City of Oxnard

Local Coastal Program Update

Sea Level Rise Adaptation Strategy Report

All information contained in this draft is subject to review by the City of Oxnard's decision making bodies and therefore, is preliminary, and subject to change.

Draft

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Acronym List

EPA United States Environmental Protection Agency

FEMA Federal Emergency Management Agency

LCP Local Coastal Program

MBGS Mandalay Beach Generating Station

MPP McGrath Peaker Plant

MW Megawatt

NRC National Research Council

OBGS Ormond Beach Generating Station

OBRAP Ormond Beach Coastal Restoration and Public Access Project

OTC once-through-cooling

SCE Southern California Edison

SLR Sea Level Rise

TNC The Nature Conservancy

Ormond Beach Wetlands, Photo Source: Rincon Consultants, Inc.

Executive Summary

This Adaptation Strategies Report is a continuation of the City of Oxnard (Oxnard) *Sea Level Rise Vulnerability Assessment and Fiscal Impact Report* (Vulnerability Report), which was prepared to address existing and future coastal hazards in combination with sea level rise (SLR) projections in the Oxnard Coastal Zone. The *Vulnerability Report* found that Oxnard has a significant amount of property at risk due to coastal and tidal flooding, as well as erosion. The most vulnerable type of property in terms of economic loss is residential property. The fiscal impact of damage to residential property amounts to over 80 percent of total citywide costs from damage to property and infrastructure in all time horizons (2030, 2060, and 2100). In conjunction with the *Vulnerability Report*, this Adaptation Strategies Report was prepared to inform the Local Coastal Program (LCP) Update process and City coastal permitting, SLR adaptation planning, and related regulatory processes.

The findings of the *Vulnerability Report* and the preliminary adaptation strategies considered in this report were presented to representatives of federal, State, and local agencies and governments; stakeholder organizations; and the public on August 9, 2017 in two workshops. Community issues of concern included coastal access, sand replenishment, coastal flooding, and potential new development in the coastal hazard zone. Comments and questions focused on climate change vulnerabilities beyond SLR, ecosystem services, and adaptation effectiveness.

Based on the August 9, 2017 workshop feedback and the set of adaptation strategies available, a subset of adaptation strategies was chosen for evaluation for each of Oxnard's four LCP Planning Areas. This report focuses on evaluating adaptation strategies for Planning Areas 1, 2, and 3 since most of Planning Area 4 is undergoing a separate SLR adaptation planning process as part of the Ormond Beach Coastal Restoration and Public Access Project plan (OBRAP plan). The City of Port Hueneme, County of Ventura, Oxnard Harbor District, and Naval Base Ventura County are invited to consider these strategies for their respective jurisdictions that border the Oxnard coastal zone. It is Oxnard's intent to identify adaptation policies in close coordination with neighboring jurisdictions as part of the next phase of the LCP update process.

Cost-benefit Analysis

This study includes a cost-benefit analysis of each strategy to allow comparison. The primary aim of the economic analysis is to provide a common metric against which the trade-offs between the costs and benefits of each adaptation strategy may be evaluated. The analysis accounts for the physical changes and economic benefits and damages associated with each adaptation strategy, including the vulnerability of beaches and coastal property. Coastal hazards included coastal flooding and erosion anticipated during a 100-year storm event and the exposure of property to monthly tidal flooding exacerbated by SLR at the 2030, 2060, and 2100 time horizons.

A cost-benefit analysis is a useful tool to compare adaptation strategies, however, there are limitations. First, cost-benefit analyses depend crucially upon the assumptions made about future states of climate change and SLR, about current and future economic valuations and about the effectiveness of various mitigation strategies to SLR. Economists have developed well-established metrics for measuring the economic benefits of beach recreation, typically measured in terms of "willingness to pay." Economists can also estimate the current value of spending and taxes generated from beach tourism with a reasonable degree of accuracy. However, a more challenging aspect of cost-benefit analyses is estimating the value of ecological loss as beaches and other coastal ecosystems disappear. Therefore, some of the tradeoffs that a community must make, particularly involving other ecological functions goods and services (EFGS) provided by beaches, cannot be quantified very well, or at all, in dollar terms. In addition, any forecasts about future SLR, flooding, or future economic valuations are also subject to a great deal of uncertainty. Thus, a cost-benefit analysis should be considered as one tool planners and policy makers can use to shape their decisions. Although the cost-benefit analysis is the main focus of this report, other factors which cannot be economically evaluated, should be incorporated when developing adaptation strategy policy.

Despite their limitations, cost-benefit analyses are an extremely useful for communities. Despite the uncertainties involved, a proper cost-benefit analysis can inform communities as they plan for SLR. A cost-benefit analysis can help communities understand what coastal hazards will be the most costly to mitigate and which strategies are worth further consideration. Second, a cost-benefit analysis can help rule-out options that are not cost-effective under any reasonable set of assumptions. Ultimately, a cost-benefit analysis is just a tool to help communities make better decisions that will also be based on the feasibility of the different strategies, including how likely it is for each strategy to provide adequate protection of development, the environmental impacts of each strategy as well as the support of the community in which the adaptation is being implemented.

Adaptation Strategies By Planning Area

The adaptation strategies considered in this report are Accommodation, Managed Retreat, Green Protect, and Hard Protect. In terms of overall benefits, Green Protect had higher economic recreational benefits compared to Hard Protect because armoring usually accelerates erosion of sandy beaches that make up most of Oxnard's coastline. Due to the large average width of Oxnard beaches, the economic and fiscal impact difference between Green Protect and Hard Protect are not significant until after 2060 when the width of beach has decreased and cannot protect against coastal hazards. In terms of overall costs, Managed Retreat (as defined in this analysis) is the least-expensive strategy, as property and infrastructure are progressively less exposed to coastal hazards damage. This does not include the cost of new infrastructure for relocated development.

Consistent with Oxnard's General Plan policies (ER-3.1, SC-2.4, CD-21.3, ICS-17.1, and SH-3.5) Managed Retreat was the only strategy considered for Planning Area 1 since relocation of the McGrath State Beach facilities and eventual decommissioning of the McGrath Peaker Plant (MPP), Mandalay Beach Generating Station (MBGS) are already planned. In Planning Area 1 (north of Fifth Street to the Santa Clara River) most of the coastal zone is owned by California State Parks (McGrath and Mandalay State Beach Park) and while in the Coastal Zone of the City of Oxnard, may be subject to the City's jurisdiction. Managed retreat planned for this area includes: (1) the relocation of McGrath State Beach facilities to higher ground inside the park; (2) coastal hazard-compatible development of recreation facilities in the Mandalay State Beach Park parcel; and (3) the eventual removal of power plant facilities at the MBGS and MPP sites.

In Planning Areas 2 and 3 (Oxnard Shores and Channel Islands Harbor), Managed Retreat, Green Protect, and Hard Protect adaptation strategies were all considered. The analysis found that Green Protect would provide the highest net benefits and that the costs of dune restoration and Hard Protect are similar. By 2060, Hard Protect provides more benefits compared to Managed Retreat over time. Managed Retreat is also not a practicable strategy because of the high number of homes and property owners in the area.

This analysis did not fully value the ecological benefits of beaches and coastal habitats. Instead, this analysis focused on two economic values of these coastal ecosystems: (1) the ability to buffer impacts from storms and coastal erosion; and (2) the recreational value of beaches.

Planning Area 4 (Ormond Beach between the Port Hueneme city limit and the Naval Base Ventura County - Point Mugu facility) mostly contains large portions of the Ormond Beach area, which is owned and managed by Oxnard, the State Coastal Conservancy, and The Nature Conservancy (TNC). The State Coastal Conservancy previously prepared a Wetlands Restoration Feasibility Study (2009) and is currently preparing the OBRAP plan (2016). The State Coastal Conservancy and TNC are pursuing acquisitions at Ormond Beach to accommodate future restoration of wetlands and associated habitats. To date, the State Coastal Conservancy, along with TNC and Oxnard, own approximately 630 acres at Ormond Beach and are currently preparing a restoration and public access plan (State Coastal Conservancy 2016). Because of this ongoing, parallel process and Oxnard's support for and participation in the restoration planning, a detailed analysis for this Planning Area is not provided here. The analysis

does include a discussion of overall adaptation strategies for Planning Area 4 and costs associated with specific infrastructure (i.e. the Oxnard wastewater treatment plant).

Next Steps

The next step as Oxnard plans for the future is to use the information provided in this *Adaptation Strategy Report* and the *Vulnerability Report* to draft LCP polices that: (1) implement the Coastal Act; (2) avoid and/or minimize coastal hazard impacts to people, public and private property, and habitats (especially of endangered species); (3) are coordinated with neighboring jurisdictions; and (4) are consistent with and implement the Oxnard LCP and the Oxnard 2030 General Plan. A key part of the development of these policies will be to balance fiscal costs with each strategy's feasibility and effectiveness over time, environmental impacts and community preference to identify the preferred adaptation strategy in each Planning Area. Coastal hazard adaptation policies will be presented to Oxnard's decision-makers and the California Coastal Commission for final approval. Public input in the planning process will be encouraged during development of the policies as well as during the LCP adoption and certification processes. After this process is completed, Oxnard will have a set of coastal hazards adaptation policies that (1) support the community's vision coastal development and use for the future, (2) address the specific coastal hazards shown in the previous *Vulnerability Report*, and (3) align with California Coastal Act requirements and California Coastal Commission guidance, and (4) reduce impacts from hazard events compared to not having taken any adaptations.

Channel Islands Harbor, Photo Source: Rincon Consultants, Inc.

I. Background

Introduction

Adapting to changes in sea level is not a new phenomenon. There are submerged harbors, abandoned port cities miles from the ocean, and evidence of higher and lower coastlines all around the world. California and the United States are relative newcomers to changes in sea level, with roughly 400 years of coastal development on the east coast, and only about 200 years in California. Since the start of the Twentieth Century, sea levels have risen roughly eight inches globally and are expected to continue to increase into the next century as ocean waters warm and expand and more water is added from melting glaciers and the Greenland and Antarctic ice caps. The challenge the City of Oxnard (Oxnard) faces is to choose feasible, flexible, and effective adaptation strategies from a range of choices that are a best fit to local coastal geography, current uses, and future anticipated development.

This Adaptation Strategy Report is a continuation of Oxnard's *Sea Level Rise Vulnerability Assessment and Fiscal Impact Report* (Vulnerability Report) that was prepared to address sea level rise (SLR) and associated coastal hazards in Oxnard's roughly nine-mile coastal zone. In conjunction with that report, this Adaptation Strategy Report was prepared to inform the Local Coastal Plan (LCP) update process and inform future Oxnard adaptation planning and regulatory processes.

