City of Oxnard

Local Coastal Program Update

Sea Level Rise Vulnerability Assessment and Fiscal Impact Report

Draft

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

May 2019

Prepared by:

City of Oxnard
214 S. C Street
Oxnard, CA 93030

With Assistance from:

Revell Coastal
125 Pearl Street
Santa Cruz, CA 95060

Rincon Consultants, Inc.
180 N. Ashwood Avenue
Ventura, CA 93003

Phil King, Ph.D.
Economics Department
San Francisco State University 1600 Holloway Avenue
San Francisco, CA 94132

Everest International Consultants
444 W Ocean Boulevard
Long Beach, CA 90802

City of Oxnard
Local Coastal Program Update
Sea Level Rise Vulnerability Assessment and Fiscal Impact Report
Draft

May 2019

Figures

Tables

Acronym List

BEACON Beach Erosion Authority for Clean Ocean and Nourishment

BESS Battery Storage System

CCC California Coastal Commission

CDP Coastal Development Permit

CEC California Energy Commission

CoSMos Coastal Storm Modeling System

CPUC California Public Utilities Commission

CSAT California Sediments Benefits Analysis Tool

CSUCI California State University Channel Islands

CUPA Ventura County Certified Unified Program Agency

DEM Digital Elevation Model

EMHW Extreme Monthly High Water Level

EPA Environmental Protection Agency

ESHA Environmentally Sensitive Habitat Areas

FEMA Flood Emergency Management Agency

FIRM Flood Insurance Rating Maps

IP Implementation Plan

IPCC International Panel on Climate Change

LCP Local Coastal Program

LUP Land Use Plan

LUST Leaking Underground Storage Tank

MBGS Mandalay Beach Generating Station

MPP McGrath Peaker Plant

MW Megawatt

NBVC Naval Base Ventura County

NOAA National Oceanic and Atmospheric Administration

NRC National Research Council

OBGS Ormond Beach Generating Station

OPC Ocean Protection Council

OPC-SAT Ocean Protection Council Science Advisory Team

OTC once through cooling

SCE Southern California Edison

SLR Sea Level Rise

TNC The Nature Conservancy

USACE U.S. Army Corps of Engineers

Executive Summary

Introduction

The California Coastal Act (Act) requires that local governments prepare and implement Local Coastal Programs (LCPs) to carry out the Act's mandate to protect natural and man-made coastal resources and maximize public access to the shoreline. Protecting these resources becomes more of a challenge in the face of climate change as temperatures rise and global sea level rise (SLR) increases. SLR will exacerbate already occurring coastal hazards such as erosion, flooding, and significant storm events and cause significant social, environmental, and economic impacts. Therefore, the California Coastal Commission and other State agencies strive to coordinate with coastal local governments, such as the City of Oxnard, to plan in a manner that considers future SLR impacts with the goal of developing short-, medium-, and long-range policies and implementing regulations that allow continued safe use of coastal resources while accommodating expected SLR. This Coastal Hazards Vulnerability Assessment and Fiscal Impact Report was prepared to address SLR and associated hazards in the City of Oxnard coastal zone and to provide a fiscal impact analysis to inform the LCP update process and future City adaptation planning and regulatory processes.

Oxnard LCP Planning Areas

The Oxnard coastal zone has four defined LCP Planning Areas extending inland between 0.5 to 1.5 miles, and having a wide range of land uses and public infrastructure. Planning Areas 1 and 4 have large-scale electricity-generation power plants that utilize once through cooling (OTC) technology. As this technology is no longer the only option for heat removal during generation and the permits are about to expire, these plants are required to be shut down by the end of 2020. Planning Area 2 includes the Oxnard Beach Park, Oxnard Shores Neighborhood, the Colony (a mix of residential, recreational, and hotel uses), two back-dune areas, and an inland marina community. Planning Area 3 encompasses Channel Islands Harbor.

The City of Port Hueneme, Naval Base Ventura County, and two unincorporated county residential neighborhoods (Hollywood Beach and Silver Strand Beach) are situated between Planning Areas 3 and 4. This study does not address these areas.

Stakeholder & Community Outreach

Public and stakeholder outreach was used to involve the coastal community and make sure priorities were addressed to the extent practicable. Public stakeholder meetings were held on October 29, 2015 and November 4, 2015, and a multi-agency meeting was held on February 25, 2016. Public stakeholder meetings were targeted at local residents and community forums, such as the Ormond Beach Task Force. The agency meeting was aimed at gathering input from local agencies and other parties with interests in the Oxnard coastal zone. The goal was to develop an LCP that addresses the local agencies' needs and concerns. Additional public and agency outreach meetings are planned for the future to gather comments on this draft Vulnerability Assessment. Comments received at those meetings will be considered prior to finalization of this report.

Vulnerability & Economic/Fiscal Impact Analysis Methodology

The economic and fiscal impact analysis prepared for this project was designed to identify the economic value of assets at risk due to coastal erosion and flooding, which is progressively exacerbated by continued SLR. Understanding current and projected vulnerabilities from coastal hazards is the critical first step a community must take to identify appropriate LCP climate adaptation policies and regulatory strategies. The economic portion of the report evaluated the impacts of three mapped coastal hazards integrated with SLR scenarios that are mostly based on the Coastal Resilience Ventura: Technical Report for Coastal Hazards Mapping (ESA PWA 2013). The three coastal processes include: 1) rising tide inundation zone, 2) coastal erosion hazard zone, and 3) coastal storm flood hazard zone. Hazard zones for each of these coastal processes were developed at three planning horizons; 2030, 2060, and 2100.

This report provides a summary of the vulnerability of Oxnard's coastal resources under three different hazard scenarios and the combined scenario. The combined hazard scenario includes the maximum extent of hazards caused by rising tide inundation, coastal erosion, and coastal storm flood. The analysis included both private and public property. Damage estimates were broken out into various sectors as a

way to organize the results and provide direction for LCP coastal policy development. The sectors include:

- Coastal Access/Recreation
- Infrastructure (Roads & Water/Sewer)
- Hazards
- Large-Scale Power Plants
- Residential Property
- Commercial/Industrial Property
- Oxnard Municipal Properties
- Channel Islands Harbor

Vulnerability and Economic Impact by Planning Horizon

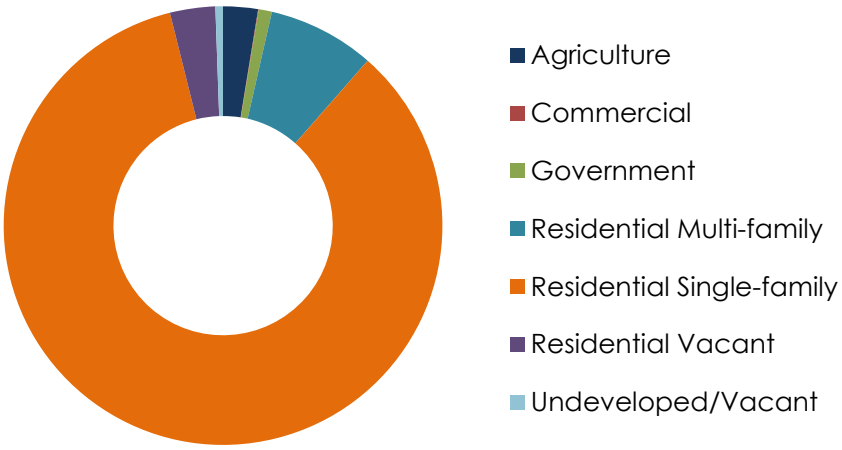
Oxnard's coastal zone has a wide range of land uses. Consequently, prioritizing where to start investing in protection against climate change and SLR can prove to be challenging. The following graphs show what Oxnard's potential economic losses are by planning year horizon. By knowing what resources are the most at risk for each planning horizon, the City can plan what actions need to be taken sooner and how to continue to incorporate the rapidly changing science regarding climate change and SLR.

Vulnerability by 2030

Many of Oxnard's coastal resources are projected to be impacted by coastal hazards by 2030. Among the impacted resources, the largest sector (for which economic value was evaluated) involves single-family residential units. Homes in Planning Area 2 (Oxnard Shores area) and Planning 3 (Channel Islands Harbor area) are highly susceptible to coastal hazards, mostly due to rising tide inundation. The Oxnard Shores mobile home park is also susceptible to projected erosion and coastal storm floods by 2030. By 2030, losses in this sector are expected to total approximately $277,360,000, due to the high value of the coastal homes. This accounts for 85 percent of the economic losses in 2030.

The second largest vulnerable economic sector is multi-family residential units for which projected losses total approximately $25,790,000. By 2030, projected losses in other sectors would total up to approximately $10 million, considerably less than those expected for the single- and multi-family residential sector.

Figure ES-1. Distribution of Economic Losses by 2030



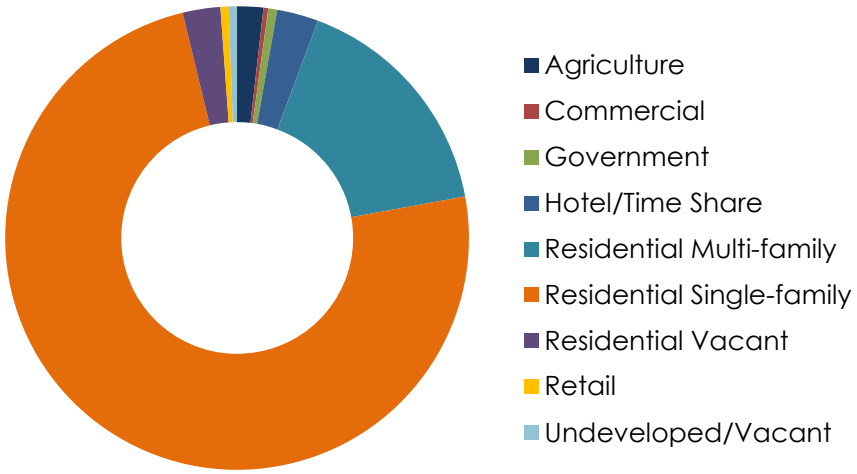
Oxnard's beaches and coastal dune areas are susceptible to coastal storm flooding as early as 2030. Two resources located near the coastal dunes include McGrath State Beach and large-scale power plants. Since McGrath State Beach is already subject to coastal and estuary tidal flooding, plans to relocate the park campgrounds are in place. California State Parks has estimated that campground relocation out of the flood zone will cost approximately $11.5 million (City of Ventura 2014). The power plants in Planning Area 1, NRG Mandalay Beach Generating Station (MBGS) and Southern California Edison (SCE) McGrath Peaker Plant (MPP), are mainly susceptible to coastal storm floods. In Planning Area 4, the proximity of the NRG Ormond Beach Generating Station (OBGS) to the shoreline makes it susceptible to coastal erosion, tidal flooding, and coastal storm flooding by 2030.

All storm drain outfalls are projected to be impacted by 2030 due to coastal storm flooding. The compromise of the coastal outfalls can cause storm drains throughout the city to back up, which would cause damage to the sewer system outside of the coastal hazard zone. Other infrastructure in the sewer network such as force mains, gravity mains, lift stations, and manholes are most susceptible to coastal erosion. The economic impact of sewer network damage in the coastal zone is approximately $4,100,000 by 2030.

Vulnerability by 2060

Even though single- and multi-family residential uses continue to be the largest vulnerable asset, hotel uses also become vulnerable. The projected economic loss for hotels by 2060 is approximately $15,560,000. In addition, the commercial shopping center at the Seabridge Marina on S. Victoria Ave becomes susceptible to tidal flooding by 2060. The projected economic impact due to commercial losses is approximately $4,890,000 by 2060. Vulnerability of infrastructure such as roads, sewer structures, and mater mains doubles by 2060.

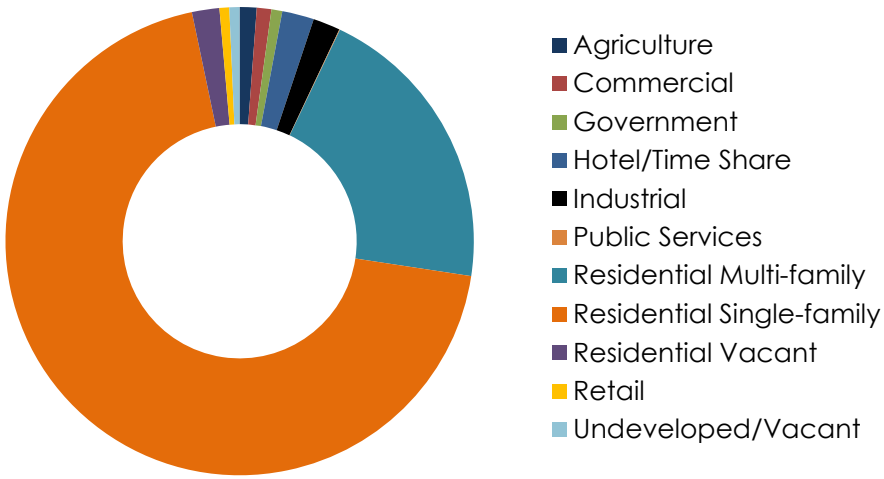
Figure ES-2. Distribution of Economic Losses by 2060



Vulnerability by 2100

After 2060, major manufacturing properties become the largest commercial and industrial sector impacted within the 2100 time horizon. These projected economic losses are approximately $29,600,000. These types of parcels are almost completely owned by New-Indy Containerboard LLC. However, economic losses related to industrial and commercial property would be relatively small when compared to the economic losses to the residential properties.

Figure ES-3. Distribution of Economic Losses by 2100



Summary of Vulnerability and Fiscal Impact

Table ES-1 summarizes the results presented in this analysis. 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. The City of Oxnard has a significant amount of property at risk due to coastal and tidal flooding, as well as erosion. By far, the most significant category in terms of economic loss is residential property. In all three planning horizons, the fiscal impact of damage to residential property amounts to over 90 percent of total costs from damage to property and infrastructure. Most of these costs would be incurred by private citizens could include residential structure damage or loss of structure.

Table ES-1 also provides estimates of the economic value of the two beaches within the Oxnard city limits (McGrath State Beach and Oxnard Shores) as well as the Channel Islands Harbor. Most of these Ormond Beach costs would be incurred by the public and could include loss of public access[1] and recreational resources provided by the beach and the harbor. In addition, this report has estimated the costs to the City and other entities due to losses in property and infrastructure. These 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 remain significant. It is important to note that these costs will be incurred by a variety of entities in Oxnard and the type of cost will differ by body or entity.

Table ES-1. Summary of Potential Damages to the City of Oxnard

Item	2030	2060	2100
Residential Property (SFDs)	$277,360,000	$400,570,000	$579,530,000
Other Residential Property	$36,660,000	$118,800,000	$204,060,000
Commercial/Industrial Property	$90,000	$4,890,000	$29,600,000
City Property	$5,070,000	$5,910,000	$9,850,000
Other Property	$8,460,000	$10,490,000	$12,560,000
Infrastructure: Roads	$4,000,000	$6,420,000	$10,640,000
Infrastructure: Water/Sewer	$4,100,000	$7,220,000	$13,830,000
Total	**$335,740,000**	**$554,300,000**	**$860,070,000**
Item			Annual Value
Beach Recreation[2]			$4,403,800
Channel Islands Harbor[3]			$120,970,000

[1] Economic value of McGrath State Beach and Oxnard Shores was evaluated based on attendance detailed in the 2009 BEACON report. Impacts to coastal access were evaluated for McGrath State Beach, Oxnard Shores, and Ormond Beach.

