los angeles county

CRSMP 2012

coastal regional sediment management plan

Coastal Regional Sediment Management Plan
Los Angeles County Coast

Prepared by

Noble Consultants, Inc.
and
Larry Paul and Associates

In collaboration with
U.S. Army Corps of Engineers Los Angeles District
California Coastal Sediment Management Workgroup

Susan M. Ming, U.S. Army Corps of Engineers, Los Angeles District
Heather R. Schlosser, U.S. Army Corps of Engineers, Los Angeles District

August 2012

Table of Contents

Introduction 1

The Los Angeles County Coast 5

Historical Perspective 15

Sediment Inventory 19

Coastal Sediment Issues 33

A Plan for the Urban Coast 37

Credits 59

References 60

Appendix A - Habitats and Sensitive Biological Resources 61

Appendix B - Los Angeles County CCSTWS

INTRODUCTION

Regional Sediment Management (RSM) is a planning approach that seeks to address coastal sediment processes and issues on a broader geographic scale. It recognizes that sand, cobble, and fine sediment is an important natural resource that is critical to the environmental health and economic vitality of the coastal zone. The sediment is what makes up the beaches, resides offshore in significant deposits, and is delivered to the coast from inland source areas by the various rivers and stream s. The relevant sediment processes extend from inland watersheds to offshore areas. This broad coverage overlaps multiple geopolitical boundaries and explains why a regional planning perspective is needed.

Regional Sediment Management is about having greater understanding and knowledge about all of the interrelationships between coastal and offshore sediment deposits, inland origins of coastal sediment, sediment pathways to the coast, and how sand moves about the shoreline. From this knowledge base, improved sediment management decisions, policies, and practices can be formulated and implemented on a regional scale to preserve or enhance existing beaches, address inter-related resource needs and opportunities, and optimally manage coastal projects for the regional benefit.

Regional sediment management is about having greater understanding and knowledge about sediment origins, pathways, and movement.

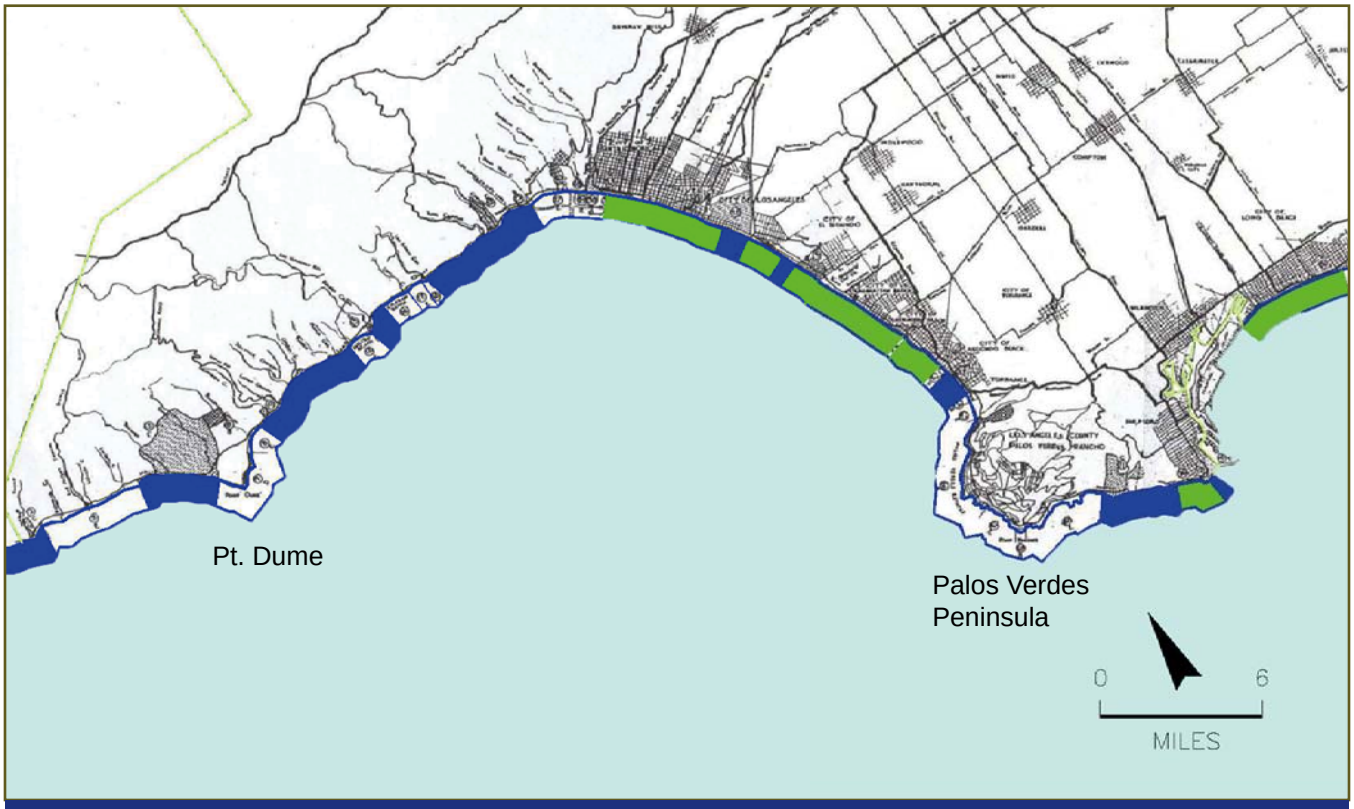
California has been actively engaged in finding ways and means to resolve coastal erosion and sediment management issues on a broader scale. The process has been formalized by the State Resources Agency and its member Departments by joining together with the US Army Corps of Engineers (USACE) and other advisory groups to form the Coastal Sediment Management Workgroup (CSMW). This multi-agency body has been tasked to coordinate the development of a California Sediment Master Plan (SMP). In recognition of the diverse nature of the California coastline, the CSMW intends to fulfill this objective by developing a series of Coastal Regional Sediment Management Plans that are geographically specific to and target the distinct shoreline regions of the California coast. Each regional plan is intended to formulate locally relevant consensus-driven sediment management policy and guidance in order to restore, preserve and maintain coastal beaches and other critical areas of sediment deficit to sustain recreation and tourism, enhance public safety and access, and restore coastal sandy habitats.

Since 1930, Los Angeles County has been a world leader in regional beach planning, shoreline preservation, and recreation management. Throughout much of the past century, its beaches have been widened and stabilized, lands have been set aside for public use, and one of the largest beach maintenance operations was created. These landmark programs grew from the visionary efforts and action inaugurated by the Board of Supervisors in the late 1920's in concert with the Citizens' Committee on Parks, Playgrounds and Beaches. Composed of distinguished civic leaders and prominent public figures, the civic group was tasked to survey the existing recreational resources in Los Angeles County, suggest needed improvements, and recommend how best to implement an enhanced County-wide program to address future population growth and demand.

The Committee's report, published in 1930, was important for several reasons. It represented the first formal recognition of the public benefit of beaches and the enormous value of the resource to the region. A key finding of the study was its determination that the public's highest recreation priority should be for more and better beach and waterside facilities. The committee established the urgency for action to preserve and maintain the existing beaches and provide for additional resources to meet the anticipated needs and demands in the future. The report also made recommendations for acquisition of additional beach frontage that ultimately resulted in the County-wide network of public beach facilities that exist today.

The Committee's recommendations were ultimately acted upon by the Board of Supervisors into a series of specific goals and objectives that established a long-term visionary beach plan:

- The joint purchase by the County and State of many miles of privately owned beaches;
- Preservation of acquired areas through comprehensive studies and reclamation of beach areas via construction of groins and other coastal structures;
- Establishment of self-supporting concessions;
- Increased use by the public;
- Provision of ample facilities for aquatic sports; and
- Adequate maintenance.



Public beach frontage of the Los Angeles County shoreline in 1930. Green denotes extent of public beaches in 1930. Blue designates recommended to be acquired for public access at that time.
Source: Map from portion of Plate 35 by Olmsted Brothers, Bartholomew & Associates, 1930

For the past 80 years, Los Angeles County has been implementing this plan through various beach nourishment projects, construction of sand retention structures, acquisition and development of public facilities, and diligent maintenance. As a result, the beaches in Los Angeles County have been transformed into one of the world's most recognizable features and important public resources. It is within this context that the Los Angeles County Coastal Regional Sediment Management Plan (CRSMP) has been advanced.

Development and adoption of the Los Angeles County CRSMP now provides the opportunity to revisit its past and ongoing programs, fine tune its goals and objectives, and map practical implementation strategies into the future.

To be effective, the Plan must be:

- technically sound and practical;
- environmentally sensitive;
- politically realistic; and
- financially feasible and sustainable.

Fulfillment of this rigorous test requires a clear understanding of what needs to be addressed and what objectives are possible. The traditional study and analysis steps to accomplish this are threefold:

- understand the physical setting, baseline science, and relevant processes;
- identify the relevant issues that currently exist;
- formulate appropriate action plans and solutions for each issue that have unanimity of purpose to positively move forward.

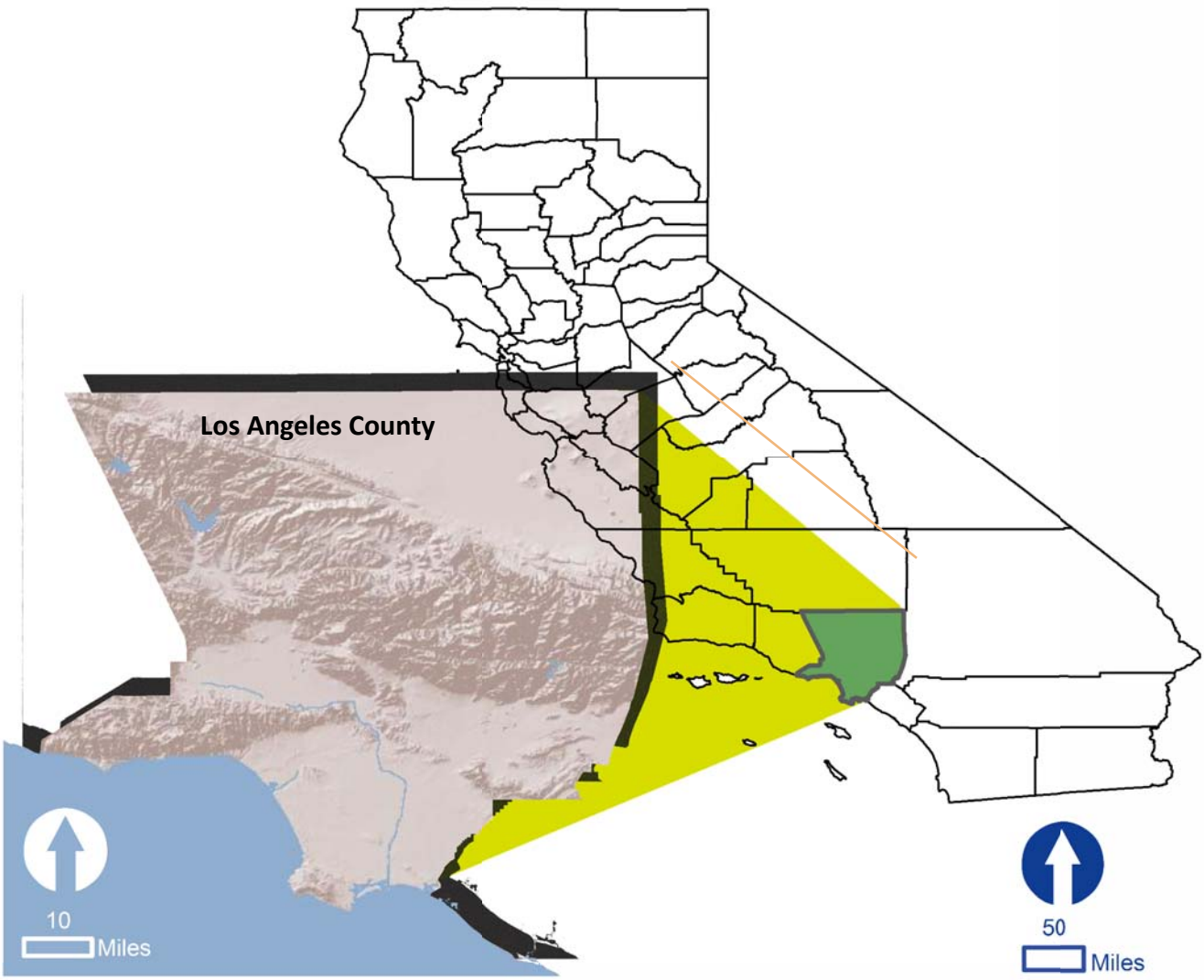
When applied to coastal sediment management, the results will allow Los Angeles County to identify and understand the issues, goals, and objectives of its beaches and shoreline more clearly so that strategy, policy, and capital improvement projects can be more effectively targeted and better focused to clear purpose and consensus within the coastal zone.

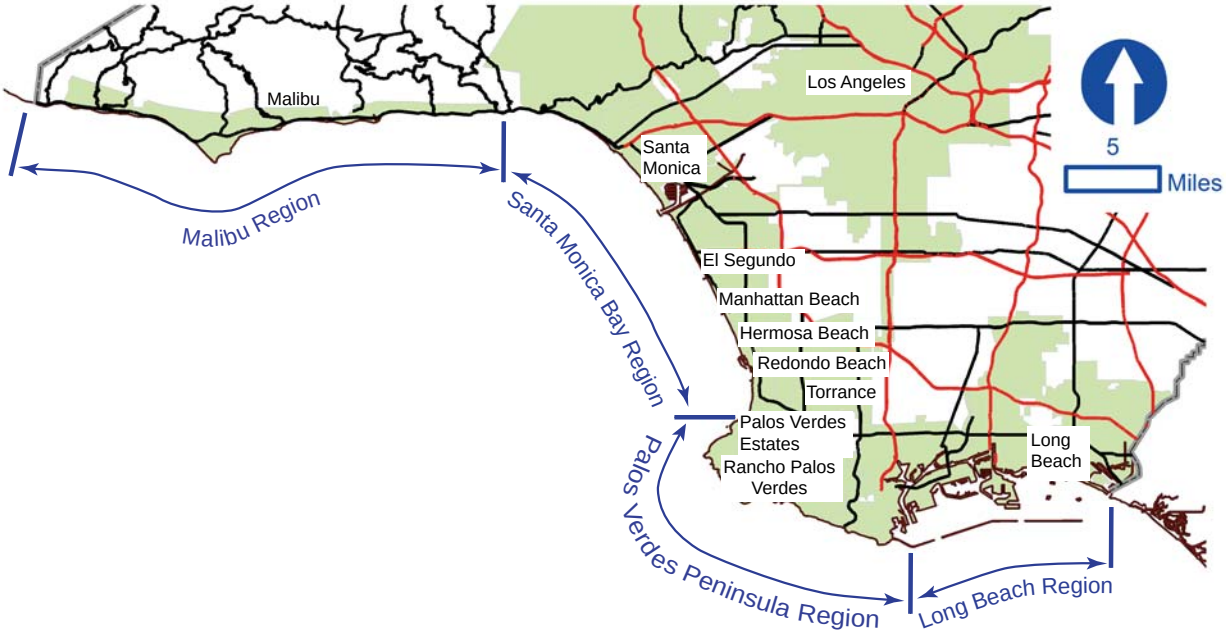
Therefore the ultimate purpose of the CRSMP is to develop a comprehensive road map that will enable the County to continue its programs to conserve and restore the valuable sediment resources along its coastline to reduce shoreline erosion and coastal storm damages, protect sensitive environmental resources, increase natural sediment supply to the coast, preserve and enhance beaches, improve water quality, and optimize the beneficial use of material dredged from harbors and other available sediment sources.

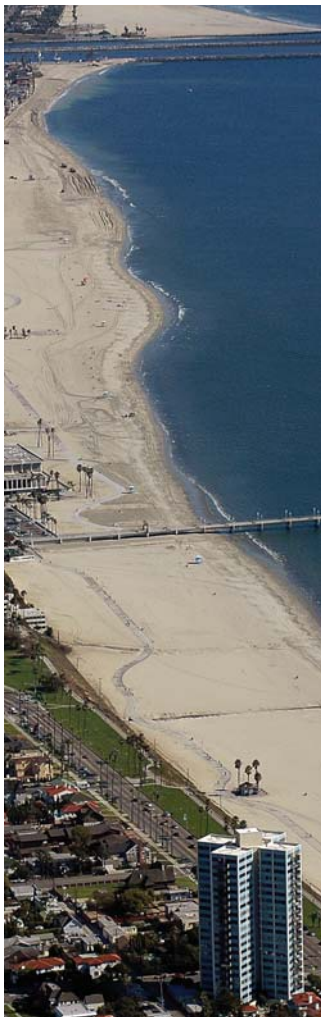
The Los Angeles County Coast

The Los Angeles County shoreline is approximately 74 miles long and extends from the Ventura County line at the west end to the mouth of the San Gabriel River and Orange County to the southeast. The stretch of coast is tributary to the most populated area in California where over 9.6 million people currently reside within the County's limits. The shoreline stretches over eleven cities and County and State land within a diverse and dynamic physical environment that has been significantly altered by regional growth and urbanization.

For planning purposes the Los Angeles County shoreline segment may be divided into four distinct regions that vary in their shoreline orientation, physical characteristics, land use, and population density.




Malibu
Los Angeles
Santa Monica
5
Miles
Malibu Region
Santa Monica Bay Region
El Segundo
Manhattan Beach
Hermosa Beach
Redondo Beach
Torrance
Palos Verdes Estates
Rancho Palos Verdes
Long Beach
Palos Verdes Peninsula Region
Long Beach Region



Malibu Region

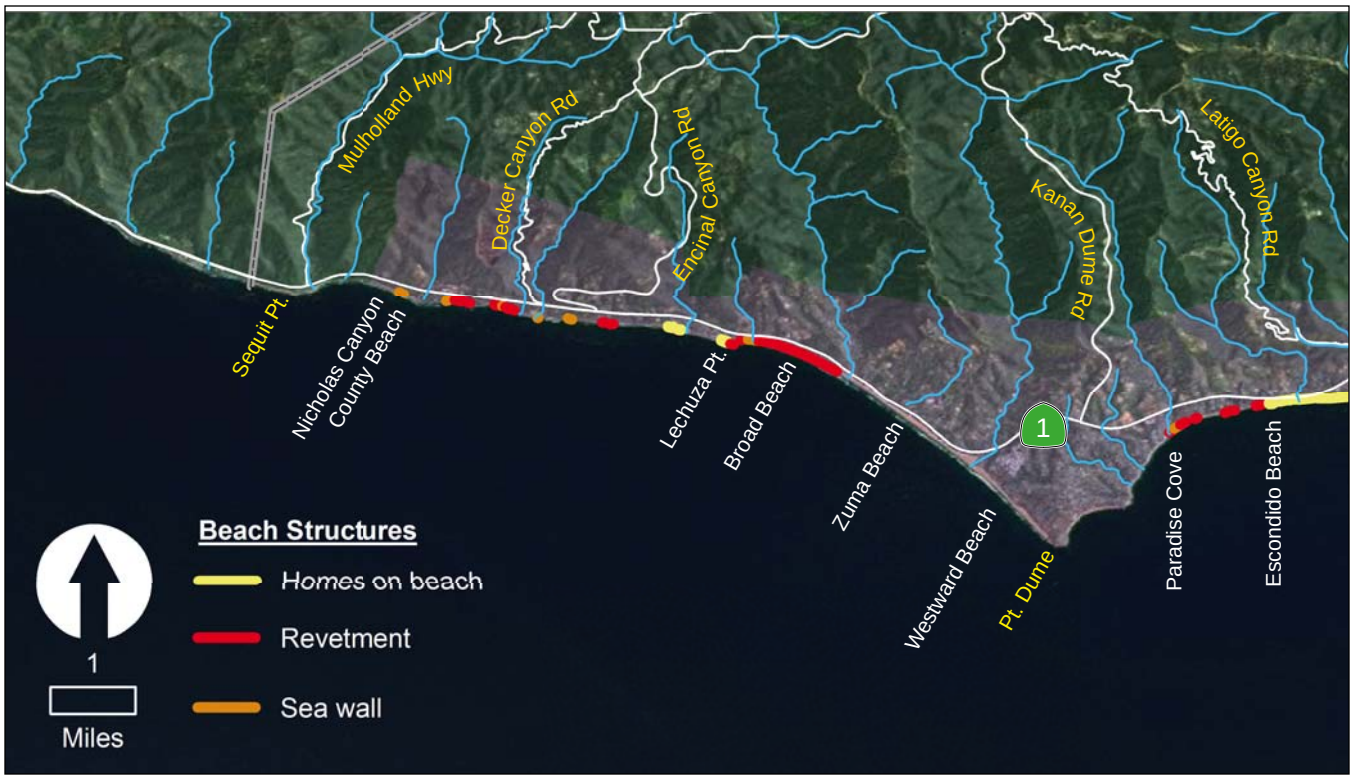
The Malibu Region extends for approximately twenty-four miles from the Ventura/Los Angeles County line to Topanga Canyon. The east-west shoreline orientation consists of a succession of narrow sandy beaches flanked by more resistant rocky headlands. The beaches that do exist are mostly the result of their proximity to the mouths of streams and the sand retention features of downcoast bedrock exposures or boulder forms at the stream mouths.

The coastline is backed by the Santa Monica Mountains and fronted by high cliffs that level off to broader marine terraces of varying width. Wider stretches of sandy beach exist at Zuma Beach and along the Malibu Colony sand spit. East of Malibu Creek, the beaches gradually diminish in width to narrow or non-existent conditions between Las Flores and Topanga Canyon. An aberrant wider beach occurs at the mouth of Topanga Canyon Creek but reverts again to a narrower strand to the east littered with boulders, cobble, and other debris.

The large outcrop of Point Dume and the adjacent Dume Submarine Canyon mark the boundary between the western, central and eastern sections of Malibu. Population density is generally more sparse in the western area and becomes more dense and populated east of Point Dume.

West of Topanga Canyon Boulevard within the Malibu shoreline the beach frontage is a mixture of private development and public infrastructure. Much of the Pacific Coast Highway and private development has encroached upon the historically sediment limited beach environment.

The public beaches are generally limited to pocket beach segments. Their improvements consist of public beach accessways, administrative buildings, parking lots, rest rooms, and lifeguard stations to provide the necessary facilities and amenities for beach recreation.



Photographs clockwise from above:

Nicholas Canyon County Beach, Broad Beach, La Costa Beach, Puerco Beach, and typical West Malibu coastline near Encinal Canyon Road.

Santa Monica Bay Region

The Santa Monia Bay Region extends from Topanga Canyon to Malaga Cove. This 21-mile long stretch of the Santa Monica Bay is the most densely populated segment of the Los Angeles County coastline. Its general north-south alignment consists of relatively wide beaches that are the direct result of artificial nourishment and construction of numerous groins and breakwaters that were mostly built between the 1930s and 1960s. Beaches at the west enu

d of the segment are narrow and gradually widen to Temescal Canyon but markedly widen further south as a result of the sand retention effects of the Santa Monica Breakwater and the Will Rogers State Beach Groin Field. Marina del Rey and Redondo King Harbor dominate the central and southern portion of the reach. The Redondo Submarine Canyon is the prominent offshore feature immediately south of Redondo-King Harbor.

East of Sunset Boulevard, the shoreline has been significantly enhanced as the beaches have been artificially widened to accommodate greater public visitation. Over 35 million cubic yards of sand has been imported from inland and offshore source areas and placed on the beaches starting in the late 1930's.

Two recreational harbors – King Harbor and Marina del Rey – were developed between the late 1930's and the early 1960's, respectively. Along this reach, private development is generally well set back from the shoreline or is located atop bluffs that are protected by retaining walls. Public beach facilities throughout the shoreline segment include rest rooms, lifeguard stations, and parking lots. In addition, Dockweiler Beach is the site of the heavily used recreational vehicle campground facility. Industrial land use between Dockweiler Beach and Manhattan Beach includes the Hyperion Sewage Treatment Plan, power generation facilities, and the Chevron Oil Refinery.

The regional County maintenance facility at Venice Beach coordinates beach maintenance work and emergency responses between Venice Beach and Marina del Rey. Similar facilities are also located at Will Rogers State Beach, Dockweiler Beach, Hermosa Beach, and Torrance Beach.

Photographs:

Below: Santa Monica Bay from Pacific Palisades.

Facing page top to bottom:

Venice Beach, Manhattan Beach, Hermosa Beach, Redondo Beach

1
Miles
Santa Monica Bay Region
Castle Rock
Sunset Blvd
Pacific Palisades
Will Rogers State Beach
Santa Monica Canyon
1
Santa Monica State Beach
Wilshire Blvd
Santa Monica Pier
10
Venice
Venice City Beach
Venice Pier
Marine del Rey
Playa del Rey
Dockweiler State Beach
Imperial Hwy
El Segundo
Chevron Groin
Manhattan County Beach
Manhattan Beach
Manhattan Beach Pier
Manhattan Beach Blvd
Hermosa Beach
Hermosa Beach Pier
Aresia Blvd
Redondo-King Harbor
Redondo County Beach
Torrance Beach
Redondo Beach
Malaga Cove

Palos Verdes Peninsula Region

The Palos Verdes Peninsula Region is approximately 16 miles long and extends from Malaga Cove to San Pedro. The peninsula's rolling hills are fronted by a shoreline that consists of narrow rocky, gravelly pocket beaches backed by high seacliffs that are up to 150 feet high. Sediment contribution to the rocky shoreline is nominal and primarily comes from seacliff erosion, active landslides, and small local streams. The shoreline within this cell has experienced little or no shoreline evolution, except for the Abalone Cove and Portuguese Bend areas where more recent landslides have advanced the shoreline since the 1950s.

