined in the LACDBH 2023 Coastal Resilience Study were used to develop three project alternatives for each site. The anticipated performance of each alternative was evaluated to estimate the relative benefits to recreation, public access, and dune habitat that could occur with project implementation. These benefits, along with the cost of design, environmental review, construction, and monitoring, were used to rank and select a preferred project for each site, as summarized below:

Zuma Beach and Point Dume Beach: The preferred project at this site includes nourishment of 500,000 cubic yards (cy) at Zuma Beach, creation of dune habitat (4.1 acres) along Zuma Beach and enhancement of the existing dune habitat at Zuma Creek and Point Dume Beach (4.5 acres). Renourishment events are expected to be necessary about every five years. The project will be monitored to determine when renourishment is needed. Future costs for renourishment have not been included.

Dockweiler State Beach: The preferred project at this site includes construction of a 700-ft long low sand barrier between the existing dune system and the bike and pedestrian path. The project also includes active management of dune habitat (2.8 acres) through installation of four designated beach access paths, sand fencing to encourage sand deposition within the dune field, installation of boundary fencing along the border, removal of non-native species, and seeding the dunes with native species.

Redondo Beach: The preferred project at this site includes beach nourishment of 300,000 cubic yards (cy) between Topaz Groin and Redondo Beach Pier and the creation of dune habitat (0.5 acres) fronting County facilities near Topaz Groin. Renourishment is not expected to be necessary for at least 20 years.

Sand Source(s)

The projects at Zuma/Point Dume Beach and Redondo Beach will each require a substantial quantity of beach nourishment (300,000 to 500,00 cy). Potential sand sources were evaluated, including those from harbor maintenance dredging, offshore borrow sites, and inland sources.

Several sand sources were identified for further exploration as part of the next project phase. These include an offshore borrow site off Dockweiler State Beach investigated in 2011 as part of the Broad Beach Restoration Project, a Temporary Nearshore Placement Area off Redondo Beach used to store dredged sediment from Marina del Rey and King Harbor, and a potential borrow area located off Redondo Beach that was identified in the early 1980s.

Economic Considerations (Benefits and Costs)

The probable cost of construction was estimated based on recent experience with similar projects in southern California. The costs include those for design, planning, permitting, monitoring, and construction. The cost for the preferred alternative at each site is provided below. A 25% contingency on the construction and monitoring costs is included.

Zuma Beach and Point Dume Beach:	$50.2M (does not include renourishment)
Dockweiler State Beach:	$ 1.9M
Redondo Beach:	$27.2M

Economic benefits derived from recreation, fiscal revenues, and ecological habitat were estimated for each project alternative and used, along with the probable cost of construction, to compute a benefit to cost ratio (BCR). The Dockweiler and Redondo Beach projects generated significant benefits relative to the project cost, resulting in a BCR of 7.8 in both cases. While benefits of up to $89M were generated as part of the Zuma and Point Dume Project, the high construction cost resulted in a BCR of 0.4, meaning that the benefits were not sufficient to cover the project cost.

Next Steps

The next two phases of the project are Preliminary Engineering and Design (Phase 2) and Environmental Review and Permitting (Phase 3). To expedite the permitting process, we recommend conducting these two phases in tandem.

Areas of particular emphasis will be optimization of the renourishment interval and construction cost for the Zuma Beach and Point Dume Beach Project, identification and permitting of at least two sediment sources for each project, and development of detailed design drawings (90%).

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Acronyms

ASBS	Areas of Special Biological Significance
BBGHAD	Broad Beach Geologic Hazard Abatement District
BBRP	Broad Beach Restoration Project
BCR	Benefit to Cost Ratio
BMP	Best Management Practice
CCC	California Coastal Commission
CCSTWS	Coast of California Storm and Tidal Wave Study
CDIP	Coastal Data Information Program
CDP	Coastal Development Permit
CDPR	California Department of Public Resources
CES4	CalEnviroScreen 4.0
CESA	California Endangered Species Act
CFC	Coastal Frontiers Corporation
CFGC	California Fish and Game Code
CNDDB	California Natural Diversity Data Base
CNPS	California Native Plant Society
COPC	California Ocean Protection Council
CPSMP	Coastal Pelagic Species Fishery Management Plan
CRC	Coastal Restoration Consultants
CRHR	California Register of Historical Resources
ECDP	Emergency Coastal Development Permit
EFH	Essential Fish Habitat
ESHA	Environmentally Sensitive Habitat Areas
FE	Federally Endangered
FESA	Federal Endangered Species Act
FT	Federally Threatened
GMP	Groundfish Management Plan

HAPC	Habitat Areas of Particular Concern
HTL	High Tide Line
HUC	Hydraulic Unit Code
LACDBH	Los Angeles County Department of Beaches and Harbors
LACFCD	Los Angeles County Flood Control District
LARIAC	Los Angeles Region Imagery Acquisition Consortium
LiDAR	Light Detection and Ranging
PCH	Pacific Coast Highway
PDO	Pacific Decadal Oscillation
MBTA	Migratory Bird Treaty Act
MdR	Marina del Rey
MF	Managed Fisheries
MHHW	Mean Higher High Water
MHTL	Mean High Tide Line
MLMA	Marine Life Management Act
MMPA	Marine Mammal Protection Act
MOP	California Coastal Wave Monitoring and Prediction System
MPA	Marine Protected Areas
MSL	Mean Sea Level
NCMP	National Coastal Mapping Program
NHD	National Hydrography Dataset
NMV	Non-Market Value
NOAA	National Oceanic Atmospheric Administration
NRCS	Natural Resource Conservation Service
NWI	National Wetlands Inventory
O&M	Operation and Maintenance
RBSP	Regional Beach Sand Projects
RCSAP	Regional Coastal Strategic Adaptation Plan

RWQCB	Regional Water Quality Control Board
SANDAG	San Diego Association of Governments
SAP	Sampling and Analysis Plan
SCOUP	Sand Compatibility and Opportunistic Use Program
SLR	Sea Level Rise
SMCA	State Marine Conservation Area
SMR	State Marine Reserve
SSC	Species of Special Concern
STR	Short-Term Rental
SWRCB	State Water Resources Control Board
TOT	Transient Occupancy Tax
USACE	U.S. Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WEAP	Worker Environmental Awareness Program
WRDA	Water Resources Development Act
WTO	Water Table Outcrop

COASTAL RESILIENCE PROJECT IMPLEMENTATION

PHASE 1: FEASIBILITY STUDY – FINAL REPORT

1 Introduction

1.1 Background

In December 2023, the Los Angeles County Department of Beaches and Harbors (LACDBH) completed a *Coastal Resilience Study* (Moffatt & Nichol, 2023) designed to identify areas threatened by coastal erosion, enhance climate resilience, and advance equitable coastal access to the 18 beaches owned or maintained by the County. As part of the study, three adaptation strategies were proposed at sites deemed to be most vulnerable to coastal hazards and of most value to the community:

- **Zuma Beach & Point Dume Beach**
  Increase sediment supply and expand habitat through beach nourishment and dune creation.

- **Dockweiler State Beach**
  Enhance dune habitat through (1) the installation of sand fencing to promote sand deposition and expansion of the existing dune field, and (2) construction of a low barrier to prevent sediment transport from the dunes into adjacent improved areas (bike path, sidewalk, parking lot).

- **Redondo Beach**
  Increase beach widths and create habitat between Topaz Groin and Redondo Pier through beach nourishment and dune creation. Investigate feasibility to construct an eco-friendly sand retention device at Redondo Pier to increase sediment retention.

Implementation of these projects is occurring though a phased approach (Figure 1-1), beginning with this feasibility study and progressing through design and engineering, environmental review and permitting, construction, and project monitoring. This approach is modeled after the successful Regional Beach Sand Projects (RBSP I and II) conducted on behalf of the San Diego Association of Governments (SANDAG) in 2001 and 2012 and is similar to that currently being used for RBSP III.

Figure 1-1. Coastal Resilience Project Implementation Phases

1.2 Feasibility Study Objectives

The objectives of the Phase 1 Feasibility Study are to (1) outline the steps needed for project implementation, (2) develop the proposed resilience concepts, (3) evaluate project alternatives, (4) estimate project costs and potential economic benefits, (5) identify the preferred alternative, and (6) provide clear and concise communication to facilitate public understanding and support.

1.3 Project Team

The multi-disciplinary project team assembled by LACDBH for this project is comprised of firms with extensive experience in all six project phases and a track record of successful collaboration. The team includes Coastal Frontiers Corporation (CFC), Moffatt & Nichol, Rincon Consultants, Summit Environmental Group, Ceto Consulting, and Coastal Restoration Consultants.

1.4 Report Scope and Organization

The purpose of this report is to summarize the results of Phase 1 (Feasibility Study), and document feedback obtained as part of stakeholder meetings held on September 23, 2024, January 29, 2025, and April 16, 2025. The conditions at each site are described in Section 2, while related projects and lessons learned from prior projects are summarized in Section 3. The project concepts and alternatives are presented in Section 4, followed by their expected performance and potential sand sources in Sections 5 and 6. Estimated construction costs and potential economic benefits are presented in Section 7. Section 8 describes the alternatives analysis and identifies the selected project at each site. A summary of stakeholder feedback and planned work for the remaining project phases follow in Sections 9 and 10, respectively. Attachment A includes an independent evaluation of specific components of the Zuma / Point Dume Beach project prepared by Dr. Gary Griggs at the request of LACDBH and CFC.

2 Site Conditions

The following section summarizes the primary factors that influence coastal processes, biological resources, dune habitat, recreational activity and economic benefits of beach use at each of the three project sites.

2.1 Coastal Processes

2.1.1 Regional Overview

The Los Angeles County coast is generally divided into the three regions shown in Figure 2-1: Malibu, Santa Monica Bay, and Palos Verdes Peninsula (Noble, 2016; Noble & Larry Paul, 2017).

The Malibu Region extends from the Los Angeles County - Ventura County line in the west to Topanga Canyon in the east, and generally consists of narrow, crescent-shaped beaches bounded by rocky headlands. For the most part, beaches in this 25-mile-long region face south and are narrow compared to other LACDBH beaches, the primary exception being Zuma Beach.

The Santa Monica Bay region is 20 miles long and extends from Santa Ynez Canyon (immediately east of Topanga Beach) in the northwest to the Palos Verdes Peninsula in the southeast. Beaches in this area generally face southwest and are backed by cliffs at both the north and south ends. Past projects, including beach nourishment, harbor construction, and the construction of sediment retention structures, have significantly affected the shoreline in this region, resulting in exceptionally wide and popular beaches in most areas (Leidersdorf *et al.*, 1994).

The Palos Verdes Peninsula Region is approximately 16 miles long and extends from the south end of Torrance Beach to the Port of Long Beach. The shoreline in this area consists of narrow, rocky, pocket beaches backed by cliffs that are up to 150-ft high (Noble, 2016). Shoreline changes in this region tend to be small and related to landslides emanating from the cliffs, rather than from oceanographic processes.

As shown in Figure 2-1, the Zuma / Point Dume Resilience Project is located in the Malibu Region, while the Dockweiler and Redondo Beach Projects are located in the Santa Monica Bay Region.

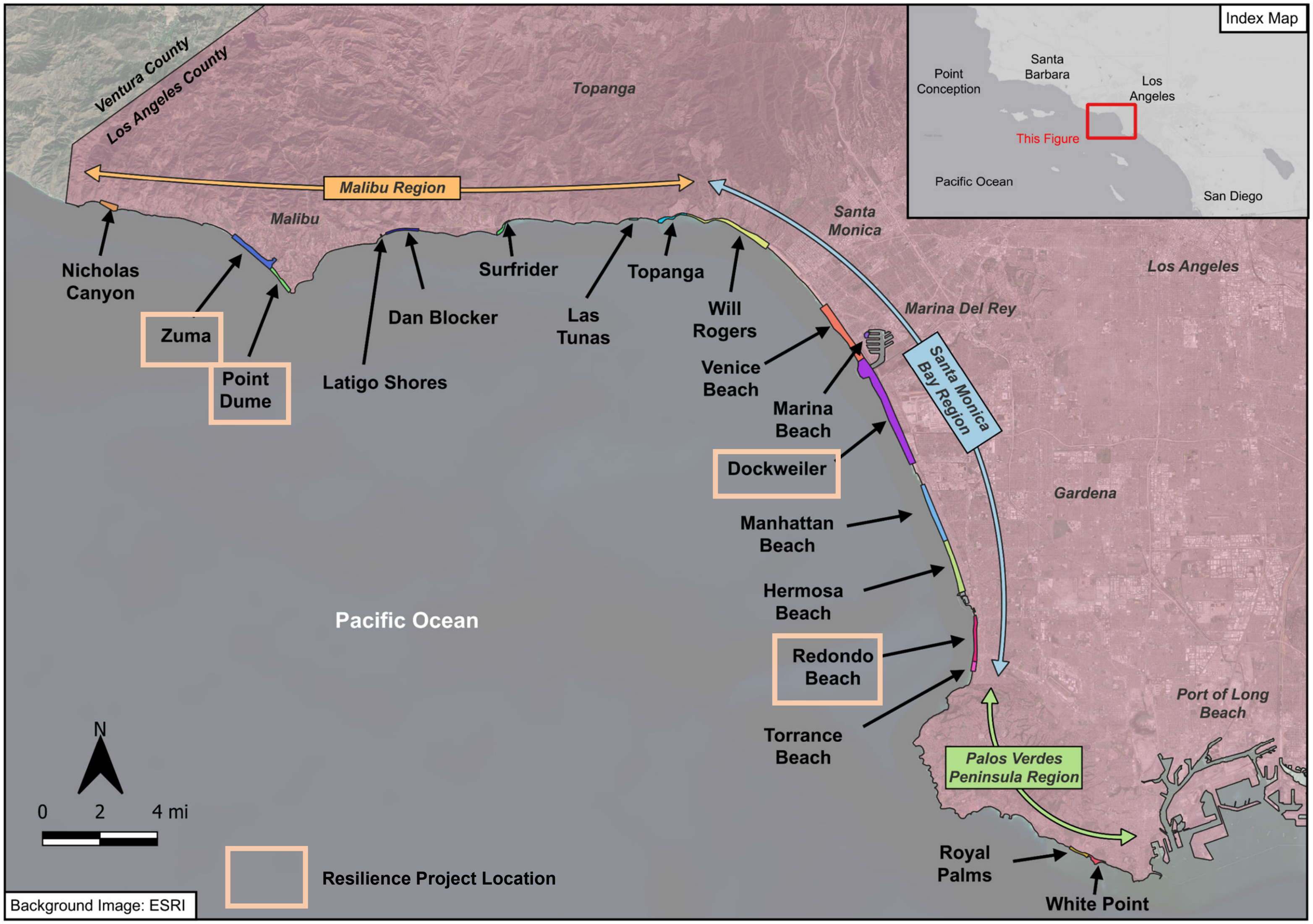

Figure 2-1. Los Angeles County-Operated & Maintained Beaches, Coastal Regions, and Resilience Project Locations

2.1.2 Littoral Processes

The quantification of coastal processes and sediment transport (sand movement) along the California coast is based primarily on the concept of littoral cells, or beach compartments, which provide a valuable beach and shoreline planning framework. A littoral cell is a closed coastal compartment or physiographic unit that contains sediment sources, transport paths, and sediment sinks (Inman and Chamberlain, 1960). A budget of sediment typically is developed for a littoral cell to evaluate and interpret coastal sedimentation and overall shoreline stability. This conceptual model applies the principle of conservation of mass to the fluxes of sediment into and out of the littoral cell. Accretion occurs if the balance is positive (*i.e.*, more sand is entering the littoral cell than leaving it), while erosion occurs if the balance is negative (*i.e.*, more sand leaving the littoral cell than entering it).

Figure 2-2 illustrates the littoral cells in the project area, based on work by Griggs and Patsch (2018). As shown in the figure, the region encompassing the three resilience projects (between Malibu and Redondo Beach) is comprised of two littoral cells: the Zuma Littoral Cell and the Santa Monica Littoral Cell.

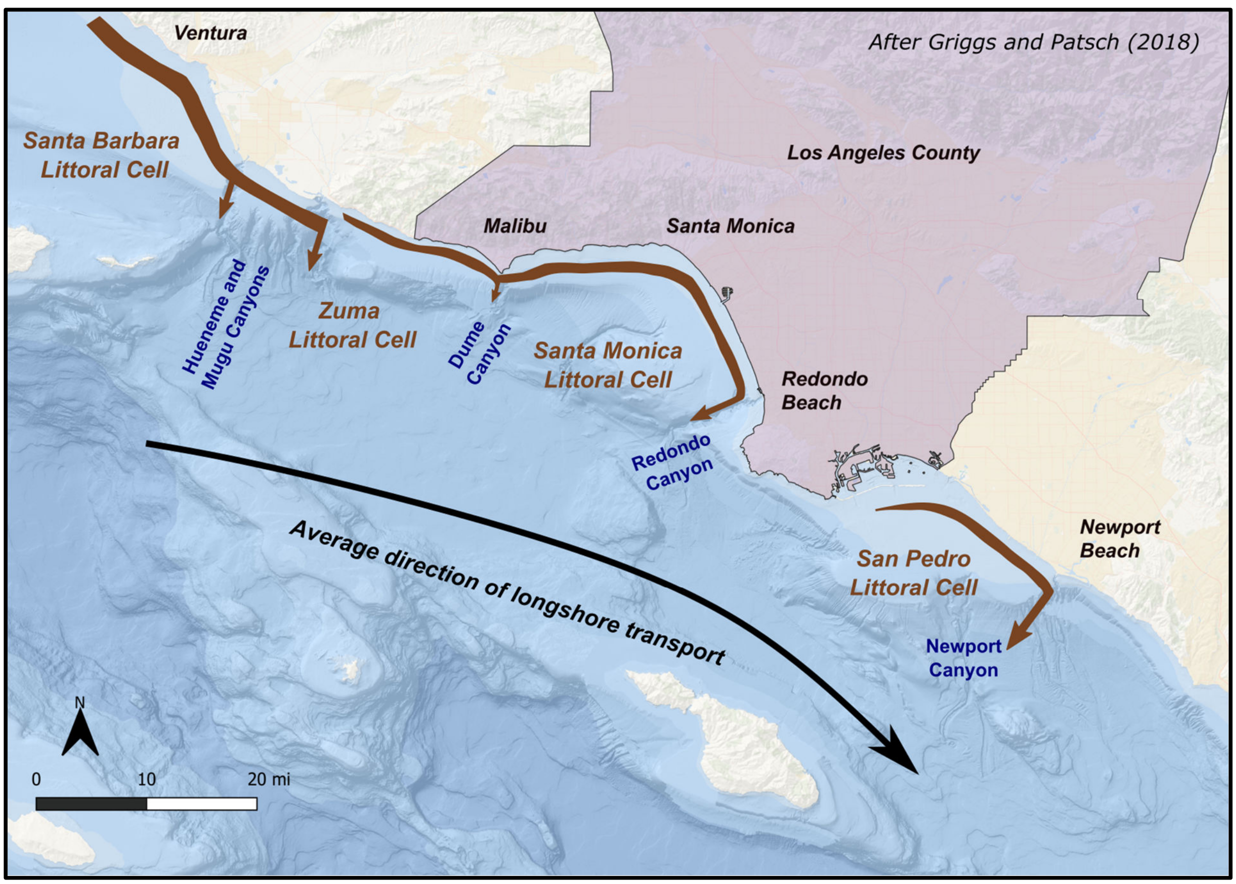

Figure 2-2. Regional Littoral Cells, Ventura to Newport Beach

Longshore sediment transport in both the Zuma and Santa Monica Littoral Cells is bidirectional and varies in accordance with seasonal changes in swell direction. The net direction of sediment transport is from west to east in the Zuma Littoral Cell and from northwest to southeast in the Santa Monica Littoral Cell (Patsch and Griggs, 2007). As described below, an exception occurs in the region south of the Redondo Submarine Canyon where the net direction of sediment transport is from south to north due to the distinct change in shoreline orientation from southwest-facing to west-facing.

Zuma Littoral Cell

The Zuma Littoral Cell begins at the Mugu Submarine Canyon and extends east to the Dume Submarine Canyon. Griggs & Patsch (2018) estimate that the primary sources of sediment within the cell are runoff from small streams and creeks (~34,000 cubic yards per year; cy/yr) and contributions from bluff erosion (~5,000 cy/yr). Prior to the late 1990's, a portion of the sediment travelling from west to east in the Santa Barbara Littoral Cell was able to bypass the head of Mugu Canyon and enter the Zuma Cell. However, Griggs & Patsch (2018) note that onshore migration of the canyon head has effectively blocked all sediment input along the western boundary of the Zuma Cell, leading to a deficit of sediment.

The primary sediment sinks within the Zuma Cell are material lost into Dume Canyon and material transported around Point Dume into the Santa Monica Littoral Cell. While investigators agree that Point Dume acts as a partial barrier to longshore sediment transport, they have not yet reached consensus regarding the percentage of material transported into the canyon versus that which is transported around Point Dume into the Santa Monica Littoral Cell (Inman, 1986; Orme, 1991; Knur & Kim, 1999; Everts & Eldon, 2005; Normark *et al.*, 2009; Everts, 2012; Griggs & Patsch, 2018, George *et al.*, 2018).

For the purpose of this study, we have adopted the conclusions presented by Everts (2012), summarized below, as they are directly related to beach nourishment placed upcoast of Point Dume (Broad Beach), and the likelihood that such material will benefit downdrift beaches in Santa Monica Bay.

> *If artificially placed at Broad Beach, sand, with the appropriate size distribution (and, of course, taken from outside any littoral zone) will initially benefit Broad Beach. Over time, it will move east thereby temporarily benefiting Zuma and Westward Beaches. But in due course, almost all of it will pass Point Dume and most of it will pass Malibu. It will eventually end up at Santa Monica and Venice. Its behavior as it moves east will be the same as that of sand that entered the coastal stream in the past from as far away as Port Hueneme.*

Beach widths within the Zuma Littoral Cell are generally characterized by short-term periods of erosion during intense storm events and decadal changes that vary in accordance with the Pacific Decadal Oscillation (PDO). During warm phases of the PDO, beaches within the Zuma Cell tend to erode, while beaches tend to accrete during the cool phase (Griggs and Patsch, 2018).

Santa Monica Littoral Cell

The Santa Monica Littoral Cell begins at Point Dume and ends at the Redondo Submarine Canyon (Figure 2-2). As noted above, the Point Dume Submarine Canyon acts only as a partial barrier to sediment transport, and we have assumed that almost all the sediment moving east through the Zuma Littoral Cell will enter the Santa Monica Littoral Cell. Presently, the only additional natural source of sediment within the Santa Monica Cell is that which is contributed through bluff erosion. Sediment delivery from creeks and streams has largely been eliminated by dams constructed within the Malibu Creek Watershed, with the Rindge Dam being the largest (Griggs and Patsch, 2018). This reduction in natural sediment delivery caused beaches in the northwestern portion of the Santa Monica Cell to become narrow, and sand retention structures, including 33 groins, were built to stabilize the shoreline along the Topanga Beach and Will Rogers section of western Santa Monica Bay. Many of these structures are now either buried, severely damaged, or destroyed (Patsch and Griggs, 2007). The Will Rogers groin field is an exception, as it continues to retain sand resulting in a wide and popular beach.

East and south of Will Rogers, beaches are much wider, reflecting the significant quantities of sand that have been delivered to the coast via beach nourishment projects. Since 1926, over 31M cy of sand has been placed on Santa Monica Bay beaches (Leidersdorf *et al.,* 1994), most of which was derived from major coastal infrastructure construction projects, such as the Hyperion Sewage Treatment Facility and Pacific Coast Highway (PCH). In recent decades, the absence of similar large-scale public infrastructure projects has led to a significant decrease in the frequency and volume of beach nourishment activities in Santa Monica Bay.

The net direction of sediment transport in the Santa Monica Littoral Cell is from west to east between Point Dume and Santa Monica, and from north to south between Santa Monica and King Harbor, which lies immediately north of the Redondo Submarine Canyon. South of the Redondo Submarine Canyon, in the area where the Redondo Beach Resilience Project is proposed, the net direction of sediment transport is from south to north due to the distinct change in shoreline orientation from southwest-facing to west-facing. Per Patsch and Griggs (2007), the *Redondo Submarine Canyon is the confluence of the southern and northern trending alongshore transport of sand established in the Santa Monica Littoral Cell. With its head located within 200 yards of the shoreline, Redondo Submarine Canyon serves as an effective sink for this cell.*

2.1.3 Wave Climate

In general, waves that occur along the southern California coast can be categorized as North Pacific swell, southern swell, or locally generated seas. North Pacific swell is generated by extra-tropical storms that form in the northern hemisphere during the winter months and approach the coast from the west and northwest. Southern swell typically occurs in the summer and fall when intense storms form in the southern hemisphere and eastern Pacific. Locally generated seas can occur year-round and typically approach from the west and southwest; however, pre-frontal seas can be generated from the southeast in winter. Figure 2-3 illustrates the wave exposure windows at the three project sites.

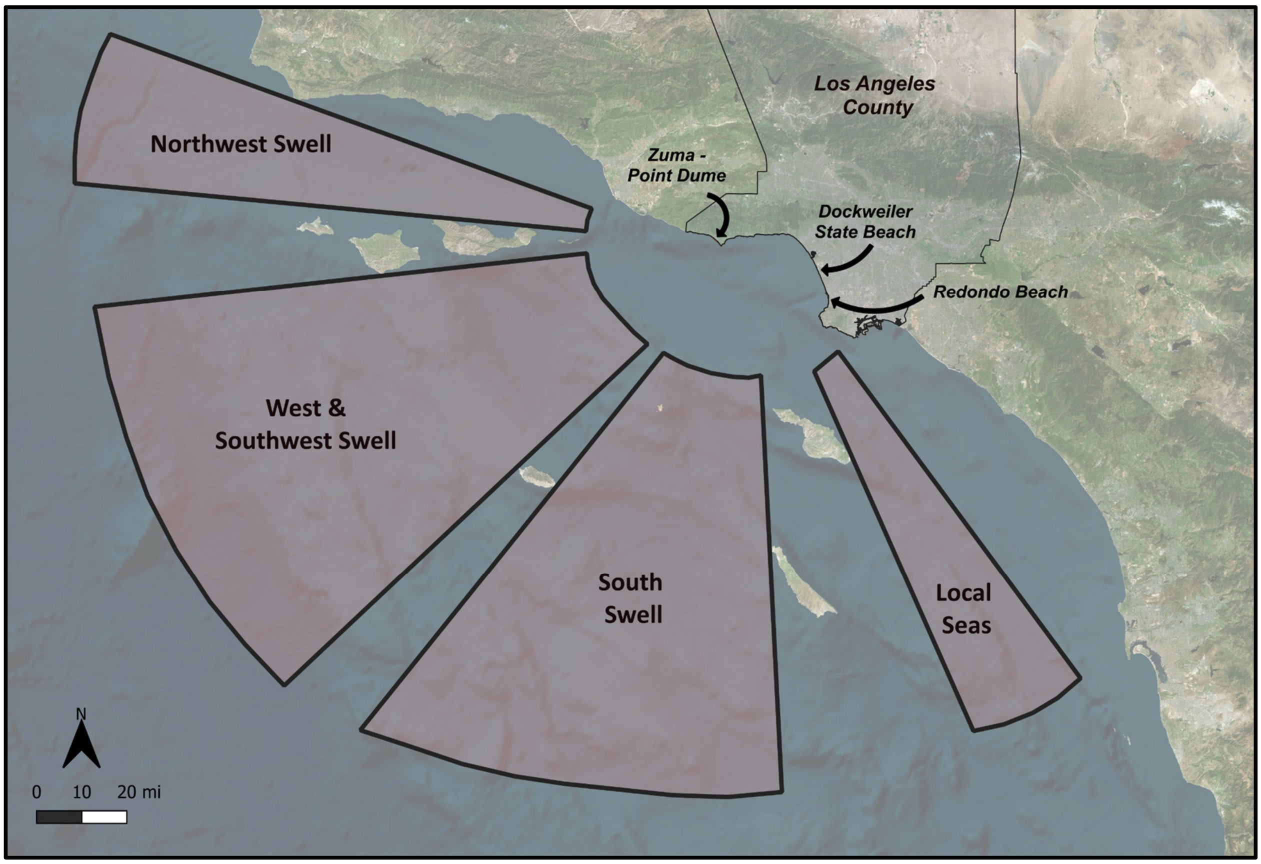

Figure 2-3. Wave Exposure Windows at Project Sites

2.1.4 Sea Level Rise

Planning decisions related to any development within the coastal zone must consider the potential impacts of future sea level rise (SLR). In California, the currently accepted, best available planning guidance for SLR is provided in the California Ocean Protection Council's (COPC) *State of California Sea-Level Rise Guidance: 2024 Science and Policy Update* (COPC, 2024).

The COPC guidance includes several projections that differ based on the greenhouse gas emissions scenario selected. Living shoreline projects, such as those proposed herein, are considered to be "low risk aversion," meaning that they have a high tolerance for varying risk levels and can be easily adapted based on observed changes (COPC, 2024). For the purpose of evaluating the impacts of SLR, the design life of each project is assumed to be 20 years, with a base year of 2030 (*i.e.,* 2030 to 2050). Based on the project adaptability and this relatively short project life, the "intermediate-low" scenario has been adopted for this study. Table 2-1 delineates the COPC SLR projections for Santa Monica in years 2030 through 2050 under this scenario.

Table 2-1. Projected Sea Level Rise for Santa Monica

Year	**Sea Level Rise (ft)** Intermediate-Low Risk Aversion Scenario
2030	0.3
2040	0.4
2050	0.6

Source: COPC, 2024

2.1.5 Shoreline Configuration

This section presents information related to the shoreline configuration at each of the three project sites, including relevant short- and long-term shoreline changes.

Zuma Beach & Point Dume Beach

Zuma Beach and Point Dume Beach are adjoining sites located in the City of Malibu, northwest of Santa Monica Bay (Figure 2-4). Zuma Beach is the widest and longest continuous beach in north LA County, with 1.8 miles of beach frontage and 105 acres of property, making it a popular destination for visitors and nearby residents. It is bound by Broad Beach to the northwest and Point Dume Beach to the southeast. Cellphone derived visitation data for the Zuma Beach area, including the contiguous areas of Broad Beach and Point Dume Beach, indicate that approximately 1.4 million people visit the area annually (Ceto, 2025).

Shoreline changes in this area were studied in detail as part of the Broad Beach Geologic Hazard Abatement District's (BBGHAD) Broad Beach Restoration Project (Coastal Frontiers Corporation, 2023)[1]. As part of the project, CFC conducted 26 beach profile surveys between 2009 and 2023, documenting the shoreline configuration at up to 16 sites between Lechuza Point and Point Dume. The surveys were conducted in the Fall (October) or Spring (May), corresponding to the beginning and end of the winter wave season, respectively.

[1] Permission to use data provided by BBGHAD (McMahon, 2024)

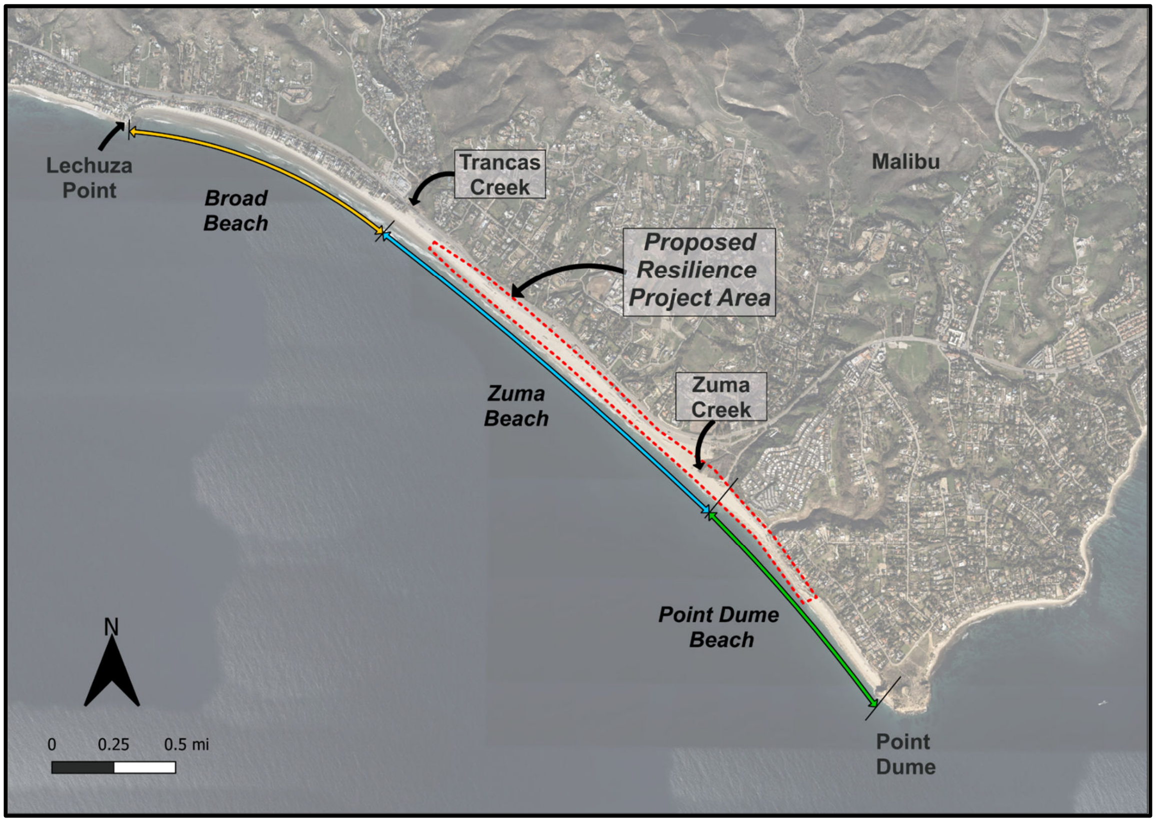

Figure 2-4. Zuma Beach and Point Dume Project Location

Figure 2-5 illustrates representative beach profiles obtained at Broad Beach, Zuma Beach, and Point Dume Beach between October 2013 and October 2023, as well as the envelope of profiles obtained between May 2002 and November 2022. As shown in the figure, the above-water portion of Zuma Beach is considerably wider than that at Broad Beach and Point Dume Beach. In addition, the nearshore slope tends to be flattest at Broad Beach and steepest at Point Dume Beach.

Figure 2-6 shows the average Fall Mean Sea Level (MSL) beach width measured during the past decade at Broad Beach, Zuma Beach, and Point Dume Beach. Between 2013 and 2019, Broad Beach was considerably narrower than both Zuma Beach and Point Dume Beach. Since that time, Broad Beach and Zuma Beach have gradually widened, while Point Dume Beach has gradually narrowed. At the time of the most recent survey (Fall 2023), the average beach width at Zuma Beach (268 ft) was almost twice that at Broad Beach (133 ft) and Point Dume Beach (158 ft).

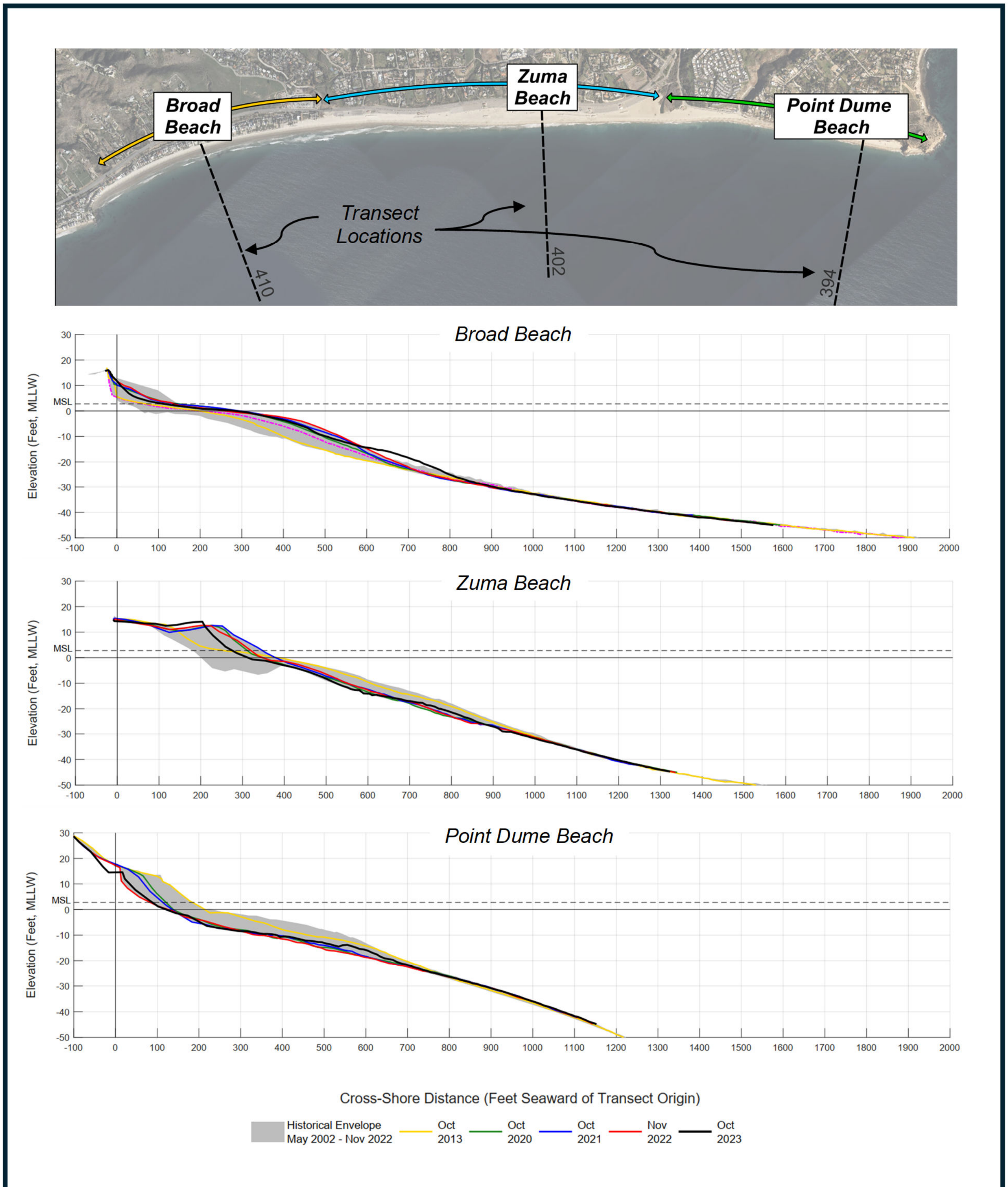

Figure 2-5. Representative Beach Profiles at Broad Beach, Zuma Beach, and Point Dume Beach

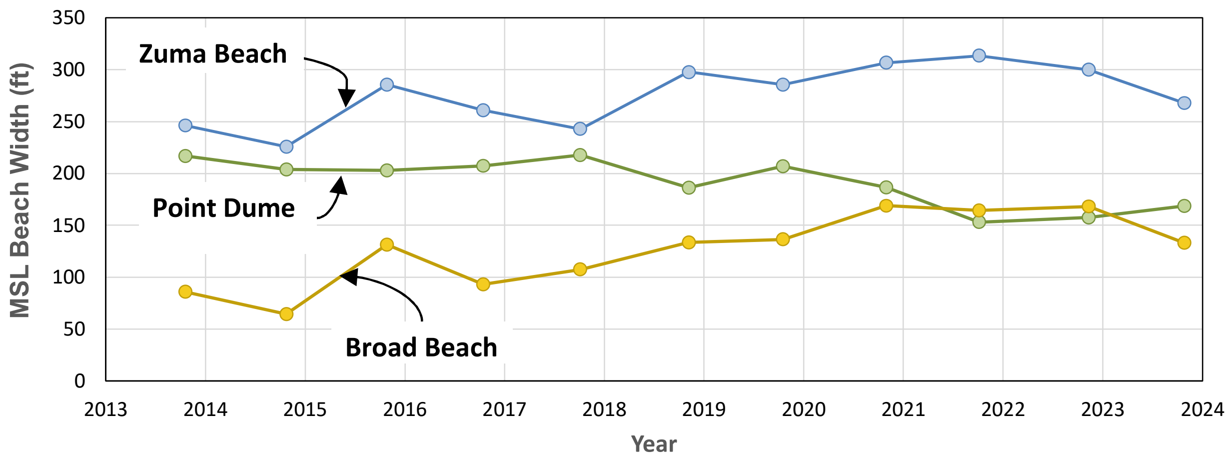

Figure 2-6. Average MSL Beach Widths at Broad Beach, Zuma Beach, and Point Dume

One of the issues that the proposed resilience project seeks to address is the vulnerability of Westward Beach Road, which serves as the only access point to Point Dume Beach. In Summer 2021, the road was undermined, requiring emergency repairs and shore protection. Storms in winter 2022-23 damaged the emergency shore protection and threatened portions of the road and a restroom on the west end of Point Dume Beach. To prevent loss of the road, access to the beach, and damage to existing facilities (including potential environmental impacts), additional rock was imported and used to construct the revetment shown in Photo 2-1. The County is preparing a proposal to remove any unnecessary stone, reduce the revetment footprint, and bury the structure (where possible) so that it acts as a "last line of defense" and has the least impact on local resources. Sand added to the beach as part of the Zuma and Point Dume Beach project proposed herein will increase sand supply in the area, leading to a greater likelihood that the structure will remain buried.

Dockweiler State Beach

Dockweiler State Beach is located in the southeast portion of Santa Monica Bay, south of Marina del Rey (Figure 2-1), in the Playa del Rey neighborhood of Los Angeles. The west-facing beach is approximately four miles long, with amenities that include fire rings, volleyball nets, a youth center, bike path, restrooms, and hang glider facilities. It is a popular destination for residents and visitors, garnering an average of 1.9 million visits per year (Ceto, 2025).

Figure 2-7 illustrates the southern portion of Dockweiler State Beach, near the site of the proposed resilience project. The area consists of a wide, sandy beach stabilized by rock groins, and has historically benefitted from sand bypassed from Marina del Rey Harbor during maintenance dredging events (Section 3.1.6).

Photo 2-1. Point Dume Beach and Westward Beach Road (March 16, 2023)

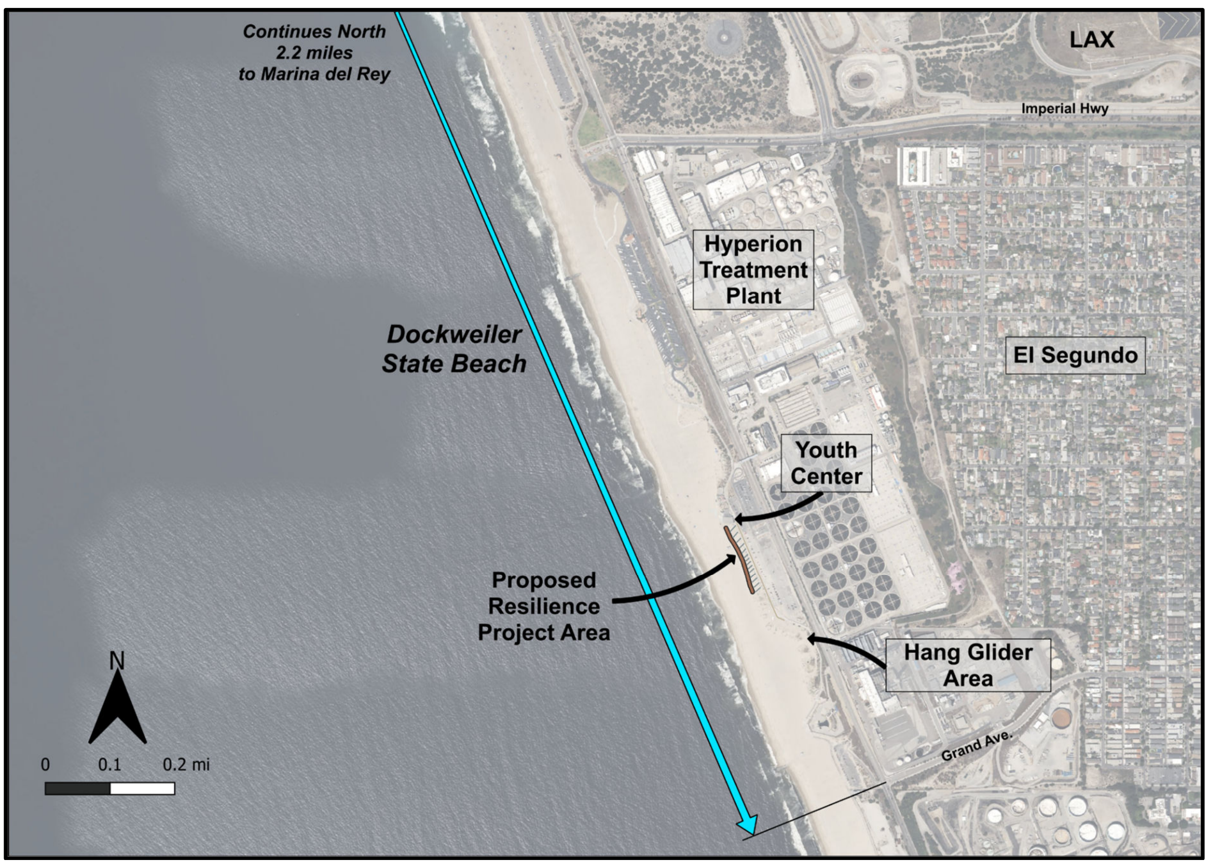

Figure 2-7. Dockweiler State Beach Project Location

The surplus of sediment in this area, however, can be driven by wind onto landward amenities, such as the Marvin Braude Bike Trail and parking lots, creating a hazard to public safety. The proposed resilience project aims to reduce this hazard through (1) construction of a low barrier to prevent migration of beach sand onto the trail and parking lot and (2) active maintenance of the dune system that fronts the bike path (Moffatt & Nichol, 2023).

Figure 2-8 illustrates representative beach profiles obtained approximately one mile north of the proposed resilience project. The profiles were obtained in June 2002 and June 2005 on behalf of the U.S. Army Corps of Engineers (USACE), and in May 2024 on behalf of LACDBH as part of the County's Sand Compatibility and Opportunistic Use Program (SCOUP). As noted above, and shown in the figure, the beach is very wide. Based on the available profile data, the site is relatively stable, with only minor differences evident between the three profiles.

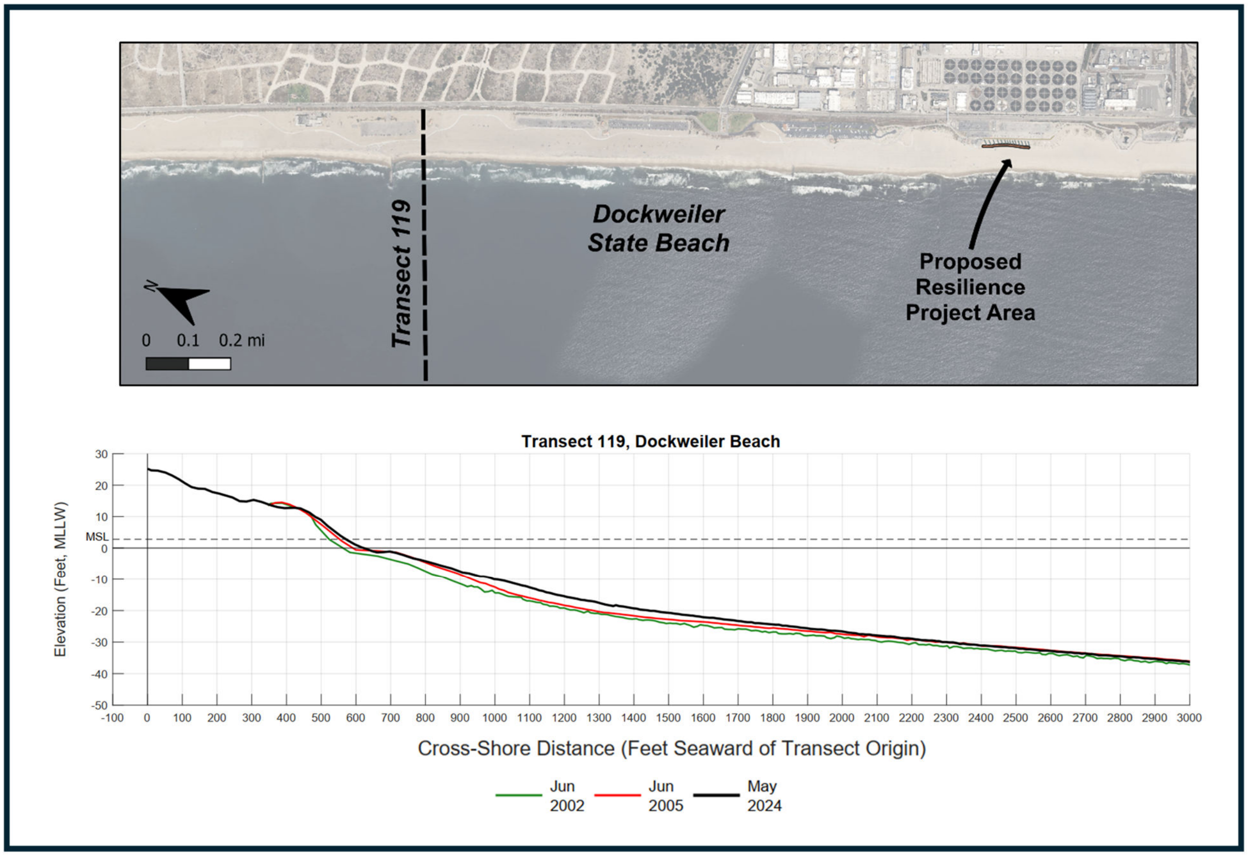

Figure 2-8. Representative Beach Profiles at Dockweiler State Beach

Redondo Beach

Redondo Beach is located near the southeast end of Santa Monica Bay, in the City of Redondo Beach (Figure 2-1). The entire beach is over a mile and a half long, beginning at the Redondo

Beach Pier and ending at Miramar Park and Torrance Beach (Figure 2-9). While not as large as the beaches at Zuma and Dockweiler, it is a popular destination, receiving approximately 750,000 annual visitors (Ceto, 2025).