[2] Time horizon predictions for recreation value are dependent upon beach width projections which are not included in this analysis. Beach width projections and recreation value by time horizon will be provided in the adaptation analysis.

[3] Time horizon predictions for Channel Islands Harbor are dependent on site specific economic information. For this analysis, economic information was extracted from the Harbor's operating expenses and revenues. A more detailed analysis of future impacts and adaptation strategies for the Harbor will be provided in the adaptation analysis.

Next Steps

The next step to help the City plan for the future is to analyze what adaptation strategies would provide the most protection against climate change and SLR. Adaptation to climate change involves a range of policies and mitigation measures to respond to the climate change impacts already being experienced and adaptation measures designed to reduce future climate change impacts. These policies and measures can be taken in advance of potential impacts, or react to them depending on the degree of preparedness and the willingness to tolerate risk. With a solid understanding of the City's coastal hazards-specific risks and the physical processes responsible for causing the risk, the City can effectively develop these adaptation measures.

Photo Source: http://suncal.com/our-communities/beachwalk-on-the-mandalay-coast/ *(Accessed May 8, 2017)*

I. Background

Introduction

While coastal areas are highly valued due to their environmental, recreational, and economic resources, they are highly vulnerable to various anthropogenic and environmental hazards. As a result, the Act requires that local governments prepare and implement LCPs to carry out the Act's mandate to protect natural and man-made coastal resources and maximize public access to the shoreline. Protecting these resources becomes more of a challenge in the face of climate change as temperatures rise and global sea level rise (SLR) increases. SLR will exacerbate already occurring coastal hazards such as erosion, flooding, and significant storm events and cause significant social, environmental, and economic impacts. Therefore, the California Coastal Commission (CCC) and other State agencies strive to coordinate with coastal local governments, such as the City of Oxnard, to plan in a manner that considers future SLR impacts with the goal of developing short-, medium-, and long-range policies and implementing regulations that allow continued safe use of coastal resources while accommodating expected SLR. This Coastal Hazards Vulnerability Assessment and Fiscal Impact Report was prepared to address SLR and associated hazards in the City of Oxnard coastal zone and to provide a fiscal impact analysis to inform the LCP update process and inform future City adaptation planning and regulatory processes.

Oxnard Local Coastal Program

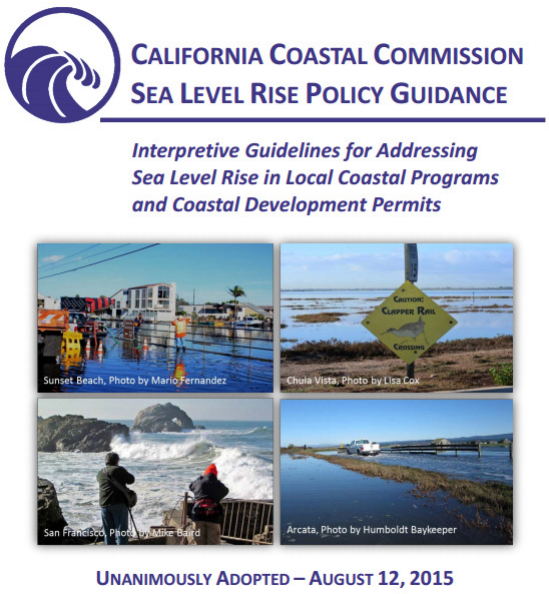
A coastal jurisdiction's LCP becomes effective after the CCC certifies that the LCP conforms to the policies found in Chapter 3 of the Act. Approximately 87 percent of the California coast is now covered by certified LCPs (CCC 2016). Each LCP includes a Land Use Plan (LUP) and an Implementation Plan (IP). The LUP defines and specifies the kinds, locations, priorities, and intensity of uses. It also contains a required Public Access Component so that maximum feasible recreational opportunities and public access to the coast are provided. The IP includes measures to implement the LUP, usually in the form of a zoning ordinance.

In 1982, the City of Oxnard adopted its Coastal Land Use Plan and Coastal Zoning Ordinance. While these governing documents have been amended to address the evolution of coastal planning and the changing needs of the City, neither has undergone a comprehensive update since that time. The CCC has recognized the need for periodic updates to LCPs statewide and published the LCP Update Guide (CCC 2013).

City of Oxnard

The City of Oxnard is home to 206,997 people and 54,735 homes (California Department of Finance 2016). Oxnard reflects the classic California story of a late-1800's small farming town that grew rapidly after World War II. It covers about 27 square miles and has a grid-based development pattern established largely on 20- and 40-acre urbanized farm parcels. The city is located about 60 miles northwest of Los Angeles along the Pacific Ocean coastline. The Pacific Ocean coastline was not a significant amenity for Oxnard until the 1960s, after which the city grew west and south toward the coast. It now includes about 10 miles of Pacific Ocean coastline between the Santa Clara River and the Ormond Beach wetlands.

Figure I-1. Regional Location for City of Oxnard



CCC SLR Policy Guidance

In August 2015, the CCC adopted the *Sea Level Rise Policy Guidance* to aid jurisdictions in preparing for SLR in LCPs, Coastal Development Permits, and regional strategies. The CCC *Sea Level Rise Policy Guidance* recommends six steps to address SLR as part of the development or update of an LCP. This Vulnerability Assessment aims to address the third step, which is to "Assess risks to coastal resources and development (i.e., identify problem areas)."

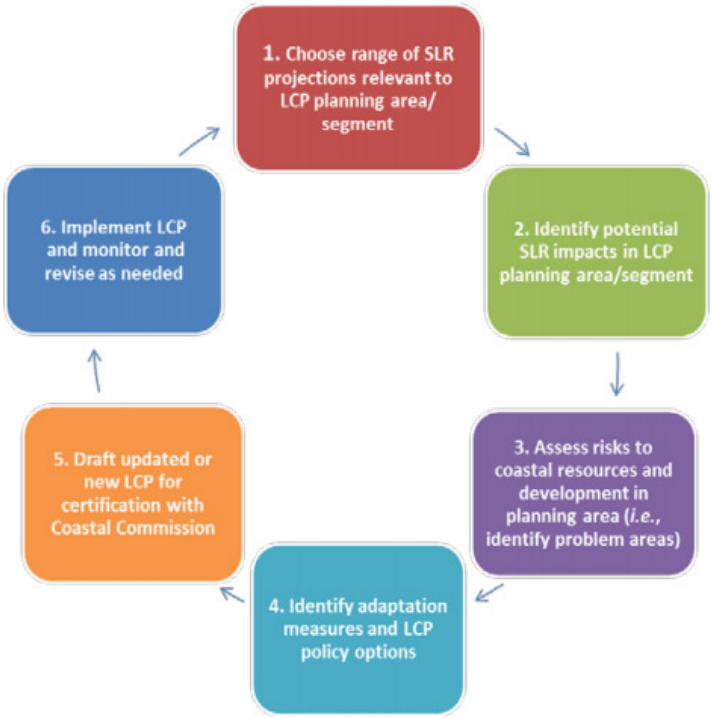


Figure I-2. California Coastal Commission Guidance for Including SLR into Local Coastal Programs (CCC 2015)

The first step is to choose a range of SLR projections relevant to LCP Planning Areas using best available science, which is currently the 2012 National Research Council (NRC) report. This Vulnerability Assessment utilizes the NRC projections and focuses on the high projected scenarios due to feedback gathered at agency stakeholder meetings. The rationale is that it is more efficient and less risky for agencies to plan for the worst-case scenario. The California Ocean Protection Council (OPC) is expected to revise projected SLR upward with the release of new information in mid-2017.

The second step involves determining how physical impacts from SLR may constrain the Planning Areas, including erosion, structural and geologic stability, flooding, and inundation. To see how the second step was addressed and to view the full extent of SLR impacts in the LCP Planning Areas, see the *City of Oxnard Sea Level Rise Atlas* [www.oxnardlcpupdate.com]. The types of hazards that were considered included monthly tidal inundation, 100-year event erosion, background/existing erosion, coastal storm wave impact, coastal storm flood impact, and a combination of all hazards.

As SLR impacts were identified and mapped in the City of Oxnard Sea Level Rise Atlas, this Vulnerability assessment examines the risks that SLR may pose to a selected range of coastal resources and development in the various LCP Planning Areas (Figure I-2). Section VII *Vulnerability and Fiscal Impacts by Sector* provides a list of the sectors analyzed, including coastal resources, development, and infrastructure. This will help inform the LCP update and assess whether the LCP Planning Areas' current and planned land uses, policies, and regulations are appropriate or consistent with Coastal Act or LCP policies, or if those land uses should be revised.

LCP Planning Areas

The Oxnard coastal zone has four defined LCP Planning Areas extending inland between 0.5 to 1.5-miles, having a wide range of land uses and public infrastructure. Figure I-2 illustrates the geographic extent of the LCP Planning Areas discussed in this document. Planning Areas 1 and 4 have large-scale electric-generation power plants that utilize once through cooling (OTC) technology. As this technology is no longer the only option for heat removal and the permits are about to expire, these plants are required to be shut down by the end of 2020. Planning Area 2 includes the Oxnard Beach Park, Oxnard Shores Neighborhood, the Colony (a mix of residential, recreational and hotel uses), two back-dune areas, and an inland marina community. Planning Area 3 encompasses Channel Islands Harbor. The following sections provide detailed descriptions of each of the LCP Planning Areas.

The City of Port Hueneme, Naval Base Ventura County, and two unincorporated county residential neighborhoods (Hollywood Beach and Silver Strand Beach) are situated between Planning Areas 3 and 4. This study does not directly include these areas.

Oxnard Shores Mobile Park, located in Planning Area 2

Figure I-3. LCP Planning Areas

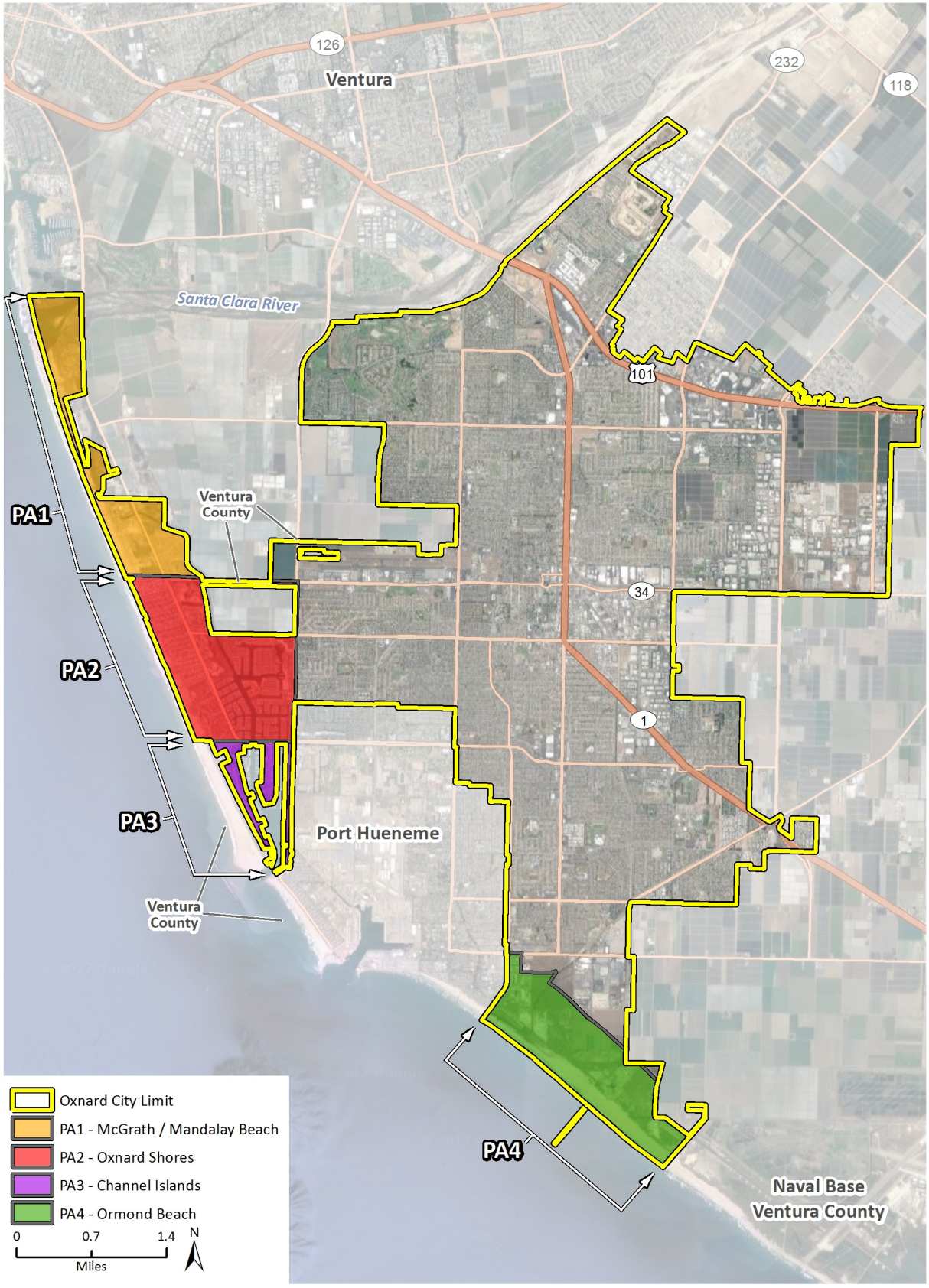


Photo Source: *http://www.caopenspace.org/mcgrath.html (Accessed May 8, 2017)*

Planning Area 1 – McGrath-Mandalay

Planning Area 1 primarily involves the natural areas of McGrath State Beach and Mandalay State Beach Park (undeveloped), which contain resource protection areas, including wetlands and federal and State threatened and endangered species habitat, with some exclusion areas for an entitled but as of mid-2017 unbuilt 292-unit residential development (North Shore) and the NRG MBGS and SCE MPP facilities. McGrath State Beach is located on the south bank of the mouth of Santa Clara River and is a popular bird-watching area due to its proximity to the Santa Clara River estuary and sand dunes along the ocean shore (California Department of Parks and Recreation 2015). This beach is a significant resource to the region as well as Oxnard as it provides affordable recreation areas for surfing, fishing, and camping as well as access to the Santa Clara Estuary Natural Preserve (California Department of Parks and Recreation 2015).

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 seasonally and the lagoon water fills to the elevation of the barrier beach berm. This causes the recreation areas in the State Beach 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 in the park boundaries to higher ground.

South of McGrath State Beach is the NRG MBGS, Mandalay State Beach (previously called Mandalay County Park), and the SCE MPP. The owner of MBGS, NRG Energy, has applied to the California Energy Commission (CEC) to replace the existing power plant with a new 262 megawatt (MW) power plant. The City of Oxnard, the Coastal Commission, and many residents oppose the proposal partly on the grounds of SLR hazards. The complete permitting record is with the CEC (www.energy.ca.gov). As of December 2017, the CEC application process was suspended when the two assigned CEC commissioners indicated they would vote to deny the NRG application.