For background information regarding topics such as the Oxnard Local Coastal Program Update or Oxnard's coastal physical setting and types of coastal hazards, please see the *Vulnerability Report.*

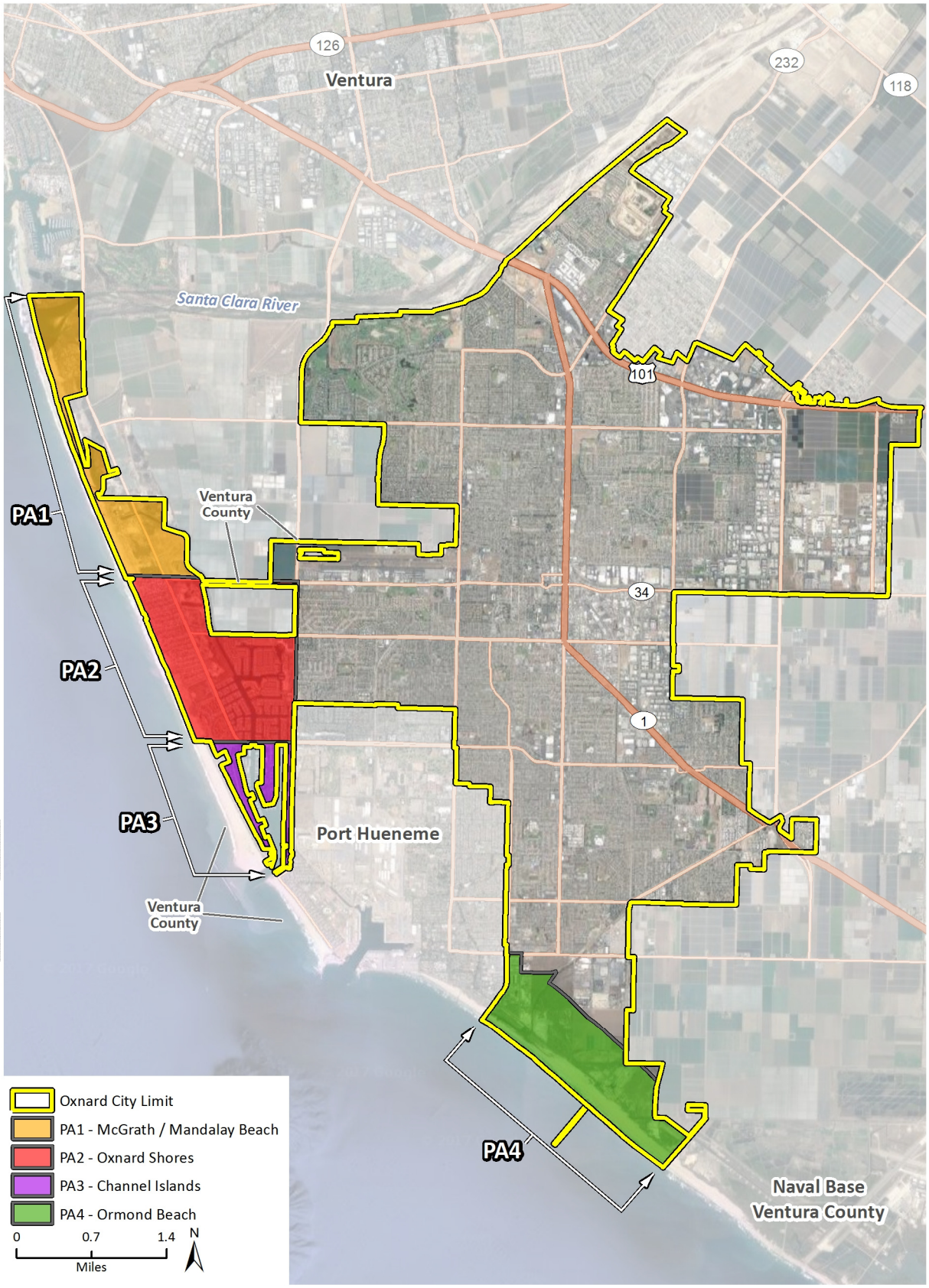
LCP Planning Areas

The Oxnard coastal zone has four LCP Planning Areas extending inland between 0.5 to 1.5-miles with a wide range of land uses and public infrastructure. Figure I-1 illustrates the geographic extent of Oxnard's LCP Planning Areas discussed in this document. The following section provides a short description of each of the LCP Planning Areas. For a more extensive description, please see the *Vulnerability Report.*

This report focuses on evaluating adaptation strategies for Planning Areas 1–3. Oxnard, State Coastal Conservancy, and The Nature Conservancy (TNC) own and manage large portions of Planning Area 4, the Ormond Beach wetlands area. The State Coastal Conservancy previously prepared a Wetlands Restoration Feasibility Study (2009) for most of the area in Planning Area 4. The Coastal Conservancy, Oxnard and TNC are currently in the process of creating the Ormond Beach Coastal Restoration and Public Access Project plan (OBRAP plan; State Coastal Conservancy 2016). Because of this ongoing, parallel process and Oxnard's support for and participation in the restoration planning, a detailed analysis for Planning Area 4 is not provided here. The analysis does include a discussion of overall adaptation strategies for Planning Area 4 and costs associated with specific infrastructure (i.e. the Oxnard wastewater treatment plant).

The City of Port Hueneme, Naval Base Ventura County (NBVC), and two unincorporated county residential neighborhoods (Hollywood Beach and Silver Strand Beach) are situated between Planning Areas 3 and 4. Although not in the Oxnard, this study includes the area of Hollywood Beach, since the adaptation strategy for Planning Area 3 would need to include in this area. Additional coordination with the County of Ventura will occur during Oxnard's LCP update process and also once the County of Ventura completes its own SLR vulnerability assessment.

Figure I-1. LCP Planning Areas



Planning Area 1 – McGrath-Mandalay

Planning Area 1 primarily involves the natural areas of McGrath State Beach and Mandalay State Beach Park (undeveloped) that contain resource protection areas, including wetlands and federal and State threatened and endangered species habitat, with some exclusion areas for an entitled but as yet (mid-2017) unbuilt 292-unit residential development (North Shore), as well as the Mandalay Beach Generating Station (MBGS) and McGrath Peaker Plant (MPP) electric generation facilities. Oxnard city limits exclude Harbor Boulevard north of the Edison Canal bridge, oil well lease areas located west of Harbor Boulevard, and the existing agricultural fields.

The McGrath State Beach area is highly susceptible to regular flooding that occurs when the Santa Clara River mouth sand bar closes to the ocean and the lagoon water fills to the elevation of the barrier beach berm. This causes the recreation areas in the park to regularly close. Measures to alleviate flooding are complicated by the Ventura Water Reclamation Facility, estuary water levels, groundwater elevation, McGrath Lake, and the sensitive, endangered, or threatened species in the estuary (City of Ventura 2014). The California Department of Parks and Recreation is planning to implement a Managed Retreat strategy to relocate camping and visitor facilities inside the park boundaries to higher ground (City of Ventura 2014).

Planning Area 2 – Oxnard Shores

Planning Area 2 is located between Fifth Street and Channel Islands Boulevard. The largely residential area includes the 62-acre Oxnard-operated Oxnard Beach Park, the Oxnard Shores neighborhood, the Colony (a mix of residential housing, recreation areas, and the Embassy Suites resort hotel), two undeveloped back-dune areas, the Mandalay Bay neighborhood, the Westport development, and the mixed-use 135-acre Seabridge Specific Plan community.

Planning Area 3 – Channel Islands Harbor

Planning Area 3 includes the area south of Channel Islands Boulevard. The majority of this Planning Area is located within the County of Ventura Channel Islands Harbor, which, while located within Oxnard, is owned and operated by the County of Ventura. Channel Islands Harbor consists of approximately 310 acres, 200 of which are water (County of Ventura 2008). The Channel Islands Harbor includes approximately 2,150 boat slips, marina facilities, restaurants, sport fishing facilities, and shops. Hollywood by the Sea, an unincorporated County of Ventura area of beachfront homes dating from 1926, is functionally within Planning Area 3 although most services are provided by the Channel Islands Beach Community Services District, formed in 1982.

Planning Area 4 – Ormond Beach

Ormond Beach is the portion of the Oxnard coastal zone southeast of the City of Port Hueneme and northwest of Naval Base Ventura County - Point Mugu. Historically, the Ormond Beach area was part of a rich wetlands ecosystem. Over time, a range of agricultural, industrial, and energy-related uses developed, including the NRG Ormond Beach Generating Station (OBGS) and a closed industrial waste metal smelter operated until 2004 by Halaco Engineering. There are no announced plans regarding OBGS, other than it must comply with State-mandated once-through-cooling (OTC) regulations by December 31, 2020. The former Halaco site is now a United States Environmental Protection Agency (EPA) Superfund site. Oxnard, State Coastal Conservancy, and TNC own and manage large portions of

the Ormond Beach area (not including the Halaco site). The State Coastal Conservancy previously prepared a Wetlands Restoration Feasibility Study (2009) and is currently preparing the OBRAP plan (2016). The study had several restoration options for the area. Oxnard's 2030 General Plan includes policies that support the Feasibility Study plan "Alternative 2U, Restore Seasonally Open Wetland Habitats and Ponds Unconstrained." The State Coastal Conservancy and TNC are pursuing additional land acquisitions at Ormond Beach to accommodate future restoration of wetlands and associated upland habitats that will accommodate inland migration of the coast due to SLR. To date, the State Coastal Conservancy, TNC, and Oxnard owns approximately 630 acres at Ormond Beach and are currently preparing a restoration and public access plan (State Coastal Conservancy 2016). It is the general intent of Oxnard to incorporate the State Coastal Conservancy's OBRAP plan into Oxnard's LCP for Planning Area 4. Additionally, Oxnard's wastewater treatment plant is located in Planning Area 4.

Stakeholder & Community Outreach

Stakeholder input and public participation are a fundamental part of generating an adaptation report that evaluates adaptation strategies appropriate to Oxnard's coastal zone. Therefore, public and stakeholder outreach was used to develop the findings of the *Vulnerability Report* and present the preliminary strategies for adaptation under consideration. A multi-agency/stakeholder meeting and a public stakeholder meeting were both held on August 9, 2017. Invitees to the Technical Advisory Group meeting included key local agencies and stakeholders affected by the LCP update. The goal of the meeting was to receive feedback on potential adaptation strategies and whether they align with other agency objectives. Attendees of the Technical Advisory Group meeting included California Coastal Commission, California State Parks, California Department of Fish and Wildlife, Naval Base Ventura County, County of Ventura, Ventura County Watershed Protection District, Ventura County Harbor Department, BEACON, Channel Islands Harbor, Oxnard Public Works Department, Oxnard Fire Department, Southern California Edison (SCE), NRG, and California State University Channel Islands. The public stakeholder meeting was targeted at residents and community organizations across the city of Oxnard and was not limited to only those within the coastal zone. All public outreach meetings regarding Oxnard's LCP have been advertised in the City's media outlets which include:

- City Homepage Website
- LCP Update Website – www.oxnardlcpupdate.com
- City Media Releases
- Inter-Neighborhood Council Organization (INCO) Notice Distributions
- Facebook
- Next Door
- Twitter

Attendees of the public meeting in August 2017 included Oxnard residents, members the Southwinds Village and Mandalay Channel Islands Waterfront HOA, and representatives of the Oxnard Shores Neighborhood Council, Ventura Audubon, Merito Foundation, Sierra Club, and Environmental Coalition. Community issues of concern included coastal access, particularly related to social justice, sand replenishment, coastal flooding prevention, and new development in the hazard zones.

The agencies were concerned with climate change vulnerabilities beyond SLR, ecosystem services, and adaptation effectiveness. Comments were also made that the Oxnard should fully plan for the 2060

planning SLR horizon rather than the 2030 planning horizon to position Oxnard ahead of other jurisdictions for the receipt of grant funding and to reduce costs over the long run. An additional public outreach meeting will be held to gather comments on this draft Adaptation Report at a future date.

Photo of public stakeholder meeting held on August 9, 2017

Oxnard Shores, Photo Source: Rincon Consultants, Inc.

IV. Adaptation Choices

To address SLR through adaptation, cities can look to the strategies others have implemented or are in the process of implementing to adapt to rising sea levels or coastal/tidal flooding hazards. Examples include the London and Venice Lagoon tidal gates, extensive dikes in the Netherlands, and a 21-mile sea wall in Korea. The six broad adaptation categories considered herein are as follows:

Accommodation

Accommodation strategies refer to those strategies that employ methods that modify existing developments or design new developments to decrease hazard risks and thus increase the resiliency of development to the impacts of sea level rise. At the project level, these accommodation strategies include actions such as elevating structures, retrofits and/or the use of materials meant to increase the strength of development, building structures that can easily be moved and relocated, or using extra setbacks. Some accommodation strategies could result in negative impacts to coastal resources such as obstruction, interference with coastal processes, and blocking of access (California Coastal Commission 2015). An example of accommodation that could be used in Oxnard is the modification of the stormwater drainage system to pump additional surface water caused by tidal flooding and storm surges to receiving facilities.

Another widely used accommodation strategy involves raising structures along the coast to allow high water and storm waves to pass under or around these structures. This strategy is sometimes required to qualify for property insurance and comply with Federal Emergency Management Agency (FEMA) regulations. Such adaptations can limit periodic damage to ground level garages, driveways, and landscaping. However, this strategy can also prolong exposure to coastal hazards as sea levels continue to rise and indirectly lead to government and insurance industry storm damage "bailouts" for a relatively small number of expensive beachfront properties. Alternatively, the raising of both land and structures may be feasible in marina and inland areas that are subject only to high tide flooding.