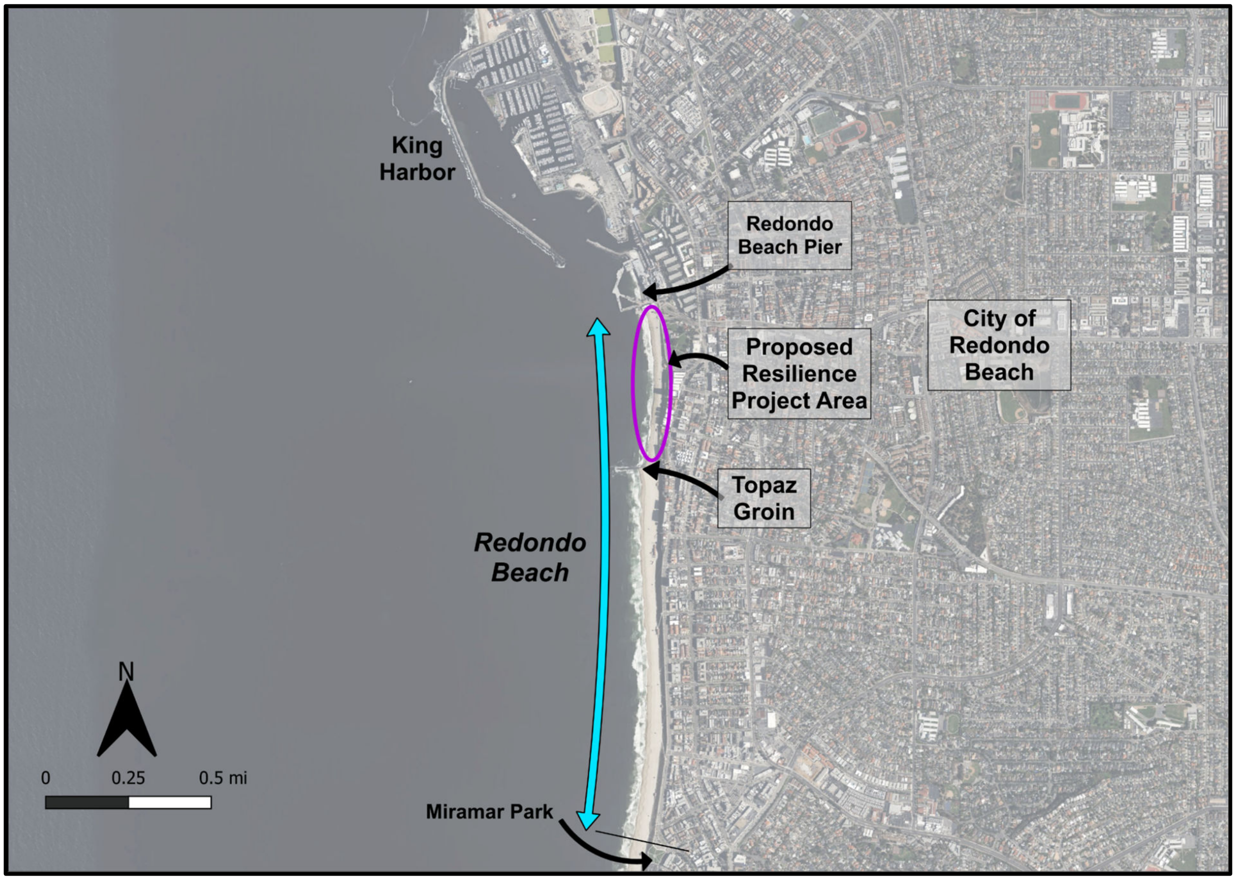

Figure 2-9. Redondo Beach Project Location

The beach consists of two primary regions, separated by Topaz Groin. South of the groin, the beach is wide and stable, due to the retention of sediment travelling along the coast from south to north (Section 2.1.2). Patsch and Griggs (2007) note that much of the sand placed in the area as part of a large beach nourishment project in 1968 and 1969 still exists along this stretch of coast. North of the groin, the beach is narrow due to the reduction in sediment supply caused by the groin, as well as the loss of sediment into the Redondo Submarine Canyon and King Harbor.

Figure 2-10 illustrates representative beach profiles obtained on the north and south sides of Topaz Groin in June 2002, June 2005, and May 2024. As shown in the figure, the beach north of the groin (Transect 028) is narrower and steeper than that to the south (Transect 016), given the proximity of the northern monitoring transect to the Redondo Submarine Canyon. Both areas appear to be stable based on the limited profile data available.

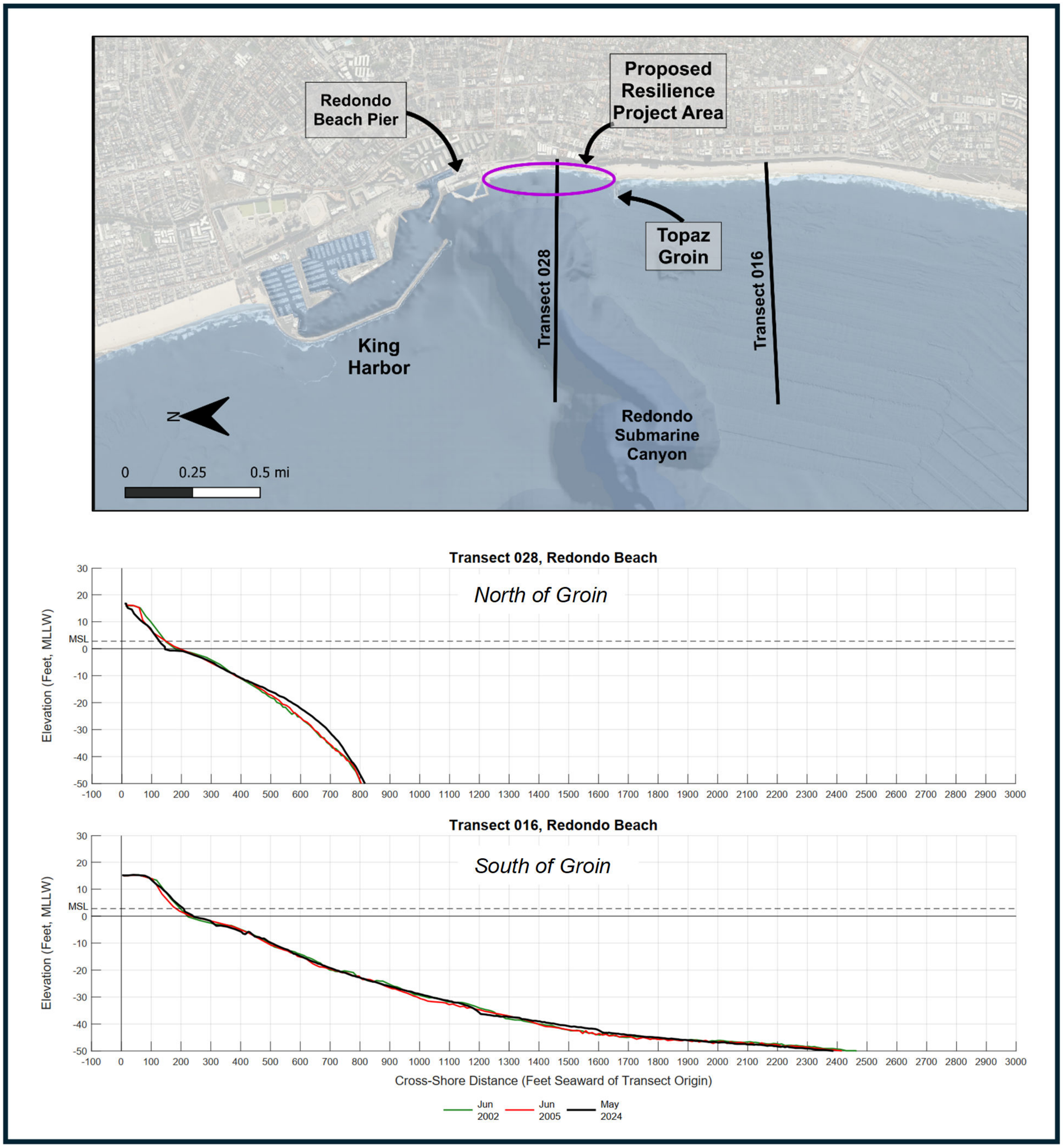

Figure 2-10. Representative Beach Profiles at Redondo Beach

The area north of Topaz Groin has been used as a beach nourishment receiver site on several occasions. In spring 2000, approximately 300,000 cy of beach quality sand dredged from Marina del Rey was placed in the region between Topaz Groin and the Pier (Ryan, 2024). Twelve years later (2012), 75,000 cy of sand from the same source was placed in the region between Topaz Groin and Pearl Street (Ryan, 2024).

2.1.6 Sediment Size

Table 2-2 summarizes the median grain size at each of the three project sites. The samples at Zuma Beach were obtained in Spring 2016 as part of the Broad Beach Restoration Project[2], while those at Dockweiler State Beach and Redondo Beach were obtained in Spring 2024 as part of the LACDBH SCOUP Project (Coastal Frontiers, 2023a). Figure 2-11 through Figure 2-13 illustrate the envelope of grain sizes. As shown in both the table and figures, the sediments at Zuma and Dockweiler State Beach were similar in size, while those at Redondo Beach tended to be coarser.

Table 2-2. Median Grain Size Distribution, Coastal Resilience Project Sites

Elevation (ft, MLLW)	D_{50} (mm)					
	Zuma Beach		Dockweiler State Beach		Redondo Beach	
	Transect 402	Transect 406	Transect 119	Transect 115	Transect 028	Transect 016
+12	0.31	0.32	0.34	0.37	0.54	0.45
+6	0.53	0.29	0.28	0.33	0.71	0.35
0	0.20	0.19	0.20	0.24	1.04	0.37
-6	0.37	0.22	0.25	0.24	0.44	0.27
-12	0.20	0.18	0.22	0.20	0.31	0.24
-18	0.17	0.17	0.10	0.16	0.18	0.16
-24	0.14	0.13	0.10	0.16	0.16	0.14
-30	0.14	0.12	0.10	0.10	0.20	0.12

[2] Grain side data provided courtesy of BBGHAD (McMahon, 2024).

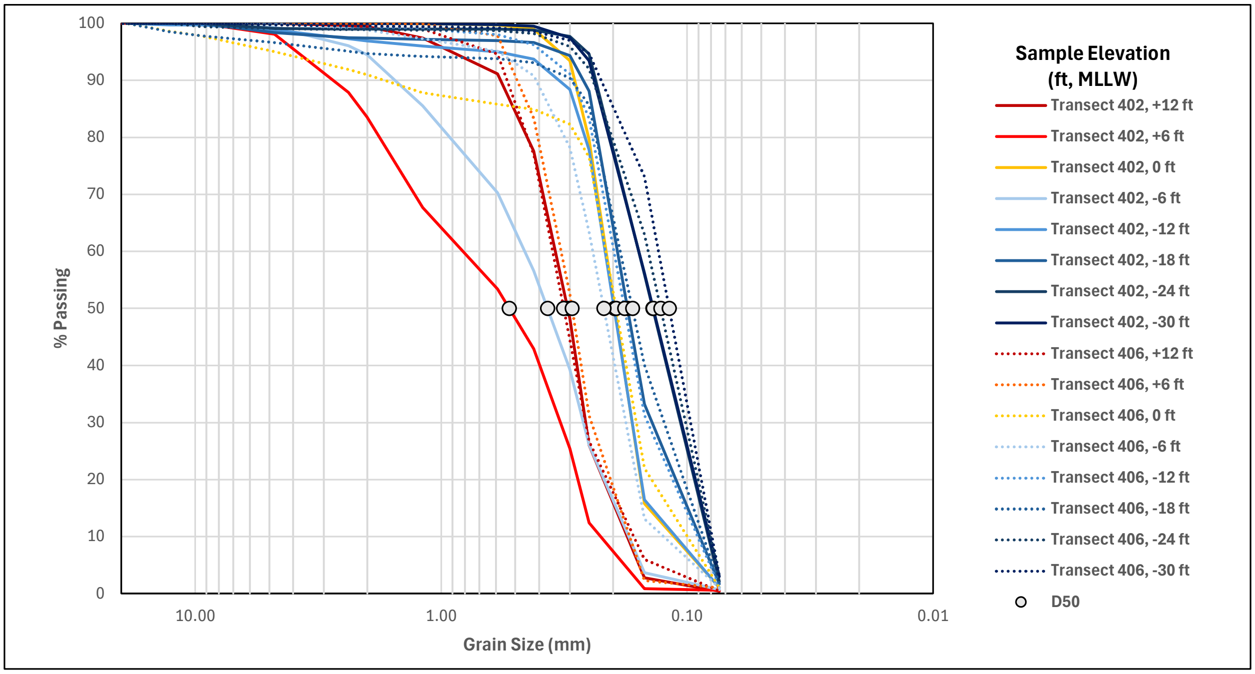

Figure 2-11. Envelope of Grain Sizes, Zuma Beach

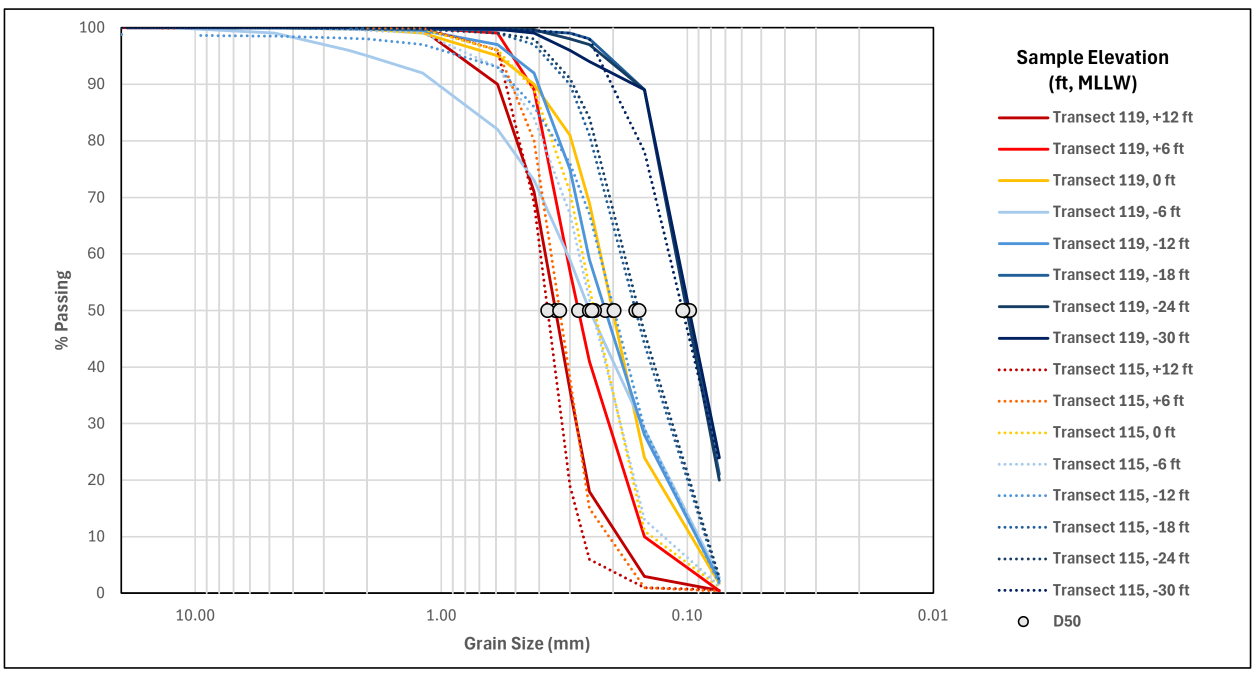

Figure 2-12. Envelope of Grain Sizes, Dockweiler State Beach

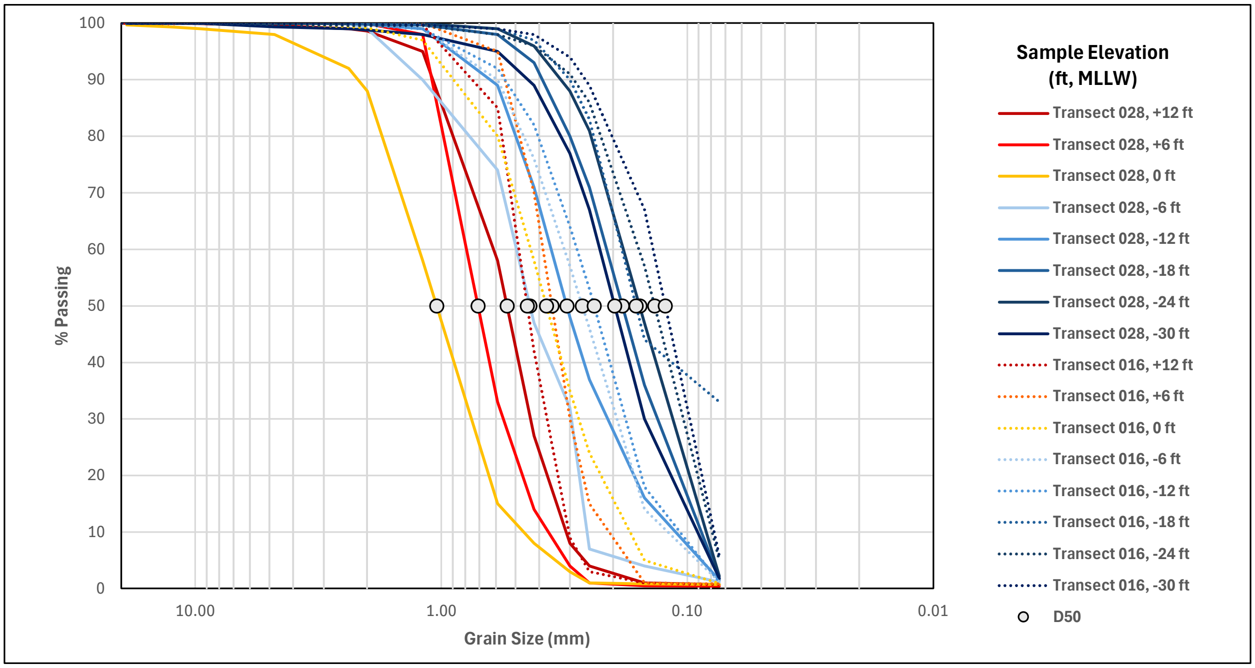

Figure 2-13. Envelope of Grain Sizes, Redondo Beach

2.2 Biological Resources

The subsections that follow summarize the regulated and sensitive biological resources relevant to the three project locations. The summary was prepared by marine scientists and biologists at Rincon Consultants (2024).

2.2.1 Data Sources

A variety of literature was reviewed to obtain baseline biological information at the three project sites. Applicable regional studies, such as the Los Angeles Department of Beaches and Harbors Coastal Resiliency Study (Moffatt & Nichol, 2023), Sand Compatibility and Opportunistic Use Program for Los Angeles County Beaches – Planning Study & Framework Report (Coastal Frontiers Corporation, 2023), Los Angeles County Public Beach Sea-Level Rise Vulnerability Assessment (Noble, 2016), and California Regional Sediment Management Plan, Los Angeles County Coast (Noble, 2012) were reviewed for regionally applicability.

Additionally, standard biological reference materials and regionally applicable regulatory guiding documents, such as aerial photographs, topographic maps, bathymetric charts, geologic maps, climatic data, and project plans were used. The results of database queries from the California Natural Diversity Data Base (CNDDB; CDFW, 2024a), United States Fish and Wildlife Service (USFWS) Information, Planning, and Conservation System (USFWS, 2024b), species managed by the National Oceanic Atmospheric Administration (NOAA, 2024b & 2024c), and the California

Native Plant Society (CNPS, 2024) were recently compiled for the LACDBH SCOUP Project (Rincon Consultants, 2025), which included a review of the three project site locations. The preliminary list of special status species for the SCOUP Project was used to evaluate which species may have a potential to occur within the three project sites. The evaluation included 83 terrestrial special-status plant species and 80 terrestrial and marine/anadromous special-status wildlife species.

Queries were conducted of several relevant scientific databases which provide information about regulated or sensitive biological resources, including the USFWS Critical Habitat Portal (USFWS, 2024a), the USFWS National Wetlands Inventory (NWI; USFWS, 2024c), the National Hydrography Dataset (NHD; United States Geological Survey [USGS], 2024), the United States Department of Agriculture National Cooperative Web Soil Survey (USDA, 2024a), the Natural Resource Conservation Service (NRCS) List of Hydric Soils (USDA, 2024b), and the Essential Fish Habitat (EFH) Mapper (NOAA, 2024a).

In addition to the literature review and databases mentioned above, Rincon staff reviewed state Marine Protected Areas (MPAs), which have been established to protect ecosystems and/or sustain fisheries production, as well as specific species regulated through the goals, objectives, policies, and mandates of the Marine Life Management Act (MLMA) and Areas of Special Biological Significance (ASBS), which were created in order to help maintain natural water quality within some of the most pristine and biologically diverse sections of California's coast.

2.2.2 Regulated Biological Resources

Special-Status Species

Special-status species include those listed, proposed for listing, or candidates for listing as threatened, endangered or species of concern by the USFWS or NOAA under the Federal Endangered Species Act (FESA); those listed or proposed for listing as rare, threatened, or endangered by the CDFW under the California Endangered Species Act (CESA); animals designated as "Fully Protected" and Species of Special Concern (SSC) by the CDFW; and species on the Special Animals List. Additionally, special-status resources include those protected under the Marine Mammal Protection Act (MMPA) and sensitive aquatic communities, such as eelgrass beds (*Zostera* spp.) or managed fisheries (MF) such as California grunion (*Leuresthes tenuis*).

No special-status plants are expected to occur within the project sites based on the absence of suitable habitat types and/or soils and being located outside the known range for these species. The following special-status terrestrial and marine/anadromous wildlife species have potential to occur at the three project sites.

- El Segundo blue butterfly (*Euphilotes battoides allyni*) (Federally Endangered [FE]) – Dockweiler State Beach
- California grunion (MF) – Zuma Beach & Point Dume Beach, Dockweiler State Beach, Redondo Beach
- Green sea turtle (*Chelonia mydas*) (Federally Threatened [FT]) – Zuma Beach & Point Dume Beach, Dockweiler State Beach, Redondo Beach
- Western snowy plover (*Charadrius nivosus nivosus*) (FT/ SSC)– Zuma Beach & Point Dume Beach and Dockweiler State Beach
- California brown pelican (*Pelecanus occidentalis*) (Federally and State Delisted) – Zuma Beach & Point Dume Beach, Dockweiler State Beach, Redondo Beach
- California least tern (*Sterna antillarum browni*) (FE/State Endangered) – Dockweiler State Beach and Redondo Beach
- Gray whale (*Eschrichtius robustus*) (FE/MMPA) – Zuma Beach & Point Dume Beach, Dockweiler State Beach, Redondo Beach
- Harbor seal (*Phoca vitulina*) (MMPA) – Zuma Beach & Point Dume Beach, Dockweiler State Beach, Redondo Beach
- Common bottlenose dolphin (*Tursiops truncatus*) (MMPA) – Zuma Beach & Point Dume Beach, Dockweiler State Beach, Redondo Beach
- California sea lion (*Zalophus californianus*) (MMPA) – Zuma Beach & Point Dume Beach, Dockweiler State Beach, Redondo Beach

Invertebrates

The El Segundo blue butterfly resides in the El Segundo sand dunes near Dockweiler State Beach and has been observed foraging in areas with their natural food source, coast buckwheat (*Eriogonum latifolium*). There is potential for the species to occur in the vegetated areas near the project site, but they are not expected to occur due to lack of their food source.

Fish

The California grunion spawns on sandy beaches in southern California. Immediately following high tides from mid-March through August, grunion may come ashore to lay eggs in the sand near the High Tide Line (HTL). The eggs are incubated in the sand until the following series of high tide conditions, when the eggs hatch and are washed into the ocean. The Zuma Beach and Redondo Beach project sites occur on the subtidal sand overlapping the HTL and therefore have the potential to impact incubating eggs if project activities occur during their spawning season.

The project should be designed to be constructed outside of the spawning season or incorporate grunion monitoring measures, such as those provided in Section 3.3.3.

Green Sea Turtle

The green sea turtle is common in southern California bays, lagoons, and other nearshore waters close to coastal inlets. Individuals are not expected at the project sites but could occur foraging or transiting through Santa Monica Bay in warm water years. The project activities could temporarily alter nearshore water quality but the potential for substantial impacts is relatively low. The project should be designed to limit the discharge of sediment or material into the nearshore waters and develop a water quality monitoring plan, as described in Section 3.3.7.

Birds

The western snowy plover exhibits strong fidelity to overwintering sites, which provide connectivity for dispersal between breeding sites. Breeding western snowy plovers have not been observed at the Redondo Beach project site since 2020 but they may occur at Zuma Beach and Dockweiler State Beach. While the beach within the project sites may provide important overwintering habitat, the sites are frequently disturbed by public use and the species is likely accustomed to ambient disturbance. If the species were present during project activities, potential direct impacts could include mortality or injury of individuals. Potential indirect impacts to the species may include increased noise and displacement of food; however, these indirect impacts to habitat are anticipated to be temporary and will not affect the long-term quality of overwintering, foraging, or nesting habitat.

The California least tern is not known to nest at the project sites but could be found in the nearshore waters foraging; therefore, direct impacts are not expected. Project activities have the potential to indirectly impact foraging individuals if present during active working periods.

The California brown pelican is present at the project sites. However, suitable nesting habitat does not exist within the project area. Should the species be present during the project, potential direct impacts could include mortality or injury of individuals. Potential indirect impacts to the species may include increased noise and displacement of food.

The project should be designed to be constructed outside of the nesting bird season or incorporate western snowy plover monitoring and nesting bird survey measures, as described in Section 3.3.4.

Marine Mammals

The offshore waters of the project sites are relatively shallow (< 40-ft Mean Lower Low Water) reducing the potential for cetaceans (*e.g.*, gray whale) to occur. The common bottlenose dolphin, California sea lion and harbor seal have a moderate to high potential to occur. Noise from project implementation is not expected to cause disturbance to marine mammals since no underwater sound is proposed. Increased turbidity may temporarily alter foraging or migration patterns but the potential for substantial impacts is relatively low.

To minimize disturbance to special-status marine mammals, the general guidelines set forth in Section 3.3.5 should be implemented. Project activities are not expected to have direct impacts on marine mammals if these guidelines are followed. Indirect impacts to marine mammals could include alteration or disturbance of foraging or haul-out habitat.

Nesting Birds

To avoid disturbance to nesting and special-status birds, including raptor species protected by the Migratory Bird Treaty Act (MBTA) and California Fish and Game Code (CFGC) 3503, activities related to the project including, but not limited to, vehicle traffic, foot traffic, and demobilization, should occur outside of the bird breeding season for migratory birds (generally February 1 through September 15), if practicable. Should any birds nest on or near the project sites, project activities could directly impact breeding by destroying the nest or disrupting normal biological behaviors. Indirect impacts could include disturbance of breeding habitat. The loss of a nest or disturbance of nesting habitat during the breeding season due to construction activities would be a violation of the MBTA and CFGC Section 3503.

To minimize the possibility of disturbance to nesting birds, the guidelines set forth in Section 3.3.4 should be implemented.

Watershed and Drainages

The Zuma Beach & Point Dume Beach site is in the Zuma Canyon-Frontal Pacific Ocean watershed within Hydraulic Unit Code (HUC 12-180701040203), which drains directly into the Pacific Ocean (USGS, 2024). The south face of the Santa Monica Mountains drains to the Pacific Ocean through several small simple watersheds draining a few hundred to a few thousand acres. The streams and coastal bluffs contribute sand to the Zuma and Santa Monica littoral cells, which extend from Mugu Canyon in Ventura County to Palos Verdes Peninsula in Los Angeles County. Several ephemeral drainages which originate in residential areas direct stormwater under the Pacific Coast Highway (PCH) and terminate at culvert outlets along the back beach (USGS, 2024). Zuma Creek, an intermittent creek, is located west of Point Dume. The creek originates in the Santa Monica Mountains and flows through Zuma Canyon before terminating at the Pacific Ocean.

Dockweiler State Beach is located along the Manhattan Beach-Frontal Santa Monica Bay watershed within Hydraulic Unit Code (HUC 12-180701040500), which drains directly into the Pacific Ocean. No other drainages occur on the project site.

Redondo Beach is in the Manhattan Beach-Frontal Santa Monica Bay watershed within Hydraulic Unit Code (HUC 12-180701040500), which drains directly into Santa Monica Bay. The NHD identifies two ephemeral drainages channeling stormwater flows from the residential areas west of the project site.

The nearshore Pacific Ocean is regulated by the USACE, Regional Water Quality Control Board (RWQCB) & State Water Resources Control Board (SWRCB), and California Coastal Commission (CCC). Temporary direct impacts to waters of the US/State/Coastal Waters may occur during project activities at Zuma & Point Dume Beach and at Redondo Beach. Potential impacts include altered turbidity, salinity, pH, light transmittance, total suspended solids, and other constituents during beach placement operations. Potential indirect impacts from project activities could occur if sediment or pollutants were allowed to enter the Pacific Ocean through stormwater runoff.

Designated Critical Habitat

The Zuma Beach & Point Dume Beach project site is located within designated critical habitat for the western snowy plover and tidewater goby (*Eucyclogobius newberryi*). The Dockweiler State Beach project site is located within designated critical habitat for western snowy plover. The Redondo Beach project site is approximately 1.1 miles south of designated critical habitat for the species. The primary constituent elements (PCEs) essential to western snowy plover include the following (NOAA, 2012):

- Sandy beaches, dune systems immediately inland of an active beach face, salt flats, mud flats, seasonally exposed gravel bars, artificial salt ponds and adjoining levees, and dredge spoil sites, with:
    - Areas that are below heavily vegetated areas or developed areas and above the daily high tides;
    - Shoreline habitat areas for feeding, with no or very sparse vegetation, that are between the annual low tide or low water flow and annual high tide or high water flow, subject to inundation but not constantly under water, that support small invertebrates, such as crabs, worms, flies, beetles, spiders, sand hoppers, clams, and ostracods, which are essential food sources;
    - Surf- or water-deposited organic debris, such as seaweed (including kelp and eelgrass) or driftwood located on open substrates that supports and attracts

small invertebrates for food, and provides cover or shelter from predators and weather, and assists in avoidance of detection (crypsis) for nests, chicks, and incubating adults; and

- Minimal disturbance from the presence of humans, pets, vehicles, or human-attracted predators, which provide relatively undisturbed areas for individual and population growth and for normal behavior.

Project activities are not expected to permanently impact or adversely modify critical habitat. Temporary impacts to these areas could include changes to water quality (*e.g.,* turbidity, pH, dissolved oxygen), increased noise, temporary removal of foraging habitat, and other increased human activity during project activities.

On July 19, 2023, NMFS issued a *Proposed Rule to Designate Marine Critical Habitat for Six Distinct Population Segments of Green Sea Turtles*. “CA04: San Onofre to Santa Monica Bay” is proposed and overlaps the Dockweiler State Beach and Redondo Beach project sites. Under the FESA, critical habitat designations are finalized at the same time the final listing rule is complete. For this report, we have assumed the Final Rule will include the Dockweiler State Beach and Redondo Beach project sites, which would extend from the HTL to 20-meter depth. This area is considered an essential foraging/resting area for green sea turtle.

Essential Fish Habitat/ Habitat Areas of Particular Concern

The offshore portion of each project site is designated as EFH for two Fishery Management Plans (FMPs): Pacific Fishery Management Council’s Groundfish Management Plan (GMP) and the Pacific Fishery Management Council’s Coastal Pelagic Species Fishery Management Plan (CPSMP; NOAA, 2024a). EFH is defined as those waters and substrate necessary to fish for spawning. Substrate includes the sediment, hard bottom, structures underlying the waters and the associated biological communities. Several species regulated by the plans include:

- Pacific sanddab (*Citharichthys sordidus*); lingcod (*Ophiodon elongatus*); leopard shark (*Triakis semifasciata*): GMP regulated
- Pacific sardine (*Sardinops sagaz*); northern anchovy (*Engraulis mordax*); Pacific mackerel (*Scomber japonicas*); krill species (*Thysanoessa spinifera, Euphausia pacifica*, and other krill species) and jack mackerel (*Trachurus symmetricus*): CPSMP regulated

Habitat Areas of Particular Concern (HAPC) are a subset of EFH that exhibit one or more of the following traits: rare, stressed by development, provide important ecological functions for federally managed species, or are especially vulnerable to anthropogenic (or human impact) degradation. The rocky reefs HAPC includes those waters, substrates and other biogenic features associated with hard substrate (bedrock, boulders, cobble, gravel, etc.) to the Mean Higher High Water

(MHHW) Line. In general, these areas support a diverse assemblage of algae, invertebrates and fish species. Surfgrass is also common in the intertidal rocky reef.

The canopy kelp HAPC includes those waters, substrate, and other biogenic habitat associated with canopy-forming kelp species (*e.g., Macrocystis pyrifera* [giant kelp]). Kelp beds are not only important spawning areas for fish, but they are important as nursery areas for juveniles. Kelp beds in southern California have fluctuated in extent over the past three decades. Kelp beds are susceptible to turbidity, grazing, sedimentation, displacement by storm surge, and lack of growth related to high temperatures and low nutrients associated with El Niño events.

Dockweiler State Beach borders Marina del Rey harbor. The estuaries present within the harbor are classified as HAPC. Estuary HAPCs include nearshore areas such as bays, sounds, inlets, river mouths and deltas, pocket estuaries, and lagoons influenced by ocean and freshwater. Because of tidal cycles and freshwater runoff, salinity varies within estuaries and results in great diversity, offering freshwater, brackish and marine habitats within close proximity. Such areas tend to be shallow, protected, nutrient rich, and are biologically productive, providing important habitat for marine organisms.

Project activities may temporarily alter EFH and HAPCs or interfere with the movement of fish or wildlife species and could temporarily impede the use of wildlife nursery sites. The project, as designed, will help preserve natural habitats and reduce erosion in the nearshore zone, providing additional soft bottom habitat suitable for foraging. Temporary impacts to these areas could include changes to water quality (*e.g.,* turbidity, pH, dissolved oxygen), increased noise, and other increased human activity during construction.

Marine Protected Areas

The Marine Life Protection Act of 1999 directs the state to redesign California's system of MPAs to function as a network to increase coherence and effectiveness in protecting the state's marine life and habitats, marine ecosystems, and marine natural heritage, as well as to improve recreational, educational and study opportunities provided by marine ecosystems subject to minimal human disturbance. Zuma Beach is located within the Point Dume State Marine Conservation Area (Point Dume SMCA). The Point Dume SMCA extends four miles along the coast and is adjacent to the Point Dume State Marine Reserve (SMR) that extends around Point Dume. The Point Dume SMR has the more restrictive regulations. Take of all living marine resources is prohibited in this area.

Take pursuant to beach nourishment and other sediment management activities is allowed inside the SMCA pursuant to any required federal, state and local permits, or as otherwise authorized by the CDFW (California Code of Regulations Title 14, Section 632). Indirect impacts may occur related to increased turbidity and burial of benthic infauna.

Areas of Special Biological Significance

The California State Water Resources Control Board created ASBS to help maintain natural water quality within some of the most pristine and biologically diverse sections of California's coast. No pollutants are allowed to be discharged within these protected areas. Malibu is home to the largest ASBS, Number (No.) 24, which was designated in 1974. ASBS No. 24 stretches 24 miles along the coast from Latigo Point to Laguna Point near Point Mugu, covering about half of the Malibu coast. The Zuma Beach & Point Dume site is located within this ASBS. Indirect impacts due to increased turbidity or a change in other water quality standards could occur.

2.3 Dune Habitat and Restoration Opportunities

Subaerial dunes (vegetated ridges or mounds of wind-blown sand that form on the back beach in many coastal areas) serve a wide range of beneficial purposes, including sand storage, biological habitat, and flood protection. They are dynamic "self-repairing" systems, whereby the seaward extent, or "foredune," is expected to erode rapidly during severe storm events, then gradually recover through the natural processes of sediment deposition and revegetation.

Restoration of dune habitat is increasingly seen as a way to support both coastal resilience and the ecological function of sandy coastlines. As part of the present project, it is being considered as an approach to protect infrastructure from wave damage, preserve sandy beach areas for recreation, and provide ecological co-benefits. The following subsections summarize the present condition of each of the project sites, along with the feasibility of creating and/or restoring dune systems in these areas. They are based on analyses and memoranda prepared by Coastal Restoration Consultants (CRC, 2024a) as part of this project.

2.3.1 Shoreline Assessment

CRC has developed a shoreline assessment methodology that provides a quantitative basis for determining the potential for dune restoration on sandy beaches at a scale that can inform restoration project planning and implementation. The approach is applicable throughout southern California and is based primarily on measurements of ecological zone widths (Table 2-3).

Table 2-3. Typical Ecological Zones on Southern California Beaches

Ecological Zone	Limits of the Zone	Field Indicator of Upper Limit	Typical Plants	Physical Drivers
Swash	Below the water table outcrop (WTO)	Saturated sand (WTO)	None	Waves and tides
Wet Sand	WTO to the high tide line (HTL)	Highest recent wrack	None	Waves and tides
Dry Sand	HTL to toe of vegetation	Dry sand without vegetation	None	High waves and king tides
Coastal Strand	Toe of vegetation to toe of the foredunes	Highest seasonal wrack or vegetation	Sea rocket, beach salt bush, red sand verbena	High waves, king tides, and aeolian sand transport
Foredune	Toe of foredunes to first dune ridge	Hummocky dunes & vegetation	Sea rocket, beach salt bush, red sand verbena, beach bur	High waves and aeolian sand transport
Dunes	First dune ridge to development or non-dune habitat	Active dunes & vegetation	Red sand verbena, beach bur, beach evening primrose	Extreme waves and aeolian sand transport

CRC measured the existing ecological zone widths at Zuma Beach in September 2024 and measured those at Point Dume Beach, Dockweiler State Beach, and Redondo Beach in October 2024. The zone widths were measured in contiguous segments (along the shoreline), each representing a length of the coast characterized by a single back beach type (revetment, bluff, lagoon, building, parking lot, etc.) or consistent width. Additional observations included the beach composition, plant species present, typical cobble size, and beach face slope.

Given that the measurements were obtained at the beginning of fall when beaches in southern California typically are widest, seasonal shoreline changes derived from aerial photos and/or shoreline monitoring data were used to adjust the ecological zone widths to those that are likely to prevail following the winter storm season.

At Zuma Beach and Point Dume, beach profile data obtained by CFC between 2012 and 2017 were used to estimate the magnitude of seasonal shoreline changes in the area and adjust the fall zone widths to those more representative of a winter condition. In comparison to the fall condition, the shoreline at the end of a “typical winter” was taken to be 75 ft narrower on the north end of Zuma Beach and 25 ft narrower on the south end of Zuma Beach, while those following an “El Niño winter” were taken to be between 110 and 75 ft (north to south) narrower than the fall condition.

At Point Dume Beach, the seasonal changes included both erosion on the north end and accretion on the south end. As a result, “typical winter” zone widths at the north end of Point Dume Beach were assumed to be 20 ft narrower than in fall, while those on the south end were assumed to be 20 feet wider. During an “El Niño winter,” the winter condition was assumed to be 60 ft narrower than the fall condition on the north end and 30 feet wider than the fall condition on the south end.

Seasonal beach profile data were not available at Dockweiler and Redondo Beach, and as a result, seasonal shoreline changes were derived from aerial photos obtained between 2014 and 2024. The aerial photos indicate that the beach near the Dockweiler site typically erodes by about 30 ft over a “typical winter”, with a maximum value of about 50 ft during an “El Niño winter.” Similar analyses of the Redondo Beach site indicate that seasonal erosion typically does not occur, and at most is limited to about 20 ft.

2.3.2 Results

All the beaches evaluated were sandy and no gravel or cobbles were observed. The beaches are heavily used for recreation and driving by public safety officials was evident at all sites. LACDBH beach management practices include periodic grooming as needed.

Zuma Beach & Point Dume Beach

Zuma Beach was divided into 24 segments (Figure 2-14), the majority of which (19), are backed by a low concrete wall located just seaward of a paved pedestrian path. Trancas Creek Lagoon and some degraded dunes (somewhat impacted by ongoing construction of the PCH bridge) are located beyond the northwest end of the wall. Zuma Creek Lagoon is located at the south end of the wall and contains dune habitat to the north (in front of the wall) and to the south (in front of upland habitat and a bathroom). Excepting the area in front of Trancas Creek, most of the beach was recently groomed from about the HTL to within 6 to 8 ft of the wall.

When adjusted to MSL, the beach widths measured by CRC in September 2024 were within the historic range, but narrower than the average values computed as part of the Broad Beach Restoration Project between 2012 and 2023 (Table 2-4). When all 24 segments are considered, beach widths in September 2024 ranged from 141 to 611 ft, with an average width of 248 ft (Figure 2-15; Table 2-5).

Figure 2-14. Beach Back Type for Zuma Beach

Table 2-4. Fall MSL Beach Width, Zuma Beach

Transect #	Fall MSL Beach Width (ft)				
	CRC	Coastal Frontiers Corporation[3] (2012 to 2023)			
	2024	2023	Average	Minimum	Maximum
400	263	263	290	263	318
402	221	282	298	249	354
404	246	272	269	198	321
406	216	254	234	168	287

Note: CRC widths derived from the segment in which the CFC transect is located. CFC transects are nominally 2,000 ft apart and transect numbers increase from southeast to northwest.

[3] Broad Beach Restoration Project (Coastal Frontiers Corporation, 2023; McMahon, 2024)

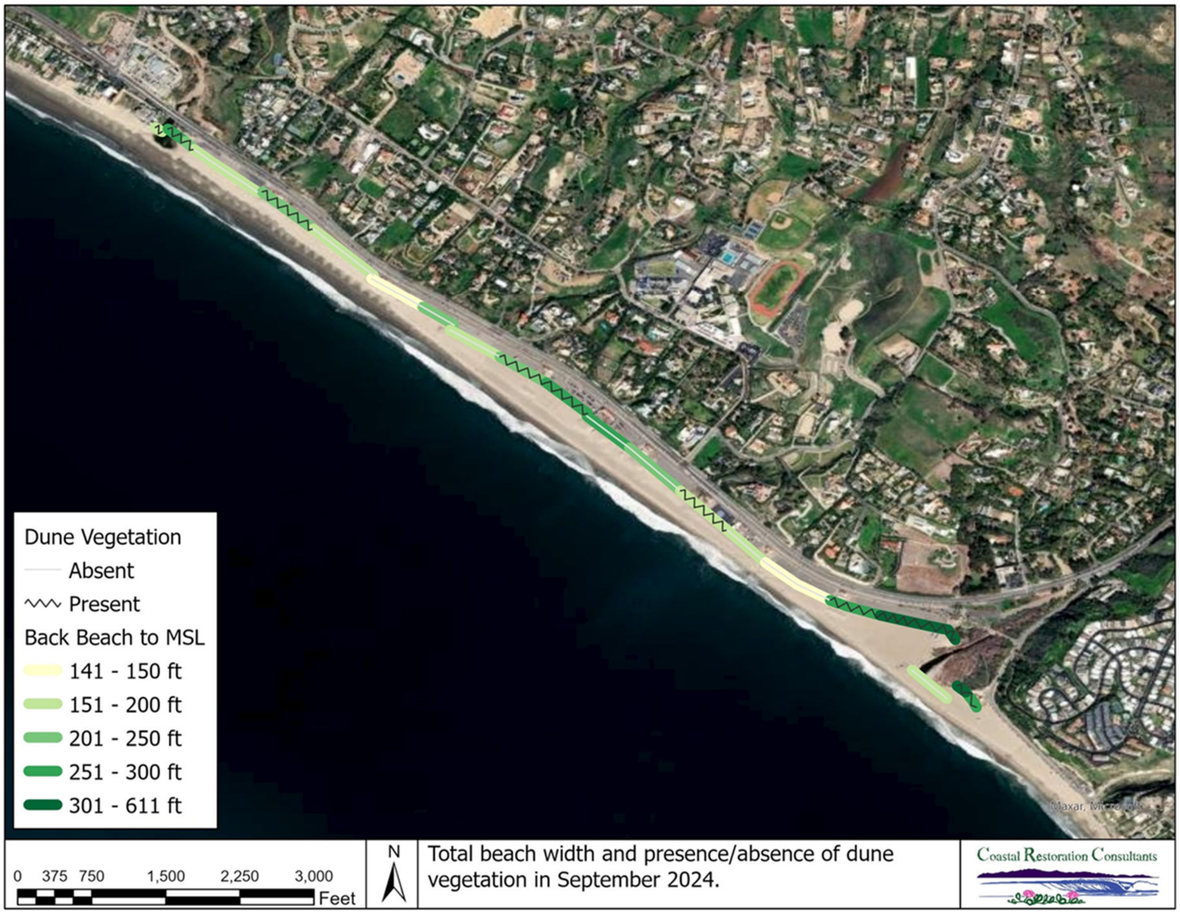

Figure 2-15. Measured MSL Beach Widths, Zuma Beach

Table 2-5. MSL Beach Width at Zuma Beach during Typical and El Niño Winters

Value	MSL Beach Width (ft)		
	September 2024	Typical Winter	El Niño Winter
Minimum	141	70	35
Maximum	611	536	501
Average	248	190	146

Note: Data derived from all 24 segments at Zuma Beach.

Dune vegetation was found in 12 of 24 segments (Figure 2-15). Except in the above-noted dune areas around the lagoons, this vegetation consisted of one to just a few plants per segment, with sea rocket, beach evening primrose, beach bur, and seaside heliotrope being the only species found. All these plants were immediately in front of the wall in a zone that was not groomed.

Estimated winter MSL beach widths for each segment at Zuma Beach were computed and are shown in Table 2-5. The values range from 70 to 536 ft, with an average of 190 ft. Estimated minimum beach widths (*i.e.*, those occurring during an El Niño winter) ranged from 35 to 501 ft and averaged 146 ft. There was not a clear geographical trend in beach width.

Point Dume Beach was divided into 21 segments, the majority of which (11) were backed by a road or parking lot (Figure 2-16). Six segments were backed by a rock revetment and two by buildings. The two segments at the southern end of the reach were backed by natural bluff/upland habitats. Beach widths measured during the October 2024 field survey were within the historical range and similar to the average value computed from beach profile data obtained between 2012 and 2023 (Table 2-6). When all 21 segments are considered, beach widths in October 2024 ranged from 30 to 302 ft with an average width of 180 ft (Figure 2-17; Table 2-7).

Figure 2-16. Back Beach Type for Point Dume Beach

Table 2-6. Fall MSL Beach Width, Point Dume Beach

Transect #	Fall MSL Beach Width (ft)				
	CRC	Coastal Frontiers Corporation[4] (2012 to 2023)			
	2024	2023	Average	Minimum	Maximum
394	197	195	234	190	292
396	56	74	70	2	102
398	292	236	269	235	303

Note: CRC widths derived from the segment in which the CFC transect is located. CFC transects are nominally 2,000 ft apart and transect numbers increase from southeast to northwest.

Figure 2-17. Measured MSL Beach Widths, Point Dume Beach

[4] Broad Beach Restoration Project (Coastal Frontiers Corporation, 2023; McMahon, 2024)

Table 2-7. MSL Beach Width at Point Dume Beach during Typical and El Niño Winters

Value	MSL Beach Width (ft)		
	October 2024	Typical Winter	El Niño Winter
Minimum	30	45	60
Maximum	302	317	331
Average	180	188	194

Note: Data derived from all 24 segments at Point Dume Beach.

Dune vegetation was found in 13 of 21 segments (Figure 2-17). Dune topography was found in 8 of the 21 segments, mostly in front of the parking lot towards the southern end of the site. Vegetation consisted of sea rocket, beach evening primrose, beach bur, pink sand verbena, and red sand verbena. Most of the dune areas were part of a restoration project implemented by the Bay Foundation over the last few years, though vegetation cover and plant diversity were low.

Estimated winter beach widths for each segment at Point Dume Beach were computed and are shown in Table 2-7. The values ranged from 45 to 317 ft (averaging 188 ft) for typical winter conditions and from 60 to 331 ft (averaging 194 ft) for El Niño winter conditions.