Photo Source: *http://www.caopenspace.org/mcgrath.html (Accessed May 8, 2017)*

Planning Area 2 – Oxnard Shores

Planning Area 2 is located between Fifth Street and Channel Islands Boulevard. The largely residential area includes the Oxnard Beach Park, the Oxnard Shores neighborhood, the Colony (a mix of residential housing, recreation areas and hotels), two undeveloped back-dune areas, an inland marina community (Seabridge and Harbor Island neighborhoods) and a mixed-use Specific Plan (Seabridge and Westport). The population of size in Planning Area 2 is approximately 5,890 (U.S. Census

Bureau 2010). The Oxnard Shores area is accessible via South Harbor Boulevard.

Photo Source: http://www.searchyourhome.com/oxnard-shores.php *(Accessed May 8, 2017)*

Planning Area 3 – Channel Islands Harbor

Planning Area 3 includes the area south of Channel Islands Boulevard. The population of size in Planning Area 3 is approximately 1,327 (U.S. Census Bureau 2010). A majority of this Planning Area includes the Channel Islands Harbor, which, while located in Oxnard, is owned and managed by the County of Ventura. Channel Islands Harbor consists of approximately 310 acres, 200 of which are water (Ventura County 2008). Channel Islands Harbor was built as a recreational harbor in the 1960s on 310 acres and includes approximately 2,150 boat slips, marina facilities, restaurants, sport fishing facilities, and shops. The majority of the Channel Islands Harbor is operated by businesses that have long-term ground leases.

Channel Islands Harbor is divided into three areas (west, east, and peninsula) served by separate public roads, with each area offering different services. The west side consists of public small-craft marinas, a park that runs along the marina, restaurants, residential development, and retail businesses. Hotels, marinas, and apartments occupy the peninsula. The east side is primarily commercial in nature with boat yards, a marine supply store, boat sales, law enforcement, administration, and U.S. Coast Guard facilities.

Planning Area 4 – Ormond Beach

Photo Source: http://www.caopenspace.org/ormond.html *(Accessed May 8, 2017)*

Ormond Beach is the portion of the Oxnard coastal zone southeast of the City of Port Hueneme and northwest of the Naval Base Ventura County (NBVC), Point Mugu facility. Historically, the Ormond Beach area was part of a rich wetlands ecosystem formed by the meandering Santa Clara River that included sandy beaches, coastal lagoons and estuaries, fore- and back-dune areas, brackish and seasonal freshwater marshes, freshwater drainages, grasslands, and transitional uplands. Over time, a range of agricultural, industrial and energy-related uses developed, including the NRG OBGS and a closed industrial waste metal smelter operated until 2004 by Halaco Engineering. The former Halaco site is now an U.S. Environmental Protection Agency (EPA) Superfund site. The City of Oxnard, California Coastal Conservancy, and The Nature Conservancy (TNC) own and manage large portions of the Ormond Beach area. The California Coastal Conservancy has developed a Wetlands Restoration Feasibility Study (2009). The Coastal Conservancy and TNC are pursuing acquisitions at Ormond Beach to accommodate

wetland restoration and other habitat needs. To date, the Coastal Conservancy along with TNC and the City of Oxnard own approximately 630 acres at Ormond Beach and are preparing a restoration and public access plan (Coastal Conservancy 2016).

The NRG OBGS is located in Planning Area 4, surrounded by coastal wetlands and dunes owned by the Coastal Conservancy and TNC (Coastal Conservancy 2016). There are no announced plans regarding this generating station, other than it must comply with State-mandated OTC regulations by December 31, 2020.

Stakeholder & Community Outreach

Stakeholder input and public participation was necessary in generating a vulnerability analysis that addressed the variety of specific needs and assets of Oxnard's coastal zone. Therefore, public and stakeholder outreach was used to involve the coastal community and make sure all priorities were addressed as sufficiently as possible. Public stakeholder meetings were held on October 29, 2015 and November 4, 2015, and a multi-agency meeting was held on February 25, 2016. Two meetings, for public stakeholders and for various agencies were held to present the findings of this report. Public stakeholder meetings were targeted at local residents and community forums such as the Ormond Beach Task Force and Saviers Road Design Team. Community issues of concerns included the protection of Oxnard's natural resources. The agency meeting was aimed toward gathering all local agencies that work within the Oxnard LCP with the goal of developing an LCP update that addresses the local agencies' needs. The agencies were concerned with evaluating critical facilities in the city and for the analysis to consider the worst case scenario of coastal hazards to facilitate the granting of funding for upgrade projects. They also commented that addressing the worst-case scenario is not necessarily a conservative estimate since, in their experience, coastal hazards are occurring at a faster rate than current models are predicting. An additional public outreach meeting will be held to gather comments on this draft Vulnerability Assessment on a future date to be determined.

Flyer provided at public stakeholder meeting

CITY OF OXNARD CALIFORNIA

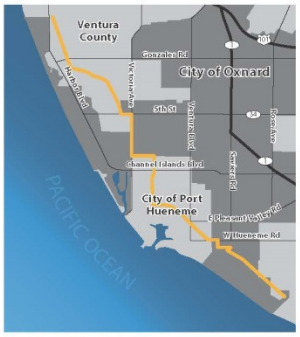
Frequently Asked Questions

What is a Local Coastal Program (LCP)?
LCPs are basic planning tools used by local governments to guide development in the Coastal Zone, in partnership with the Coastal Commission. Each LCP has two components, a Land Use Plan (LUP), which outlines policies, and an Implementation Plan (IP), which outlines procedures to implement the LUP policies. LCPs reflect the unique characteristics of each individual local coastal community as well as addressing regional and statewide interests and concerns. Following adoption of an update to a certified LCP by a City Council, it is submitted to the Coastal Commission for review for consistency with Coastal Act requirements, and ultimately, certification.

Why does the City need to update its LCP?
The Coastal Commission recognizes the need for periodic updates to LCPs statewide. In 1982, the City of Oxnard adopted its Coastal LUP and IP (Chapter 17, Coastal Zoning of the Code of Ordinances). While these governing documents have been amended to address the evolution of coastal planning and the changing needs of the City, neither has undergone a comprehensive update since that time.

The update process will need to bring the LCP into conformance with Coastal Commission policy directives and approaches to address climate change adaptation strategies, such as those for sea level rise (SLR). As well, the City adopted its 2030 General Plan in October 2011, which includes goals and policies related to climate change, sea level rise, and the LCP itself. There are also several studies and existing programs that will need to be incorporated into the update, including: 1) restoration and habitat management plans for land owned and managed by The Coastal Conservancy and The Nature Conservancy (TNC) in an around the Santa Clara River and Ormond Beach wetlands; 2) the certified Public Works Plan (PWP) for half of the Channel Islands Harbor (south of Channel Islands Boulevard) which is owned and managed by the Ventura County Harbor Department; and 3) McGrath State Beach Master Plan which calls for relocating McGrath State Beach camping and visitor facilities within the park boundaries. In light of the need to address all of these directives and plans, a comprehensive update of Oxnard's LCP is timely.

How can I participate?
A project website, www.oxnardlcpupdate.com, has been established to give the public opportunities to learn more about the effort and share their ideas. Workshops, meetings and multiple events are planned throughout the 18 month planning process.



For more information visit:
www.oxnardlcpupdate.com

For comments and questions email:
lcpupdate@oxnard.org

TIDEGATE rrm design group EVEREST

II. Physical Setting

Littoral Cell

Oxnard's coastal zone is in the Santa Barbara Littoral Cell, which extends from the Santa Maria River at the north end of Santa Barbara County to the Mugu Submarine Canyon (Figure II-1). The South Region of the Santa Barbara Littoral Cell is approximately 22 miles long and extends from the Ventura River to NBVC at Pt. Mugu. The shoreline is oriented more north to south compared to the east-west oriented northern and central region and is adjacent to some of the most densely populated areas in the entire littoral cell. The less developed areas in the region are backed by wind-swept dunes or wetlands. The shoreline characteristics and natural supply of sediment in this region are defined by the Ventura and Santa Clara Rivers, which both drain large watersheds. The Mugu Submarine Canyon is the ultimate sediment sink for the littoral cell because it provides a pathway for sand to deposit into the deep Santa Barbara Basin (Beach Erosion Authority for Clean Oceans and Nourishment [BEACON] 2009).

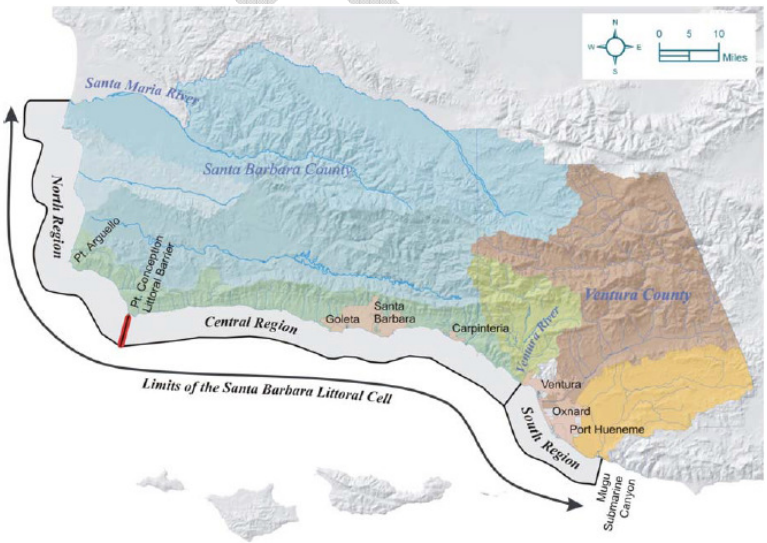


Figure II-1. Santa Barbara Littoral Cell from the Coastal Regional Sediment Management Plan by BEACON (BEACON 2009)

In the South Region, Oxnard is mostly located in the Oxnard Plain Reach, the section between the Ventura River and Port of Hueneme that opens into a broad and low-lying alluvial plain dominated by the Ventura and Santa Clara Rivers, three man-made harbors (Ventura, Channel Islands, and Port Hueneme), and one submarine canyon (Hueneme Submarine Canyon) (BEACON 2009).

The Oxnard shoreline mostly consists of a long and wide sandy coast historically backed by dunes. However, historical development since the late 1800s and mid 1900s has significantly altered the shore as the densely populated shoreline has become dependent upon continued sand bypassing (dredging) across the navigational channels to maintain natural sediment processes and conditions. The creation of Channel Islands Harbor has helped to maintain wide beaches along Hollywood Beach. Channel Islands Harbor was originally built in 1970 partly out of the need to remedy the littoral barrier created by the 1940 construction of Port Hueneme Harbor at the head of the Hueneme Submarine Canyon. Regular sand bypassing at Channel Islands Harbor is now necessary to maintain beaches east of Port Hueneme and, to a lesser extent, at the adjacent Silver Strand Beach (BEACON 2009).

Oxnard's most southern LCP Planning Area, Planning Area 4, is located in the Submarine Canyon Reach. The Mugu Submarine Canyon is the terminus of the reach and the entire Santa Barbara Littoral Cell. The canyon ultimately captures all of the sand transported by waves and longshore ocean currents from points to the west (BEACON 2009).

Sediment Budget

Due to continued monitoring and scientific study of the shoreline processes, information regarding how sediment is delivered to the coast and how it moves alongshore is still improving. In the Santa Barbara Littoral Cell, north of Point Conception, alongshore transport travels predominantly from north to south in response to the prevailing northwest sea and swell from the Pacific Ocean. However, most of the sand does not enter the Santa Barbara Channel due to blocking of the channel by the mountainous coast between Point Arguello and Point Conception.

East of Point Conception, the Channel Islands afford shelter to the east to west-oriented shoreline. Waves entering this narrow Santa Barbara channel swell window causing alongshore sand transport from west to east. This nearly unidirectional sediment current causes all sand between Point Conception and Port Hueneme to end up in the Mugu Submarine Canyon.

Most of the information on alongshore sand movement has been gathered from studying the sand that accumulates at the harbors within the littoral cell, including the Channel Islands Harbor, located in Planning Area 3. All of these harbors are littoral sand traps, and regular dredging is required to maintain sand supply to the downcoast beaches. The annual average volume of sand that is dredged from each artificial harbor indicates the increasing gradient of sand movement along the littoral cell shoreline from west to east:

- Santa Barbara Harbor – 315,000 cubic yards per year
- Ventura Harbor – 597,000 cubic yards per year
- Channel Islands Harbor – 1,010,000 cubic yard per year

Because of this movement from northwest to southeast, Oxnard beaches are relatively stable, meaning there is usually an adequate supply on the beach that can be moved regardless of the duration and intensity of the incident waves. However, harbor dredging and episodic river discharge can alter this sand supply and cause erosion or accretion of the beaches and dunes.

Dredging

Dredging occurs infrequently in Channel Islands Harbor due to the relatively low input of sediment into the harbor. In contrast, the Army Corps of Engineers dredges the harbor mouth channel approximately every two years and deposits the accumulated material on the City of Port Hueneme's beaches (Patsch and Griggs 2009). Without that dredging, the harbor entrance would be partially blocked.

Photo Source: *https://petrolicious.com/articles/jay-leno-buys-city-of-oxnard (Accessed May 8, 2017)*

III. Climate Science

Climate Change

Climate change is any change in the climate over time, whether due to natural variability or as a result of human activity (International Panel on Climate Change [IPCC] 2007). The term "climate change" is often used interchangeably with the term "global warming," but "climate change" is preferred to "global warming" because it helps convey that there are other changes in addition to rising temperatures. The baseline against which these changes are measured originates in historical records identifying temperature changes that have occurred in the past, such as during previous ice ages. The global climate is continuously changing, as evidenced by repeated episodes of substantial warming and cooling documented in the geologic record. The rate of change has typically been incremental, with warming or cooling trends occurring over the course of thousands of years. The past 10,000 years have been marked by a period of incremental warming, as glaciers have steadily retreated across the globe. However, scientists have observed acceleration in the rate of warming during the past 150 years. Per the IPCC (2014), the understanding of anthropogenic warming and cooling influences on climate has led to a high confidence (95 percent or greater chance) that the global average net effect of human activities has been the dominant cause of warming since the mid-twentieth century (IPCC 2014).

Sea Level Rise

Globally, sea levels are rising as a result of two factors related to increasing temperature caused by human-induced climate change. The first factor is the thermal expansion of the oceans. As ocean temperatures warm, the water in the ocean expands and occupies more volume, resulting in a SLR. The second factor contributing to eustatic (global) SLR is the additional volume of water added to the oceans

from the melting of mountain glaciers and ice sheets. It is predicted that if all of the ice were to melt on Earth, ocean levels would rise by approximately 220 feet above present-day levels. The rate at which it rises will largely depend on the feedback loop between the melting of the ice, which changes the land cover from a reflective ice surface, and the open ocean water, which absorbs more of the sun's energy and increases the rate of ice melt.

The global rate of SLR is currently 3.2 mm/year. When global SLR is combined with the relative (or local) SLR that is caused by the vertical land motion (uplift or subsidence), local SLR is often higher than the global rate. Additionally, a considerable amount of groundwater extraction occurs in Oxnard, causing subsiding of Oxnard's coastal area. Therefore, the relative rate of SLR in Oxnard is likely larger than the global average.

Planning Horizons

This study evaluates a range of SLR scenarios consistent with the intent of the CCC (2015) adopted guidance on SLR, the National Research Council (2012), and the U.S. Army Corps of Engineers (2011). 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 (NRC, 2012), the sea level rise 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 sea level rise scenarios. The specific scenarios used in the modeling are shown in Table 1 and reflect projected low, moderate, and high levels of SLR for 2030, 2060, and 2100 (ESA PWA 2013).