Managed Retreat

Ideally, a Managed Retreat strategy would relocate or remove existing development out of hazard areas and limit the construction of new development in vulnerable areas before impacts to coastal hazards could occur. However, due to the increasing pace in which sea levels are expected to rise, the Managed Retreat strategy in this report assumes coastal hazards would impact coastal development before the properties are removed or "retreated". This report assumes that coastal hazard impacts would need to occur to structures before they could then be relocated or replaced and moved to beyond the highest coastal hazard zone. Even though managed retreat strategies are intended to occur in a way that prevents significant damage to structures by removing them prior to being damaged, this report assumes that option is not politically feasible because coastal landowners are highly unlikely to relocate until significant damage to their land and structures occur. However, when managed retreat is implemented only after structures are impacted, the assumption is that the beach is already lost because it was not given the opportunity to naturally migrate inland.

The opportunity to naturally migrate inland, requires an adequate amount of room to move back. In densely developed coastal communities, this adaptation is probably not financially

feasible. At public beaches, beach parking lots and bike paths are already being moved back as part of managed retreat strategies in response to coastal hazards.

For uses that do not need to be in coastal hazard areas or have little or no economic value, leaving the area entirely is a permanent adaptation. Government policies could encourage moving out by restricting new uses to those that can adapt to SLR and are of limited duration based on the rate of increasing coastal hazards. Acquisition and buyout programs, transfer of development rights programs, and removal of structures where the right to protection was waived (i.e., via permit condition) are examples of strategies designed to encourage managed retreat. This report also looks at leaseback[1] options as a way of financing managed retreat for private property.

Green Protect

This adaptation strategy relies on "natural infrastructure" such as stable sand dunes and coastal wetlands to protect coastal development from high water levels and damaging waves. Sand dunes absorb and deflect wave energy. Wetlands slow wave velocity and, to some extent, a storm surge. Dunes and wetlands are often damaged or destroyed by coastal storms; the Green Protect option may consider sand and wetlands replenishment. The Green Protect strategy is an alternative to Hard Protect (discussed below).

Hard Protect

The final adaptation strategy is the most prevalent globally (Dugan et. al. 2011). Seawalls, dikes, flood gates, groins, revetments, and riprap are relatively easy to engineer, can be financed through bonds or special assessments, and have relatively well-known performance metrics and lifespan costs. However, hard infrastructure will deteriorate over time and does not always prevent damage. In some situations, the Hard Protect strategy in one area may increase storm damage to an unprotected area. While Hard Protect measures are widely used, there is a difficult question of "how much is too much?" over time. Incrementally raising a seawall to protect development could lead, over the long run, to a very high and expensive wall that could eventually blocks views and public access.

Hard Protect Strategies are also associated with loss of beaches and the associated beach tourism and ecological loss, such as ESHA. This negative effect on beaches occurs because once sea water reaches a Hard Protect strategy, the water "bounces" off them with more energy than a wave would washing back off of a normal sand beach. Consequently, more sand is carried off shore, promoting beach loss. Additionally, when Hard Protect strategies are placed perpendicular to the beach, they disrupt along-beach currents and cause sand losses downstream of the hard protect strategy.

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[1] In a leaseback option, a government, municipal utility or private agency (e.g., an NGO) buys the residential property and leases it back until a time where it is no longer habitable.

Although the loss in beach tourism can be estimated, the loss in ecological value caused by armoring is difficult to assess or quantify, but it is significant. The loss of sandy beaches may also impact property values in a community, though economists have not been able to estimate these impacts in California.

Mixing and Matching Sea Level Rise Adaptations

Adaptations should consider coastal geography and existing land uses. If the coastal zone is relatively flat and lightly developed, Accommodate and Green Protect are likely the most feasible and cost-effective solutions to adapt to increasing SLR coastal hazards. If the coastline is a narrow beach with dense bluff-top development, Hard Protect may be the best short-term strategy and Managed Retreat the appropriate long-term strategy as the land erodes under the bluff. Some combination of adaptation strategies may be required to form short-, medium-, and long-term approaches and programs to best address each coastal area's geography, development pattern, policy choices, and fiscal resources.

Mandalay Waterway Community, Photo Source: Rincon Consultants, Inc.

V. Adaptation Strategies for City of Oxnard

Starting in 2014, TNC's Coastal Resilience Ventura modeling included four adaptation strategies matched to Oxnard's four Planning Areas. The adaptation scenarios were chosen with input from Oxnard staff during the Coastal Resilience Ventura project. Modeling was done in *Economic Analysis of Nature-Based Adaptation to Climate Change, Ventura County, CA* prepared by Environ International Corporation and ESA PWA for TNC (2013). As part of this report, with input from local agencies and public stakeholders, Oxnard staff re-evaluated these early TNC strategies and drafted a revised list of approaches to evaluate and ultimately inform Oxnard's LCP Update policies. The primary additions of this report to the preceding reports by TNC includes an update of the parcel list, more specific engineering cost estimates, and updated recreation values estimates. The following details the various adaptation strategies that are being considered by Oxnard for each Planning Area. Not all strategies are included in the Adaptation Strategy Analysis (Section V).

Planning Area 1 – McGrath-Mandalay

Managed Retreat

This adaptation strategy involves the relocation of McGrath State Beach facilities to higher ground in the park. This is the only strategy considered for Planning Area 1 since relocation of the McGrath State Beach facilities and eventual decommissioning of the MPP and MBGS are already planned. This adaptation incorporates McGrath State Beach's planned relocation of beach park facilities as outlined in the *Santa Clara River Estuary Habitat Restoration and Enhancement Feasibility Study (2014)*.

This strategy would also include the eventual removal of all facilities at the MBGS site, to be phased by updates to 100-year flood zone mapping per General Plan policies SC-2.4, CD-21.3, ICS-17.1, and SH-3.5. Interim energy production and storage uses may be allowed, such as solar panels, battery storage, and/or a less than 50 megawatt (MW) peaker plant with a terminal use permit based on exposure to coastal hazards. All uses would be conditioned to not allow coastal armoring (Hard Protect). The SCE MPP is planned for removal after its 25-year permit expires, in approximately 2037. The MPP and MBGS properties may be suitable for alternative coastal recreation uses, such as a commercial RV park.

Planning Area 2 – Oxnard Shores

Green Protect

Beach and Dune Management along Oxnard Shores. This strategy includes the construction and maintenance of additional sand dunes that would protect the existing shoreline and adjacent residential and other infrastructure from SLR-increased coastal hazards up to 2100. Based on beach width modeling, the amount of beach and dune nourishment required to protect the existing shoreline through 2100 would include 10 beach nourishments and 7 dune treatment events (Revell Coastal 2017). Modeling shows initial nourishment would occur in 2028 and initial dune treatment would occur in 2038. After that nourishment and dune treatment would occur approximately 5-10 years apart. See Appendix B for beach modeling results.

Accommodation

Modification of Oxnard stormwater pump system. This strategy evaluates the costs and benefits of a modified stormwater drainage system that will prevent the flooding of Mandalay Road and nearby streets. The modified storm system will consist of a gravity system and may be required to eventually transition to a pump system.

Hard Protect

New Seawall and/or Revetment from 5th Street to Channel Islands Boulevard. This strategy includes the construction of a sea wall/revetment that would begin at the 5th Street dunes and extend to Channel Islands Boulevard with the goal of protecting residential houses and other infrastructure in the Oxnard Shores area.

Managed Retreat

Retreat of Oxnard Shores. This strategy looks at removal of all public and private development located within the Oxnard Shores area by each Planning Horizon (2030, 2060, and 2100).

Planning Area 3 – Channel Islands Harbor

Hard Protect

New Seawall and/or Revetment from the Channel Islands Boulevard to Channel Islands Harbor entrance. This strategy includes the construction of a seawall/revetment that would begin at Channel Islands Harbor Boulevard and extend to the entrance of the harbor. The goal of this revetment would be to protect harbor infrastructure that is adjacent to the shoreline in addition to the residential units in Oxnard's and the County of Ventura's jurisdiction.

Green Protect

Dune construction along shoreline. This strategy includes the construction and maintenance of a sand dune that would protect the existing shoreline, adjacent residential uses in Hollywood-by-the-Sea (County of Ventura's jurisdiction), Channel Islands Harbor, and other infrastructure from coastal hazards.

Accommodation

Elevate Channel Islands Harbor. This strategy involves elevating Channel Islands Harbor landside development and the surrounding areas to a height where they would not be impacted by future coastal hazards. This would require engineering strategies to elevate the various structures, such as bulkheads, docks, utilities, buildings, and building pads, which could involve negative visual impacts since these structures may obstruct views of the ocean and beaches.

Managed Retreat

Retreat of Channel Islands Harbor. This strategy looks at the removal of development located within Channel Islands Harbor by each Planning Horizon (2030, 2060, and 2100).

Planning Area 4 – Ormond Beach[2]

Green Protect

Restoration of Ormond Beach Wetlands. Implement the OBRAP plan, allowing for natural shoreline migration and upland conversion.

Managed Retreat

Removal of Halaco EPA Superfund site. This strategy looks at the complete removal of the Halaco EPA Superfund site to restore the area to its previous state as wetlands and prevent the release of hazardous contaminants when groundwater levels rise and/or waves erode

[2] This analysis does not evaluate the economic cost and benefits associated with adaptation strategies within Planning Area 4. A qualitative discussion of the trade-offs associated with each strategy is provided.

the Halaco “pile.”

Removal of OBGS. Require eventual removal of all facilities at the OBGS site phased by updates to 100-year flood zone mapping per existing LCP policies 39, 40 and General Plan policies SC-2.4, CD-21.3, ICS-17.1, and SH-3.5.

Relocation of Oxnard wastewater treatment plant. This strategy would require relocation of Oxnard’s wastewater treatment plant to an area outside of the coastal hazard zone. This strategy includes the phasing out and incremental demolition of the existing facility and construction of a new facility.

Coastal flooding of Oxnard Shores Mobile Home Park, Photo Source: Rincon Consultants, Inc.

VI. Adaptation Strategy Analysis

In order to compare adaptation strategies, this study conducted a generalized cost-benefit analysis of strategies where available information and common practice estimates were available. The primary aim of the economic analysis is to provide a common metric against which the trade-offs between the costs and benefits of each adaptation strategy may be evaluated. The analysis assumes that adaptation strategies Green Protect and Hard Protect would remove the vulnerability of coastal hazards to coastal properties once the adaptation strategy is in place. Green protect is also assumed to maintain a minimum beach width of at least 100 feet of sand and a minimum of 50 feet of dune area, while Hard Protect is assumed to reduce beach to zero feet after installation. Table 1 reflects the projected low, moderate, and high levels of SLR for 2030, 2060, and 2100. Some of the specific numbers used in the analysis, however, are not the same as those listed in the CCC guidance. Instead of using the rates for subsidence south of Cape Mendocino (National Research Council [NRC] 2012), the SLR curves were adjusted for the vertical land motion reported at the Santa Monica Bay tide gage so that the models presented in this document from *Coastal Resilience Ventura* (ESA PWA 2013) more accurately predict the possible outcomes of various SLR scenarios.

Based on feedback from the stakeholder meetings, this study evaluated the impacts of the high SLR scenario only to estimate the "worst-case" impacts of SLR, which is in accordance with the most recent California Coastal Commission SLR guidance (2017).

The SLR scenarios in Table 1 are from *Coastal Resilience Ventura* (ESA PWA 2013), which drew information from both reports by the NRC (2012) U.S. Army Corps of Engineers (2011). The medium and

high projections in Table 1 report are from the NRC report (2012) and were modified in *Coastal Resilience Ventura* (ESA PWA 2013) by removing a previously assumed 1.5 mm/year subsidence. However, a considerable amount of groundwater extraction occurs in Oxnard, causing subsidence of Oxnard's coastal area. Therefore, the SLR scenario elevations may be a minor underestimate based on the current best available science, resulting in minor underestimates of the costs and benefits associated with each adaptation scenario.

Coastal hazards included coastal flooding and erosion due to a 100-year storm event and the exposure of property to monthly tidal flooding exacerbated by SLR at the 2030, 2060, and 2100 time horizons.

Table 1. SLR Scenario Elevations for each Planning Horizon

	SLR Scenarios		
Planning Horizon	Low (inches)	Moderate (inches)	High (inches)
2030	2.3	5.2	8.0
2060	7.4	16.1	25.3
2100	17.1	36.5	58.1

Cost/Benefit Analysis

The adaptation strategies included in the cost/benefit analysis are the following:

Managed Retreat  **Green Protect**  **Hard Protect** 

It is important to realize that each of these strategies has its own corresponding advantages and disadvantages that are difficult to evaluate without the benefit of meaningful, comprehensive data. Accommodation strategies were not included in the cost/benefit analysis because they are generally project-specific actions which require an evaluation of detailed engineering options, which was not in the scope of this analysis. General cost estimates for accommodation strategies, such as modification of the stormwater drainage system, was included for informational purposes but was not included in the cost/benefit analysis due to the lack of specifics that could be determined within the scope of the report.