Dockweiler State Beach

The project area at Dockweiler State Beach was divided into four segments, three of which were backed by a bike path and one that was backed by buildings (Figure 2-18). The beach widths measured in October 2024 ranged from 328 to 574 ft (Figure 2-19) with an average width of 419 ft.

Dune vegetation and topography were found in three of four segments (Figure 2-19). Vegetation consisted of sea rocket, beach evening primrose, beach bur, seaside buckwheat, and iceplant. The dune habitat was located on a steep slope between the fairly flat upper beach and the bike path and considerable trampling through the dunes was evident.

Estimated typical winter beach widths for each segment at Dockweiler State Beach ranged from 298 to 544 ft, with an average value of 389 ft. Estimated minimum beach widths during El Niño winters ranged from 278 to 524 ft and averaged 369 ft.

Figure 2-18. Back Beach Type for Dockweiler State Beach

Figure 2-19. Measured MSL Beach Widths, Dockweiler State Beach

Redondo Beach

The project area at Redondo Beach was divided into nine segments, seven of which were backed by a bike path, one was backed by a building and one by a wall/staircase (Figure 2-20). The beach widths measured in October 2024 ranged from 105 to 177 ft (Figure 2-21) with an average width of 136 ft.

Figure 2-20. Back Beach Type for Redondo Beach

Figure 2-21. Measured MSL Beach Widths, Redondo Beach

Dune vegetation was found in two segments (Figure 2-21) and consisted of a patch of iceplant next to a bathroom and a sea rocket plant at the mouth of a storm drain. No dune topography was observed.

Estimated typical winter beach widths at Redondo Beach ranged from 105 to 177 ft, with an average value of 136 ft. Estimated minimum beach widths during El Niño winters ranged from 85 to 157 ft and averaged 116 ft.

2.3.3 Implications for Nature-Based Solutions

Current state guidance (Newkirk *et al.,* 2018) recommends that dunes restored as a nature-based solution for protecting inland areas from flooding should be at least 50 ft wide and 100 ft long, with 100 to 200 ft of fronting beach (Figure 2-22). It is assumed that the recommended beach width applies to summer/fall (maximum width) conditions, although this is not explicit. Additionally, this guidance is meant to apply to all of California, including northern California beaches where wave energy is significantly higher. Based on this guidance and the measurements noted above, the minimum recommended beach width fronting dunes is taken to be 100 ft at Zuma, Point Dume, and Dockweiler Beaches and 50 ft at Redondo Beach.

From Newkirk *et al.* (2018)

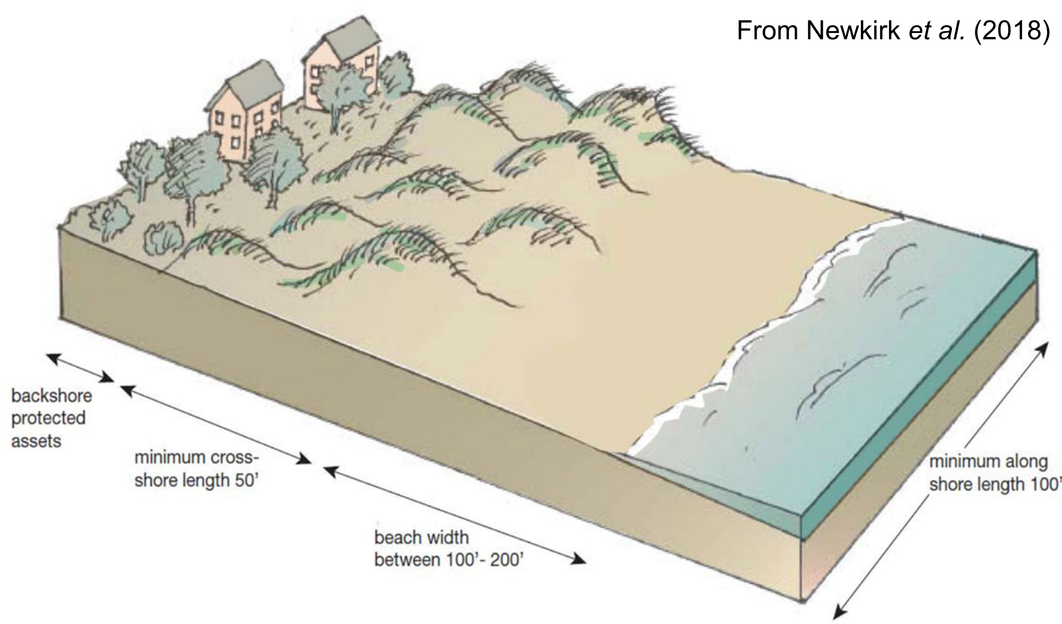

Figure 2-22. Current Design Guidance for Dunes in Nature-Based Adaptation Strategies

Assuming that the restored dunes are at least 50 ft wide, beach segments that were at least 150 ft wide at the time of the September and October 2024 field measurements at Zuma, Point Dume, and Dockweiler Beaches are considered to be potential candidates for restoration of sustainable, self-repairing dunes.

The potential was categorized as “marginal” if the segment was between 150 to 200 ft wide, “high” if the segment was 200 to 300 ft wide, and “sufficient” if the segment was more than 300 ft wide.

The categories used at Redondo Beach were 50 ft narrower than those at Zuma, Point Dume, and Dockweiler to account for the reduction in seasonal shoreline erosion at that site.

Zuma Beach & Point Dume Beach

Figure 2-23 illustrates the 24 Zuma Beach segments categorized using the criteria above. As shown in the figure, two regions were identified as being too narrow to accommodate healthy, self-repairing dunes (beach width less than 150 ft); one just west of the entrance to Zuma Beach and one near the restrooms at the west end.

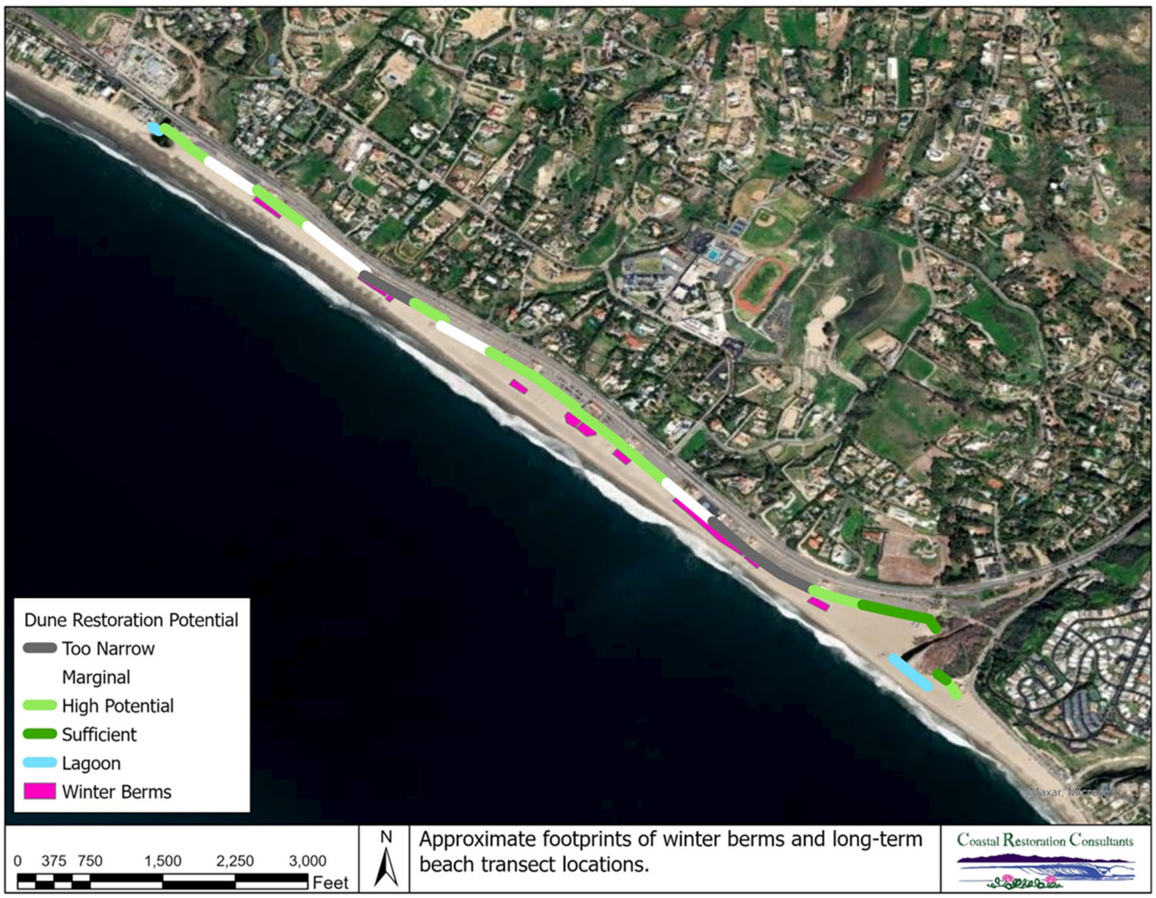

Figure 2-23. Potential for Restoring Self-Sustaining Dunes at Zuma Beach

Four additional areas were identified as marginal, most of which were located along the west half of the beach. The remaining areas were considered to have high potential or to be sufficient to support a self-sustaining dune system. All segments identified having as marginal, high potential, or sufficient were greater than 100 ft long and therefore exceeded the minimum length (100 ft) specified by Newkirk *et al*. (2018).

Figure 2-24 illustrates the potential for the 21 Point Dume Beach segments to support self-sustaining dunes. As shown in the figure, one small area was identified as being too narrow and two adjacent areas were identified as marginal. All three areas were located adjacent to the newly constructed revetment near the north end of the Point Dume Beach parking lot. The remaining segments were considered to have high potential or to be sufficient to support a self-sustaining dune system.

Figure 2-24. Potential for Restoring Self-Sustaining Dunes at Point Dume Beach

Dockweiler State Beach

Given that beach widths measured at Dockweiler State Beach in Fall 2024 exceeded 300 ft, the entire project site is sufficiently wide to support self-sustaining dunes (Figure 2-25). In addition, the existing dunes at the stie could be enhanced by reducing trampling, seeding with native dune species, and removing non-native vegetation.

Figure 2-25. Potential for Restoring Self-Sustaining Dunes at Dockweiler State Beach

Redondo Beach

Despite the relatively narrow beach at this site, the absence of significant seasonal changes in beach width indicate that this site could support a narrow self-sustaining dune field throughout most of the reach (Figure 2-26). If the beach is nourished and that sand is retained, the beach would be wide enough to support a dune system along with considerable recreation space.

Figure 2-26. Potential for Restoring Self-Sustaining Dunes at Redondo Beach

2.4 Socio-Economic Characteristics of Beach Use

The following subsections include socio-economic profiles of beach users at each of the proposed coastal resilience sites. The profiles were prepared by Ceto Consulting (2024) and are based on the California Coastal Commission Coastal Access Database (Patsch and Reineman, 2024). This information was obtained to inform the economic analysis presented in Section 7.

Zuma Beach & Point Dume Beach

Zuma and Point Dume Beach are characterized by wide, sandy shorelines. Zuma Beach serves as a heavily frequented site for recreational activities such as swimming, surfing, and beach sports, and is supported by infrastructure including lifeguard stations, restrooms, showers, and parking facilities.

Point Dume Beach is less developed than Zuma Beach, while still offering amenities such as restrooms, showers, lifeguards, and restaurants in close proximity (Figure 2-27). This area has four known access points, over a dozen amenities, more than 2,000 paid parking spaces, and a little over 500 free parking spaces.

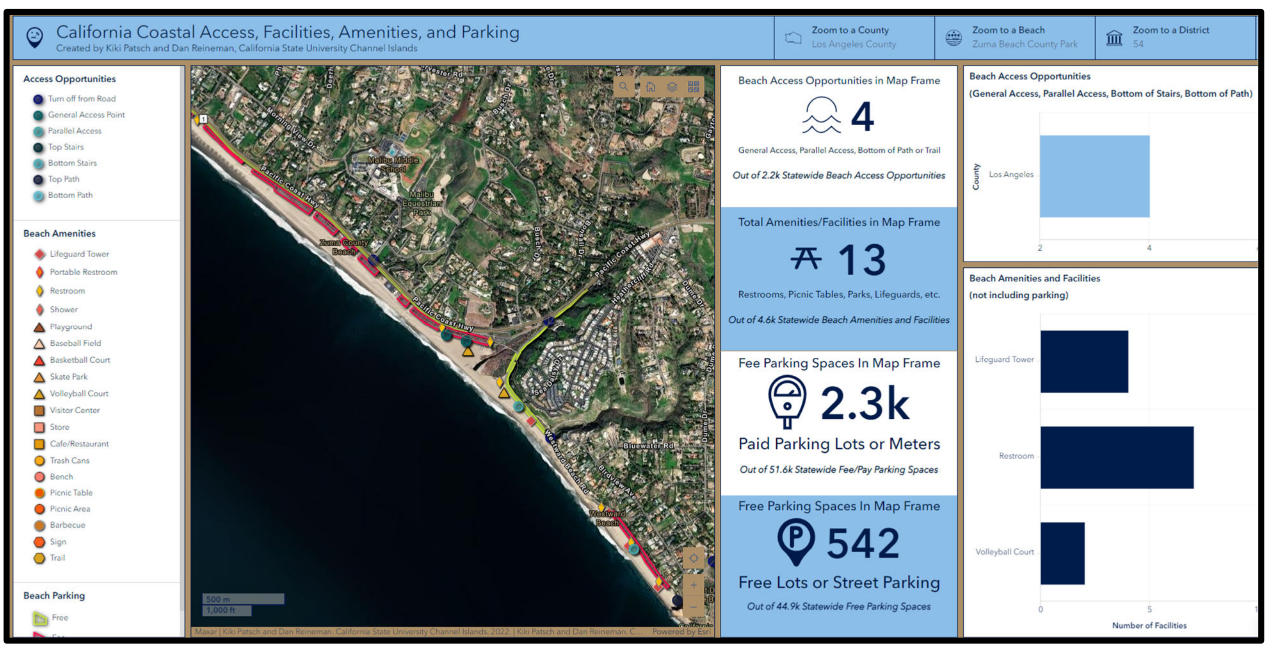

Figure 2-27: Snapshot of Coastal Access Dashboard, Zuma and Point Dume Beach

Utilizing the network analysis tool in esri's ArcGIS Pro software, service area buffers were constructed around the Zuma Beach Access Point delineating the areas that are within 1, 10, 25, 50, and 100 km (Figure 2-28).

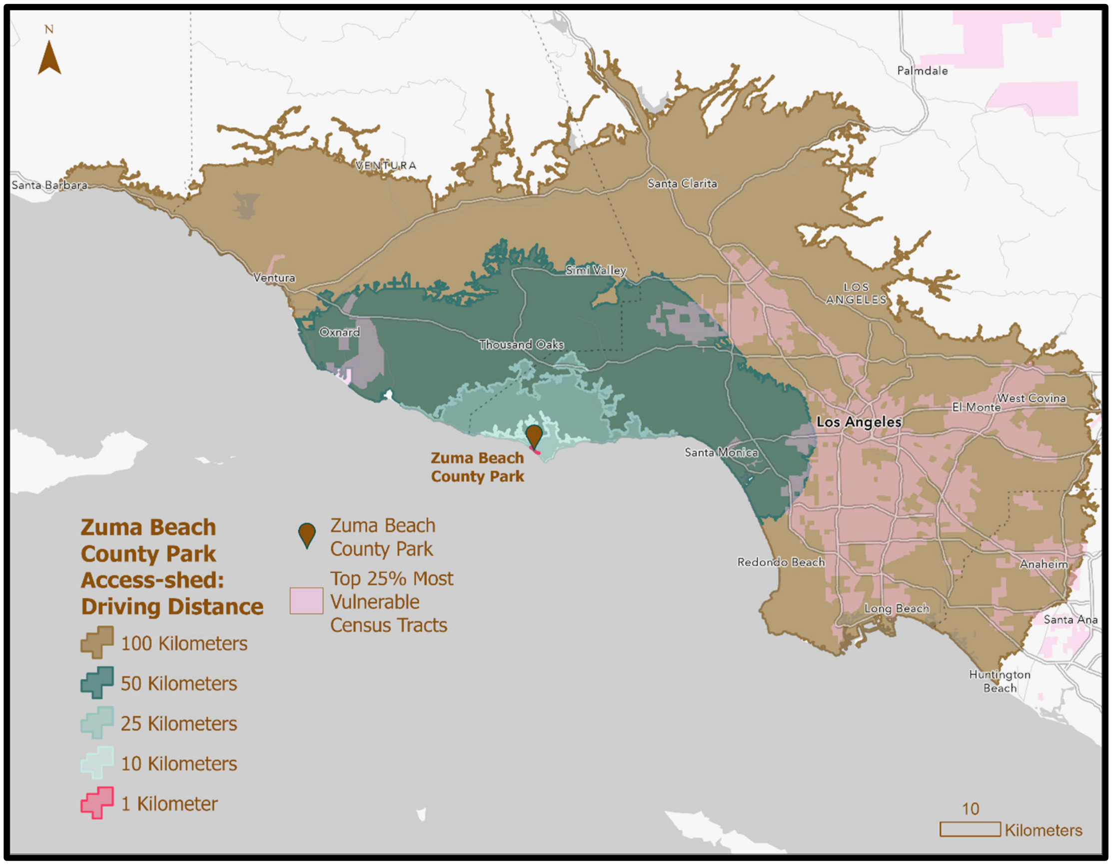

Figure 2-28. Access-Sheds, Zuma Beach

In Los Angeles County, depending on the time of day and year, drive times over these distances will range from several minutes to several hours, but are considered a reasonable distance that people will travel to go to the beach. Once generated, demographic and socioeconomic data were summarized using the Enrich Tool in ArcGIS Pro.

Information gleaned using this methodology was used to characterize the population that theoretically has access to Zuma Beach. Table 2-8, Figure 2-29, and Figure 2-30 characterize the 11 million potential visitors to Zuma Beach, as well as the demographic and socioeconomic snapshot of the region. Moving away from the coast, the population tends to get increasingly diverse, housing prices drop, the median age of the population drops, and the area considered to be vulnerable per CalEnviroScreen 4.0 (CES4) increases (State of California Office of Environmental Health Hazard Assessment, 2024).

Table 2-8. Socioeconomic Information, Zuma Beach's Access-Sheds

Zuma Beach: Access-shed Statistics								
Driving Distance Buffer	Total Population (2020)	Population over 65 (2020)	Median Age (2020)	Total Households (2020)	Median Home Value (2024)	Average Home Value (2024)	Median Household Income	Mean Census Diversity Index (2020)
1 km	39	10	48.3	4	$ 2,000,001	$ 1,916,667	$ 200,001	2
10 km	6,230	1,583	51.0	2,537	$ 2,000,001	$ 1,860,591	$ 189,324	18
25 km	33,979	7,610	46.4	12,419	$ 1,468,490	$ 1,535,574	$ 178,687	33
50 km	2,200,582	363,827	39.0	858,451	$ 1,005,804	$ 1,212,620	$ 109,479	46
100 km	11,405,265	1,697,230	37.9	3,886,505	$ 865,350	$ 999,202	$ 90,955	49

The mean Census Diversity Index measures the likelihood that two randomly chosen individuals in a given area will belong to different racial or ethnic groups, with values ranging from 0 (no diversity) to 100 (complete diversity).

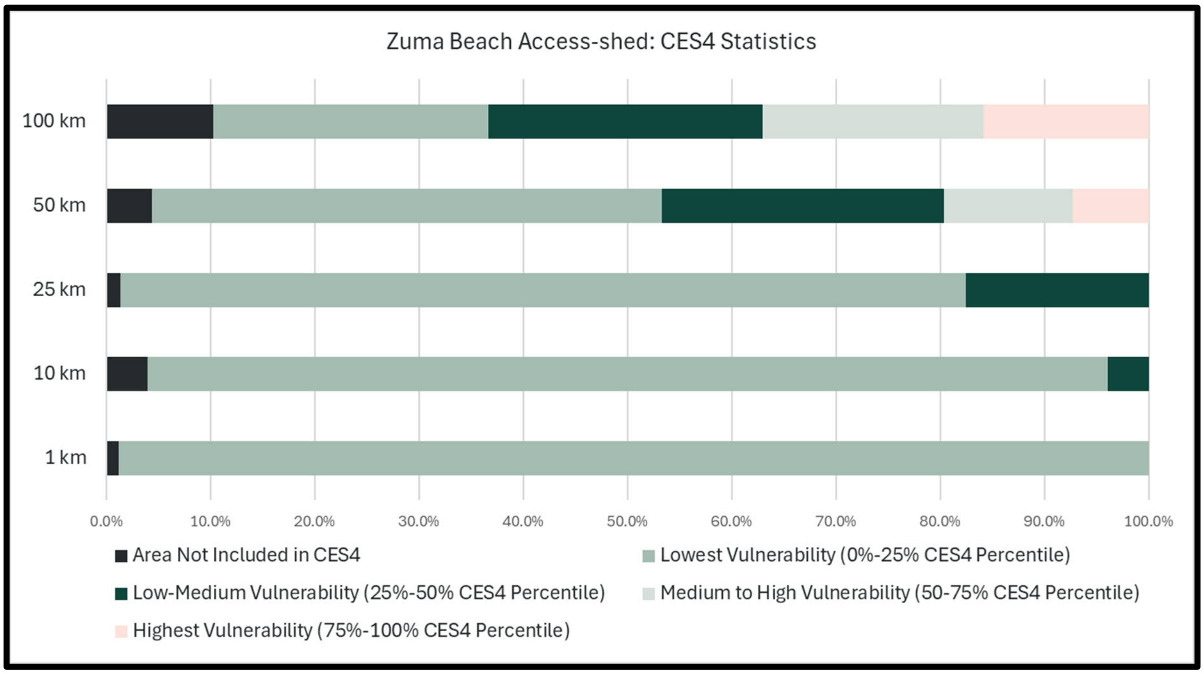

Figure 2-29. CES4 Assessment of Vulnerability, Zuma Beach Access-Sheds

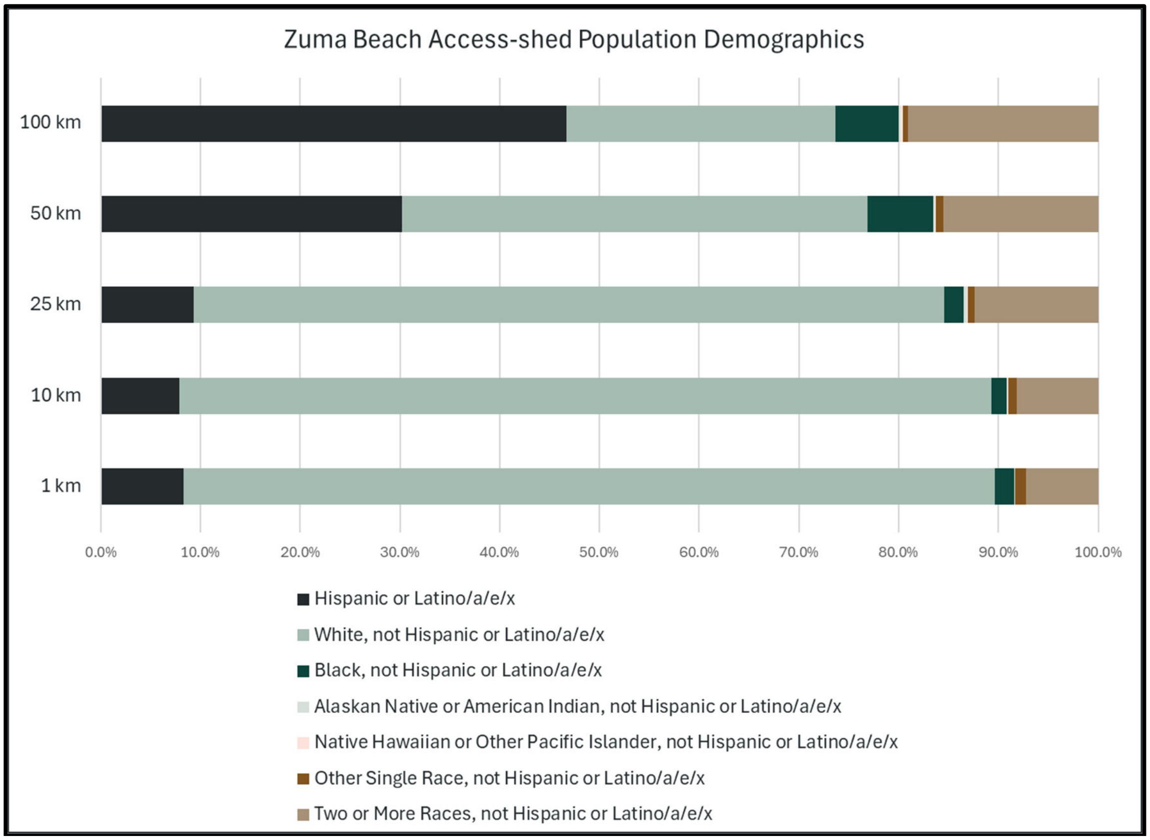

Figure 2-30. Race and Ethnicity, Zuma Beach Access-Sheds

Dockweiler State Beach

Dockweiler State Beach has over 30 access points with a variety of amenities, including cafes, restaurants, lifeguards, picnic areas, playgrounds, restrooms, showers, and volleyball courts (Figure 2-31). There are over 2,000 paid parking spaces and over 150 free parking spaces. Figure 2-32 delineates the access-sheds for Dockweiler State Beach within driving distances of 1, 10, 25, 50, and 100 km. With more than 14.5 million people with reasonable access to this beach, the region is diverse, both in terms of its vulnerability classification as well as race and ethnicity (Figure 2-33 and Figure 2-34), with a diversity index of 52 (Table 2-9). Home values average nearly $1M in this area with a median age in the upper 30s.

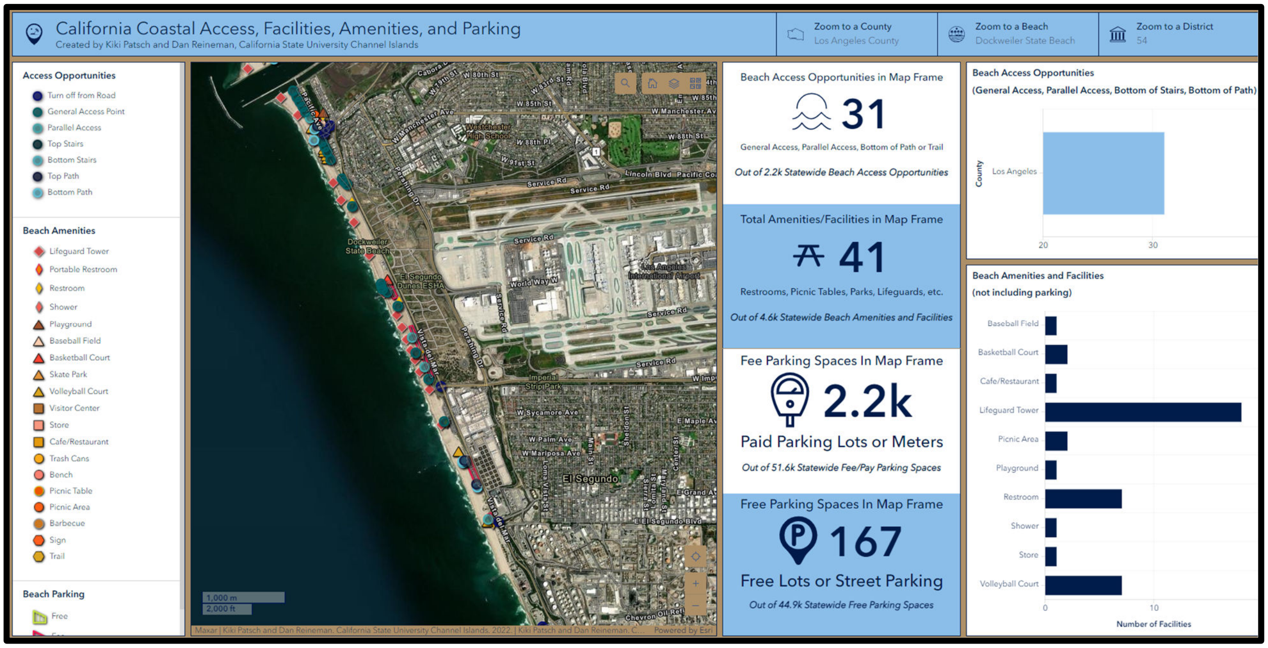

Figure 2-31. Snapshot of Coastal Access Dashboard, Dockweiler State Beach

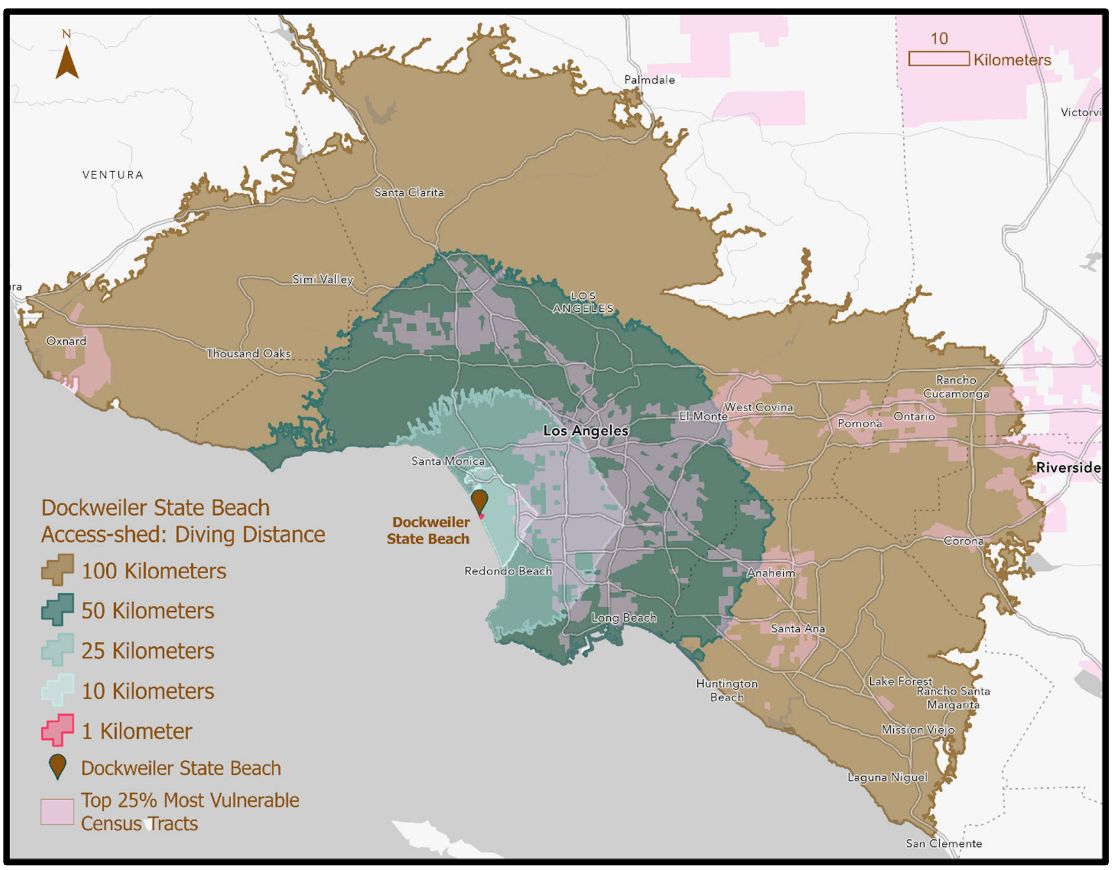

Figure 2-32. Access-Sheds, Dockweiler State Beach

Table 2-9. Socioeconomic Information, Dockweiler State Beach's Access-Sheds

Dockweiler Beach: Access-shed Statistics								
Driving Distance Buffer	Total Population (2020)	Population over 65 (2020)	Median Age (2020)	Total Households (2020)	Median Home Value (2024)	Average Home Value (2024)	Median Household Income (2024)	Mean Census Diversity Index (2020)
1 km	-	-	-	-	$ -	$ -	$ -	2
10 km	285,044	38,975	37.8	112,925	$ 1,335,513	$ 1,413,904	$ 121,208	55
25 km	3,070,585	419,701	36.5	1,111,578	$ 962,939	$ 1,162,205	$ 85,484	49
50 km	8,741,467	1,274,558	37.6	3,036,662	$ 883,845	$ 1,035,382	$ 86,821	50
100 km	14,632,094	2,159,387	37.9	4,934,406	$ 860,103	$ 989,806	$ 96,367	52

**The mean Census Diversity Index measures the likelihood that two randomly chosen individuals in a given area will belong to different racial or ethnic groups, with values ranging from 0 (no diversity) to 100 (complete diversity).*

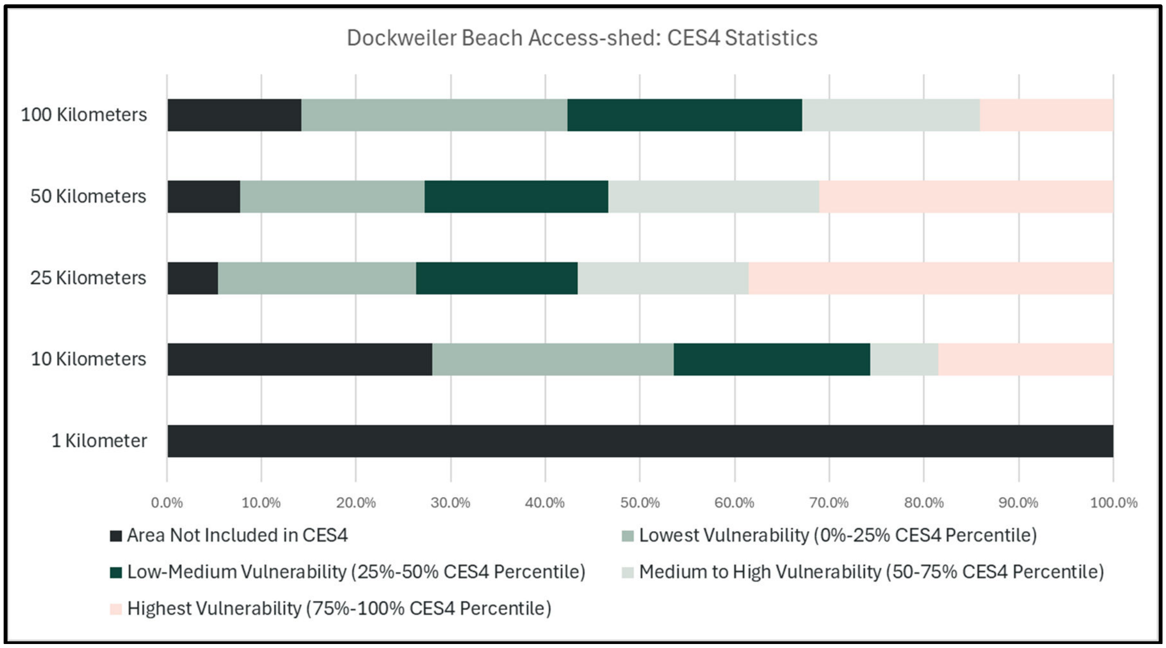

Figure 2-33. CES4 Assessment of Vulnerability, Dockweiler State Beach Access-Sheds

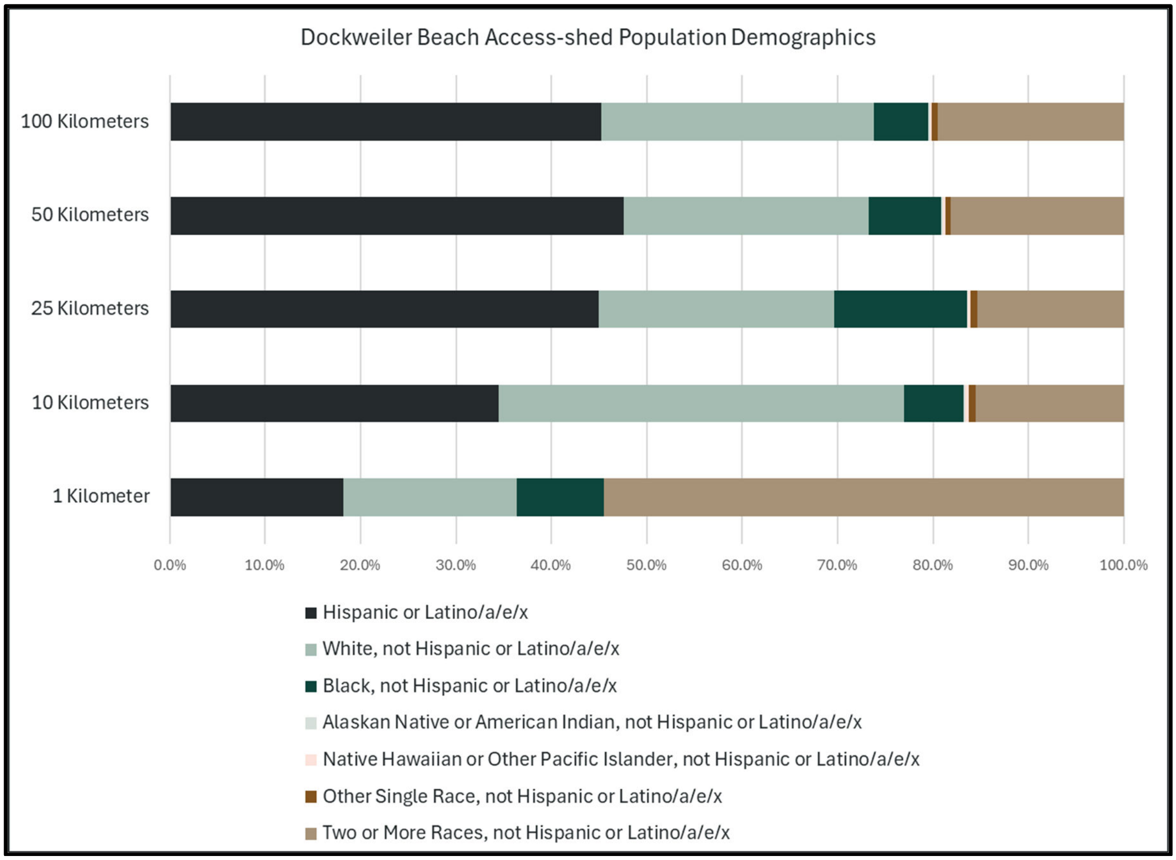

Figure 2-34. Race and Ethnicity, Dockweiler State Beach Access-Sheds

Redondo Beach

Redondo Beach is a highly developed coastal area featuring a mix of recreational spaces, a pier, and residential properties. The beach is popular for swimming, surfing, volleyball, and other water activities, with amenities such as restrooms, parking, and lifeguard stations (Figure 2-35). Parking can be challenging in this area with only a little over 800 spaces for paid parking.

With more than 14.5 million people with reasonable access to this beach (Figure 2-36), the region is diverse both in terms of its vulnerability classification as well as race and ethnicity (Figure 2-37 and Figure 2-38), with a diversity index around 50 (Table 2-10). Home values average nearly $1M in this area and the median age is in the upper 30s to lower 40s.

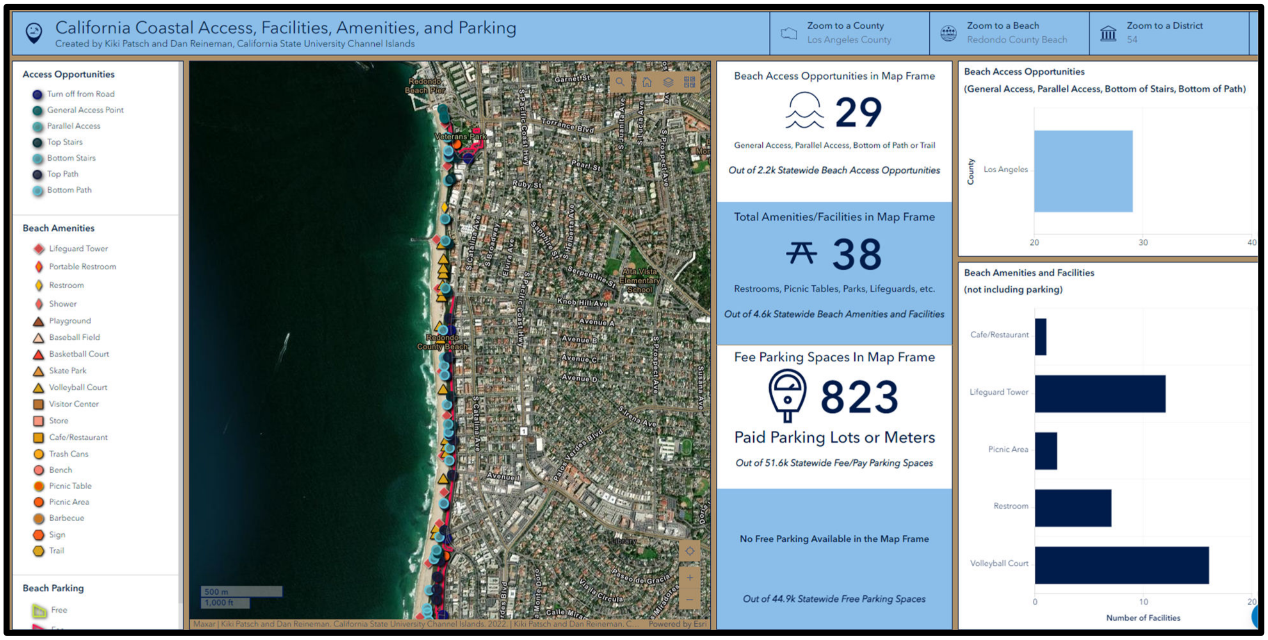

Figure 2-35. Snapshot of Coastal Access Dashboard, Redondo Beach

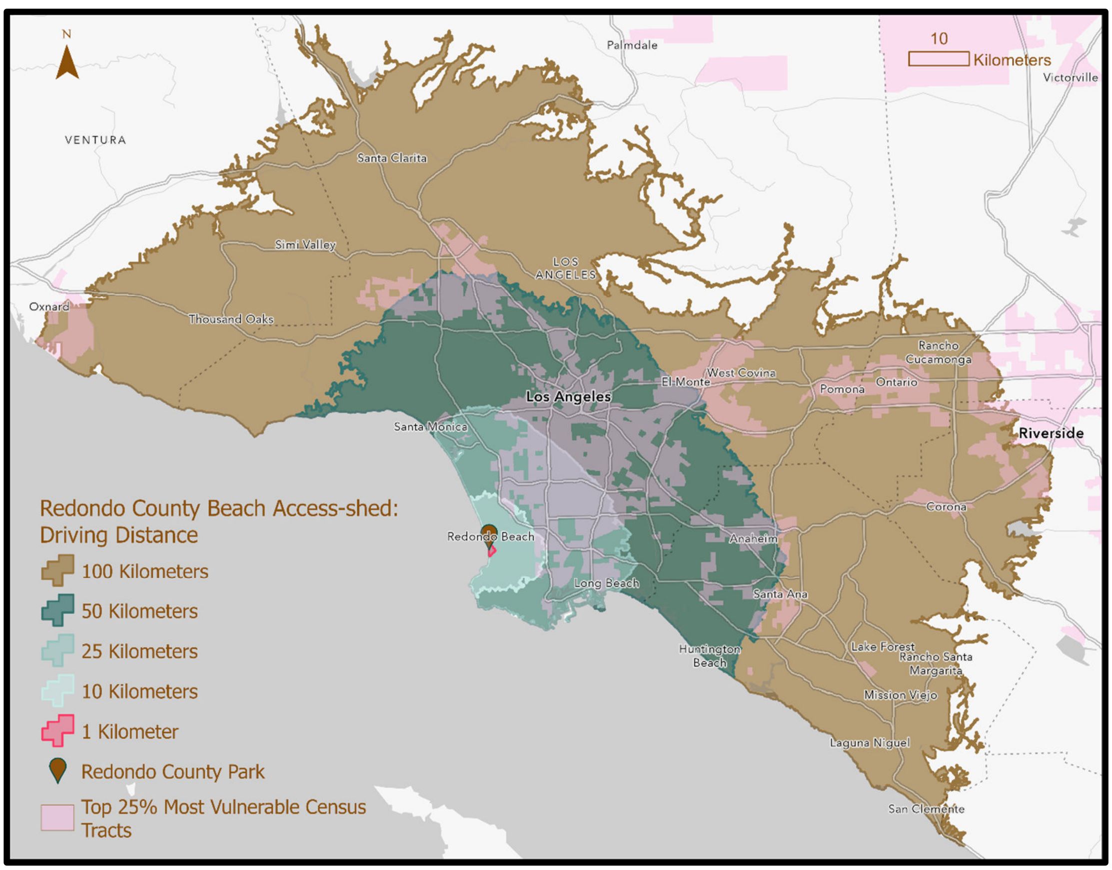

Figure 2-36. Access-Sheds, Redondo Beach

Table 2-10. Socioeconomic Information, Redondo Beach's Access-Sheds

Redondo Beach: Access-shed Statistics								
Driving Distance Buffer	Total Population (2020)	Population over 65 (2020)	Median Age (2020)	Total Households (2020)	Median Home Value (2024)	Average Home Value (2024)	Median Household Income (2024)	Mean Census Diversity Index (2020)
1 km	6,691	1,314	46.6	3,464	$ 1,437,870	$ 1,533,340	$ 124,757	35
10 km	396,587	67,418	41.9	151,593	$ 1,155,374	$ 1,286,169	$ 124,507	57
25 km	2,421,998	331,424	37.0	836,514	$ 872,708	$ 1,023,993	$ 86,917	56
50 km	8,406,714	1,208,177	37.4	2,913,349	$ 882,837	$ 1,031,788	$ 85,823	51
100 km	14,496,499	2,141,554	38.0	4,897,425	$ 863,194	$ 994,606	$ 96,474	51

**The mean Census Diversity Index measures the likelihood that two randomly chosen individuals in a given area will belong to different racial or ethnic groups, with values ranging from 0 (no diversity) to 100 (complete diversity).*

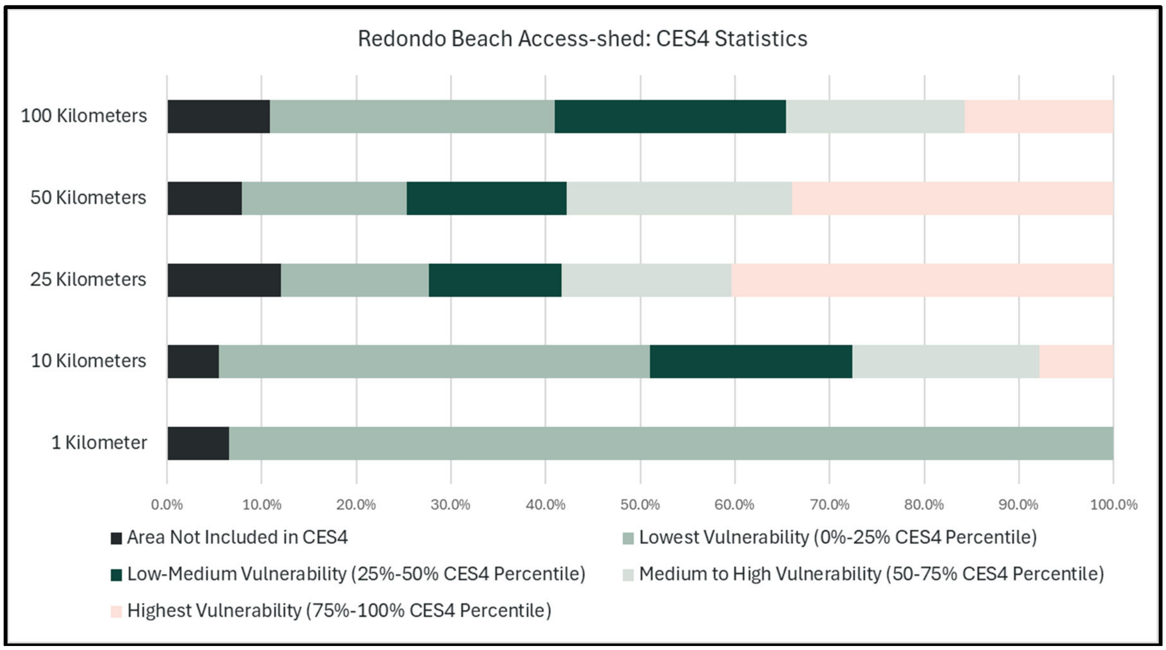

Figure 2-37. CES4 Assessment of Vulnerability, Redondo Beach Access-Sheds

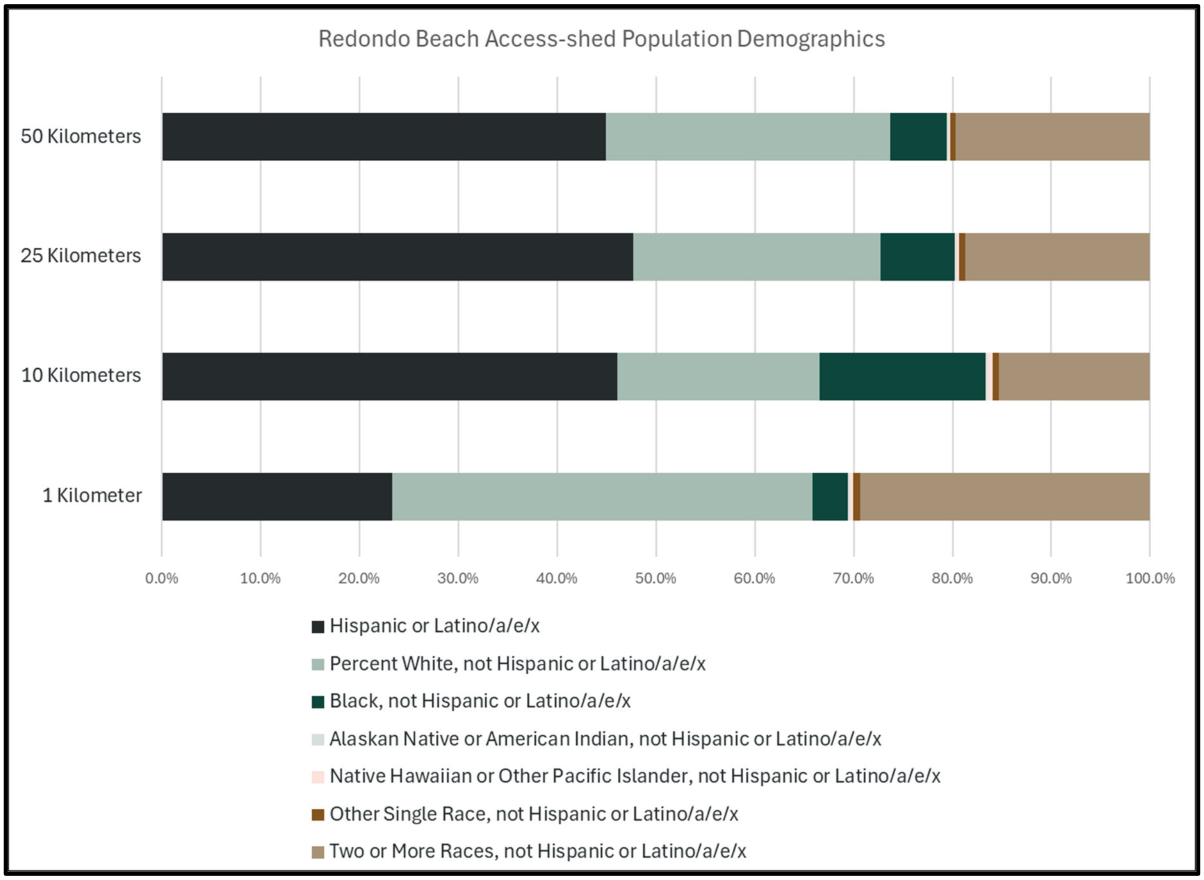

Figure 2-38. Race and Ethnicity, Redondo Beach Access-Sheds

3 Related Projects and Lessons Learned

Numerous projects with elements similar to those proposed herein have been constructed in southern California in the recent past. These projects were reviewed to identify best practices and lessons learned that can be inform the current work. The following subsections summarize 12 such projects (listed in alphabetical order).