Photographs clockwise from above: Malaga Cove, Bluff Cove, Royal Palms County Beach, coastline between White Point and Long Point, and Lunada Bay.

Palos Verdes Region
Lunada Bay
Bluff Cove
Malaga Cove
Palos Verdes Estates
Point Vicente
Hawthorne Blvd
Long Point
Abalone Cove
Rancho Palos Verdes
Portuguese Bend
Palos Verdes Dr
N 25th st
Western Ave
Royal Palms County Beach
White Point County Beach
San Pedro
110
Gaffey St
Point Fermin
Port of Los Angeles
Cabrillo Beach
1
Miles

Long Beach Region

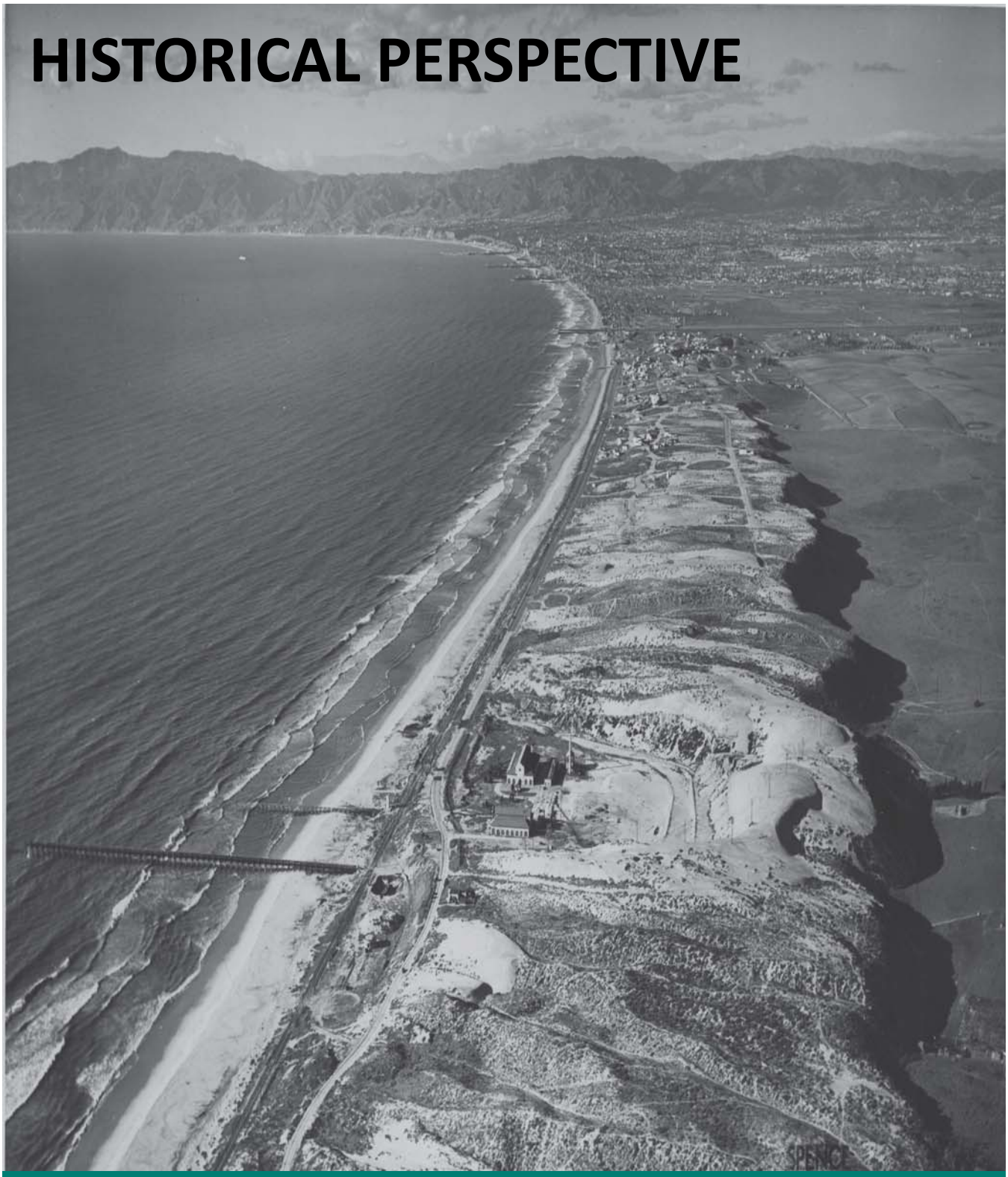
The section of coast is dominated by the industrial Los Angeles/ Long Beach commercial port complex. Beaches within the twelve mile long segment consist of the isolated man-made pocket beach of Cabrillo Beach, and the City of Long Beach strand which includes the Belmont and Peninsula Beaches. Historically sediment supply in this littoral cell has been from the Los Angeles River; however today most of the fluvial delivery is unsuitable fine grained silt and clay.

In the City Beach of Long Beach, the west jetty of the Alamitos Bay and the San Gabriel River mouth acts as a littoral barrier that impacts the natural sand supply for Peninsula Beach. Sand regularly migrates upcoast and creates a localized erosion hot spot. Consequently, regular sand bypass operations have been conducted over the years to replenish Peninsula Beach with sand that accumulates at the wider and more stable Belmont Shore segment.

Photographs top to bottom: beach near Marina Green Park; looking east from Bluff Park; Bluff Park to Belmont Shore; Peninsula Beach and County line

Long Beach Region

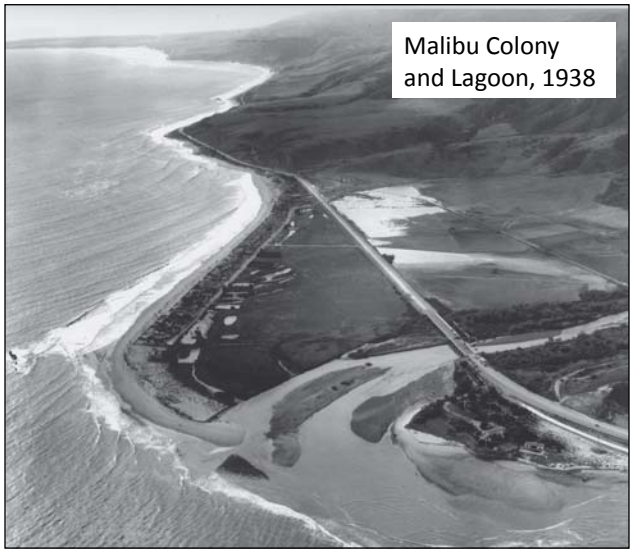
HISTORICAL PERSPECTIVE



Dockweiler Beach in 1941 showing the narrow shoreline that typified the Los Angeles County coast prior to the massive program of beach fills. The Hyperion Dunes were the source of sand that were excavated that eventually transformed the Santa Monica Bay beaches into their wide widths that exists today.

The Los Angeles County shoreline was a much different place 100 years ago. Beaches at that time were more narrow than they are today, and up until the late 1880s, the coast was sparsely populated. However, shortly after the founding of Santa Monica in 1875 the first bathhouses, dance halls, amusement piers, and other attractions were opened on the beach. These improvements and the Southern Pacific Railroad's attempt to develop Santa Monica Bay into a regional port and tourist destination gave birth to the leisure industry, modern tourism, and the demand for coastal property. By the 1920s, booming business in oil, transportation, aeronautics, real estate, and entertainment brought professionals and industry to Los Angeles establishing it as a major city in the United States. With the rapid growth came change and a demand for more private beach clubs, commercial development, and homes along the coast. When the Pacific Coast Highway was built and opened in the 1920s, the demand for coastal property extended into Malibu whereupon private development proliferated and began encroaching on the narrow beaches there.

The demand for coastal property and leisure industry opportunities throughout the Los Angeles County resulted in a classic development encroachment that has been typical throughout Southern California. Between the 1920s and 1950s homes and infrastructure were built close to or on the beach putting many of them at risk to the destructive effects of storm surf or localized shoreline


Malibu Colony and Lagoon, 1938

Torrance Beach, 1930

Redondo Beach , 1930

Long Beach , c. 1930

erosion. As was typical of the time, non-coordinated efforts began in the early 1900s to either retain, manage areas of the shoreline, or protect property along a coastline that was quickly evolving into a densely populated urban setting. Groins, breakwaters, seawalls, and other coastal structures were built between Malibu and Long Beach to retain sand, stabilize channels, shelter harbors, provide small craft moorings, and protect ocean piers, coastal development, highways, and stormwater outfalls. The net result of this piece-meal action implemented over a span of nearly 100 years is that much of the Los Angeles County coast has been significantly impacted by man.

Ultimately the growth within Santa Monica Bay contributed to a dramatic shift in beach conditions when a series of coastal developments and beach nourishments began in the early 1930s. Construction of the Santa Monica Breakwater, Hyperion Wastewater Treatment Plant, and Marina del Rey harbor dramatically altered the shoreline. These three developments have been responsible for providing nearly all of the sand that exists on the beaches today. Since the initial construction of the Hyperion sewage treatment facility in 1938, excavation of sand dunes within the plant site has contributed over 15 million cubic yards of sand that was distributed along six miles of shoreline between El Segundo and the Santa Monica Pier. Dredging of the Marina del Rey basins and channels in the early 1960's provided another 3.2 million cubic yards of sand that was used to further widen Dockweiler Beach.

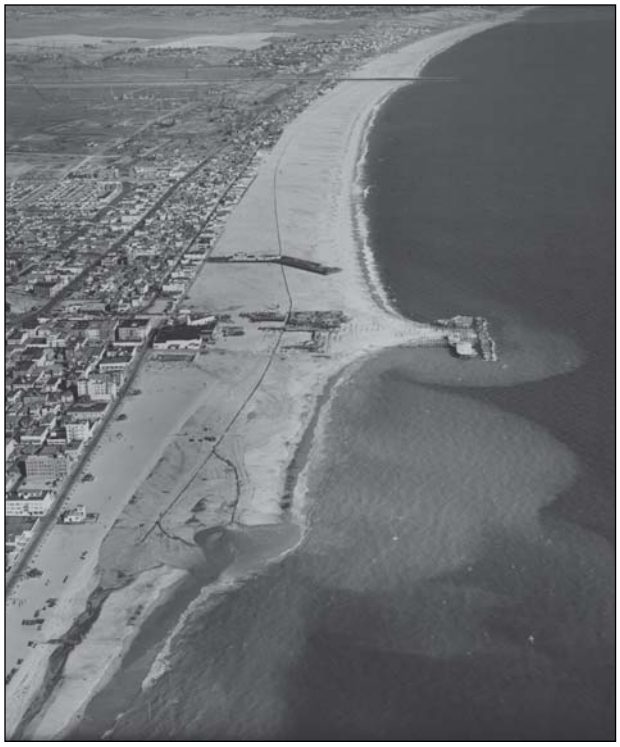
The last significant artificial nourishment took place at Redondo/Torrance Beach when approximately 1.4 million cubic yards of sand was dredged from a nearby offshore borrow area and placed on the beach in the late 1960s.

Other nourishment projects have also been conducted over the past 70 years. The beaches within Santa Monica Bay have been augmented by over 30 million cubic yards of sand. The net result of these actions is that the Santa Monica Bay shoreline has evolved largely as a consequence of the artificial sand nourishments and shoreline stabilization projects into a nearly continuous stretch of wide publicly accessible strand. The beaches between Santa Monica and Torrance have been substantially widened from 200 feet to over 600 feet which represents a significant public asset. It is this shoreline history that primarily defines what the Los Angeles County coast is today.

The Malibu coast has been mostly privatized although several notable and important public beach facilities have been created within this reach.

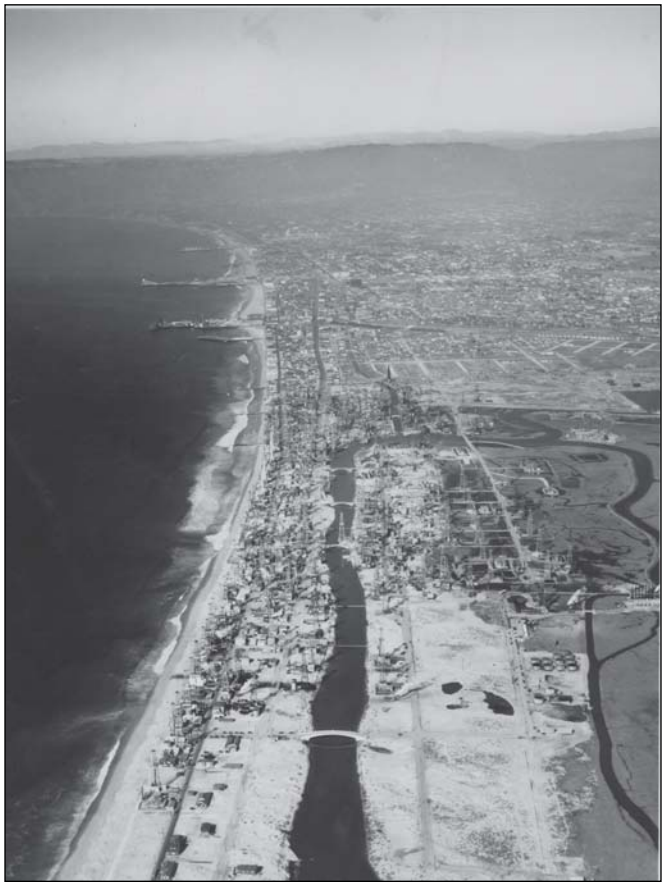
The Palos Verdes hills coastline remains today much like it existed in the past. The high cliffs and rocky beaches have limited recreational opportunities such that much of the land use is confined to single family residential uses.

The urban Long Beach strand has been defined by the commercial harbor development of the neighboring commercial port facilities. The extensive offshore breakwater system that was built in the early 1900s to protect the inner harbor area has created a mostly sheltered beach environment that is unique to the reach.

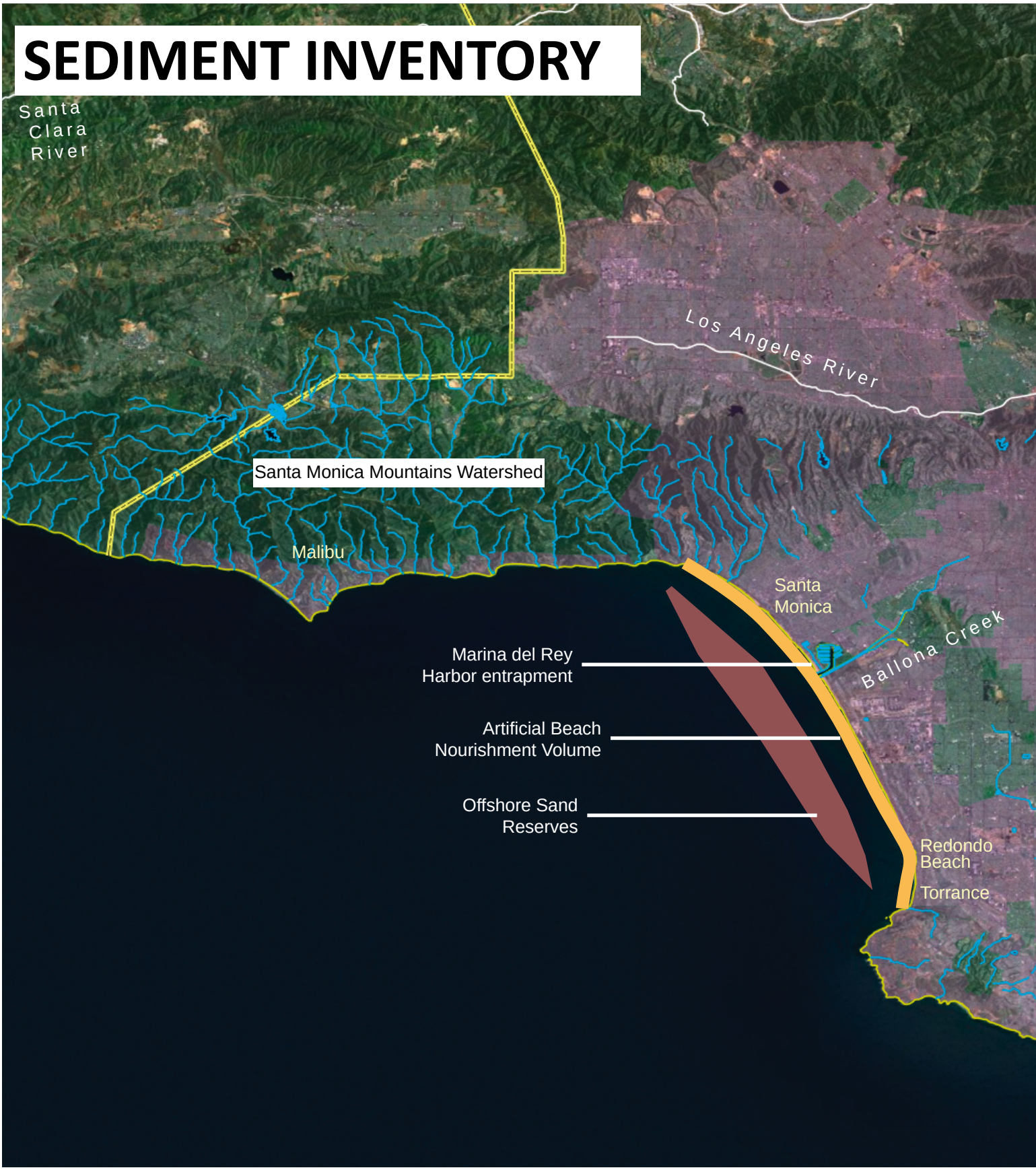


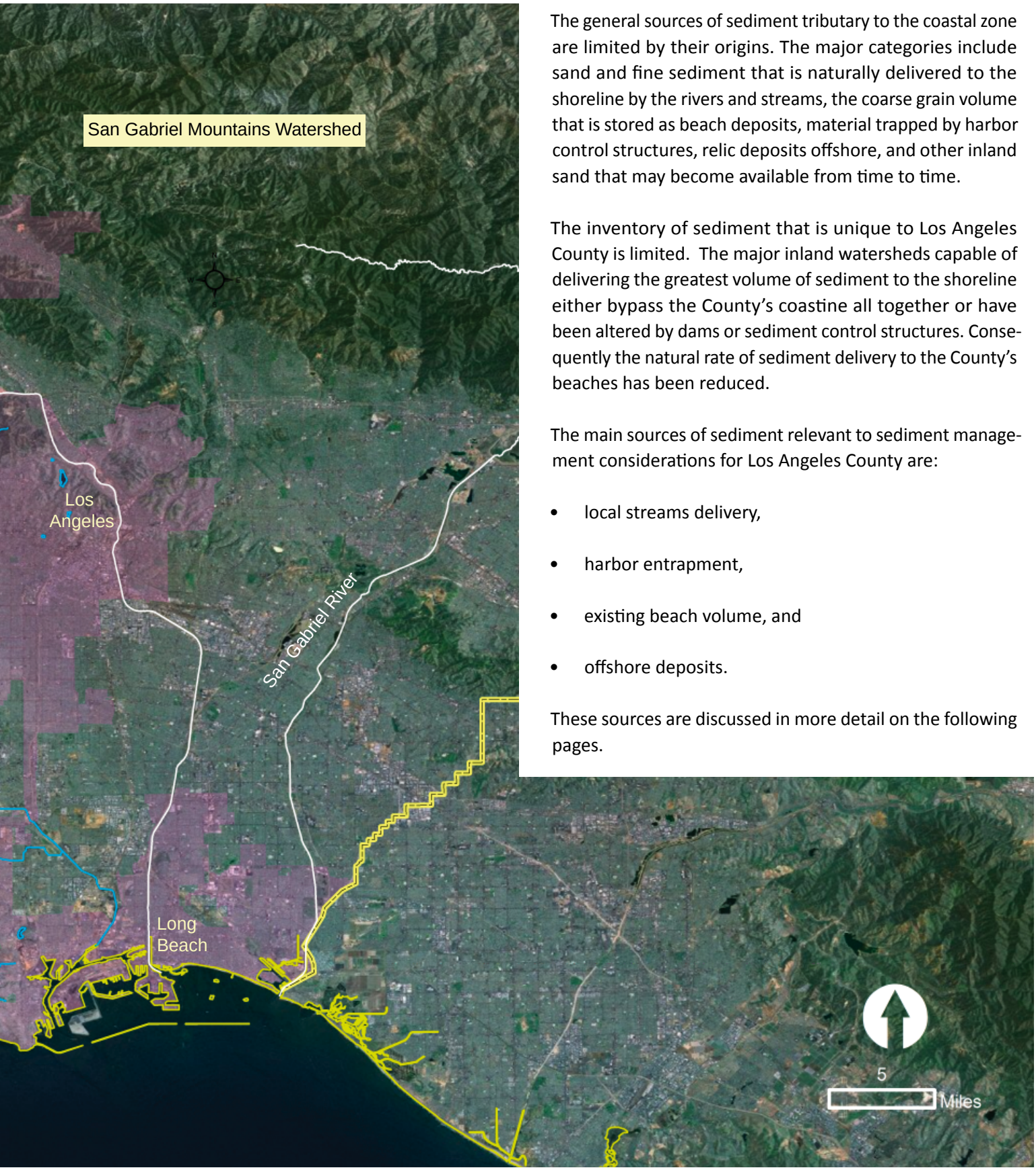
Photographs: Facing page: Marina del Rey Harbor during 1960 construction.

Clockwise from top left: Hyperion sand placement nearing end of completion in Santa Monica, 1948; Santa Monica Pier c. 1938.; Ballona Creek looking north to Venice Beach after completion of Hyperion nourishment in 1948; Venice Beach in 1931 prior to the Hyperion Beach nourishment.



SEDIMENT INVENTORY





The general sources of sediment tributary to the coastal zone are limited by their origins. The major categories include sand and fine sediment that is naturally delivered to the shoreline by the rivers and streams, the coarse grain volume that is stored as beach deposits, material trapped by harbor control structures, relic deposits offshore, and other inland sand that may become available from time to time.

The inventory of sediment that is unique to Los Angeles County is limited. The major inland watersheds capable of delivering the greatest volume of sediment to the shoreline either bypass the County's coastine all together or have been altered by dams or sediment control structures. Consequently the natural rate of sediment delivery to the County's beaches has been reduced.

The main sources of sediment relevant to sediment management considerations for Los Angeles County are:

- local streams delivery,
- harbor entrapment,
- existing beach volume, and
- offshore deposits.

These sources are discussed in more detail on the following pages.

Rivers and streams

The Los Angeles County shoreline is unique in that the natural delivery of sand to its beaches is relatively low as there are no major rivers that discharge to the shoreline between Malibu and Long Beach. The region's three major river watersheds - Santa Clara, Los Angeles, and San Gabriel – essentially bypass the County's coastline such that sediment discharged from these major tributaries does not and never did nourish Los Angeles County beaches throughout modern geologic time. The Santa Clara River is the largest river system in southern California that remains in a relatively natural state. Although it delivers on average about 1.2 million cubic yards of sediment to the coast annually, the mouth discharges in Ventura County upcoast of the Mugu Submarine Canyon where most if not all of the sand is ultimately lost before it can reach the Los Angeles County coast.

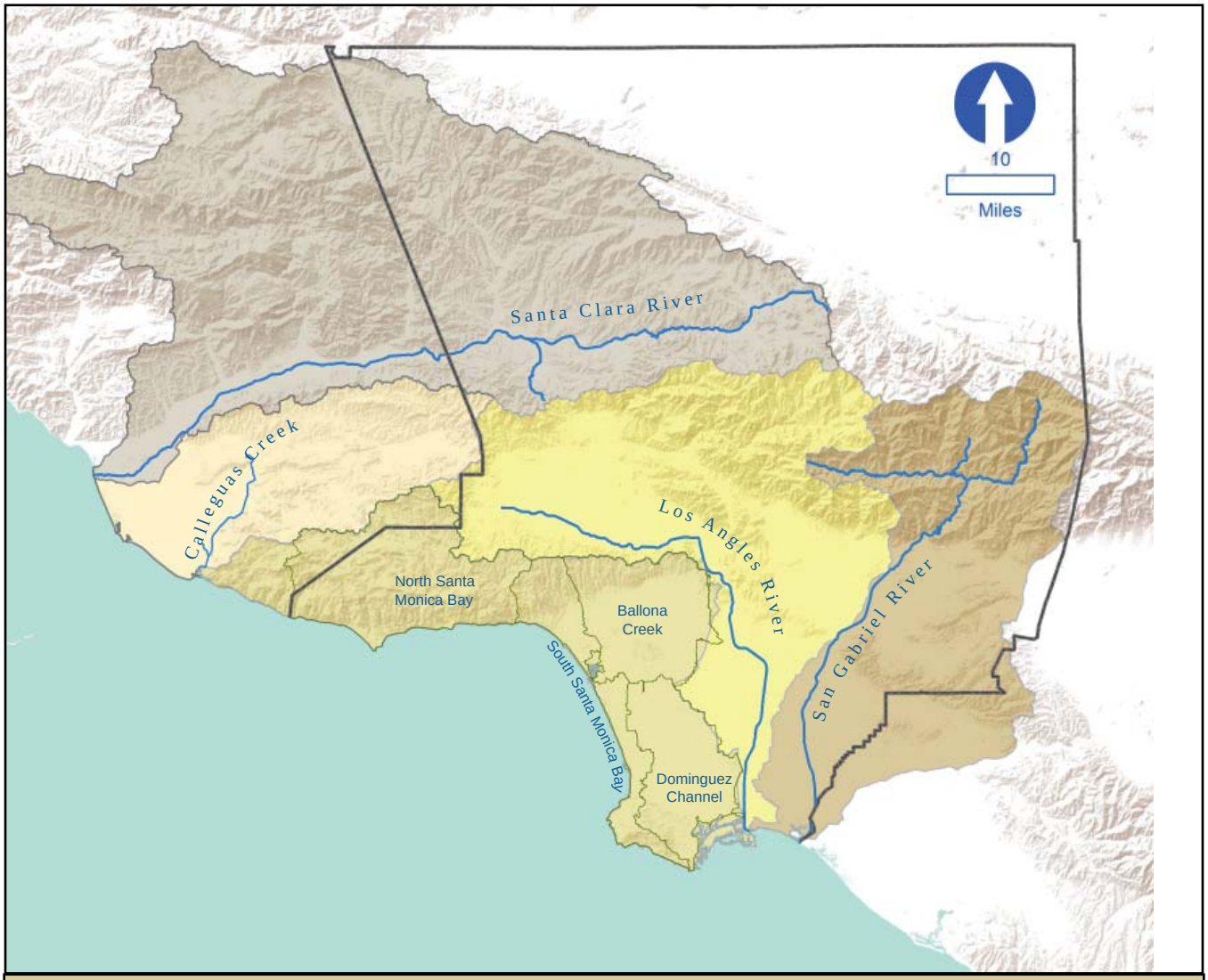
The Los Angeles River Watershed includes land area from the eastern slopes of the Santa Monica Mountains, Simi Hills, Santa Susana Mountains, and San Gabriel Mountains. The densely populated urban watershed has been significantly channelized and controlled to the point where the estimated annual sediment delivery that discharges into East san Pedro Bay is about 77,000 cubic yards. However most of the sediment is fine grained, at times contaminated, and does not now contribute to any beach nourishment within the reach.