Based on feedback from the agency meetings, this study evaluated the impacts of the high SLR scenario only to estimate the "worst-case" impacts of SLR. The SLR scenarios in Table 1 are from *Coastal Resilience Ventura* (ESA PWA 2013), which drew information from both reports by the National Research Council (2012) US Army Corps of Engineers (2011). The medium and high projections in Table 1 report are from the National Research Council 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 subsiding 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.

It is important to note that due to the timing of the analysis, the SLR scenario elevations may be a minor underestimate based on the current best available science, resulting in minor underestimates of vulnerabilities within Oxnard's coastal zone.

Table 1 reflects the projected low, moderate, and high levels of SLR for 2030, 2060, and 2100; however, only the high level was used.

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

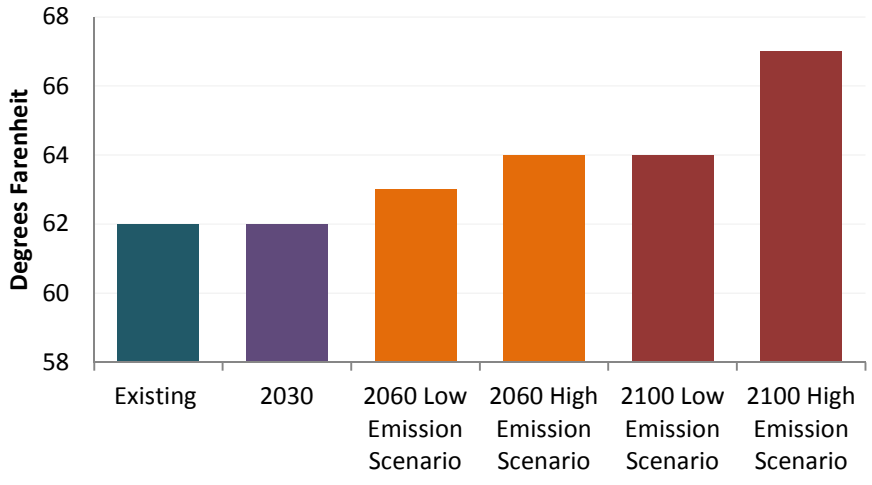
Future Climate Projections

Temperature

Temperature increase, one of the primary impacts of climate change, is caused by the increase in greenhouse gases in the atmosphere, which traps more heat. Temperature changes can cause health risks associated with increases in extreme heat days, increase the length of warm period heat waves, increase the length of droughts, and force species to move from existing habitats to more suitable, cooler habitats. Rainfall patterns will change and vary regionally, with winter and spring rainfall in the northern United States expected to rise and rainfall in the Southwest, including California, to decrease, particularly in the spring. Even as overall precipitation in the southwest is projected to decrease, the number of heavy rainfall events is anticipated to increase (Walsh et al. 2014).

Overall temperatures are expected to rise throughout this century. During the next few decades, scenarios project average temperature to rise between 1 and 2.3 degrees Fahrenheit (°F). Oxnard has already experienced an approximate 1.0°F increase compared to the end of the last century (i.e., 1961-1990). This change in temperature is projected to increase another 1.0°F by 2060 and another 2°F to 5°F increase in 2100. Currently, the average annual temperature for Oxnard is approximately 62°F. The temperature typically is in the 50°F range in the winter and in the 70°F in the summer. As climate change is predicted to intensify these extremes on both ends of the temperature spectrum, the average temperature is not expected to change considerably over the next 20 years. The average temperature is expected to increase to 64°F by 2060 (CEC 2009).

Figure III-1. Projected Changes in Temperature (Decadal Average) (CEC 2009)



Precipitation Changes

Changes in precipitation patterns will affect public health primarily through extreme events such as floods, droughts, and wildfires. In addition, higher temperatures combined with changes in precipitation patterns create conditions that are more conducive to the occurrence and spread of infectious diseases. On average, the projections show little change in total annual precipitation in California. Furthermore, precipitation projections do not show a consistent trend during the next century. However, even modest changes would have a significant impact because California ecosystems are conditioned to historical precipitation levels and water resources are nearly fully utilized.

Oxnard has had an average rainfall of 15 inches, which is 85 percent less than the average nationwide (30 inches per year) and 39 percent less than the average in California (23 inches per year) (CEC 2009). However, the range of annual rainfall can vary from as little as 10.5 to 17.8 inches in 2016/17 (National Oceanic and Atmospheric Administration [NOAA] 2017). Average rainfall in Oxnard is predicted to decline to approximately 2 inches per year by 2060 (CEC 2009). This decrease in annual precipitation is not expected to have a significant impact on Oxnard, due to the limited amount of water it already receives and the variability of the project rainfall amounts.

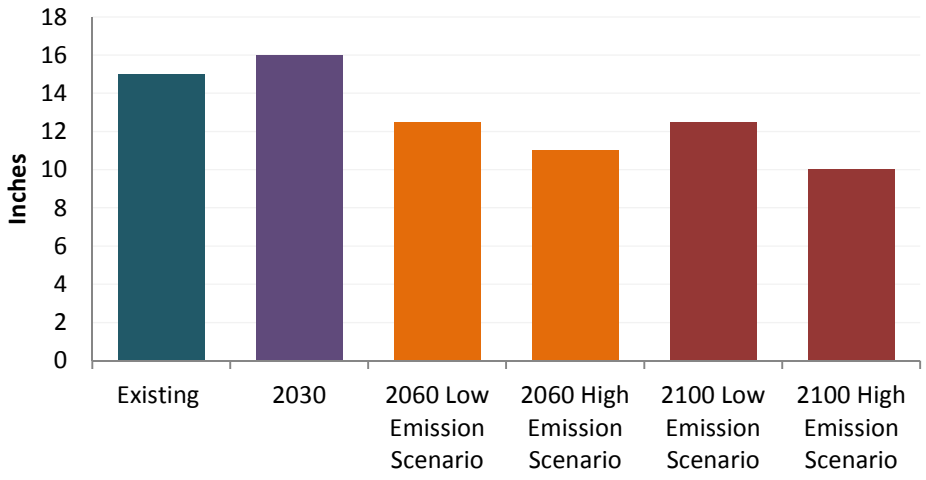


Figure III-2. Projected Changes in Precipitation (Decadal Averages) (CEC 2009)

Regional Scientific Initiatives

The Nature Conservancy's 2015 Coastal Resiliency Project

The Coastal Resiliency Mapping Tool by TNC has been developed for geographies around the world to visualize the extent and magnitude of SLR and coastal hazards. The web mapping application (maps.coastalresilience.org/California) provides an interactive visualization tool. This tool allows users to explore the risks of different scenarios of coastal hazards—such as SLR, storm surges, and inland flooding—at a variety of spatial scales.

Ormond Beach Restoration and Public Access Project

Ormond Beach is one of the few areas in southern California with an intact dune-transition zone–marsh system. However, over the past century agriculture and industrial uses near the beach have drained, filled, and degraded the area wetlands and other habitat.

Photo Source: *http://www.vcstar.com/story/news/special-reports/outdoors/2017/03/14/snowy-plovers-getting-ready-mate-ormond-beach/99146590/ (Accessed May 8, 2017)*

The Coastal Conservancy has completed a wetlands restoration feasibility study for Ormond Beach and adjoining wetlands that shows how this area could be restored and linked hydrologically and as an ecosystem. The 2009 study includes baseline recommendations that address habitat needs of the coastal landscape ecosystem, habitat needs of special status species, water supply and quality issues, mitigation of contaminants, wetland restoration alternatives, priority and timing of restoration activities, public access and interpretive center opportunities, and costs for restoration and management. In 2011, the City adopted its 2030 General Plan, with GOAL CD-22 (Environmentally sound Ormond Beach wetlands with appropriate public access) and implementing Policies CD 22.1 (Participation in the Ormond Beach Wetlands Restoration Plan) and CD-22.2 (Develop an Ormond Beach Visitor Access Plan) (Coastal Conservancy 2016).

Since then, TNC and the Coastal Conservancy continue to monitor Ormond Beach conditions, negotiate to purchase additional land, monitor ESA-listed bird nesting sites, and seek funding for additional research and studies. The Coastal Conservancy, TNC, and the City of Oxnard are now preparing an Ormond Beach Restoration and Public Access Plan. The City intends to adopt a Local Coastal Program that would permit issuance of a CDP for a comprehensive wetlands restoration with appropriate visitor access.

COSMOS 3.0

The Coastal Storm Modeling System of the United States Geological Survey (CoSMoS 3.0) is focusing coastal hazard modeling on the area between Point Conception and the U.S.–Mexico border. The aim is to provide region-specific, consistent information on coastal storm and SLR scenarios. The model uses downscaled global climate models and considers factors such as long-term coastal shoreline change,

stream inputs, dynamically downscaled winds, and varying SLR scenarios to produce hazard projections, accounting for various planning horizons and risk tolerance. It is intended to support policy and planning through usage in vulnerability assessments, hazard mitigation plans, and LCPs and by providing data for other shoreline change or hazard models in the region. However, CoSMoS does not include the effects of maximum wave run-up in its analysis (i.e., the full extent of water that could be carried inland by waves). In some cases, the incorporation of maximum wave run-up could result in a six foot difference in elevation of waves along the shore. Therefore, the extent of the coastal hazard area predicted by CoSMoS is generally less compared to the results in this analysis. Also, because Oxnard's coastal infrastructure (houses, roads, buildings, etc.) are in close proximity to shore, the effects of wave run-up can be severe. Consequently, the results of this analysis are more conservative and provide a more suitable "worst-case scenario" compared to the results of the CoSMoS analysis.

Ocean Protection Council

On April 26, 2017, the OPC released *Rising Seas in California: An Update on Sea-Level Rise Science*, which was produced by a Working Group of the California Ocean Protection Council Science Advisory Team (OPC-SAT) and supported and convened by the California Ocean Science Trust. This report will help guide the update of the State's Sea Level Rise Guidance and in turn help state and local agencies incorporate sea level rise into their programs, policies, and decision-making. The report summarizes the latest in sea level rise science and projections, based on different greenhouse gas emission scenarios and including the potential impacts on California from rapid ice loss from the Antarctic ice sheet.

The report suggests that evaluating the impacts of sea level rise will be varied and depend on many factors including selecting the appropriate sea level rise projection for the project. This will depend on location, project type, life span, adaptability, and economic costs. The final sea level rise guidance document will be presented to the OPC for approval at its January 2018 meeting.

FEMA Flood Insurance Rate Map Updates

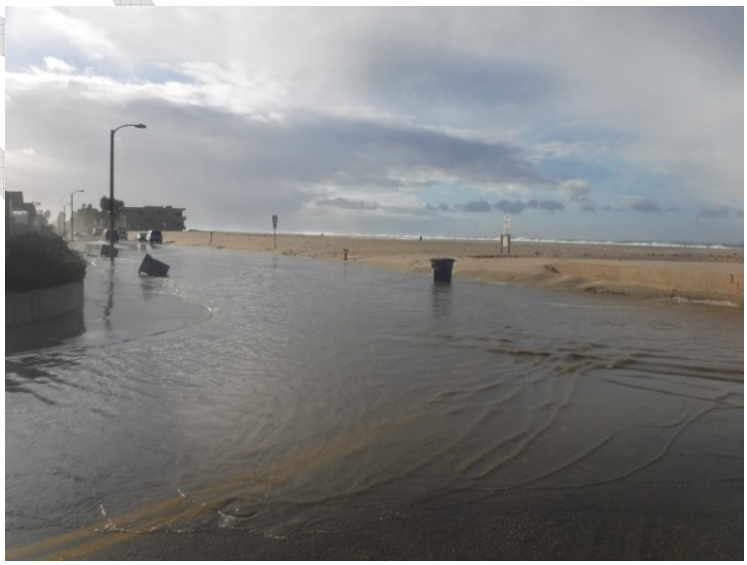
Federal Emergency Management Agency (FEMA) is currently updating the Pacific Coastal Flood Insurance Rating Maps (FIRM) flood maps for FEMA Region IX. The California Coastal Analysis and Mapping Project is conducting updates to the coastal flood hazard mapping with best improved science, coastal engineering, and regional understanding. Specific to the Southern California Bight (the area between Point Conception and the U.S.-Mexico border), the project incorporates regional wave transformation modeling and new run-up methods and will be revising the effective flood insurance rate maps for coastal flood hazard zones. This will include revised VE (wave velocity), AE (ponded water), and X (minimal flooding) zones. The anticipated completion date is 2018. FEMA FIRM maps depict only current hazards without an SLR component.

Photo Source: http://coastalcare.org/2015/09/el-nino-and-la-nina-will-exacerbate-coastal-hazards-across-entire-pacific/ *(Accessed May 8, 2017)*

IV. Existing Coastal Hazards

Coastal Storm Flooding

Flooding is a frequent coastal hazard to the City of Oxnard's coastal zone. Flooding occurs most commonly in the northern area near McGrath State Beach. In recent years, the campground has often been closed to the public because of shallow flooding caused by high water levels in the estuary (Stillwater Sciences 2011). Flooding also occurs in the Oxnard Shores area in Planning Area 2 during major storm events. See photo on right.



Coastal Storm Flooding at Fifth Street and Mandalay Beach Road

Erosion of Dunes

Photo Source: http://www.lbknews.com/tag/beach-erosion/ *(Accessed May 8, 2017)*

The Oxnard shoreline was historically backed by dunes. However, development since the late 1800s and mid-1990s caused a large removal of the dunes for development of homes, agriculture, and Channel Islands Harbor. Dune erosion in areas with remnant dunes is particularly an issue in the coastal zone near the NRG MBGS facilities. A vulnerability study of the NRG MBGS was completed in 2015 by Dr. David Revell for the City of Oxnard. The study found that by 2030 coastal erosion has the potential to occur near the MBGS. By 2060 and with influence of SLR, these impacts are expected to intensify, making the MBGS power plant site more susceptible to erosion, flooding, and wave impacts. The study also states that any efforts to provide coastal armoring to the MBGS site would cause the shoreline and existing beach front to erode.

Photo Source: https://roadtrippers.com/regions/oxnard-ca/things-to-do *(Accessed May 8, 2017)*

V. Vulnerability Assessment Methods

This mapping of coastal hazards integrated with SLR scenarios is primarily based on *Coastal Resilience Ventura: Technical Report for Coastal Hazards Mapping* (ESA PWA 2013). Information on three coastal processes: 1) monthly spring tide inundation, 2) erosion (existing), and 3) coastal storm floods, were extracted from that report and mapped over the entire city. Hazard zones for each of these coastal processes were developed for three planning horizons: 2030, 2060, and 2100. For the coastal storm wave flood hazard, flood extents were extracted from *Coastal Resilience Ventura*, while flood depths were interpreted from the spatial extents by Revell Coastal using simplifying assumptions of 3-foot water depth for the high velocity wave zones that were then escalated with SLR. The existing and future coastal hazard modeling methods and assumptions are summarized below. For more information, readers are encouraged to review the technical documentation included in *Coastal Resilience Ventura: Technical Report for Coastal Hazards Mapping* (ESA PWA 2013).

This report provides a summary of the vulnerability of Oxnard's coastal resources by sector under three different coastal hazard scenarios and the combined hazard scenario, which includes the maximum extent of hazards caused by rising tide inundation, coastal erosion, and coastal storm flooding. The sectors include coastal access, infrastructure, hazards, and land uses such as open space, power plants, residential, commercial, municipal, and Channel Islands Harbor. Hazard scenarios were overlaid onto a variety of geographic data from these sectors to analyze the impact from the different coastal processes at the varying planning horizons. The resulting amounts of impacted variables pertain to only the time horizon described and are, therefore, not cumulative.