3.1 Related Projects

3.1.1 Broad Beach Restoration Project

This project is particularly relevant to the Zuma Beach and Point Dume resilience project due to their comparable project features and proximity. The following summary was derived from public documents available on the Broad Beach Geologic Hazard Abatement District (BBGHAD) website[5].

The Broad Beach Restoration Project (BBRP) is located immediately west of Zuma Beach, between Lechuza Point and Trancas Creek. The purpose of the BBRP is to protect residences from coastal erosion by creating and maintaining a wide sandy beach backed by a restored dune system similar to that which historically existed along this reach of coastline.

Relevant project features include (1) beach nourishment of up to 300,000 cy approximately every five years; (2) restored dune habitat; (3) sand backpassing designed to prolong nourishment; and (4) retaining the emergency rock revetment constructed in 2010 as a permanent feature.

3.1.2 Hermosa Beach Resilience Project and Living Shoreline Project

The City of Hermosa Beach conducted a feasibility study that included installing a living shoreline at the north end of the City near the boundary with Manhattan Beach. Project objectives were to install a pilot resilience project, create additional habitat, and manage sand from blowing onto the pedestrian/bicycle pathway at the Strand. The conceptual designs consisted of two alternative layouts with sand dune habitat along the northern City boundary, toward the back beach. The site was positioned to provide resilience and sand management opportunities, minimize interference with public recreation such as beachgoing and volleyball, and prevent conflicts with two existing storm drainage outfalls along the City's northern boundary.

3.1.3 Los Angeles County Public Beach - Sea Level Rise Vulnerability Assessment

Noble Consultants (2016) prepared an assessment of the vulnerability of Los Angeles County public beach facilities to future SLR. The study includes an overview of the shoreline conditions,

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[5] http://www.bbghad.com

separated into three general regions: Malibu, Santa Monica Bay, and Palos Verdes Peninsula. An inventory of facility assets for each of the County-operated beaches is provided, including parking lots, restroom buildings, concessions, lifeguard safety stations, maintenance yards, utilities, and other recreational amenities.

The report summarizes the state of SLR science at that time. Vulnerability of the public beach assets to coastal hazards was assessed using their ground elevation, proximity to the shoreline, and exposure to beach erosion, wave runup, and inundation.

Results from the USGS CoSMoS 3.0 model (Barnard *et al.*, 2018) were used to estimate the potential percentage of shoreline loss for SLR scenarios of 100 cm and 200 cm. Impacts on beach assets were evaluated for several SLR scenarios concurrent with a 100-yr storm event.

Finally, a public beach asset management strategy was presented. Future planning included implementation of the *Los Angeles County Coastal Regional Sediment Management Plan* (Noble Consultants & Larry Paul and Associates, 2017), which cites beach nourishment as the primary strategy. Longer term strategies of retreat, elevate, and/or protect are also discussed.

3.1.4 Malibu Creek Ecosystem Restoration Project (Rindge Dam Removal)

The Malibu Creek Ecosystem Restoration Project entails the removal of Rindge Dam, which is situated approximately three miles upstream of Malibu Lagoon, and the removal of eight smaller dams upstream of the main one.

Dam removal would restore ecological integrity to Malibu Creek and the lagoon by reestablishing the fluvial connection of lower and upper Malibu Creek with Malibu Lagoon, and its oceanic outlet. The dam has significantly inhibited natural sand replenishment from upstream Malibu Creek to the coastline and associated nearshore habitats and presents a barrier to the endangered Southern Steelhead Trout.

There are approximately 780,000 cy of impounded sediment behind Rindge Dam that would otherwise flow downstream and reach the coastline. The Project is assessing the suitability for the 170,000 cy of gravel and 280,000 cy of sandy materials to be used for inshore habitat creation and littoral zone nourishment, respectively. The proposed placement strategy supports existing subtidal hard-bottom habitat for benthic species or creates new habitat (*e.g.,* a rubble field that promotes the recruitment of and successful attachment for kelp species). Excavated sandy material is being considered for beneficial reuse at nearby nearshore locations and/or via direct beach placement to nourish the littoral cell and enhance the resiliency of the nearby coastline. Direct beach placement may occur on the beach to the east of Malibu Pier or at Zuma Beach. This sediment would then feed downcoast beaches to the east of the placement site.

3.1.5 Manhattan Beach Living Shoreline Project

The Manhattan Beach Living Shoreline Project aims to enhance three acres of existing dunes along Manhattan Beach from 36th to 23rd Street. The Bay Foundation, along with the City of Manhattan Beach, LACDBH, and California State Coastal Conservancy implemented this project in 2022 which consists of the removal of non-native vegetation, seeding and planting of native vegetation, installation of temporary sand fencing to promote dune and vegetation growth, and installation of educational features and interpretive signage. The overall objective is to increase resiliency of the shoreline by implementing green infrastructure for protection against SLR, coastal flooding, and erosion. Ongoing scientific monitoring of this pilot project is being used to inform other living shoreline projects throughout southern California.

3.1.6 Marina del Rey Maintenance Dredging Projects

Marina del Rey is a small craft harbor located in Santa Monica Bay. While the harbor is managed by LACDBH, maintenance of the ocean entrance navigation channel is under the authority of the USACE, Los Angeles District, as part of their civil works mission.

Sediment accumulates in both the north and south ocean entrance channels of the marina. The source of sediment trapped in the north entrance channel is littoral transport from the northwest and is comprised of beach sand from within the littoral system. Conversely, the source of sediment trapped in the south entrance channel is Ballona Creek. Sediments discharged at the mouth of Ballona Creek historically were unsuitable for ocean placement. However, sediment sampling in 2023 at the creek mouth revealed clean sediment suitable for placement at the Dockweiler Nearshore site (Ryan, 2025).

Since 1969, the average shoaling rate at the north entrance to the marina is approximately 80,000 cy/yr (Ryan, 2025). The material typically is dredged and placed downdrift at Dockweiler State Beach. Material is occasionally dredged and placed updrift at Venice Beach or placed further downdrift in a nearshore placement site near Redondo Beach (Section 6.1.2).

3.1.7 Mugu Submarine Canyon Sand Bypassing Project

The USACE commissioned a study of submarine canyons for the purpose of assessing possible approaches to preventing sand loss. As part of the study, Moffatt & Nichol (2009) presented a strategy to dredge the nearshore zone upcoast of the canyon and pump the sand south of Mugu Rock. This action would allow sand to continue its travel south from Ventura County to Los Angeles County, thus restoring the historical sand supply to LA County beaches.

3.1.8 San Diego Regional Beach Sand Projects (RBSP)

The San Diego Association of Governments (SANDAG) has conducted two Regional Beach Sand Projects (RBSP): RBSP I in 2000 and RBSP II in 2012.

RBSP I was intended to serve as a pilot project to demonstrate that regional nourishment can benefit the coast without causing significant environmental impacts. As part of the project, 2.1M (million) cy of sand was placed at 12 beaches. Beach width gains and economic benefits were documented throughout the project and found to be significant.

Lessons learned as part of RBSP I were used to inform the design of RBSP II, namely relatively coarse-grained sand was placed at the receiver sites to extend the longevity of benefits and avoid environmental impacts. As part of the RBSP II project, 1.5M cy of sand was placed at eight beaches, all of which were included in RBSP I. Shoreline and economic monitoring conducted following construction indicate that the project was very beneficial and an improvement on RBSP I.

SANDAG is currently in the planning phase of RBSP III and 5.8M cy of sand is proposed to be placed on beaches in San Diego County and Southern Orange County (San Clemente and Dana Point). RBSP III also includes a sand retention element planned for the City of Oceanside.

3.1.9 Santa Monica Beach Living Shoreline Project

The Santa Monica Beach Living Shoreline Project was constructed in 2016 by The Bay Foundation to restore approximately three acres of coastal dune habitat on Santa Monica Beach. A living shoreline was constructed by installing sand fencing and seeding native vegetation to encourage vegetated dune growth. Vegetated dunes not only provide essential coastal habitat but also increase coastal resilience to SLR, coastal flooding, and erosion. Integrated beach pathways and interpretive signs were installed to accommodate beach goers and provide educational opportunities on native plants and living shorelines. Ongoing scientific monitoring of this pilot project is being used to inform other living shoreline projects throughout southern California.

3.1.10 Topanga Lagoon Restoration Project

The Topanga Lagoon Restoration Project seeks to expand the existing habitat area and return the lagoon to its historic footprint. Construction of the surrounding segments of PCH and the bridge that spans the lagoon obstructed the natural fluvial and tidal flushing of the lagoon habitat and artificially impounded sediments that constrict the lagoon, decreasing roughly 93% of the natural habitat area from the historic lagoon footprint.

By lengthening the existing 79-ft long PCH bridge that spans the lagoon and removing up to 256,000 cy of sediment from the site, this project will create up to 10 acres of valuable coastal wetland habitat. Excavated sediment from the project has been approved for beneficial reuse at a nearby nearshore location to nourish the littoral cell. The sediment will be pumped to a location offshore of Topanga Point. This type of nearshore placement will allow natural processes to push sandy material onto the beaches while disbursing finer clays and silts offshore, leaving any rocks in the placement footprint. This will enhance the resilience of surrounding beaches and benefit the system by adding locally-sourced sediment to the littoral cell.

3.1.11 USACE Coast of California Storm and Tidal Wave Study

The USACE Coast of California Storm and Tidal Wave Study for the Los Angeles Region (CCSTWS-LA; USACE, 2009a) was an extensive effort by the federal agency to present an assessment of existing conditions, areas of concern, and determine the need for any actions. The study presents the shoreline history, its position over time and trends, beach profiles, longshore sediment transport, sand sources and sinks, maintenance dredging, beach nourishment, structures, particularly unique areas and/or sensitivities, and any specific needs for shoreline protection.

3.1.12 Westward Beach Living Shoreline Project

This project is located within the Zuma Beach and Point Dume Beach resilience project area. As noted previously, severe coastal erosion occurred adjacent to Westward Beach Road during Summer 2021. A portion of the road was undermined, and a water line and drainage pipe were damaged. An emergency revetment was constructed to prevent further damage to the access road. In winter 2022-2023, additional coastal erosion resulted in the need to extend the emergency revetment east to protect the road and a restroom at Point Dume Beach.

CFC prepared a draft coastal engineering study in summer/fall 2022 to evaluate a range of solutions, including nature-based elements. Currently, CFC is assisting LACDBH in a long-term solution to protect Westward Beach Road and impacted public beach facilities. The coastal resilience project at Zuma Beach and Point Dume Beach supports the overall goal of reducing the magnitude of present and future coastal erosion threats at this location and may serve as a mitigation measure for the loss of sandy beach habitat at Point Dume Beach.

3.2 Lessons Learned from Past Project Experience

The Project Team has led successful local and regional beach enhancement projects throughout southern California for more than 25 years. Lessons learned as part of these projects are summarized below and used to develop recommendations for implementation. The lessons learned and recommendations encompass planning and environmental concerns, project design, construction, permitting, public outreach, and pre- and post-project monitoring.

3.2.1 Planning/Environmental Concerns

- Identify and permit multiple suitable borrow sites to provide back-up sand sources during construction in the event that the primary borrow site contains lower sand quality or quantity than expected.
- Consider including retention devices for receiver beaches that demonstrate a tendency to be naturally narrow or those where the beach fill disperses quickly.
- Incorporate nature-based restoration elements to broaden the range of benefits.
- Planning documents (namely air quality reports and water quality analyses) should anticipate possible equipment needs, such as a dredge similar in size/capacity to the *Liberty Island* owned by Great Lakes Dredge and Dock Company, which was used to build RBSP II in 2012 (hopper capacity of 5,000 cy). Due to the larger volume of discharge from the *Liberty Island,* as compared with the small hopper dredge used for RBSP I in 2001, turbidity plumes were, at times, relatively large. However, they were temporary and were not prohibitive given the 401 permit conditions.
- Future planning documents should consider beach access and safety, construction areas, and horizontal (longshore) access. For reference, the RBSP II construction area (length of beach affected) generally exceeded 500 ft, and horizontal access across the beach was only restricted during active construction or pumping. Active construction or pumping lasted an hour to an hour and a half per cycle, with between 4 to 6 cycles per day. Sand discharge points, and thus access restrictions, moved progressively along the beach each day.
- Include maintenance activities to grade vertical scarps that can form on the seaward edge of receiver sites. These features can form early in a nourishment project as the beach is equilibrating and can present hazards to beach users, particularly at night when visibility is limited.
- Implement project design features to reduce potential impacts to sensitive marine and biological resources (described in Section 3.3).

3.2.2 Permitting

- Coordinate with agencies in advance and understand what to expect regarding permit conditions. Meetings for RBSP II commenced a year and a half before construction.

Some of the information obtained during the meetings was used in the contractor solicitation and provided the client with possible monitoring requirements and costs.

- Review Environmentally Sensitive Habitat Areas (ESHA) and grunion constraints with the California Coastal Commission to identify potential construction impacts for work occurring in spring and summer.
- Determine the most efficient Coastal Development Permit for the project if it occurs within both the California Coastal Commission and the local government jurisdictions.
- Work with the RWQCB to maintain similar monitoring requirements for construction as were applied to RBSP I and RBSP II.

3.2.3 Project Design

- Grain size is critical to the longevity of the beach fill. Coarser-than-native grained sand is preferred to extend beach width benefits. Fine-grained sediment is preferred on the upper beach to promote aeolian transport processes necessary for dune creation and enhancement.
- Locate borrow sites as close to shore as possible while remaining within the target dredge area. This should maximize the coarse sand fraction and reduce the amount of silt covering the existing seabed.
- Consider larger borrow site footprints to allow the dredging contractor more flexibility during construction.
- Consider larger receiver site footprints to allow some flexibility in construction.
- Grade the surface of the beach fill berm to slope slightly toward the ocean to minimize or reduce ponding on the newly placed material; a slope of 1% is sufficient.
- Consider/analyze access routes used by the contractor from coastal ingress points.
- Public and emergency pathways through dunes should be oriented oblique to the prevailing wind and wave directions to limit the accumulation of wind-blown sand and wave-induced upland flooding.
- Dune features should be built onshore (landward) of storm drains, which may require drains to be extended.

- Restored dunes of sufficient width can virtually eliminate wind-blown sand on adjacent infrastructure (e.g., bike paths, parking lots). Short-term sand stabilization can be used during the initial project phases as the dune vegetation is established.

3.2.4 Construction

- Weekly meetings should start one month prior to construction; this was critical during the planning process and mobilization period for RBSP I and II.

- Target construction later in the season to avoid potential issues with grunion, birds, and the public. Because of the later-than-anticipated start of RBSP II, there was a reduction in environmental monitoring costs (on the order of several hundred thousand dollars) and potential construction delays and change orders were avoided. Regarding recreational users, a late summer start date reduced (but did not eliminate) the number of interactions. If construction were to occur during the summer (upon which some cities had placed restrictions), greater vigilance would be required to ensure public safety. Coordination with City public safety officers (*i.e.,* lifeguards) was critical in maintaining public safety during construction.

- Develop transit routes for the dredge that minimize conflicts with fishermen and recreational boaters. While the routes may not be necessary for support vessels (crew boats and tugs), the contractor should reinforce a “good neighbor” philosophy to avoid conflicts.

  Since RBSP I and II construction overlapped the commercial lobster season (typically October to mid-March), the construction schedule was adjusted to minimize impacts to fishable areas, especially in the first part of the season, by constructing in areas where there was limited fishing (*e.g.,* Oceanside) or closed areas (*e.g.,* Swamis MPA). Weekly updates were posted at the commercial fisherman docks in Oceanside, Mission Bay, and San Diego Bay.

- Require daily construction management oversight to verify that plans (*e.g.,* safety, spill prevention, BMPs, etc.) are followed.

- Dune topography can be constructed directly by moving sand with heavy equipment, or indirectly using sand fencing and vegetation. The former is more desirable where dunes are designed to provide flood protection.

- When constructing dunes, the native beach sand should be used. If imported sand is used, it should match the texture (grain size) of the native sand closely and have less than 3% fines.

- Irrigation may be necessary to promote healthy vegetation in dune systems.

3.2.5 Public Outreach

- Public meetings should occur prior to, and throughout, construction to provide information to everyone, regardless of stakeholder affiliation.
- Coordinate with Cities and other focused stakeholder groups in advance of project implementation.
- Develop a Frequently Asked Questions (FAQ) document that can be widely distributed and published on the project website to address common questions and effectively disseminate information to the public.
- Focused stakeholder groups should include the lobster fishing industry, the Surfrider Foundation or other local surfing groups dedicated to sites near construction, homeowners near construction areas, public agencies affected by construction, tribal representatives and other environmental groups (*e.g.*, Heal the Bay, Sierra Club, Audubon Society, the Bay Foundation).
- Outreach should continue right up to the time of construction to alert stakeholders to the upcoming work. Provide a contact name and number at the agency responsible for the project so that the public can ask questions and submit comments or concerns.
- A press contact should be provided to represent the Project Lead Agency in interviews and status reports.
- Web postings should occur early in the planning process and continue through construction with updated and post-construction monitoring. This provides transparency and limits misinformation.
- Restored dunes provide opportunities for interpretive signage and other educational activities.

3.2.6 Pre- and Post-Project Monitoring

- Conduct beach profile surveys early to establish pre-construction conditions, including the natural range in beach width and any hard-bottom coverage. Continue profiling during construction as the construction activities progress along the shoreline.
- Consider implementing a program similar to the 2002 Nearshore Inventory Program to map offshore biological resources prior to a project.

- Pre-construction rocky subtidal and intertidal habitat reef surveys are critical in identifying potential pipeline corridors; corridors should be located between or away from rocky habitat.
- Partner with a group, such as Surfrider Foundation or Surfline, to conduct and/or participate in surf monitoring before and after project implementation.
- Dune topography and vegetation should be monitored prior to construction, during construction, and at least annually for at least five years post-construction. Monitoring should be designed to support adaptive management and permit compliance. Where feasible, project sites should be monitored concurrently with one or more local reference sites to account for natural variability in these dynamic coastal systems.
- Maintenance of dune fencing, removal of weeds, and trash collection will be necessary and should be planned for.

3.3 Recommended Avoidance and Minimization Measures

The following avoidance and minimization measures are recommended to be incorporated into the project design as “Project Design Features.”

3.3.1 Worker Environmental Awareness Program

Prior to initiation of project activities (including staging and mobilization), all personnel associated with project construction should attend a Worker Environmental Awareness Program (WEAP) training, conducted by a qualified biologist, to aid workers in recognizing special-status terrestrial and marine species, native birds, and other biological resources that may occur on the project site. The specifics of this program should include identification and habitats of special-status species with potential to occur at the project site, a description of the regulatory status and general ecological characteristics of sensitive resources, and review of the limits of construction and mitigation measures required to reduce impacts to biological resources within the work areas.

A fact sheet conveying this information should be prepared for distribution to all contractors, their employers, and other personnel involved with construction. All employees should sign a form provided by the trainer indicating they have attended the WEAP and understand the information presented to them.

3.3.2 General Best Management Practices

The following Best Management Practices (BMPs) should be followed by project personnel to ensure pollution prevention and minimize the introduction of pollutants into coastal waters.

- During construction, heavy equipment should be operated in accordance with standard BMPs. All equipment should be properly maintained such that no leaks of oil, fuel, or residues will take place. Provisions should be made to remediate any accidental spills. Materials should be stored and equipment fueled at least 100 ft from water features, as feasible, or equipment should utilize secondary containment.
- Spill prevention and control measures should be implemented to ensure the proper handling and storage of petroleum products and other construction materials; including a designated fueling and vehicle maintenance area with appropriate protection to prevent spillage of gasoline or related petroleum products or contact with runoff.
- All food-related trash should be disposed of in closed containers and removed from the project site each day during the construction period. Project personnel should not feed or otherwise attract wildlife to the project site.
- All work should occur during daylight hours for safety and wildlife protection. Lighting of the beach and water area should be prohibited to prevent wildlife attraction.
- Construction work or equipment operations below Mean Lower Low Water (MLLW) should be minimized to the extent feasible, and, where possible, limited to times when tidal waters have receded from the authorized work area.
- Any spillage of material should be stopped if it can be done safely. The contaminated area should be cleaned, and any contaminated materials properly disposed of.
- Adequate spill prevention and response equipment should be maintained on site and be readily available to ensure minimal impacts to the aquatic and marine environments.
- A 50-ft long spill containment boom and absorbent pads should be kept on-site and deployed in the event there is a release of fluids into the water.
- Fire suppression equipment should be provided at the worksite. A fire extinguisher should be available in every 3,000 ft^2 of construction area, no more than 100 ft away from heavy equipment. Heavy equipment operators should attend a training session on appropriate responses to fire suppression during the pre-construction meeting.

3.3.3 Grunion Surveys

The project should avoid placing material or conducting any work on the beach below the Mean High Tide Line (MHTL) during the seasonally predicted grunion run and egg incubation period of March 14 through August 31. If project activities must occur during an expected grunion run, a grunion survey should be conducted in accordance with the expected grunion runs provided by CDFW. Project activities should proceed only in areas where no grunion spawning was observed.

3.3.4 Western Snowy Plover and Nesting Bird Monitoring

To avoid disturbance of nesting birds and special-status birds, including western snowy plover and California least tern, protected by the FESA, CESA, MBTA, and CFGC 3503, activities related to the project should occur outside of the breeding season for migratory birds (generally February 1 through August 31), as feasible.

If project activities must occur during the breeding season, then full-time monitoring should be conducted during all beach activities requiring the use of heavy machinery. Reduced monitoring or clearance surveys may be suitable depending on the activity. A qualified monitor should walk ahead of vehicle(s) and equipment to help ensure that western snowy plover and California least tern are out of harm's way before the vehicle(s) or equipment can proceed. If birds do not move out of vehicle traffic path, the monitor should attempt to guide vehicle(s) on an alternate path to avoid grounding birds and walk ahead of vehicle(s) to ensure the path is cleared while maintaining a minimum 150-ft buffer.

If nests are found, an avoidance buffer (dependent upon the species, the proposed work activity, and existing disturbances associated with land uses outside of the site) should be determined and demarcated by the biologist with bright orange fencing, flagging, or other means to mark the boundary. All project personnel should be notified as to the existence of the buffer zone and to avoid entering the buffer zone during the nesting season. Project activities should not occur inside this buffer until the avian biologist has confirmed breeding/nesting is complete, and the young have fledged the nest. Encroachment into the buffer should occur only at the discretion of the qualified biologist.

3.3.5 Marine Mammal and Sea Turtle Avoidance

All project personnel should adhere to the guidelines set forth in the Marine Mammal Protection Act (MMPA). If a stranded or hauled out marine mammal or sea turtle is observed, all project equipment and personnel should remain at least 100 yards (300 ft) away from whales and 50 yards (150 ft) from dolphins, porpoises, seals and sea lions. The Marine Mammal Care Center should be notified if the animal appears sick or injured. Work should cease within the buffer area until the animal has been allowed to leave without harm.

3.3.6 ESHA Avoidance

During the project, ESHA should be clearly delineated in the field to prevent direct impacts outside of the designated project boundary. All sensitive species and sensitive species' habitats, including

ESHA, located within 100 ft of project activities should be delineated with specific sensitive species labeling (*e.g.,* signage stating, “No Entry – Environmentally Sensitive Habitat” attached to temporary fencing). Since the project is temporary, orange snow fencing would be sufficient for the duration of the project. In areas that are separated by existing chain-link fencing, signage should be secured to the existing fencing.

3.3.7 Water Quality Monitoring

A Water Quality Monitoring Plan should be prepared to avoid and minimize potential adverse effects to water quality (*e.g.,* increased turbidity, altered pH, decreased dissolved oxygen levels). The plan should establish water quality thresholds consistent with the SWRCB Ocean Plan and include measures for water quality monitoring up current and down current of the project site. If water quality thresholds established in the Ocean Plan are exceeded, the monitor should inform the project manager and be granted the authority to temporarily halt project activities until monitoring indicates the constituent measurements are within the Ocean Plan thresholds.

3.3.8 Unanticipated Discovery of Cultural Resources

In the event archaeological resources are unexpectedly encountered during ground-disturbing activities, work within 50 feet of the resource find shall halt and an archaeologist meeting or exceeding the Secretary of the Interior’s Professional Qualifications Standards for Archeology (NPS 1983) shall be contacted immediately to evaluate the resource. If the resource is determined by the qualified archaeologist to be prehistoric, a Native American representative shall also be contacted to participate in the evaluation of the resource. If the qualified archaeologist and/or Native American representative determines it to be appropriate, archaeological testing for California Register of Historical Resources (CRHR) eligibility shall be completed. If the resource is determined to be eligible for the CRHR and significant impacts to the resource cannot be avoided via project redesign, the qualified archaeologist shall prepare a data recovery plan tailored to the physical nature and characteristics of the resource, per the requirements of CCR Guidelines Section 15126.4(b)(3)(C). The data recovery plan shall identify data recovery excavation methods, measurable objectives, and data thresholds to reduce any potential significant impacts to the resource. Pursuant to the data recovery plan, the qualified archaeologist and Native American representative, as appropriate, shall recover and document the scientifically consequential information that justifies the resource’s significance. The Los Angeles County Department of Beaches and Harbors (LACDBH) shall review and approve the treatment plan and archaeological testing, as appropriate, and the resulting documentation shall be submitted to the regional repository of the California Historical Resources Information System, per CCR Guidelines Section 15126.4(b)(3)(C).

3.3.9 Unanticipated Discovery of Tribal Cultural Resources

In the event that archaeological resources of Native American origin are identified during implementation of the project, ground-disturbing activities within 50 ft of the find shall be temporarily suspended or redirected until an archaeologist has evaluated the nature and significance of the find as a cultural resource and an appropriate local Native American representative is consulted. If the County, in consultation with a traditionally and culturally affiliated Native American group(s), determines the resource is a tribal cultural resource and thus significant under CEQA, a mitigation plan shall be prepared and implemented in consultation with the traditionally and culturally affiliated Native American group(s). The plan shall include measures to ensure the find is treated in a manner that respectfully retains, to the degree feasible, the qualities that render the resource of significance to the local Native American group(s). Examples of appropriate mitigation for tribal cultural resources include, but are not limited to, avoidance, protecting the cultural character and integrity of the resource, protecting traditional use of the resource, protecting the confidentiality of the resource, or heritage recovery.

4 Project Concepts and Alternatives

The *Coastal Resilience Study* (Moffatt & Nichol, 2023) provided conceptual descriptions of projects at Zuma and Point Dume Beach, Dockweiler State Beach, and Redondo Beach. Each project was developed to proactively preserve and enhance LA County Beaches, including existing critical infrastructure, existing structures and facilities, recreational open space, natural and cultural resources, and habitat for sensitive species. These concepts were used as a framework to develop three alternatives for each site. The subsections that follow summarize the objectives, opportunities and constraints, and three project alternatives at each site.

4.1 Zuma Beach and Point Dume

The concept at Zuma Beach and Point Dume Beach developed as part of the *Coastal Resilience Study* included widening Zuma Beach via beach nourishment and creating or enhancing dune habitat at both Zuma and Point Dume Beach. The primary objectives of the project are to:

- Expand public access and recreational opportunities for LA County residents and visitors;
- Increase protection of existing critical public coastal infrastructure;
- Increase and enhance sandy beach and dune habitat; and
- Expand local and regional economic benefits associated with beach use and visitations.

4.1.1 Opportunities and Constraints

Opportunities

Opportunities that can be leveraged as part of the resilience project include:

- Sediment placed at Zuma Beach is expected to widen vulnerable portions of Point Dume Beach, where direct placement of sand is prohibited (see constraints, below), via natural processes.
- Beach nourishment within the Zuma Littoral Cell is expected to nourish downdrift beaches within Santa Monica Bay, further leveraging the economic benefits from project implementation.
- The existing emergency revetment located along portions of Westward Beach Road at Point Dume Beach may require some form of mitigation for impacts to the sandy beach. Two revetment segments were approved and constructed under emergency coastal development permits (ECDPs) from the CCC and will ultimately require a standard coastal development permit (CDP). The beach nourishment could provide in-kind

impact mitigation for any permanent shoreline protective device included as part of the long-term Westward Beach Road shore protection project.

- CRC identified significant portions of the Zuma Beach shoreline as having potential for self-sustaining dunes (Section 2.3), including areas where winter sand dikes are constructed.
- Existing dune habitat around Zuma Creek Lagoon can be enhanced through invasive species removal, symbolic fencing, and planting to enhance native plant diversity and cover.
- Restored dunes would provide habitat for sensitive species such as wintering western snowy plover, globose dune beetles, legless lizards, and red sand verbena.

Constraints

The primary constraints warranting careful consideration in the project planning stage are related to the existence of regulated or sensitive biological resources, as noted in Section 2.2 and summarized below:

- The regions below the Mean High Tide Line (MHTL) at Zuma Beach and Point Dume Beach are located within the Point Dume State Marine Conservation Area (Point Dume SMCA) and Point Dume State Marine Reserve (SMR), respectively (Figure 4-1). An important difference between these two areas, as it relates to this study, is that beach nourishment is permitted within the Point Dume SMCA (*i.e.,* Zuma Beach) but is <u>not</u> allowed in the Point Dume SMR (*i.e.,* Point Dume Beach).

  California Code of Regulations Title 14, Section 632 specifically states the following:

  <u>Point Dume SMCA</u>

  Beach nourishment and other sediment management activities are allowed inside the conservation area pursuant to any required federal, state and local permits, or as otherwise authorized by the department.

  <u>Point Dume SMR</u>

  In a state marine reserve, it is unlawful to injure, damage, take, or possess any living, geological, or cultural marine resource, except under a scientific collecting permit issued by the department pursuant to Section 650 or specific authorization from the commission for research, restoration, or monitoring purposes.

Figure 4-1. Pt. Dume State Marine Conservation Area & Pt. Dume State Marine Reserve

- The project site is located within designated critical habitat for the western snowy plover and tidewater goby. While project activities are not expected to permanently impact or adversely modify this habitat, temporary impacts could include changes to water quality, increased noise, temporary removal of foraging habitat, and other increased human activity during project activities.
- The offshore portion of the site is designated as EFH. Project activities may temporarily alter EFH and HAPCs or interfere with the movement of fish or wildlife species and could temporarily impede the use of wildlife nursery sites; however, they are not expected to have any significant impacts on these habitats, populations, or the fisheries that depend on them. The project will help preserve natural habitats and reduce erosion in the nearshore zone, providing additional soft bottom habitat suitable for foraging. Temporary impacts to these areas could include changes to water quality, increased noise, and other increased human activity during construction.
- The Zuma Beach & Point Dume site is located within ASBS No. 24. The project will not result in direct impacts, such as wastewater and pollutant discharges. However, indirect impacts due to increased turbidity or a change in other water quality standards may occur.
- The site is located on the sandy beach and subtidal sand overlapping the HTL. Project activities have the potential to impact incubating grunion eggs if activities occur during

their spawning season. This is a universal constraint for any / all beach nourishment projects.

Additional constraints include:

- Recreational beach area (“towel space”) will be reduced in areas where dunes are created.
- Vertical access through dune areas must be provided for and managed.
- Dunes may impact public view corridors and these corridors should be considered in project planning.
- Restoration adjacent to lagoon habitats must consider potential effects on sensitive aquatic species (e.g., tide water goby).

4.1.2 Project Alternatives

Key components of the project alternatives are provided in Table 4-1 and described in detail below.

Table 4-1. Key Elements of Project Alternatives, Zuma Beach & Point Dume

Project	Beach Nourishment	Renourishment Interval	New Dune Habitat	Enhanced Dune Habitat
Alternative 1	500,000	5 years	4.1 acres	4.5 acres
Alternative 2	500,000	5 years	8.3 acres	4.5 acres
Alternative 3	750,000	8 years	4.1 acres	4.5 acres

Alternative 1

Alternative 1 includes an initial beach nourishment of 500,000 cubic yards (cy) at Zuma Beach, with renourishment events of the same magnitude every five years. New dune habitat (4.1 acres) will be created along Zuma Beach where sand dikes are constructed each winter and the existing dunes at Zuma Creek and Point Dume Beach will be enhanced or expanded (4.5 acres).

Figure 4-2 conceptually illustrates all project elements, while Figure 4-3 provides a detailed plan view and cross-section of the beach fill construction template and dune elements at Zuma Beach. The beach fill template is 5,900 ft long with a 190 to 360-ft wide berm at an elevation of +12 ft (MLLW) and a foreshore slope of 1:5 (V:H). The dunes at Zuma Beach will be constructed on the back beach in areas typically occupied by winter berms that are used to reduce flooding at County facilities. The dunes will be approximately 100 ft wide, 6 ft high, and vegetated with native dune plants (*e.g.*, beach sand verbena, beach primrose, coast woolly heads).

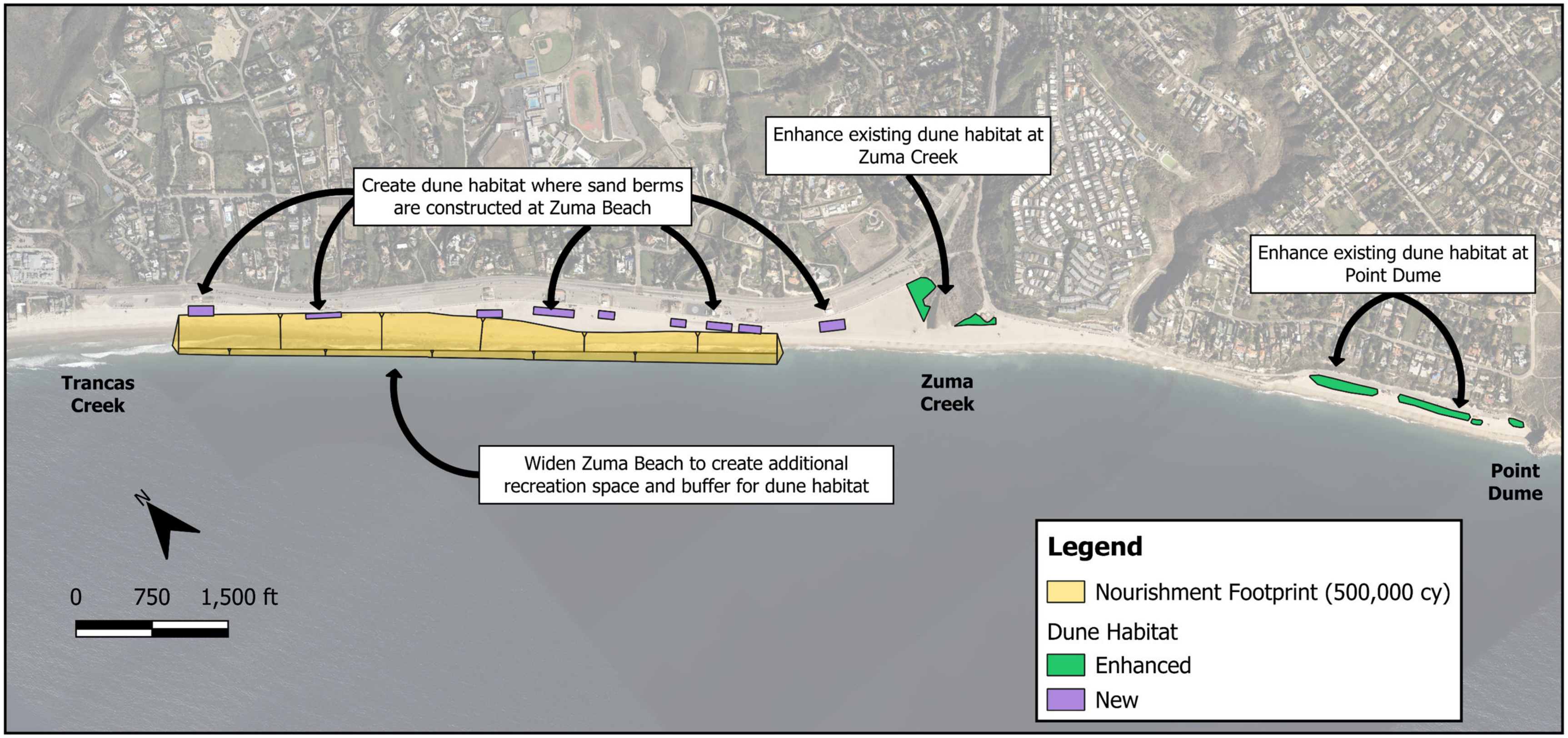


Figure 4-2. Alternative 1 at Zuma Beach and Point Dume Beach

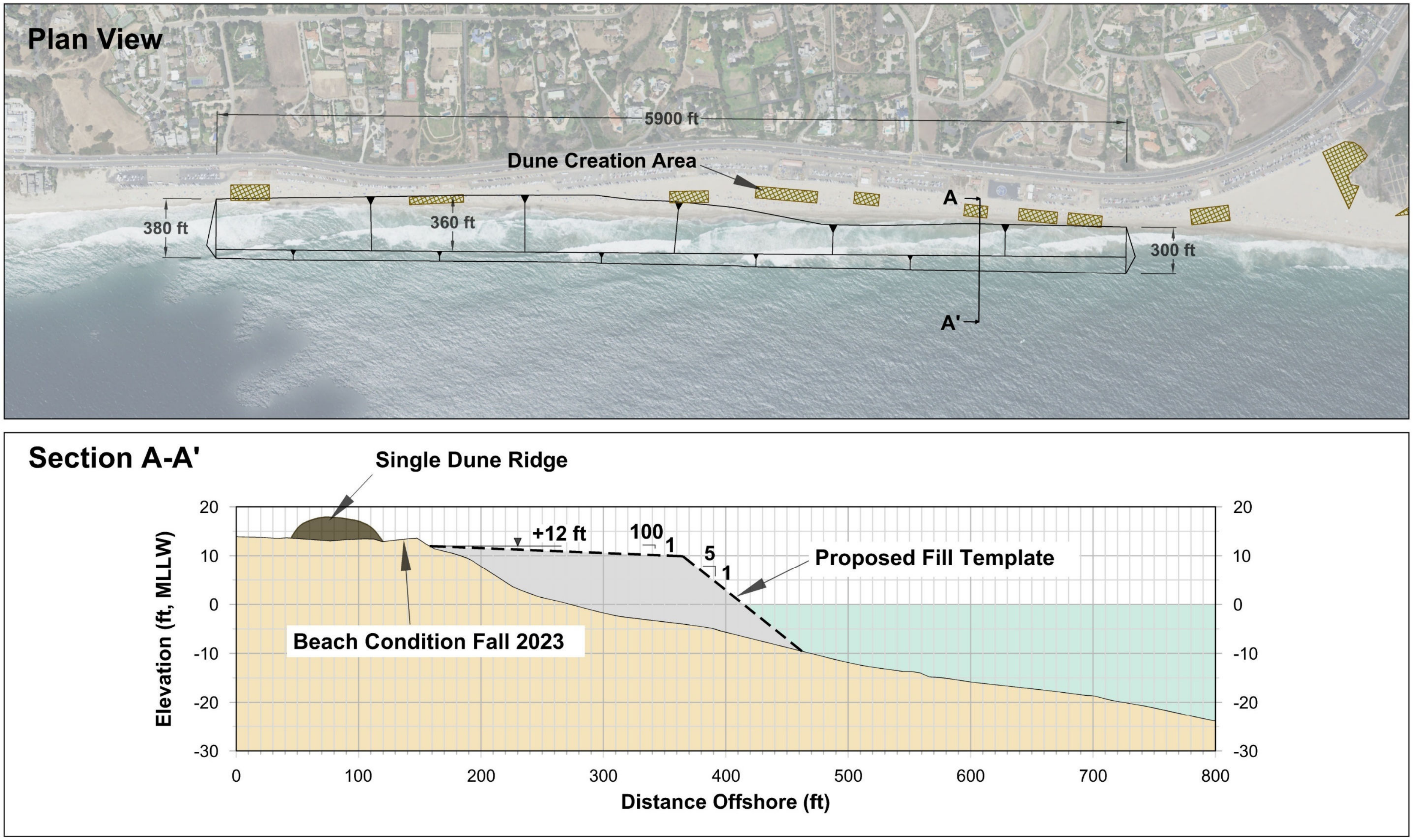


Figure 4-3. Beach Nourishment and Dune at Zuma Beach, Alternative 1

A post and rope barrier will be placed on the perimeter to discourage trespassing, with informational signage for the public as an educational/interpretive opportunity. An example of such fencing is provided in Photo 4-1[6].

Photo 4-1. Rope and Post Fencing and Educational Signage at Cardiff State Beach

At Zuma Creek and Point Dume, the existing dunes will be enhanced and/or expanded. The County will partner with and build upon the Malibu Living Shoreline Project currently being implemented by The Bay Foundation in both areas (The Bay Foundation, 2024). At Zuma Creek, the surface of the dunes will consist of randomly positioned small mounds ("hillocks") interspersed with swales. The hillocks will be vegetated with native dune plants and designated paths will be provided to reduce trampling by foot traffic. Figure 4-2, prepared as part of the Malibu Living Shoreline Project (Rios Clemente Hale Studios and Coastal Restoration Consultants, 2019), provides an artistic rendering of the dunes at Zuma Creek following completion of the project.

At Point Dume, the existing dune system will be enhanced by removing non-native species, seeding with native species, and creating designated pedestrian corridors to the beach, thereby reducing trampling by foot traffic. The dune height will be such that sight lines to the beach are not obscured and sand collection fencing will be installed to encourage dune growth and limit

[6] https://www.resilientcoastlines.com/

deposition in unwanted areas, such as the parking lot. Figure 4-5 provides an artistic rendering of the dune concept (CRC, 2024b).

Figure 4-4. Artistic Rendering of Dunes at Zuma Creek following Project Completion

Figure 4-5. Artistic Rendering of Dunes at Point Dume Beach following Project Completion

It is likely that sediment used for the project will be dredged from an offshore borrow site within Santa Monica Bay and hydraulicly pumped onto the beach from offshore (Section 6). Prior sand source investigations (Coastal Frontiers Corporation, 2011a; 2011b; 2012) have located high quality sand offshore in Santa Monica Bay that is compatible with the native sediments at the site.

Alternative 2

Alternative 2, illustrated in Figure 4-6, includes all the elements of Alternative 1 along with an additional 4.2 acres of new dune habitat along Zuma Beach, resulting in a total of 8.3 acres of new dune habitat and 4.5 acres of enhanced dune habitat. As was the case at Point Dume, designated corridors to the beach will be provided through the dune system and sand collection fencing will be installed to encourage dune growth. Given that the nourishment element is identical to Alternative 1, refer to Figure 4-3 for the plan view and representative cross section of the beach fill.

Alternative 3

As part of Alternative 3, the volume of the beach nourishment and renourishment events are increased to 750,000 cy and the renourishment frequency is increased to 8 years (assuming a renourishment volume equal to the initial volume of 750,000 cy). The dune creation and enhancement areas are identical to Alternative 1. Figure 4-7 conceptually illustrates all project elements, while Figure 4-8 provides a detailed plan view and cross-section of the beach fill construction template and dune elements at Zuma Beach. The beach fill template is 8,000 ft long with a 200 to 380-ft wide berm at an elevation of +12 ft (MLLW) and a foreshore slope of 1:5 (V:H).

4.2 Dockweiler State Beach

The concept presented at Dockweiler State Beach as part of the *Coastal Resilience Study* (Moffatt & Nichol, 2023) included two elements: (1) installation of a physical barrier to prevent sand migration from the beach / dunes onto the bicycle and pedestrian path and parking lot, and (2) active management of the existing dune system between the Youth Center and the Hang Glider area.

The specific objectives of the project are to:

- Reduce the quantity of sediment blown onto the bike / pedestrian path and parking lot;
- Manage and expand the existing dune system at the site; and
- Provide educational information related to the role that dunes play in habitat creation, risk reduction, and resilience planning.