The San Gabriel River Watershed located within the eastern portion of Los Angeles County delivers approximately 59,000 cubic yards of sand per year to the coast under present-day conditions. However the sediment discharges at the river mouth located at the southern end of Long Beach and completely bypasses Los Angeles County beaches.

Sediment supply to the Los Angeles County coastline is confined primarily to fluvial sources from the Santa Monica Mountains watershed between Point Mugu and Santa Monica Canyon. This region contains 19 streams with drainage areas ranging in size from 1.1 to 41.7 square miles. The total annual sand delivery from the collection of small creeks and streams was originally estimated to be about 150,000 cubic yards per year based on the unit coarse sediment yield rates calculated for the region. However, this natural delivery rate has been altered by the construction of numerous catch basins that have been intercepting sediment and debris since the 1920's.

It is currently believed that the present natural volume of sand delivered to the coast from streams within the Santa Monica Mountains has been reduced. The present sediment yield of Malibu Creek is now thought to be on the order of 24,000 to 34,000 cubic yards per year whereas the sediment contribution from Topanga Creek is believed to be limited. The total sand contribution from the remaining Santa Monica Mountains streams is estimated to be about 43,000 cubic yards per year.

Ballona Creek discharges within central Santa Monica Bay. Its watershed is comprised of the heavily populated and urbanized cities inland from Marina del Rey. Its estimated sediment yield is believed to be less than 50,000 cubic yards per year, but the sediment is generally too contaminated and fine grained to be suitable for beach placement or ocean disposal. It s proximity to the Marina del Rey sand traps is problematic in that the dispersion of contaminants has been impacting adjacent sand that formerly was eligible for beneficial reuse. Similarly the limited sediment delivery in the urbanized Dominguez Watershed is also mostly too fine grained and unsuitable for beach nourishment.



Map of the Los Angeles County region showing the major watershed systems. The three major river systems - Santa Clara River , Los Angeles River, and San Gabriel River - all bypass most of the County's coast and do not significantly contribute sediment to the region's beaches. The much smaller North Santa Monica Bay watershed is the only remaining source of sand to naturally replenish beaches within the Malibu and Santa Monica Bay areas. The Ballona Creek and Dominguiz Channel systems produce only fine grained sediment not suitable for beach nourishment.

Harbor sand storage

Sediment that accumulates north of the Marina del Rey harbor entrance is a significant sand source for the Santa Monica Bay region. The littoral sand that would otherwise propagate downcoast by waves and currents to nourish and maintain the southern beaches is trapped by the harbor's jetties and offshore breakwater. Maintenance dredging is required on a regular basis to remove the shoaled sand and place it downcoast. Since 1969 over 1.5 million cubic yards of sand has been bypassed around the harbor which translates to an annual average shoaling rate of approximately 40,000 cubic yards per year.

Although the Redondo Beach-King Harbor breakwaters similarly act as littoral barriers, the harbor's proximity to the Redondo Submarine Canyon minimizes impoundment impacts. No significant maintenance dredging has been performed at King Harbor since the completion of the breakwaters in the late 1930s except for a one-time minor dredging of 7,600 cy on the harbor side of the south breakwater in 2004-2005. A survey of the harbor area in 2004 showed that about 25,000 cubic yards of sand had shoaled in the lee of the breakwater between 1959 and 2004. This represents a nominal seepage through the breakwater of around 500 cubic yards per year.

Maintenance Dredging History at Marina del Rey

Date	Source	Placement Location	Quantity (yd^3)	
			North Channel	South Channel
1969	Marina del Rey	Dockweiler Beach	390,000	-
1973	Marina del Rey	Venice Beach	16,000	-
1981	Marina del Rey	Dockweiler Beach	217,000	-
1987	Marina del Rey	Dockweiler Beach	35,000	-
1992	Marina del Rey	in situ (in harbor)	-	21,500[1]
1994-95	Marina del Rey	Ocean Disposal	-	55,000[1]
1996	Marina del Rey	Dockweiler Beach	240,000	-
1998	Marina del Rey	Ocean Disposal	-	56,000[1]
1998	Marina del Rey	Dockweiler Beach	40,000	-
1999-00	Marina del Rey	Redondo Beach	300,000	390,000[1]
2007	Marina del Rey	Dockweiler Beach	327,000[2]	-
Total			1,565,000	522,500[1]

Notes: [1] Non-beach disposal(i.e., non suitable for beach placement)
[2] Nearshore disposal
Source: Ryan, 2010

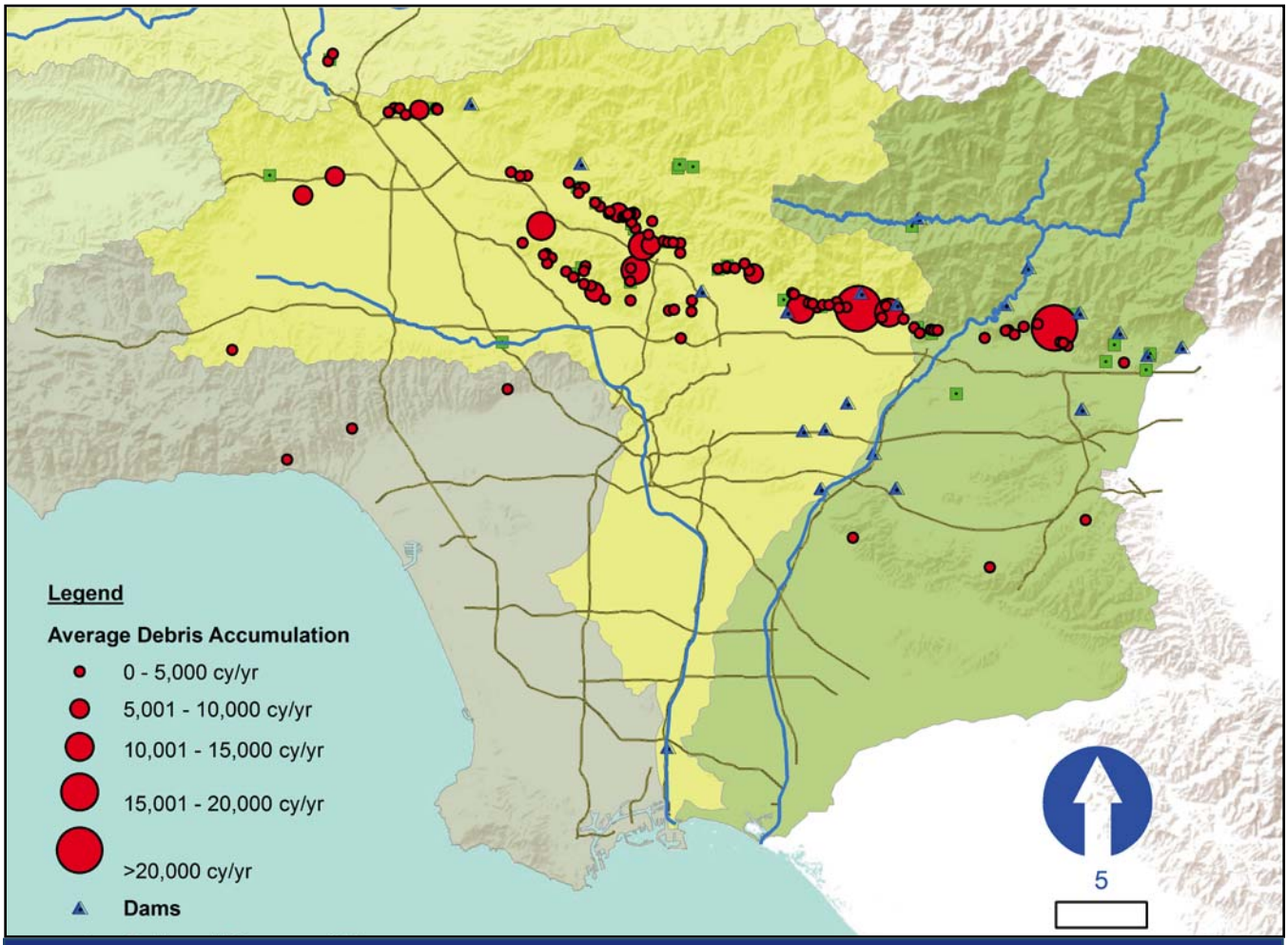
Marina del Rey Harbor and the mouth of Ballona Creek above; Redondo-King Harbor below.

Inland Sand Sources

Los Angeles County operates and maintains over 100 debris basins and dams throughout the region's watersheds. Typically located at the mouths of canyons, they are designed to capture sediment, gravel, boulders, and vegetative debris that flow during storm runoff. The debris basins are designed to capture the material before it propagates further downstream clogging the drainage system and causing flooding. The basins are regularly cleaned out to restore capacity for subsequent sediment storm flows. The infrastructure presents a competing interest and potential conflict between the need to maintain flood protection for the Los Angeles metropolitan area and a desire to ensure that the natural flow of sediment to the coast is unimpeded.

Most of the County's debris basins are located in the foothills of the steep San Gabriel Mountains. The first basins were constructed in the 1930s and as development increased additional facilities were built to keep pace with the growing flood protection need. Records maintained by the Los Angeles County Department of Public Works indicate that over 18 million cubic yards of sediment has been collected since the 1930s at an average annual total capture rate of over 300,000 cubic yards. However the ultimate pre-development fate of most of this sediment was the Los Angeles and San Gabriel Rivers. As previously discussed these rivers discharge at the southern end of the County's shoreline and thus have never been responsible for renourishment of Los Angeles County's beaches.

Dunsmuir Debris Basin, San Gabriel Mountains



Location of dams and debris basins in Los Angeles County maintained by the Department of Public Works. The size of the red circle indicates the average annual volume of sediment trapped by each facility. The inland location of these faciities and the formidable challenges associated with processing and hauling their sand fraction to the coast makes them unfeasible as a potential nourishment source.

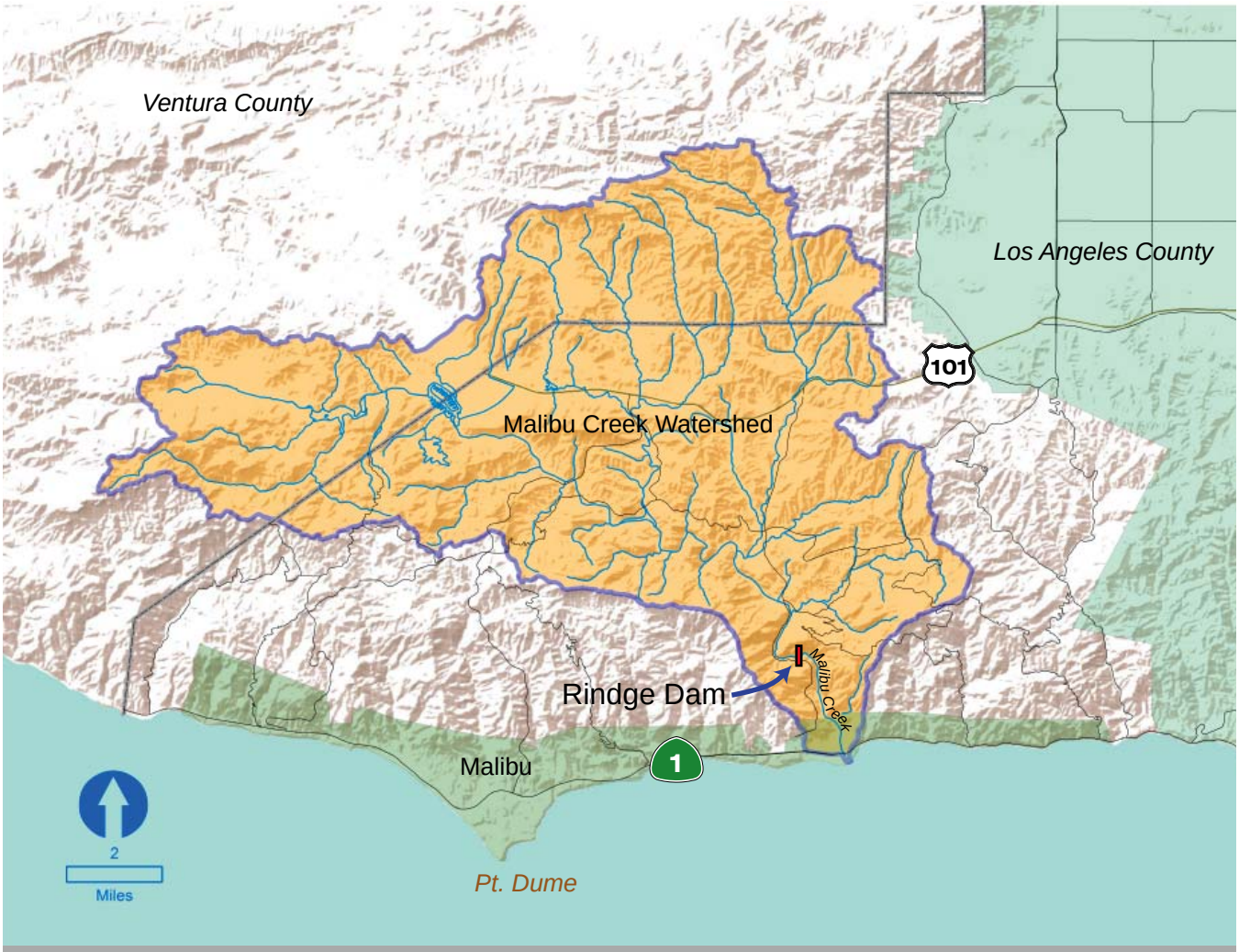
Los Angeles County's most significant inland sediment source closest to the shoreline is the Rindge Dam reservoir in Malibu. The deposit was created when the 100-foot high concrete arch dam was privately built in the 1920s for water supply. The dam which is located in Malibu Creek about three miles upstream from the mouth, collected the runoff from most of the watershed's 110 square mile area. Initially a storage pool of about 574 acre-feet was created over three-thousand feet of the lower Malibu Canyon.

Much of the soil within the watershed is considered to be highly erodible. Since the dam also completely trapped the natural flow of sediments to the coast, the reservoir rapidly filled with soil and debris. By the 1950s the reservoir's pool had almost completely filled with sediment such that it was no longer functional for water storage or flood protection.

It is currently estimated that approximately 780,000 cubic yards of sediment of all types and grain sizes lie impounded behind the dam. At least half of that volume is expected to consist of beach compatible sand.

The U.S. Army Corps of Engineers is currently studying the feasibility of removing the dam to restore the Malibu Creek ecosystem to its more natural state. As part of that study various alternatives for removal, relocation, and beneficial reuse of the accumulated sediment are being considered. Reclamation and distribution of the sand fraction for regional beach nourishment could be a formidable task. Access to the narrow canyon reservoir site is limited, and it is not yet certain how the fine grained sediments and debris can be economically separated from the sand content.

Rindge Dam, June 2008. The construction of the dam in 1926 led to the trapping of about 780,000 cubic yards of sediment behind it as shown in the photograph.



The Malibu Creek Watershed and the location of Rindge Dam. Although only three miles from the coastline, the reservoir deposit poses a difficult challenge to recover the beach compatiable fraction of the trapped sediment for beach replenishment.

Offshore Sand Sources

Significant offshore sand deposits may be found within a band of the inner continental shelf of Los Angeles County. Deposited over 10,000 years ago when sea level was over 200 feet lower than today and exposed much of the offshore shelf, the sandy material is generally classified as late Quaternary or Holocene sediments in reference to the geologic epoch of formation. Prior studies have identified several potential offshore sediment sources within Santa Monica Bay and San Pedro Bay that consist of fine to medium grained sand.

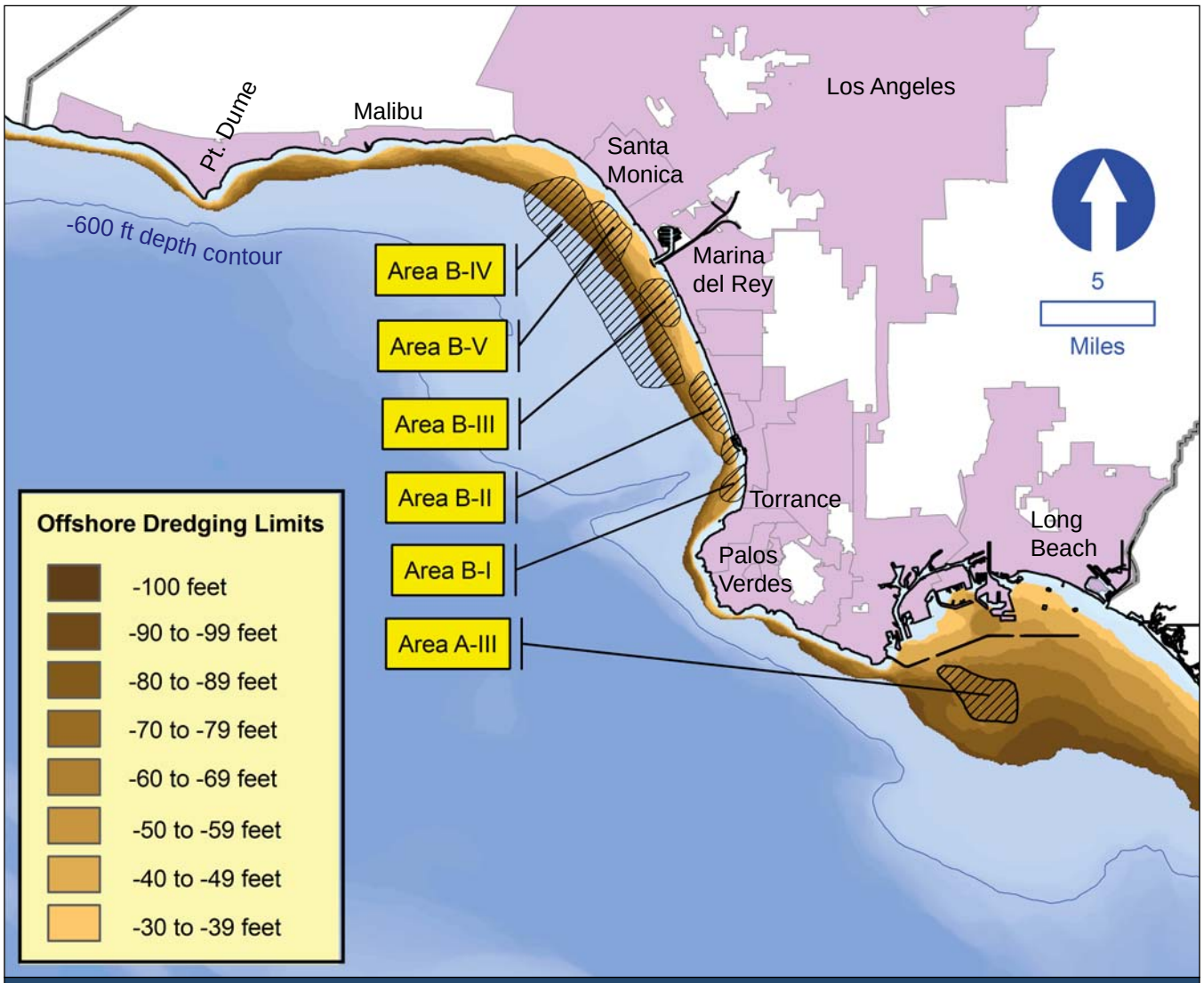
West of Point Dume a relatively thin discontinuous strip of ancient Holocene sediments exists. However, the deposits thicken east of Point Dume most likely as a reflection of the long term influences of the ancient local creeks that fed fluvial sediment into the region. This geological formation constitutes the potential offshore sediment reservoir that may be considered for nourishment of Los Angeles County beaches.

Between Malibu and Palos Verdes over 372 million cubic yards of sand and gravel deposits are believed to exist. Subsurface sediment thicknesses of over 60 feet have been mapped. However, considerable portions of these sediments are located in depths that are currently deeper than the capability of dredges to retrieve them. In addition it is not known how much of this volume would provide sand coarse enough to be compatible for beach nourishment.

The U.S. Army Coastal Engineering Research and Development Center (ERDC) made the first assessment of the potential of this offshore sediment reserve in Santa Monica Bay between 1973 and 1978. Three sites between Santa Monica and Torrance County Beach were estimated to contain about 26 million cubic yards of suitable beach sand. Osborne et al (1983) performed a more detailed reconnaissance level inventory of the four sites identified by the Corps of Engineers. They surveyed the nearshore shelf between the submarine canyons at Point Dume and Palos Verdes Point. High-resolution seismic-reflection profiles were taken and limited vibracore drilling performed to delineate the extent and volume of potential sand deposits. The studies by Osbourne identified a fifth potential offshore borrow site north of Marina del Rey.

More recent studies to locate suitable offshore sand closer to west Malibu have not been successful as the sediment was found to be too fine grained for beach nourishment.

Nourishment of Redondo and Torrance Beaches in 1968. The 1.4 million cubic yard project is one of the most successful beach nourishment projects in the United States. The photograph shows the hydraulic dredge pumping sand onshore from the offshore under water borrow site.



Location of offshore sediment deposits as determined from past reconnaisance field studies. The black hatched areas are the locations believed to contain the largest reserves of beach compatible sand that may be utilized for beach nourishment. The quality and suitability of the remaining offshore deposits is less known. The brown color bands shows the extent of bottom depths between -30 and -100 feet MLLW where sand could be mined if available. However taking sand inshore of -40 feet MLLW has a greater potential to adversely impact the adjacent beach. As depths approach -100 feet MLLW the material becomes more out of reach of today's dredges. The total Los Angeles County offshore sand deposit is finite and should be carefully managed.

Beach Deposits

Significant volumes of sand exist between Santa Monica and Torrance as a result of historical beach fills and construction of sand retention structures. Since the 1920s Santa Monica Bay beaches have been augmented and stabilized with over 30 million cubic yards of sand. The majority of the nourishment came from excavations within the Hyperion Dunes.

As a result beach widths have been widened by as much as 600 feet from their historically more narrow condition. This sand source represents a significant man-made deposit that has dramatically enhanced beach opportunities within the area.