Managed Retreat in this analysis is generally the least expensive from the perspective of public funding since no infrastructure to protect from coastal hazards would be needed and the major costs would include the removal of damaged property. However, it could also involve the purchasing of property by the City which was not evaluated in this analysis. If the City were to orchestrate a retreat of the coastal zone and purchase development and land from current land owners, the costs would be substantially higher. It also has the advantage of maintaining the wide, sandy beach, which is conducive to beach recreation, local economic prosperity, and the ecological benefits that come with a natural shoreline. However, this strategy leaves publicly- and privately-owned development vulnerable to coastal hazards since this analysis assumes that removal of development and loss of property value would occur after

coastal hazards cause damage to development by each planning horizon (2030, 2060, 2100). This can cause loss of property value to owners, loss of property taxes to Oxnard and conflicts regarding property-owner compensation and responsibility over removal of damaged property. If the demolition of properties does not occur in a timely manner, this could also have negative visual impacts. However, if demolition were to occur as or before properties are impacted by SLR, Managed Retreat may provide more access and views of coastal resources. Finally, depending on the level of SLR, public access may have to be reconfigured.

Green Protect involves the construction of protective sand dunes and the periodic replenishment of the sandy beach by nourishing with sand. The benefits of this option include both the protection of publicly- and privately-owned property and the maintenance of a wide, sandy beach. The primary downside of this option is the public costs of the initial dune construction and the periodic beach sand and dune replenishments, as well as potential ecological losses from the disturbance cause by transporting potentially large amounts of sand. This analysis assumes dune restoration would occur as soon as possible (before 2030) to mitigate existing and expected coastal hazards before they occur and cause property damage. Other advantages of Green Protect include maintenance of sandy beaches, property protection, public access and positive visual impacts.

Hard Protect involves building a one-time revetment, which would protect the Planning Area from erosion and coastal flooding. The downsides to coastal armoring are four-fold: not only does the construction of revetments come at a significant cost, but it can result in a reduction in sandy beach width, obstruct public access, and have negative visual impacts. This analysis does not consider this strategy in Planning Area 1 and assumes that coastal armoring would not be built until after 2030 in Planning Area 2, and after 2060 in Planning Area 3, based on the level of coastal hazards in the modeling. The height of the armoring would depend on the amount needed to prevent against SLR hazards.

There are also advantages and disadvantages to each adaptation strategy that cannot be easily quantified and included in a cost/benefit analysis. Some of these factors include availability of access to sandy beaches, public access, and visual impacts. See Table 2 below. The advantages associated with the Managed Retreat strategy include fewer impacts to visual resources, such as sustained sandy beach without construction of infrastructure or dunes. Managed Retreat would result in temporary visual impacts from demolition of structures, but these are short-term and consequently would have less of a visual impact than a longer-term Hard Protect strategy, such as a sea wall. The disadvantage of Managed Retreat (as defined in this report) is that the protection of existing property is not afforded over the long-term. Also, impacts to public access could occur if access points and parking are required to be removed and/or relocated away from the shoreline.

The advantages of Green Protect include a sustained sandy beach, protection of property and public access, and no visual impacts. The disadvantage of Green Protect is the costs associated with ongoing beach nourishment and dune treatments and potential impacts to local species during nourishment events.

The advantage of Hard Protect is the protection of existing property. However, there are several disadvantages such as construction costs and loss of sandy beach, which causes reduced public access.

Visual impacts could also occur depending on the height of the engineered structure, through obstruction of views of the beach and ocean.

Table 2. Advantages and Disadvantages to Each Adaptation Strategy

Strategy	Construction Costs	Sandy Beach	Property Protection	Public Access	Visual Impacts
	+	+	-	+/-	+
	-	+	+	+	+
	-	-	+	-	-

This cost-benefit analysis evaluates the level of benefits that come from beach recreation against the costs of expected property losses and damages and the costs of implementing the adaptation strategy itself. The costs of other strategies, such as Accommodation, are included in this report but not in the overall cost-benefit analysis due to the unavailability of the economic benefits associated with each one. Therefore, only an estimate of the cost of each is provided.

It is important to keep in mind that a cost-benefit analysis is a useful tool to compare adaptation strategies; however, it only evaluates economic values and benefits. A cost-benefit analysis cannot encompass values that are cultural, historic, or personal. Thus, a cost-benefit analysis should be considered as one tool planners and policy makers can use to shape their decisions. Although the cost-benefit analysis is the main focus of this report, other factors which cannot be economically evaluated (See Table 2), should be incorporated when developing adaptation strategy policy.

Benefits

While a wide, sandy beach provides many benefits, including ecological value, recreation, public access, and tax benefits (e.g. sales and transient occupancy tax revenues), this analysis primarily focuses on the recreational benefits associated with a day visit to beaches in Oxnard. While public beaches do not currently charge admission, there is still an economic value associated with how much people are willing to pay for a one-day visit to the beach. The California Coastal Commission (Personal Communication, July 10, 2017) has established the day use value for Oxnard beaches to be approximately $40 per person per day, and this analysis is based on that value. These benefits do not include the intrinsic value of beaches for people who do not attend the beach.

This analysis uses the Coastal Sediment Benefits Analysis Tool (CSBAT) to estimate both the changes in beach attendance and day use value corresponding to the predicted changes in beach width. The CSBAT model takes into consideration the following variables: water quality, beach width and quality (erosion and nourishment impact this), overcrowding, facilities/services (e.g., bathrooms, picnic areas, surfing), and availability of other beaches nearby. If, for example, Oxnard chooses to armor the Planning Area 2 and Planning Area 3 shorelines, this could result in a reduction in sandy beach width. The decrease in beach width would cause the day use value associated with visiting that beach and annual visits to that beach to decrease commensurately. Consequently, the recreational value associated with each adaptation strategy is equal to the projected sum of all visits to the beach in each Planning Area and within each time horizon. (As in the case of expected losses, a one percent present discount value was applied to all recreation values[3]).

Oxnard revenues due to sales tax and transient occupancy tax associated with each strategy were estimated using the following rates:

- Sales tax rates
  - City: 0.50%
  - County: 0.25%
  - Special: 1.0%
- Transient occupancy tax rate
  - 12%

Transient occupancy revenues were estimated by assuming that 10 percent of beach visits are overnight visits at hotels, which pay transient occupancy tax and that the average spent on lodging for an overnight visit to the beach is $25.25 per person, per night.[4] The estimation of $25.25 per person per day is based on the average spending for all overnight trips, independent of what type of lodging a visitor uses. This approach is based on BEACON (2009) sponsored survey data, which indicates that 10% of visitors will be staying at lodging that will administer a transient occupancy tax. The other 90% of visitors are either day-trippers and don't require lodging or lodging includes camp sites, staying with friends or relatives or staying in second homes they own themselves.

Costs

While there are many types of costs directly and indirectly associated with SLR adaptation strategies, such as limits to beach access, potential visual impacts, construction, and maintenance costs, this analysis primarily focuses upon the economic costs associated with construction and maintenance of the adaptation strategy and the property damage costs that would occur as a result of the adaptation strategy. Loss of coastal recreation is modeled in this analysis as a reduction in benefits.

The economic value of infrastructure in the city was valued by using replacement costs and metrics provided by engineers or industry standards. For example, to estimate the replacement cost of power lines, publicly available data from SCE was utilized.

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[3] When dealing with future benefits and costs, standard economic practice is to apply a "present discount rate." The average person would rather receive $100 today than in the future, therefore, future gains/losses have less value than present gains/losses. While typical economic analyses use discount values of three percent or higher, environmental economic analyses use approximately one percent.

[4] Taken from San Diego Association of Governments (SANDAG) survey results.

The analysis assumed costs of $10 per square foot for removing single-family residences and $20 per square foot for multiple-family residences. This analysis examined the removal/demolition costs of roads and examined the costs of creating new roads as a proxy for the losses involved. To provide an economic value for water and wastewater infrastructure, the analysis utilized replacement costs.

For more details regarding how costs were quantified please see Oxnard's *Vulnerability Report.*

Coastal flooding on the corner of 5th Street and Mandalay Beach Road, Photo Source: Rincon Consultants, Inc.

VII. Economic Analysis

This section presents the results of the analysis of benefits and costs of each adaptation strategy based on the methods and assumptions described earlier in this report. See Section V, for definitions of each strategy in each Planning Area. Planning Area 4 is undergoing a separate SLR adaptation planning process as part of the OBRAP plan. Because of this ongoing, parallel process and Oxnard's support for and participation in the restoration planning, a cost/benefit analysis for Planning Area 4 is not provided here. The analysis does include a discussion of overall adaptation strategies for Planning Area 4 and costs associated with specific infrastructure (i.e. the Oxnard wastewater treatment plant).

Economic Benefits

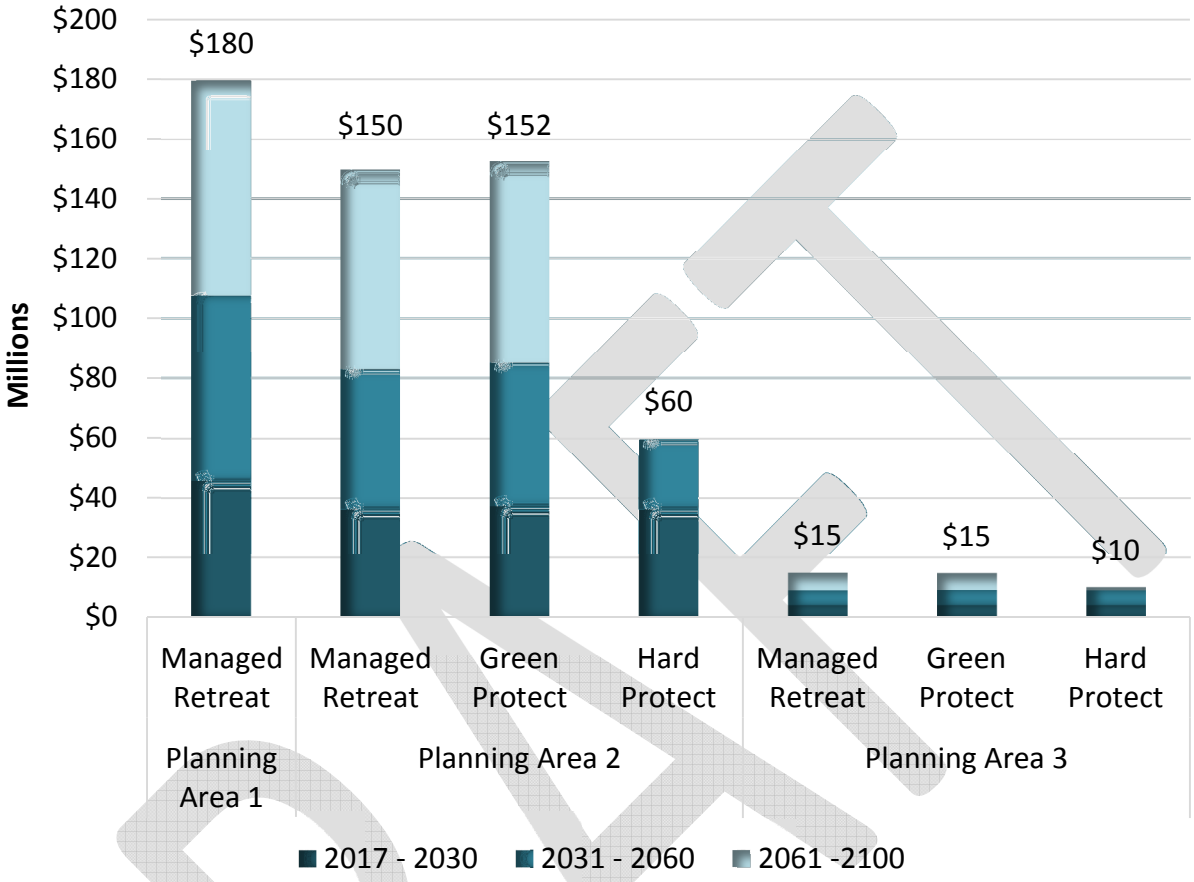
Figure VII-1 provides estimates of the expected benefits associated with each adaptation strategy in Planning Areas 1, 2, and 3. Key findings include:

- Because recreational value is derived exclusively from beach attendance, those areas with the highest annual attendance (Planning Areas 1 and 2) also provide the most economic benefits.