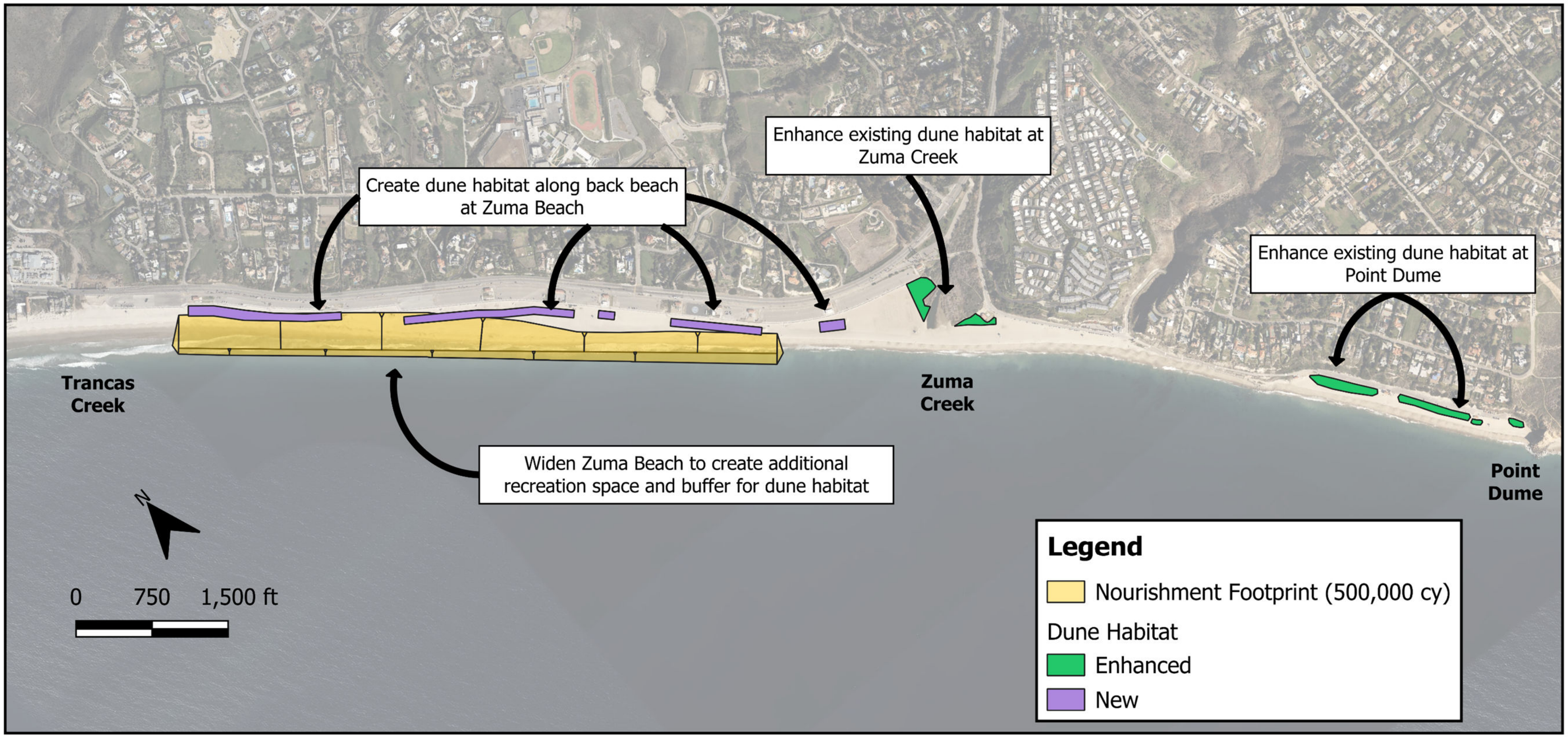


Figure 4-6. Project Alternative 2 at Zuma Beach and Point Dume Beach

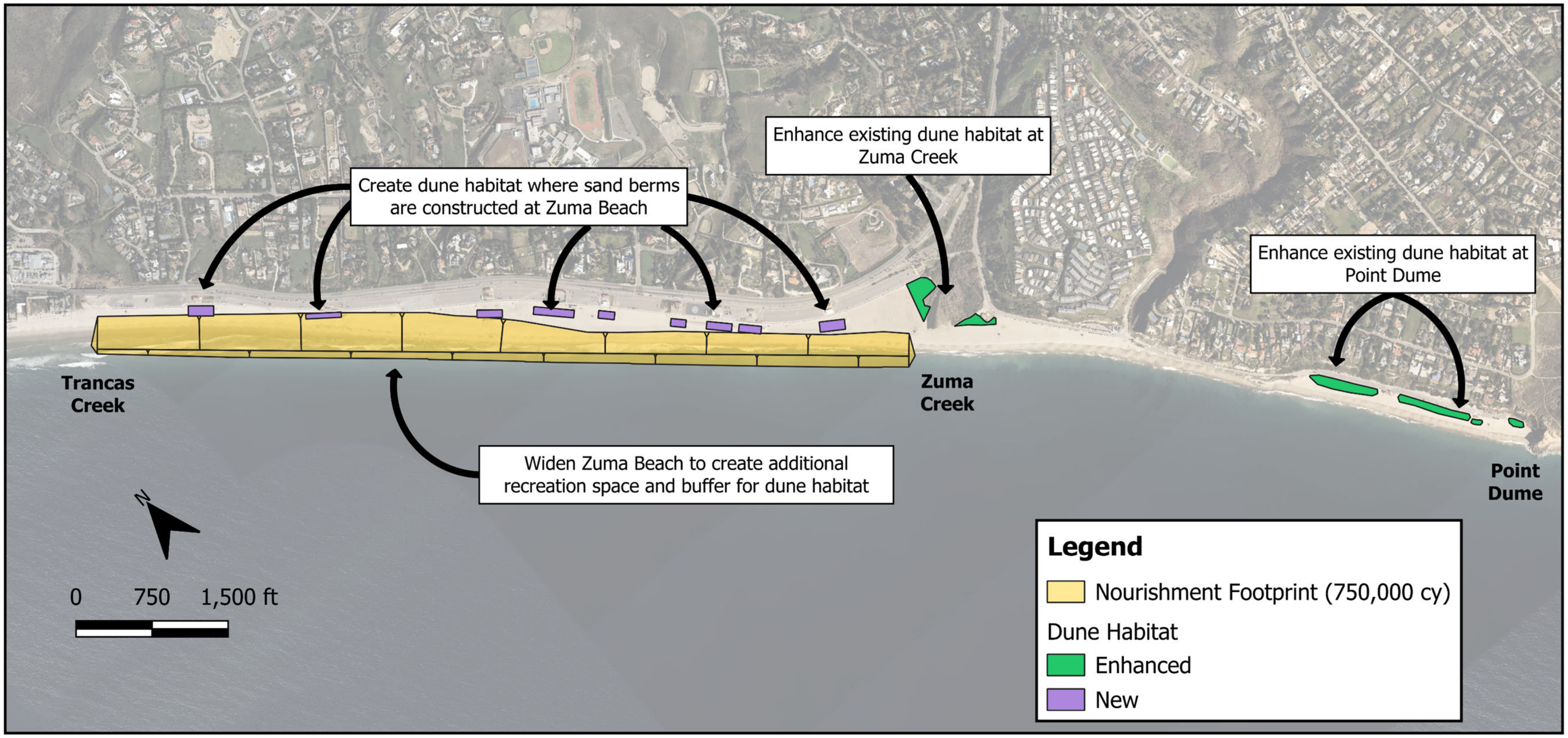


Figure 4-7. Project Alternative 3 at Zuma Beach and Point Dume Beach

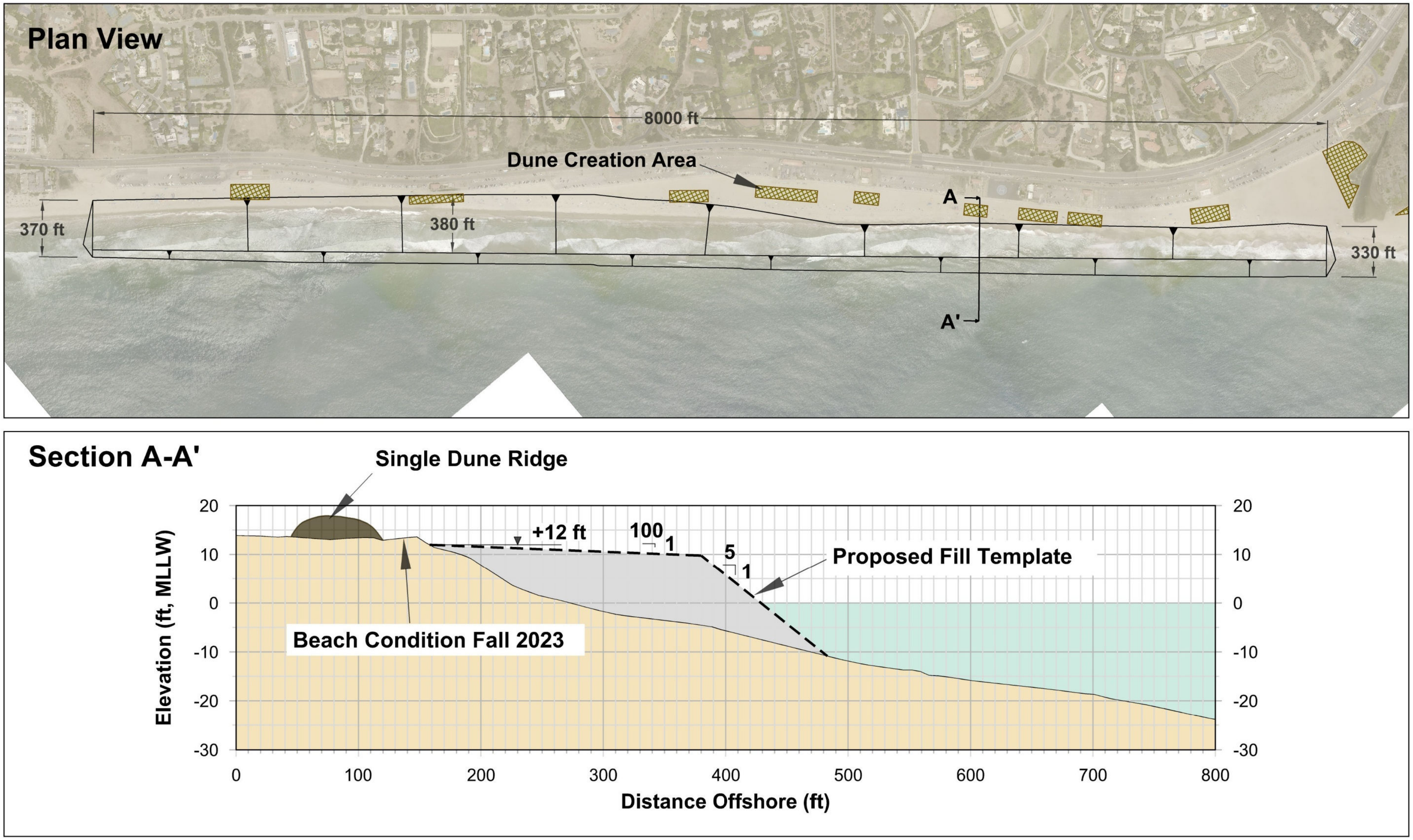


Figure 4-8. Beach Nourishment and Dune at Zuma Beach, Alternative 3

4.2.1 Opportunities and Constraints

Opportunities

Opportunities that can be leveraged as part of the coastal resilience project include:

- Dunes presently exist at the site and can be enhanced through invasive species removal, symbolic fencing, and planting to increase native plant diversity and cover.
- Restored dunes will provide habitat for sensitive species such as wintering western snowy plover, globose dune beetles, legless lizards, and red sand verbena.
- Project scale is relatively small with low implementation costs, thereby improving likelihood of obtaining funding and expediting construction.

Constraints

The primary constraints warranting careful consideration in the project planning stage are:

- Any barrier constructed to limit sediment transport onto the bike path should be low enough to allow a person of average height to easily cross while carrying beach gear and should utilize a narrow foundation to limit the footprint on the beach.
- Vertical access to the beach and horizontal access along the beach must be provided.
- Hang Gliding is a popular activity at the south end of the site. The project should not impact established takeoff points.
- The project site is located within designated critical habitat for western snowy plover. While project activities are not expected to permanently impact or adversely modify this habitat, temporary impacts could include changes to water quality, increased noise, temporary removal of foraging habitat, and other increased human activity during project activities.
- The El Segundo blue butterfly resides in the El Segundo sand dunes near Dockweiler State Beach and has been observed foraging in areas with their natural food source, coast buckwheat. There is a low potential for the species to occur in the vegetated areas near the project site, and they are not expected to occur due to lack of food sources.

4.2.2 Project Alternatives

Key components of the project alternatives are provided in Table 4-2 and described in detail below.

Table 4-2. Key Elements of Project Alternatives, Dockweiler State Beach

Project	Enhanced Dune Habitat	Restored Dune Habitat	Length of Sand Barrier	Number of Beach Access Points
Alternative 1	1.3 acres	1.3 acres	850 ft	3
Alternative 2	1.3 acres	1.5 acres	850 ft	2
Alternative 3	1.3 acres	1.4 acres	700 ft	4

Alternative 1

Alternative 1 is illustrated in Figure 4-9. The primary components include a low barrier wall along the west edge of the bicycle path, enhancement and restoration of the existing dune field, and creation of established accessways between the parking lot and beach. The barrier wall is intended to prevent wind-blown sand from reaching the bike/pedestrian path and parking lot and will be similar to that found at other County-managed beaches, such as Zuma Beach (Figure 4-10). There are two segments with a combined length of 850 ft, beginning at the Youth Center and ending east of the Hang Glider takeoff area. The wall is a little more than 2 ft tall with a base that is about 1-ft wide.

The existing dune system will be enhanced through active management that includes installation of sand fencing within the dune field, installation of boundary fencing along the border, removal of non-native species, and seeding with native species. In addition, sand and boundary fencing will be installed west (offshore) of the existing dune field in an effort to restore former dune habitat. Public access to the beach will be provided at three locations: via the stairs on the south side of the Youth Center, along a designated path immediately south of the Youth Center, and at the Hang Glider takeoff area. Breaks in the barrier wall will be provided at all three locations.

Alternative 2

Alternative 2 is illustrated in Figure 4-11. The barrier wall is identical to that in Alternative 1. The beach access point immediately south of the Youth Center is removed, resulting in a larger area of continuous dunes from the Youth Center to the Hang Glider take-off area. Access to the beach is maintained at the Youth Center stairs and at the Hang Glider area. The enhanced dune area is identical to Alternative 1 (1.3 acres) and the restored dune area is slightly larger (1.5 acres compared to 1.3 acres under Alternative 1).

Alternative 3

As part of Alternative 3, the barrier wall is terminated at the south end of the dune system, resulting in a single segment with a total length of 700 ft. As shown in Figure 4-12, the dune restoration area is expanded to the north and extends along the entire offshore edge of the Youth Center.

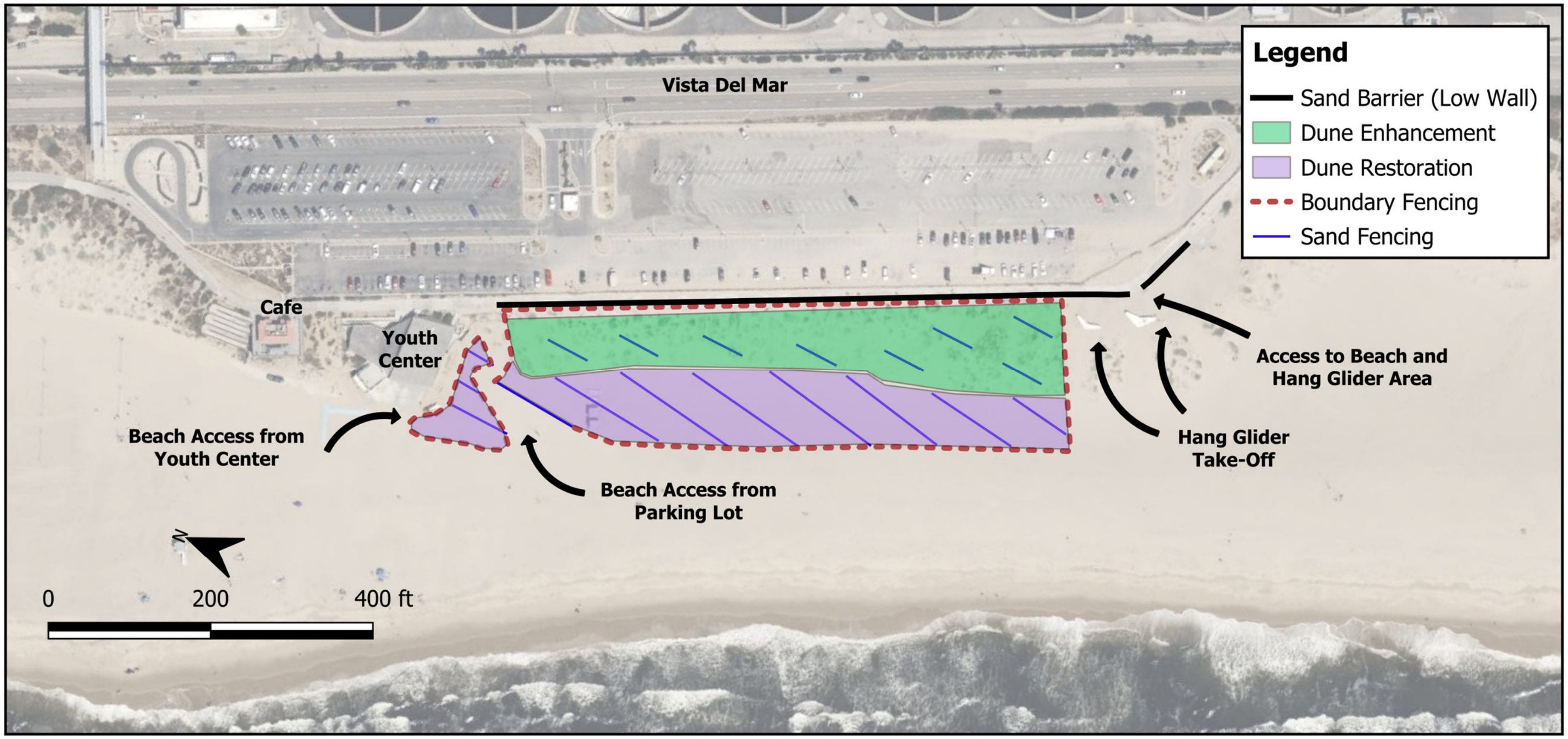


Figure 4-9. Alternative 1 at Dockweiler State Beach

Figure 4-10. Photo and Cross Section of Low Sand Barrier at Zuma Beach

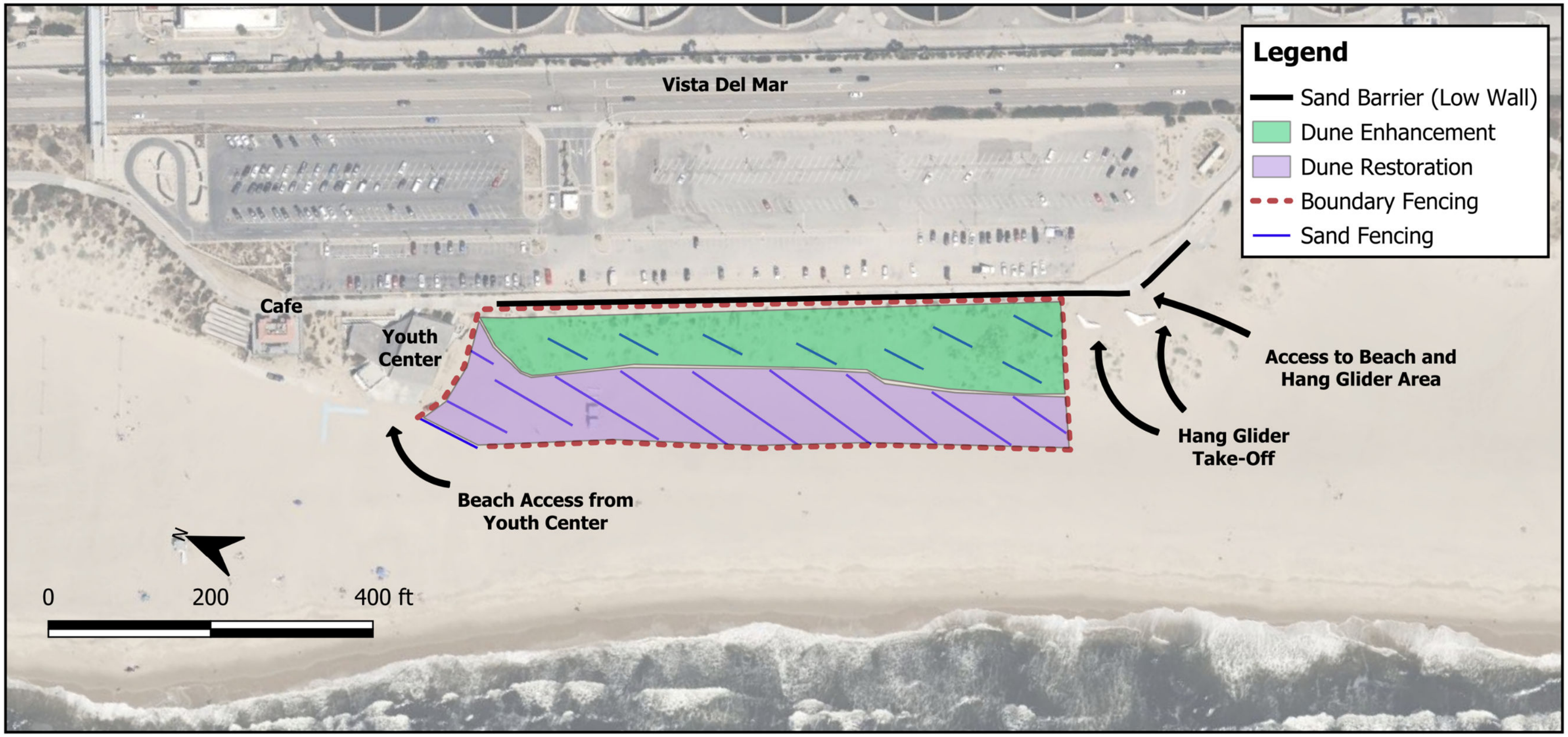


Figure 4-11. Project Alternative 2 at Dockweiler State Beach

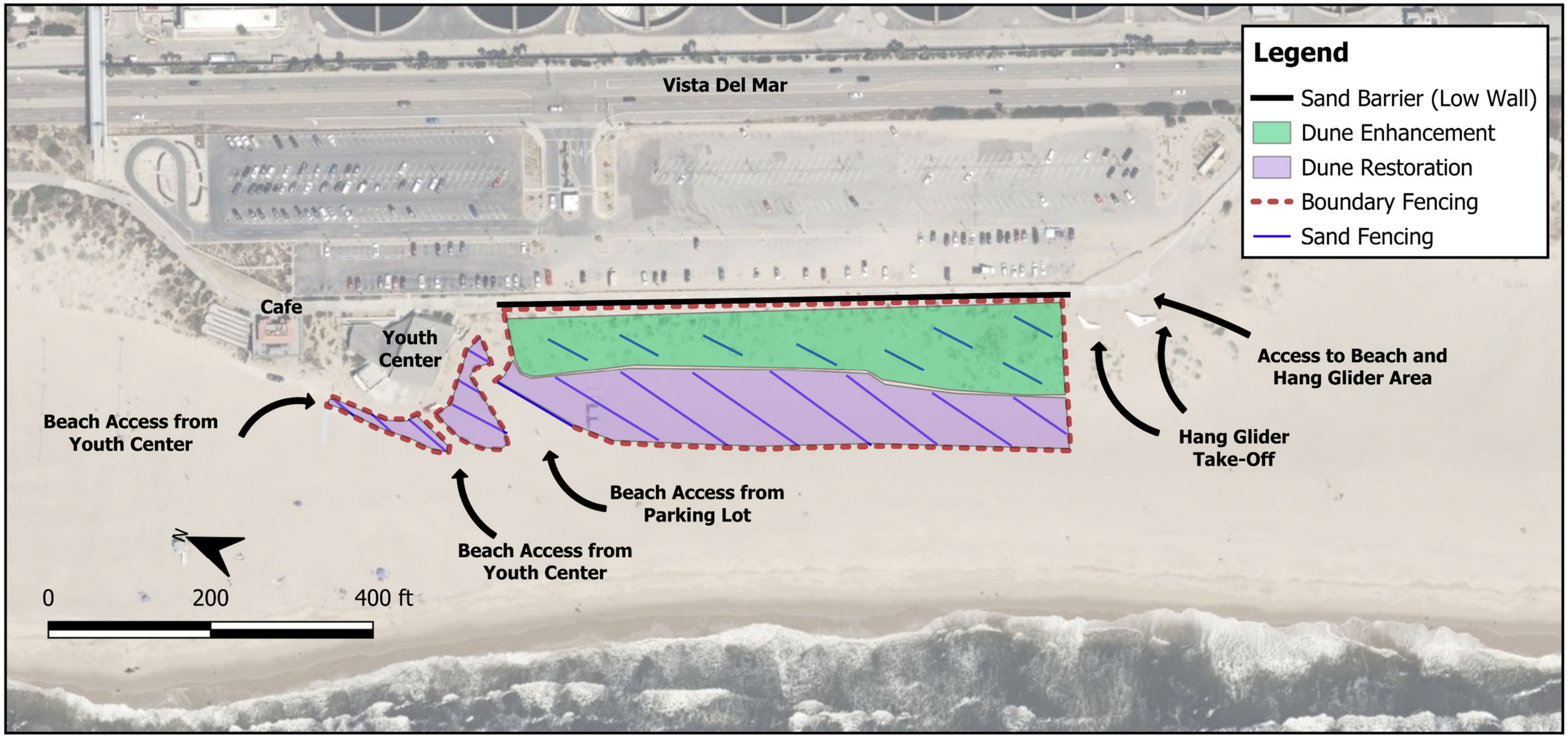


Figure 4-12. Project Alternative 3 at Dockweiler State Beach

Four beach access points are provided: three at Youth Center and one at the Hang Glider area. The restored dune area is slightly larger than Alternative 1 (1.4 acres) and the enhanced dune area is identical (1.3 acres).

4.3 Redondo Beach

The concept at Redondo Beach developed as part of the *Coastal Resilience Study* (Moffatt & Nichol, 2023) included widening the beach via nourishment between Topaz Groin and Redondo Pier, installation of a sheet-pile groin at the Pier to retain the nourishment material, and creation of dune habitat in selected areas along the back beach. The objectives of the project are to:

- Expand public access and recreational opportunities for residents and visitors;
- Increase protection of critical public infrastructure and beach amenities;
- Increase and enhance sandy beach and dune habitats; and
- Expand local and regional economic benefits.

4.3.1 Opportunities and Constraints

Opportunities

Opportunities that can be leveraged as part of the coastal resilience project include:

- Prior use as a beach nourishment receiver site by the USACE.
- Pier structure provides an optimal location to add a non-intrusive sediment retention device.
- Pier is adjacent to the entrance to King Harbor, resulting in no negative down-drift impacts from sediment retention device.

Constraints

The primary constraints warranting careful consideration in the project planning stage are:

- Recreational beach area (“towel space”) will be reduced in areas where dunes are created.
- Vertical access through dune areas must be provided for and managed.
- Dunes may impact view corridors and should be considered in project planning.
- The site is located on the sandy beach and subtidal sand overlapping the HTL. Project activities have the potential to impact incubating grunion eggs if activities occur during their spawning season.

4.3.2 Project Alternatives

Key components of the project alternatives are provided in Table 4-3 and described in detail below.

Table 4-3. Key Elements of Project Alternatives, Redondo Beach

Project	Beach Nourishment	Renourishment Interval	Sediment Retention	New Dune Habitat
Alternative 1	300,000	None	Yes	0.5 acres
Alternative 2	300,000	None	No	0.5 acres
Alternative 3	150,000	None	Yes	0.5 acres

Alternative 1

Alternative 1, shown in Figure 4-13, includes a one-time beach nourishment of 300,000 cy between Topaz Groin and Redondo Beach Pier, construction of a sand retention device on the south side of Redondo Beach Pier, and creation of dune habitat fronting the County facility near Topaz Groin. Due to the relative stability of the shoreline in this area, renourishment is not expected to be necessary over the 20-year project life.

The beach nourishment construction template (Figure 4-13) is comprised of a berm up to 265 ft wide with a crest elevation of +12 ft (MLLW) and a foreshore slope of 1:5 (V:H). The proposed sediment retention device consists of a sheet-pile groin, similar to that which currently exists on the north side of Seal Beach Pier. The sheet-pile structure has the benefits of a reduced footprint relative to a rock structure, and the ability to blend with the pier structure and reduce aesthetic impacts. Figure 4-14 illustrates the effectiveness of the Seal Beach Pier groin in retaining sediment travelling from south to north within the pocket beach between Seal Beach Pier and the Alamitos Bay north jetty.

Negative impacts typically associated with sediment retention devices, such as down-drift erosion, are not applicable at Redondo Beach, given that little to no beach presently exists between the pier and the harbor. In addition, the proposed structure will include a facade of ECOncrete, a patented product that encourages biological recruitment, increases carbon sequestration, and improves water quality (ECOncrete, 2024). Figure 4-15 provides a conceptual illustration of the proposed structure, a cross section and photo of the Seal Beach Pier Groin, and illustration of ECOncrete used at a pier in Spain. It is estimated that the structure will be approximately 180 ft long.

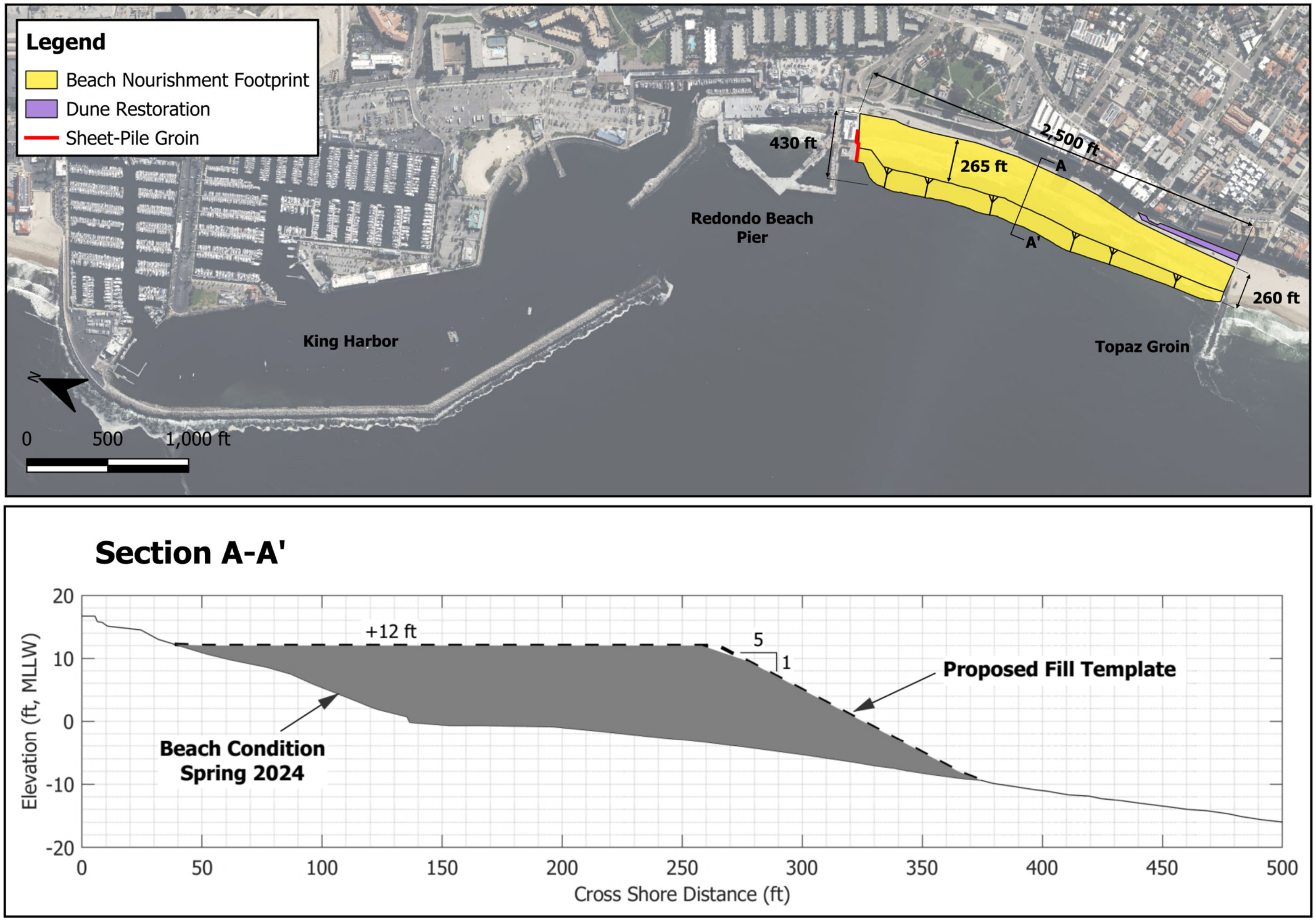


Figure 4-13. Alternative 1 at Redondo Beach

Figure 4-14. Beach Retained by Sheet Pile Groin at Seal Beach Pier

Following placement of the beach fill, dunes will be constructed adjacent to and south of the County facility near Topaz Groin (Figure 4-13). This area was selected based on the location of the facility and the fact that it is distant from popular beach access points near the pier. The total dune area proposed to be created is 0.5 acres.

It is likely that sediment used for the project will be dredged from an offshore borrow site or harbor within Santa Monica Bay and hydraulicly pumped onto the beach from offshore. Potential sand sources are discussed in Section 6, and include a stockpile of sediment dredged from Marina del Rey and located just offshore of Topaz Groin.

Alternative 2

Alternative 2, shown in Figure 4-16, is identical to Alternative 1, but without the sand retention structure at the pier.

Alternative 3

While the dune and sediment retention components of Alternative 3 are identical to Alternative 1, the volume of sediment placed on the beach is reduced by 50% from 300,000 to 150,000 cy. Figure 4-17 illustrates the project components and provides a representative cross section through the beach nourishment construction template.

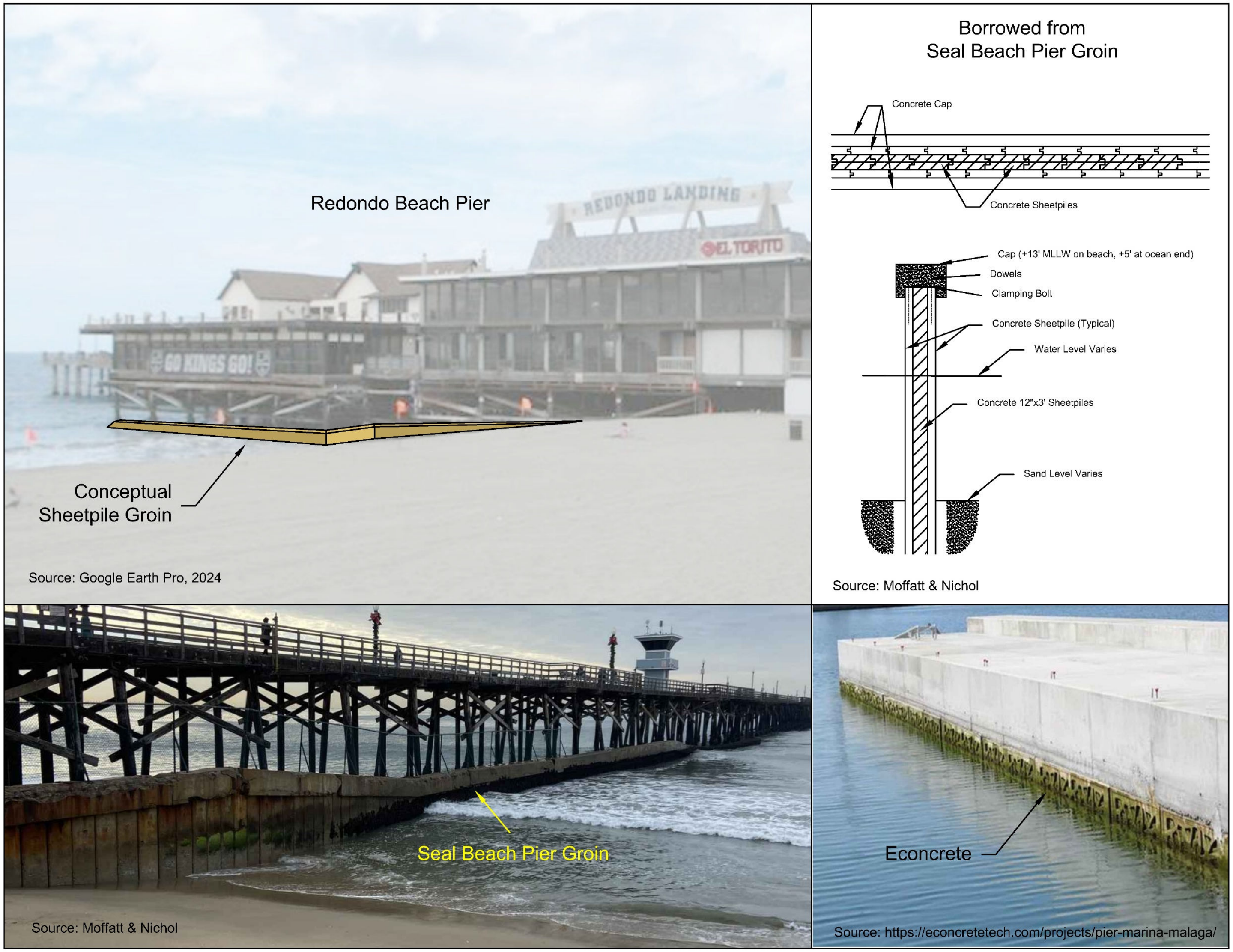


Figure 4-15. Conceptual Illustration of Proposed Sheet Pile Groin, Seal Beach Pier Groin, and ECOncrete Finish

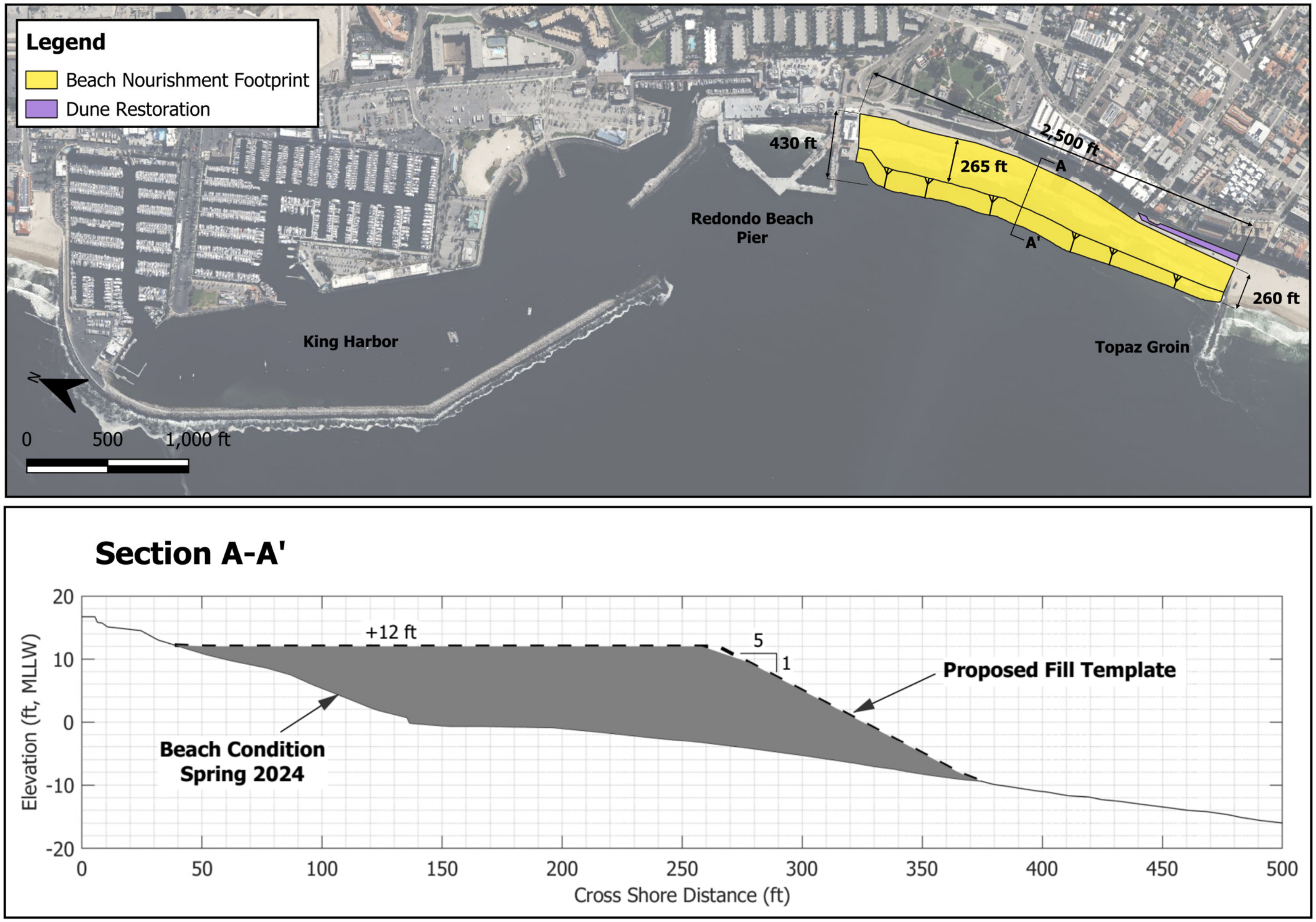
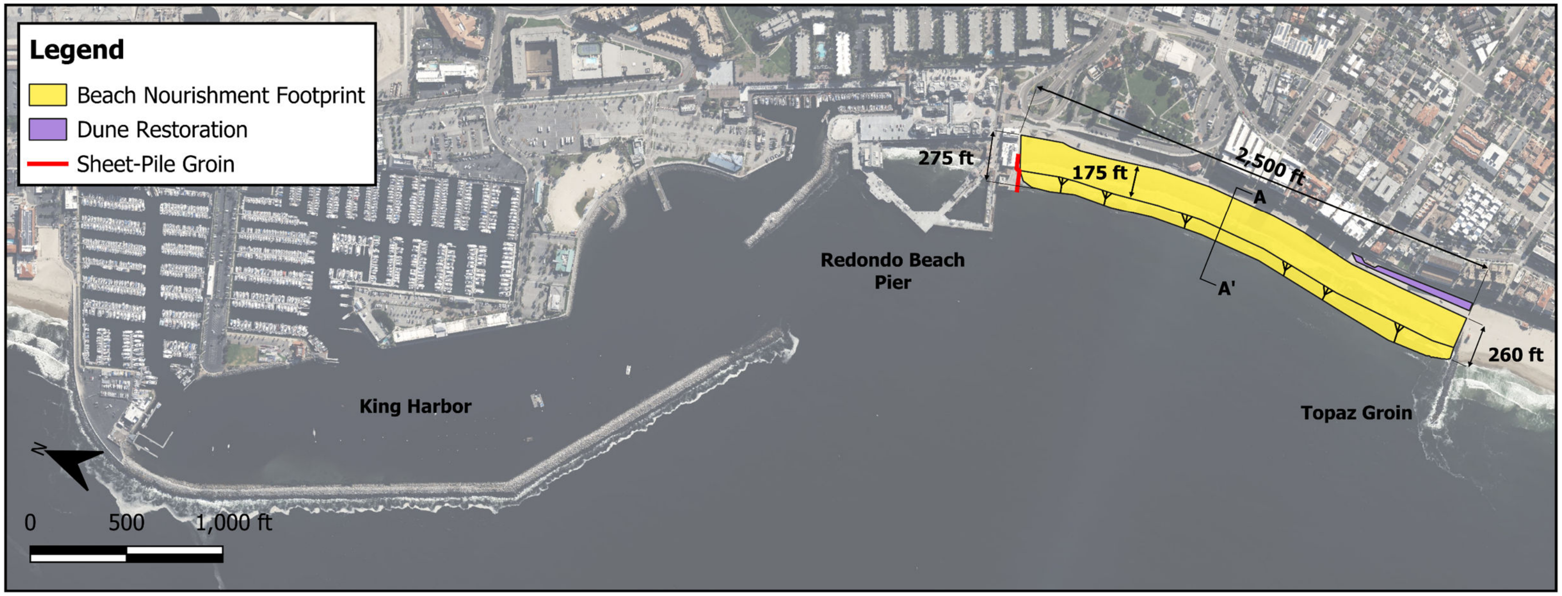


Figure 4-16. Project Alternative 2 at Redondo Beach



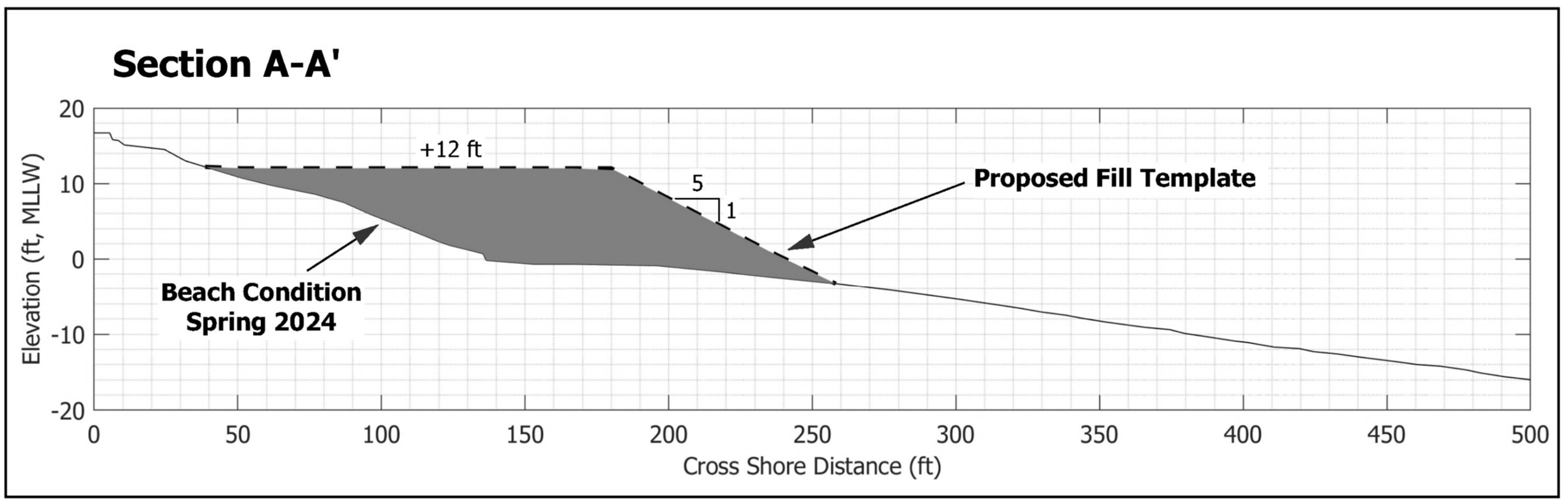


Figure 4-17. Project Alternative 3 at Redondo Beach

5 Anticipated Performance

This section summarizes analyses conducted to evaluate the anticipated outcomes of the project alternatives.

5.1 Zuma Beach and Point Dume

As noted in Section 4, the primary components of the Zuma Beach and Point Dume Project are beach nourishment and dune creation and enhancement. An overview of the key elements of each alternative is provided in Table 5-1.

Table 5-1. Overview of Key Project Elements, Zuma Beach & Point Dume

Project	Beach Nourishment	Renourishment Interval	New Dune Habitat	Enhanced Dune Habitat
Alternative 1	500,000	5 years	4.1 acres	4.5 acres
Alternative 2	500,000	5 years	8.3 acres	4.5 acres
Alternative 3	750,000	8 years	4.1 acres	4.5 acres

5.1.1 Shoreline Changes

To assess the potential benefits and impacts related to the beach nourishment activities, numerical simulations of shoreline evolution were conducted using the GenCade model (Frey *et al.*, 2012) developed by the USACE. GenCade is a one-line model of shoreline change and wave-induced longshore sediment transport applicable to open coasts and inlets. Inputs to the model include the initial shoreline configuration, sediment characteristics, location of coastal structures (*e.g.,* seawalls, jetties, breakwaters, or groins), sediment sources (*e.g.,* contributions from rivers, bluffs, and beach nourishment), and sediment sinks (*e.g.,* harbors, submarine canyons, offshore losses, losses resulting from SLR). The model is driven by nearshore wave conditions and typically is calibrated using measured shoreline data obtained in the area of interest.

Beach Profile Equilibration following Nourishment

When beach nourishment projects are constructed, sand is initially placed high on the profile in a wide berm, as shown in Figure 4-3. This is to maximize the recreational area immediately available and to facilitate construction. The fill material, however, is quickly dispersed offshore and along the beach by nearshore waves and currents. As the material is redistributed, the beach undergoes a process of equilibration to a more natural condition. This condition, referred to as the "equilibrium beach profile," is related to the sediment grain size, berm height, and nearshore wave conditions (Dean, 2002).

For example, the construction template for Alternative 1 at Zuma Beach shown in Figure 4-3 adds approximately 200 ft to the width of the berm. Following equilibration, it is estimated that the additional berm width may be reduced to 50 ft, as is illustrated in Figure 5-1. This estimate is based on the assumption that the fill and native grain sizes are the same. As was noted in Section 3.2, however, coarser-than-native material can be used to increase the equilibrated beach width and extend the fill longevity. In the interest of conservatism, the analyses presented herein do not include such increases in width or longevity.

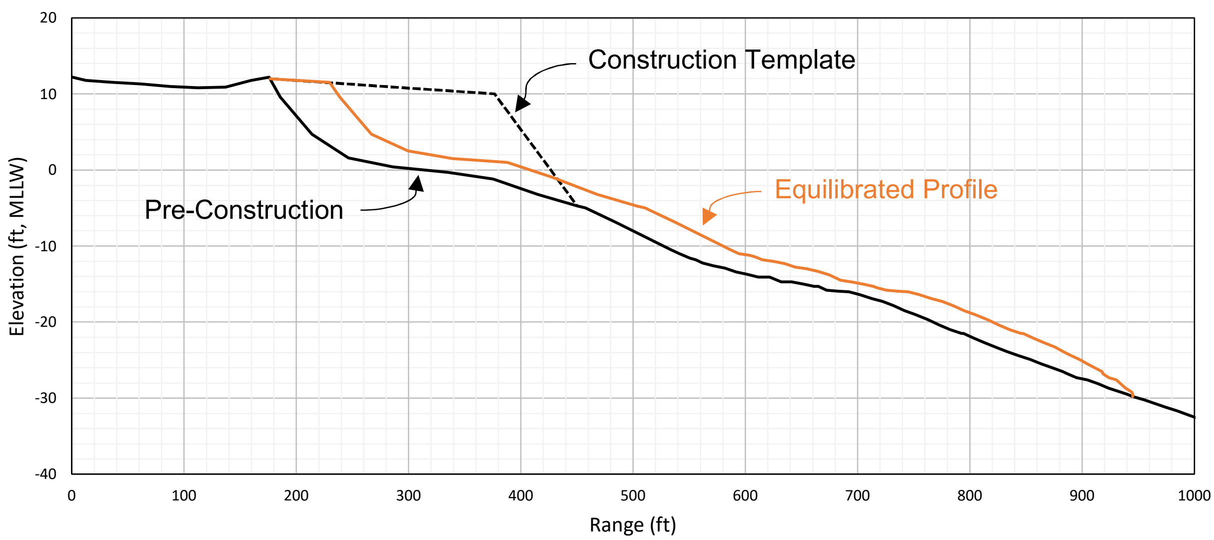


Figure 5-1. Pre-Construction, Construction Template, and Equilibrium Beach Profile

Model Configuration and Calibration

The domain selected for the numerical simulations is illustrated in Figure 5-2. It begins at Point Dume and extends west to Lechuza Point. Sediment characteristics were derived from the samples obtained at Zuma Beach in 2016 (Section 2.1.6), resulting in an average median grain size diameter of 0.23 mm. Beach profile data obtained between 2016 and 2023 (Coastal Frontiers Corporation, 2023a) were used to estimate the typical berm elevation (+9 ft, MHHW) and depth of closure (-34 ft, MHHW). Coastal structures included in the model consisted of revetments at Broad Beach and Westward Beach Road and those structures that limit landward migration of the beach, such as parking lots, coastal facilities, and roads.