Photographs clockwise from right: Venice Beach looking to Santa Monica; looking south from Santa Monica Pier; Torrance Beach

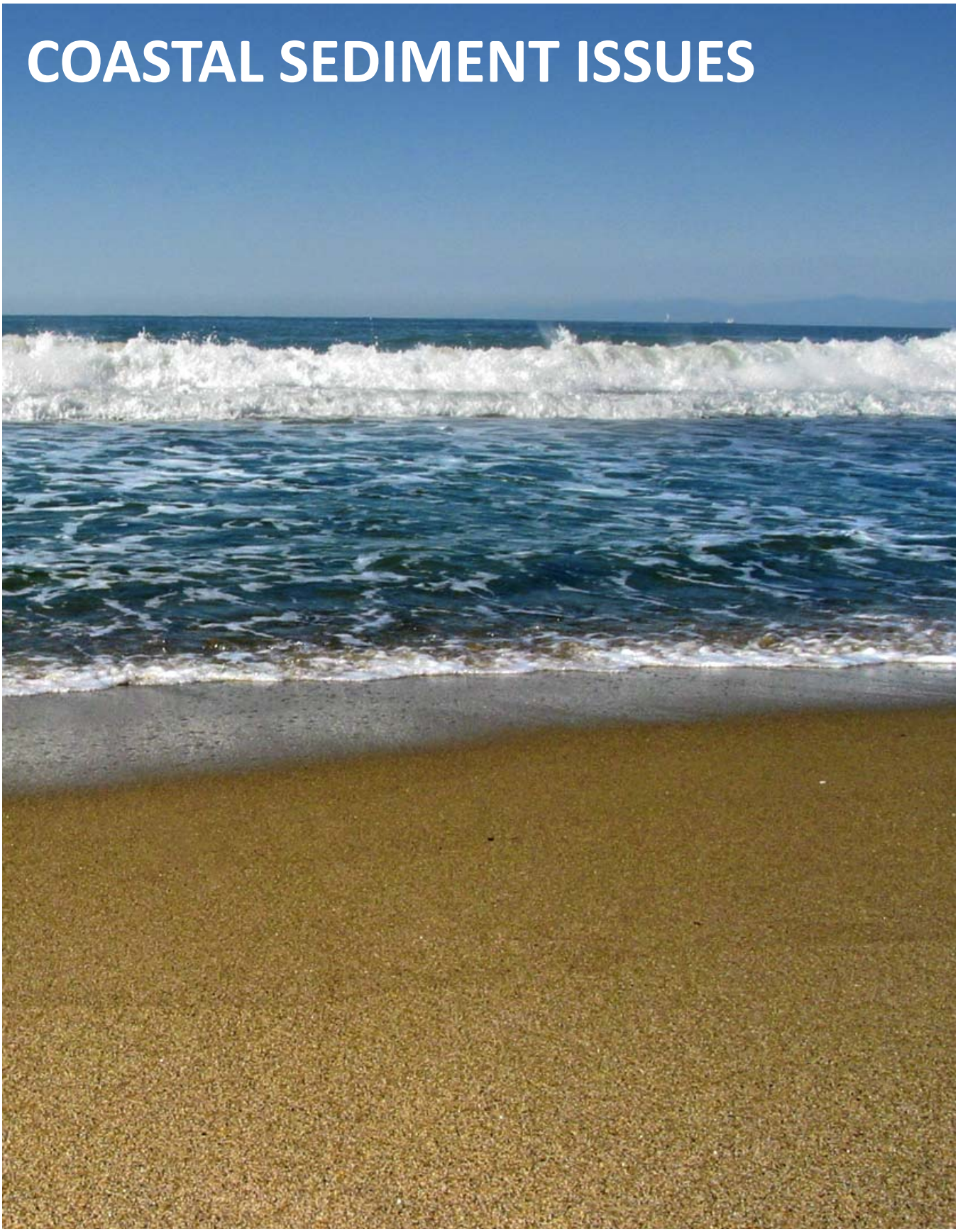
Los Angeles County Beach Nourishment History			
Date	Source	Placement Location	Quantity (yd3)
1920's	PCH construction	Malibu Shoreline	1,242,000[1]
1938	Hyperion	Dockweiler Beach	1,800,000
1939	SM Breakwater	South SM Beach	60,000[2]
1945	Hyperion	Venice Beach	150,000
1947	Onshore	Redondo Beach	100,000
1947	Hyperion	SM Beach/Venice/Dockweiler Beach	13,900,000
1947	Sand Hills	South Redondo/Torrance Beach	220,000
1949-50	SM Breakwater	South SM Beach	960,000[2]
1951	DWP Power Plant	Dockweiler Beach	240,000
1956	DWP Power Plant	Dockweiler Beach	2,400,000
1957-58	SM Breakwater	South SM Beach	780,000[2]
1959	PCH construction	Will Rogers Beach	114,000
1960-62	Marina del Rey	Dockweiler Beach	3,200,000
1960-74	Unknown	Las Tunas Beach	50,000
1962	Sand Hills	South Redondo/Torrance Beach	220,000
1967-68	Offshore sand	South Redondo/Torrance Beach	1,400,000
1969	Marina del Rey	Dockweiler Beach	390,000[2]
1973	Marina del Rey	Venice Beach	16,000[2]
1979	Unknown	Zuma Beach	22,000
1980	Sullivan Debris	Charthouse area	30,000
1981	Rustic Canyon	Charthouse area	3,000
1981	Marina del Rey	Dockweiler Beach	217,000[2]
1983	Pepperdine Debris	Charthouse area	300-600
1984	Offshore	El Segundo (Chevron Groin)	620,000
1987	Marina del Rey	Dockweiler Beach	35,000[2]
1988	Hyperion	Dockweiler Beach	155,000
1988	Hyperion	El Segundo	550,000
1989	Hyperion	El Segundo	150,000
1994	Unknown	Corral Beach	18,000
1996	Marina del Rey	Dockweiler Beach	240,000[2]
1998	Marina del Rey	Dockweiler Beach	40,000[2]
1999-00	Marina del Rey	Redondo Beach	300,000[2]
2004-05	King Harbor	Redondo Beach	76,002
2007	Marina del Rey	Dockweiler Beach	327,000[3]

Notes: 1 Estimated from representative cross section of PCH

2 Sand bypass/backpass

3 Nearshore disposal (i.e., non suitable for beach placement)

COASTAL SEDIMENT ISSUES

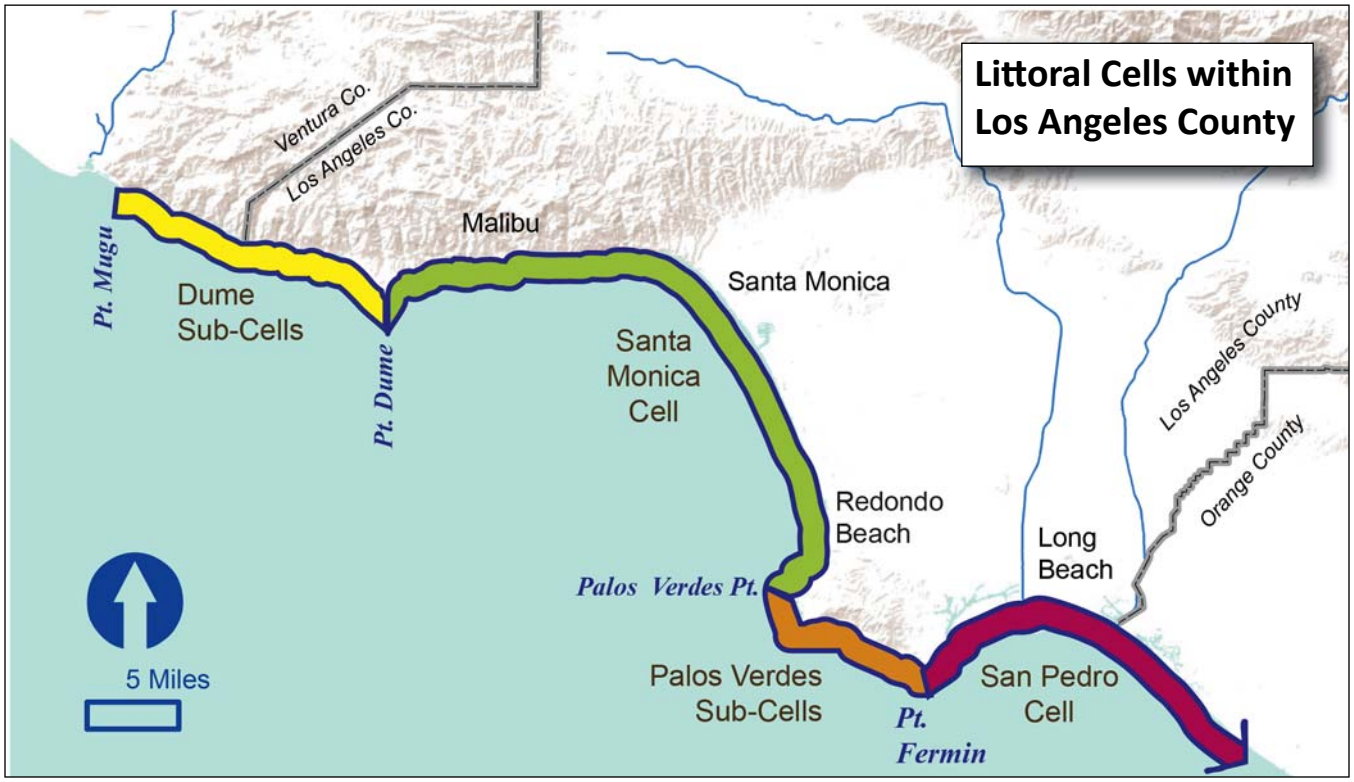


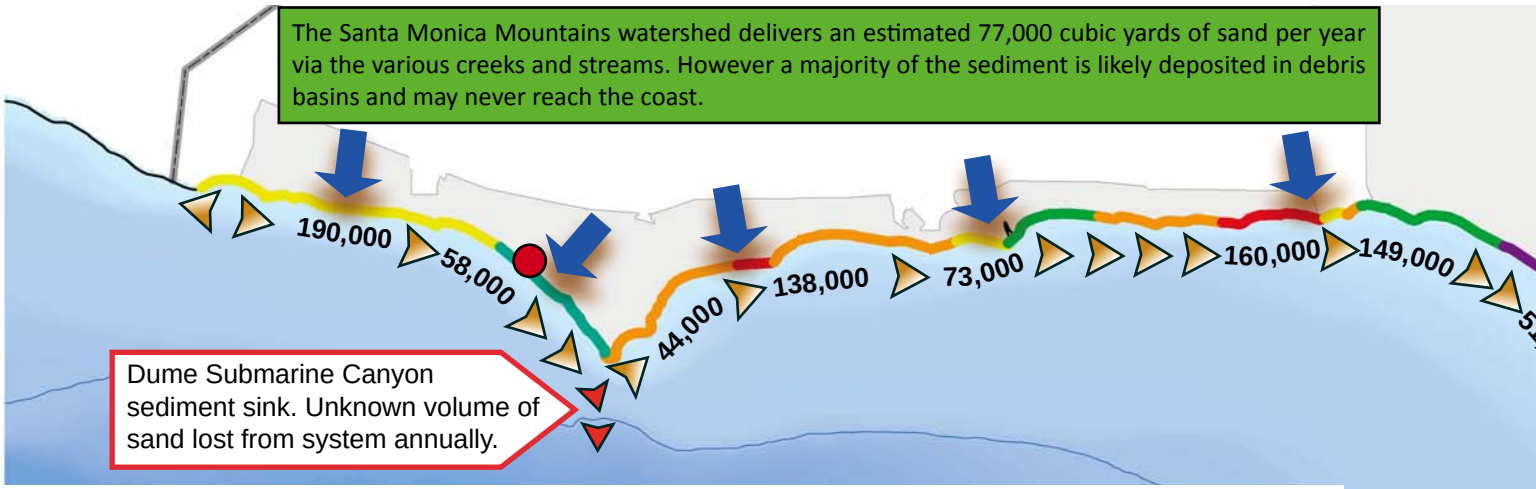
A littoral cell, as defined by Inman (1950), is a shoreline compartment within which a complete cycle of sediment processes including sources, sinks, and transport paths can be independently assessed. Typically, each littoral cell is bounded by a prominent natural feature (e.g. headland) or man-made artificial structure (e.g. harbor jetties). The Los Angeles County shoreline is located within two main geographic units: the Santa Monica Cell and its extended Dume Sub-Cells and a portion of the San Pedro Cell and all of its extended Palos Verdes Sub-Cells. The Dume and Palos Verdes Sub-Cells consist primarily of sandy or gravel beaches and rocky coast whereas the 40 mile long Santa Monica Cell east of Point Dume is the dominant littoral feature in the County. Over half of its length consists of wide sandy beach. The Long Beach area of the San Pedro Cell has been significantly altered by the Ports of Los Angeles/Long Beach offshore breakwaters that greatly reduce wave energy on the Long Beach shoreline.

The Corps of Engineers is nearing completion of a comprehensive study of the coastal processes within the entire Los Angeles County coastline under the authority of the Coast of California Storm and Tidal Waves Study (CCSTWS). The scientific effort is intended to study the historic data, measure current conditions, and identify and evaluate the relevant sediment processes within the region. The findings of the CCSTWS provide the current and best basis of understanding of how the Los Angeles County coast behaves and provides guidance and focus for this coastal sediment management plan.

Simply stated, sandy beaches in Southern California are the cumulative result of the natural process of sediment delivery by rivers and streams to the coast over eons. Rainfall within the tributary watersheds transforms into runoff, and as it travels to the coast, the terrain and stream beds erode to release the inland sediments that ultimately feed the beaches and deposit within the nearshore shelf.

As the sediment deposits on the coast, waves and currents transport it predominantly alongshore but also offshore. The exact distribution of sediment and its ultimate littoral fate is generally known but not always understood to a high level of quantitative confidence. The





sediment delivery and transport processes vary seasonally and in longer term decadal cycles related to local and marine weather patterns and climatic change. In response the beaches often show immediate and temporary short term changes or longer term and more delayed oscillations that can vary in magnitude with the irregularity of the process. The complexity and interdependence of all of the physical forces in play make it difficult to fully understand and predict how the shoreline works. However as more field data is collected and studied, a greater understanding of Los Angeles County's coastal processes emerges.

The County shoreline is dominated by the 40-mile long Santa Monica Bay feature. This coastline is controlled to varying degrees by the two submarine canyons within the reach, and man's intervention that began with development of the region in the late 1800s and early 1900s. The results of the CCSTWS study have indicated that the Los Angeles coast is for the most part relatively stable. A summary of the unique and significant findings that are relevant to this regional sediment management study are summarized below.

1 The historical beach fills within Santa Monica Bay have played a major role in shaping the beaches. Natural sediment delivery to the Los Angeles County coast by rivers and streams is relatively low and has been diminished further over time with alterations and development within the watersheds. Bluff erosion contributes only a small percentage of littoral sediment.

2 The Redondo Submarine Canyon is a major sediment sink intercepting all sand that is transported by waves and currents to its head. Its nearshore presence has also greatly influenced a localized and chronic erosion that has been experienced at Redondo Beach. To a lessor extent and less understood the Dume Submarine Canyon acts as a sediment sink during storms when littoral sediments are transported by waves and currents further offshore.

3 Littoral sediment moves alongshore and inshore and offshore within a relatively narrow depth limit. However duri ng extreme storm events sand can be carried further offshore and permanently lost to the beaches.

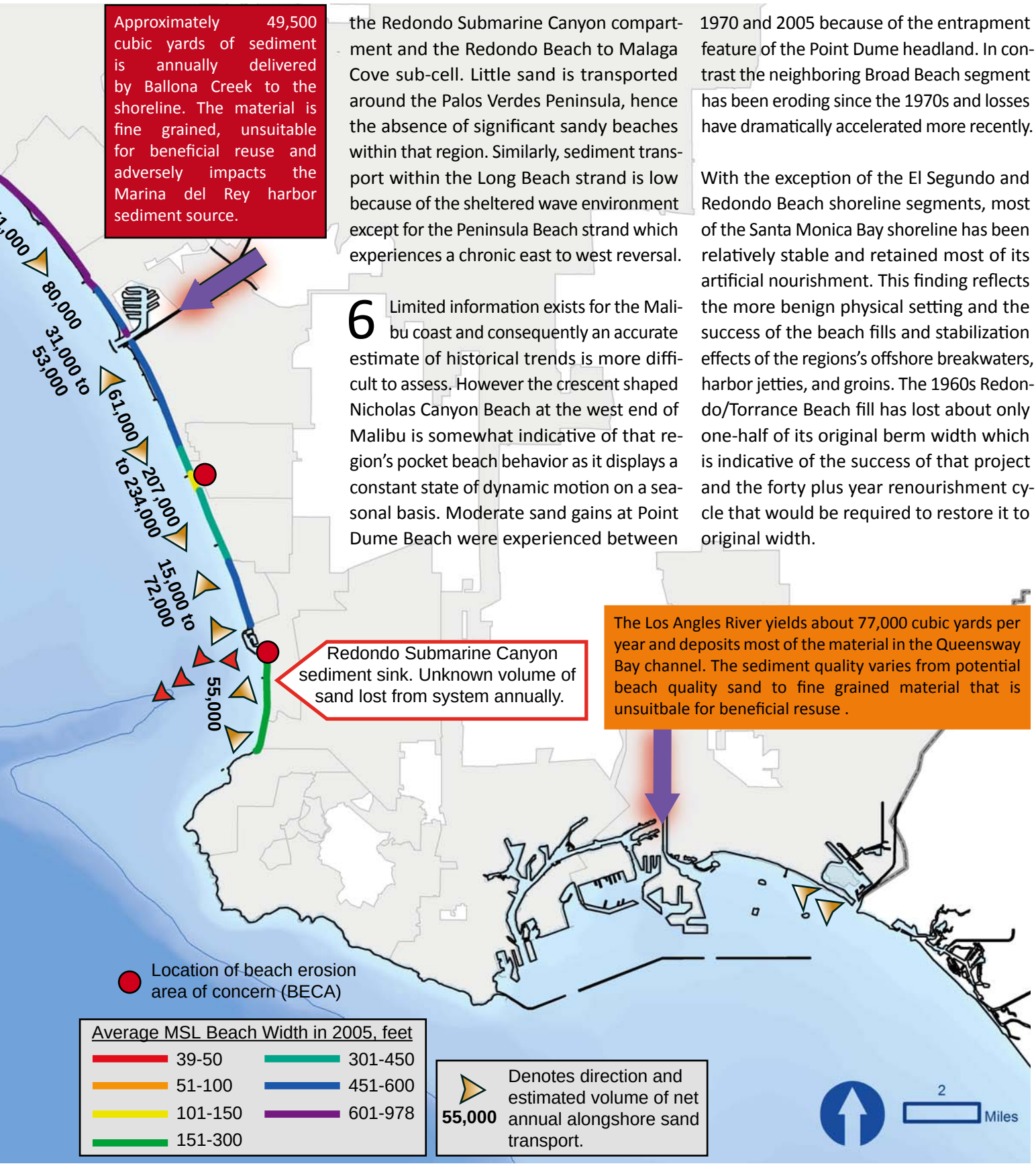
4 The sand will move alongshore in response to currents induced by surf. Numerical estimates conducted as part of the CCSTWS indicate that for the most part the net rates of alongshore transport are higher along the Malibu coast and less within Santa Monica Bay as shoreline orientation transitions from east-west to north south. Estimates generally range from 100,000 to 150,000 cubic yards per year or less in Malibu and less than 100,000 cubic yards per year along the Santa Monica Bay shoreline. Some anomalous zones of higher transport rates were noted in the vicinity of the Chevron Groin at El Segundo and near Broad Beach in Malibu and correspond to erosion hot spot areas. Small rates of net upcoast reversal at Nicholas Canyon Beach, Dockweiler Beach, Hermosa Beach, and Redondo Beach were noted.

5 The fate of sediment within the Los Angeles County coast is better understood within Santa Monica Bay than elsewhere because of the greater historical database. For the most part sediment transport paths are confined to an easterly direction from the Malibu coast to

the Redondo Submarine Canyon compartment and the Redondo Beach to Malaga Cove sub-cell. Little sand is transported around the Palos Verdes Peninsula, hence the absence of significant sandy beaches within that region. Similarly, sediment transport within the Long Beach strand is low because of the sheltered wave environment except for the Peninsula Beach strand which experiences a chronic east to west reversal.

6 Limited information exists for the Malibu coast and consequently an accurate estimate of historical trends is more difficult to assess. However the crescent shaped Nicholas Canyon Beach at the west end of Malibu is somewhat indicative of that region's pocket beach behavior as it displays a constant state of dynamic motion on a seasonal basis. Moderate sand gains at Point Dume Beach were experienced between 1970 and 2005 because of the entrapment feature of the Point Dume headland. In contrast the neighboring Broad Beach segment has been eroding since the 1970s and losses have dramatically accelerated more recently.

With the exception of the El Segundo and Redondo Beach shoreline segments, most of the Santa Monica Bay shoreline has been relatively stable and retained most of its artificial nourishment. This finding reflects the more benign physical setting and the success of the beach fills and stabilization effects of the regions's offshore breakwaters, harbor jetties, and groins. The 1960s Redondo/Torrance Beach fill has lost about only one-half of its original berm width which is indicative of the success of that project and the forty plus year renourishment cycle that would be required to restore it to original width.



A PLAN FOR THE URBAN COAST

The Los Angeles County shoreline is a densely populated urban coast that includes some of the most beautiful, heavily utilized, and maintained beaches in California and the world. The shoreline is a diverse physical environment that supports an equally diverse array of land uses that range from private, commercial, and industrial facilities. The beaches provide valuable recreation benefits, important storm damage protection for substantial amounts of development and infrastructure, and natural habitat for sensitive environmental resources. As such, the beaches represent some of the County's most important assets. Their continued health and vitality are critical to the region's vibrant economy and well being.

Southern California's coast has historically been transformed from a natural undeveloped state to a more densely populated and altered environment. Los Angeles County is the most urbanized shoreline in the State. The beauty and physical setting of its shoreline has always been a magnet for development, and the early 1900s saw a tremendous demand for coastal property. This growth occurred during a time when the understanding of the coastal environment was in its infancy. By the 1930s, substantial amounts of shoreline real estate were already acquired and developed by private, commercial, and industrial interests. Left unchecked at that time, the entire Los Angeles County coast was destined to be privatized. In response to this classic competing interest between private development and public access, the Board of Supervisors had the foresight to set a goal to dedicate as much coastline as possible for public use and endorsed its citizens' call for increased acquisition and maintenance of beaches for enjoyment and use by all. The resultant network of beach facilities that has been created from this 1930 initiative has established a public resource that extends from Malibu to Long Beach and has proven to be a valuable and important asset for the County and the region. For the past 80 years the County has been committed to implement and maintain what has evolved into the most extensive network of coastal facilities anywhere and the most successful beach management program in California.

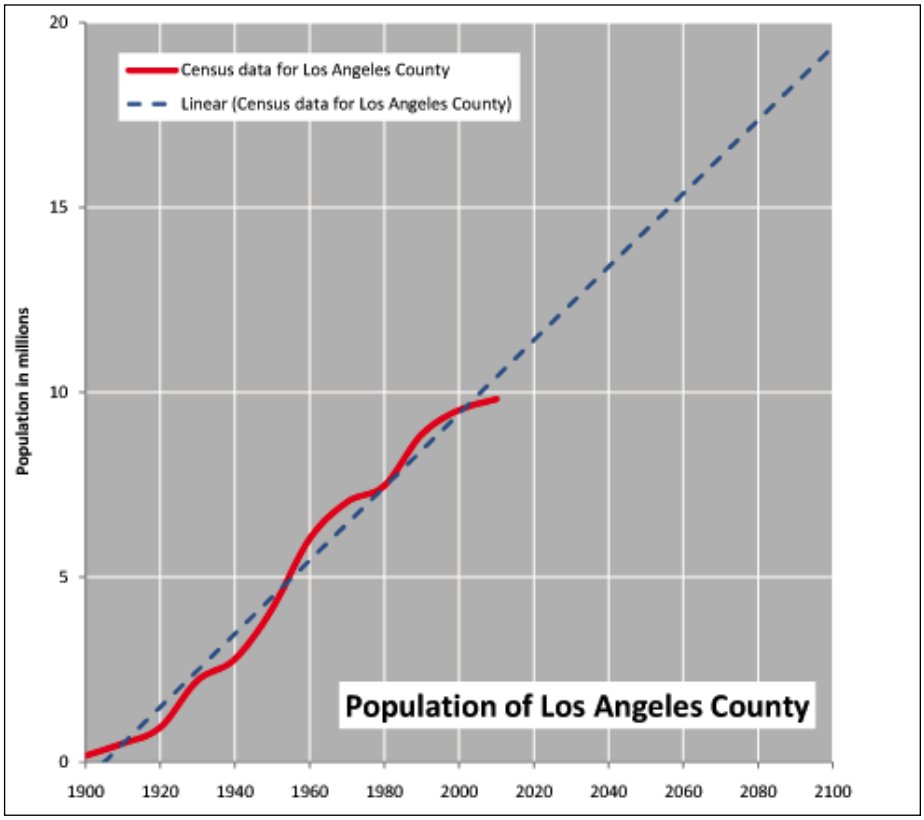
As previously discussed, the Los Angeles County Coast can be divided into four distinct shoreline compartments that vary dramatically in their physical attributes and land use characteristics. The Malibu and Palos Verdes regions are relatively low density, cliffed coasts that are characterized by narrow to non-existent beaches. In stark contrast, the Santa Monica and Long Beach regions are broader plains of densely developed and populated urbanscape whose beaches have been augmented and/or stabilized significantly by substantial beach nourishments and coastal structures. Throughout the County, a number of beaches have been preserved or molded into a network of public infrastructure that is utilized year round.

The Los Angeles County shoreline is unique in that there are no large rivers and streams along its shoreline to naturally replenish its beaches to a significant degree. Consequently it has never been subject to high rates of natural sediment supply as some other coastal regions in California. This means that the Los Angeles County coastline historically consisted of narrow or ephemeral beaches. Were it not for the large artificial beach nourishments that occurred between the 1940s and 1960s, Santa Monica Bay would not have its tremendous resource of beach facilities that it enjoys today. This absence of a significant natural supply of sediment to the coast means that implementation of beach management strategies that emphasize preservation of the remaining natural shoreline environments and the man-made urban beach assets will be vital to ensuring that the Los Angeles County coast is sustained well into the 21st Century for the enjoyment and well being of current and future generations.

The US Army Corps of Engineers has conducted a comprehensive scientific and technical study of the Los Angeles County Coast to better understand the shoreline dynamics and how the coast behaves. The findings of the Los Angeles County Coast of California Storm and Tidal Waves Study (CCSTWS) have helped to identify some of the critical and important issues that should be considered or reviewed in development of the regional sediment management plan. Prior to the completion of that

study the County's Department of Beaches and Harbors conducted an inventory of sediment management needs that reviewed beach existing conditions, the related impacts on public facilities, and suggestions for future action. Both studies verified that for the most part the Los Angeles County shoreline is a relatively stable environment. Erosion hot spots were identified and exist primarily because of a close proximity of development and infrastructure to the water's edge.

The previous technical studies have greatly helped to improve the understanding of the Los Angeles County shoreline and sediment and coastal processes that drive it. Although some data and knowledge gaps still remain, there is a good fundamental basis of understanding to move forward with a sound action plan.