The combined hazard scenario includes the maximum extent of hazards caused by rising tide inundation, coastal erosion, and coastal storm flooding.

Coastal Hazards

The following hazard descriptions are from *Coastal Resilience Ventura: Technical Report for Coastal Hazards Mapping* prepared for TNC by ESA PWA (2015). Please refer to the report for more details.

Rising Tide Inundation Zone

Tidal inundation modeling represents the Extreme Monthly High Water level (EMHW, similar to a King Tide). This monthly elevation is estimated by averaging the maximum monthly water level for every month recorded at the Rincon Island tide gauge (EHW = 2.0 meters NAVD8864) averaged from the maximum monthly water level from the Rincon Island tide gauge (EMHW = 6.56 ft NAVD88 or 9.3 ft MSL) and is applied to each SLR scenario. SLR projections were added to the EHW for each SLR and planning horizon and mapped over the 2009–2011 California Coastal Conservancy Digital Elevation Model (DEM). This analysis is intended to represent areas that may be inundated at least on a monthly recurrence. The hydraulic conveyance (flow rate and volume) through the connections (e.g. culvert) were not modeled, and hence these are potential flood limits.

Coastal Erosion Hazard Zone

Erosion hazard zones were developed using methods described in the Pacific Institute 2009 study, with the backshore characterization as the main input. The most important variables in this model are the backshore toe elevation and the total water level. This study used an erosion level that combines the existing erosion rates with the projected high sea level scenario. For more details about the methods please see the complete Pacific Institute study (Pacific Institute 2009 and Revell et al 2011).

Coastal Storm Flood Hazard Zone

This hazard zone maps two types of flooding caused by coastal processes: flooding caused by storm waves rushing inland and flooding due to ocean storm characteristics such as storm surge (a rise in the ocean water level caused by waves and pressure changes during a storm). The zones were developed using representative wave conditions based on observed historical events most notably the storm of record, the January 1983 wave event, with added SLR. This hazard zone also takes into account areas that are projected to erode in the future, sometimes leading to additional flooding through new hydraulic connections between the ocean and low-lying areas.

Combined Hazards

For each planning horizon, all three projected hazards were combined into a single layer using a process called “spatial aggregation” (ESA PWA 2013). This layer represents the overlap in all of the hazard zones and shows how many of the various SLR scenarios impact specific areas during a specific planning horizon. For example, an area mapped under three scenarios indicates that the area was hazardous during that planning horizon for all scenarios.

---

[4] Extreme High Water is approximately 36 cm (14 inches) above Mean Higher High Water (the daily average of the highest tides) at the Rincon Island tide gauge.

Analyses Not Included

Hazards

Coastal wave impact area was not evaluated explicitly as it is a component of the coastal storm hazard zone. This hazard area is somewhat analogous to the FEMA V zone where the dominant hazard is wave momentum. This is the zone where water could potentially rush inland due to waves breaking at the coast and damage structures, move cars, and knock people off their feet.

Fluvial 100-year storm floodplains as estimated in *Coastal Resilience* are future 100-year floodplains for the Santa Clara River and Ventura River, based on hydraulic modeling driven by future run-off projections and increasing SLR. The future run-off projections were derived using downscaled climate models (ESA PWA 2013). Fluvial 100-year storm floodplains were not incorporated due to a levee that will be built on Santa Clara River (SRC-3); Phase I to be complete in February 2018 and Phase II to be complete in June 2019. The levee will extend from US 101 to just down southeast of Victoria Avenue and will largely reduce the amount of flooding that is projected to occur near the Wagon Wheel and River Ridgearea of Oxnard.

Saltwater Intrusion

Sea level rise can increase saltwater intrusion into groundwater aquifers. Saltwater intrusion into groundwater aquifers can increase treatment costs for drinking water facilities or render groundwater wells unusable. The potential effects of saltwater intrusion that could occur were not evaluated but will be taken into consideration during the LCP update process.

Shoreline Protection

The Oxnard coast does not contain any shoreline protection devices (e.g. seawalls, revetments, jetties) except for the jetty that protects the Channel Islands Harbor in Planning Area 3. Because the rate of erosion in this area is dependent on how the jetty is maintained, the area at the mouth of harbor was excluded from the erosion hazard zone analysis. Therefore, the predicted extent of the erosion hazard zone in this area is not included in this analysis. The impacts of the maintenance of the jetty should be taken into consideration regarding coastal hazard impacts to the Channel Islands Harbor.

Sediment Delivery

Climate change and other anthropogenic factors may cause changes to sediment delivery to the coast through the Santa Clara and Ventura Rivers. As discussed in Section 2.0 *Physical Setting*, the dredging of the local harbors provides enough sand movement that Oxnard beaches are considered to be relatively stable, meaning there is usually an adequate supply of sediment on the beaches. However, the discontinuation of Harbor dredging and episodic river discharge can alter this sand supply and cause erosion or accretion of the beaches and dunes. Although this was not analyzed in this report, the potential effects of SLR on the local sediment budget will be included in the next steps of the LCP update process.

Elevation Changes

The rising tide inundation zone is modeled by adding each SLR scenario to the average maximum monthly water levels recorded at the Rincon tide gauge, and those water levels are then mapped over

the 2009-2011 Coastal Conservancy Digital Elevation Model (DEM). This method does not account for changes to the DEM that will likely result from erosion (as exacerbated by SLR) over time, therefore likely underestimating the depth and/or geographic extent of inundation. This potential underestimation should be considered during future adaptation planning and LCP policy development.

Expected Updated SLR Projections

During the completion of this analysis *Rising Seas in California-An update on Sea Level Rise Science* was published by the California Ocean Protection Council Science Advisory Team Working Group (2017). The report points out potential updates to be expected in future sea level rise projections. *Rising Seas* synthesizes developing research on the potential contribution of ice sheet melt to SLR projections and predicts this could cause potential increases of SLR scenarios of up to 10 feet. Due to this and other factors, this developing research may cause the State of California to update its recommended SLR projections for use in vulnerability assessments.

Social Vulnerability

Social vulnerability was not included among the sectors evaluated. Addressing the impacts of SLR on disadvantaged communities is an important planning priority. Social vulnerability will be considered during the next steps of the LCP update process, including the adaptation analyses and LCP policy development.

Uncertainty

As with any economic modeling, the results presented above are based on certain assumptions. This report does not include uncertainty around these assumptions such as the geographic extent of the uncertainty of the hazard extents. To understand the role of each of these assumptions, future analyses will incorporate a sensitivity analysis, which involves applying running the model using a range of values for key parameters to determine how sensitive the model is to changes in that parameter.

Assumptions

Impact Threshold

In order to determine if a coastal resource (e.g. land use, infrastructure, and public access points) were to be impacted by projected coastal hazards, it was assumed that if the extent of the coastal hazard overlapped with any portion of the resource then it would be considered “vulnerable”. Flood depth was only taken in account when discerning economic and fiscal impacts due to projected coastal storm flood hazards. See the

economic methods section below.

Photo Source: *http://www.thegastongroup.com/community/oxnard-beaches/ (Accessed May 8, 2017)*

VI. Economic and Fiscal Impact Analysis Methodology

The economic and fiscal impact analysis prepared for this project was designed to identify the economic value of assets at risk due to coastal erosion and flooding, which is progressively exacerbated by continuing SLR. Understanding current and projected vulnerabilities from coastal hazards is the critical first step a community must take to identify appropriate LCP climate adaptation policies and regulatory strategies. The economic portion of the report evaluated the impacts of three mapped coastal hazards: 1) rising tide inundation zone, 2) coastal erosion hazard zone, and 3) coastal storm flood hazard zone. See *Coastal Hazards* section above for a full description. The analysis included both private and public property. Damage estimates were broken out into various sectors as a way to organize the results and provide direction for LCP coastal policy development. The sector types used in this analysis are:

- Coastal Access/Recreation
- Infrastructure (Roads & Water/Sewer)
- Hazards
- Large-Scale Power Plants
- Residential Property
- Commercial/Industrial Property
- Oxnard Municipal Properties
- Channel Islands Harbor

Where feasible, the market value of land and replacement cost value for structures were used. All values are in 2017 dollars. The analysis aggregates all public and private property.

Methods

Depth of Flooding Determination

The *Coastal Resilience Ventura* modeling did not include depth of flooding estimates except for tidal waters. For coastal flooding, depths were determined using the following assumptions.

- For any parcels inside the wave velocity zone or coastal erosion zone, a depth of 3 feet was assumed based on the cut-off depth of flooding in the FEMA guidelines for high velocity wave zones. (Note that presently the depth damage curves do not make a distinction between standing water and water with momentum, thus these estimates may be conservative.)
- For parcels outside the wave velocity hazard zone but inside the coastal flood hazard zone, the depth of flooding was assigned as 1 foot.
- For each time horizon, the appropriate SLR was added to the depth of flooding. For the time period between existing and 2030, 1 foot was added.
- For the time period between 2030 and 2060, another 1 foot was added (2 feet total if in existing hazard zone).
- For the time period between 2030 and 2060, an additional 3 feet was added (5 feet total if in existing hazard zone).
- If at any time the coastal hazard went from tidal or coastal flooding to wave driven or erosion, then 3 feet was added to the flood depth for that time period.

Private Property (Residential and Commercial)

Escalating the Assessor's Data to Fair Market Value

Coastal flooding and erosion are existing risks to public and private land, structures, and other facilities in Oxnard. Economists and engineers have developed and refined a number of methodologies to assess these risks. The analysis utilized property tax data from Ventura County that contains detailed information for each parcel subject to property tax. This "parcel data" contains detailed information about the size of the parcel, the size of the structure, the type of structure, (e.g., single-family dwelling, multiple-family dwelling). The parcel data was combined with geographic flood/erosion data to analyze flood erosion hazards.

Limitations of Assessor's Data

In California, due to Proposition 13, any increase in the assessed value of the land/structure is capped at 2 percent a year until the parcel is resold. Since the rate of housing inflation in Oxnard has exceeded 2 percent for many years, the original sales price of the parcel—land and structure(s)—was adjusted to reflect current market conditions using a housing price index created for this analysis from local housing sales data. The replacement cost of each structure was estimated per square foot using FEMA's Hazard Guidance files (2006).

Flood damages to structures were estimated by applying the U.S. Army Corps of Engineers (USACE) depth damage curves that estimate damages as a percent of the total value of the structure.

City Properties

A number of non-taxable public properties are listed in the Assessor's database as having both land and improvement value at $0. These public records were reviewed with City staff to determine if these properties could have potential value as a majority of the parcels were undeveloped, open-space parcels. Discussion with City and former City staff indicated that these parcels have remained undeveloped and would likely be undeveloped in the foreseeable future. It was therefore assumed that these public parcels are likely constrained in their opportunity for development. This does not, however, entail that this land holds no economic value.

It was determined that scenic and conservation easements recorded in the Assessor's database were the closest proxy for an undeveloped, open-space parcel. The land values of these property interests were analyzed by referencing previous reports provided by local organizations that had purchased similar land parcels. This resulted in the application of a conservative value per square foot to the non-taxable public parcels. It is assumed that these parcels will remain undeveloped. However, there is a very rare possibility that some of this land could be sold on the open market for a value greatly exceeding the value used in this study.

For public, non-taxable parcels, where no information was available to determine the fair market value of land, a conservative proxy value was determined of $0.30 per square foot by analyzing sale price information from scenic and open space easements in Ventura County. The only exception was a medium-sized parcel in the beachfront residential area that the City confirmed has potential for residential development. Therefore, that parcel was valued at market value for residential land in the same area.

Infrastructure (Including Transportation) and Other Parcels

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. Various parcels associated with infrastructure that were subject to tidal flooding and were also valued as easement property.

Channel Islands Harbor

Economic information for the Channel Islands Harbor was extracted from the Harbor's operating expenses and revenues resulting from current operations such as commercial/recreational boating and commercial leases onsite. The information was then used to estimate the economic impact of Channel Islands Harbor on the region.

Recreational

The primary coastal recreational activity impacted by coastal hazards in Oxnard is the beach activity that occurs at McGrath State Beach and Oxnard Shores beach. Therefore, the current recreational activity at these beaches was estimated. Since campgrounds at McGrath State Beach are already subject to flooding, the State of California has prepared plans to move the sites in the park. The cost estimates provided by State Parks regarding this relocation was used. Economic value of McGrath State Beach and

Oxnard Shores was evaluated based on attendance detailed in the 2009 BEACON report. Impacts to coastal access were evaluated for McGrath State Beach, Oxnard Shores, and Ormond Beach.

Summary of Methods Used

A summary of the methods, sources, and metrics used in this report are provided in Table 2. As previously mentioned, all land was valued at market rates based upon current usage and/or zoning. Infrastructure was valued at replacement cost using the metrics described in Table 2. To estimate the recreational value of beaches, survey data collected by Dr. Philip King for BEACON and other studies completed in California were used. The recreational value of these beaches was estimated using the California Sediment Benefits Analysis Tool (CSAT) developed by Dr. King with the State of California and USACE.

Table 2. Methods, Data Sources, and Metrics Used in this Analysis

Item	Cost/Value	Cost Basis	Source
Erosion Vulnerability	Updated Total Value of parcel	per parcel	Assessors Database
Tidal Flooding Vulnerability	Updated Total Value of parcel	per parcel	Assessors Database
Coastal Flooding Vulnerability	Updated Improvement Value	per building	County Database, Army Corps Depth Damage Curves
Land Easement Valuations	$0.30	per sq. ft. of land	Recent Sales Data
Building Removal	$10/$20	per sq. ft. (single-family/other)	Engineering Reports
Railroads	$1.5 Million	per mile	http://www.acwr.com/
Oxnard Shores Day Use Value	$40.03	per person, per day	CSBAT/Benefits Transfer Model
McGrath Day Use Value	$40.03	per person, per day	CSBAT/Benefits Transfer Model
Avg. Day Trip Spending	$8.10	per person, per day	Beach Survey Data
Avg. Overnight Trip Spending	$25.25	per person, per day	Beach Survey Data
Road Replacement	$135	per foot	Engineering Reports
Road Removal	$4	per foot	Engineering Reports
Sewer Mains Replacement	$130	per foot	Rincon Consultants
Sewer Mains Removal	$20	per foot	Engineering Reports
Sewer Lift Station Replacement	$450,000	per station	Rincon Consultants
Sewer Lift Station Removal	$1,000	per station	Engineering Reports
Storm Drain Manholes	$150	per manhole	Engineering Reports
Water Main Replacement	$130	per foot	Rincon Consultants
Water main Removal	$20	per foot	Engineering Reports
Halaco Migration	$1,839,700	total	https://yosemite.epa.gov/
McGrath Campsite	$11,503,587	total	CA State Parks

Item	Cost/Value	Cost Basis	Source
Relocation			

Sectors Not Included In the Analysis

Specific Ecosystems/ESHA

The vulnerability of the Environmentally Sensitive Habitats (ESHA) was not included in the analysis. This is partly due to the fact that ESHA habitats may be less vulnerable if they can evolve in response to climate change and coastal hazards through time. The City is already working to restore certain ESHA areas and provide adaption mechanisms for SLR. For example, as described in Section I Background, the Coastal Conservancy, TNC and the City own and manage a large portion of the Ormond Beach coastal area and are preparing a restoration and public access plan. A goal of the restoration is to accommodate inland migration of wetlands and other habitat (California Coastal Conservancy 2015 and 2016). Vulnerability of ESHA was also not included in this analysis because wetlands are suited for some level of inundation and therefore it is difficult to determine the level of inundation that is harmful to the wetland area. It is important to note that restoration of Ormond Beach will provide SLR mitigation in the form of a natural buffer for a large portion of the Planning Area 4 that exists inland of Ormond Beach. This would reduce the SLR impacts and site-specific mitigation for other infrastructure in the planning area such as Halaco, OBGS, and the industrial properties.