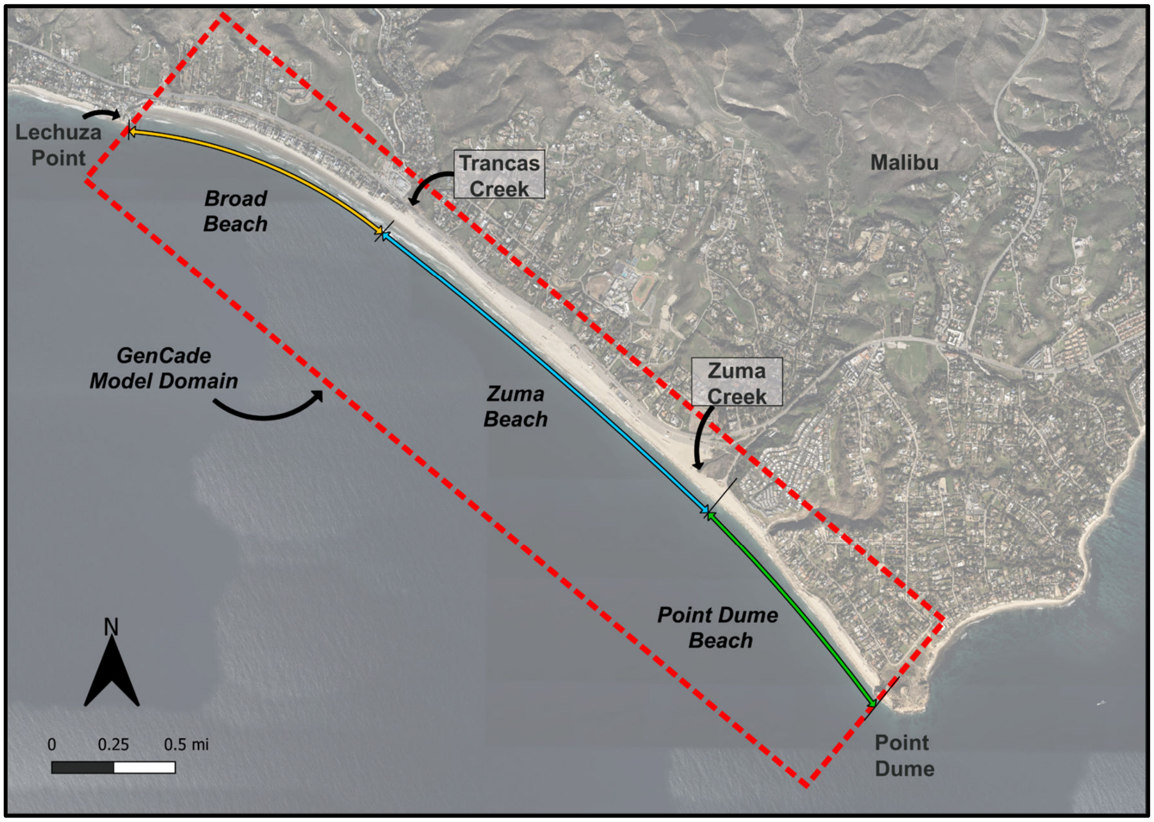


Figure 5-2. GenCade Model Domain

As noted in Section 2.1.2, sediment input to the Zuma littoral cell is derived primarily from local creeks and streams. For the purposes of the numerical simulations, two sources were used: 19,500 cy/yr at Trancas Creek and 19,500 cy/yr at Zuma Creek (total input of 39,000 cy/yr).

Wave conditions used to drive the model were obtained from the California Coastal Wave Monitoring and Prediction System (MOP; O'Reilly *et al*., 2016) maintained by the Coastal Data Information Program (CDIP, 2024) and from wave conditions forecast as part of the USGS CoSMoS simulations (Barnard *et al.*, 2018).

Model calibration was performed between 2009 and 2016, a period during which high-resolution Light Detection and Ranging (LiDAR) shoreline data are available in the project area. The data were obtained by the USACE as part of the National Coastal Mapping Program (NCMP; USACE, 2009b) and by Los Angeles County as part of the Los Angeles Region Imagery Acquisition Consortium (LARIAC, 2016). Given that the LiDAR data becomes less reliable near the water surface, the Mean Higher High Water (MHHW) elevation was used as the basis for the shoreline data. In the project area, MHHW lies 5.43 ft above MLLW (NOS, 2024).

The modeled 2016 shoreline position from GenCade agreed well with the 2016 shoreline position measured as part of the LARIAC LiDAR survey. The RMS error between the measured and modeled shorelines was 22 ft and the model skill, a measure of the model's accuracy, was 0.8. This value exceeds the threshold typically accepted by the USACE, 0.3, by a comfortable margin.

Model validation then was conducted by simulating shoreline changes from 2016 to 2023 and comparing the model results to beach profile data obtained in October 2023 (Coastal Frontiers, 2023b). While differences between the measured and modeled 2023 shorelines were greater than those observed during the calibration phase, the agreement was acceptable (RMS error of 77 ft).

Forecast Shoreline Simulations

The calibrated model was used to evaluate the three project alternatives over the 20-year period beginning on January 1, 2030, and ending on January 1, 2050. This period was selected to provide ample time over which to assess both evolution of the beach fill and the appropriate renourishment frequency. The base year, 2030, corresponds to the 2024 COPC SLR forecast scenario closest to the likely start of construction. To reach the base year (2030), the model was advanced from the most recent beach profile survey (October 26, 2023) to January 1, 2030.

Shoreline recession due to SLR was included in the forecast simulations (October 2023 to January 2050) based on the values presented in Section 2.1.4 and the Bruun Rule (Bruun, 1962). Given the minor increase in sea level over this period (0.4 ft), the erosion due to SLR was only 26 ft over the nearly 26-year simulation.

Renourishment Interval and Added Beach Width

Figure 5-3 illustrates the additional beach width provided by Alternatives 1 and 2 (500,000 cy) relative to the pre-nourishment condition (January 1, 2030) for the first five years of the project. The increase in beach width is greatest within the fill footprint initially, then spreads downcoast toward Point Dume as time progresses. By 2035 (year 5), most of the added material within the fill footprint has dispersed, indicating that a 5-year renourishment interval is necessary to maintain beach widths greater than or equal to the pre-project condition for the 500,000-cy beach nourishment.

Figure 5-4 illustrates the additional beach width provided by the 750,000-cy beach nourishment proposed as part of Alternative 3, relative to the pre-nourishment condition (January 1, 2030) for the first eight years of the project. As was the case for Alternatives 1 and 2, the gains are greatest

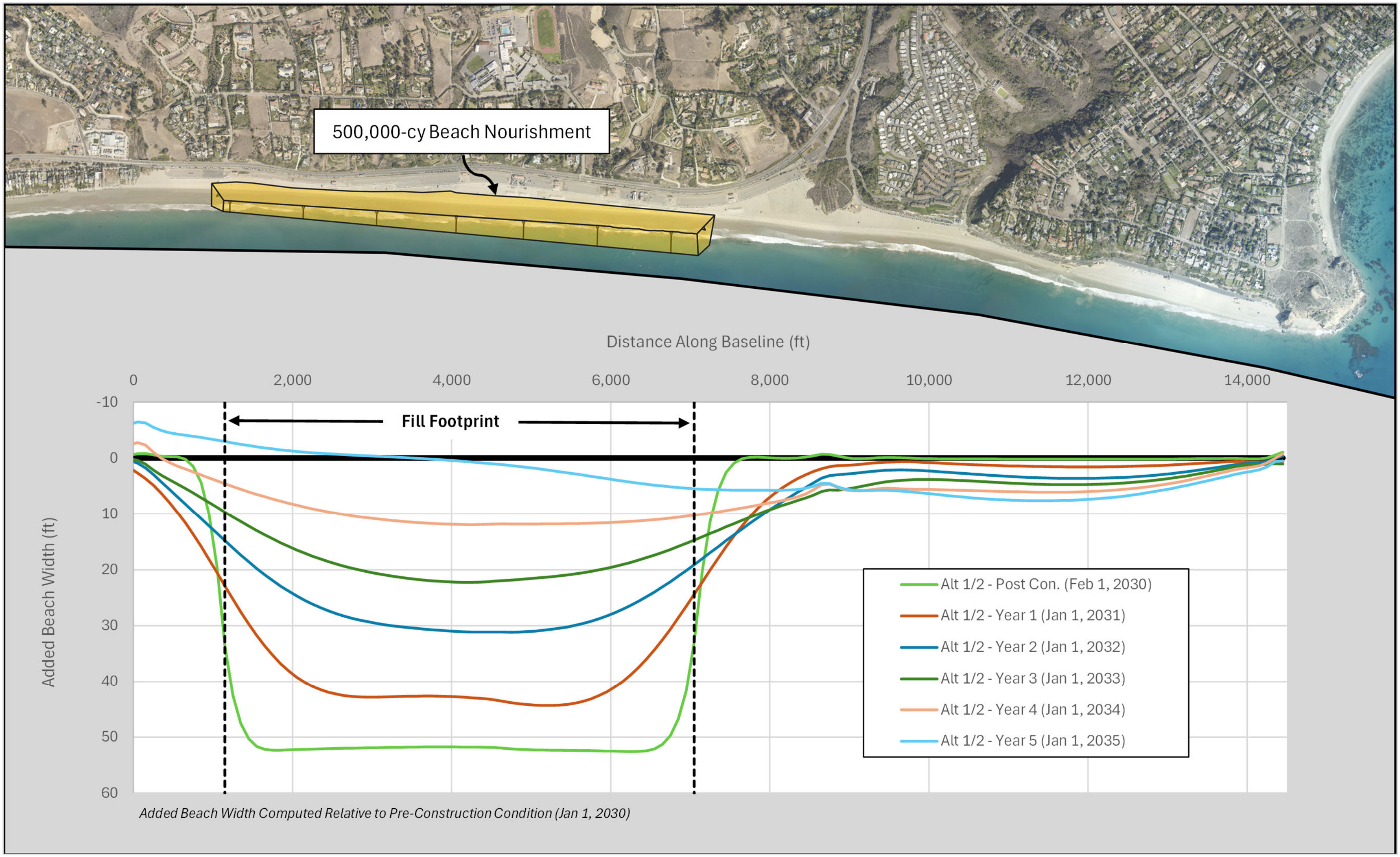


Figure 5-3. Added Beach Width relative to Pre-Nourishment Condition (Jan. 1, 2030), Alternative 1 and Alternative 2

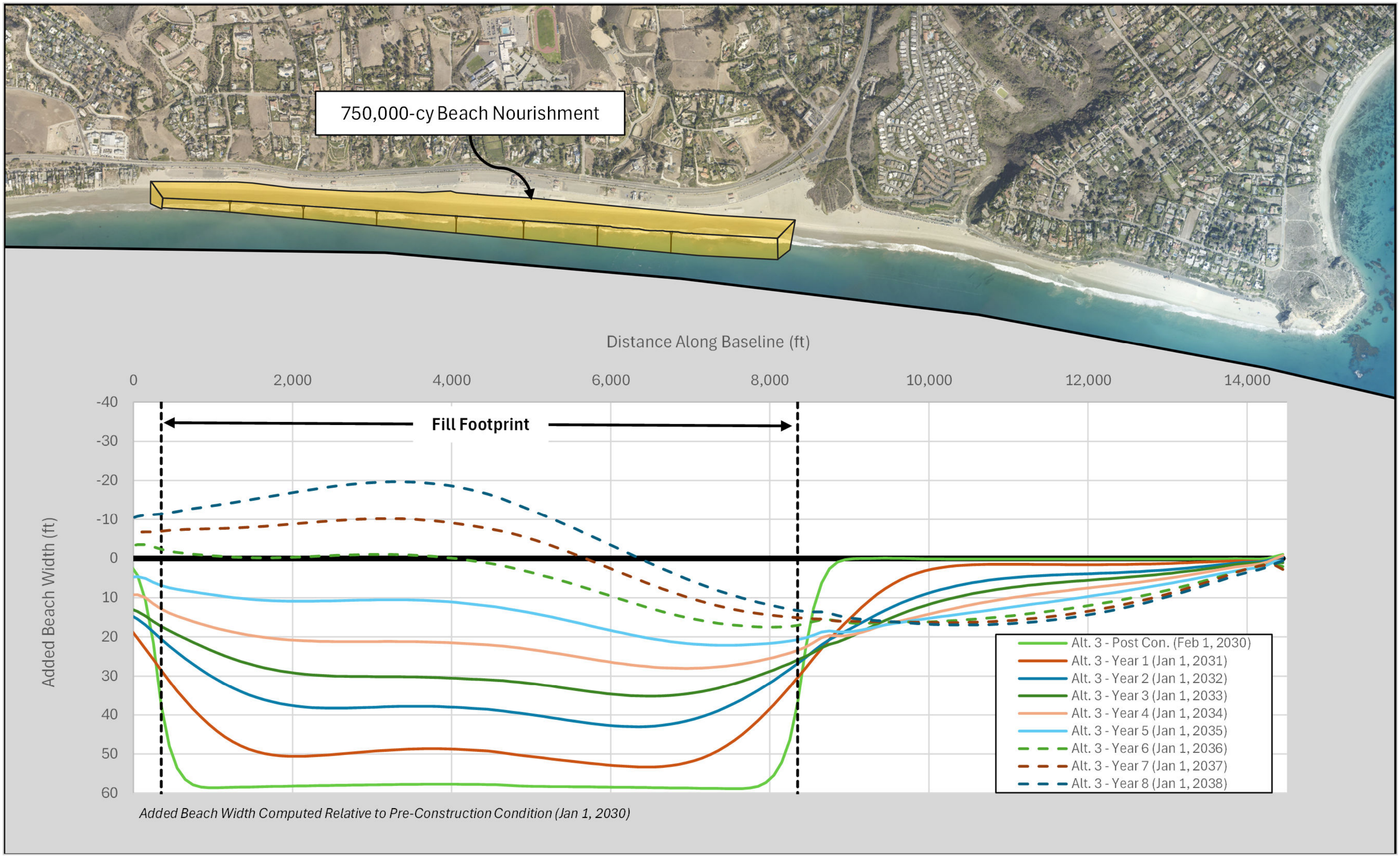


Figure 5-4. Added Beach Width relative to Pre-Nourishment Condition (Jan. 1, 2030), Alternative 3

within the fill footprint and are dispersed downcoast (toward Pt. Dume) as time progresses. For this case, an eight-year renourishment interval is recommended based on the fact that, on average, the additional beach width gains are lost within the area of concern (Zuma Beach and Point Dume Beach) by year 8.

5.1.2 Performance

The performance of each alternative was evaluated based on three factors, each of which are directly related to the project objectives identified in Section 4.1: public recreation, public access, and dune habitat. In Section 8, these three factors, along with the cost of each project, are used to select the preferred project for each site.

Public Recreation

Recreational benefits were quantified by computing the average increase in beach width relative to the pre-construction condition over the first renourishment cycle. For Alternatives 1 and 2, both of which include a nourishment volume of 500,000 cy, the average increase in beach width between Trancas Creek and Point Dume is 12.5 ft over the first 5-year renourishment cycle. For Alternative 3, which includes a nourishment volume of 750,000 cy, the average increase in beach width in the same area is 16.4 ft over the first 8-year nourishment cycle.

Public Access

Potential impacts on public access are primarily related to the dune areas along the back beach, which will reduce, but not eliminate, opportunities for beach users to reach the beach from the parking lots. In an effort to quantify this impact, the total length (measured along the beach) of the new and expanded dune areas was computed for each alternative and compared to the total length of the beach from Trancas Creek to Point Dume (14,500 ft). Approximately 32% of the shoreline is impacted for Alternatives 1 and 3, whereas 47% of the shoreline is impacted for Alternative 2 as a result of the additional dune area created at Zuma Beach.

Dune Habitat

Potential environmental benefits resulting from the creation of dune habitat were quantified using the area of dune habitat created or enhanced. As noted in Section 4.1, 8.6 acres of dune habitat are included as part of Alternatives 1 and 3, whereas 12.8 acres of dune habitat are included in Alternative 2.

5.2 Dockweiler State Beach

The project alternatives at Dockweiler State Beach were assessed based on the same criteria outlined for Zuma Beach, above: public recreation, public access, and dune habitat. Key elements of the project alternatives are provided in Table 5-2.

Table 5-2. Overview of Key Project Elements, Dockweiler State Beach

Project	Enhanced Dune Habitat	Restored Dune Habitat	Length of Sand Barrier	Number of Beach Access Points
Alternative 1	1.3 acres	1.3 acres	850 ft	3
Alternative 2	1.3 acres	1.5 acres	850 ft	2
Alternative 3	1.3 acres	1.4 acres	700 ft	4

5.2.1 Shoreline Changes

The primary objective of the project at Dockweiler State Beach is not to increase recreational opportunities or beach width. Nevertheless, beach width changes were estimated for the purpose of determining potential economic impacts (Section 7.2). Mean Higher High Water (MHHW) shoreline positions were computed annually, beginning with that derived from the 2016 LARIAC LiDAR data, and continuing through the life of the project (2050) at an average retreat rate of 4.6 ft/yr (Moffatt & Nichol, 2023).

5.2.2 Performance

Public Recreation

While the project at Dockweiler State Beach is not intended to influence the recreational beach area available for public use, it does provide enhanced recreational benefit to users of the bike and pedestrian path by reducing the quantity of sand blown onto the path. To this end, the recreational benefit is directly related to the length of the path protected by the sand barrier. For Alternatives 1 and 2, the barrier is 850 ft long, resulting in the greatest benefit, while a 700-ft long barrier is proposed for Alternative 3, slightly reducing the anticipated benefit to the public.

Public Access

As noted in Section 2.3, the public presently accesses Dockweiler Beach via makeshift paths trampled through the existing dune system. By adding fencing, educational signs and establishing clear, delineated pedestrian pathways between the parking lot and the beach, the proposed resilience project will provide an enhanced user experience allowing beach users to walk through a thriving coastal dune ecosystem. This benefit can be quantified via the number of established access points included as part of each alternative. As shown above, Alternative 3 results in the greatest benefit (4 access points), while Alternative 2 results in the least (2 access points).

Dune Habitat

The quantity of dune habitat for the three project alternatives is outlined in Table 5-2. While the total dune area is similar among the three proposals, Alternative 2 includes the greatest dune area (2.8 acres), while Alternative 1 includes the least dune area (2.6 acres).

5.3 Redondo Beach

The primary components of the Redondo Beach Project are beach nourishment, sediment retention, and dune creation (Table 5-3). Potential benefits and impacts of each component have been evaluated and are summarized below for all three alternatives.

Table 5-3. Overview of Key Project Elements, Redondo Beach

Project	Beach Nourishment	Renourishment Interval	Sediment Retention	New Dune Habitat
Alternative 1	300,000	None	Yes	0.5 acres
Alternative 2	300,000	None	No	0.5 acres
Alternative 3	150,000	None	Yes	0.5 acres

5.3.1 Shoreline Changes

Given the complex nearshore bathymetry, proximity to coastal structures, such as the King Harbor Breakwaters, and relatively short length of coastline, detailed numerical modeling similar to that applied at Zuma Beach is not an appropriate tool for use at Redondo Beach. However, shoreline changes prior to and following nourishment projects conducted at the site in 2000 and 2012 (Section 2.1.5) serve as a reasonable proxy for the expected performance of the proposed beach fills, particularly due to the fact that the 2000 event was identical in size and location to that included in Alternatives 1 and 2.

Shoreline data were derived from *CoastSat* (Vos et al., 2019), a web-based toolkit that derives global shoreline position from historic satellite imagery. Figure 5-5 illustrates the change in shoreline position between Topaz Groin and the Pier from 1985 to 2022. The influence of the two nourishment events is clear, with instantaneous increases in beach width in both 2000 and 2012, and similar rates of retreat following each event. Between 2000 and 2012, the erosion rate estimated using the available data was 2.6 ft/yr. A similar rate, 1.7 ft/yr, prevailed between 2012 and 2022.

Shoreline recession due to SLR was estimated using the Bruun Rule (Bruun, 1962). For the 20-year period from 2030 (the assumed base year) to 2050, the shoreline is expected to erode about 9 ft (0.5 ft/yr) as a result of the 0.3-ft rise in sea level. This is approximately a third of the expected recession at Zuma Beach due to the relatively coarse-grained material that predominates at Redondo (Section 2.1.6) and resulting decrease in width of the active shorezone.

For the purposes of this study, it is assumed that the rate of retreat following the proposed nourishment projects without sediment retention will be 2.5 ft/yr, roughly representing the average retreat rate following the two nourishment events (2.0 ft/yr) plus the recession expected due to SLR (0.5 ft/yr). With the inclusion of a sediment retention structure at the pier, it is assumed that the rate of recession will be 1.5 ft/yr, based on a 50% reduction in shoreline recession derived from the shoreline changes between 2000 and 2022 (1 ft/yr), plus the expected recession due to SLR (0.5 ft/yr). While the 50% reduction is merely an assumption, it should not markedly influence the outcome, given the modest rates of retreat.

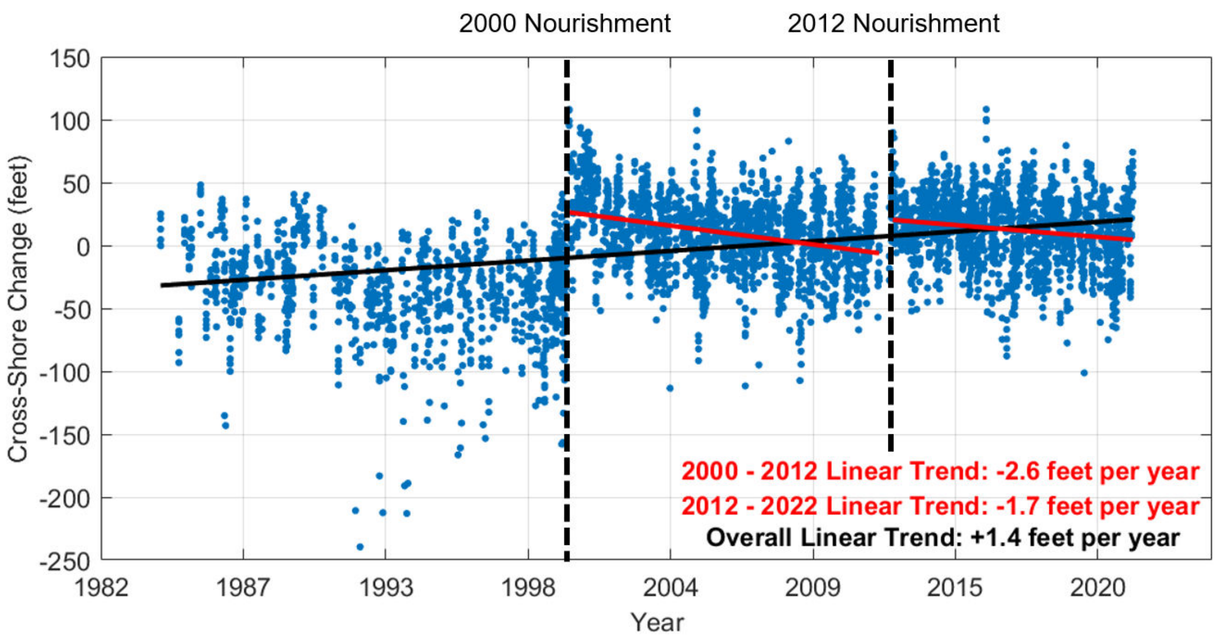


Figure 5-5. Historic Shoreline Changes at Redondo Beach (Topaz Groin to Pier)

Relative to the pre-construction condition, the 300,000-cy nourishment event included in Alternatives 1 and 2 will initially (after the profile equilibrates) increase the beach width by approximately 90 ft. Alternative 3, which includes a 150,000-cy beach fill, will increase the pre-construction beach width by 45 ft (after the profile equilibrates).

Using the rates of retreat outlined above and an assumed 20-year project life, it is anticipated that approximately 60 ft of additional beach width (relative to the pre-construction condition) will remain for Alternative 1, 40 ft will remain for Alternative 2, and 15 ft will remain for Alternative 3. Thus, no renourishment is expected to be necessary over the 20-year project life.

5.3.2 Performance

The project alternatives were evaluated using the three criteria outlined for Dockweiler and Zuma/Point Dume: public recreation, public access, and dune habitat.

Public Recreation

Similar to the Zuma and Point Dume site, the recreational benefit of each Redondo Beach alternative was quantified using the average increase in beach width relative to the pre-construction condition. However, given that there is no renourishment in this case, a 20-year period (the assumed project life) was used to compute the average. The increase in beach width for Alternative 1 is expected to vary from 90 to 60 ft, resulting in an average value of 75 ft over the 20-year period. Alternative 2, which does not include sediment retention, will increase the pre-construction beach width by an average of 65 ft, and Alternative 3 is expected to increase the pre-construction beach width by 30 ft, on average.

Public Access

Potential impacts to public access are primarily related to lateral access impediments introduced by the sheet pile groin included in Alternatives 1 and 3. Any public access issues introduced by the dune area will be equal among the three options, as the proposed dune habitat does not change.

Dune Habitat

All three project alternatives include the addition of 0.5 acres of dune habitat.

6 Potential Sand Sources

Both the Zuma & Point Dume and Redondo Beach projects include large-scale beach nourishment. The subsections below outline potential sediment sources, including harbor maintenance dredging, offshore borrow sites in Santa Monica Bay, and inland sites in Los Angeles County. Sediments of marine origin, such as those from harbor maintenance dredging and offshore borrow sites, typically are used for large-scale beach nourishment projects for reasons that include sediment compatibility, environmental impact, timing, and cost (Dean, 2002). Terrestrial (inland) sources are more likely to be suitable for smaller projects (less than 150,000 cy) and for periodic maintenance needs.

6.1 Harbor Maintenance Dredging

6.1.1 Marina del Rey

As noted in Section 3.1.6, beach quality sediment dredged from Marina del Rey as part of USACE navigation channel maintenance operations typically is returned to the littoral system via beach nourishment at Venice Beach, Dockweiler State Beach, or Redondo Beach. Based on dredging records beginning in 1969, it is anticipated that approximately 80,000 cy/yr of sediment is deposited in the entrance to the marina and available for beach nourishment (Ryan, 2025).

Section 125a of the Water Resources Development Act (WRDA) 2020 provides an opportunity for the USACE to share in the incremental cost of placement of dredged material for beneficial use during an Operation and Maintenance (O&M) Federal navigation project. The WRDA 2020 wording provides for the USACE to *use funds appropriated for construction or operation and maintenance of a project involving the disposal of dredged material when selecting a disposal method that is not the least cost option based on a determination that the incremental costs of the disposal method are reasonable in relation to the environmental benefits or the hurricane and storm or flood risk reduction benefits.* The non-Federal interest share of the incremental cost of beneficial use placement is 35%.

Discussions with USACE staff (Ryan, 2025) indicate that approximately 600,000 cy of sediment is slated for removal as part of the upcoming 2026-2027 maintenance cycle. Of that that, 300,000 to 400,000 cy is expected to be beach compatible. The USACE is in favor of partnering with the County to utilize these sediments for coastal resilience projects similar to those described herein, making this an attractive option.

6.1.2 King Harbor

The City of Redondo Beach maintains the navigation basins within King Harbor, while the USACE is responsible for maintenance of the breakwaters. Sources indicate that the harbor has been dredged on four occasions (Patsch, 2025). The dates and approximate volumes are provided below:

- 1990: 157,000 cy (following storm-induced shoaling)
- 2005: 60,000 cy
- 2020: less than 10,000 cy
- 2024: 60,000 cy

Most of the material is dredged in the north part of the harbor adjacent to the main breakwater. Sedimentation does not appear to impact the southern portion of the harbor (adjacent to Redondo Beach Pier and the south breakwater), as the volume of sediment removed has historically been relatively small. During the most recent dredging event (2024), only 2,000 cy were removed from the area (Trivedi, 2025). Given the relatively small and infrequent dredging events at the harbor, it is unlikely to support large-scale beach nourishment programs, such as those presented herein; however, the proximity of the site to Redondo Beach makes it a clear choice for opportunistic beach nourishment activities, when possible.

Both the City of Redondo Beach and the USACE have temporarily stored beach quality sediments dredged from Marina del Rey and King Harbor at an offshore site located approximately 2,000 ft southwest of Topaz Groin (Figure 6-1). The quantity of material that presently exists at the offshore site is not known and should be investigated in the next phase of the study to determine its viability to support the Redondo Beach resilience project.

6.2 Offshore Sand Sources

In 2011 and 2012, CFC and Moffatt & Nichol conducted an extensive search for beach quality sediment in Santa Monica Bay in support of the Broad Beach Restoration Project (BBRP; Section 3.1.1). Seven sites were considered: Broad Beach, Corral Canyon, Malibu Point, Santa Moncia, Venice Beach, Dockweiler State Beach, and Manhattan Beach (Moffatt & Nichol, 2011a; 2011b; 2012). These sites were selected based on the findings of historical marine geology studies (Osbourne *et al.,* 1983 and Fischer *et al.*, 1983) and proximity to the project. All sites included in the search were offshore of the zone of active littoral transport and can be dredged using vessels of the type typically available.

Both geophysical survey data and marine vibracores were obtained as part of the search and used to evaluate the sediment at each offshore borrow site. A geophysical survey was conducted in February 2011 and vibracore programs were conducted in June 2011, October 2011, and August 2012. Details regarding the field efforts can be found in reports prepared on behalf of the Broad Beach Geologic Hazard Abatement District (BBGHAD; Coastal Frontiers, 2011a, 2011b, 2012), on the project website[7], and in publicly available reports submitted to regulatory agencies (AMEC, 2012; Moffatt & Nichol, 2011a; 2011b; 2012). Permission to use the BBGHAD documents for this project has been provided and is greatly appreciated (McMahon, 2025). Brief descriptions of the geophysical and geological findings at each site are provided below.

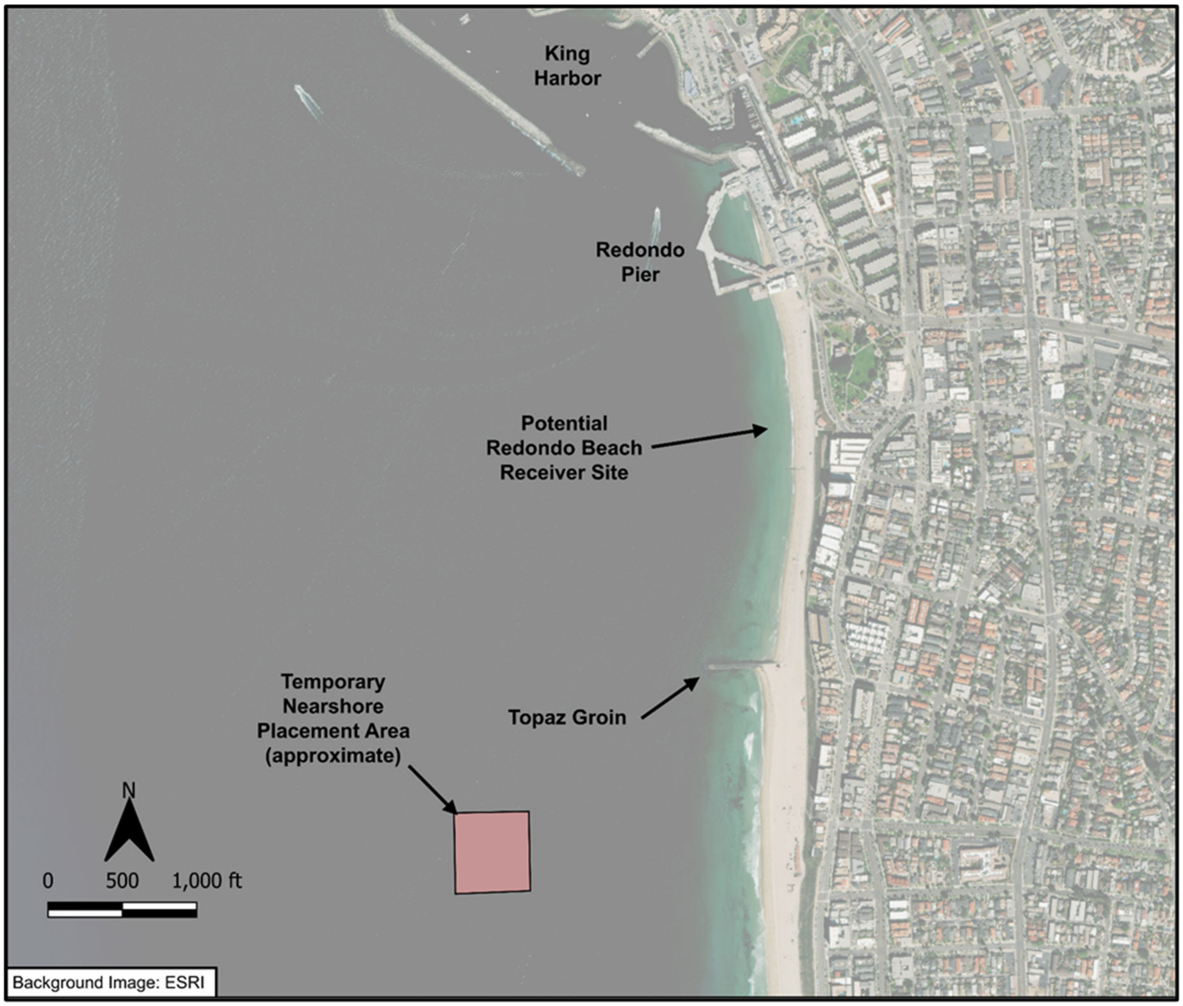


Figure 6-1. Temporary Nearshore Placement Area at Redondo Beach

6.2.1 Broad Beach-Zuma Beach

Based on geophysical and geological data obtained as part of the BBRP, an abundance of sediment is available off the coast of the Broad-Zuma Beach area in charted water depths ranging from approximately 40 to 60 ft (MLLW); however, it is much finer than the native beach sand at both Zuma/Point Dume Beach and Redondo Beach and thus is considered less-than-optimal for beach nourishment. For example, median grain sizes (D_{50}) derived from the 23 vibracores

[7] http://www.bbghad.com/project-documents/

obtained in the area (Figure 6-2 and Figure 6-3) ranged from 0.10 to 0.16 mm, whereas the average median grain size at Zuma Beach and Redondo Beach is 0.23 and 0.36 mm, respectively (Table 2-2).

6.2.2 Corral Canyon

In the early 1980s, sediment samples collected by the University of Southern California suggested that the sediment off Corral Canyon are primarily silty sands. This was confirmed through collection of a single vibracore in 2011 (Figure 6-4), which revealed sediment with high fines content and organics in a charted water depth of approximately 60 ft (MLLW). As a result, material in this area is not anticipated to be suitable for beach nourishment at either coastal resilience site.

6.2.3 Malibu Point

While the region near Malibu Point was initially considered as a possible sand source, prior investigations indicated that the material is silty sand. In addition, the site's proximity to both Malibu Pier and the world-famous surfing location at Malibu Point present challenges for conducting large-scale dredging activities. Geophysical data were obtained as part of the BBRP study but no vibracores were obtained in this area (Moffatt & Nichol, 2011a). Therefore, use of this site is not expected to be considered for the LACDBH coastal resiliency projects.

6.2.4 Santa Monica

Osborne *et al.* (1983) collected several vibracores around the Santa Monica survey area in the early 1980's. The material was classified as fine to very fine-grained sand, sandy silt, and greenish-black mud and clay, with estimated grain sizes ranging from 0.09 to 0.18 mm. While geophysical data were obtained as part of the BBRP, no vibracores were collected. The material is considered to be too fine for placement on Zuma or Redondo Beach. Therefore, use of this site is not expected to be considered for the LACDBH coastal resiliency projects.

6.2.5 Venice Beach

Osborne *et al.* (1983) identified a potential borrow area offshore of Venice Beach with an estimated sediment thickness ranging from less than 6 ft to 46 ft. However, vibracores obtained in the area at that time contained a high gravel content, rendering it an unlikely source for beach nourishment. No geophysical or vibracore data were obtained in this area as part of the BBRP. Therefore, use of this site is not expected to be considered for the LACDBH coastal resiliency projects.

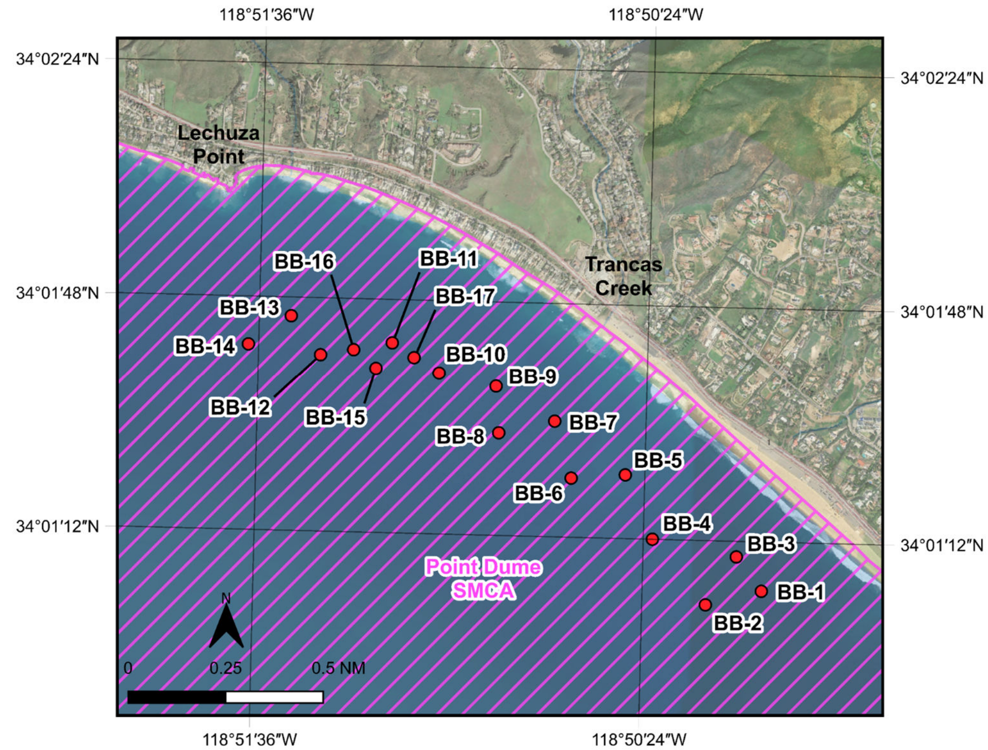


Figure 6-2. Vibracore Sites, Broad Beach

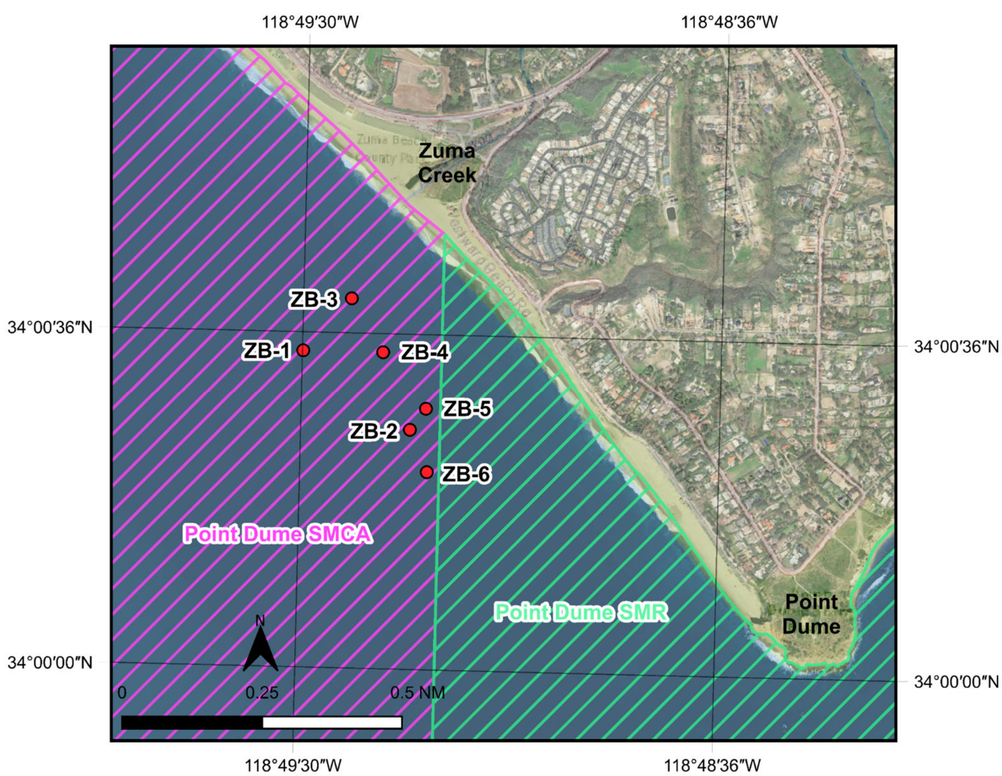


Figure 6-3. Vibracore Sites, Zuma Beach

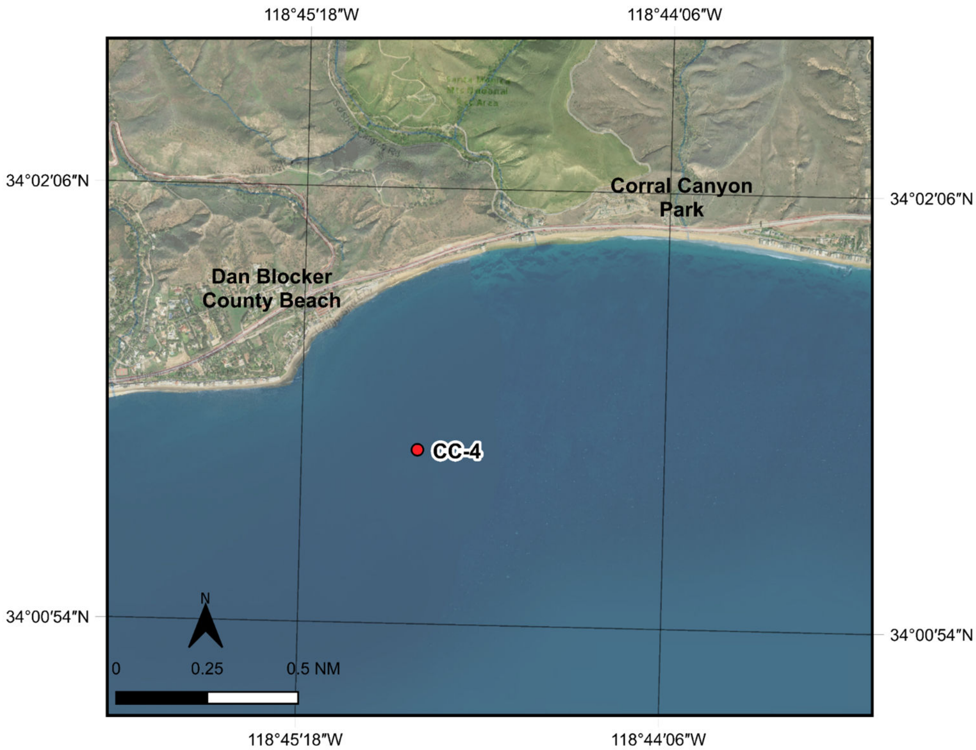


Figure 6-4. Vibracore Site, Corral Canyon

6.2.6 Dockweiler State Beach

Geophysical and vibracore data obtained by Osbourne *et al.* in the early 1980's suggest that coarse sediment exists off Dockweiler State Beach. Eight vibracores were obtained in this region in 2011 (Figure 6-5) to confirm Osbourne's findings. No bedrock was encountered, and the vibracores were able to achieve penetration depths of 18 to 20 feet in charted water depths of approximately 30 to 50 ft below MLLW.

The median grain sizes within the northern portion of the study area (sites DN-1 through DN-4) were all very close to 0.5 mm, and the cores contained a relatively small fines content. The sediments tended to be slightly finer in the southern portion of the study area (sites DS-1 through DS-4) with median grain sizes typically ranging from 0.42 to 0.49 mm and a fines content slightly above 1%. At the far south end, a 3-ft surface layer of stiff clay was noted at site DS-4. No contaminants were found in the study area.

Based on the foregoing, the sediment located off Dockweiler State Beach is well-suited for beach nourishment at either Zuma/Point Dume or Redondo Beach and it is estimated that the site could yield over 3,000,000 cy of suitable material (AMEC, 2012).

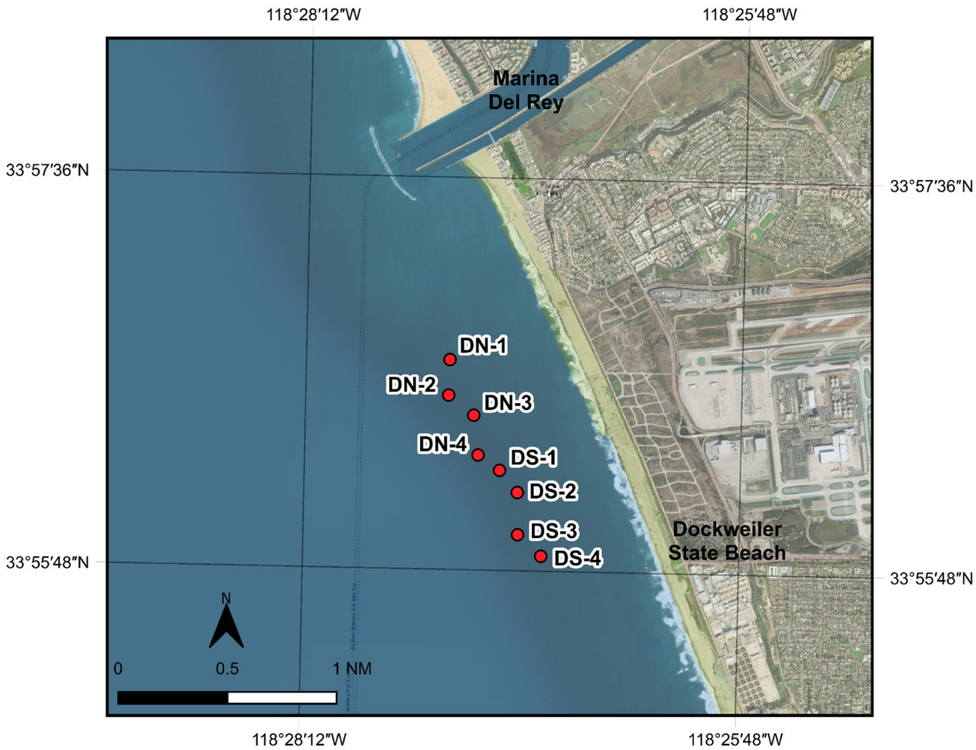


Figure 6-5. Vibracore Sites, Dockweiler State Beach

6.2.7 Manhattan Beach

In 2012, a total of 21 vibracores were obtained in charted water depths ranging from approximately 40 to 60 ft (MLLW) as part of the BBRP (Figure 6-6). In the southern and central areas (cores denoted CMW, CME, SMW and SME), visual inspection indicated that the sand was too fine to be used for effective beach nourishment. In the northern area, coarser sediments were found; however, it was confined to distinct strata that varied in grain size and layer thickness. Median grain sizes in the various layers ranged from 0.11 to 2.1 mm, with several layers in the acceptable range (about 0.3 to 0.6 mm). However, the complexity involved in targeting the layers of interest, while avoiding those that are less desirable makes this site an unlikely candidate for beach nourishment. Therefore, use of this site is not expected to be considered for the LACDBH coastal resiliency projects.

6.2.8 Redondo Beach

Osborne *et al.* (1983) identified a potential sediment source offshore of Redondo Beach in water depths ranging from approximately 30 to 90 ft below MLLW (Figure 6-7) with the potential to yield as much as 20M cy of beach quality sediment. Vibracores obtained by Osborne indicate that the sediment in this area is coarse-grained, slightly gravelly sand, with median grain size diameters ranging from 0.12 to 0.73 mm and an average value of 0.44 mm. While this site was not investigated as part of the BBRP, it is recommended for further investigation as part of Phase 2 of the County's resilience project.