- Because coastal armoring was assumed to reduce sandy beach width, it has lower economic benefits associated with recreation. However, because sandy beaches in Oxnard are quite wide, the difference in strategies does not have a substantial impact until later time horizons. By way

of illustration, the total absence of recreational benefits for Planning Area 2 after 2060 is due to the beach width having been reduced to zero under the armoring strategy.

Figure VII-1. Expected Recreational Value Associated with Each Adaptation Strategy (2017 dollars)

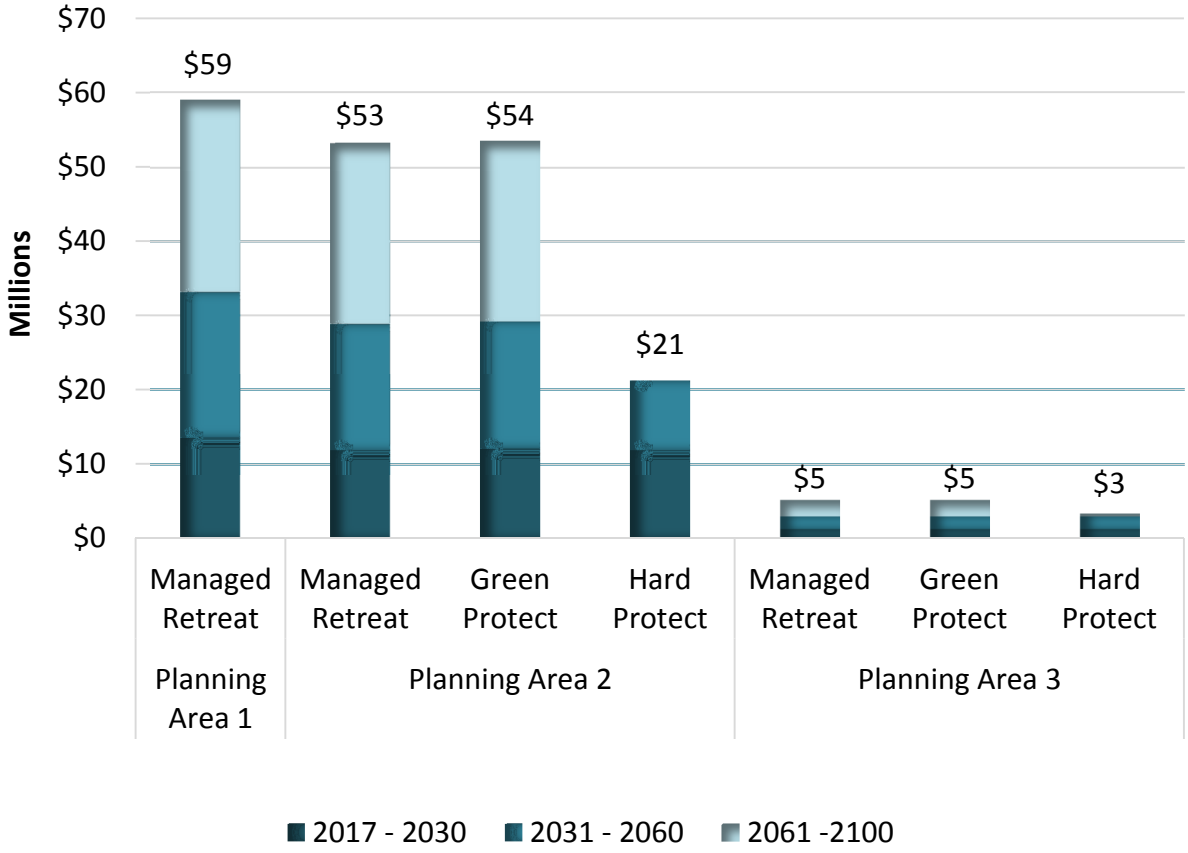


Changes in beach attendance also produce corresponding changes in local spending. Although local spending data for Oxnard was not obtained, numerous recent studies of beach spending in California indicate that beach spending per person is fairly consistent from region to region in California (King and Symes 2004; King, McGregor and Whittet 2015). The one key distinction is between visitors who come for the day and those who stay overnight. This analysis utilized recent survey data from San Diego for spending (King and Symes 2004). To determine the percentage of visitors who are overnight visitors versus day-trippers, this report utilized survey data from a BEACON report (2009). On average, beach goers in Oxnard spend an average of $11.79 per person per day due on beach spending (BEACON 2009; King and Symes 2004).

Recreational value for Planning Area 3 is considerably lower compared to Planning Areas 1 and 2 since beach attendance is lower, which is based on a number of factors (BEACON 2009). Survey data collected by Dr. Philip King for BEACON and other studies completed in California were used. Attendance for McGrath State Beach and Oxnard Shores was estimated to be 55,000 individuals per year, per area. Due to the lack of data for Hollywood-by-the-Sea in Planning Area 3 (Ventura County Jurisdiction), the attendance values were distributed as follows: 55,000 individuals per year for McGrath State Beach, 50,000 individuals per year for Oxnard Shores, and 5,000 individuals per year for Hollywood-by-the-Sea.

While this local spending is not included in the final cost-benefit analysis, Figure VII-2 does provide an estimate of the expected local spending associated with each adaptation strategy. Predictably, the results are roughly proportional to the recreational values.

Figure VII-2. Local Spending Associated with Each Adaptation Strategy (2017 dollars)



Figures VII-3 and VII-4 are similar to the figure above. Whereas the latter showed the amount of local spending associated with each adaptation strategy, Figures VII-3 and VII-4 show Oxnard revenues due to sales tax and transient occupancy tax associated with each strategy, respectively. Neither of these is included in the final cost-benefit analysis because although spending patterns provide a measure of the impact or influence of beach recreation on the local economy, they should not be conflated with actual goods/services that the beach itself provides. For example, people value a visit to the beach at approximately $40 per day (and spend on average $25.25 on lodging since most people do not stay in hotels), which is different from the value of goods that people buy locally and then bring to the beach. One is a benefit provided directly by beach itself, while the other is an indirect benefit that is associated with beach attendance due to the complementary nature of goods and beach.

Figure VII-3. Sales Tax from Local Spending Associated with Each Adaptation Strategy (2017 dollars)

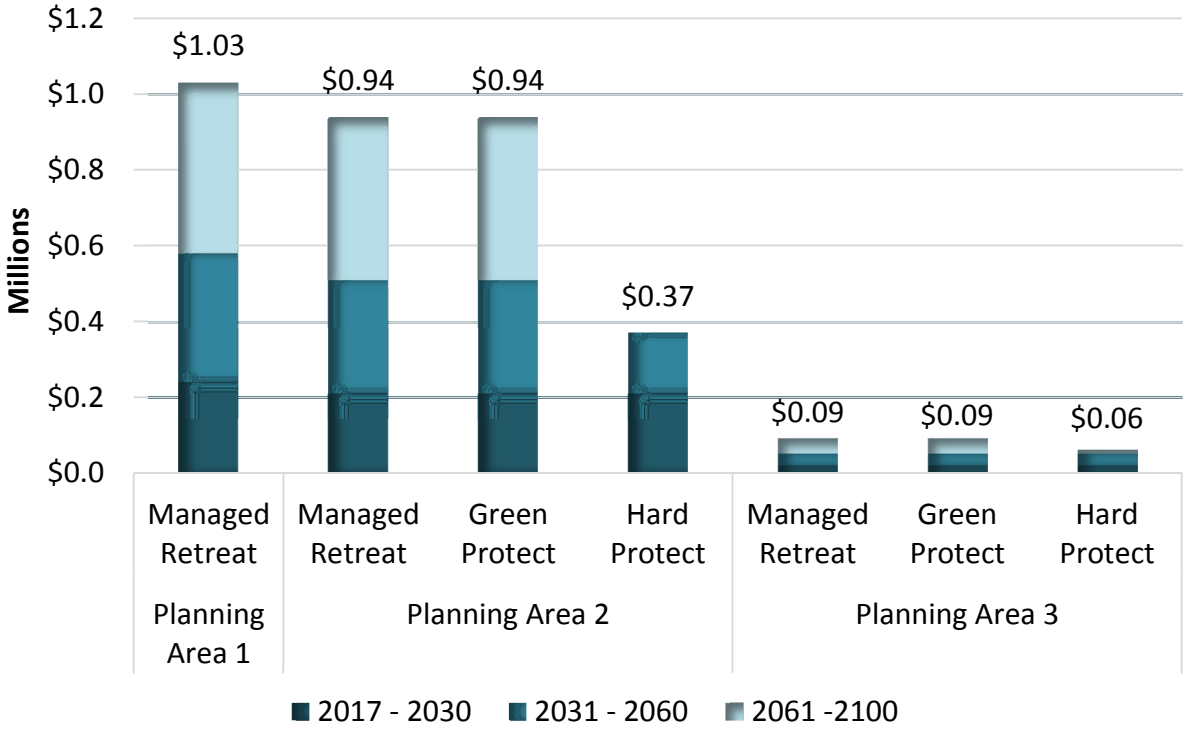
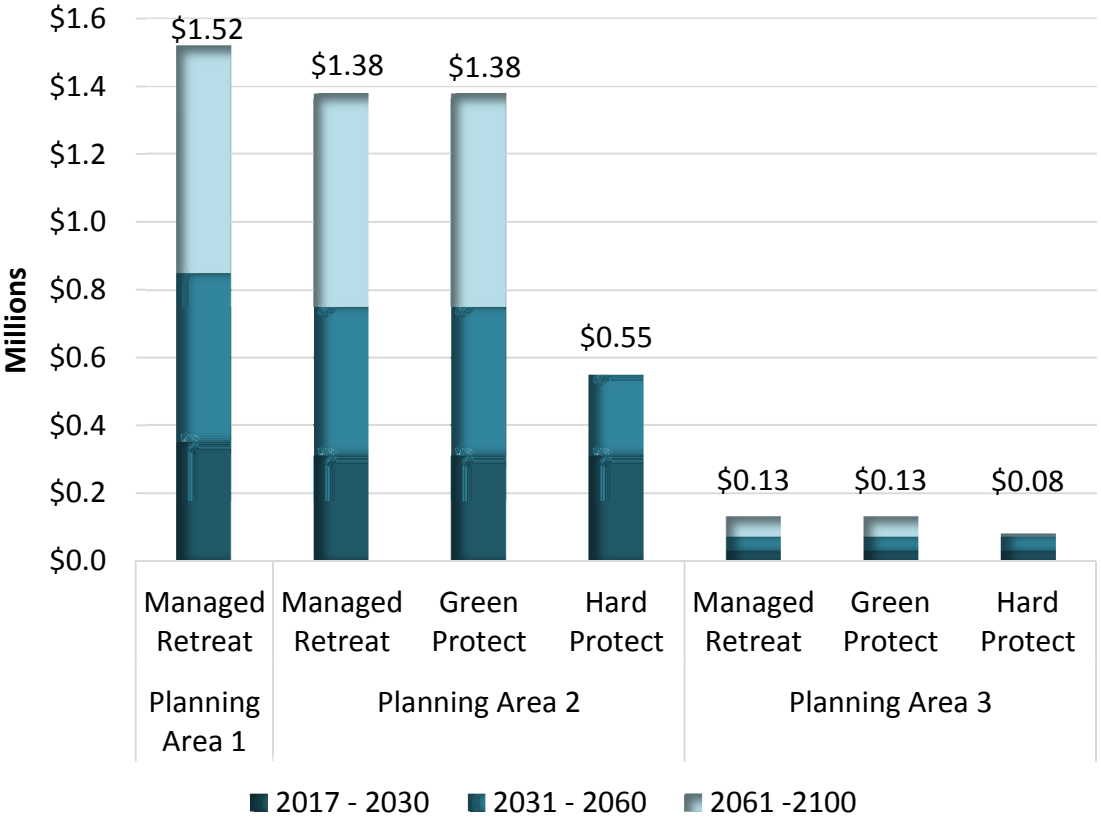