Natural Gas Pipelines and Oil Wells

Natural gas pipelines and oils wells were also not included in the analysis due to the unavailability of the data and the sensitivity of the information.

Photo Source: *http://www.panoramio.com/user/1151480 (Accessed May 8, 2017)*

VII. Vulnerability and Fiscal Impacts by Sector

Coastal Access

Oxnard's coastal zone offers a variety of ways to access the beach and water areas. This analysis includes existing access points, proposed access points, land dedicated to hotels, public parking spaces, existing beaches, and proposed public beaches and parks. Existing beaches are the current designated beaches for which the acreage was estimated from the ESHA Coastal Dune/Beach designation. Therefore, impacts to coastal access were evaluated for McGrath State Beach, Oxnard Shores, and Ormond Beach. The proposed beaches and parks included the site where the relocation of the McGrath State Beach campgrounds is proposed.

Potential beach access points referenced in the McGrath State Beach Relocation Feasibility Study are included in Planning Area 1. Potential access points surrounding the Mandalay County Park include a privately proposed boardwalk trail connecting to the proposed Northshore residential development that would extend through the dune area to the beach, pending to approval by State Parks and the City of Oxnard. Lastly, a potential access point in Planning Area 4 was included to enhance access from public facilities existing in Port Hueneme, adjacent to Ormond Beach.

Table 3 shows the vulnerability of each type of coastal access resource included in this study under the combined hazards scenario as well as hazards caused by rising tide inundation, coastal erosion, and coastal storm flood. Most of the impacted coastal access areas are projected to be impacted by the 2030 planning horizon. In the case of coastal erosion impacts to coastal access, it was assumed that the

back of the beach would not migrate inland and therefore, impacted access points would not be able to migrate inland and would be vulnerable and/or lost. It should be noted that some beach loss due to coastal erosion could potentially be prevented by allowing the back of the beach to migrate inland, thus slowing or halting beach width loss. However, bach migration may also result in other land use changes such as loss of agriculture land and residential development. Due to the complexity of this issue, the option of beach migration inland as an adaptation strategy was not evaluated in this study but will be considered during the adaptation planning and policy development process.

Table 3. Vulnerability of Coastal Access Resources by Coastal Hazard and Planning Horizon

Hazard Zones	Planning Horizon	Existing Access Points (No.)	Potential Access Points (No.)	Coastal Dune/ Beach (ESHA) (Acres)	Hotel Parcels (No.)	Public Parking Areas (Acres)
Total in City		35	6	584	19	NA[5]
All Hazard Zones Combined	**2030**	**29**	**4**	**508**	**0**	**4**
	2060	**35**	**4**	**527**	**2**	**9**
	2100	**35**	**5**	**547**	**2**	**15**
Rising Tide Inundation Zones	2030	3	0	81	0	0
	2060	3	0	94	0	1
	2100	6	1	204	1	4
Coastal Erosion Hazard Zones	2030	21	2	442	0	0
	2060	32	2	453	1	1
	2100	33	2	463	1	2
Coastal Storm Flood Hazard Zones	2030	29	4	508	0	4
	2060	35	4	527	2	9
	2100	35	5	547	2	15

Figures VII-1 – VII-8 provide maps showing the vulnerability of each type of coastal access resource included in this study under each planning horizon and the three different hazards scenarios.

[5] The number of parking spaces within the hazard area were digitized for this report and consequently, information regarding the total number of parking spaces for the entire City was not available.

Figure VII-1. Vulnerability of Coastal Access Resources in Planning Area 1 by Planning Horizon

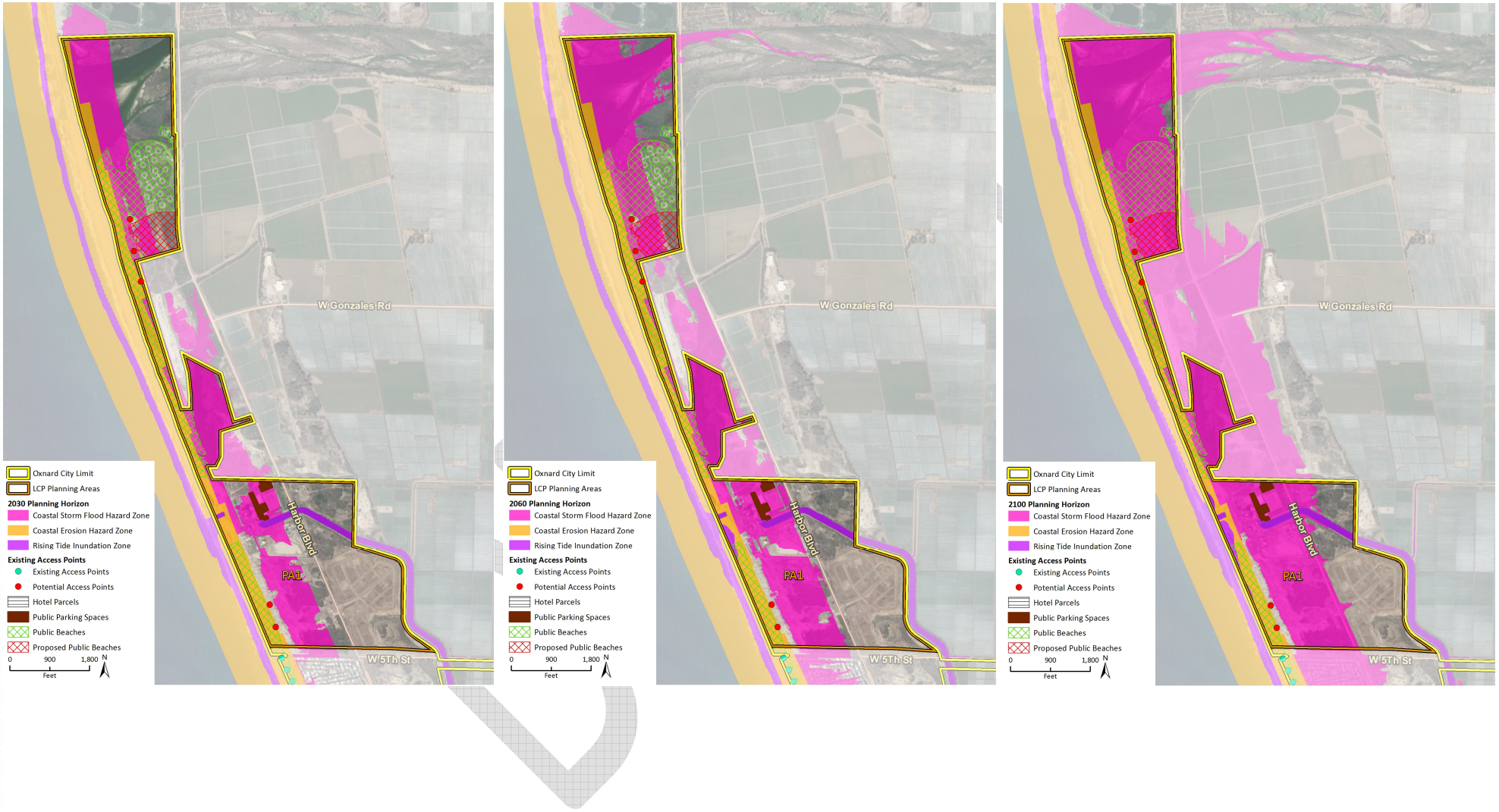


Figure VII-2. Vulnerability of Coastal Access Resources in Planning Area 1 by Coastal Hazard

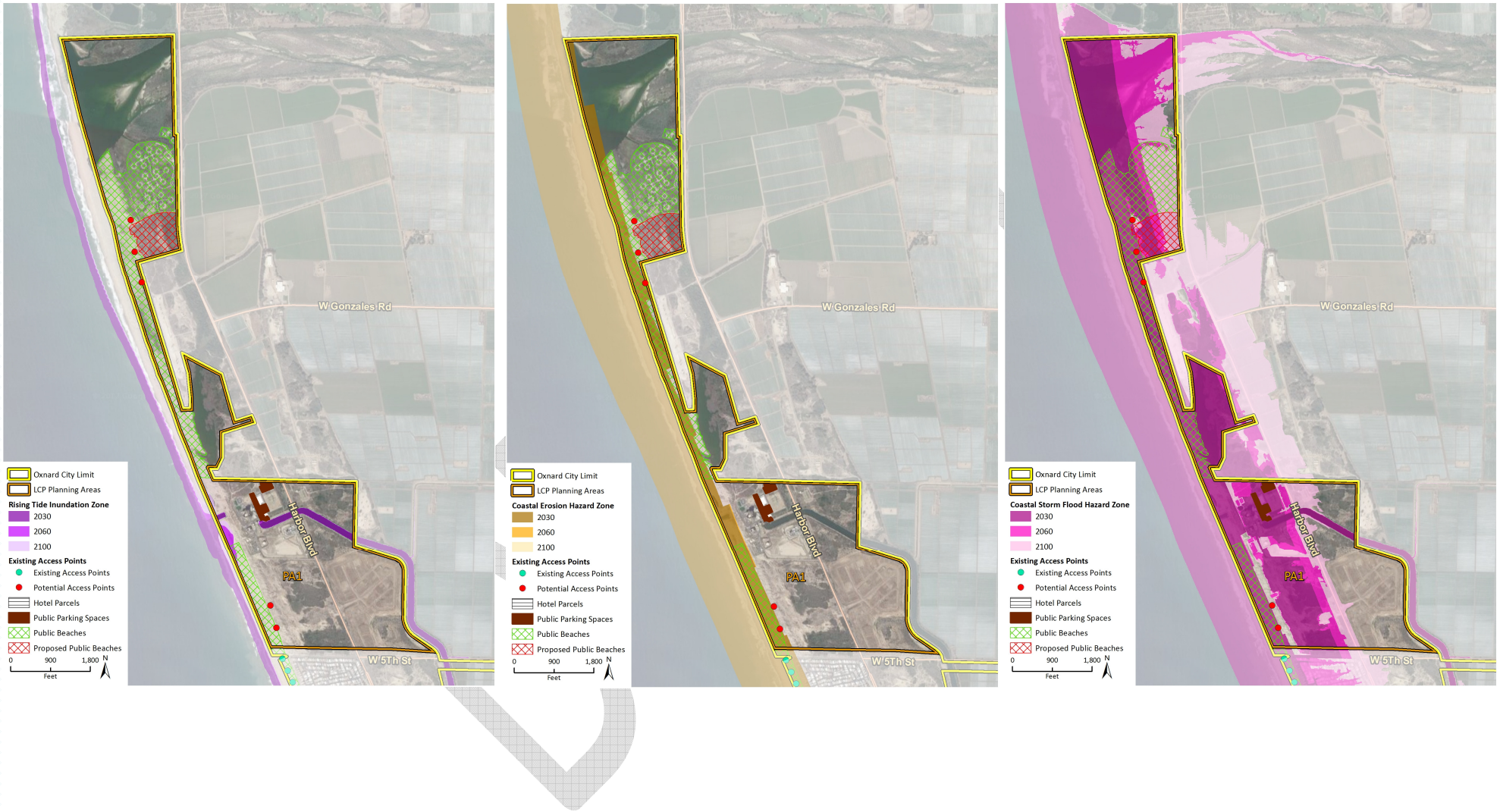


Figure VII-3. Vulnerability of Coastal Access Resources in Planning Area 2 by Planning Horizon

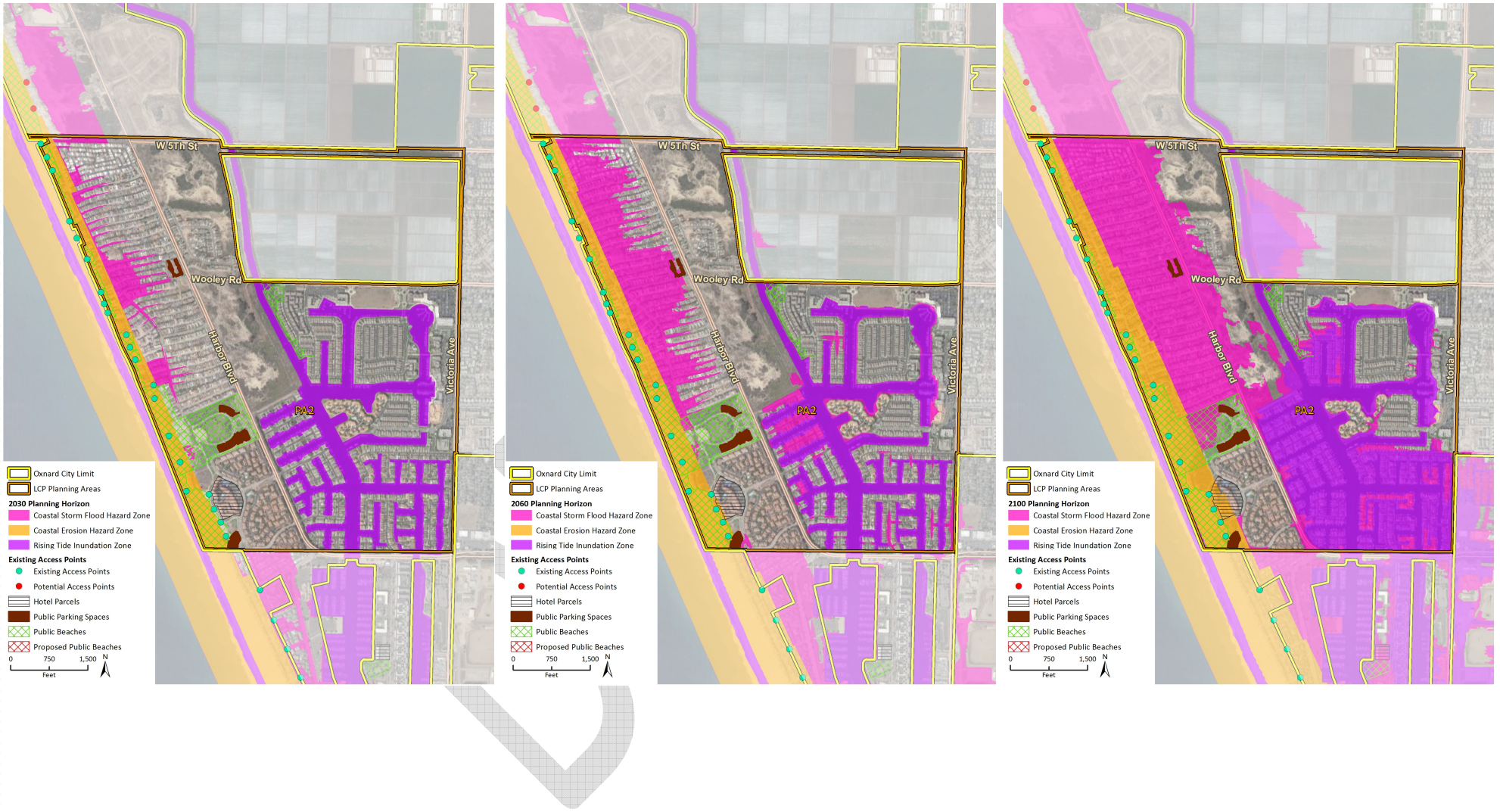


Figure VII-4. Vulnerability of Coastal Access Resources in Planning Area 2 by Coastal Hazard