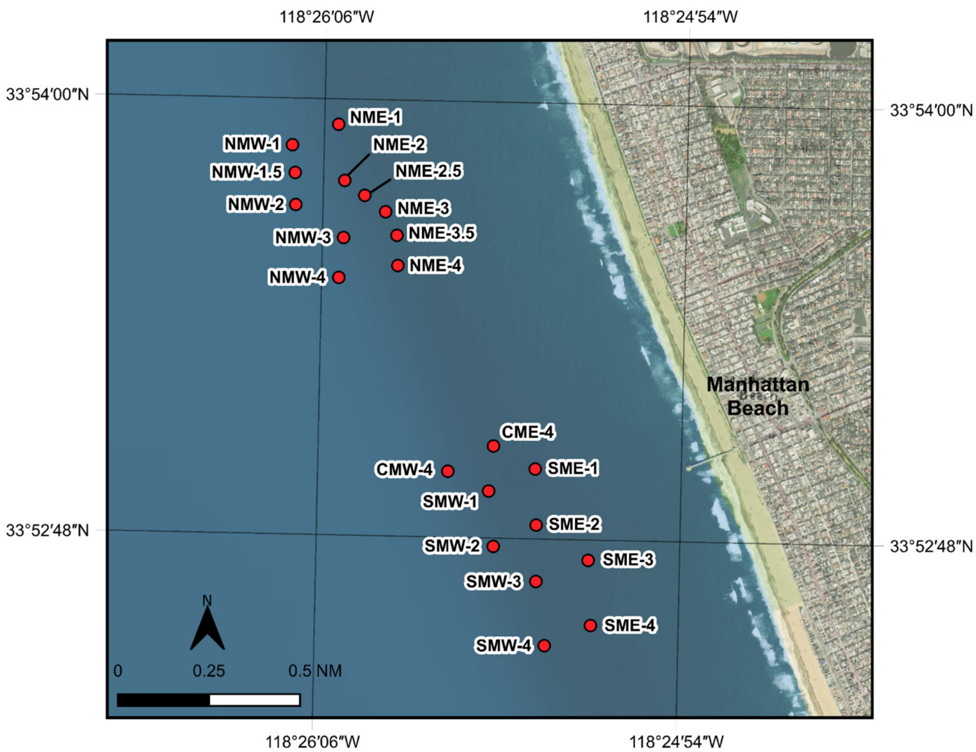


Figure 6-6. Vibracore Sites, Manhattan Beach

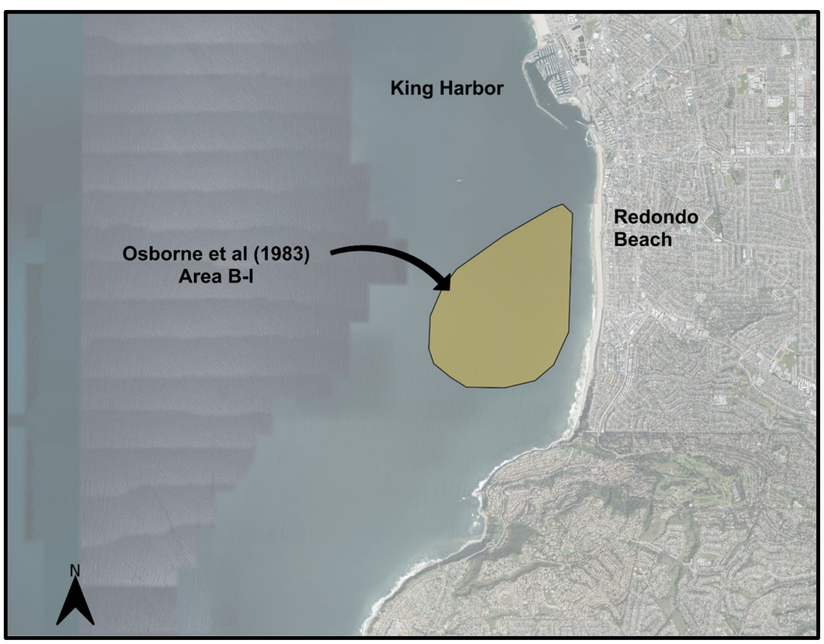


Figure 6-7. Osborne Site B-I off Redondo Beach

6.2.9 Summary

In 2011 and 2012, seven areas were considered as potential sources of sediment for beach nourishment: Broad Beach-Zuma Beach, Corral Canyon, Malibu Point, Santa Monica, Venice Beach, Dockweiler State Beach, and Manhattan Beach. Of these, only the site off Dockweiler State Beach contained sediment that is compatible with the native sand at Zuma/Point Dume Beach and Redondo Beach and suitable for beach nourishment. It is estimated that over 3,000,000 cy of sand with a median grain size of about 0.5 mm may exist at the Dockweiler site, making it an appropriate candidate source for the proposed resilience projects. In addition, Osborne *et al.* (1983) identified a source offshore of Redondo Beach with the potential to yield significant volumes of beach quality sediment. Further exploration of both the Dockweiler and Redondo Beach sites is recommended for the next phase of the LACDBH Coastal Resiliency Implementation Project.

6.3 Inland Sediment Sources

This section outlines potential inland sediment sources, including reservoirs and debris basins managed by the County, dams, local watercourses (rivers, creeks, streams, and lagoons), and transportation and development projects. The locations of the potential sources are shown in Figure 6-8. While inland sources are not used for large-scale beach nourishment as commonly as offshore borrow sites (Dean, 2002), they are an important resource, particularly for smaller projects (e*.g.,* dune construction) and for beach maintenance.

On a related note, LACDBH is developing a Sand Compatibility and Opportunistic Use Program (SCOUP) that is currently in the permitting phase. LACDBH SCOUP will utilize inland and upland sand sources described in this report when they become opportunistically available for placement. The LACDBH SCOUP program encompasses five LACDBH beaches including Zuma Beach, Will Rogers State Beach, Dockweiler State Beach, Manhattan Beach and Redondo Beach beginning as early as 2027.

6.3.1 County-Owned Reservoirs and Debris Basins

Reservoirs and debris or retention basins trap material that may otherwise travel downstream and cause flooding. Infilling is sporadic and dependent on several factors, including the rate and timing of precipitation. Material impounded within these features is removed during maintenance events and typically is placed in a landfill, used as landfill cover, or repurposed as construction fill or to make cement or concrete.

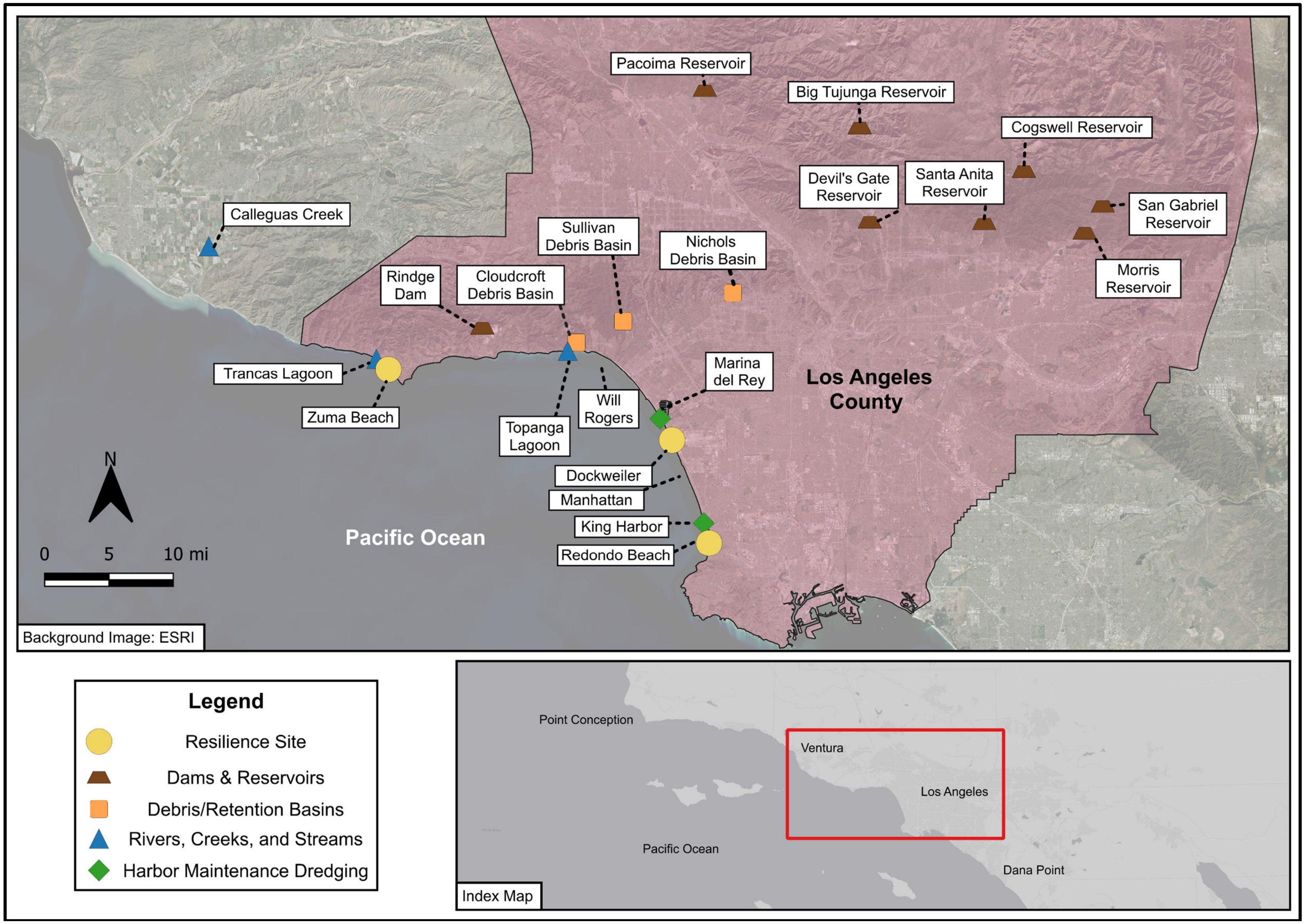


Figure 6-8. Location Map of Potential Inland Sand Sources

If beach quality sediment within the reservoir can be identified and segregated, it can be diverted for beneficial reuse in the form of beach nourishment on public beaches. Potentially viable beach sand sources from reservoirs and debris basins managed by the Los Angeles County Flood Control District (LACFCD) are listed in Table 6-1 along with the approximate minimum trucking distance between the sand source and each of the three coastal resilience sites included in this report.

6.3.2 Dams

LA County's largest inland source of beach quality sediment proximate to the coast is the Rindge Dam reservoir in Malibu (Noble Consultants and Larry Paul & Associates, 2017). The dam was constructed in the 1920's along Malibu Creek for water supply and flood control purposes. The dam effectively trapped sediments that would have travelled to the coast naturally, resulting in rapid filling of the reservoir with soil and debris. By the 1950s, the reservoir was almost filled with sediment and no longer functional for water storage or flood protection.

The Malibu Creek Ecosystem Restoration Project is investigating removal of the dam and restoration of natural sediment delivery to the shoreline. As part of the project, approximately 276,000 cy of beach quality sediment has been identified as suitable for beach nourishment. This material is presently designated for beach nourishment just east of Malibu Pier or Zuma Beach. Discussions between the County and the project team are ongoing.

6.3.3 Local Watercourses

Rivers, creeks, streams, and lagoons along the coast offer a potential source of fill material when flood control or maintenance activities generate beach quality sediments. Three sites near the resilience projects are Calleguas Creek, Trancas Creek and Lagoon, and Topanga Lagoon.

6.3.4 Transportation and Development Projects

Major transportation projects such as roadways and bridges may generate surplus sediment from excavation activities, and development projects frequently generate beach-quality sediments that can be used for beach nourishment. However, it should be noted that the quantity of available sediment is likely to be small and more suited to opportunistic beach nourishment projects under LACDBH SCOUP or for dune maintenance.

Table 6-1. Distance Between Reservoirs / Debris Basins and Resilience Sites

Receiver Site	Minimum Distance (miles)									
	Reservoir							Debris Basin		
	Pacoima	Big Tujunga	Devil's Gate	Cogswell	San Gabriel	Morris	Santa Anita	Cloudcroft	Sullivan	Nichols
Zuma Beach	48	61	54	80	67	65	59	17	24	33
Dockweiler SB	32	45	34	60	48	45	42	13	12	13
Redondo Beach	42	54	39	65	52	49	47	24	23	24

Note: Debris Basins are relatively small and may not generate adequate volumes of sediment for beach nourishment (Zimmer, 2025).

6.4 Marine Sources vs. Inland Sources

Dean (2002) estimates that more than 95% of all sand volumes placed in beach nourishment projects are derived from marine sources (offshore borrow sites or harbor dredging). Nevertheless, inland sources may be a viable option in certain cases. Factors to carefully consider include efficiency and potential environmental impact:

- **Efficiency:** The placement rate using hydraulic methods typically is greater than that which can be achieved via trucking, resulting in potential cost and schedule benefits. Even in the case of a very efficient trucking operation, whereby a 14-cy truck load is placed every five minutes for ten consecutive hours, the resulting placement rate is 1,680 cy/day. By comparison, it is estimated that the placement rate via hopper dredge of the type typically available in the area (including transit time to/from the Dockweiler Offshore Borrow Site) is between 4,000 and 8,000 cy/day for the Zuma and Redondo Beach receiver sites, respectively; two to four times faster than via inland source.

- **Environmental Impact:** The relatively small capacity of haul trucks (nominally 14 cy) necessitates a large number of truck trips for large-scale beach nourishment projects. For example, placement of 300,000 to 500,000 cy will require between 21,000 and 36,000 individual truck trips. While truck traffic is common in Los Angeles County, the additional number of truck trips in a concentrated area has the potential to result in significant traffic, air quality, and noise impacts to the communities that lie between the sand source and the receiver site.

6.5 Recommended Sand Sources for Further Investigation

Potential sand sources recommended for further investigation as part of Phase 2 of each resilience project are delineated in Table 6-2. At Zuma Beach, the Dockweiler Offshore Borrow Site investigated as part of the BBRP is most promising, given the known quality and quantity of sediment in this area. At Dockweiler State Beach, the relatively small volume of sediment required for dune creation can potentially be sourced from surplus sediment on the nearby beach; however, in the event this is not feasible, sediment from County-Owned Debris Basins, such as Devil's Gate should be considered. Finally, the most promising sediment sources for the Redondo Beach Project are the Temporary Placement Area offshore of Redondo Beach, the Dockweiler Offshore Borrow Site and the Osborne Site B-I.

For all three projects, material dredged from Marina del Rey is an attractive option, given the federal cost-sharing opportunities. However, this site is not listed in the table, given that the USACE is responsible for investigating these sediments.

Table 6-2. Sand Sources Recommended for Further Investigation

Receiver Site	Sand Source		
Zuma Beach	Dockweiler Offshore Borrow Site	Osborne Investigation Area B-I	Manhattan Beach Borrow Site
Dockweiler State Beach	Dockweiler State Beach	County-Owned Debris Basins	Dockweiler Offshore Borrow Site
Redondo Beach	Redondo Beach Temporary Placement Area	Dockweiler Offshore Borrow Site	Osborne Investigation Area B-I

7 Economic Benefits and Considerations

The following subsections outline the probable costs to design, construct, and monitor the project alternatives and present the estimated economic benefits derived from recreation, fiscal revenues, and ecological habitat.

7.1 Cost Estimation

Moffatt & Nichol (2025) estimated the probable cost to design, permit, construct, and monitor the project alternatives. The estimates are based on unit costs for similar and recent southern California projects, including:

- **USACE San Clemente Beach Nourishment Project:** Ongoing beach nourishment project that utilizes an offshore borrow site and hopper dredge similar to that which could be used for the Zuma/Point Dume and Redondo Beach coastal resilience projects. Stage 1 of the project was completed in late 2024.
- **USACE Encinitas-Solana Beach Shoreline Protection Project:** Ongoing beach nourishment project that utilizes an offshore borrow site and hopper dredge similar to that which could be used for the Zuma/Point Dume and Redondo Beach coastal resilience projects. Stage 1 of the project was completed in early 2024.
- **USACE Surfside/Sunset Beach Nourishment Project**: Ongoing beach nourishment project in north Orange County that utilizes a cutterhead section dredge similar to that which could be used for the Redondo Beach project in the event the borrow site is within close proximity of the receiver site (Section 6.1.2, e.g., Temporary Nearshore Placement Area). Stage 13 of the project was completed in early 2024.

All costs are provided in 2025 dollars and have not been escalated or discounted for future work.

7.1.1 Zuma Beach & Point Dume

Table 7-1 summarizes the probable cost to construct each project alternative at Zuma Beach and Point Dume. Detailed costs follow. It is important to note the following:

1. The cost covers the period up to but not including the first renourishment cycle (Section 5.1.1).
2. The sand source is assumed to be offshore of Dockweiler State Beach (Section 6.2.6). Costs utilizing inland sand sources were not evaluated due to the length of time, potential environmental effects, and impacts to local stakeholders resulting from trucks delivering sand quantities of 500,000 to 750,000 cy (36,000 to 54,000 truck trips).

Table 7-1. Probable Cost of Construction, Zuma Beach and Point Dume

Alternative	Beach Nourishment	Dune Habitat	Monitoring and Maintenance	Contingency	Planning and Support	Total
Alternative 1 *500,000-cy Nourishment; 8.6-acre Dune Habitat*	$33,394,500	$261,500	$885,000	$8,635,250	$6,908,200	**$50,084,450**
Alternative 2 *500,000-cy Nourishment; 12.8-acre Dune Habitat*	$33,394,500	$355,500	$885,000	$8,658,750	$6,927,000	**$50,220,750**
Alternative 3 *750,000-cy Nourishment; 8.6-acre Dune Habitat*	$46,644,500	$261,500	$885,000	$11,947,750	$9,558,200	**$69,296,950**

Notes:
1. Cost **does not** include renourishment.
2. Sand source is assumed to be offshore of Dockweiler State Beach.
3. Cost contingency is 25%.

DRAFT OPINION OF
PROBABLE CONSTRUCTION COSTS
LA County DBH Coastal Resilience Project
Zuma Beach Alternative 1
[500,000 CY Nourishment From Offshore and 9 Acres of Dune]

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL
	Beach Nourishment Components				
1	Mobilization & Demobilization of Earthmoving Equipment	1	LS	$25,000.00	$25,000
2	Mobilization & Demobilization of Dredging Equipment	1	LS	$6,850,000.00	$6,850,000
3	Temporary Protective Construction Fence	6,500	LF	$3.00	$19,500
4	Offshore Dredging off Dockweiler Beach & Transport Onto the Beach	500,000	CY	$47.00	$23,500,000
5	Grading New Sand on the Beach and Longitudinal Dikes for Turbidity	500,000	CY	$6.00	$3,000,000
	Subtotal Beach Nourishment				**$33,394,500**
	Dune Components				
6	Install Sand Dune Fencing (3,000 lf per acre)	27,000	LF	$6.00	$162,000
7	Remove Non-Natives	9	AC	$2,500.00	$22,500
8	Apply Dune Plant Seeds (1,000 per acre)	9,000	EA	$0.25	$2,250
9	Install New Perimeter Fencing - Cable and Post (1,000 lf per acre)	9,000	LF	$2.50	$22,500
10	Install Kiosk (one on each end of the dune fields)	2	EA	$25,000.00	$50,000
11	Install Signage (one per dune acre)	9	EA	$250.00	$2,250
	Subtotal Dune				**$261,500**
	Monitoring and Maintenance				
13	Pre, During, and Post Construction Monitoring	1	LS	$200,000.00	$200,000
14	Shoreline Monitoring	1	LS	$180,000.00	$180,000
15	Borrow Site Survey Support	1	LS	$180,000.00	$180,000
17	Borrow Post-Construction Monitoring	1	LS	$80,000.00	$80,000
18	Pre and Post Receiver Site Detailed Topo	1	LS	$95,000.00	$95,000
19	Permit Compliance Reporting/Monitoring	1	LS	$150,000.00	$150,000
	Subtotal Monitoring				**$885,000**
	Subtotal Items				**$34,541,000**
	Contingency of 25%				$8,635,250
	Planning, Environmental Review, Permitting, Design (7.5%)	1	EA		$3,238,219
	Construction Support Services (2%)	1	EA		$863,525
	Construction Management (3.5%)	1	EA		$1,511,169
	Inspection, Survey, and Administration (3%)	1	EA		$1,295,288
	Grand Total				**$50,084,450**

Revised 5/6/2025

ASSUMPTIONS:
1 Contractor stages at entire north end parking lot and south end parking from restrooms to Point Dume.
2 No construction fencing needed at dune location.
3 Mobilization & Demobilization cost is taken directly from 2024 contractor bids for the USACE Encinitas and Solana Beach Project. These may increase over time by escalation/inflation but that is not factored in yet.
4 Sand is dredged from the Dockweiler Offshore Borrow Site and the sand quality is excellent.
5 Cost **does not** include renourishment.

DRAFT OPINION OF
PROBABLE CONSTRUCTION COSTS
LA County DBH Coastal Resilience Project
Zuma Beach Alternative 2
[500,000 CY Nourishment From Offshore and 13 Acres of Dune]

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL
	Beach Nourishment Components				
1	Mobilization & Demobilization of Earthmoving Equipment	1	LS	$25,000.00	$25,000
2	Mobilization & Demobilization of Dredging Equipment	1	LS	$6,850,000.00	$6,850,000
3	Temporary Protective Construction Fence	6,500	LF	$3.00	$19,500
4	Offshore Dredging off Dockweiler Beach & Transport Onto the Beach	500,000	CY	$47.00	$23,500,000
5	Grading New Sand on the Beach and Longitudinal Dikes for Turbidity	500,000	CY	$6.00	$3,000,000
	Subtotal Beach Nourishment				**$33,394,500**
	Dune Components				
6	Install Sand Dune Fencing (3,000 lf per acre)	39,000	LF	$6.00	$234,000
7	Remove Non-Natives	13	AC	$2,500.00	$32,500
8	Apply Dune Plant Seeds (1,000 per acre)	13,000	EA	$0.25	$3,250
9	Install New Perimeter Fencing - Cable and Post (1,000 lf per acre)	13,000	LF	$2.50	$32,500
10	Install Kiosk (one on each end of the dune fields)	2	EA	$25,000.00	$50,000
11	Install Signage (one per dune acre)	13	EA	$250.00	$3,250
	Subtotal Dune				**$355,500**
	Monitoring and Maintenance				
13	Pre, During, and Post Construction Monitoring	1	LS	$200,000.00	$200,000
14	Shoreline Monitoring	1	LS	$180,000.00	$180,000
15	Borrow Site Survey Support	1	LS	$180,000.00	$180,000
17	Borrow Post-Construction Monitoring	1	LS	$80,000.00	$80,000
18	Pre and Post Receiver Site Detailed Topo	1	LS	$95,000.00	$95,000
19	Permit Compliance Reporting/Monitoring	1	LS	$150,000.00	$150,000
	Subtotal Monitoring				**$885,000**
	Subtotal Items				**$34,635,000**
	Contingency of 25%				$8,658,750
	Planning, Environmental Review, Permitting, Design (7.5%)	1	EA		$3,247,031
	Construction Support Services (2%)	1	EA		$865,875
	Construction Management (3.5%)	1	EA		$1,515,281
	Inspection, Survey, and Administration (3%)	1	EA		$1,298,813
	Grand Total				**$50,220,750**

Revised 5/6/2025

ASSUMPTIONS:
1. Contractor stages at entire north end parking lot and south end parking from restrooms to Point Dume.
2. No construction fencing needed at dune location.
3. Mobilization & Demobilization cost is taken directly from 2024 contractor bids for the USACE Encinitas and Solana Beach Project. These may increase over time by escalation/inflation but that is not factored in yet.
4. Sand is dredged from the Dockweiler Offshore Borrow Site and the sand quality is excellent.
5. Cost **does not** include renourishment.

DRAFT OPINION OF
PROBABLE CONSTRUCTION COSTS
LA County DBH Coastal Resilience Project
Zuma Beach Alternative 3
[750,000 CY Nourishment From Offshore and 9 Acres of Dune]

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL
	Beach Nourishment Components				
1	Mobilization & Demobilization of Earthmoving Equipment	1	LS	$25,000.00	$25,000
2	Mobilization & Demobilization of Dredging Equipment	1	LS	$6,850,000.00	$6,850,000
3	Temporary Protective Construction Fence	6,500	LF	$3.00	$19,500
4	Offshore Dredging off Dockweiler Beach & Transport Onto the Beach	750,000	CY	$47.00	$35,250,000
5	Grading New Sand on the Beach and Longitudinal Dikes for Turbidity	750,000	CY	$6.00	$4,500,000
	Subtotal Beach Nourishment				**$46,644,500**
	Dune Components				
6	Install Sand Dune Fencing (3,000 lf per acre)	27,000	LF	$6.00	$162,000
7	Remove Non-Natives	9	AC	$2,500.00	$22,500
8	Apply Dune Plant Seeds (1,000 per acre)	9,000	EA	$0.25	$2,250
9	Install New Perimeter Fencing - Cable and Post (1,000 lf per acre)	9,000	LF	$2.50	$22,500
10	Install Kiosk (one on each end of the dune fields)	2	EA	$25,000.00	$50,000
11	Install Signage (one per dune acre)	9	EA	$250.00	$2,250
	Subtotal Dune				**$261,500**
	Monitoring and Maintenance				
13	Pre, During, and Post Construction Monitoring	1	LS	$200,000.00	$200,000
14	Shoreline Monitoring	1	LS	$180,000.00	$180,000
15	Borrow Site Survey Support	1	LS	$180,000.00	$180,000
17	Borrow Post-Construction Monitoring	1	LS	$80,000.00	$80,000
18	Pre and Post Receiver Site Detailed Topo	1	LS	$95,000.00	$95,000
19	Permit Compliance Reporting/Monitoring	1	LS	$150,000.00	$150,000
	Subtotal Monitoring				**$885,000**
	Subtotal Items				**$47,791,000**
	Contingency of 25%				$11,947,750
	Planning, Environmental Review, Permitting, Design (7.5%)	1	EA		$4,480,406
	Construction Support Services (2%)	1	EA		$1,194,775
	Construction Management (3.5%)	1	EA		$2,090,856
	Inspection, Survey, and Administration (3%)	1	EA		$1,792,163
	Grand Total				**$69,296,950**

Revised 5/6/2025

ASSUMPTIONS:
1 Contractor stages at entire north end parking lot and south end parking from restrooms to Point Dume.
2 No construction fencing needed at dune location.
3 Mobilization & Demobilization cost is taken directly from 2024 contractor bids for the USACE Encinitas and Solana Beach Project. These may increase over time by escalation/inflation but that is not factored in yet.
4 Sand is dredged from the Dockweiler Offshore Borrow Site and the sand quality is excellent.
5 Cost **does not** include renourishment.

7.1.2 Dockweiler State Beach

Table 7-2 summarizes the probable cost to construct project alternatives at Dockweiler State Beach. Detailed costs follow.

Table 7-2. Probable Cost of Construction, Dockweiler State Beach

Alternative	Dune Habitat	Sand Barrier	Monitoring and Maintenance	Contingency	Planning and Support	Total
Alternative 1 *850-ft Sand Barrier;* *2.6-acre Dune Habitat;* *3 Beach Access Points*	$107,625	$1,327,500	$40,000	$368,781	$460,977	**$2,304,883**
Alternative 2 *850-ft Sand Barrier;* *2.8-acre Dune Habitat;* *2 Beach Access Points*	$111,775	$1,327,500	$40,000	$369,819	$462,273	**$2,311,367**
Alternative 3 *700-ft Sand Barrier;* *2.7-acre Dune Habitat;* *4 Beach Access Points*	$109,700	$1,095,000	$40,000	$311,175	$388,969	**$1,944,844**

Notes:
1. Cost contingency is 25%.

DRAFT OPINION OF
PROBABLE CONSTRUCTION COSTS
LA County DBH Coastal Resilience Project
Dockweiler State Beach Alternative 1
[Dune Habitat (1.3 acres enhanced + 1.3 acres restored), Sand Barrier Wall]

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL
	Dune Components				
1	Install Sand Dune Fencing (3,000 linear feet per acre, over 2.6 ac)	7,800	LF	$6.00	$46,800
2	Remove Non-Natives (Weeding over 1.3 Acres of Enhancement Area)	1.3	AC	$2,500.00	$3,250
3	Apply Dune Plant Seeds (1,000 per acre) over 1.3 acres Restoration Area	1,300	EA	$0.25	$325
4	Install New Perimeter Fencing - Cable and Post (1,000 linear feet per acre)	2,600	LF	$2.50	$6,500
5	Install Kiosk (one on each end of the dune fields)	2	EA	$25,000.00	$50,000
6	Install Signage (one per dune acre rounded up to the nearest whole number)	3	EA	$250.00	$750
	Subtotal Dune				**$107,625**
	Sand Barrier Wall Components				
7	Mobilization	1	LS	$10,000.00	$10,000
8	Footing	850	LF	$500.00	$425,000
9	Wall Installation	850	LF	$1,000.00	$850,000
10	Sculpting	850	LF	$50.00	$42,500
	Subtotal Sand Barrier Wall				**$1,327,500**
	Monitoring and Maintenance				
11	Pre-Construction - Snowy Plovers	1	LS	$10,000.00	$10,000
12	Construction - Snowy Plovers	1	LS	$10,000.00	$10,000
13	Post-Construction - Dune Plants, Weeding	1	LS	$20,000.00	$20,000
	Subtotal Monitoring				**$40,000**
	Subtotal Items				**$1,475,125**
	Contingency of 25%				$368,781
	Planning, Environmental Review, Permitting, Design (15%)	1	EA		$276,586
	Construction Support Services (2.5%)	1	EA		$46,098
	Construction Management (5%)	1	EA		$92,195
	Inspection, Survey, and Administration (2.5%)	1	EA		$46,098
	Grand Total				**$2,304,883**

ASSUMPTIONS:
1 Contractor stages at parking lot.
2 No construction fencing needed at dune location.

DRAFT OPINION OF
PROBABLE CONSTRUCTION COSTS
LA County DBH Coastal Resilience Project
Dockweiler State Beach Alternative 2
[Dune Habitat (1.3 acres enhanced + 1.5 acres restored), Sand Barrier Wall]

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL
	Dune Components				
1	Install Sand Dune Fencing (3,000 linear feet per acre, over 2.8 ac)	8,400	LF	$6.00	$50,400
2	Remove Non-Natives (Weeding over 1.3 Acres of Enhancement Area)	1.3	AC	$2,500.00	$3,250
3	Apply Dune Plant Seeds (1,000 per acre) over 1.5 acres Restoration Area	1,500	EA	$0.25	$375
4	Install New Perimeter Fencing - Cable and Post (1,000 linear feet per acre)	2,800	LF	$2.50	$7,000
5	Install Kiosk (one on each end of the dune fields)	2	EA	$25,000.00	$50,000
6	Install Signage (one per dune acre rounded up to the nearest whole number)	3	EA	$250.00	$750
	Subtotal Dune				**$111,775**
	Sand Barrier Wall Components				
7	Mobilization	1	LS	$10,000.00	$10,000
8	Footing	850	LF	$500.00	$425,000
9	Wall Installation	850	LF	$1,000.00	$850,000
10	Sculpting	850	LF	$50.00	$42,500
	Subtotal Sand Barrier Wall				**$1,327,500**
	Monitoring and Maintenance				
11	Pre-Construction - Snowy Plovers	1	LS	$10,000.00	$10,000
12	Construction - Snowy Plovers	1	LS	$10,000.00	$10,000
13	Post-Construction - Dune Plants, Weeding	1	LS	$20,000.00	$20,000
	Subtotal Monitoring				**$40,000**
	Subtotal Items				**$1,479,275**
	Contingency of 25%				$369,819
	Planning, Environmental Review, Permitting, Design (15%)	1	EA		$277,364
	Construction Support Services (2.5%)	1	EA		$46,227
	Construction Management (5%)	1	EA		$92,455
	Inspection, Survey, and Administration (2.5%)	1	EA		$46,227
	Grand Total				**$2,311,367**

ASSUMPTIONS:
1 Contractor stages at parking lot.
2 No construction fencing needed at dune location.

DRAFT OPINION OF
PROBABLE CONSTRUCTION COSTS
LA County DBH Coastal Resilience Project
Dockweiler State Beach Alternative 3
[Dune Habitat (1.3 acres enhanced + 1.4 acres restored), Sand Barrier Wall]

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL
	Dune Components				
1	Install Sand Dune Fencing (3,000 linear feet per acre, over 2.7 ac)	8,100	LF	$6.00	$48,600
2	Remove Non-Natives (Weeding over 1.3 Acres of Enhancement Area)	1.3	AC	$2,500.00	$3,250
3	Apply Dune Plant Seeds (1,000 per acre) over 1.4 acres Restoration Area	1,400	EA	$0.25	$350
4	Install New Perimeter Fencing - Cable and Post (1,000 linear feet per acre)	2,700	LF	$2.50	$6,750
5	Install Kiosk (one on each end of the dune fields)	2	EA	$25,000.00	$50,000
6	Install Signage (one per dune acre rounded up to the nearest whole number)	3	EA	$250.00	$750
	Subtotal Dune				**$109,700**
	Sand Barrier Wall Components				
7	Mobilization	1	LS	$10,000.00	$10,000
8	Footing	700	LF	$500.00	$350,000
9	Wall Installation	700	LF	$1,000.00	$700,000
10	Sculpting	700	LF	$50.00	$35,000
	Subtotal Sand Barrier Wall				**$1,095,000**
	Monitoring and Maintenance				
11	Pre-Construction - Snowy Plovers	1	LS	$10,000.00	$10,000
12	Construction - Snowy Plovers	1	LS	$10,000.00	$10,000
13	Post-Construction - Dune Plants, Weeding	1	LS	$20,000.00	$20,000
	Subtotal Monitoring				**$40,000**
	Subtotal Items				**$1,244,700**
	Contingency of 25%				$311,175
	Planning, Environmental Review, Permitting, Design (15%)	1	EA		$233,381
	Construction Support Services (2.5%)	1	EA		$38,897
	Construction Management (5%)	1	EA		$77,794
	Inspection, Survey, and Administration (2.5%)	1	EA		$38,897
	Grand Total				**$1,944,844**
	ASSUMPTIONS:				
1	Contractor stages at parking lot.				
2	No construction fencing needed at dune location.				

7.1.3 Redondo Beach

Table 7-3 summarizes the probable cost to construct the project alternatives at Redondo Beach. Detailed costs follow. It is important to note the following:

1. Renourishment is <u>not</u> proposed over the 20-year life of the Redondo Beach projects.
2. The sand source is assumed to be offshore of Dockweiler State Beach (Section 6.2.6). The Temporary Nearshore Placement Area is a viable option for Alternative 3 and the total cost utilizing this source is provided in the table notes. Costs utilizing inland sand sources were not evaluated due to the feasibility of 10,000 to 20,000 trucks accessing the site via the vehicle ramp at the Torrance Beach parking lot.

Table 7-3. Probable Cost of Construction, Redondo Beach

Alternative	Beach Nourishment	Groin	Dune Habitat	Monitoring and Maintenance	Contingency	Planning and Support	Total
Alternative 1 *300,000-cy Nourishment; Groin at Pier; 4.5-acre Dune Habitat*	$17,982,500	$3,884,575	$35,625	$715,000	$5,654,425	$4,523,540	**$32,795,665**
Alternative 2 *300,000-cy Nourishment; 4.5-acre Dune Habitat*	$17,982,500	n/a	$35,625	$715,000	$4,683,281	$3,746,625	**$27,163,031**
Alternative 3 *150,000-cy Nourishment; Groin at Pier; 4.5-acre Dune Habitat*	$12,432,500	$3,884,575	$35,625	$715,000	$4,266,925	$3,413,540	**$24,748,165**

Notes:
1. Sand source is assumed to be offshore of Dockweiler State Beach.
2. Use of Redondo Beach Temporary Nearshore Placement Area reduces cost of Alternative 3 to $16,193,165.
3. Cost contingency is 25%.

DRAFT OPINION OF
PROBABLE CONSTRUCTION COSTS
LA County DBH Coastal Resilience Project
Redondo Beach Alternative 1
[300,000 CY Nourishment From Offshore, Pier Groin, and 0.5 Acres of Dune]

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL
	Beach Nourishment Components				
1	Mobilization & Demobilization of Earthmoving Equipment	1	LS	$25,000.00	$25,000
2	Mobilization & Demobilization of Dredging Equipment	1	LS	$6,850,000.00	$6,850,000
3	Temporary Protective Construction Fence	2,500	LF	$3.00	$7,500
4	Offshore Dredging off Dockweiler Beach & Transport Onto the Beach	300,000	CY	$31.00	$9,300,000
5	Grading New Sand on the Beach and Longitudinal Dikes for Turbidity	300,000	CY	$6.00	$1,800,000
	Subtotal Beach Nourishment				**$17,982,500**
	Pier Groin Components				
6	Mob/Demob/Prep Work	1	LS	$1,000,000.00	$1,000,000
7	Groin Installation (520 feet long) in 2004 dollars	520	LF	$2,667.00	$1,386,840
8	Escalation from 2004 to 2030	0.78	%	$1,386,840	$1,081,735
9	Econcrete Covering	10,400	SF	$ 40.00	$416,000
	Subtotal Pier Groin				**$3,884,575**
	Dune Components				
10	Install Sand Dune Fencing (3,000 linear feet per acre, over 0.5 ac)	1,500	LF	$6.00	$9,000
11	Apply Dune Plant Seeds (1,000 per acre) over 0.5 acres Restoration Area	500	EA	$0.25	$125
12	Install New Perimeter Fencing - Cable and Post (1,000 linear feet per acre)	500	LF	$2.50	$1,250
13	Install Kiosk (one assumed)	1	EA	$25,000.00	$25,000
14	Install Signage (one per dune acre rounded up to the nearest whole number)	1	EA	$250.00	$250
	Subtotal Dune				**$35,625**
	Monitoring and Maintenance				
15	Pre, During, and Post Construction Monitoring	1	LS	$100,000.00	$100,000
16	Shoreline Monitoring	1	LS	$100,000.00	$100,000
17	Borrow Site Survey Support	1	LS	$180,000.00	$180,000
18	Borrow Post-Construction Monitoring	1	LS	$80,000.00	$80,000
19	Pre and Post Receiver Site Detailed Topo	1	LS	$95,000.00	$95,000
20	Permit Compliance Reporting/Monitoring	1	LS	$150,000.00	$150,000
21	Post-Construction - Dune Plants, Weeding	1	LS	$10,000.00	$10,000
	Subtotal Monitoring				**$715,000**
	Subtotal Items				**$22,617,700**
	Contingency of 25%				$5,654,425
	Planning, Environmental Review, Permitting, Design (7.5%)	1	EA		$2,120,409
	Construction Support Services (2%)	1	EA		$565,443
	Construction Management (3.5%)	1	EA		$989,524
	Inspection, Survey, and Administration (3%)	1	EA		$848,164
	Grand Total				**$32,795,665**

ASSUMPTIONS:
1 Contractor stages at parking lot.
2 Mobilization & Demobilization cost is taken directly from 2024 contractor bids for the USACE Encinitas and Solana Beach Project. These may increase over time by escalation/inflation but that is not factored in yet.
3 Sand is dredged from the Dockweiler Offshore Borrow Site and the sand quality is excellent.

DRAFT OPINION OF
PROBABLE CONSTRUCTION COSTS
LA County DBH Coastal Resilience Project
Redondo Beach Alternative 2
[300,000 CY Nourishment From Offshore and 0.5 Acres of Dune]

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL
	Beach Nourishment Components				
1	Mobilization & Demobilization of Earthmoving Equipment	1	LS	$25,000.00	$25,000
2	Mobilization & Demobilization of Dredging Equipment	1	LS	$6,850,000.00	$6,850,000
3	Temporary Protective Construction Fence	2,500	LF	$3.00	$7,500
4	Offshore Dredging off Dockweiler Beach & Transport Onto the Beach	300,000	CY	$31.00	$9,300,000
5	Grading New Sand on the Beach and Longitudinal Dikes for Turbidity	300,000	CY	$6.00	$1,800,000
	Subtotal Beach Nourishment				**$17,982,500**
	Dune Components				
6	Install Sand Dune Fencing (3,000 linear feet per acre, over 0.5 ac)	1,500	LF	$6.00	$9,000
7	Apply Dune Plant Seeds (1,000 per acre) over 0.5 acres Restoration Area	500	EA	$0.25	$125
8	Install New Perimeter Fencing - Cable and Post (1,000 linear feet per acre)	500	LF	$2.50	$1,250
9	Install Kiosk (one assumed)	1	EA	$25,000.00	$25,000
10	Install Signage (one per dune acre rounded up to the nearest whole number)	1	EA	$250.00	$250
	Subtotal Dune				**$35,625**
	Monitoring and Maintenance				
11	Pre, During, and Post Construction Monitoring	1	LS	$100,000.00	$100,000
12	Shoreline Monitoring	1	LS	$100,000.00	$100,000
13	Borrow Site Survey Support	1	LS	$180,000.00	$180,000
14	Borrow Post-Construction Monitoring	1	LS	$80,000.00	$80,000
15	Pre and Post Receiver Site Detailed Topo	1	LS	$95,000.00	$95,000
16	Permit Compliance Reporting/Monitoring	1	LS	$150,000.00	$150,000
17	Post-Construction - Dune Plants, Weeding	1	LS	$10,000.00	$10,000
	Subtotal Monitoring				**$715,000**
	Subtotal Items				**$18,733,125**
	Contingency of 25%				$4,683,281
	Planning, Environmental Review, Permitting, Design (7.5%)	1	EA		$1,756,230
	Construction Support Services (2%)	1	EA		$468,328
	Construction Management (3.5%)	1	EA		$819,574
	Inspection, Survey, and Administration (3%)	1	EA		$702,492
	Grand Total				**$27,163,031**

ASSUMPTIONS:
1 Contractor stages at parking lot.
2 Mobilization & Demobilization cost is taken directly from 2024 contractor bids for the USACE Encinitas and Solana Beach Project. These may increase over time by escalation/inflation but that is not factored in yet.
3 Sand is dredged from the Dockweiler Offshore Borrow Site and the sand quality is excellent.

DRAFT OPINION OF
PROBABLE CONSTRUCTION COSTS
LA County DBH Coastal Resilience Project
Redondo Beach Alternative 3
[150,000 CY Nourishment From Offshore, Pier Groin, and 0.5 Acres of Dune]

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL
	Beach Nourishment Components				
1	Mobilization & Demobilization of Earthmoving Equipment	1	LS	$25,000.00	$25,000
2	Mobilization & Demobilization of Dredging Equipment	1	LS	$6,850,000.00	$6,850,000
3	Temporary Protective Construction Fence	2,500	LF	$3.00	$7,500
4	Offshore Dredging off Dockweiler Beach & Transport Onto the Beach	150,000	CY	$31.00	$4,650,000
5	Grading New Sand on the Beach and Longitudinal Dikes for Turbidity	150,000	CY	$6.00	$900,000
	Subtotal Beach Nourishment				**$12,432,500**
	Pier Groin Components				
6	Mob/Demob/Prep Work	1	LS	$1,000,000.00	$1,000,000
7	Groin Installation (520 feet long) in 2004 dollars	520	LF	$2,667.00	$1,386,840
8	Escalation from 2004 to 2030	0.78	%	$1,386,840	$1,081,735
9	Econcrete Covering	10,400	SF	$ 40.00	$416,000
	Subtotal Pier Groin				**$3,884,575**
	Dune Components				
10	Install Sand Dune Fencing (3,000 linear feet per acre, over 0.5 ac)	1,500	LF	$6.00	$9,000
11	Apply Dune Plant Seeds (1,000 per acre) over 0.5 acres Restoration Area	500	EA	$0.25	$125
12	Install New Perimeter Fencing - Cable and Post (1,000 linear feet per acre)	500	LF	$2.50	$1,250
13	Install Kiosk (one assumed)	1	EA	$25,000.00	$25,000
14	Install Signage (one per dune acre rounded up to the nearest whole number)	1	EA	$250.00	$250
	Subtotal Dune				**$35,625**
	Monitoring and Maintenance				
15	Pre, During, and Post Construction Monitoring	1	LS	$100,000.00	$100,000
16	Shoreline Monitoring	1	LS	$100,000.00	$100,000
17	Borrow Site Survey Support	1	LS	$180,000.00	$180,000
18	Borrow Post-Construction Monitoring	1	LS	$80,000.00	$80,000
19	Pre and Post Receiver Site Detailed Topo	1	LS	$95,000.00	$95,000
20	Permit Compliance Reporting/Monitoring	1	LS	$150,000.00	$150,000
21	Post-Construction - Dune Plants, Weeding	1	LS	$10,000.00	$10,000
	Subtotal Monitoring				**$715,000**
	Subtotal Items				**$17,067,700**
	Contingency of 25%				$4,266,925
	Planning, Environmental Review, Permitting, Design (7.5%)	1	EA		$1,600,097
	Construction Support Services (2%)	1	EA		$426,693
	Construction Management (3.5%)	1	EA		$746,712
	Inspection, Survey, and Administration (3%)	1	EA		$640,039
	Grand Total				**$24,748,165**

ASSUMPTIONS:

1 Contractor stages at parking lot.

2 Mobilization & Demobilization cost is taken directly from 2024 contractor bids for the USACE Encinitas and Solana Beach Project. These may increase over time by escalation/inflation but that is not factored in yet.

3 Sand is dredged from the Dockweiler Offshore Borrow Site and the sand quality is excellent.

7.2 Economic Benefits

Ceto Consulting (2025a; 2025b) utilized the anticipated performance of each project (Section 5) to estimate the economic benefits derived from recreation, fiscal revenues, and ecological habitat. Potential benefits related to protection of public property (restrooms, lifeguard facilities, roads) also were evaluated; however, the relative benefits (*i.e.,* additional benefit when compared to the "No-Project" condition) were not of sufficient magnitude to include herein.

The subsections that follow outline the methods and results of the economic analysis and present benefit-to-cost ratios (BCR) for each project alternative. These methods are well established and have been applied to other California beach nourishment projects, including those in Hermosa Beach and San Diego County.

All benefits are reported in 2025 dollars at a 3% discount rate.

7.2.1 Methodology

Recreational Value

Beaches provide substantial economic value to the public beyond what shows up in market transactions like hotel stays, parking fees, or concessions. This "consumer surplus" is quantified using non-market value (NMV), a measure of the value that visitors place on beach recreation (*i.e.*, how much a visitor would be willing to pay for a trip to the beach, even though no direct transaction occurs; King *et al.*, 2018). NMV benefits were computed based on the "carrying capacity" of each site (the number of visitors that the site can accommodate) and visitation estimates derived from mobility-derived location data, as described below.

Visitation

Visitation to each site was estimated using anonymized cellphone location data obtained between 2018 and 2024 (2020 omitted; Placer Labs, 2024) and a modeling framework developed by Ceto. Attendance estimates derived in this manner are preferred over traditional methods, such as lifeguard counts, which have been shown to overestimate attendance by a factor of four or more (King and MacGregor, 2012; Mazzotta *et al.*, 2021; Merril *et al.*, 2020; Patsch *et al.*, 2024; Tsai *et al.*, 2023). At the Zuma and Point Dume sites, a substitution model also was incorporated to account for increased visitation as nearby beaches erode:

- **Substitution:** In the future, nearby Malibu beaches (e.g., Broad Beach, Leo Carrillo, El Matador, Lechuza) are expected to narrow through a combination of storm-induced erosion, long-term deficits in sand supply, and sea level rise, thereby reducing the number of visitors each site can accommodate. Zuma and Point Dume Beach are close substitutes by distance and amenities. To account for this increase in visitation, Ceto used Placer mobility data and linear interpolation to model steady growth in demand for Zuma and Point Dume as alternate sites erode.

Carrying Capacity

The carrying capacity was computed annually for each alternative using established methods in recreational economics (King *et al.*, 2018; Pendleton *et al.*, 2006; Sheehan *et al.,* 2022). The assumptions that formed the basis of the computations are:

- **Towel Space:** Each visitor occupies 100 ft^2 of beach area (Sheehan *et al.*, 2022); and
- **Turnover Rate:** 2.5 visitors can occupy the same towel space in a single day (King and McGregor, 2012).

Recreational Area

The recreational area was taken to be the beach area landward of the Mean Higher High Water (MHHW) shoreline. Areas within 25 ft of the back beach, lifeguard towers, sidewalks, dunes, and lagoons were excluded given that most visitors avoid placing their towels there. In addition, the area between the MHHW shoreline and the dry, flat beach berm[8] was excluded at Zuma and Point Dume Beach based on the observation that visitors tend to congregate on the berm, rather than the beach face (Photo 7-1). For each project alternative, the recreational area was computed annually using the forecast shoreline changes described in Section 5.

NMV Benefits

For each project alternative, the estimated carrying capacity was compared to the forecast visitation annually. In the event that the carrying capacity was not sufficient to accommodate the anticipated number of visitors, the difference was recorded as an NMV loss. NMV rates of $64 per visitor per day were used at Zuma/Point Dume Beach and Dockweiler State Beach, while an NMV rate of $62 per visitor per day was used at Redondo Beach.