Figure VII-4. Transient Occupancy Tax Revenue Associated with Each Adaptation Strategy (2017 dollars)



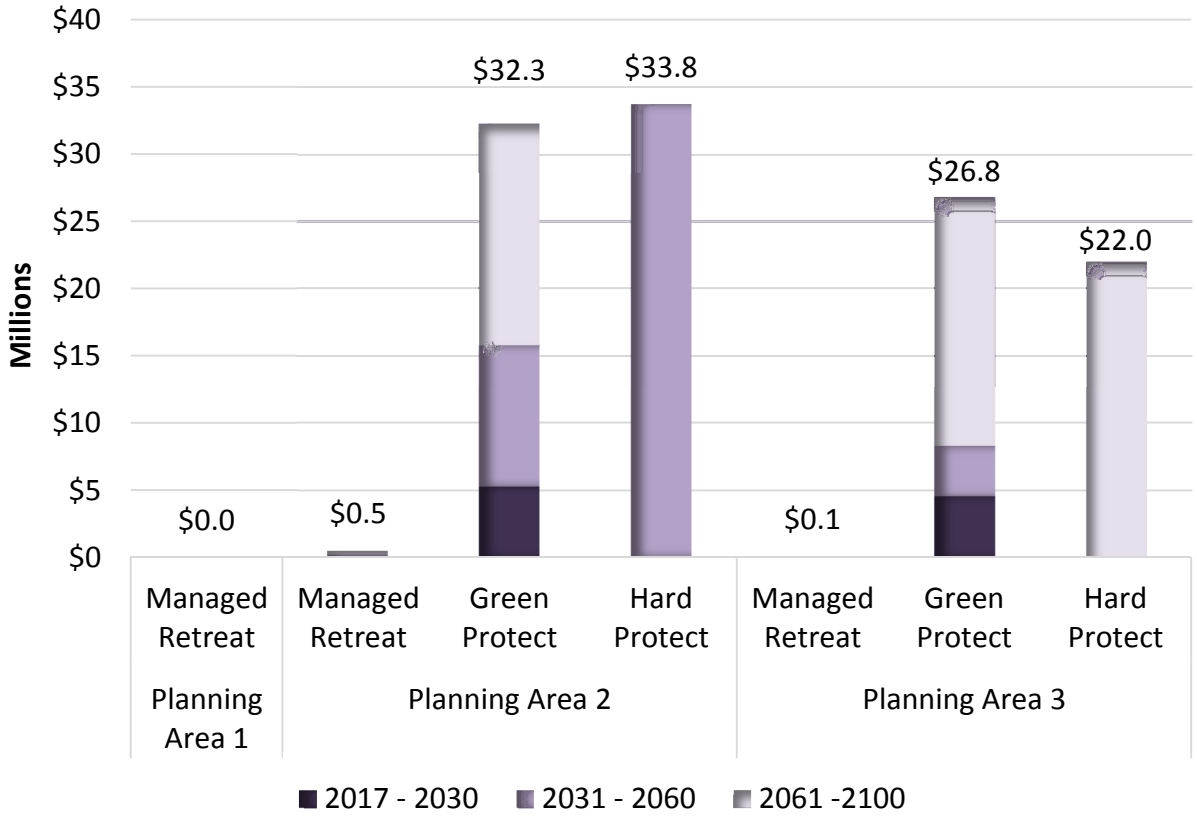
Costs

Figure VII-5 presents the estimated costs of implementing the various adaptation strategies over the three time horizons (2030, 2060, and 2100). As expected, retreat is the least costly option since it does not include the cost associated with building coastal protection infrastructure. In Planning Areas 2 and 3, where both coastal armoring and dunes are an option, the costs of dune restoration and coastal armoring are similar at $32.3 million and $33.8 million, respectively (within a reasonable margin of error approximately 10 percent).

These costs will be incurred by a variety of entities in Oxnard and the type of cost will differ by body or entity. Therefore, the type of cost and to who it could be incurred by should be taken in consideration in future planning deliberations. By far, the most significant category in terms of economic loss is residential property associated with the Managed Retreat strategy. Most of these costs would be incurred by private citizens and would be attributable to residential structure damage or loss of structure. Ideally, Managed Retreat would occur before damage to property due to coastal hazards could occur. However, because Oxnard is already susceptible to coastal hazards, this analysis assumed a more realistic approach where Managed Retreat would occur after property is damaged by coastal hazards.

Other costs would be incurred by the public and could include loss of public access and recreational resources provided by the beach and the harbor. The City and other public entities could experience costs due to losses in property and infrastructure. Costs incurred by the City could include expenses such as damages to public property and lost tax revenues. These losses are far more modest than losses to residential property, but still significant. For more details regarding the costs associated with the City's vulnerability to SLR see the *Vulnerability Report.* Most costs associated with implementing adaptation strategies, such as dune nourishment, coastal armoring, and/or a managed retreat lease buy back option would be incurred by the City, an NGO or other government entity.

Figure VII-5. Expected Costs of Implementing Each Adaptation Strategy (2017 dollars)



Overall Results

Figures VII-6 to VII-8 present the overall results of the benefit/cost analysis. This section discusses each of the Planning Areas separately followed by a more general discussion of the results and key findings.

Planning Area 1

Figure VII-6 shows the net benefits (benefits minus costs) of the adaptation strategy considered for Planning Area 1 which includes relocation of the McGrath State Beach and eventual decommissioning of MPP and MBGS.

Figure VII-6. Overall Net Benefits for Planning Area 1 (2017 dollars)

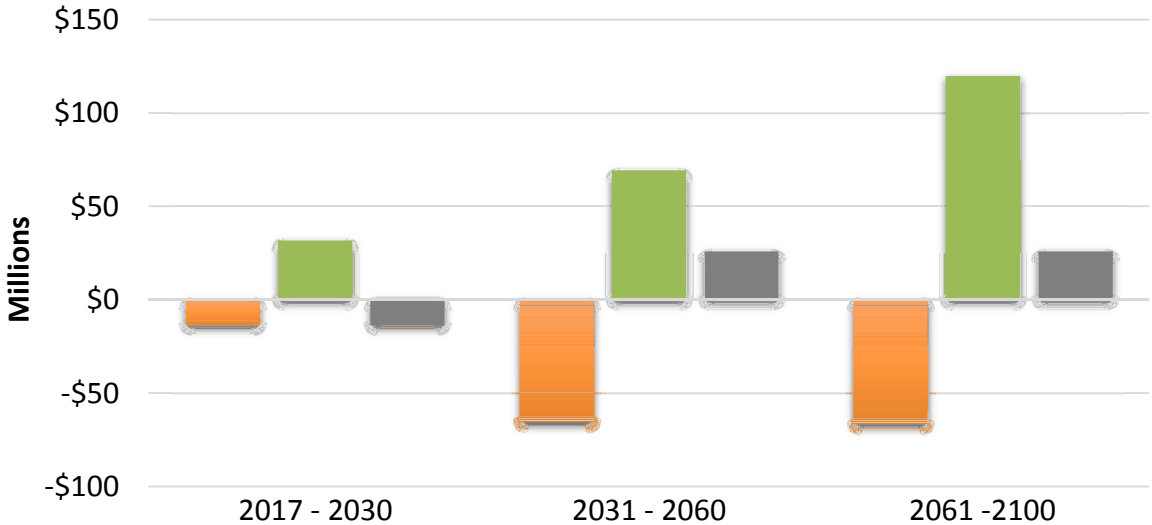
The costs associated with the demolition and relocation of the McGrath State Beach facilities were not included in the cost benefit analysis since plans to accomplish this are already underway and the timeline of implementation is still being determined. This analysis estimated the cost associated with the demolition of the McGrath State Beach facilities is approximately between $278,000 and $418,000. It is also important to note that McGrath State Beach and other large portions of Planning Area 1 is State land and consequently, the City has no discretion over how that area is managed. Therefore, this analysis is provided for informational purposes.

Managed Retreat would also include the eventual removal of all facilities at the MGBS site per General Plan policies SC-2.4, CD-21.3, ICS-17.1, and SH-3.5. This analysis estimates the decommissioning of the site to cost as low as $24 million and as high as $36 million. Once removal of the facilities is complete the Planning Area would not include any infrastructure, therefore Managed Retreat would continue to be the most reasonable adaptation strategy.

Planning Area 2

Figures VII-7 compares the net benefits (benefits minus costs) of the three adaptation strategies considered for Planning Area 2. In Planning Area 2, which has the most assets at risk, primarily in the form of single-family residences, dune restoration is the superior choice by a wide margin from a cost-benefit perspective without including the ecological benefits of maintaining a sandy beach and dune ecosystem. Armoring and retreat yield similar (negative) net benefits. Beach and dune replenishment and nourishment accrues higher costs in the later time horizons due to higher rates of SLR resulting in increased erosion rates, which in turn requires more frequent nourishments. And since armoring is predicted to not be required until mid-century, this results in greater costs in the 2061 and 2100 time horizons. Managed Retreat, as defined in this analysis, results in increased property damage over time with higher SLR because property damage occurs at more inland and consequently, structures are moved out of the coastal hazard area.

Figure VII-7. Overall Net Benefits for Planning Area 2 (2017 dollars)



	2017 - 2030	2031 - 2060	2061 -2100
Managed Retreat	-$13,261,000	-$65,131,000	-$66,332,000
Green Protect	$32,000,000	$69,200,000	$120,100,000
Hard Protect	-$13,261,000	$26,039,000	$26,039,000

Another option not included in the cost-benefit analysis is the modification of the stormwater drainage system[5] (the Accommodation strategy) to alleviate impacts associated with monthly tidal flooding. This analysis estimates that the cost to add pumps to the storm drain system to address tidal inundation/flooding is from $800,000 to $1,200,000. Because this is assumed to be the more cost-efficient option in the short-term, if SLR impacts begin to occur earlier than projected, this option maybe the most viable until funding and permits for longer term strategies can be employed. This strategy would not, however, provide complete protection against coastal flooding and erosion resulting from a 100-year storm event. Therefore, more long-term strategies such as Green Protect would still need to be employed for more protection against coastal hazards.

Because the scope of this analysis is to provide a broad evaluation of strategies to adapt to SLR and coastal hazards on a plan-level, more detailed-project specific analysis is not available at this time. The update of the LCP will include policies, however, requiring project-specific analysis to adequately evaluate the protection of specific resources in Planning Area 2. The Green Protect strategy discussed here would provide protection to residences and infrastructure along the shore, such as the Oxnard Mobile Home Park[6], Oxnard Shores, and Embassy Suites Mandalay Beach Resort. However, because impacts to the Seabridge Marina Community is a waterway community, its adaptation to SLR requires an

[5] Oxnard's drainage system is already impacted to coastal hazards and is susceptible to flooding during coastal storms and high tide events.
[6] The Oxnard Shores mobile home park is susceptible to projected erosion and coastal storm floods by 2030.

evaluation of detailed engineering options, which was not in the scope of this analysis.[7] Therefore, the LCP update should include policies to investigate options for adaptation for this waterway community which will involve further coordination with Channel Islands Harbor that provides the entrance to the community.