Santa Monica Beach, August 2011

Socioeconomics

In addition to the local benefits for Los Angeles County residents, its beaches are an important attraction for tourists in Southern California. Their significant recreational draw provides an important source of income to the local economy. State and Federal agencies have conducted several studies to better quantify beach valuation and its economic implication for the Los Angeles County beaches (King and Symes, 2002; King, 1999; and CSU at Chico, 2002).

King and Symes (2002) studied seven representative beaches in southern California including Venice Beach, to assess the potential loss in Gross National Product (GNP) and Gross State Product (GSP) if the resource diminished. The study findings indicate that the loss of a wide Venice Beach would result in tourist dollar income losses of approximately 218 million dollars per year. A national economic impact on the order of 105 million dollars was also estimated.

The magnitude of GSP loss is predicted to be in the billions of dollars if all of the County's beaches are allowed to deteriorate. Accordingly, King and Symes have concluded that Los Angeles County is well justified to maintain and enhance its beaches. Preservation of wide beaches for recreational activity is one of the shoreline management objectives considered to be essential in order to maintain the economic welfare of the local coastal communities.

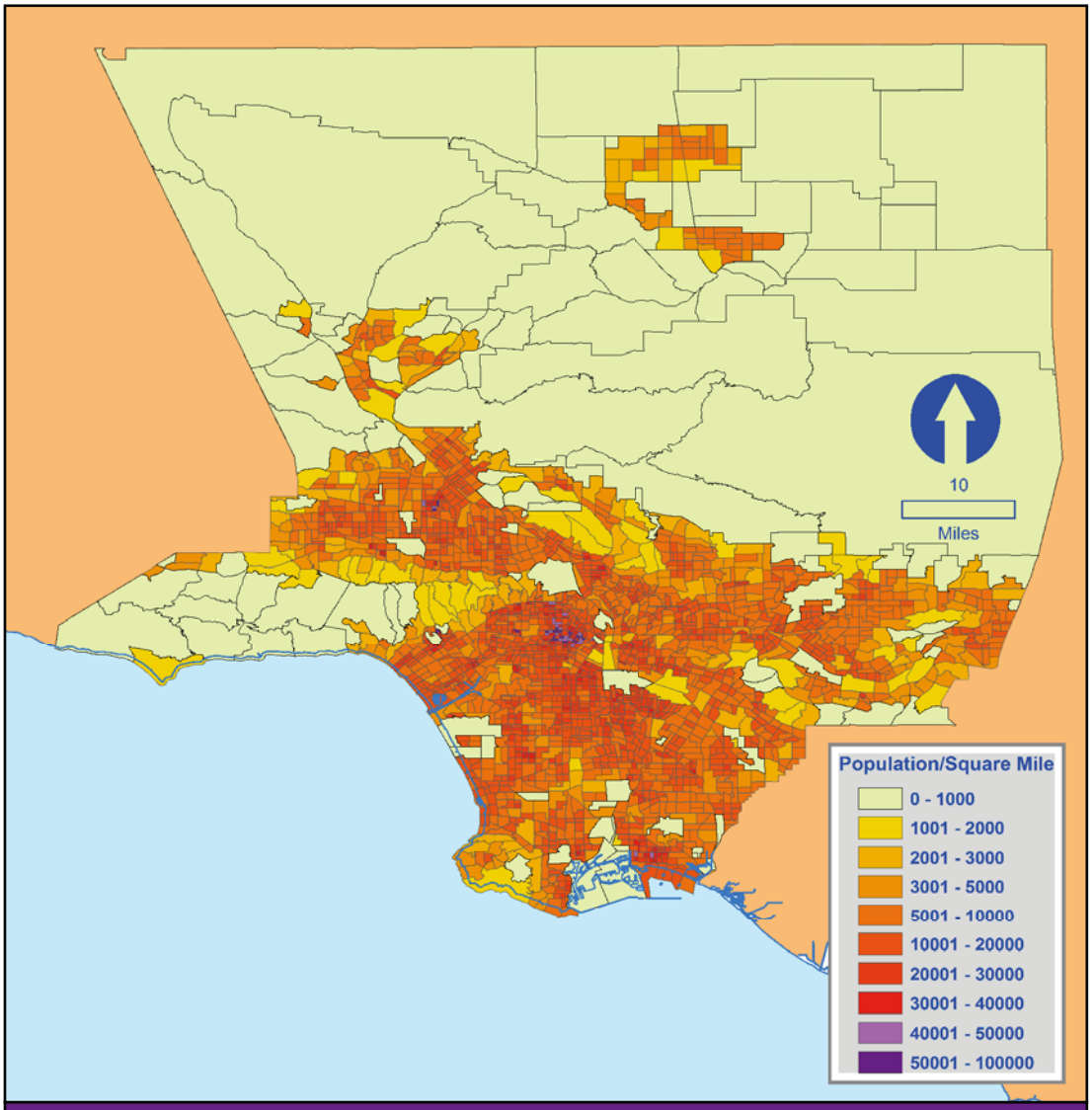
Governance and Funding

The County of Los Angeles currently manages its beach assets via the Department of Beaches and Harbors. The Department is charged with the operation of 14 County owned, 2 city owned, and 2 state owned beaches between Malibu and San Pedro. The public facilities include parking lots, restrooms, showers, concessions, various amenities, and the only "on the beach" recreational vehicle park in the County. For Fiscal Year 2011-12, the Department projects that 255 staff positions will oversee a gross operating budget of almost 39 million dollars. However this budget covers primarily administration and facilities operation and maintenance costs. Financing capital improvements for public beach facilities is generally budgeted from other County revenue sources in limited amounts.

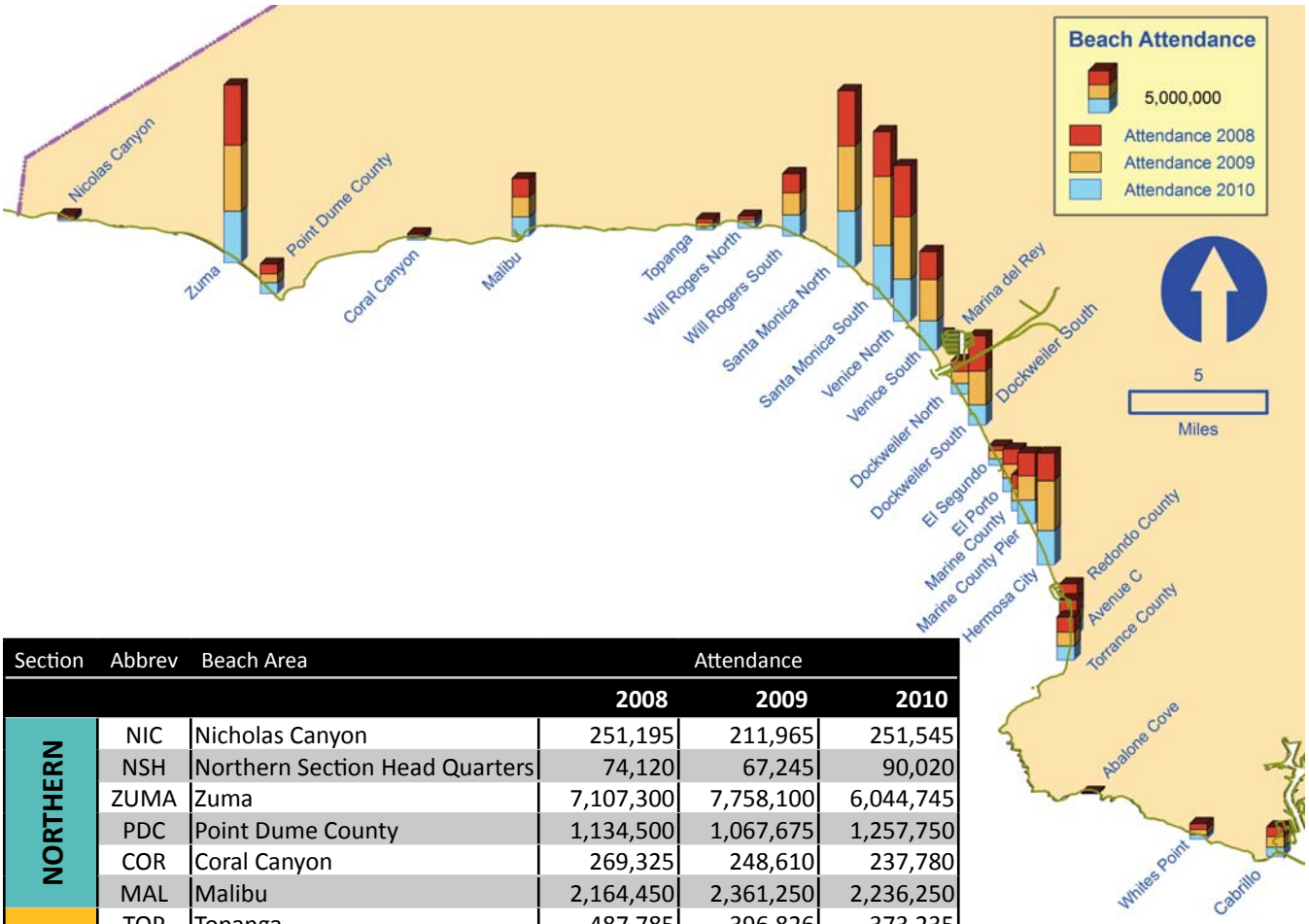
Dockweiler Beach, August 2011

Lifeguard services to patrol the public beach system are administered separately out of the County's Fire Department at an annual cost of approximately 25 million dollars. The Cities of Long Beach and Santa Monica independently maintain their respective sections of municipal shoreline frontage.

As is the case for every coastal community in California, the County is currently not budgeted to finance significant regional sediment management projects and programs. Implementation of such activities must rely heavily upon state and federal funding support. However the County has augmented the federal maintenance dredging program at Marina del Rey on several occasions to expedite the delivery of sand to more distant beaches for beneficial reuse.



Population density of Los Angeles County based upon the 2010 census. The data shows that the majority of its citizens live within close proximity to the shoreline. It is this demographic that helps to explain the County's high demand for beach facilities and use throughout the year.



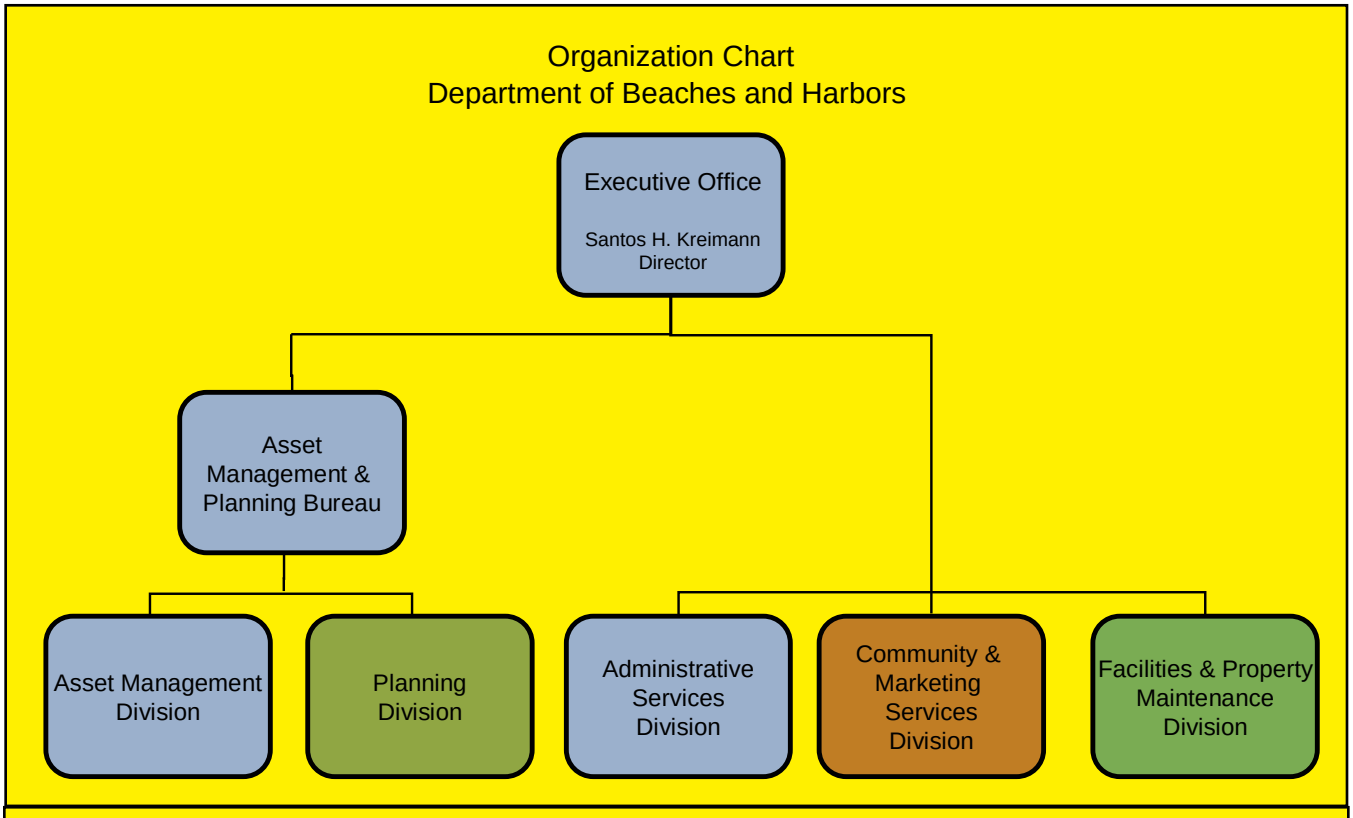
Section	Abbrev	Beach Area	Attendance		
			2008	2009	2010
NORTHERN	NIC	Nicholas Canyon	251,195	211,965	251,545
	NSH	Northern Section Head Quarters	74,120	67,245	90,020
	ZUMA	Zuma	7,107,300	7,758,100	6,044,745
	PDC	Point Dume County	1,134,500	1,067,675	1,257,750
	COR	Coral Canyon	269,325	248,610	237,780
	MAL	Malibu	2,164,450	2,361,250	2,236,250
CENTRAL	TOP	Topanga	487,785	396,826	373,235
	WRN	Will Rogers North	421,825	316,330	689,070
	WRS	Will Rogers South	2,252,750	2,594,215	2,497,400
	SMN	Santa Monica North	6,498,960	7,641,600	6,568,950
	SMS	Santa Monica South	5,252,710	8,144,230	6,299,940
	VNN	Venice North	6,025,700	7,332,551	4,946,900
	CSH	Central Section Head Quarters	943,440	1,146,660	1,188,955
	VNS	Venice South	3,312,100	4,850,600	3,411,200
	MDR	Marina del Rey	162,160	169,015	150,275
SOUTHERN	DWN	Dockweiler North	1,313,350	1,408,310	1,199,850
	DWS	Dockweiler South	4,173,700	3,942,030	2,398,200
	ELS	El Segundo	558,290	978,700	752,950
	ELP	El Porto	1,788,050	1,633,950	1,511,800
	MCO	Marine County	1,537,030	1,441,450	1,200,200
	MCP	Marine County Pier	2,712,750	2,759,025	2,754,250
	HCC	Hermosa City	3,205,800	5,851,895	4,010,900
	RCO	Redondo County	1,619,350	1,012,950	1,146,730
	CCO	Avenue C	1,396,075	1,286,620	1,439,050
	SSH	Southern Section Head Quarters	704,855	1,021,217	706,710
	TCO	Torrance County	1,786,955	1,595,925	1,661,850
	ABC	Abalone Cove	62,320	54,880	67,025
	WPT	White Point	725,250	607,980	491,220
	CAB	Cabrillo	1,144,175	1,242,432	1,065,550
			59,086,270	69,144,236	56,650,300

Beach attendance data as recorded by the Lifeguard Division of the Los Angeles County Fire Department between 2008 and 2010. The estimates highlight the importance of Zuma Beach and the Santa Monica Bay beaches to fulfill the region's demand for active and passive recreation.

The County lifeguards patrol over 72 miles of shoreline via 158 lifeguard towers, 15 substations, and four section headquarters.

The County's ability to implement the scope of its coastal regional sediment management plan will require continued close collaboration with state and federal agencies who remain as the most viable partner to help fund sediment management programs in the future. This partnership should be enhanced and made stronger and will require that the County develop and program the minimal revenue streams necessary to produce the required state and federal matching fund percentages.

Implementation of the County's coastal regional sediment management plan will also require a dedicated and focused administrative effort to address the myriad of complexities that are inherent in coastal programs. Traditionally, coastal issues management within the County has been shared between various divisions within the Departments of Beaches and Harbors and Public Works. However, implementation of the coastal regional sediment management plan for Los Angeles County will require a program manager who can be dedicated full time to perform the variety of projects, studies, and management tasks that will be needed to collaborate with other agencies, vigorously pursue funding, maintain liaison with stakeholders, and implement all other facets of the CRSMP's goals and objectives.



The current organization chart for the Los Angeles County Department of Beaches and Harbors. The Department is responsible for the myriad of planning and management tasks to maintain the beach and harbor assets of the County. Some responsibilities for capital projects administration are shared with the Department of Public Works. Successful implementation of the complex programs and activities associated with regional coastal sediment management will require the establishment of clear responsibility and a singular and dedicated staff person who can maintain continuity and respond to the ever changing needs and demands that will arise.

Coastal Sediment Management Solution Strategies

Coastal sediment management issues relevant to the Los Angeles County Coast cover a broad spectrum of technical, environmental, political, and economic challenges and opportunities. Based upon the current understanding of the region today, the key issues together with corresponding solutions strategies to effectively deal with them are outlined on the following pages.

Issue	Solution strategy
1 The natural sediment supply to the County coast is limited.	Prioritize preservation of existing deposits and resources.
2 The more narrow and sediment limited Malibu beaches are more sensitive to shoreline changes because of low sediment supply to the coast and vulnerability to the effects of coastal flooding during winter storms. If the shoreline recedes, existing beach facilities will become increasingly more exposed to storm damage and the already narrow beaches will be more inadequate in some areas to meet future public demand for recreation or protection of existing development and infrastructure.	Areas within the Malibu coast can benefit from sand nourishments, but the longevity of the placed material will be relatively short unless appropriate and approved sand retention structures are incorporated as an enhancement feature. The natural setting of the Malibu coast is better suited to preservation of existing sediment resources. This means that beaches will be better served by limiting development encroachments and minimizing fortification to protect back beach development. Appropriate management of the more significant watersheds within the reach will also help to preserve what natural sediment supply does exist to feed the narrow pocket beaches and sandy beach segments that remain.
3 The huge volume of sand that was used to nourish Santa Monica Bay beaches between 1938 and 1988 represents a significant asset within an otherwise sediment limited coastline. This sediment resource should be protected and maintained. Some of the artificial beaches have become depleted, berm elevations are too low in areas to provide adequate wave runup protection, and most of the existing sand retention devices that have seen many years of service are now in need of repair or refurbishment.	The Santa Monica Bay region is a unique stretch of coast that has been significantly enhanced by man. The substantial beach widening and stabilization of the shoreline is in essence a public infrastructure that will require perpetual maintenance to preserve it.

Issue	Solution strategy
4 The Palos Verdes Peninsula is a high cliffed coast with a shoreline that is mostly privately owned and of limited public access. Its pocket beaches that do exist are narrow and consist of boulders, cobble, gravel, and finer sediments. The region is relatively stable.	The reach can most benefit by maintaining a policy of preservation to maintain existing conditions.
5 The Long Beach region has been dramatically transformed by the Port of Los Angeles/ Port of Long Beach industrial complex and the urbanization of the City of Long Beach. The wide city strand between the ports and the County line benefits from the wave shelter formed when the extensive outer breakwaters were built in the early 1900s to protect the two commercial ports. With the exception of Peninsula Beach, the Long Beach shoreline is quite stable. The erosion hot spot at the south end of the strand near the Alamitos Bay Harbor entrance currently depends upon regular sand backpassing to return sand transported upcoast by waves and currents.	At a minimum, continuance of the sand backpassing policy will be necessary to keep pace with the localized erosion rate and protect the private development at Peninsula Beach. The area may also benefit from the addition of appropriate and approved sand retention stabilization measures to reduce sand losses and maintain minimal beach widths.
6 Coastal areas that are prone to ocean storm damage are primarily the result of the aggressive development encroachment that occurred in the early 1900s.	Given the high value of the public and private investment that has expanded and matured over time, relocation or retreat strategies will be limited only to those areas that are less populated and can accommodate relocation or removal strategies.
7 The extensive network of sand retention groins, breakwaters, and jetties that have been built throughout Santa Monica Bay have been effective in helping maintain these heavily utilized beaches. However the infrastructure is showing the effects of its age and will need attention to maintain function into the future.	Review the network of existing coastal structures throughout Santa Monica Bay. Maintain, rehabilitate, or modify existing structures as required to improve function.

Issue	Solution strategy
8 Several erosion hot spots exist within the County. Areas include Nicholas Canyon County Beach, Broad Beach, Venice Beach, El Segundo near the Chevron Groin, and Redondo Beach north of the Topaz Groin. Each location presents a unique situation and range of possible solutions. There is no "one size fits all" solution for any beach erosion problem on the Los Angeles County Coast. More recent construction of infrastructure at Nicholas Canyon has become exposed to future erosion damages. The impacts or non-impacts of the recent fortification of Broad Beach upon the popular and heavily utilized Zuma Beach public facility is not yet known. Venice, El Segundo, and Redondo beaches have chronic problems that require constant attention.	Continue and expand the beach monitoring program to keep vigilant watch over the health and condition of Los Angeles County beaches. Less populated sections of shoreline may benefit from implementation of appropriate managed retreat programs whereby threatened improvements are removed or relocated to less vulnerable locations landward. Beneficial reuse of sand trapped at Marina del Rey presents a sustainable sand s ource to maintain chronic erosion areas at beach locations between Venice and Redondo Beach. Erosion hot spots within the County coastline may benefit from modification of existing sand retention structures or placement of appropriate and approved ones. The subject is controversial, but given the urban setting of the Los Angeles County coast, the topic should be carefully investigated to evaluate its merit where appropriate. Several areas may present excellent enhancement opportunities. If feasible and acceptable, sand retention technology should be demonstrated.
9 The higher littoral sediment transport between South Dockweiler Beach and El Segundo merits attention to preserve beaches in those areas.	Perform a technical study to review the shoreline reach and recommend appropriate strategies to address the localized high wave energy environment.
10 The specter of future sea level rise poses the greatest potential threat to the Los Angeles County shoreline into the next century. If predictions materialize as forecast, beaches could dramatically recede. Unless contingency measures are in place to deal with the situation, beach widths may be inadequate to address future recreation and storm protection needs.	Perform a comprehensive study to locate and quantify the location of offshore sand deposits that would provide adequate beach compatible sand. The highest quality offshore sand should be set aside and dedicated as a strategic reserve for use should it be necessary to renourish public beaches impacted by sea level rise effects.

Issue	Solution strategy
11 The Los Angeles County coast is the most heavily utilized public recreation facility of its type in the State. Its purpose and function was uniquely established by a special Board of Supervisors action in 1930. The beach facilities that were developed represent a unique form of urban infrastructure that was dedicated to and prioritized for public use. The capital improvements that have been built over the past 80 years are intended to serve a high and growing demand for active and passive beach recreation. As with any public facility, the urban beach assets require constant maintenance to provide and guarantee adequate and safe facilities for the public use. Recently, sensitive species habitat and other environmental issues have introduced competing demands and requirements.	The Los Angeles County coastal environment is a unique urban setting that is dramatically different from other California coastal areas. This implies that considerations should be in place to acknowledge and address the needs and requirements of Los Angeles County's predominantly man-made urban beaches. Develop and implement a comprehensive Los Angeles County local regional general maintenance authority that unifies local, state, and federal regulatory entitlements into a single agreement that implements reasonable environmental protections for the coast and allows Los Angeles County to perform its public mandate efficiently and effectively.
12 Sediment from Ballona Creek and the Los Angeles River watersheds is not suitable for beneficial resuse and becoming increasingly more difficult to manage. The Ballona Creek discharge corrupts the beach compatible sand trapped at Marina del Rey and threatens the viability of the critical beach nourishment program at that harbor.	Pursue and implement watershed programs to capture and treat contaminated sediment prior to discharge at the shoreline.
13 The high cost of implementing regional sediment management programs, capital projects, and shoreline maintenance efforts means that revenue streams must be in place to pay the expensive costs associated with the various tasks. Los Angeles County currently funds an important facilities management and maintenance program. However additional revenue will be needed in order to rehabilitate, maintain, and expand the regional beach assets.	Review ways and means to supplement local funding by collaborating with state and federal authorities to tap into those programs. Implement a federally funded Los Angeles County Regional Sediment Management Project Authority.

Issue

14 Regional sediment management implementation demands vigilant attention to address the multitude of local, state, and federal agencies involved and affected stakeholders. Coastal programs and issues are currently administered in Los Angeles County via a loosely defined agency and division structure that is sometimes divided between the Departments of Beaches and Harbors and Public Works staffs. The lack of a single and clear administrative voice hinders the County's ability to effectively respond to short term and long range planning issues.

Solution strategy

Create a new management position within the Department of Beaches and Harbors organization. This staff person would be solely dedicated to short term and long range coastal issues that are relevant to implementation of the County's coastal regional sediment management program. The position would be responsible for collaboration with local, state, and federal resource and regulatory agencies as well as stakeholders to address funding needs, project/ program development and implementation, and long term coastal sediment management strategy and planning.