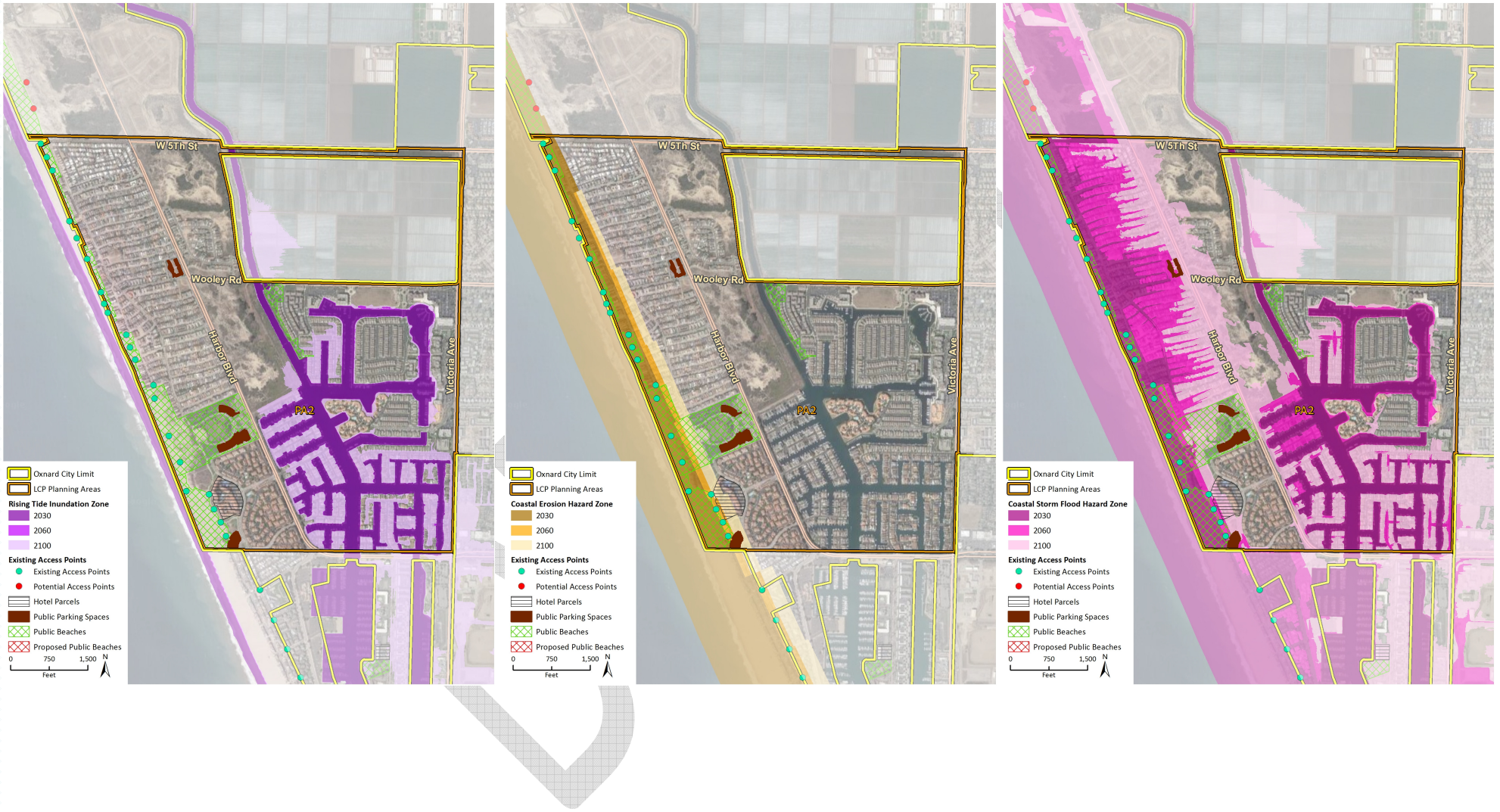


Figure VII-5. Vulnerability of Coastal Access Resources in Planning Area 3 by Planning Horizon

Figure VII-6. Vulnerability of Coastal Access Resources in Planning Area 3 by Coastal Hazard

Figure VII-7. Vulnerability of Coastal Access Resources in Planning Area 4 by Planning Horizon

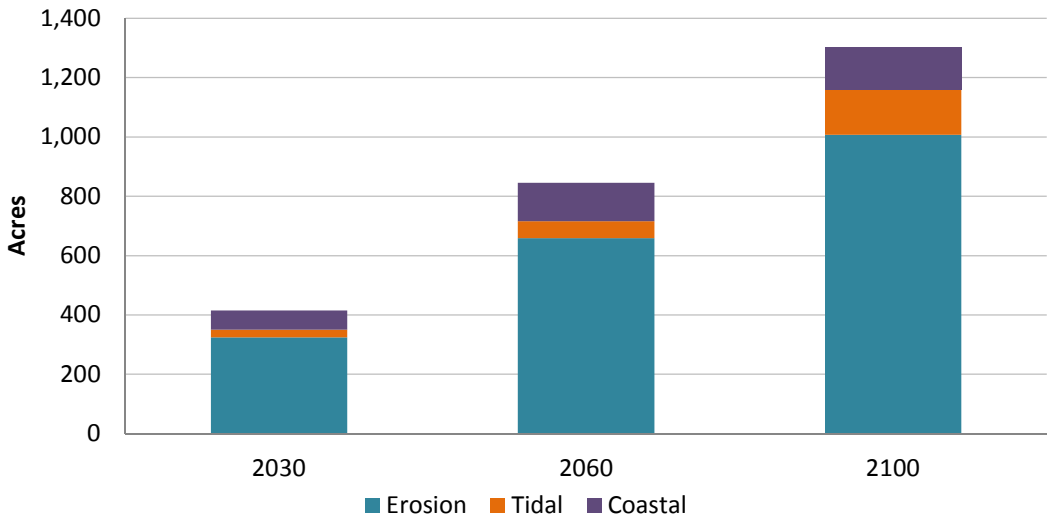
Figure VII-8. Vulnerability of Coastal Access Resources in Planning Area 4 by Coastal Hazard

As part of this analysis, the two most frequented beaches in the city, McGrath State Beach and Oxnard Shores, were evaluated. Both beaches generate a significant amount of economic and recreational value to local businesses and beach visitors, respectively. The primary data utilized to evaluate beach recreation is contained in a 2009 report prepared for BEACON, which included McGrath State Beach and Oxnard Shores. Due to the date the report was published, spending and recreational values were updated to account for inflation. It was also assumed that attendance would increase at the same rate as population and employment increases in Ventura County (approximately 10 percent higher compared to 2009 values). Table 4 presents the number of access points and amount of beach acres that will be impacted by coastal hazards. Figure VII-9 presents acres of beach that will be lost due to erosion as well as coastal and tidal flooding.

Table 4. Beach Access Points and Acres Impacted

Year	Existing Access Points	Potential Access Points	Proposed Public Beaches (acres)	Public Beaches (acres)
2030	28	5	72	415
2060	62	10	159	846
2100	96	15	255	1,304

Figure VII-9. Beach Area Losses due to Erosion, Tidal, and Coastal Flooding by Planning Horizon



	2030	2060	2100
Erosion	324	658	1,007
Tidal	26	58	153
Coastal	65	130	144
Total	**415**	**846**	**1,304**

The economic value of beach recreation at McGrath State Beach and Oxnard Shores was also updated based on the 2009 BEACON report and is presented in Table 5.

Table 5. Yearly Economic Value of McGrath and Oxnard Shores Beaches

Reach	Day Use Value	Recreation Value	Local Spending
Oxnard Shores	$15.77	$2,201,500	$1,646,002
McGrath	$15.39	$2,202,300	$1,686,600

Since McGrath Beach is already subject to coastal and estuary tidal flooding, plans to relocate park campgrounds are in place. California State Parks has estimated that campground relocation will cost approximately $11.5 million (City of Ventura 2014).

Additionally, the tax revenue impacts of beach tourism for the City of Oxnard were estimated based on beach-related spending patterns derived from updated BEACON survey data and are shown in Table 6.

Table 6. Yearly Tax Revenue Generated for the City of Oxnard at Oxnard Shores and McGrath State Beach

Tax Type	Tax Rate	Oxnard Shores	McGrath Beach
Sales Tax: City	0.50%	$3,200	$3,200
Sales Tax: County	0.25%	$1,600	$1,600
Sales Tax: State	6.0%	$38,900	$38,900
Sales Tax: Special	1.0%	$6,500	$6,500
Trans. Occ. Tax	12.0%	$16,700	$16,700
Total		$66,900	$66,900

Both beaches are equally utilized and generate equal amount of yearly tax revenue. However, tax revenue generated by Oxnard Shores goes to the City, while tax revenue generated by McGrath State Beach goes to California State Parks.

Infrastructure

Since residents depend on the functionality of the City's infrastructure, vulnerability of infrastructure in is a priority for the City and other associated agencies. The infrastructure included in this analysis includes roads, sewers, storm drains, water mains, and communication towers.

Table 7 shows the vulnerability of each type of infrastructure included in this study by coastal hazard and planning horizon.

Table 7. Vulnerability of Infrastructure by Coastal Hazard and Planning Horizon

Hazard Zones	Planning Horizon	Comm Towers (No.)	Roads (miles)	Sewer Force Mains (miles)	Sewer Gravity Mains (miles)	Sewer Network Structures - Lift Stations (No.)	Sewer Network Structures - Floor Drain (No.)	Sewer Network Structures - Grease Traps (No.)	Storm Drain Manholes (No.)	Storm Drain Outfalls (No.)	Water Mains (miles)
Total in City		84	595	18	389	45	5	20	2161	18	585
All Hazard Zones Combined	**2030**	**1**	**12**	**1**	**5**	**3**	**0**	**0**	**28**	**18**	**5**
	2060	**2**	**22**	**1**	**11**	**5**	**0**	**0**	**37**	**18**	**12**
	2100	**4**	**38**	**3**	**23**	**13**	**0**	**0**	**68**	**18**	**25**
Rising Tide Inundation Zones	2030	0	1	0	0	0	0	0	4	12	0
	2060	0	1	0	0	0	0	0	7	12	1
	2100	1	14	1	10	5	0	0	26	14	9
Coastal Erosion Hazard Zones	2030	1	3	0	1	0	0	0	3	8	1
	2060	1	4	0	2	0	0	0	7	8	2
	2100	1	7	0	4	1	0	0	17	8	4
Coastal Storm Flood Hazard Zones	2030	1	12	1	5	2	0	0	28	18	5
	2060	2	22	1	11	3	0	0	37	18	12
	2100	4	38	3	23	11	0	0	68	18	25

Figures VII-10 through VII-17 show the location of the various types of infrastructure in Oxnard. Due to the extensive amount of sewer and water mains in the city, the figures only show the larger (> 20-inch diameter) pipelines. Impacts to infrastructure from SLR mainly occur in the coastal zone and outside the coastal zone near the Santa Clara River. Larger pipelines (having a diameter of 20 inches or more) exist in Planning Area 4 and would be susceptible to coastal hazards starting in 2060, with more impacted by 2100. Various types of infrastructure outside of the coastal zone but inside the city boundary near the Santa Clara River would be impacted by 2060.

Coastal flooding of the city's sewer network can cause drainage systems to back up citywide. Even though the analysis includes the vulnerability of infrastructure outside of the coastal zone, it is limited to the coastal hazard area and does not take into account indirect effects of coastal flooding to the citywide drainage system.

Discussion of the potential impacts to Oxnard's power plants is discussed in the *Large-Scale Power Plants* section.

Figure VII-10. Vulnerability of Infrastructure in Planning Area 1 by Planning Horizon

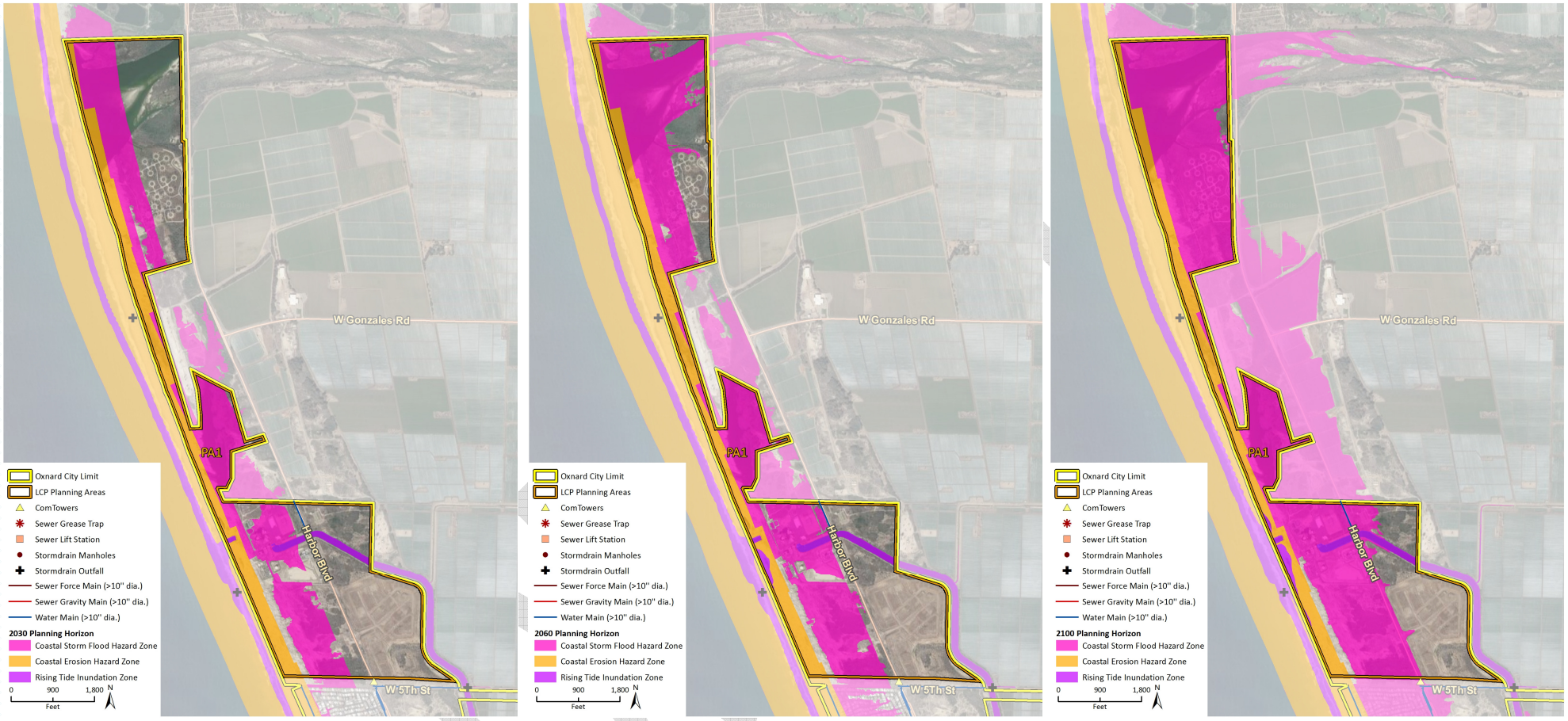


Figure VII-11. Vulnerability of Infrastructure in Planning Area 1 by Coastal Hazard