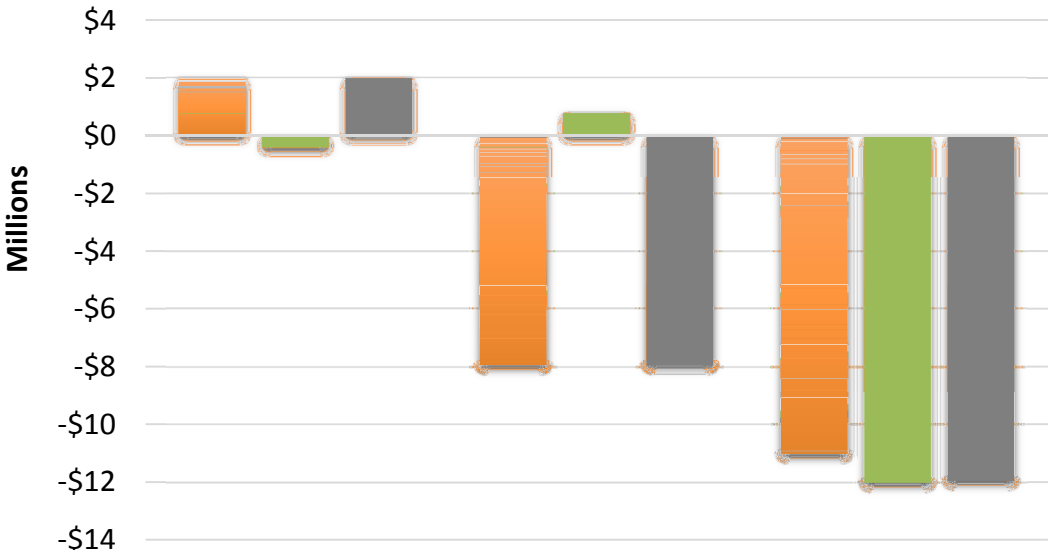
Planning Area 3

Figure VII-8 compares the net benefits (benefits minus costs) of the three adaptation strategies considered for Planning Area 3. These results are similar to Planning Area 2. In Planning Area 3, Green Protect provides the highest net economic benefits from 2031 to 2060, and Hard Protect provides similar economic benefits to Managed Retreat over long time horizons, because the high cost associated with damage to structures would not occur. It is important to note that beyond the economic impacts, other impacts associated with coastal armoring, such as the impediment of the ability of natural beaches and habitats to migrate inland over time, as well as the loss of public recreational beaches, would occur as sea level continues to rise. Other detrimental impacts associated with the Hard Protect strategy may include negative visual impacts or interference with other ecosystem services. These negative non-fiscal impacts would not occur under the Green Protect strategy and would need to be balanced against costs as part of the overall City decision-making process.

Note that armoring may not need to occur in Planning Area 3 until mid-century because modeling suggests that until then, the beach has enough width to protect against coastal hazards. Therefore, shoreline armoring may not be necessary until that point. Also, this analysis assumes dune restoration requires costs associated with an engineered dune system that would include bulldozers and other construction costs. There are methods to grow dunes naturally that require less labor and financial investment that would increase the net benefits of the Green Protect strategy. It is important to note the multi-jurisdictional oversight in this area. Policies that guide the development of Channel Islands Harbor are identified within the *Channel Islands Harbor Public Works Plan* and the beach in this area is under the jurisdiction of County of Ventura. Coordination with Channel Islands Harbor and County of Ventura will be required to determine the most appropriate adaptation strategies to be applied since a considerable amount of the property in this Planning Area is in their jurisdiction.

[7] Impacts to the waterway communities north of Channel Islands Harbor in Planning Area 2 show erosion, coastal storm flooding, and tidal impacts starting in 2060 with the complete southern area of the community impacted by 2100. See the Sea Level Rise Vulnerability Assessment and Fiscal Impact Report.

Figure VII-8. Overall Net Benefits for Planning Area 3 (2017 dollars)



	2017 - 2030	2031 - 2060	2061 -2100
Managed Retreat	$2,000,000	-$7,940,000	-$11,017,000
Green Protect	-$400,000	$800,000	-$12,000,000
Hard Protect	$2,000,000	-$7,940,000	-$11,940,000

The overall negative net benefits for Planning Area 3 is because beach attendance is considerably lower in this area compared to the other Planning Areas (BEACON 2009). This assumption is likely due to several factors and without further investigation it would be speculative to provide a rationale. . Attendance numbers would need to exceed 10,000 before a net benefit for Managed Retreat and Hard Protect would be realized. However, Green Protect would still have the most net benefits and Managed Retreat and Hard Protect would still have equal net benefit value. Since the beach in Planning Area 3 is under the County of Ventura jurisdiction and not within Oxnard, more specific beach attendance data was not available. Also, because recreation values were the only benefit considered in this economic analysis, the amount of beach attendance assumed for recreation values does not create enough economic benefits to outweigh the economic costs of any adaptation strategy between 2060 and 2100. Consequently, this analysis assumes that protecting Planning Area 3 would not add any economic/recreational benefits but would only prevent losses of property[8]. A vulnerability and adaptation analysis of the beach area within this Planning Area will also be included in the County of Ventura's ongoing vulnerability assessment.

A strategy not analyzed for Planning Area 3 is the Accommodation option where the landside development in Channel Islands Harbor and the surrounding areas would employ engineering strategies

[8] Data obtained for Channel Islands Harbor includes gross spending that occurs within Channel Islands Harbor, This data was not disaggregated into different components or location based. Therefore, could not be evaluated by Planning Horizon. Additionally, most of the gross spending in the Channel Islands Harbor is not subject to sales tax; therefore, an estimation of sales or other taxes for Channel Islands Harbor was not included in the analysis.

to elevate the various structures, such as bulkheads, buildings, and pads. These were not included in the analysis because estimating costs associated with this strategy are highly dependent on specific engineering design. Additionally, as mentioned above, *Channel Islands Harbor Public Works Plan* provides policy direction for development and retrofitting in Channel Islands Harbor.

Planning Area 4

Due to the plans already in place or being developed for most of Planning Area 4, this analysis did not include an overall cost-benefit analysis for this Planning Area. However, costs were prepared to provide Oxnard with information regarding the costs associated with protection or removal of infrastructure in the Planning Area, specifically the City's wastewater treatment plant[9]. The cost associated with protecting the wastewater treatment plant was estimated to be in the range of $5,597,000 to $8,395,000. The cost associated with relocating the wastewater treatment plant was estimated to be in the range of $428,480,000 to $642,720,000. However, it is important to note that due to the age of the wastewater treatment plant, if it were to remain in its current location it would require substantial operational upgrades, and that cost is not included in this analysis.

Portions of the Halaco site are located in the OBRAP plan. The costs associated with protecting Halaco from coastal hazards and rising groundwater levels due to SLR are currently being estimated by the EPA. Therefore, the costs and benefits associated with future SLR adaptation of the Halaco site are not included in this report.

There will also be costs associated with the planned wetland restoration in the Planning Area. However, these were not included in the report as they are currently being formulated by the State Coastal Conservancy, Oxnard, and TNC as they develop the OBRAP plan.

Lastly, benefits to this Planning Area were not included since they would mostly be ecological and ecological benefits were not quantified in this analysis.

Even though a quantitative analysis of Planning Area 4 cannot be provided at this time, the LCP update will include policies to continue to facilitate coordination of the various different adaptation efforts already in place. Coordination will continue to occur between Oxnard, State Coastal Conservancy, and TNC as the development of the OBRAP continues to provide an adaptation strategy that includes a combination of managed retreat, restoration, and improvements to public access. Coordination will also occur with EPA as it develops project-specific details regarding adaptation options for Halaco. Policies will also include further detailed investigation regarding how other infrastructure in the Planning Area, such as the industrial properties and wastewater treatment plant, will be affected by these plans and determine the most efficient way the City can utilize the large adaptation efforts already underway to supplement the additional adaptation efforts that will be required.

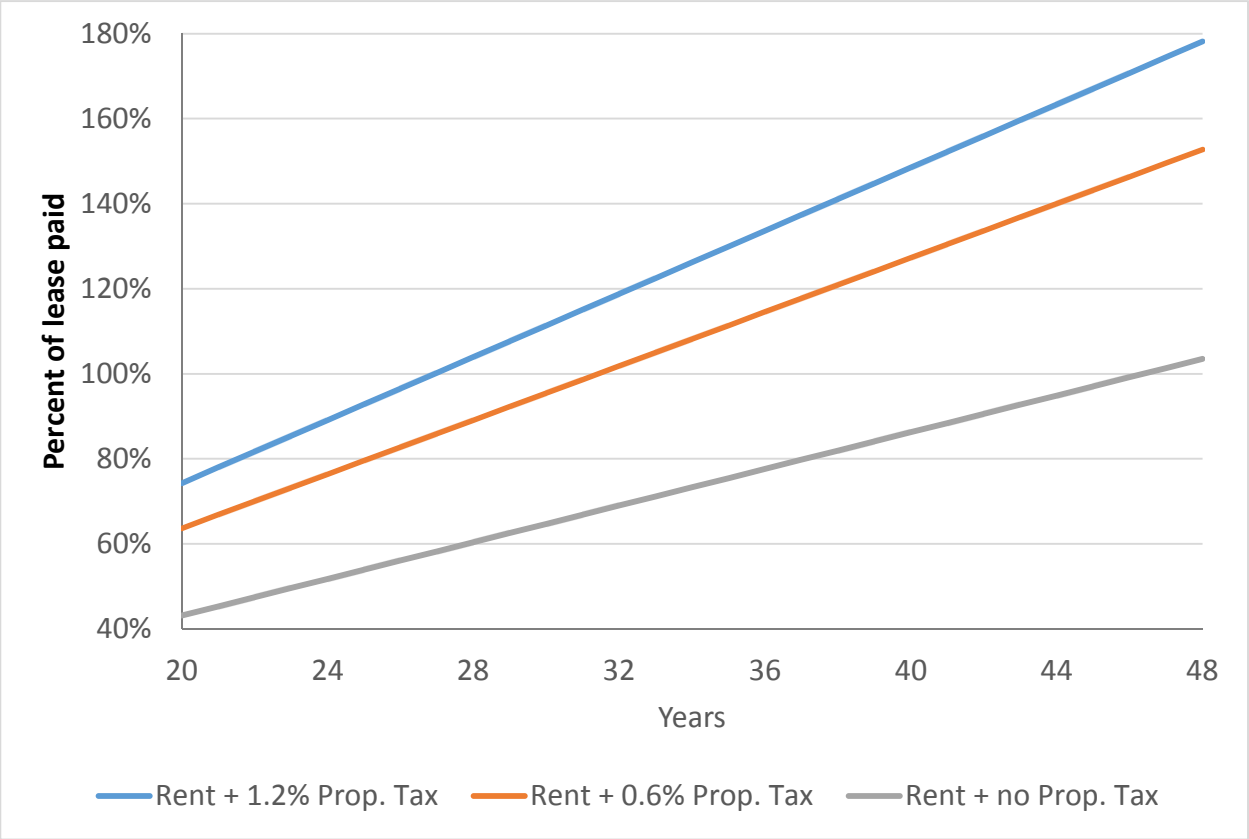
[9] Oxnard's Advanced Water Purification Facility is not within Oxnard's coastal zone but is projected to be impacted by coastal hazards by 2100.

Financing Managed Retreat for Private Property: Leaseback Options

In many cases, managed retreat involves moving buildings and infrastructure. In Oxnard, residential property represents the most significant expense in terms of market value. One problem with managed retreat is the question of who pays for the land that is being retreated. For government land and infrastructure, government entities will need to pay. For municipal utilities, the utility will likely pay. However, asking private residential property owners to give up their property without compensation may not be politically feasible. One possible solution is a leaseback option. In a leaseback option, a government, municipal utility or private agency (e.g., an NGO) buys the residential property and leases it back until a time where it is no longer habitable.

In order for a leaseback to be financially palatable, the property must be purchased before it is abandoned. The analysis below assumes that residential property is purchased at market values and leased/rented back also at market rates. It is also assumed that some type of governmental authority or municipal utility can borrow money at current municipal bond rates, approximately 2.5%. A 5% vacancy rate and maintenance costs of 2% a year are also assumed for this analysis. The price to rent ratio in Oxnard is 16:1, implying that the average residential property rents for 1/16 of the total (market) value per year. Figure VII-9 below presents the payback ratio based on this rent/property value ratio. The top (blue) line assumes that leaseback tenants are exempt from property tax. The middle (orange) line assumes that half of property taxes are paid. The bottom (grey) line assumes 100% of property taxes are paid. The assumption is that a reduction in property tax allows the leaser to pay higher lease payments, resulting in a shorter payback period. With no property taxes, the payback period is 27 years, about the length of a typical (30 year) mortgage. If 50% of property taxes are paid, the payback is just over 30 years. However, if 100% of property taxes are required, the payback is about 45 years. Of course, it is also possible that these buybacks are subsidized. For example, if another entity (such as a bigger governmental entity) pays for 20% of the market value of the property, the payback time is reduced to 21 years (with no property taxes). The analysis below is independent of time and place and could be used anywhere in Oxnard assuming that these parameters apply. For example, the City might impose a buyback in 2030 on properties expected to be lost to coastal hazards by 2060. The analysis indicates that such a buyback option could be self-financing if property taxes were exempted.