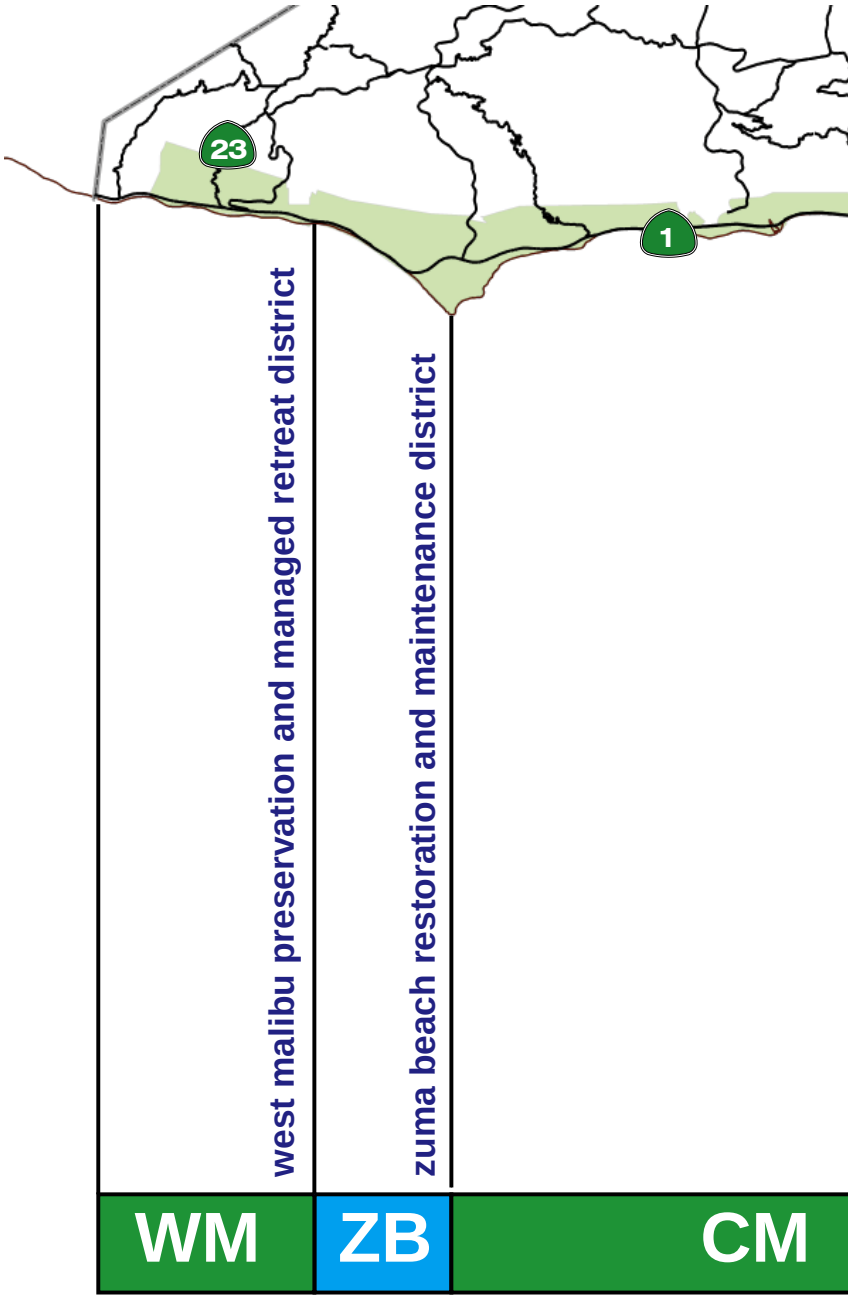
In summary the theme of the Los Angeles County CRSMP may be simply stated as a plan that focuses on maintaining and preserving what already exists. Preservation strategies are appropriate for those areas of the coast that remain in or close to their natural state. Continuance of the vigilant maintenance programs that the County has been performing for the past 80 years will be critical to preserve the extensive beach assets that were artificially created over 65 years ago. Adoption of an appropriate balance of these two diverse goals and objectives is key to implementation of a successful plan. The Los Angeles County Board of Supervisors had the extraordinary vision in 1930 to plan for a County coastline that exists today. Their foresight placed strong emphasis on providing for the future beach recreational needs for the region. It is this fundamental purpose and objective that should be endorsed and improved upon wherever possible and is the basis for the Los Angeles County CRSMP.

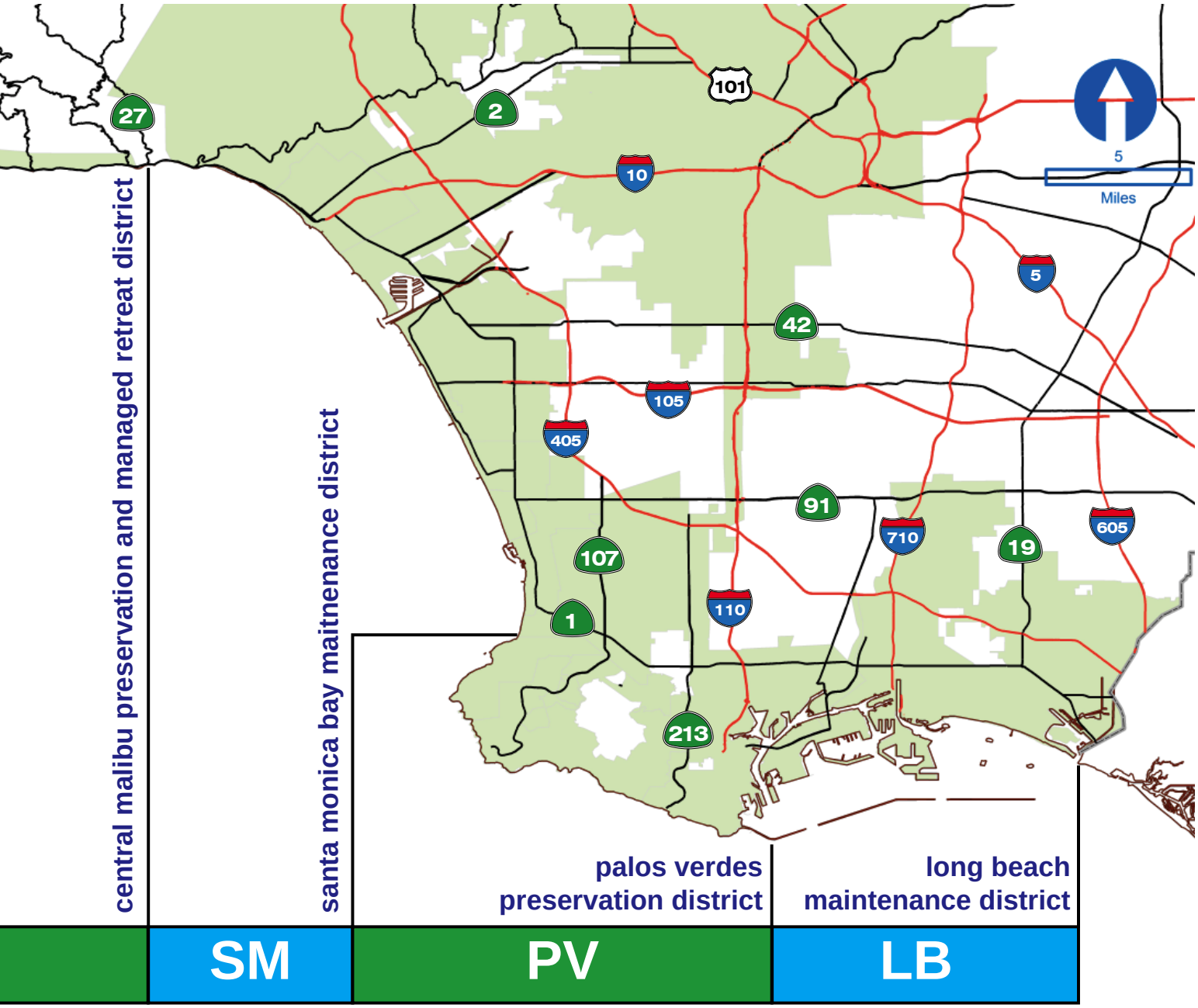
The Plan

The regional sediment management issues that are unique to the Los Angeles County coast reflect the fact that the shoreline is a densely populated urban environment that has been significantly altered by human activity. The County's shoreline supports a mixed land use that consists of private, commercial, and industrial development, and an extensive network of publicly accessible beach infrastructure. Collectively the coastline and signature collection of natural and artificial beaches are a vital resource for the County that helps define it's valuable identity, provides economic stimulus to the region, and satisfies the high demand for active and passive recreation for a growing population.

A dominant characteristic of the urbanized Los Angeles County coast is that its coastal sediment resources are finite and limited. This means that judicious management and preservation of its existing and available sediment sources are critically important goals and objectives so that the County's beach assets will exist well into the future. With this in mind, the Plan has been formulated to address specific key strategies: existing sediment supplies should be protected wherever possible; distribution of existing sediment resources to supplement existing beaches should be carefully allocated; vigilant monitoring of beach conditions should continue to provide early warning of adverse trends; and existing man-made beaches should continue to be maintained. Taken as a whole the Plan is ultimately intended to provide the road map to preserve, maintain, and carefully manage the Los Angeles County coast in perpetuity.

The specific components of the recommended Plan have been organized into region wide and reach specific elements. This allows the County's goals and objectives to be fulfilled on two levels. Region wide elements are those aspects of the Plan that pertain to and benefit the entire County coast. The reach specific plans provide specific and more locally relevant actions that are intended to address the individual physical setting, land use, and needs characteristics of each of the six distinct reaches of the Los Angeles County coast that are delineated on the following pages.



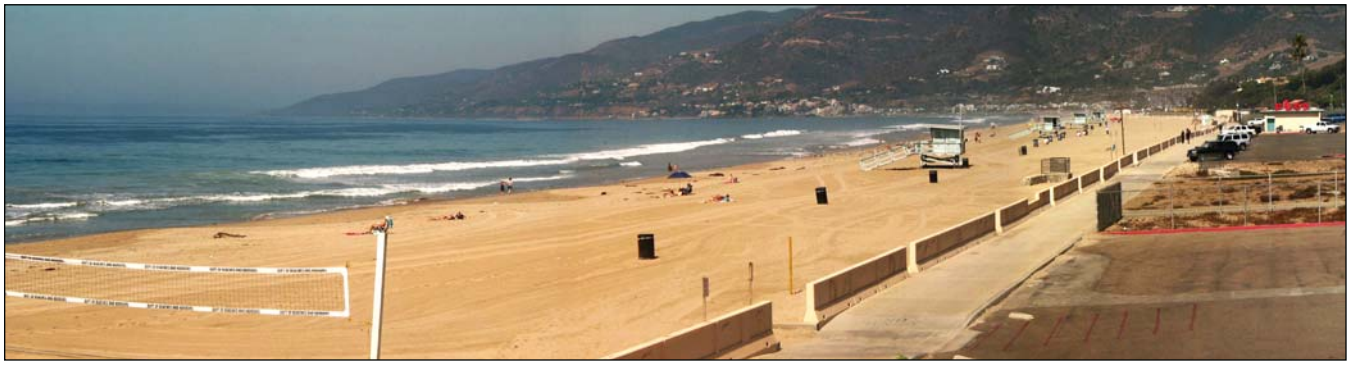

central malibu preservation and managed retreat district
santa monica bay maitnenance district
palos verdes preservation district
long beach maintenance district
SM
PV
LB
27
2
101
10
5
42
105
405
91
710
605
19
107
1
110
213
5
Miles

Malibu District

The Malibu District is comprised of the West Malibu, Zuma Beach, and Central Malibu reaches. The West Malibu segment, which extends from the west County line to Lachuza Point, is primarily a cliffed coast with narrow pocket beaches and sparse development. It is the last remnant of shoreline that still exists in a natural relatively unpopulated state. As such the reach is most appropriate for implementation of strategies and policy that advocate preservation of natural coastal processes and limitations on artificial enhancements or shoreline armoring.

The Zuma Beach Reach has recently evolved into a beach erosion area of concern. Accelerated beach erosion has resulted in a nearly continuous line of seawalls and revetments between Lachuza Point and Trancas Creek. The potential impacts of the cumulative fortification on the vitally important Zuma Beach public asset is unknown. Therefore the Plan recommends a program of vigilant monitoring to track beach trends and restoration when necessary to preserve the County beach facilities.

The Central Malibu coastal segment between Point Dume and Topanga Creek consist of a continuous strand of narrow beach that is densely populated with private homes. The characteristics and environmental setting of the fragile coastline reach is most appropriate for establishment of more formal preservation strategies and implementation of managed retreat policy where appropriate.



Zuma beach maintenance reach

What	Establish an ongoing beach nourishment and erosion control program within the littoral sub-cell.
Why	Recent fortification of the west end of the reach has altered the natural shoreline setting of the area and introduced the potential for long term erosion impacts. The extent and close proximity of the armoring to Zuma Beach raises a concern of potential adverse impacts that might occur in the future as a result.
How	Recommend that the resource and regulatory agencies establish a permanent beach monitoring and renourishment mitigation program.

Managed Retreat Strategy

What	Remove or relocate improvements in response to long term natural shoreline erosion trend.
Why	Allowance for some natural shoreline retreat to offset potential environmental impacts and/or economic issues associated with the protection of existing shoreline improvements.
How	Review the West and Central Malibu coastline for areas where managed retreat may be appropriate. Implement where feasible.

Natural Littoral Processes Zone

What	Areas of the shoreline are relatively sediment limited and exist in a more natural state.
Why	The beaches are too narrow, the development is mostly private and sparse, and natural setting does not lend itself to alteration to enhance or preserve without incurring significant investment and environmental impacts.
How	Allow natural processes to continue unimpeded.

Rindge Dam Removal

What	Remove Rindge Dam and pursue economical ways and means to recover the trapped sediment behind it for beneficial reuse.
Why	The Rindge Dam reservoir is the most significant and proximate source of inland sediment available for recovery and distribution for beach nourishment along the Malibu coast. Removal of the dam helps to restore the natural supply of sediment to the region's beaches.
How	Pursue dam removal and sediment recovery via a Federal Malibu Creek Watershed Ecosystem Restoration authority.

Santa Monica Bay Maintenance District

The Santa Monica Bay Maintenance District is directed to implementation of strategies, policies, and capital improvement projects that preserve and restore the existing historical beach fills, redistribute sand within the reach to areas where it can be most beneficial, and maintenance of the network of groins and breakwaters that are collectively responsible for the wide sandy beaches that define this reach. Specific elements recommended for this reach are:

Sand retention structure maintenance	
What	Maintain sand retention structures and propose new structures where appropriate and approved.
Why	Some beaches within the Santa Monica Bay reach are maintained in part by a system of sand retention structures that provide a pivotal role in maintaining their width for those locations. Some locations may benefit from modifications to existing structures or strategic placement of new ones.
How	Perform a comprehensive investigation of the condition and efficacy of existing devices and the benefit of new opportunities for siting of additional structures.

Marina del Rey beneficial reuse zone

What Distribute sand trapped at Marina del Rey Harbor to beach locations between Venice and Redondo Beach based on need.

Why Marina del Rey is the main source of sand available on a sustainable basis to renourish areas vulnerable to periodic erosion cycles

How Augment the Corps of Engineers O&M dredging program to include RSM objectives to allow harbor sand to be placed where most needed.

Redondo offshore sand stockpile

What Designate an underwater stockpile area for storage of Marina del Rey harbor sand

Why Timing of Redondo Beach nourishment need does not always correspond to the Federal dredging cycle at Marina del Rey.

How Utilize Federally approved offshore deposition area.

Marina del Rey to Venice Beach backpass

What Return sand from accumulation area at Marina del Rey North Jetty to address Venice Beach erosion area.

Why Relieve Marina del Rey shoaling stress, protect Los Angeles County Lifeguard Headquarters and public parking lot, and balance local shoreline sand movement

How Construct scraper access pathway through parking lot to allow regular use and access for earth moving equipment.

Palos Verdes Preservation District

The Palos Verdes shoreline is a cliffed, rocky coast with limited access. The unique coastal setting and land uses make it appropriate for implementation of a "hands off" policy that advocates preservation of the natural setting and limitations upon shoreline alteration or fortification.

The artificial segment at Cabrillo Beach may be considered for study and implementation of sand retention methods that would enhance and preserve the small public beach.

Long Beach Maintenance District

The industrialized and urban coastal segment between the Port of Los Angeles and the east County line is dominated by the Long Beach peninsula. The City beach is a continuous wide strand of sandy beach that is well protected by the offshore breakwaters built 65 to 100 years ago to form the commercial harbor complex. With the exception of Peninsula Beach which is a beach erosion area of concern, the Long Beach strand has been significantly altered and is quite stable. Maintenance of the municipal Peninsula Beach sand backpass program is the primary focus of the reach. Consideration and review of appropriate sand retention strategies that may be beneficial to alleviate the dependency upon the existing municipal sand backpass program is the minimum action plan recommended for this shoreline segment.

Peninsula Beach (Long Beach) backpass

What	Return sand from area of accumulation back to area of erosion
Why	Most economical method to balance local shoreline sand movement
How	Conventional earth moving equipment – maintain City program

County Wide

The Plan recommends several programs that have County-wide benefit. The Department of Beaches and Harbors conducts one of the most extensive programs of beach maintenance in the world. Throughout its network of public beaches, duties include beach grooming to provide for safe recreation, winter berm construction to protect public beach infrastructure, and other programs to provide the safe and accessible recreation demanded by the Los Angeles County metropolitan area. This unique maintenance program is hindered at times by regulatory issues that are broad based and less appropriate for the unique urban setting of the Los Angeles County public beach network. Therefore, establishment of a regional specific maintenance agreement is recommended to streamline regulatory protocol in an agreement specifically tailored to the region.

A critical element of the Plan is the recommendation to quantify the characteristics and extent of the region's offshore sand reserves. The deposits represent a future source that may be tapped to replenish beaches should sea level rise adversely impact them. This offshore sand source represents the most valuable sand asset of the County that economically can be utilized for beach nourishment. Therefore, delineation and dedication of the offshore sand reserve for future public beach use should be a prioritized objective.

Finally, the importance of the Los Angeles County coast and the complex issues and collaborative processes that are inherent in coastal sediment management demands undivided and constant attention in order to effectively implement specific policy, strategy, and projects that will arise from the Plan's implementation. Therefore it is recommended that the County dedicate a commensurate level of administrative governance to that objective.

Los Angeles County (LACO) Regional maintenance agreement

What	Establish pre-approved beach maintenance programs that allows for relocation and transfer of sand, infrastructure repair, and other related activities where needed in order to maintain public access and safety at recreational beach areas.
Why	LACO beaches are the most heavily used in the world. This demand creates an obligation for responsible beach management activities.
How	Initiate negotiations and establish long term agreements with regulatory and resource agencies that support LACO operations to support beach maintenance needs and fulfill maximum public beach usage goals and objectives.

Beach monitoring program

What	Expand the LACO beach monitoring program to include all beach facilities
Why	Basic monitoring of beach widths provides an economical indicator to track erosion trends, provides data for project development, and supports efforts to secure State and Federal funding during coastal erosion emergency events.
How	Perform monthly beach width surveys at pre-established transects using existing Department of Beaches and Harbors staff and procedures.

Offshore sand source sea level rise strategic reserve

What	Identify, quantify, and dedicate the LACO offshore sand resources to restore public beaches in the future as needed.
Why	The potential for future sea level rise may result in significant loss of sand and beach recession. Offshore sand presents the only proximate source to restore beaches to maintain the recreation value and coastal protection.
How	Solicit commitments from State/Federal agencies to prioritize and perform a comprehensive inventory and delineation of the entire LACO offshore strategic sand reserves. Designate and dedicate the best offshore sand sources as reserves to preserve and maintain existing Los Angeles County public beach infrastructure.

Dedicated Los Angeles County CRSMP program manager

What	Create a dedicated Department of Beaches and Harbor program manager position to focus entirely on coastal projects, coordination and collaboration with State and Federal resource and regulatory agencies, Marina del Rey dredging program, and other Los Angles County Coastal Regional Sediment Management issues.
Why	The complexity of maintaining, permitting, and funding of coastal projects and programs requires a singular focus to address and respond to the broad spectrum of constantly evolving issues that must be dealt with on a timely basis.
How	Create and staff a dedicated CRSMP program manager position.

Credits

Photographs

Noble Consultants, Inc.

Page: Cover, 1, 8, 9, 10, 11, 13, 31, 33, 39, 40, 48, 51, 53, 55, 56, 57

Aerial Photographs

Bing Maps, http://www.bing.com/maps/

Page: 25

Bruce Perry, Department of Geologic al Sciences, CSU Long Beach, http://geology.cnsm.ad.csulb.edu/people/bperry/AerialPhotosSoCal/AerialPhotographyIndexMapPage.htm

Page: 6, 11, 13, 24, 25, 37, 55

UCLA Department of Geography, The Benjamin and Gladys Thomas Air Photo Archives Spence and Fairchild Collections

Page: 15, 16, 18

U.S. Army Corps of Engineers, Los Angeles District

Page: 17, 24, 27, 29

References

Fujioka, W.T. and W.L, Watanabe, 2011. County of Los Angles 2011-12 Recommended Budget, prepared for the Los Angeles County Board of Supervisors, April 2011.

Inman, D.L., 1950. "Report on Beach Study in the Vicinity of Mugu Lagoon, California", US Army Corps of Engineers, Beach Erosion Board, Technical Memorandum No. 14, 47 pp.

King, P., 1999. "The Fiscal Impact of Beaches in California", prepared for the California Department of Boating and Waterways.

King, P. and Symes, D., 2002. "The Potential Loss in Gross National Product and Gross State Product from a Failure to Maintain California's Beaches", prepared for the California Department of Boating and Waterways.

Kreimann, S. H., 2011. County of Los Angeles Department of Beaches & Harbors Strategic Plan 2011-2013, February 2011.

Mesa2, Inc., 1983. Study on quaternary deposits (sand and gravel) of Southern California, Report No. FR 82-11, prepared for the California Department of Boating and Waterways, Beach Erosion Control Project, Sacramento, CA.

Noble Consultants. Inc., 2006. California Beach Restoration Survey 2006, Los Angeles County, prepared for the Los Angeles County Department of Beaches and Harbors for the California Department of Boating and Waterways.

Olmsted Brothers and Bartholomew Associates, 1930. Parks, playgrounds and beaches for the Los Angeles Region, a report submitted to the Citizen's Committee on Parks, Playgrounds and Beaches.

Osborne, R.H., N.J. Darigo, and R.C. Schneidemann, Jr., 1983. Report of potential offshore sand and gravel resources of the inner continental shelf of Southern California, prepared for the California Department of Boating and Waterways.

Schumaker, W., 2011. Personal communication.

Thompson, W.C., 1988. "Report on the Present Effectiveness of the Groins on Las Tunas Beach", prepared for the Office of the Attorney General, California Department of Justice, April 1988.

U.S. Army Corps of Engineers, Los Angeles District, 1994. "Malibu/Los Angeles County Coastline, Los Angeles County, California", Reconnaissance Report F5 Submittal, April 1994.

U.S. Army Corps of Engineers, Los Angeles District, 2010. The Coast of California Storm Waves and Tidal Study for Los Angeles Region. Draft report, prepared by Noble Consultants, Inc., November 2010.

U.S. Army Corps of Engineers, Los Angeles District, 2012. "Malibu Creek Watershed Ecosystem Restoration Feasibility Study", Hydrology, Hydraulics & Sedimentation Appendix, AFB Milestone Draft, June 2012.

U.S. Census Bureau , 2011. American FactFinder, http://factfinder.census.gov/home/saff/main.html?_lang=en

Woodell, G., 2010. Personal communication.

Los Angeles County

Coastal Regional Sediment Management Plan

Appendix A

Habitats and Sensitive Biological Resources of the Los Angeles County Shoreline from the Ventura/Los Angeles County Line to Malaga Cove

Prepared by:

Chambers Group, Inc.

August 2012

1. Overview

The Los Angeles County shoreline contains a variety of marine habitats including sandy beaches, subtidal sand bottom, rocky shoreline, subtidal reefs and cobble beds, and coastal lagoons (Figures 1 through 4). Rocky substrate often supports beds of giant kelp (*Macrocystis pyrifera*) and surfgrass (*Phyllospadix torreyi* and *P. scouleri*). In a few locations, eelgrass (*Zostera pacifica*) grows on offshore sand bottom. The GIS layers depicted on the habitat maps (Figures 1 through 4) were obtained from the California Department of Fish and Game (CDFG). CDFG developed the layers to support their planning for the Marine Life Protection Act.

In general, the Los Angeles County shoreline consists of long stretches of sandy beach with areas of rocky shore and offshore hard bottom. Rocky intertidal habitat, subtidal hard bottom, and kelp beds occur primarily at the northwestern and southeastern ends of the Los Angeles County coastline, at Malibu and Palos Verdes respectively. Including Palos Verdes, which is outside of the project area for this study, only about 25 percent of the Los Angeles County shoreline is hard bottom habitat (Pondella 2009). The rocky portions of the Malibu coastline are broken by the long sandy expanse of Zuma Beach. Coastal lagoons along the Los Angeles County coastline include the mouth of Zuma Creek, Malibu Lagoon and the mouth of Topanga Creek.

Hard bottom habitat is considered more sensitive than sand beaches and subtidal soft bottom because it is so much more limited in extent. In addition, by providing hard substrate for the attachment of macrophytes and sessile invertebrates, and holes and crevices to shelter fishes and mobile invertebrates, reefs and tidepools tend to concentrate marine life. Kelp beds and seagrass beds (surfgrass and eelgrass) are considered particularly valuable marine habitats because they extend off the bottom and provide shelter and attachment surfaces for marine animals. Kelp, surfgrass and eelgrass also represent a food source both while living and as detritus.

