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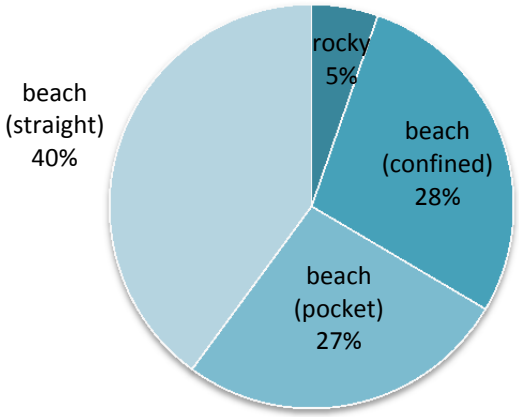
Coastal Zone

Orange County has approximately 43 miles of shoreline, extending from the border of Los Angeles County to San Diego County. The coastal zone area encompasses approximately 37,800 acres (59 square miles), not including bays, harbors, or lagoons and includes portions of the County of Orange and 10 incorporated cities. Orange County is the third most populous county in California, and has also been identified by the Pacific Institute as the county with the highest population at risk to sea level rise. Orange County is well known for its touristic activities, beautiful beaches, and iconic coastal cities such as Seal Beach, Huntington Beach, Newport Beach, Laguna Beach, and Dana Point. Miles of uninterrupted beaches lead to a range of recreational activities, including swimming, body boarding, surfing, volleyball and others. Orange County is also home to the Seal Beach National Wildlife Refuge (NWR) which is located within the Naval Weapons Station Seal Beach.

Outer Coast Shoreline



Coastal Zone Resources

Ports & Harbors: Dana Point, Newport Beach
Publicly Owned/Accessible: 4,100 acres
Public Access Coastal Areas: 123 locations
Coastal Zone Wetlands: 3,300 acres

Ocean Economy

2013 County Ocean Sector GDP	**$3.8 B**
2013 Major Ocean Economic Sectors	
Tourism & Recreation GDP	$2.0 B
Transportation GDP	$1.6 B
Minerals GDP	$0.04 B

10%

of State Ocean Sector GDP

Source: National Ocean Economics Program, 2016

Orange County is famous for its tourist locations and miles of uninterrupted beaches and recreational assets. The ocean economy is the fourth largest in the state and accounts for 10% of the State's total ocean sector gross domestic product (GDP). More than half of the county's ocean economy is associated with beach tourism and recreation. In turn, this makes the ocean economy susceptible to the vulnerabilities associated with rising sea levels.

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Hazards and Vulnerability

Regions in Orange County have been assessed for vulnerabilities to rising sea levels, and continue to be heavily studied through further vulnerability assessments. With moderate sea level rise projections (55 inches by 2100), the Orange County Climate and Health Profile Report highlights the vulnerabilities of coastal aquifers to saltwater intrusion, and coastal erosion's negative impacts to recreation, infrastructure and public safety. The report states that 28% more land in Orange County will be vulnerable to 100-year floods [1]. According to Pacific Institute data, Orange County will have the highest population vulnerable to 100-year flooding. CoSMos 3.0: Southern California, a modeling tool used to predict coastal flooding due to both sea level rise and storms driven by climate change, also shows several large contiguous areas in the northern part of Orange County susceptible to flooding with 59 inches of sea level rise by 2100 [2].

Pacific Coast Highway at Sunset Beach (Coastal Records Project, 2013).

The U.S. Department of the Interior's analysis of sea level rise in the Santa Ana River Watershed states that rising sea levels are likely to reduce the area of beaches and wetlands, increase erosion of cliffs, bluffs, sand bars, dunes, and beaches [3]. This analysis reiterated that a high number of people will be vulnerable to inundation with sea level rise, as well as a high vulnerability of saltwater inundation into coastal aquifers for Orange County [5].

The Huntington Beach Sea Level Rise Vulnerability Assessment's key findings showed that the city is most vulnerable in the future to flooding during extreme high tides which are expected to overtop protective barriers (such as seawalls and levees) as early as 2030 [4]. Coastal infrastructure and resources are most vulnerable to flooding from extreme wave events and extreme high tides. The assessment also found that between 2030 and 2050, major roadways, public facilities, and residential areas will be vulnerable to extreme high tide and storm events [4]. Similarly, by 2100 there is a high potential for even more widespread inundation across northern Huntington Beach (in the vicinity of Huntington Harbor and Bolsa Chica). Facilities such as the AES Southland power plant, the Orange County Sanitation District wastewater treatment facility, stormwater and transportation infrastructure, public facilities, beaches, ecosystems, and commercial and residential buildings are vulnerable to tidal inundation, extreme wave events, and stormwater runoff [4]. Specifically, the Pacific Coast Highway (PCH) at Warner Avenue and some areas of Sunset Beach currently experience flooding with high tides and rain events [4], and PCH along with other roads are expected to experience tidal inundation as early as 2030. By 2030, properties in Sunset Beach and Huntington Harbor will become vulnerable to flooding from tides, and by 2050 there is expected to be widespread inundation of residential and commercial property [4]. Estuary and bay ecosystems are also incredibly vulnerable to inundation, which could result in habitat shifts [4]. Beaches throughout the City of Huntington Beach are vulnerable to significant erosion.