Figure VII-9. Payback Time-Period for Leaseback Option



Summary

Table 3 below shows a comparison of overall net benefits of each strategy by planning horizon. It is important to note that the net benefits in the analysis include (1) recreational value in the form of beach attendance; (2) costs associated with construction and maintenance of the adaptation strategy, and (3) property damage costs that would occur as a result of the adaptation strategy. Therefore, other factors such as public access, economic value of commercial development (mostly a concern in Planning Area 3 Channel Islands Harbor), ecological impacts, and visual impacts were not considered. These will need to be balanced against the economic costs during the policy development phase.

In Planning Areas 2 and 3, where adaptation strategies are compared, results show that different strategies may yield more benefits for each Planning Area. In Planning Area 2 Oxnard Shores, Green Protect yields the most benefits in all time horizons. Due to the value of the property in this Planning Area, Managed Retreat provides the least benefits throughout all time horizons. In Planning Area 3 Channel Islands Harbor, the results show that Green Protect will yield negative net benefits in 2030 but by 2060, it is the only strategy that yields positive benefits. By 2100, all strategies yield negative benefits

in Planning Area 3. This is mostly because the analysis does not consider the economic value of the commercial development in the Channel Islands harbor[10].

Table 3. Overall Net Benefits of each Adaptation Strategy by Planning Area (2017 dollars)

	Planning Horizon		
Planning Area	By 2030 (8.0 inches of SLR)	By 2060 (25.3 inches of SLR)	By 2100 (58.1 inches of SLR)
1 Mandalay McGrath	Managed Retreat $45.5 million	Managed Retreat $107.6 million	Managed Retreat $179.5 million
2 Oxnard Shores	Managed Retreat -$13.2 million Green Protect $32.0 million Hard Protect -$13.2 million	Managed Retreat -$65.1 million Green Protect $69.2 million Hard Protect $26.0 million	Managed Retreat -$66.3 million Green Protect $120.1 million Hard Protect $26.0 million
3 Channel Islands Harbor	Managed Retreat $2.0 million Green Protect -$0.4 million Hard Protect $2.0 million	Managed Retreat -$7.9 million Green Protect $800 million Hard Protect -$7.9 million	Managed Retreat -$11.0 million Green Protect -$12.0 million Hard Protect -$11.9 million

Note: Planning Area 4 is undergoing a separate SLR adaptation planning process as part of the OBRAP plan. Because of this ongoing, parallel process and Oxnard's support for and participation in the restoration planning, a cost/benefit analysis for Planning Area 4 is not provided.

Environmental Justice

Demographic variables for Oxnard indicate a somewhat higher incidence of poverty than the State of California (16.6% of its population is below the poverty line compared to 14.3% in California). Some 73.5% of Oxnard's residents self-identify to the US Census as "Hispanic" compared to 38.9% for the State of California. More than half (61.1%) of Oxnard's residents speak Spanish as their primary language at home—just over double the state average of 28.8%. Further, 23.3% of Oxnard residents have less

[10] The economic value of Channel Islands Harbor could not be included in the analysis because the economic data provided was not location based. Therefore, gradual impacts to Channel Islands Harbor over time could not be quantified.

than a 9th grade education compared to 10% in California overall. Similarly, just over a third (34.4%) of Oxnard's residents have less than a high school education compared to 18.2% for California.

Table 4. Select Demographic Variables for the City of Oxnard (Source: US Census 2015 data)

Demographic Item	Oxnard	California
Education <9th grade	23.30%	10.00%
Education <High School	34.40%	18.20%
Spanish primary Language	61.10%	28.80%
Other language total	68.20%	43.90%
Median HH income	$60,621	$61,818
% below poverty line	16.60%	14.30%
% > 65 years old	8.30%	11.40%
% Hispanic	73.50%	38.90%

According to CalEnviroScreen[11], there are two designated disadvantaged communities pursuant to Senate Bill 535, (census tracts 6111002905 and 6111004715) that intersect withOxnard's Coastal Zone.

In Census Tract 6111002905, some of the land zoned is currently zoned Resource Protection and Energy Facilities. The pollution and population burden indicators identified for the disadvantaged communities located in Census Tract 6111002905 include:

- Air Quality PM2.5
- Diesel Particulate Matter
- Toxic Releases from Facilities like Nitrogen Oxides and Sulfur Oxides
- Traffic Density

In Census Tract 6111004715, the land is zoned for Recreation, Energy Facilities, and Industry Priority to Coastal Development. The pollution and population burden indicators identified for the disadvantaged communities located Census Tract 6111004715, include:

- Air Quality: PM 2.5
- Diesel Particulate Matter
- Toxic Releases from Facilities
- Traffic Density
- Drinking Water Contaminants
- Clean Up Sites
- Groundwater Threats

[11] A screening methodology used to help identify California communities that are disproportionately burdened by multiple sources of pollution, https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30

- Hazardous Waste Generators and Facilities
- Impaired Water Bodies
- Solid Waste Sites and Facilities

Potential adaptation strategies to address these issues are to commit land in these areas to a Resource Protection zoning designation. This designation would involve the eventual removal of the power plants and could result in improved air quality, through a reduction in fine particulate matter (PM2.5), diesel particulate matter, toxic releases from facilities (e.g. nitrogen oxides and sulfur oxides) and reducing traffic density.

The Halaco EPA Superfund Site and the NRG Ormond Beach Generation Station (OBGS) are located in Census Tract 6111004715. The U.S. EPA is in the process of determining the type of clean-up and remediation for the Halaco EPA Superfund Site. Also the OBGS must comply with State-mandated once-through-cooling regulations by December 31, 2020 and eventually all facilities at the OBGS site will be removed in pahses according to updates to 100-year flood zone mapping per existing LCP policies 39, 40 and General Plan policies SC-2.4, CD-21.3, ICS-17.1, and SH-3.5. The clean-up process of the Halaco site and the removal of OBGS could also improve air quality and water quality by reducing any threat of drinking water and groundwater contaminants caused by the Superfund site and the OBGS site.

While, the adaptation strategies discussed in this report may not directly impact Oxnard's disadvantages communities outside of the coastal zone, Oxnard's coastal resources are utilized by all residents. Coastal resources used by all residents, including disadvantaged communities include: beach recreation, fishing, boating, and tourism. Adaptation strategies such as Green Protect and Managed Retreat, which would maintain beach width and coastal access, would provide indirect benefit for beach users throughout the city, including its disadvantaged communities.

Additionally, displacement of coastal housing that may occur under a managed retreat scenario may have indirect impacts such as causing a greater demand for housing throughout the city. The City would need to take additional measures to address this issue, such as relocating or increasing housing in other areas of the City. Therefore, future implementation of the selected adaptation strategies will need to involve a diversity of partners and stakeholders in conversations and decisions. Also due to the demographics of the rest of the City, more efforts towards public access and transportation should be considered in future adaptation planning to meet Coastal Act requirements, beyond what is required to address SLR. This would include encouraging the continued restoration and costal access programming for OBRAP area to increase coastal access at Ormond Beach; an area where coastal access is generally more restricted.

Channel Islands Harbor Jetty, Photo Source: Rincon Consultants, Inc.

VIII. Conclusions

In terms of overall benefits, the analysis determined that Green Protect had greater economic benefits compared to the Hard Protect option because coastal armoring is expected to lead to a reduction in sandy beach width and thus reduces beach access, attendance and the accompanying economic value, in addition to the unquantified losses in habitat and visual amenities provided by this resource. Due to the large average width of Oxnard beaches, the difference between the cost of Green Protect and Hard Protect is not considerable until after 2060 in Planning Area 2 and 3, where these strategies were considered. Methods to establish dunes naturally that require less labor and financial investment would increase the net benefits of the Green Protect strategy. In terms of overall costs, Managed Retreat is the least expensive option since new protection devices do not need to be built. However, this option does not provide protection for existing private or public property.

In Planning Areas 2 and 3, Managed Retreat, Green Protect, and Hard Protect were compared to determine overall net benefit. This analysis found that Green Protect provides the highest net benefits in Planning Area 2 regardless of time horizon. Managed Retreat and Hard Protect provide similar levels of benefits by 2030 and Managed Retreat is inferior to Hard Protect by 2100 in Planning Area 2. For Planning Area 3, Managed Retreat provides higher net benefits by 2030, lower benefits by 2060 and very similar benefits by 2100.

Due to the plans already in place for most of Planning Area 4, this analysis did not include a cost-benefit analysis for that Planning Area. The costs and benefits associated with wetland restoration will depend on the ultimate design of the OBRAP plan that is currently being developed by the State Coastal Conservancy, Oxnard, and TNC. Also, the costs associated with protecting existing infrastructure (i.e. the wastewater treatment plant) would be less than relocating them. Relocation may still be desired since these uses are not coastal dependent and their transition out of the coastal zone may align with other Oxnard policies and priorities.

This analysis did not fully value the ecological benefits of beaches and dune systems, however, a supplemental analysis which provides a range of ecological benefits is provided in Appendix A. . This analysis primarily focused on the following two economic values of coastal ecosystems: (1) the ability to buffer impacts from storms and coastal erosion, and (2) the recreational value of beaches. Beaches and coastal ecosystems provide many other ecological functions goods and services that were not fully evaluated. For example, it should be noted though that adding in a parameter for the ecological value of beaches and ESHA alters the ordering of net-benefits for adaptation strategies in Planning Area 3. As shown in the ecological appendix, adding in a component for the ecological value of beaches and ESHA reduces the net benefits of Hard Protect relative to the two other strategies and for higher values of EFGS, resulting in Hard Protect having the lowest net benefits. See Appendix A.

This analysis did not also evaluate differences in public access and visual impacts. Different strategies would cause different impacts to public access. For example, Hard Protect would cause erosion of the shoreline and prevent or reduce public access to Oxnard beaches and the view of the shoreline would also be withdrawn. Green Protect may cause more dunes to cover that shoreline than flat sandy beach but shoreline would still be maintained and the dunes would be low to the ground and not prevent view of the shoreline. Managed Retreat would potentially cause new shoreline levels to be created and public access and views of the beach would have to change and adapt accordingly. Also, because the community of Oxnard is considered more demographically disadvantaged compared to the rest of California, special considerations for public access should be considered in future SLR adaptation planning as projects are proposed.

In evaluating the trade-offs between retreat and dune creation and restoration, Oxnard should also consider the relative ecological benefits of each strategy. Dune creation and restoration would provide additional ecological benefits, not just storm damage prevention. However, this depends on how it is accomplished. Basic sand nourishment can have negative ecological consequences since the process of placing sand on a beach can bury existing flora and damage sensitive habitat (Dugan et. al. 2008, 2012, 2016). Dune restoration takes these challenges into consideration and aims to restore the natural habitat while trying to minimize impacts to sensitive species. If no type of protection occurs and coastal hazards are allowed to impact coastal areas, over time natural physical processes occur and the beach and dune system can evolve to its natural state. However, the time period and political feasibility of removing private properties to restore or enhance the physical processes can also be challenging since this may take a longer time frame to achieve and the generation of people that is burdened with the costs may not be able to experience the benefits.

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Oxnard Shores, Photo Source: Rincon Consultants, Inc.

IX. Next Steps

The next step in Oxnard's planning for the future is to use the information provided in this *Adaptation Report* and the *Vulnerability Report* to draft LCP polices that facilitate future adaptation projects and management actions that provide the greatest benefits. Policies designed to reduce coastal hazard impacts and that balance the cost implications with other intrinsic values associated with coastal resources, such as views, habitats and beach width, as well as other public priorities will be presented to local agencies and public stakeholders for evaluation and comments. Once local feedback is received and addressed, the LCP policy framework addressing SLR and coastal hazards will be presented to Oxnard's decision-makers and the California Coastal Commission for final approval. Public comment will be essential to the success of this project. After this process is completed, the Oxnard will have a set of SLR policies that: (1) support the community's vision for the future; (2) address the specific coastal hazard risks identified in the previous Vulnerability Report; (3) are consistent with the California Coastal Act, (4) generally follow the policy directions in the Coastal Commission's adopted 2015 Sea Level Rise Policy Guidance; and (5) reduce impacts from hazard events compared to not having taken any adaptations.

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PERSONAL COMMUNICATION

California Coastal Commission. 2017. EMAIL. July 10, 2017. RE: Coastal Commission staff comments on the City of Oxnard Administrative Draft Vulnerability Assessment and Fiscal Impact Report, dated May 23, 2017.