Listed species that occur on the beaches or in the nearshore waters of the Los Angeles County shoreline include the State and federal endangered California least tern (*Sternula antillarum browni*), the Federal threatened western snowy plover (*Charadrius alexandrinus nivosus*), and the Federal endangered southern steelhead (*Oncorhynchus mykiss irideus*). The federal endangered black abalone (*Haliotis cracherodii*), historically occurred in the Malibu area (Morin and Harrington 1978), but now are extirpated from most locations south of Point Conception (NOAA 2011). Another species that may be of concern with regard to Los Angeles County sediment management plans are California grunion (*Leuresthes tenuis*), a nearshore fish that lays its eggs on southern California sandy beaches during nighttime extreme high tides between March and August.

Section 2 of this Appendix describes the habitats in the Los Angeles County coastal area. Section 3 discusses sensitive species in the project area. Section 4 describes areas designated for special protection. Section 5 briefly addresses constraints to sediment placement activities and protective measures to avoid or minimize impacts.

2. Habitats

2.1. Sandy Beach

Of the approximately 14.2 miles of shoreline in the project area, 12.1 or approximately 85 percent is sandy beach. Sandy beaches in southern California are inhabited by an abundant invertebrate community that is an important food source for vertebrate predators, including shorebirds, seabirds, and fishes (Dugan et al. 2000). Intertidal invertebrates of sandy beaches show a characteristic zonation related to tidal exposure. The composition of the invertebrate community at a given beach, as well as the zonation, tends to be extremely dynamic due to the highly mobile nature of the sandy substrate and the resources on which these animals depend (Dugan and Hubbard 2006). Most exposed sandy beaches have two to three zones inhabited by distinct groups of mobile animals. These zones generally correspond to the relatively dry substrate of the upper intertidal zone at and above the drift line, the damp sand of the mid-intertidal zone, and the wet sand of the lower intertidal zone.

The lower intertidal zone (swash zone) in southern California sandy beaches is dominated by the filter feeding mole crab, *Emerita analoga*, which moves up and down the beach with the tides. The polychaete "bloodworm," *Euzonus*, also is common in the mid to lower intertidal. In the upper intertidal, drift kelp is an important source of food for many invertebrates. Common organisms associated with macrophyte wrack include beach hoppers (*Megalorchestia* spp.), kelp flies (*Coleopa vanduzeei*), isopods (*Alloniscus perconvexus* and *Tylos punctata*), and various species of beetles.

Sandy beaches are used by a variety of shorebirds for foraging and roosting. Common shorebirds on Los Angeles County beaches include snowy plover, sanderling (*Calidrus alba*), willet (*Catrophorus semipalmatus*), whimbrel (*Numenius phaeopus),* marbled godwit (*Limosa fedoa*), and black-bellied plover (*Pluvialis dominica*). Gulls (*Larus heermanni, L. delawarensis, L. argentutus, L. californicus,* and *L. occidentalis*) also use sandy beaches for resting and foraging.

The sandy intertidal is also used by a nearshore fish, the California grunion, which lays its eggs in the high intertidal zone between March and August. During the grunion spawning season, eggs and developing embryos are buried in the sand to incubate between the highest tides of each month, at the full and new moon (Martin 2006).

Sand beaches in Los Angeles County are heavily used by recreational beach goers. Many beaches are groomed. Beach grooming removes wrack, which supports invertebrates that are eaten by shorebirds. Beach grooming also can dislodge grunion eggs. Beachgoers may disturb foraging shorebirds. Dogs, which tend to chase shorebirds, can be especially devastating because migrating shorebirds have high nutrition needs and disruption of foraging time can result in a negative energy balance.

2.2. Rocky Shoreline

Rocky shoreline is much more limited in extent along the Los Angeles County coast compared to sandy beach. Only about 1.38 miles or 10 percent of the shoreline between the Ventura County line and Malaga Cove is rocky shore habitat. An additional 0.77 miles is classified as hardened shores, which includes man-made structures such as jetties and revetments. Within the project area, which does not

include the Palos Verdes peninsula, most of the rocky shoreline is found in the Malibu area. The most extensive and biologically rich rocky intertidal habitat in the project area occurs at Sequit Point, El Matador State Beach, Lechuza Point, Point Dume, the shoreline between Dume Cove and Paradise Cove, and the shoreline off Old Malibu Road (Tway 1991). Boulder/cobble habitat is also found at numerous places along the western shoreline of Los Angeles County from the terminus of Sunset Blvd. to the west. Much of this rocky intertidal habitat, especially low relief cobble/boulder areas, is covered and uncovered seasonally by sand. Typically rocks are uncovered as sand moves offshore in winter and covered as sand moves onshore again in late spring and summer.

Rocky intertidal habitat shows a distinct zonation related to the amount of daily tidal inundation. This zonation is most pronounced in areas with high relief. In general, species diversity in the intertidal increases from the upper to the lower zones. The uppermost or splash zone is populated by periwinkles, limpets and barnacles (Morin and Harrington 1978). The high intertidal zone from about +2.5 to +5.0 feet Mean Lower Low Water (MLLW) supports a more diverse assemblage that includes black turban snails (*Tegula funebralis*), lined shore crabs (*Pachygrapsus crassipes*), and sea lettuce (*Ulva* spp.) as well as several species of barnacles and limpets. The mid-intertidal zone from MLLW to +2.5 feet MLLW) is characterized by dense growths of California mussels (*Mytilus californianus*), gooseneck barnacles (*Pollicipes polymerus*), aggregate anemones (*Anthopleura elegantissima*), ochre sea stars (*Pisaster ochraceus*) and several species of red algae. The low intertidal from about -1.6 to 0.0 MLLW supports the most diverse assemblage with a considerable variety of invertebrate and algae species including the feather boa kelp, (*Egregia menziesii*). In some locations, surfgrass may be common in this zone. Shallow water subtidal fishes forage throughout this zone at high tide.

The rocky intertidal zone in Los Angeles County is especially vulnerable to disturbance by human visitation because of the large population of Los Angeles and the popularity of beaches for recreation (Ambrose and Smith 2004). Estimates of use, extrapolated from observations of UCLA researchers during daytime low tides, indicate that more than 20,000 people visit the most popular sites each year. Human impacts on rocky intertidal ecosystems include disturbances from collecting, trampling, handling, and overturning of rocks. UCLA researchers found that the densities of sea stars, sea urchins, sea hares, and other conspicuous invertebrates were lower at sites with high levels of human use (Ambrose and Smith 2004). Owl limpet (*Lottea gigantea*) sizes were significantly smaller, with fewer large individuals, at sites that received a high number of visitors. Anemones and tube-building worms and mollusks had lower cover at sites with high levels of human use. Surfgrass cover also was lower at the most highly used sites.

2.3. Soft Bottom Subtidal

Most of the nearshore subtidal habitat off Los Angeles County is soft bottom. The physical factor that probably has the greatest influence on the biota of nearshore sands is ocean swell and its accompanying wave surge, which suspends sand particles (Morin and Harrington 1978). The effect of the surge decreases as the water depth increases. The fauna of nearshore soft bottom habitats consists of the infauna, which live buried in the sand, and the epifauna, which spend at least part of their time on the surface of the sand.

Infauna at the shallowest depths are buffeted almost constantly by the shifting sediments associated with wave surge. In these shallow depths, the infauna tends to be dominated by mobile crustaceans, including a variety of amphipods and cumaceans. As water depth increases and wave surge becomes less pronounced, soft bodied polychaete worms become the dominant infaunal type.

The most common epifauna on shallow water sand bottoms at depths less than 30 feet in Los Angeles County are sand dollars (*Dendraster excentricus*) and sea pansies (*Renilla kollikeri*), (Morin and Harrington 1978). In the shallowest subtidal depths the purple olive snail (*Olivella biplicata*) and the spiny sand crab (*Blepharipoda occidentalis*) also are common. The sand star (*Astropecten armatus*) also comes into shallow nearshore waters during periods of calm surf. Common fishes associated with shallow water soft bottoms in Los Angeles County include speckled sanddab (*Citharichthys stigmaeus*), C-O turbot (*Pleuronichthys coenosus)*, diamond turbot (*Hypsopsetta guttulata*), California halibut (*Paralichthys californicus*), corbina (*Menticirrhus undulates*), and walleye surfperch (*Hyperprosopon argenteum*) (Morin et al. 1988). Bat rays (*Myliobatis californica*), thornback rays (*Platyrhinoides triseriata*), and shovelnose guitarfish (*Rhinobatos productus*) also are common on shallow water soft bottoms in Los Angeles County.

2.4. Subtidal Reefs

Morin and Harrington (1978) characterized the biota of shallow water and nearshore reefs in the Malibu area. Shallow water rocks and reefs, which are the most likely to be affected by beach sand, includes hard bottom substrate from the intertidal zone to about 15 foot water depth. These low reefs and isolated boulders, are close to shore and are strongly affected by a variety of physical factors including swell and longshore currents. Because shallow water reefs are in the zone of active sand transport they are subjected to sanding in, high turbidity and scour. Furthermore, nearshore reefs are affected by local runoff from the land, and even by lowered salinity from rain storms (Morin and Harrington 1978). Biological communities on these shallow rocks are often characterized by rapid turnover of species. Bare rock can be extensive after catastrophic events such as sanding in and subsequent re-exposure of rock. Long-lived sand-tolerant species typical of nearshore rocks at this depth include aggregate anemones, surfgrass, feather boa kelp and California mussels. Generally, low-relief reefs that experience substantial sand disturbance in the form of deposition and scour support fewer species than higher relief, vegetated reefs (SAIC 2011).

Nearshore reefs at depths between 15 feet and 30 feet represent a transition between shallow water reefs and offshore reefs. The most prominent species on the tops of these reefs tend to be the shrub-like intermediate height brown kelps like the sea palms (*Eisenia arborea* and *Pterygophora californica*) and the bladder kelp (*Cystoseira osmundacea*). The sides of the reefs generally support a rich encrusting fauna of sponges, tunicates and bryozoans. Giant kelp occurs on some of these nearshore reefs particularly at the western end of the project area. Giant kelp is sparse or absent on reefs between Topanga and Palos Verdes. Sea urchins (*Strongylocentrotus purpuratus* and *S. franciscaus*) often are abundant. Subtidal reefs typically attract a large variety of fish species including cryptic species that blend in with the growth on the rocks, demersal species that usually stay near the bottom, and water column species that hover above the reef. Fish diversity on reefs increases with the amount of vertical

relief until a reef height of about 3 feet after which increased reef height has little additional effect on fish diversity (Cross and Allen 1993).

Pondella (2009) used the characteristics (number of feeding guilds, fish size, density, and fidelity) of fish assemblages associated with reefs to compare the habitat quality of mainland reefs in the Southern California Bight. The reefs off Point Dume had the highest score for habitat quality of any of the reefs surveyed. The reefs off Nicholas Canyon also had a high score.

2.5. Kelp Beds

Figures 1 through 4 show giant kelp beds in the project area. Most of the kelp beds are located between Malibu Point and the Los Angeles/ Ventura County line at the western end of the Los Angeles County shoreline. Scattered patches of kelp also occur between Topanga and Malibu Point. Kelp beds are absent southeast of Topanga until Malaga Cove in Palos Verdes, which is the southeastern boundary of the project area for the Los Angeles County Sediment Management Plan. Off the Los Angeles County shoreline, kelp beds grow only on rocky substrate usually in depths between 20 and 60 feet.

Kelp attaches to the rock by means of a root-like structure called a holdfast. Giant kelp beds form "kelp forests" that extend from the sea floor to the surface to form a vertically structured habitat throughout the water column. Kelp beds exert a marked influence on physical and biological features of the coastline (Murray and Bray 1993). Giant kelp provides food, shelter, nursery and a point of reference for invertebrates and fishes (MBC 1988.) In addition to the importance of living kelp as a structural and nutritional resource, drift kelp is extremely important in detritus-based food chains. Drift kelp is an important food source to species such as sea urchins and abalone. On the beach, kelp is a food source for insects and crustaceans that, in turn are eaten, by shorebirds including the federal threatened western snowy plover. Kelp beds support a greater variety of marine organisms than kelp stands, which consist of a localized group of plants (SAIC 2011).

The abundances of water column fishes such as kelp surfperch (*Brachyistius frenatus),* kelp bass *(Paralabrax clathratus),* giant kelpfish (*Heterostichus rostratus),* and kelp rockfish (*Sebastes atrovirens)* are directly correlated with kelp density (Cross and Allen 1993).On low relief or cobble areas, the presence of kelp is associated with a greater biomass and diversity of fish than on low or cobble reefs without kelp(Cross and Allen 1993). Kelp beds are not important spawning areas for fishes but they are important as nursery areas for juveniles (Cross and Allen 1993).

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 Nino events. There have been a number of attempts to restore kelp in Santa Monica Bay.

2.6. Surfgrass

Surfgrass is a marine flowering plant. Surfgrass, like kelp, is considered to be a particularly valuable marine habitat because it provides shelter for fishes and invertebrates, attachment sites for sessile

invertebrates and algae, and forms the basis of many marine food chains, both as living material and detritus. Surfgrass provides nursery habitat for fishes and invertebrates, including the California spiny lobster (*Panuliris interruptus*). Because it provides structure, food, shelter and nursery habitat, in many ways, surfgrass is the low intertidal/shallow subtidal equivalent of giant kelp.

Surfgrass occurs in limited areas along the Los Angeles County coast, usually on hard bottom substrate in the lower subtidal below mean lower low water and shallow subtidal out to depths of about 25 feet. Surfgrass has not been mapped along the Los Angeles County shoreline, but would be expected where low intertidal and shallow subtidal rocky substrate occurs. Locations known to support substantial surfgrass beds include Sequit Point, Nicholas Canyon, Encinal Canyon, Lechuza Point, Point Dume to Paradise Cove, Latigo Point, Corral Canyon, Old Malibu Road, Big Rock, and Sunset Blvd. (Tay 1991, Coastal Resources Management 1997, Chambers Group 2011).

2.7. Eelgrass

Like surfgrass, eelgrass is a marine flowering plant, but it grows on soft substrate rather than on rocks. Eelgrass (*Zostera marina*) is most common in bays and estuaries, but there is an offshore form (thought to be *Zostera pacifica*) that occurs in a few locations in southern California. Eelgrass has similar habitat values to surfgrass. On relatively monotonous soft bottom, eelgrass provides structure, shelter, attachment sites, food, and nursery habitat. With its root-like rhizomes, eelgrass also tends to stabilize the substrate where it grows.

An eelgrass bed in 24 to about 47 feet of water has been present just southeast of Lechuza Point since at least 1971 and was observed in September, 2010 (N. Davis, personal observation, Egstrom 1974, Morin and Harrington 1978, Chambers Group 2011). Eelgrass also reportedly was present off Los Alisos Canyon in the 1970's (Egstrom 1974, Morin and Harrington 1978). It is not known whether the Los Alisos Canyon bed is still present.

2.8. Coastal Lagoons

Coastal lagoons form where rivers meet the ocean. Coastal lagoons support a biota that is transitional between marine and freshwater. Lagoons are productive coastal ecosystems that play a role as nursery habitat for many coastal invertebrates and fishes (URS 2010). Coastal lagoons also support estuarine species such as pacific staghorn sculpin (*Leptocottus* armatus), arrow goby (*Clevlandia* ios), cheekspot goby (*Ilypnus* gilberti), shadow goby (*Quietula y*-cauda) and Calfironia killifish (*Fundulus parvipinnis*). Malibu Lagoon and Topanga Creek support Federal endangered steelhead. Coastal lagoons are heavily used by marine birds for foraging and roosting.

Coastal lagoons in Los Angeles County include the mouth of Zuma Creek, Malibu Lagoon, and the mouth of Topanga Canyon. In addition, the Ballona Wetlands are a tidal wetlands connected to the tidal flows of Ballona Creek through culverts. With the exception of the Ballona Wetlands, the coastal lagoons of the project area are periodically closed by sand bars that reopen during winter storms.

3. Sensitive Species

3.1. Listed Species

There are four listed species that may occur on the beaches or nearshore waters of Los Angeles County between the Los Angeles/Ventura County line and Malaga Cove. Each of these is discussed below.

3.1.1. **Black Abalone (Haliotis cracherodii)-Federal Endangered** – Black abalone are marine gastropods that occur in intertidal and shallow subtidal rocky habitat from Northern California to Bahia Tortugas, Mexico. Black abalones are most common in the middle and lower intertidal zones. Black abalones inhabit rocky shores where bedrock provides deep protective crevice structure (Schwaab 2010). Black abalone populations have declined dramatically since the 1970's from overfishing and a bacterial disease known as withering syndrome. Black abalones were present along the Los Angeles County shoreline at least up until the 1970's (Morin and Harrington 1978). Severe declines in abundance of black abalone in southern California were observed in the late 1980's (Butler et al 2009).The Palos Verdes Peninsula has been designated as Critical Habitat for black abalone, but no black abalone Critical Habitat has been proposed for the project area between Malaga Cove and the Los Angeles County/Ventura County border.

3.1.2. **Southern Steelhead Distinct Population Segment (DPS) (Oncorhynchus mykiss) – Federal Endangered** - Steelhead are born in freshwater and spend a portion of their lives in the ocean before returning to freshwater to spawn. Adults require cool, well-oxygenated streams for spawning. The steelhead populations within the Southern California Steelhead Distinct Population Segment (DPS) have declined dramatically from estimated annual runs totaling 55,000 adults to less than 500 returning adult fish (NOAA Fisheries 2009). The Southern California Steelhead DPS is at the extreme southern limit of the steelhead range. There has been extensive loss of populations, especially south of Malibu Creek, due to urbanization, dewatering and channelization of rivers and creeks. Most of the spawning and rearing habitat of the major streams has been rendered inaccessible by dams, debris basins, road crossings, and other in-stream structures which block or impede migration of adult steelhead to headwater spawning and rearing areas, as well as restricting the out-migration of juveniles to the ocean. Three streams within the Los Angeles County coastal area are known to still support steelhead. These streams are Arroyo Sequit, Malibu Creek, and Topanga Creek (Becker and Reining 2008). Low numbers of steelhead may be present in the nearshore waters of the project area.

3.1.3. **Western Snowy Plover (Charadrius alexandrinus nivosus)** – Federal Threatened – The western snowy plover is a small shorebird that is found on sandy beaches, salt pond levees, and the shores of large alkali lakes. This species needs sandy, gravelly, or friable soils for nesting. Snowy plovers forage for insects and marine invertebrates in wet sand along the edge of the water and in macrophyte wrack on the upper beach.

Snowy plovers have not bred on Los Angeles County beaches since 1949 (Ryan Ecological Consulting and Los Angeles Audubon 2010). The nearest snowy plover nesting areas to Los Angeles County are Mugu Lagoon in Ventura County to the north and Bolsa Chica Ecological

Reserve in Orange County to the south. However, several beaches in Los Angeles County are used extensively by snowy plovers as wintering habitat. Approximately 196 to 334 snowy plovers (about 7.3 percent of the California population) overwinter in Los Angeles County each year (Ryan Ecological Consulting and Los Angeles Audubon 2010). The primary roosting sites for wintering snowy plovers in Los Angeles County are Zuma Beach, Malibu Lagoon, Santa Monica, Dockweiler State Beach near Lifeguard Tower 47, Dockweiler State Beach near Tower 58, and Hermosa Beach (Ryan Ecological Consulting and Los Angeles Audubon 2010). Snowy plovers also occasionally use sites at Leo Carrillo State Beach, Paradise Cove, Dan Blocker County Beach, Big Rock Beach, Will Rogers State Beach, Venice Beach, central Dockweiler State Beach, El Segundo Beach, Manhattan Beach, and Redondo Beach, but 96 percent of all detections in the 2010 winter survey were at the 6 main roosting sites, which consistently support the largest number of snowy plovers (Ryan Ecological Consulting and Los Angeles Audubon 2010). Zuma Beach is the largest roosting area and supports approximately 41 percent of the Los Angeles County wintering snowy plover population. Malibu Lagoon is the second largest roost and typically supports about 16 percent of the county population. The roost at Santa Monica State Beach supports about 8 percent of the countywide wintering population. The remainder of the wintering snowy plovers is generally found at Dockweiler Beach and Hermosa Beach.

Designated Critical Habitat for snowy plovers within Los Angeles County includes Zuma Beach from Trancas Canyon to the north side of Point Dume, Santa Monica Beach from Santa Monica Canyon to Montana Avenue, Dockweiler North centered at Sandpiper Street, Dockweiler South centered at Grand Avenue, and Hermosa State Beach from 6th Street to 2nd Street (USFWS 2005). In March, 2011, the United States Fish and Wildlife Service proposed to revise Critical Habitat for the western snowy plover (USFWS 2011). The revised designations would extend the Critical Habitat at Zuma Beach about 0.2 miles toward Point Dume. The revised designation would add Critical Habitat at Malibu Beach from about 300 feet north of Malibu Pier to Malibu Point. The proposed rule would extend the Critical Habitat at Santa Monica Beach by about 0.1 mile. The revised Critical Habitat at Dockweiler North would be slightly smaller than the existing Critical Habitat (34 acres compared to 43 acres). Critical Habitat at Dockweiler South would be extended about 0.3 miles to the north to Imperial Highway and the Critical Habitat at Hermosa State Beach would be extended about 0.25 miles to stretch from 11th Street to 1st Street.

3.1.4. California Least Tern (*Sterna antillarum browni)*- Federal and State Endangered – The California least tern nests along the coast from San Francisco Bay south to northern Baja California. This species is a colonial breeder on bare or sparsely vegetated, flat substrates, sand beaches, alkali flats, land fills, or paved areas. California least terns are only present in California during their breeding season of April to September.

California least terns have a major breeding site within the project area on Venice Beach, about 400 feet upcoast from the northern entrance jetty to Marina del Rey (Figure 3). The colony is protected by a chain link fence. A total of 295 pairs nested in this colony in 2009 but produced no young (Marschalek 2010). Predation due to American crows (*Corvus brachyrhynchos*) was

extremely high and resulted in complete failure of nesting attempts. Least terns from the Venice Beach nesting colony forage in all of the waterbodies in the vicinity of the colony (Atwood and Minsky 1983). In their study of foraging behavior of the Venice Beach least tern colony, Atwood and Minsky (1983) found that at least 75 percent of the foraging took place in the ocean within 0.75 miles of the nest site.

3.2. Other Species of Concern

3.2.1. **California Grunion (Leurethes tenuis)** – The California grunion is a nearshore fish that lays its eggs on sandy beaches between March and September. Grunion spawn on the upper beach during nighttime high tides from two to six nights after the new and full moon between March and August. Although grunion are not listed as threatened or endangered or as a species of special concern, this species has been negatively affected by human activities on beaches and NOAA Fisheries recommendsthat their eggs be protected from disturbance whenever feasible.

4. Designated Marine Areas

4.1. Marine Protected Areas

4.1.1. Marine Life Protection Act

4.1.2. In 1999, the State of California passed the Marine Life Protection Act, which redesigned California's system of protected areas to increase coherence and effectiveness in protecting the state's marine life and habitats (URS 2010). Two Marine protected Areas have been designated within the project area between the Los Angeles/Ventura County line and Malaga Cove. These are the Point Dume State Marine Conservation Area (SMCA) and the Point Dume State Marine Reserve (SMR) (Figure 1). The area between Point Dume and El Matador State Beach has been designated the Point Dume SMCA. From Point Dume to ParadiseCove has been designated the Point Dume SMR. The Point Dume SMR has the more restrictive regulations. Take of all living marine resources are prohibited in this area. Within the Point Dume SMCA recreational take of pelagic finfish , including Pacific bonito and white sea bass by spearfishing, is allowed as is commercial take of coastal pelagic species by round haul net and swordfish by harpoon. Take pursuant to beach nourishment and other sediment management activities is allowed inside the conservation area pursuant to any required federal, state and local permits, or as otherwise authorized by the departmentAreas of Special Biological Significance

4.2. Thirty-four Areas of Special Biological Significance (ASBS) were designated by the State Water Resources Control Board in the 1970's as areas that required special protection from water quality degradation. Since 1983, the State Water Board's Ocean Plan has officially prohibited all waste discharges, both point and nonpoint, into ASBSs. The western portion of the project area

is within the Mugu-Malibu ASBS. The Mugu-Malibu ASBS extends from Latigo Point in Los Angeles County to Laguna Point in Ventura County. The ASBS extends from the intertidal to 100 foot depths or 1000 feet offshore, whichever is further. The Mugu-Malibu ASBS is the only ASBS on the Los Angeles County mainland coast.

5. Constraints and Impact Reduction Measures for Sediment Management

5.1. Sensitive Habitats

Because they are limited in extent and because they may be vulnerable to sedimentation, kelp beds, seagrass beds, tidepools, and reefs may pose a constraint to sediment management activities. The resource agencies are concerned with sedimentation of these habitats. To the extent possible, beach nourishment plans should place sediment on sand beach habitat and avoid direct placement on kelp, surfgrass, or tidepool habitats. Even if the initial sand placement avoids direct placement on a sensitive habitat, there are concerns that subsequent distribution of sand by wave action may result in the deposition of sand on sensitive habitats including offshore reefs, kelp beds, and seagrass beds. Modeling may be used to predict the likely sediment deposition on sensitive habitats and the results may suggest that further adjustments in sediment placement should be made. In addition, if sediment management activities generate excessive turbidity, there could be effects on kelp or seagrasses, which require light for growth, as well as on the associated biota. The resource agencies usually request monitoring of sensitive habitats near sediment placement sites and may request habitat compensation if long term degradation of a sensitive habitat by sediment management activities is documented.

Sediment management activities also could affect the opening of coastal lagoons. Sediment management plans near coastal lagoons should address the potential for harmful lagoon closures if excessive sand moves into the lagoon mouth at a time when the lagoon is normally open. If there is a potential for sand placement to result in harmful closure of a lagoon, it may be necessary to monitor the movement of sand into the lagoon area and, if necessary, address opening of the sand bar.