NMV benefits were computed as the NMV losses avoided by implementation of each project alternative. For example, at Zuma Beach the NMV loss for the No-Project case was $11.4M at the end of 2049, whereas the NMV loss for Alternative 1 was $9.1M, resulting in $2.3M in avoided NMV losses or NMV benefits.

[8] Beach profile data obtained between 2009 and 2023 (Coastal Frontiers, 2023b) indicate that the area between the MHHW shoreline and the berm is approximately 32 ft wide.

Photo 7-1. Visitors Congregating on Beach Berm at Zuma Beach

Fiscal Impacts

In addition to the recreational value described above, economic benefits derived from beach visitation include what beach goers spend on shopping, dining, and overnight accommodation, and from local tax revenue. Ceto utilized spending data from a recent study of two southern California beaches to derive the following assumptions:

- **Day-Trippers:** Visitors traveling less than 100 miles. Estimated to spend an average of $63 per day per person.
- **Overnight Visitors:** Visitors traveling more than 250 miles. Estimated to spend an average of $82 per day per person.
- **Split:** Visitors traveling between 100 and 250 miles. Assumed to be 50% day-trippers ($63 per person per day) and 50% overnight visitors ($82 per day per person).

Tax revenue was estimated as follows:

- **Local (City and County) Sales Tax:** 10% (Zuma and Point Dume) and 9.5% (Dockweiler and Redondo). Note: The State of California collects 6% of the sales tax revenue; only the local share was included (4% and 3.5%, respectively).
- **Transient Occupancy Taxes (TOTs)**: 12% (uniform across the study area). This is the tax collected by the local jurisdiction (City or County if unincorporated) from hotels, motels, and short-term rentals, but not camping at State Parks.

Ecological Value

The valuation of beaches and dunes in California has become increasingly important as sea level rise and coastal erosion accelerate. King *et al.* (2018) developed a framework for estimating the non-market ecological value of beach habitat on a per-acre basis using project data, benefit transfer, and established environmental economics methods. For the present study, data from projects at Pacifica, Surfers Point, Oceana Beach, and Goleta (King *et al.,* 2018) were used to derive an ecological value of $5.63M per acre. While high, this figure is consistent with prior NOAA-supported expert work.

The ecological value of each project alternative was computed based on the per-acre value above and the number of acres of new or enhanced dunes shown in Section 4. No value was assigned to existing dunes in the No-Project case, given that the dunes are not enhanced or actively managed as will be done in the with-project case.

Flooding and Storm-Damage Reduction

As noted above, the project team evaluated potential benefits resulting from a reduction in flooding and storm damage along Zuma and Point Dume Beach (such analyses were not necessary at Dockweiler or Redondo Beach). However, given the relatively mild rise in sea level predicted to occur over the project life (Table 2-1), major flooding is likely to be confined to the parking lots fronting Pacific Coast Highway (PCH) and damages associated with such flooding are not expected to be of sufficient magnitude to justify their inclusion.

In the case of Westward Beach Road, damage similar to that which occurred in 2021 (Section 3.1.12) is not likely to occur given that most of this reach is now armored. This is based on the assumptions that: (1) the revetment will remain in service through 2050, and (2) damages to the revetment that may occur in the No-Project case (e.g., due to undermining) also may occur following implementation of the resilience projects.

7.2.2 Results

Table 7-4 presents the economic benefits, construction cost, and BCR for all three alternatives at each site. A summary of the findings follows.

Table 7-4. Economic Benefits, Construction Cost and BCR

Area	Scenario	Recreational Benefit	Fiscal Benefit	Ecological Benefit	Total Benefit	Construction Cost	BCR
Zuma & Point Dume Beach	Alternative 1	$19.0M	$0.7M	$48.7M	$68.4M	$199.2M	0.3
	Alternative 2	$15.6M	$0.6M	$72.9M	$89.1M	$199.3M	**0.4**
	Alternative 3	$19.7M	$0.7M	$48.7M	$69.1M	$207.1M	0.3
Dockweiler State Beach	Alternative 1	$0	$0	$14.6M	$14.6M	$2.3M	6.3
	Alternative 2	$0	$0	$15.5M	$15.5M	$2.3M	6.7
	Alternative 3	$0	$0	$14.8M	$14.8M	$1.9M	**7.8**
Redondo Beach	Alternative 1	$202.7M	$6.2M	$2.8M	$211.7M	$32.8M	6.5
	Alternative 2	$202.5M	$6.2M	$2.8M	$211.5M	$27.2M	7.8
	Alternative 3	$187.8M	$5.7M	$2.8M	$196.3M	$24.7M	**7.9**

Notes:
1. Bold text indicates Alternative with highest BCR.
2. Construction costs for Zuma and Point Dume Beach include renourishment (Alternative 1 & 2 = every 5 years; Alternative 3 = every 8 years).

Zuma Beach & Point Dume Beach

Data obtained from Placer Labs (2024) indicate that 1.4 million beachgoers visit the contiguous area that makes up Zuma Beach and Point Dume Beach each year. The expected visitation exceeds the carrying capacity under the existing (No-Project) condition beginning in 2041, resulting in NMV losses totaling $20.3M by 2050.

All three project alternatives generate recreational, fiscal and ecological benefits (Table 7-4). Recreational benefits range from $15.6M (Alternative 2) to $19.7M (Alternative 3), with the lower relative benefit resulting from the conversion of recreational area to dune habitat in Alternative 2. Fiscal benefits are small by comparison, ranging from $0.6M to $0.7M. Over half of the total benefit is realized through creation or enhancement of dune areas, accounting for $48.7M in benefits for Alternatives 1 and 3 and $72.9M in Alternative 2. Despite having the lowest recreational benefit, Alternative 2 generates the greatest total benefit ($89.1M) among the three alternatives.

Despite these benefits, the BCR is between 0.3 and 0.4 in all three cases, indicating that the project benefits do not offset the cost. This is primarily due to the high construction cost associated with the initial and renourishment events. As part of the next phase of the study, we recommend optimizing the renourishment interval based on the carrying capacity and expected visitation. It is likely that doing so will lower the construction cost, thereby increasing the BCR.

Dockweiler State Beach

The No-Project scenario and all three resilience alternatives at Dockweiler State Beach are expected to comfortably accommodate the 1.9 million beachgoers that visit the site annually. Even when accounting for the loss of recreational area converted to dune habitat, as well as the shoreline retreat forecast to occur over the 20-year project, the beach can accommodate over 75,000 visitors per day in all cases. This is well above the expected maximum number of daily visitors (26,000) by 2050.

Economic benefits, therefore, are derived solely from the ecological value of the dune field. These range from $14.6M to $15.5M in Alternatives 1 and 2, respectively. The BCR exceeds 6 in every case, with Alternative 3 generating the greatest return on investment (BCR = 7.8).

Redondo Beach

The economic model indicates that in the absence of beach nourishment (the “No-Project” condition), Redondo Beach will not have adequate recreational area to meet demand. However, the beach area generated under Alternatives 1 and 2 provides sufficient carrying capacity, resulting in $209M in recreational and fiscal benefits over the life of the project. Alternative 3, which adds less sand to the beach, generates slightly less ($194M) recreational and fiscal benefit. Taken together with the $3M in ecological benefit, the projects generate between $196M and $212M of value over the 20-year project.

The BCR is at least 6.5 in all cases. Alternative 3 has the highest BCR (7.9), with Alternative 2 closely behind (7.8).

7.2.3 Limitations and Considerations

The estimates in this analysis are based on present-day socioeconomic conditions and assume relatively stable population trends in Los Angeles County. However, several factors could influence beach attendance and fiscal impacts over time:

- **Shifts in Tax Rates**: The analysis applies current sales tax and transient occupancy tax (TOT) rates, but these could change over the project lifespan, affecting fiscal outcomes.
- **Spending and Accommodation Trends**: Visitor spending behavior and lodging preferences may evolve; particularly as short-term rentals (STRs) and hotel rates fluctuate.
- **Beach Profile Changes and Attendance Assumptions**: The model assumes consistent visitation patterns as the beach profile changes, without accounting for potential adaptive behavior by visitors.

These limitations highlight the dynamic nature of coastal recreation and fiscal impacts, reinforcing the need for continued monitoring and adaptive management to inform future policy decisions.

8 Alternatives Analysis and Selection of the Preferred Project

In an effort to objectively select the preferred alternative at each site, ranking matrices were developed based on the project objectives and the anticipated performance of each alternative. The ranking categories, described in Section 5, include recreation, public access, dune habitat, and cost. Scores between 0.0 and 1.0 were assigned to each category, then weighted and summed to arrive at a final score, with 1.0 being the most favorable and 0.0 being the least favorable. All four categories are weighted equally; however, the weightings can be adjusted in the future based on County or stakeholder input.

8.1 Zuma Beach and Point Dume

The ranking matrix developed for Zuma Beach and Point Dume is shown in Table 8-1. As shown in the table, the recreation score was computed based on the average increase in beach width over the first renourishment cycle, relative to the pre-construction condition. The public access score was taken to be the portion of the shoreline not impacted by the addition of dunes to the back beach, while the dune habitat score was computed based on the total area of new or expanded dunes. Finally, the cost score was computed as the relative cost among the three options, with the lowest cost receiving a score of 1 and the highest cost receiving a score proportional to the increase in cost relative to the lowest cost.

As shown in the table, Alternative 2, which includes a 500,000-cy beach nourishment and 12.8 acres of dune habitat is the preferred alternative, based primarily on the relatively low cost and the additional dune habitat created along the back beach. Alternative 1 was runner-up, while Alternative 3 was least preferred.

8.2 Dockweiler State Beach

The ranking matrix developed for Dockweiler State Beach is shown in Table 8-2. As shown in the table and described in Section 5.2.1, the recreation score was computed based on the relative length of the low sand barrier that prevents sand from being blown onto the bike and pedestrian path. The longest (850 ft) received a score of 1, while the shortest (700 ft) received a score of 0.82, as it is 18% shorter. The public access score was computed based on the number of beach access points, while the dune habitat score was computed based on the total area of new or expanded dune. Finally, the cost score was computed as the relative cost among the three options, with the lowest cost receiving a score of 1 and the highest cost receiving a score proportional to the increase in cost relative to the lowest cost.

As shown in the table, Alternative 3 is the preferred alternative, primarily based on it having the highest number of access points and relatively large dune area. Alternative 1 was runner-up, while Alternative 2 was least preferred.

8.3 Redondo Beach

The ranking matrix developed for Redondo Beach is shown in Table 8-3. As shown in the table and described in Section 5.3.2, the recreation score was computed based on the average increase in beach width over the 20-year project life, relative to the pre-construction condition. Public access is primarily limited by the presence of the groin in Alternative 1 and Alternative 3, and as a result, these were given a score of 0.75. The dune habitat score was computed based on the total area of new or expanded dune. As was the case for Zuma / Point Dume and Dockweiler, the cost score was computed as the relative cost among the three options, with the lowest cost receiving a score of 1 and the highest cost receiving a score proportional to the increase in cost relative to the lowest cost.

As shown in the table, Alternative 2 is the preferred alternative due to the relatively low cost and absence of public access impacts. Alternative 1 was runner-up, while Alternative 3 was least preferred.

8.4 Summary

The highest ranked and thus preferred alternative for each site is:

Zuma Beach and Point Dume: *Alternative 2*: 500,000-cy beach nourishment, 12.8 acres of dune habitat, cost $50.2M (not including renourishment), BCR 0.4

Dockweiler State Beach: *Alternative 3*: 700-ft long sand barrier, 4 beach access points, 2.7 acres of dune habitat, cost $1.94M, BCR 7.8

Redondo Beach: *Alternative 2*: 300,000-cy beach nourishment, 4.5 acres of dune habitat, cost $27.2M, BCR 7.8

Table 8-1. Ranking Matrix, Zuma Beach and Point Dume

	Category				Weighted Score
	Recreation[9]	**Public Access**[10]	**Dune Habitat**[11]	**Cost**[12]	
Weight	25%	25%	25%	25%	-
Scoring	0 = No Added Beach Width	0 = Significant Impacts	0 = No New or Expanded Habitat	0 = Highest Relative Cost	1 = Highest Score
	1 = Maximum Added Beach Width	1 = No Impacts	1 = Maximum New or Expanded Habitat	1 = Lowest Relative Cost	0 = Lowest Score
Alternative 1 *500,000-cy Nourishment; 8.6-acre Dune Habitat*	**0.76** Average Additional Beach Width = 12.5 ft	**0.68** 4,600 ft of 14,500-ft long shoreline impacted by dunes	**0.67** 8.6 acres of new/expanded dune habitat	**1.00** Cost = $50.1M	**0.78** Runner Up
Alternative 2 *500,000-cy Nourishment; 12.8-acre Dune Habitat*	**0.76** Average Additional Beach Width = 12.5 ft	**0.53** 6,830 ft of 14,500-ft long shoreline impacted by dunes	**1.00** 12.8 acres of new/expanded dune habitat	**1.00** Cost = $50.2M	**0.82** **Selected Project**
Alternative 3 *750,000-cy Nourishment; 8.6-acre Dune Habitat*	**1.00** Average Additional Beach Width = 16.4 ft	**0.68** 4,600 ft of 14,500-ft long shoreline impacted by dunes	**0.67** 8.6 acres of new/expanded dune habitat	**0.62** Cost = $69.3M	**0.74** Last Place

Legend: Low Score (0 – 0.5), Average Score (0.6 – 0.7), High Score (0.8 – 1.0)

[9] Recreation Score computed as Average Additional Beach Width normalized by maximum Average Additional Beach Width for all alternatives. Average values computed relative to pre-construction condition over first renourishment cycle.
[10] Public Access Score computed as % of shoreline not impacted by dune creation or expansion.
[11] Dune Habitat Score computed as area of new or expanded dune habitat normalized by maximum area of new or expanded dune habitat.
[12] Cost Score computed as the difference between the project cost and the lowest cost, normalized by the lowest cost. Cost includes initial nourishment only. No renourishment.

Table 8-2. Ranking Matrix, Dockweiler State Beach

	Category				Weighted Score
	Recreation[13]	**Public Access**[14]	**Dune Habitat**[15]	**Cost**[16]	
Weight	25%	25%	25%	25%	-
Scoring	0 = No Protection for Bike/Pedestrian Path	0 = No Beach Access Points	0 = No Enhanced or Restored Habitat	0 = Highest Relative Cost	1 = Highest Score
	1 = Max Protection for Bike/Pedestrian Path	1 = Maximum No. of Beach Access Points	1 = Maximum Enhanced or Restored Habitat	1 = Lowest Relative Cost	0 = Lowest Score
Alternative 1 *850-ft Sand Barrier; 2.6-acre Dune Habitat with 3 Beach Access Points*	**1.00** 850-ft long Sand Barrier to Prevent Sand Accumulation on Bike and Pedestrian Path	**0.75** 3 Beach Access Points	**0.93** 2.6 acres of Enhanced or Restored Dune Habitat	**0.81** Cost = $2.30M	**0.87** Runner Up
Alternative 2 *850-ft Sand Barrier; 2.8-acre Dune Habitat with 2 Beach Access Points*	**1.00** 850-ft long Sand Barrier to Prevent Sand Accumulation on Bike and Pedestrian Path	**0.50** 2 Beach Access Points	**1.00** 2.8 acres of Enhanced or Restored Dune Habitat	**0.81** Cost = $2.31M	**0.83** Last Place
Alternative 3 *700-ft Sand Barrier; 2.7-acre Dune Habitat with 4 Beach Access Points*	**0.82** 700-ft long Sand Barrier to Prevent Sand Accumulation on Bike and Pedestrian Path	**1.00** 4 Beach Access Points	**0.96** 2.7 acres of Enhanced or Restored Dune Habitat	**1.00** Cost = $1.94M	**0.95** **Selected Project**

Legend: Low Score (0 – 0.5), Average Score (0.6 – 0.7), High Score (0.8 – 1.0)

13 Recreation Score computed as % of bike and pedestrian path protected by low sand barrier along 850-ft long project reach.
14 Public Access Score computed as number of beach access points relative to maximum number of beach access points (4).
15 Dune Habitat Score computed as area of enhanced or restored dune habitat normalized by maximum area of enhanced or restored dune habitat.
16 Cost Score computed as the difference between the project cost and the lowest cost, normalized by the lowest cost. Cost includes initial nourishment only. No renourishment.

Table 8-3. Ranking Matrix, Redondo Beach

	Category				Weighted Score
	Recreation[17]	Public Access[18]	Dune Habitat[19]	Cost[20]	
Weight	25%	25%	25%	25%	-
Scoring	0 = No Protection for Bike/Pedestrian Path	0 = Maximum Impact	0 = No Enhanced or Restored Habitat	0 = Highest Relative Cost	1 = Highest Score
	1 = Max Protection for Bike/Pedestrian Path	1 = No Impact	1 = Maximum Enhanced or Restored Habitat	1 = Lowest Relative Cost	0 = Lowest Score
Alternative 1 *300,000-cy Beach Nourishment; Groin at Pier; 4.5-acre Dune Habitat*	**1.00** Average Additional Beach Width = 75 ft	**0.75** Lateral access impeded by groin at pier	**1.00** 4.5-acre dune habitat	**0.67** Cost = $32.8M	**0.86** Runner Up
Alternative 2 *300,000-cy Beach Nourishment; 4.5-acre Dune Habitat*	**0.87** Average Additional Beach Width = 65 ft	**1.00** No Impacts	**1.00** 4.5-acre dune habitat	**0.90** Cost = $27.2M	**0.94** **Selected Project**
Alternative 3 *150,000-cy Beach Nourishment; Groin at Pier; 4.5-acre Dune Habitat*	**0.40** Average Additional Beach Width = 30 ft	**0.75** Lateral access impeded by groin at pier	**1.00** 4.5-acre dune habitat	**1.00** Cost = $24.7M	**0.79** Last Place

Legend: Low Score (0 – 0.5), Average Score (0.6 – 0.7), High Score (0.8 – 1.0)

[17] Recreation Score computed as Average Additional Beach Width normalized by maximum Average Additional Beach Width for all alternatives.
[18] Public Access Score computed as 0.75 for alternatives with groin at pier and 1.00 for alternatives without groin at pier.
[19] Dune Habitat Score computed as area of enhanced or restored dune habitat normalized by maximum area of enhanced or restored dune habitat.
[20] Cost Score computed as the difference between the project cost and the lowest cost, normalized by the lowest cost. Cost includes initial nourishment only. No renourishment.

9 Stakeholder Feedback

Stakeholder feedback was received as part of three public meetings: September 23, 2024, January 29, 2025, and April 16, 2025. The sections that follow summarize the feedback received and responses given.

9.1 General Comments

Comment	Response
There are established protocols for monitoring wildlife during coastal construction projects, including California Grunion, and the report could state that those will be followed if construction occurs during a season when the resource could be impacted.	Recommended avoidance and mitigation measures, including those for California Grunion, have been added (see Section 3.3).
Is there a CEQA document identifying the Proposed Project and evaluating the project alternatives? If so, when should the agencies expect to review it?	The CEQA document has not been prepared. It will be prepared as part of Phase 3 of the project.
I would suggest that your schedule includes a few years of adaptive management and long-term maintenance.	Each project will include a 5-year post-construction monitoring period to evaluate project performance and adapt to new discoveries.
Are the “proposed” alternatives simply what was proposed originally when the project was submitted, or are they the current preference?	This was a consistent point of confusion. To provide more clarity, the report has been revised such that the three alternatives at each site are denoted “Alternative 1,” “Alternative 2,” and “Alternative 3.” The preferred project is denoted “Preferred Project.”
What is the difference between dune creation and enhancement?	Dune creation refers to creation of a dune in an area that they currently do not presently exist. Dune enhancement refers to improvement and management of existing dunes.

Comment	Response
In terrestrial settings, maintaining living biotic parts of the soil is critical to success in restoration / gardening / agriculture. NRCS says 5% living material is preferential for soil. I recognize that dunes accrue from wind-blown sediment, so this may be a different scenario. For clarification do beach dunes also need to have a living microbiome to thrive? If so, is that an element of these projects?	No microbiomes are needed to create heathy dune habitats.
<u>Impacts to Surfing</u> Does the consulting team expect any positive or negative impacts on surfing resources at any of the three sites? This is a recreation pattern which may be different than an "average" day visit.	We do not expect the projects to generate long-term negative impacts to surfing resources. However, it is possible that short-term impacts may occur. Surf monitoring will be included prior to, during, and following project implementation. Tools, such as Surfline, will be used to quantify surfer and beach attendance.

9.2 Zuma Beach and Point Dume

Comment	Response
What is the timing of beach nourishment?	Ideally, beach nourishment will occur outside of the high beach use season (Memorial Day to Labor Day) and prior to grunion runs (March 14 through August 31).

Comment	Response
How do the proposed dune habitat areas interplay with the existing dune areas?	The existing habitat will be expanded and enhanced. Planned activities include removing non-native species, seeding with native species, and creating designated corridors to the beach. Sand collection fencing will be installed to encourage dune growth and limit deposition in unwanted areas.
What is the length of Zuma / Point Dume?	Approximately 14,500 feet (Trancas Creek to Point Dume).
Is there revetment or cobble contemplated in this project?	We are not currently considering the use of revetments or cobble. Note that cobbles do not naturally occur at the project site in large quantities.
Do these projects use opportunistic sources of sediment or sediment that needs to be purchased and transported?	The most likely sand source will be harbor maintenance dredging or an offshore borrow site. The sand will need to be transported from the source to the beach via vessel and pumped onshore.
If an offshore borrow source is an option, have any borrow sampling been conducted or plans to do so?	See Section 6.2. We will be preparing and implementing our own sampling and analysis plan for this project as part of the next phase of work.
Will you be reviewing opportunities to partner with local municipalities to add misc. trash capture and nuisance urban runoff flow capture and infiltration?	No, stormwater quality improvement features are outside of the project scope.
What does the runoff look like at Zuma? Will a dune retain significant volumes of runoff from road/upland?	The project will be designed to allow for sufficient runoff at those locations where it currently exists. We do not expect the dunes to impound runoff.
I fully support the concept of offshore, underwater reef/rock structure for fish habitat and sand stabilization in front of Point Dume Beach.	At this time, offshore reef structures are not being considered, due in part to the area's designation as a State Marine Reserve. Our plan is to monitor the shoreline and potentially revisit such alternatives with the State if conditions warrant.

Comment	Response
Sea Grant funded a study a few years ago that looked at how sand was transported at Point Dume. A lot of it is apparently lost in the canyon. How will the sand be prevented from moving offshore into the canyon rather than along the nearshore for deposition?	See Section 2.1.2. While investigators agree that Point Dume acts as a partial barrier to longshore sediment transport, they have not yet reached consensus regarding the percentage of material transported into the canyon versus that which is transported around Point Dume into the Santa Monica Littoral Cell.
<u>Westward Beach Road Revetment</u> Has a replacement of the revetment with a co-benefiting nature-based alternative been explored within the scope of this project? On the same point, could some of the rock revetment be replaced by dune creation if we were able to create dunes in that area? I am concerned that the presence of the revetment will cause scouring. Would you consider relocating the restroom and otherwise narrowing the road or reducing parking to pull the beach further back and better able to sustain near-term nourishment. Otherwise, I don't see ever getting to a wet sand beach where the revetment is. The rocks scour the beach and impede growth.	The revetment was built in 2021 and 2023 as an emergency repair to protect the only access road to Point Dume Beach from storm damage. Replacement of the revetment is not being considered as part of the present scope of work; however, a separate meeting can be set up to discuss the revetment including interplay with the narrow beach, access road, adjacent cliff, restroom, parking lot, etc.
Since the Palisades fire burned materials from downcoast have made their way to Zuma beaches. Can you describe how that happens since this project assumes a dominant down-coast transport?	The burned materials are driven primarily by wind on the surface of the water. Sediment transport is driven primarily by waves.
Where will the new Zuma sand come from?	See Section 6. Most likely sources are harbor maintenance dredging and an offshore borrow site.

Comment	Response
Why doesn't the shoreline modelling data extend beyond 2016--nine years ago?	See Section 5. The shoreline simulations cover the period from 2023 to 2050. The calibration period is from 2009 to 2016 based on the availability of high-resolution shoreline data derived from Light Detection and Ranging (LiDAR) datasets. Validation was conducted between 2016 and 2023 using a combination of LiDAR and beach profile data.
Can you use some of the sediment behind Rindge Dam at this site?	Yes, LACDBH is discussing the option with CA State Parks. See Section 6.3.2.
Doesn't the dune creation project need to be continuous laterally across the beach? The dunes that you show on the plan are some distance apart. Won't that result in the destruction of the dunes in high wave/tide times?	See Section 2.3.3. Current state guidance indicates that dunes should be at least 100 ft long. Each of the proposed dunes meets this criterion.
How would you change the beach grooming regime?	Due to Zuma/Point Dume's increasing popularity for recreation (primary objective of most visitors), we expect mechanical grooming to continue, as it is the main way to continue compliance with the Trash Total Maximum Daily Load. That being said, DBH staff will be trained to avoid impacts to dune habitat from mechanical grooming. The training will be similar to that currently used for the dune habitat near Zuma lagoon.
Zuma Beach has been eroding for decades and reducing the capacity of the beach. Looking back on historical photos shows a beach I estimate as several hundred feet wide, and the capacity much larger. Why isn't there an added recreational benefit to create dunes and a wider beach that can accommodate more visitors? The argument would be that historical narrowing of the beach has reduced capacity since the 1950's. This project would restore the total space of the beach for more visitor use. Does this approach work toward increasing the recreational benefit?	The recreational benefits are computed based on current visitation, with increases in visitation at Zuma Beach due to erosion of nearby beaches (substitution) and climate impacts. This approach is consistent with economic analyses conducted for similar projects.

9.3 Dockweiler State Beach

Comment	Response
What is expected in terms of dune expansion seaward, and how the dune will be affected with the rising sea level?	The dunes are expected to expand offshore. As sea levels rise and the shoreline erodes, the dunes will function as reservoirs of sand to nourish the beach during high tide or severe storm events.
There is a hang glider area in the project area.	The project is designed to avoid obstructions to hang gliding access and activities.
Consider extending the existing Snowy Prover protection area from the north to the project area. This area has lower foot traffic and can be a good opportunity.	Noted.
Will the homeless encampment issue be addressed by this project?	No. Though it is an important issue, the homeless encampment issue will be addressed outside of this project.
What is the height of the proposed low sand barrier?	See Section 4.2.2. The wall is a little more than 2 ft tall with a base that is about 1 ft wide.
Will the fencing be permanent or removed after initial dune growth?	The fencing can be removed once the dunes are established. Rope and post barriers are expected to remain in place to reduce trampling.
Is the primary goal to keep sand off concrete or to build dunes?	Both.
Is a plant palette already selected for the dune?	Not yet. We will develop a plant palette in the next phase of this project.
The drains at the base of the wall could be a source of severe erosion on this inclined dune system. Is there a way to engineer a diffusion device, such that the water will run downhill less violently?	Noted. We'll take it into consideration.
What is the benefit of shortening the wall to 700 ft for the third alternative (Alternative 3)?	Less obstruction to the hang-gliding launch area. Lower cost.

Comment	Response
Use of signage at dune project in Santa Monica has been very successful.	Noted.
Does "free access" refer to physical freedom of movement or financially free?	Financially free.
What are the implications for Dockweiler Beach if sand is being taken from the "borrow area" to send to other beaches?	The sand is located offshore of the area of active sand movement. Removal of this sand will not impact littoral processes at Dockweiler.
[LA County Public Works] Any modifications to bike paths must follow the Highway Design Manual. Specifically, minimum of 2-ft buffer between the bike trail and proposed sand barrier is required. Additionally, end treatment for the wall may be required.	Noted. DBH will consult with Public Works on the design in the next phase of the project.

9.4 Redondo Beach

Comment	Response
What is the anticipated volume for beach nourishment at Redondo?	See Section 8.3. The preferred project includes approximately 300,000 cy of sand.
Assuming the ECOncrete groin is somewhat reflective, has there been any analysis on infragravity or edge wave trapping that could cause large velocity gradients and potentially localized erosion?	No. At this point, the groin is not included in the preferred alternative. If it is included at a later date, further study will be necessary.
This area has been nourished before. The sand came from Marina del Rey through Army Corps' dredging project. Recently, City of Redondo placed dredged sand from King Harbor to nearshore of the project area. The sand is available for this project.	Noted.

Comment	Response
[City of Redondo Beach Harbor Commission] The Commission expressed their concerns on using MdR sediment to nourish Redondo Beach. The 2012 MdR dredging and beach nourishment project brought a lot of trash to the beach with the sediment that was transported from MdR. They don't want to have the same incident happen again. Is it possible to use sand from King Harbor to replenish the project site? Maybe a smaller scale beach nourishment with higher frequency may be more economical and effective?	The dredging contractor will be required to ensure the sediment is free from trash and monitoring will be included prior to, during, and following construction. The 2024 MdR dredge material placed on the Dockweiler nearshore placement site was monitored for trash during and after the operation, and none was detected. Certainly, we welcome more collaboration with local jurisdictions to make beach nourishment projects more effective and cost-efficient. This kind of a long-term planning can be incorporated into the LA County Regional Coastal Strategic Adaptation Plan (RCSAP) and discussed with and evaluated by a wider audience.
Most sand is lost to Redondo Canyon, which is located about a half a mile outside of the beach. A rock structure may help retain sand longer and create a fish habitat.	We considered this in the initial part of the study; however, such techniques are unproven and can have unintended consequences. Given the relative stability of the beach in this area, we do not feel that such a structure is necessary.
Is there a study that measures sand movement?	Sand tracer studies can be conducted but are typically used for scientific purposes.
The Pier is pretty aged. The construction of a groin using the pier would not be structurally sound.	Noted. The groin is not included in the preferred alternative. In the event that a groin is included, detailed structural engineering design would be conducted along with inspection of the pier.
Why would you do Alternative 2 or Alternative 3 with no or a smaller sand retention feature. What is the benefit, except for cost? Would there need to be more frequent renourishment?	The alternatives are meant to provide a range of options from which to evaluate the relative merits of each approach. Based on the analysis, once the beach is nourished, renourishment would not be needed at Redondo Beach for at least 20 years, and a groin is not included in the preferred alternative.

Comment	Response
Sand retention (groin) alternative is not preferable due to its downcoast effect.	Downcoast effects are minimal due to the location of King Harbor. Nevertheless, a groin is not included in the preferred alternative.
Where is the sand coming from for Redondo?	See Section 6. Most likely sources are harbor maintenance dredging and an offshore borrow site.
I'm not very familiar with what is inland of this public beach...are the dunes just proposed for habitat value, or would they provide protection for some development?	The dunes provide habitat value and protection for the restroom, bike path, and parking lots.
What is ECOncrete? How many other examples of green-grey projects like the groin proposal do we have on our shorelines?	ECOncrete has an admixture that promotes growth of marine habitat. It is being used to construct green-grey revetments in San Diego Harbor. Sea Grant is studying the effectiveness, but the results are not complete.
Where is a 'temporary sand stockpile area' in Redondo Beach, if needed?	A temporary sand stockpile area for the Redondo Beach SCOUP site was identified near the base of the vehicle ramp off the Torrance Beach parking lot. This site is not large and should be considered only for temporary storage of very small (< 2,000 cy) volumes of sediment.

10 Summary, Next Steps and Recommendations

As part of the first phase of the LACDBH Resilience Project Implementation, a feasibility study was conducted to evaluate projects proposed as part of the 2023 Coastal Resilience Study (Moffatt & Nichol, 2023) at three sites: Zuma Beach & Point Dume Beach, Dockweiler State Beach, and Redondo Beach.

10.1 Selection of the Preferred Project

The concepts outlined in the 2023 Coastal Resilience Study were used to develop three project alternatives at each site. The anticipated performance of each alternative was evaluated to estimate the relative benefits to recreation, public access, and dune habitat. These benefits, along with the cost of design, environmental review, construction, and monitoring, were used to select a preferred project for each site. The preferred projects are summarized below:

Zuma Beach and Point Dume Beach

Beach nourishment of 500,000 cubic yards (cy) at Zuma Beach. Creation of dune habitat (4.1 acres) along Zuma Beach and enhancement of the existing dune habitat at Zuma Creek and Point Dume Beach (4.5 acres). Renourishment events are expected to be necessary about every five years. The project will be monitored to determine when renourishment is needed. Costs for renourishment have not been included.

Dockweiler State Beach

Construction of a 700-ft long low sand barrier between the existing dune system and the bike and pedestrian path. Active management of dune habitat (2.8 acres) through installation of four designated beach access paths, sand fencing to encourage deposition within the dune field, installation of boundary fencing along the border, removal of non-native species, and seeding with native species.

Redondo Beach

Beach nourishment of 300,000 cubic yards (cy) between Topaz Groin and Redondo Beach Pier. Creation of dune habitat (0.5 acres) fronting County facilities near Topaz Groin. Renourishment is not expected to be necessary for at least 20 years.

10.2 Sand Sources

The projects at Zuma/Point Dume Beach and Redondo Beach will require a substantial quantity of beach nourishment (300,000 to 500,00 cy). Potential sand sources were evaluated, including those from harbor maintenance dredging, offshore borrow sites, and inland sources. Several sand sources were identified for further exploration as part of the next project phase. These include an offshore borrow site off Dockweiler State Beach investigated in 2011 as part of the Broad Beach Restoration Project, a Temporary Nearshore Placement Area off Redondo Beach used to store dredged sediment from Marina del Rey and King Harbor, and a potential borrow area located off Redondo Beach that was identified in the early 1980s.

10.3 Economic Benefits and Considerations

The probable cost of construction was estimated based on recent experience with similar projects in southern California. The costs include those for design, planning, permitting, monitoring, and construction. The cost for the preferred alternative at each site is provided below. A 25% contingency on the construction and monitoring costs is included.

Zuma Beach and Point Dume Beach:	$50.2M (does not include renourishment)
Dockweiler State Beach:	$ 1.9M
Redondo Beach:	$27.2M

Economic benefits derived from recreation, fiscal revenues, and ecological habitat were estimated for each project alternative and used, along with the probable cost of construction, to compute a benefit to cost ratio (BCR). The Dockweiler and Redondo Beach projects generated significant benefits relative to the project cost, resulting in a BCR of 7.8 in both cases. While benefits of up to $89M were generated as part of the Zuma and Point Dume Project, the high construction cost resulted in a BCR of 0.4, meaning that the benefits were not sufficient to cover the project cost.

10.4 Next Steps and Recommendations

The next two phases of the project are Preliminary Engineering and Design (Phase 2) and Environmental Review and Permitting (Phase 3). To expedite the permitting process, we recommend conducting these two phases in tandem. Areas of particular emphasis will be optimization of the renourishment interval and construction cost for the Zuma and Point Dume Project, identification and permitting of at least two sediment sources for each project, and development of detailed design drawings (90%).

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Attachment A

The following memorandum was prepared by Dr. Gary Griggs at the request of LACDBH and Coastal Frontiers to answer specific questions related to littoral processes near Zuma Beach and Point Dume.

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REVIEW OF COASTAL RESILIENCE PROJECT IMPLEMENTATION
PHASE 1: FEASIBILITY STUDY – FINAL REPORT
COASTAL FRONTIERS CORPORATION

APRIL 18, 2025

Scope of Review

The following document is a focused review of the Coastal Resilience Project Implementation Final Feasibility Study Draft Report and was prepared at the request of Coastal Frontiers as a response to two questions related to the Zuma Beach portion of the report submitted by a stakeholder:

1. Does the report accurately describe longshore sediment transport processes in the pocket between Lechuza Point and Point Dume?
2. Is it reasonable to expect that sediment placed at Zuma Beach is likely to benefit Westward and Point Dume Beaches in the future?

Introduction

As an introduction to this focused review, I believe it is important to state that Coastal Frontiers has a long and respected history as a coastal consulting firm with wide experience record in Southern California involving beach and shoreline processes including all phases of beach nourishment. This report is clear, comprehensive, well-referenced, up-to-date, and was assembled by an experienced and competent team of coastal scientists.

Question 1.

Does the report accurately describe longshore sediment transport processes in the pocket between Lechuza Point and Point Dume?

The section of coastline between Lechuza Point and Point Dume is part of the Zuma Littoral Cell, which extends from Mugu Submarine Canyon on the west to Point Dume on the east (Figure 1). A historically wide beach existed along this approximately four-mile-long stretch of coastline as a result of the trapping of littoral drift of sand moving west to east by the Pt. Dume headland (Figure 2). The ~32-mile-long shoreline from Point Mugu to the beginning of Santa Monica Bay trends roughly east-west such that littoral drift

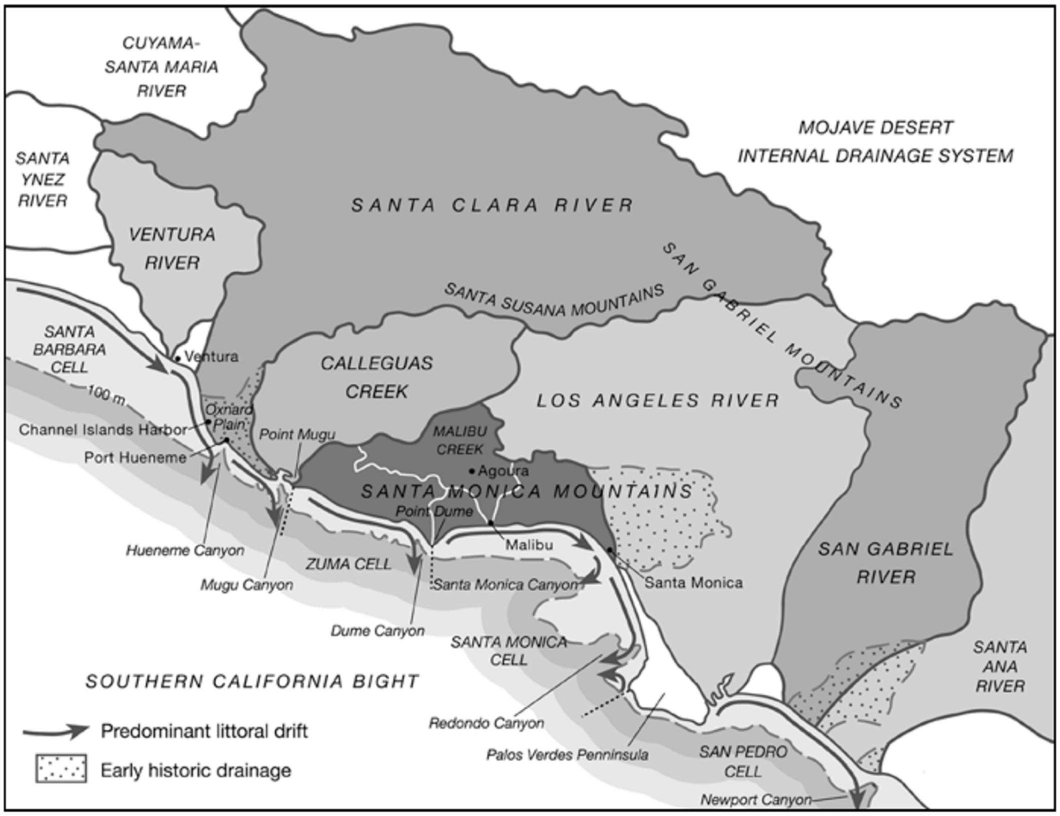

Figure 1. Littoral cells of the southern California coast (From Zoulas and Orme, 2007).

Figure 2. Pt. Dume looking west across Westward and Zuma beaches (1924 -Spence Collection UCLA).


Figure 3. View west from Point Dume towards Point Mugu showing the ~4-mile-long sandy beach that has accumulated against Point Dume as a result of littoral drift from the west (2005 photo).

driven by the dominant waves from the west move sand eastward (Griggs and Patsch, 2018). The accumulation of the sandy beaches and their configuration from Point Dume west to Lechuza Point provides strong evidence for easterly transport of littoral drift (Figures 1 and 3).

While there are seasonal differences in wave approach, the blocking effects of the offshore Channel Islands and the nearly east-west orientation of this section of shoreline, combined with the dominant waves from the west or northwest, drive littoral drift from west to east, or from Pt. Mugu along the entire Malibu coast to Santa Monica Bay.

Sand budgets determined for the stretch of coast indicate that the while there is a modest amount of sand provided at present by the few small creeks (~25,000 yds^3/yr.), and an even lesser amount provide by cliff/bluff erosion (~4,000 yds^3/yr), the major source of sand historically was leakage across the head of Mugu Submarine Canyon from the upcoast Santa Barbara Littoral Cell (Knur, 2000; Knur and Kim, 1999; Griggs and Patsch, 2018). About 1995, however, the headward growth of Mugu Canyon led to the interception of essentially all of the littoral transport. An erosion wave has slowly migrated through the Zuma Cell and has now led to the narrowing and then nearly complete loss of Broad Beach.

A report by Moffatt and Nichol (2009) includes a clear summary of this process:

*"Between 1938 and 1995, the portion of the net longshore sand transport rate of 1,065,000 yds^3/yr (810,000 m^3) that was captured in Mugu Canyon progressively increased from 0.88 to 1.0 as determined by measurements of the position of the canyon head relative to the shoreline in the canyon lee (Moffatt and Nichol 1995). In the 1960s, a seawall (*actually a rock revetment*) was constructed at the back of the adjacent beach… In response to a retreating shoreline, the rim of the canyon intercepted the structure and progressively more of the net transport rate was captured. The result was a measurable level of shore retreat up to 15 miles (24 km) downcoast".*

All prior studies of this area are in agreement regarding longshore sediment transport direction (Orme 2005; Zoulas and Orme, 2007; Griggs & Associates, 2008; Everts, 2012; Griggs and Patsch, 2018; George, et al., 2018). The Coastal Frontiers report, therefore, accurately describes longshore sediment transport processes and direction along the shoreline between Lechuza Point and Point Dume - sand moves from west to east along the Zuma Beach and Point Dume Beach shoreline. (Question 1).

Question 2.

Is it reasonable to expect that sediment placed at Zuma Beach is likely to benefit Westward and Point Dume Beaches in the future?

Based on the above discussion responding to Question 1 that concludes that littoral drift or longshore transport of sand moves from west to east, any sand placed on Zuma Beach will over time move eastward towards Point Dume. As the upcoast supply of sand that was bypassing the head of Mugu Canyon was gradually reduced in the mid- to late-1990s, an erosion wave moved to the east or downcoast and was first felt at the beach immediately east of Lechuza Point. Due to the loss of the littoral sand supply by the headward erosion of the Mugu Submarine Canyon, the erosion wave continued east, narrowing the downcoast beaches. Although older photographs (Figure 4) show a significant beach immediately east of the Lechuza Point, by 2004, the first 1,300 feet of shoreline east of Lechuza Point had no dry sand exposed (Figure 5; Griggs & Associates, 2008). During a site visit in August 2008, there was no dry beach at a distance of ~1,500 feet east of Lechuza Point, as the existing beach sand was being transported east towards Point Dume. Sandbags had been emplaced for protection, which were short lived (Figure 6). These were replaced by 2010 with a rip rap revetment that extended essentially the entire frontage of the 109 homes on Broad Beach Drive as the erosion wave continued to migrate eastward (Figure 7).

Figure 4. 1972 aerial photograph showing wide beach at western end of Broad Beach next to Lechuza Point (California Coastal Records Project).

Figure 5. September 2002 aerial photograph showing lack of beach at Lechuza Point end of Broad Beach (California Coastal Records Project).

Figure 6. Sandbags were placed along the western end of Broad Beach in 2008.

Figure 7. By 2010 a rip rap revetment extended the entire length of Broad Beach as the beach progressively eroded eastward (California Coastal Records Project).

I believe that the late Craig Everts had as good an understanding of the Zuma Littoral Cell including the reach from Lechuza to Point Dume as any other coastal scientist that I am aware of. In his 2012 report (Everts, 2012), he stated:

If artificially placed at Broad Beach, sand, with the appropriate size distribution (and, of course, taken from outside any littoral zone) will initially benefit Broad Beach. Over time, it will move east thereby temporarily benefiting Zuma and Westward Beaches. But in due course, almost all of it will pass Point Dume and most of it will pass Malibu. It will eventually end up at Santa Monica and Venice. Its behavior as it moves east will be the same as that of sand that entered the coastal stream in the past from as far away as Port Hueneme.

Zoulas and Orme (2007) also carried out a comprehensive study of the Zuma Littoral Cell shoreline and beach changes and their relation to climate cycles (Pacific Decadal Oscillation cycles). Their conclusions are stated below from the 2007 publication:

*The Zuma littoral cell is thus a discrete segment of coast extending from Point Mugu to the bold promontory of Point Dume, which acts as a natural groin trapping littoral drift at the eastern end of the cell. There, some beach sand moves onshore with the prevailing westerly wind, forming backshore dunes… but most beach forming sediment is deflected by the headland into Dume Canyon offshore, thereby starving beaches to leeward of the point.….waves approaching from the west along the Santa Barbara Channel (*Figure 8*), window 1)…and from the southwest between the northern Channel Islands and San Nicholas Island (window 2) promote strong littoral drift eastward to Point Dume… Although southeasterly storm waves are generated briefly ahead of winter storms passing across the Southern California Bight (window 4), their effect on the Zuma cell is minimal, protected as it is by Pont Dume. Beach erosion is aggravated when storm waves are superimposed on super-elevated ocean levels and high tides, notably under El Niño conditions.*

All previous work in the Zuma Cell makes it clear that littoral drift of sand moves from west to east from Broad and Zuma beaches towards Point Dume and Westward beaches. Any sand added artificially to Zuma Beach as proposed in the Coastal Frontiers Feasibility Study will be transported east towards Point Dume, with a rate dependent upon the wave and sea level or tidal conditions. In other words, yes, any sediment placed at Zuma Beach will benefit Westward and Point Dume Beaches in the future.

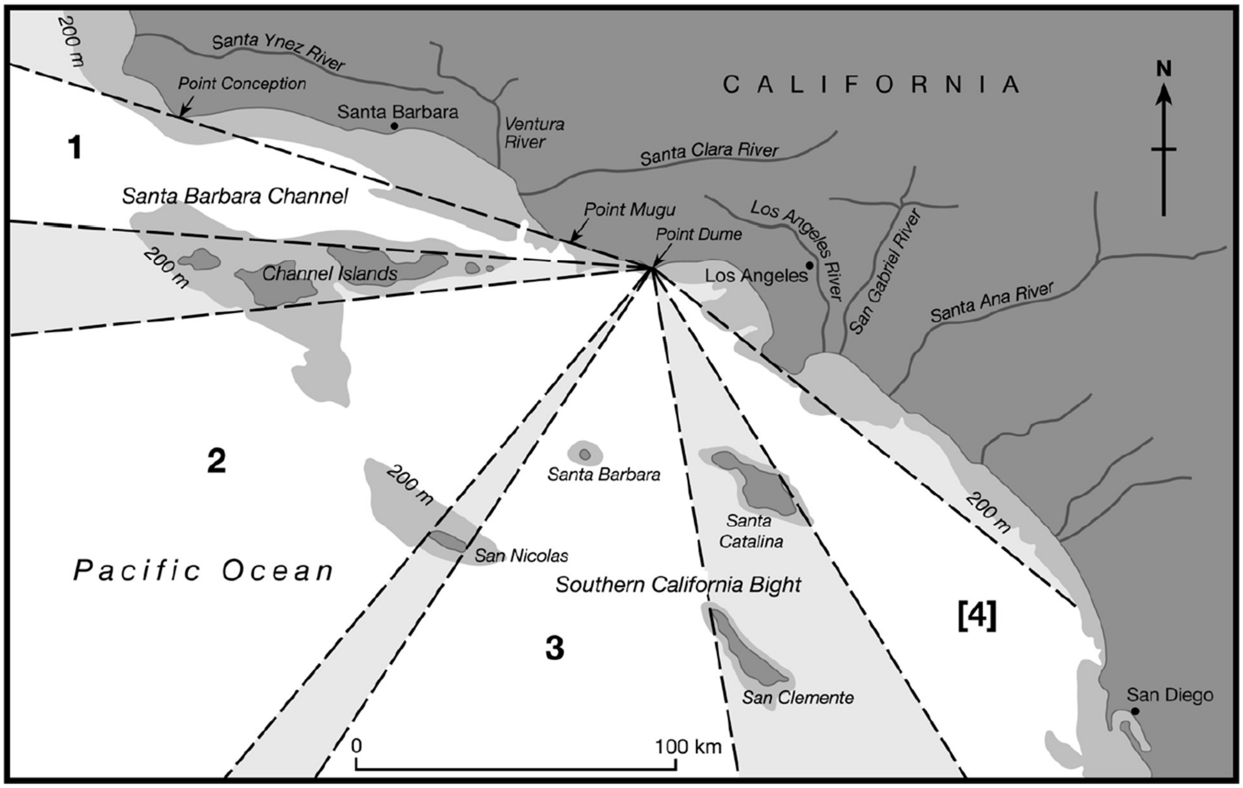

Figure 8. Southern California Bight showing wave exposure of the shoreline between Lechuza Point and Point Dume (from Zoulas and Orme, 2007)

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Respectfully submitted,

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