Potential Bluff Erosion Risk w/ 1.5m SLR

1,500 properties

Source: CoSMoS 3.0 (2016), County parcel data

The City of Newport Beach is particularly vulnerable to sea level rise as parts of the city already experience flooding. Areas around

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Newport Harbor and Newport Bay are known to experience flooding of streets and walkways around the Balboa Peninsula, Balboa Island and other parts of the Newport Beach when high water levels occur, even though much of the shoreline in these areas is armored [5]. Wave overtopping and flooding cause damages to businesses, residences, public infrastructure, and the surrounding coastal habitat. The City of Newport Beach's storm drains empty by gravity into the Newport Bay, causing the system to be unable to provide flood relief when Bay water levels are high [5]. On the Balboa Islands, high water levels can cause sewer and storm drain effluent to spill into the streets during floods which can expose both people and the environment to raw sewage [5]. These vulnerabilities are projected to increase with rising sea levels, increased flooding and storm surge, potentially leading to a rise of public health and safety concerns. A tool that could be useful for addressing potential flooding in this area is FloodRISE, an advance computer model that maps flood hazards on a house by house basis in Newport Bay [6]

Population at risk to 100yr Flood

72,000 = current risk|110,000 = future w/1.4m SLR

Source: Heberger et al., 2009

The City of Laguna Beach has a low lying downtown region, which may be vulnerable to rising sea levels. The Main Beach Park public walkway is vulnerable to both ocean and stream flooding [7]. Other walkways, such as those surrounding Aliso Beach, are frequently washed out.

The Dana Point Harbor Revitalization Preliminary Shoreline Management Plan sets goals and objectives for managing sea level rise and potential impacts of flooding resulting from significant storm events. The plan found potential impacts from sea level rise related flooding and inundation in Dana Point Harbor to be in low lying parking areas, pedestrian walkways located immediately adjacent to seawalls, wastewater, stormwater infrastructure, boat launch areas, vertical accessways, and utility infrastructure [8]. Increased wave action and higher water levels are expected to damage piers, docks, and marina facilities [8]. The Island Bridge may have less bridge clearance due to increased and prolonged increases in tidal heights and higher likelihood of bridge failure from water damage to the bridge structure [8]. Decreased beach and sand areas, resulting in loss of recreational areas are also expected to occur with rising sea levels [8]. Saltwater intrusion and increased groundwater levels in the region are also expected to limit the effectiveness of existing stormwater management practices [8].

Many beach facilities in the City of San Clemente are experiencing flooding, which will be exacerbated with rising seas [7]. Walkways to Poche Beach, parking lots (including the North Beach parking lot, which is the City's main beach parking reservoir), and trails to beaches are already threatened by erosion and flooding, which will increase with sea level rise [7].

LCP and Sea Level Rise Planning

Local Coastal Programs (LCPs) are planning tools used by local governments to guide development in the coastal zone, in partnership with the Coastal Commission. LCPs specify the appropriate location, type, and scale of new or changed uses of land and water and include a land use plan and measures to implement the plan (such as zoning ordinances). The Coastal Commission has awarded three rounds of the Local Assistance Grant Program since January 2014 to support certification and updates of LCPs, with an emphasis on addressing the impacts of climate change. Within this county, the Cities of Seal Beach (Round 3), Newport Beach (Round 2), Dana Point (Round 3), and San Clemente (Round 1 and

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Round 3) have all been awarded grants from the Coastal Commission to address the impacts of sea level rise within their LCP jurisdictions. Table 1 below shows whether jurisdictions have LCPs that address sea level rise. "In part" means an LCP segment has some explicit policy language addressing sea level rise and "in progress" refers to jurisdictions with LCP grants or other sources for addressing sea level rise. A case study for the City of Newport Beach is available to highlight the Commission's LCP planning work on sea level rise [10].

Table 1. LCP Planning in Orange County (as of Dec. 2016)

Jurisdiction/Segment	Certified LCP?	Grant?	Vulnerability Assessments	Updated for SLR?	Shoreline by Jurisdiction*
Orange County	No	No	In Progress [9] Yes [1,2]	No	13%
Bolsa Chica Segment	No	No	Yes [3]	No	
Santa Ana River Segment	No	No	Yes [3]	No	
Santa Ana Heights Segment	No	No	Yes [3]	No	
Newport Coast Segment	1988	No	No	No	
Emerald Bay Segment	1989	No	No	No	
Aliso Viejo Segment	1983	No	No	No	
City of Seal Beach	No	CCC	No	In Progress	2%
City of Huntington Beach	1985	No	Yes [4]	No	22%
Sunset Beach Segment	No	No	Yes [3]	In Progress	
City of Costa Mesa	No	No	No	No	1%
City of Newport Beach	No	CCC	Yes [4,5]	In Part	27%
City of Irvine	1982	No	No	No	None
City of Laguna Beach	1993	No	No	In Part	7%
City of Aliso Viejo	No	No	No	No	None
City of Laguna Niguel	1990	No	No	No	None
City of Dana Point	1989	CCC	Yes [8]	In Progress	6%
City of San Clemente	No	CCC	No	In Progress	4%
Federal Lands					18%
*harbors included in shoreline length percentages					