5.2. Sensitive Species – Constraints and Protective Measures

5.2.1. Black Abalone

5.2.2. Black abalone likely are extirpated from the project area. If any still exist within the project area they would be expected to occur in high quality rocky intertidal or shallow nearshore reef habitat in the Palos Verdes area only.

5.2.3. Southern Steelhead DPS

Southern steelhead are present in low numbers offshore and would be unlikely to be affected by sediment management activities. The most likely impact to steelhead would be if sediment placed on a beach resulted in closure of a lagoon mouth, such as the mouth of Topanga Creek, during the time that steelhead would be migrating or if mouth closure caused a degradation of lagoon habitat that resulted in adverse effects on juvenile steelhead in the lagoon. Monitoring of sediment placement near lagoon

mouths and breaching, of the sandbar, if necessary could minimize potential adverse impacts to steelhead.

5.2.4. Western Snowy Plover

Western snowy plovers would be expected to benefit in the long-term by sediment placement that resulted in the widening of sand beaches because an increase in beaches would increase their foraging and roosting habitat. However, there is a concern that snowy plovers could be disturbed or injured by beach construction activities. Snowy plovers are colored so that they are hard to see against a sand background and have a habit of resting motionless in depressions including vehicle tracks. Snowy plovers have been killed by vehicle strikes on Los Angeles County beaches (Ryan Ecological Consulting and Los Angeles Audubon 2010). To avoid construction impacts to snowy plovers, a biological monitor should be present to warn the construction crew to avoid any areas where snowy plovers occur until the plovers leave the area and to escort vehicles crossing roosting areas. This measure avoids disturbance to foraging or roosting snowy plovers and also insures that one will not be killed by a vehicle strike.

5.2.5. California Least Tern

California least terns are only present in southern California between April and September. Sediment management activities in the vicinity of the Venice Beach colony can be conducted with no restrictions due to availability of foraging within Ballona Creek, Ballona Wetlands, Ballona Lagoon and Venice Canals.

Species of Concern – Constraints and Protective Measures

5.2.6. California Grunion

Grunions spawn on sandy beaches between March and early September. Sediment management activities between mid September and the beginning of March would avoid any impacts to grunion. Beach placement during the grunion spawning season has the potential to impact grunion if movement of sediment results in digging up eggs or placement of sediment results in burying the eggs. Impacts can be avoided or minimized by having biologists monitor predicted grunion runs on the beach where sand placement is occurring. The monitors should mark the location of any areas where grunion were observed to spawn. Beach activities involving digging or placing sediment should avoid wherever possible those grunion spawning areas for two weeks when the eggs will hatch during the next nighttime high tide series. Impacts can be minimized by the use of single-point discharges where avoidance is not feasible.

6. Literature Cited

Ambrose, R.F. and J. Smith. 2004. Restoring Rocky Intertidal Habitats in Santa Monica Bay. Report to Santa Monica Bay Restoration Commission

Atwood, J.L. and D.E. Minsky. 1983. Least Tern Foraging Ecology at Three Major California Breeding Colonies. *Western Birds* 14: 57-71

Becker, G.S. and I.J. Reining. 2008. Steelhead/Rainbow Trout (*Oncorhynchus mykiss*) Resources South of the Golden Gate, California. Prepared for the California State Coastal Conservancy and the Resources Legacy Fund Foundation

Butler, J., A. DeVogelaere, R. Gustafson, C. Mobley, M. Neuman, D. Richards, S.Rumsey, B. Taylor, and G. VanBlaricom. 2009. Status Review Report for Black Abalone. NMFS Southwest Region

Chambers Group, Inc. 2011. Reconnaissance Survey of Marine Biological Resources at Broad Beach. Letter Report from N. Davis to R. Boudreau of Moffatt&Nichol Engineers

Coastal Resources Management. 1997. Marine Biological Resources Inventory and Environmental Assessment for the County of Los Angeles Department of Public Works Evaluation of Proposed Malibu Area Sediment Placement Sites Study Los Angeles County, California. Prepared for Owen Group

Cross, J.N. and L.G.Allen. 1993. Fishes. In M.D. Dailey, D.J. Reish, and J.W. Anderson eds. *Ecology of the Southern California Bight. A Synthesis and Interpretation:* 459-540

Dugan, J.E. and D.M. Hubbard. 2006. Ecological Responses to Coastal Armoring on Exposed Sandy Beaches. Shore & Beach 74(1): 10-16.

Dugan, J.E., D. M. Hubbard, J.M. Engle, D.L. Martin, D.M. Richards, G.E. Davis, K.D. Lafferty, and R.F. Ambrose.2000 Macrofauna communities of exposed sandy beaches on the Southern California mainland and Channel Islands. Fifth California Islands Symposium, MMS 99-038: 339-346.

Egstrom, G.H. 1974. The Los Angeles County Underwater Resource Inventory. University of California Sea Grant Program.

Knaggs, E.H. , E.R. fleming and T. Hoban. 1977. Results of the 1977 Southern California Pismo Clam Survey. Marine Resources. Administrative Report No. 77-15

Marschalek, D.A. 2010. California Least Tern Breeding Survey 2009 Season. Final Report to State of California. Department of Fish and Game. Southcoast Region

Martin, K. 2006. Ocean Outlets and Grunion in the County of Orange.

MBC Applied Environmental Sciences. 1988. The State of Santa Monica Bay: Part One: assessment of Conditions and Pollution Impacts. Prepared for Southern California Association of Governments

Morin, J.G. and A. Harrington. 1978. Reconnaissance Survey of the Mugu-Malibu Area of Special Biological Significance. Prepared for the California Department of Fish and Game and State Water Resources Control Board

Morin, J.G., J.E. Kastendiek, A. Harrington and N.Davis. 1988. Organisms of a Subtidal Sand Community in Southern California. *Bull. Southern California Acad. Sci.* 87(1): 1-11

Murray, S.N. and R.N.Bray. 1993. Benthic Macrophytes in M.D. Dailey, D.J. Reish, and J.W. Anderson eds. *Ecology of the Southern California Bight. A Synthesis and Interpretation*: 304-368

NOAA (National Oceanic and Atmospheric Administration). 2009. Southern California Steelhead DPS. NOAA's National Marine Fisheries Service Southwest Regional Office

NOAA (National Oceanic and Atmospheric Administration. 2011. Endangered and Threatened Wildlife and Plants: Final rulemaking to Designate Critical Habitat for Black Abalone, Final Rule. Federal Register Vol. 76 No. 208, October 27, 2011: 66806- 66844

Pattison, C.A. 2001. Pismo Clam. In W.S.Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson eds. California's Living Marine Resources: A Status Report. The Resources Agency. The California Department of Fish and Game

Pondella, D.J. 2009. The Status of Nearshore Rocky Reefs in Santa Monica Bay for Surveys Completed in the 2007-2008 Sampling seasons. Vantuna Research Group

Ryan Ecological Consulting and Los Angeles Audubon, 2010. The Western Snowy Plover in Los Angeles County, California: January to August 2010. Prepared for The California Department of Fish and Game

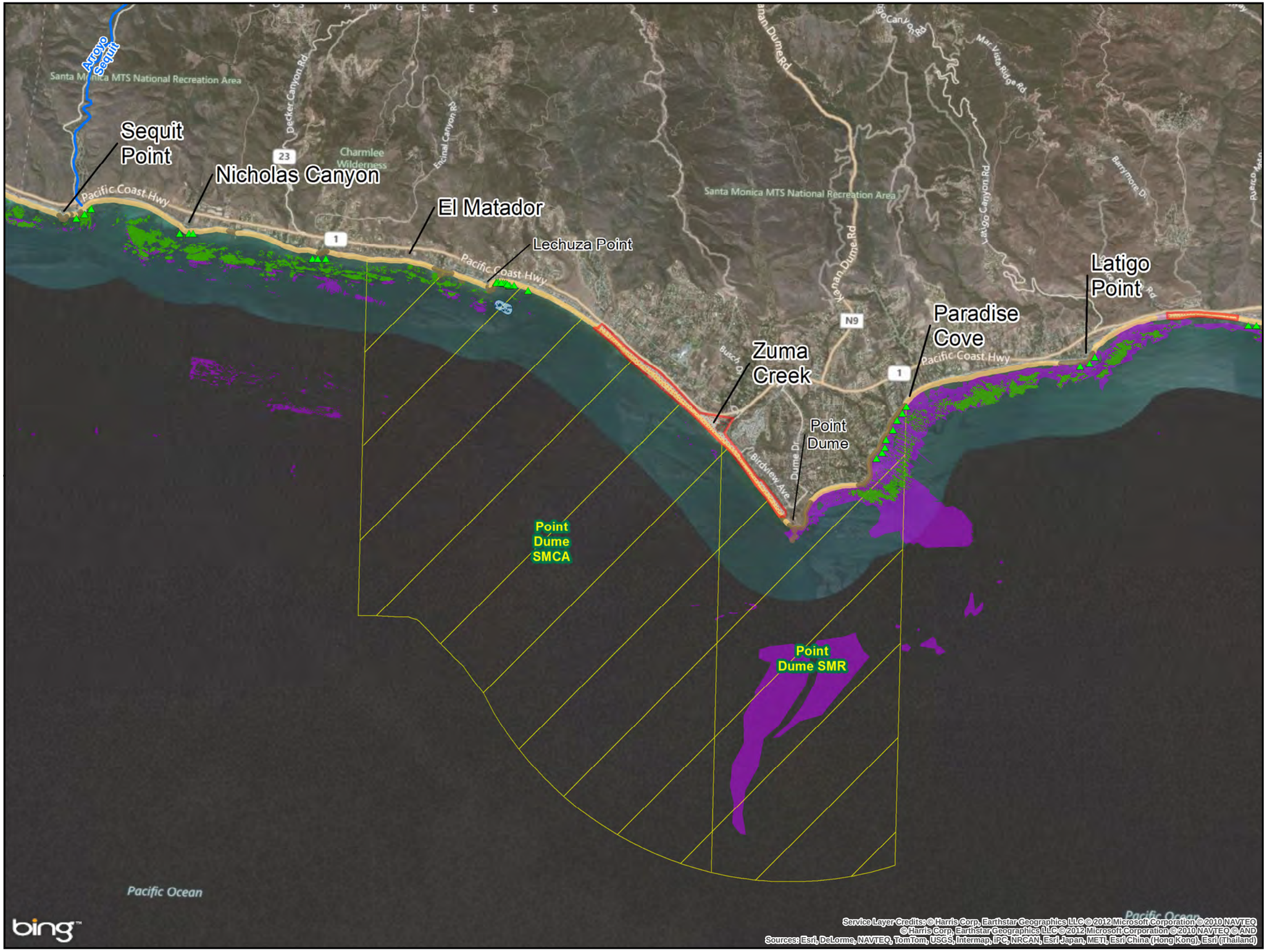
SAIC. 2011. Review of Sediment Management Impacts and Issues Relevant to Protection of California Coastal Biota. Prepared for California Coastal Sediment Management Workgroup

Tway, L.E. 1991. *Tidepools of Southern California.* Capra Press. Santa Barbara.

URS. 2010. Draft Environmental Impact Report California Marine Life Protection Act Initiative South Coast Study Region

U.S. Fish and Wildlife Service. 2005. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Pacific Coast Population of the Western Snowy Plover; Final Rule. Federal Register Volume 70. No. 188: 56970-57119

U.S. Fish and Wildlife Service. 2011. Endangered and Threatened Wildlife and Plants; Revised Critical Habitat for the Pacific Coast Population of the Western Snowy Plover; Proposed Rule. Federal Register Volume 76. No. 55: 16046 - 16165



Shoreline Habitats
Los Angeles County Sediment Management Plan
Figure 1

 Version Date: 8/15/2012

Adopted Marine Protected Areas

Biological Habitats
- Western Snowy Plover Critical Habitat
- Steelhead Streams

Marine Biological Habitats
- Predicted Substrate - Hard
- Kelp Beds
- Eel Grass
- Surf Grass Locations

Shoreline Types
- Beaches
- Coastal Marsh
- Hardened Shores
- Rocky Shores
- Tidal Flats

N

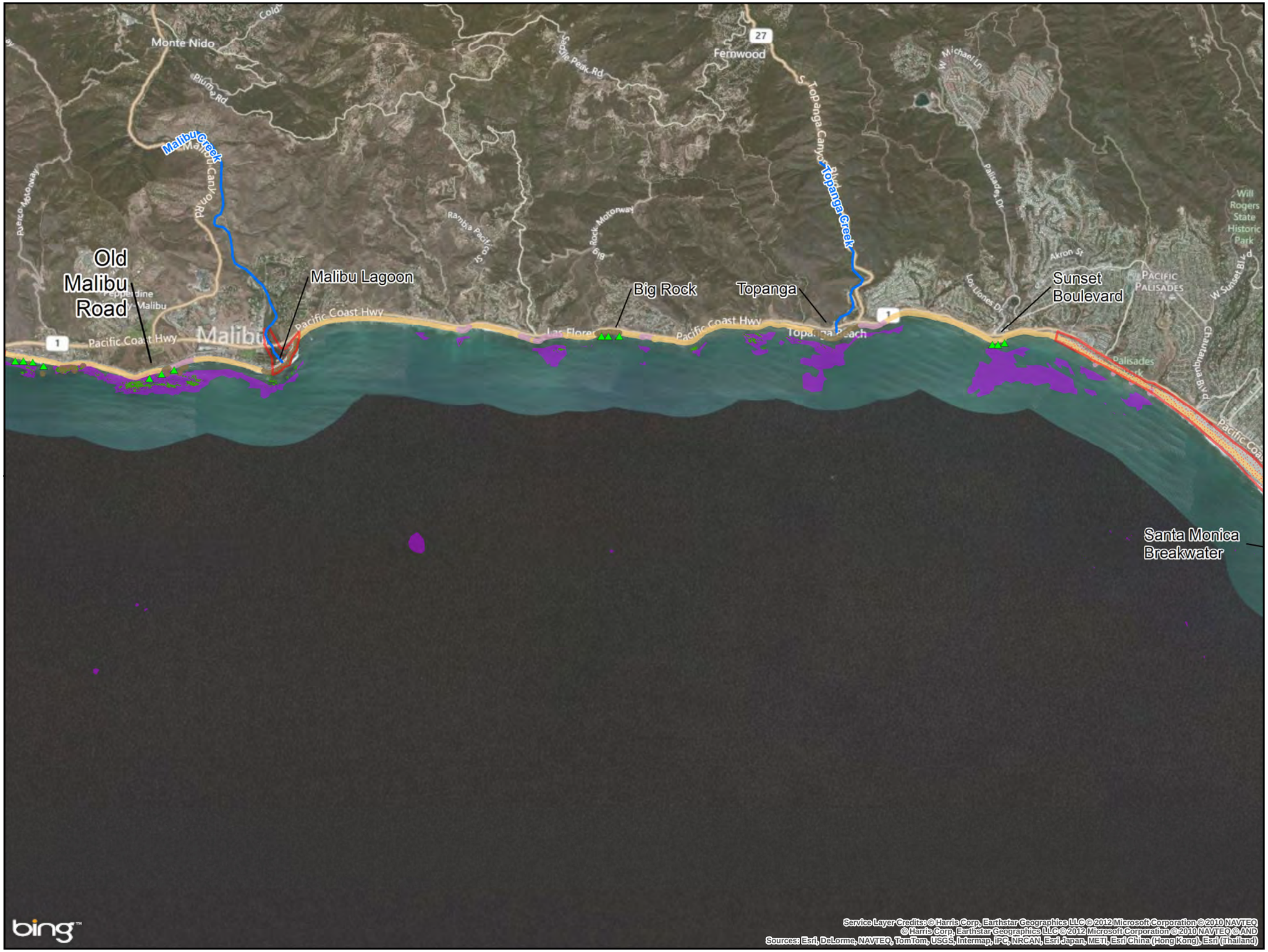
SCALE=1:60,000

0 1,700 3,400 6,800

Feet

CHAMBERS GROUP

3316 - Y:\Projects\3316 LA County Sediment\Shoreline Habitats.mxd



Shoreline Habitats
Los Angeles County Sediment Management Plan
Figure 2

 Version Date: 8/15/2012

Adopted Marine Protected Areas

Biological Habitats
- Western Snowy Plover Critical Habitat
- Steelhead Streams

Marine Biological Habitats
- Predicted Substrate - Hard
- Kelp Beds
- Eel Grass
- Surf Grass Locations

Shoreline Types
- Beaches
- Coastal Marsh
- Hardened Shores
- Rocky Shores
- Tidal Flats

N

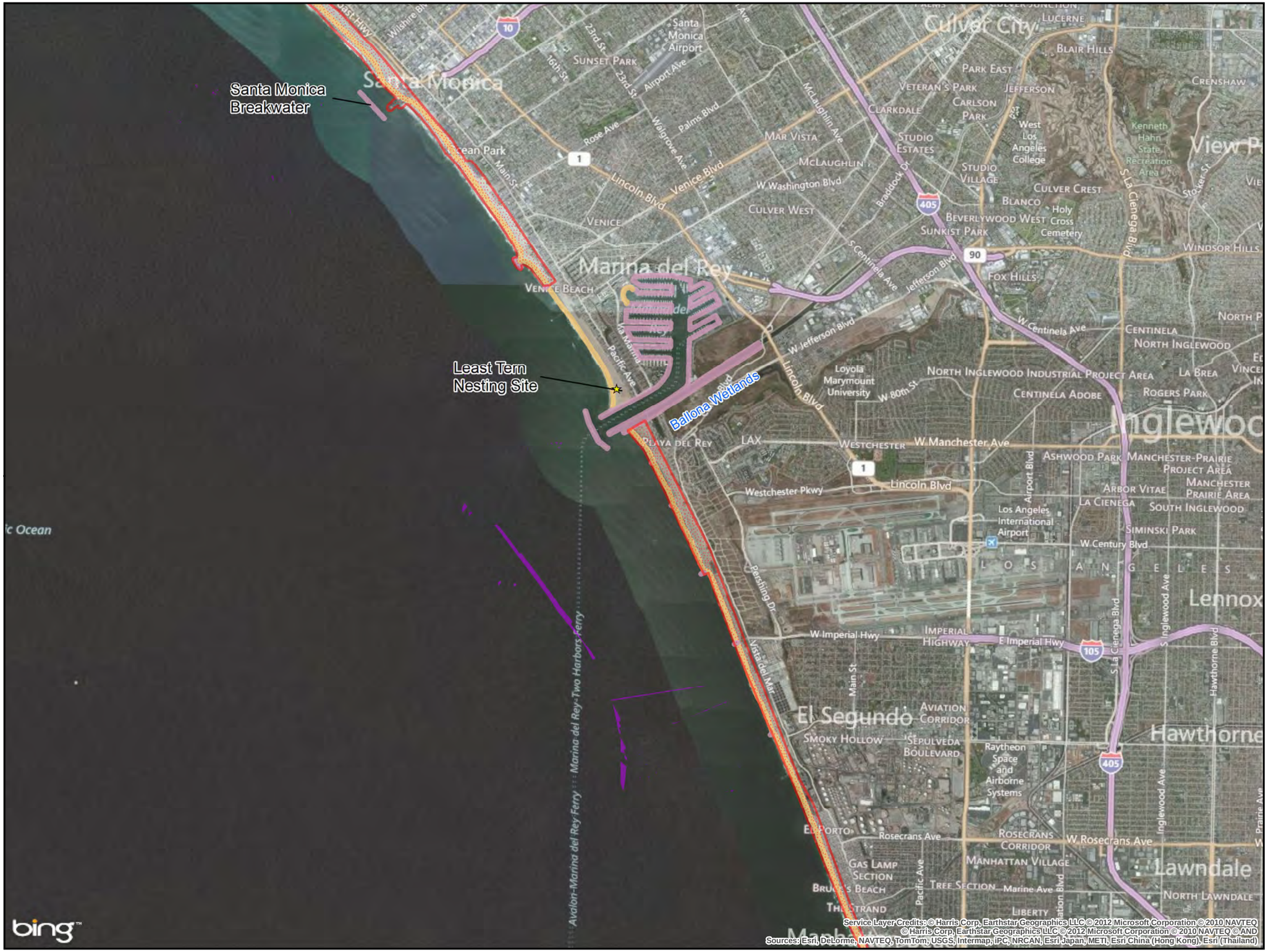
SCALE=1:60,000

0 1,700 3,400 6,800

Feet

CHAMBERS GROUP

3316 - Y:\Projects\3316 LA County Sediment\Shoreline Habitats.mxd



Shoreline Habitats
Los Angeles County Sediment Management Plan
Figure 3

 Version Date: 8/15/2012

Adopted Marine Protected Areas

Biological Habitats
- Western Snowy Plover Critical Habitat
- Steelhead Streams

Marine Biological Habitats
- Predicted Substrate - Hard
- Kelp Beds
- Eel Grass
- Surf Grass Locations

Shoreline Types
- Beaches
- Coastal Marsh
- Hardened Shores
- Rocky Shores
- Tidal Flats

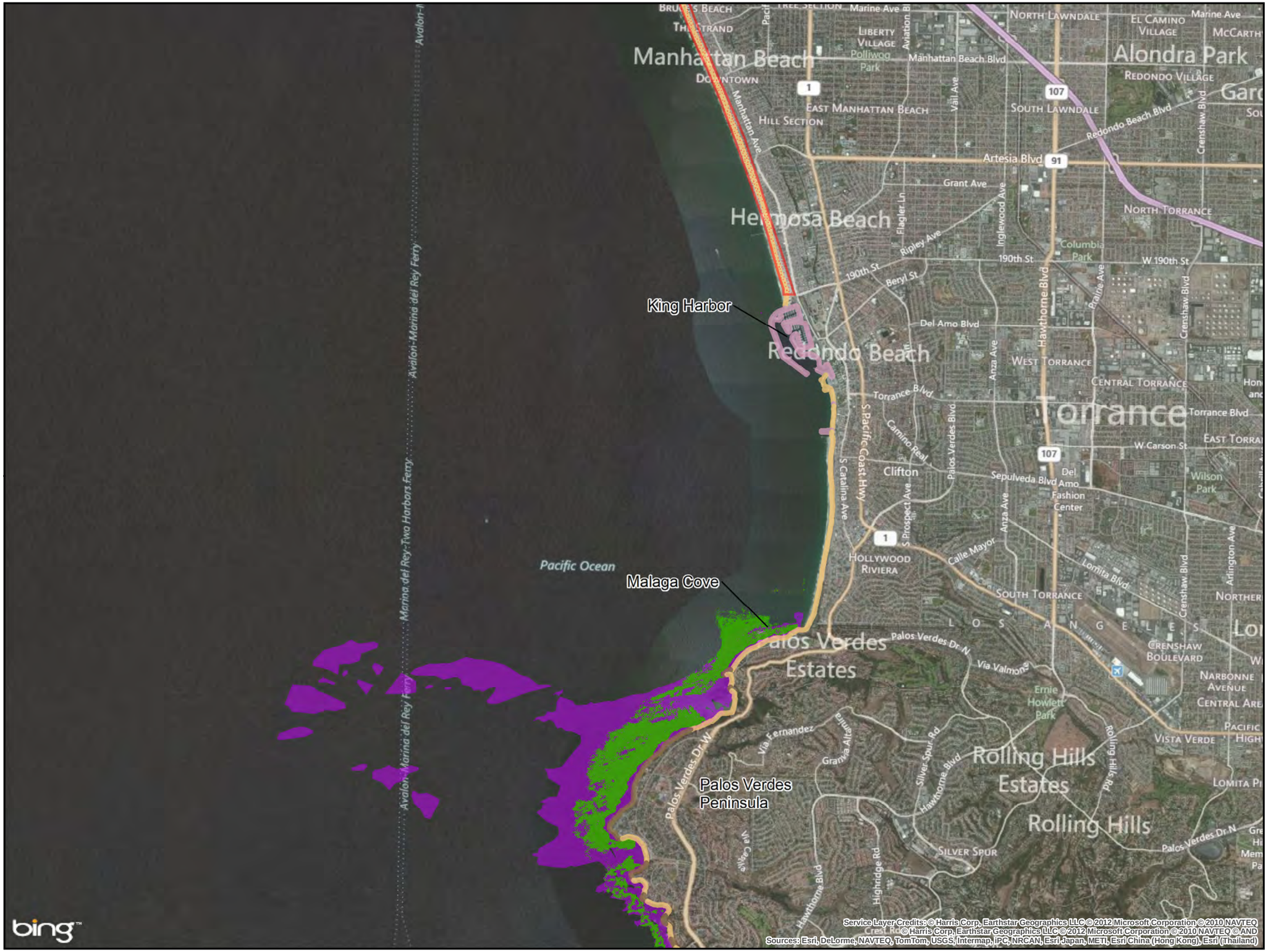
SCALE=1:60,000

0 1,700 3,400 6,800

Feet

CHAMBERS GROUP

3316 - Y:\Projects\3316 LA County Sediment\Shoreline Habitats.mxd



Shoreline Habitats

Los Angeles County Sediment Management Plan

Figure 4

 Version Date: 8/15/2012

Adopted Marine Protected Areas

Biological Habitats

Western Snowy Plover Critical Habitat

Steelhead Streams

Marine Biological Habitats

Predicted Substrate - Hard

Kelp Beds

Eel Grass

Surf Grass Locations

Shoreline Types

Beaches

Coastal Marsh

Hardened Shores

Rocky Shores

Tidal Flats

N

SCALE=1:60,000

0 1,700 3,400 6,800

Feet

CHAMBERS GROUP

3316 - Y:\Projects\3316 LA County Sediment\Shoreline Habitats.mxd