Coastal Act Management Priorities

Orange County faces significant sea level rise vulnerabilities in every sector. The county must address likely long term impacts to its extremely valuable beach and recreational resources. It also must deal with storm flooding, continued shoreline erosion, increasing pressure for seawall development in the urban areas and managing public-serving infrastructure susceptible to sea level rise impacts in urban areas (e.g., tidal flooding damaging stormwater operations). Some top priorities by Coastal Act themes are presented below.

Coastal Development and Hazards (Coastal Act Sections 30235, 30236, 30250, 30253)

There is a need throughout Orange County for shoreline management planning in LCPs to address residential development vulnerable to sea level rise, especially because models show this county has the highest number of people living in areas vulnerable to flooding from sea level rise as compared to any other coastal county in the state. To protect shoreline development in the county, many jurisdictions have relied on sand replenishment projects and seasonal berms as storm defenses. Some Orange

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County jurisdictions must also prioritize planning for operations of stormwater, wastewater, and transportation infrastructure that could be susceptible to tidal flooding as early as 2030. Other important developed assets that need multi-entity/agency collaboration and coordination for long-term sea level rise planning in the county are energy plants, harbors, wastewater facilities, railroads, and roads. Additional study of erosion threats to Highway 1 and the potential for riverine flooding in some areas of the county are also needed to inform this planning.

Public Access and Recreation (Coastal Act Sections 30210, 30211, 30213, 30220, 30221)

One of the highest priorities in the Coastal Act is the mandate to protect and maximize public access to the coast. Sea level rise could lead to a loss of public access and recreational opportunities due to permanent inundation, episodic flooding or erosion of beaches, recreational areas, and trails. In addition, many public beaches in Orange County are backed by parking lots and some of these beach areas already have space conflicts between parking and sandy beach area. Providing or improving public transportation opportunities to these beaches could help alleviate space conflicts. Given the prevalence of flooding impacts already affecting public parking lots and access ways in cities like Newport Beach, Laguna Beach, Dana Point, and San Clemente, planning for future relocation of access ways and actions to preserve beach area as sea levels rise is particularly important.

Coastal Habitats, ESHA, and Wetlands (Coastal Act Sections 30230, 30231, 30233, 30240)

While much of the Orange County shoreline is heavily developed, there are pockets of unique wetland habitats in areas of Seal Beach, Bolsa Chica and Santa Ana River mouth. Sea level rise threatens wetland and lagoon habitats with saltwater intrusion, drowning of marsh habitat, and vegetation conversion. Thus, there is a need for additional study of management options to preserve wetlands like those at Bolsa Chica, the Seal Beach NWR, and Santa Ana River mouth. Testing adaptation strategies can help examine options to preserve coastal habitat, like a sediment augmentation project underway at Seal Beach NWR. Where environmentally sensitive lands are outside the jurisdiction of a local government (e.g., Naval Weapons Station Seal Beach, Seal Beach NWR, or Bolsa Chica Basin State Marine Conservation Areas), coordination with the appropriate federal agencies and/or land owners will continue to be very important.

Additional Considerations

- Long term planning with Caltrans, State Lands Commission, California State Parks, Orange County Transit Authority and others should be a priority to address vulnerabilities to transportation infrastructure and beach access.
- Some areas such as Highway 1 in Huntington Beach and along the Newport Coast south of Crystal Cove face erosion threats that might require adaptation strategies that are a phased combination of armoring and managed retreat over time (i.e. a hybrid approach).
- Bulkheads are often used to protect development along harbors and islands – development in these areas will likely need to be elevated in the future to address sea level rise. Local governments should consider developing a more comprehensive set of standards for redevelopment and for evaluating the efficacy of existing bulkheads that factor in how flooding will impact properties and public infrastructure (i.e. utilities) as a whole in any given area.
- Land use policies are needed to assure that shoreline structures that are built to protect existing private development on public and private lands fully mitigates for the impacts they have on shoreline ecosystems, public access, recreation, and other coastal resources.
- One potential adaptation strategy for cities such as Huntington Beach is to create zoning overlays to ensure that modification to existing buildings or construction of new buildings in vulnerable areas would include designs standards to withstand coastal flooding.

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- Planning for saltwater intrusion and higher groundwater levels in the region will be vital to maintain the effectiveness of stormwater/wastewater management and protect water quality.
- Beach communities in the county should analyze public transit opportunities and incentives to encourage beach users to reduce private vehicle use.

References

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[7] California Coastal Commission South Coast District Staff Interview. July 22, 2016.
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