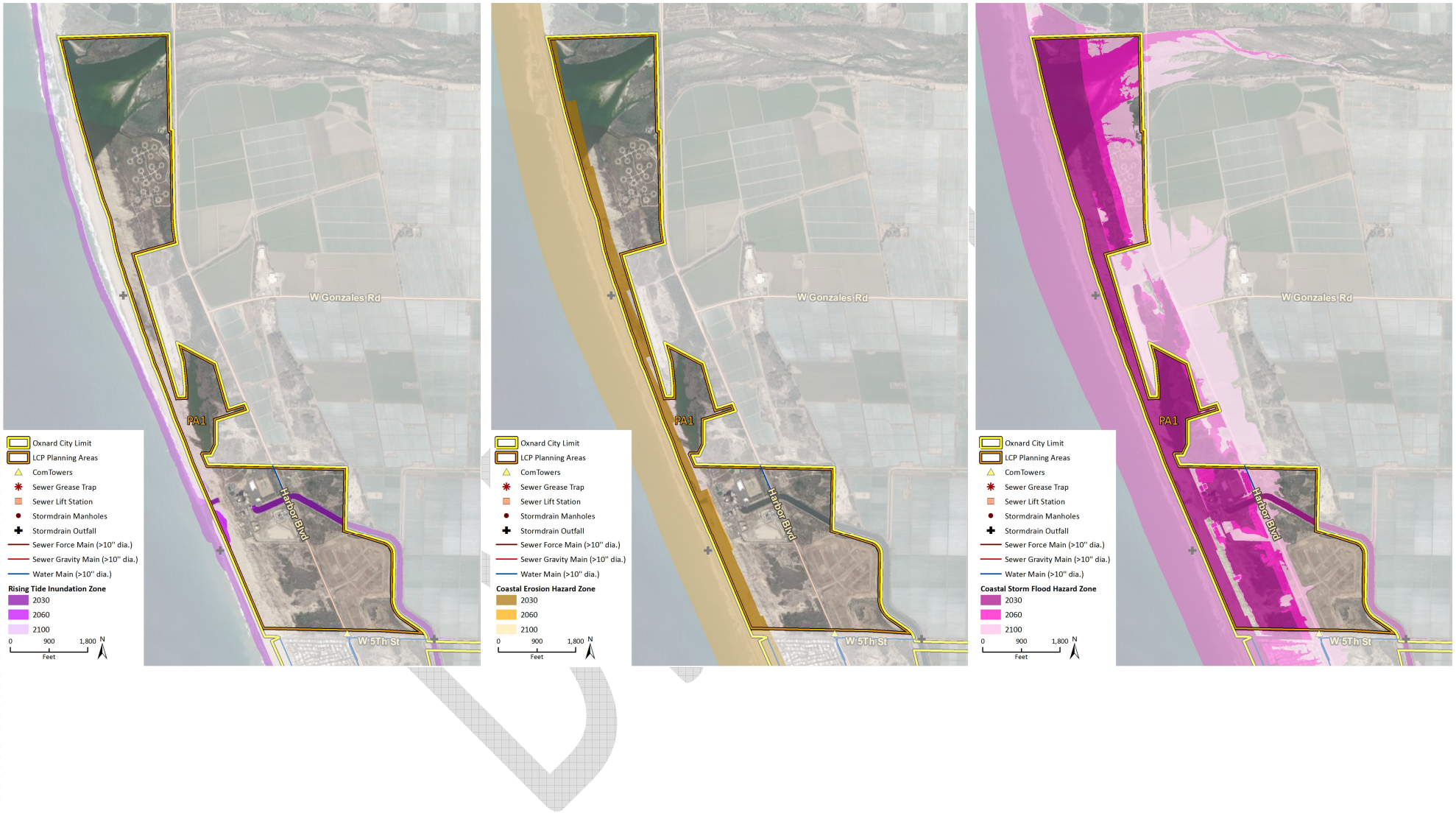


Figure VII-12. Vulnerability of Infrastructure in Planning Area 2 by Planning Horizon

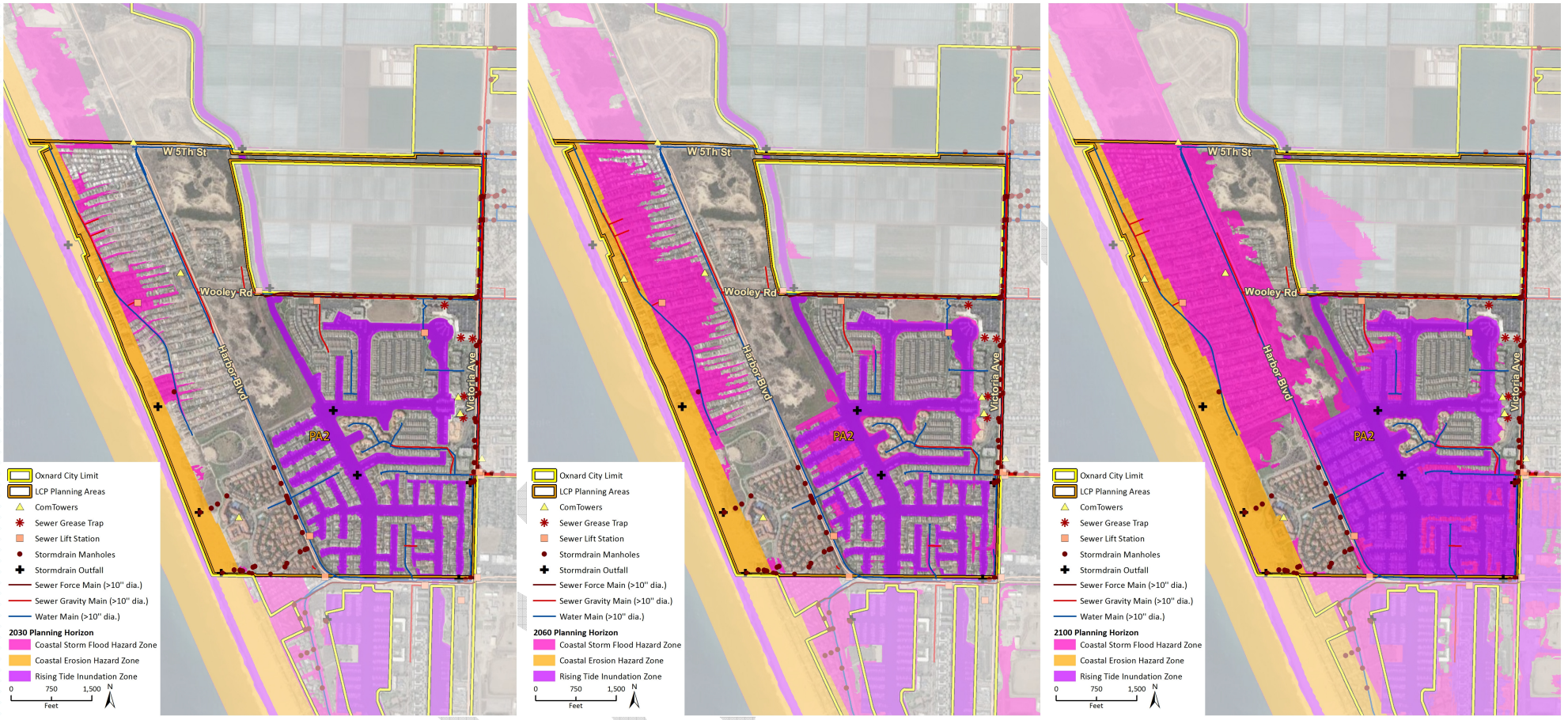


Figure VII-13. Vulnerability of Infrastructure in Planning Area 2 by Coastal Hazard

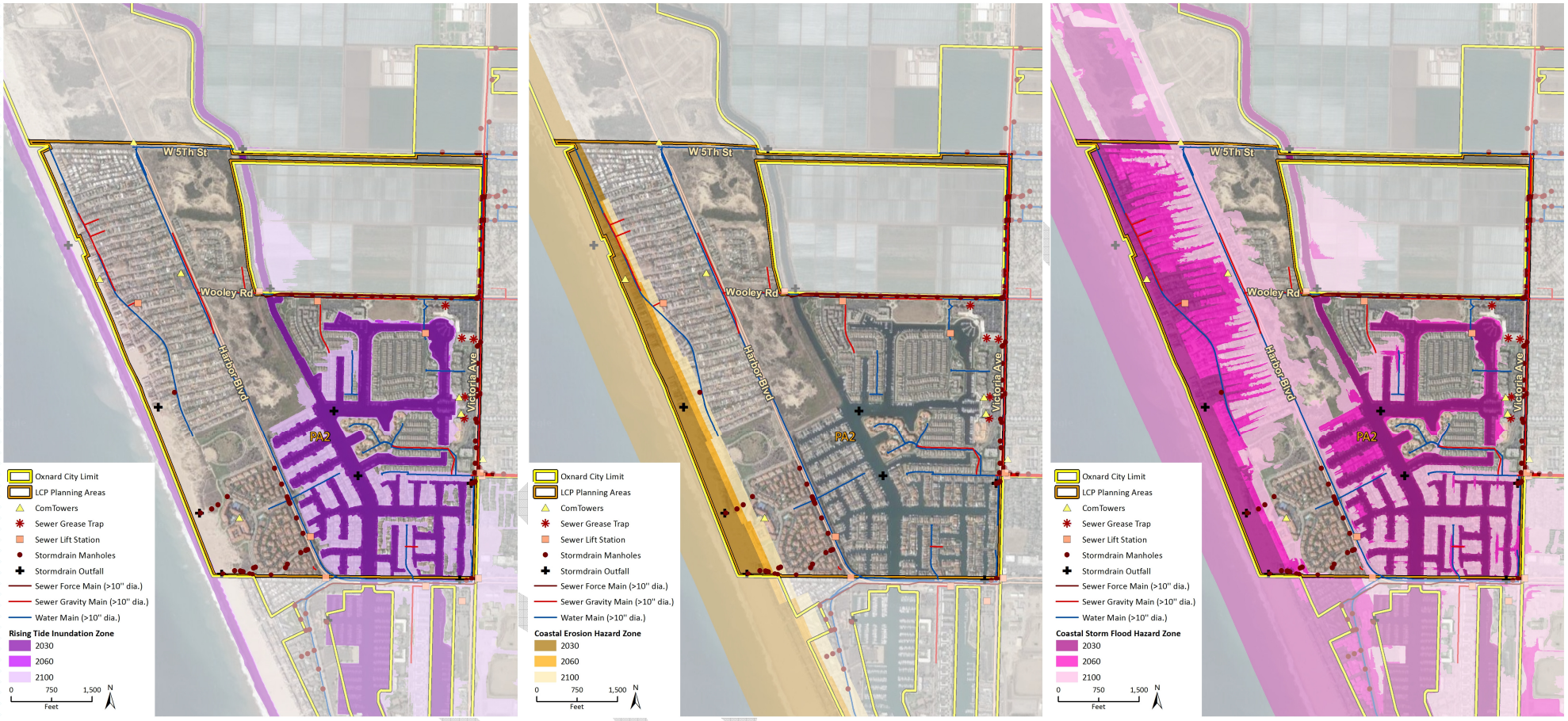


Figure VII-14. Vulnerability of Infrastructure in Planning Area 3 by Planning Horizon

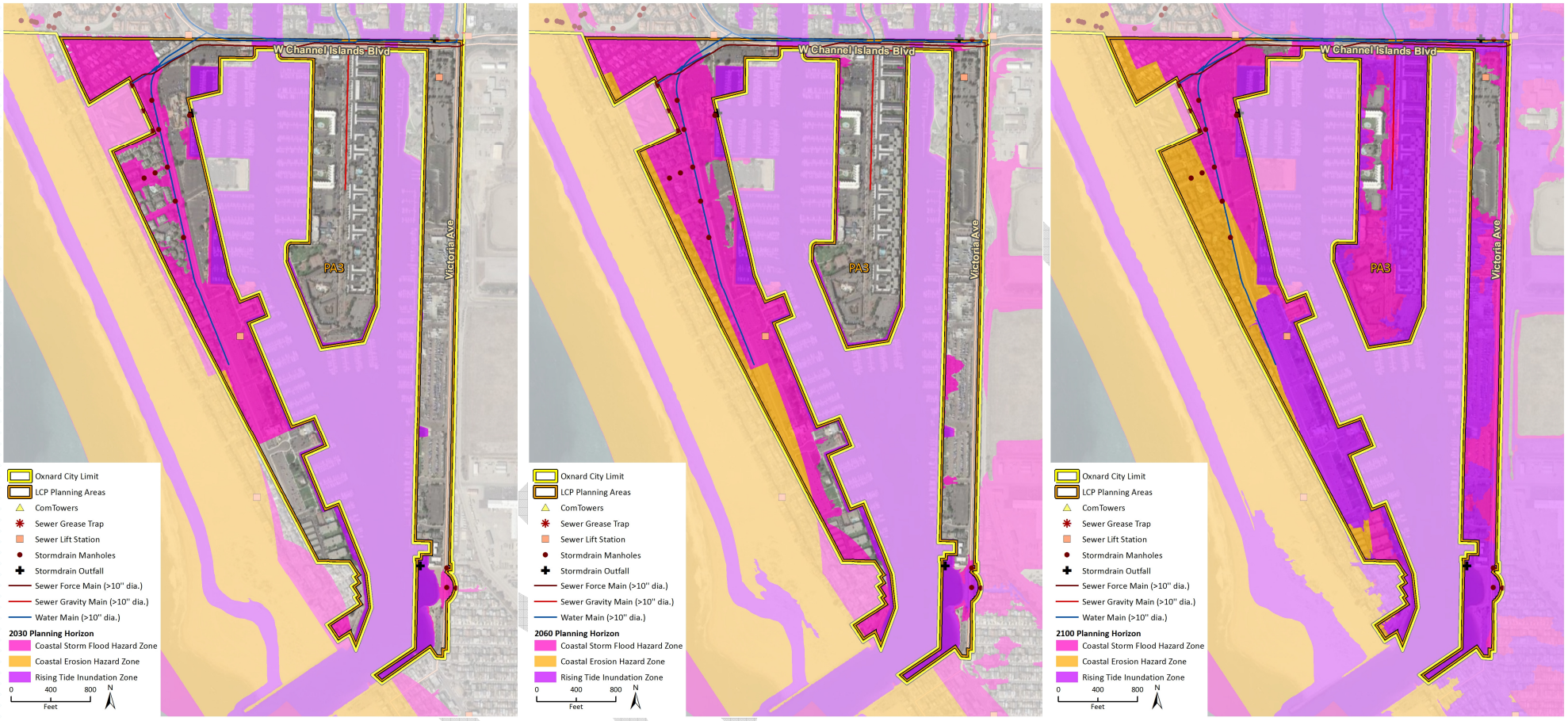


Figure VII-15. Vulnerability of Infrastructure in Planning Area 3 by Coastal Hazard

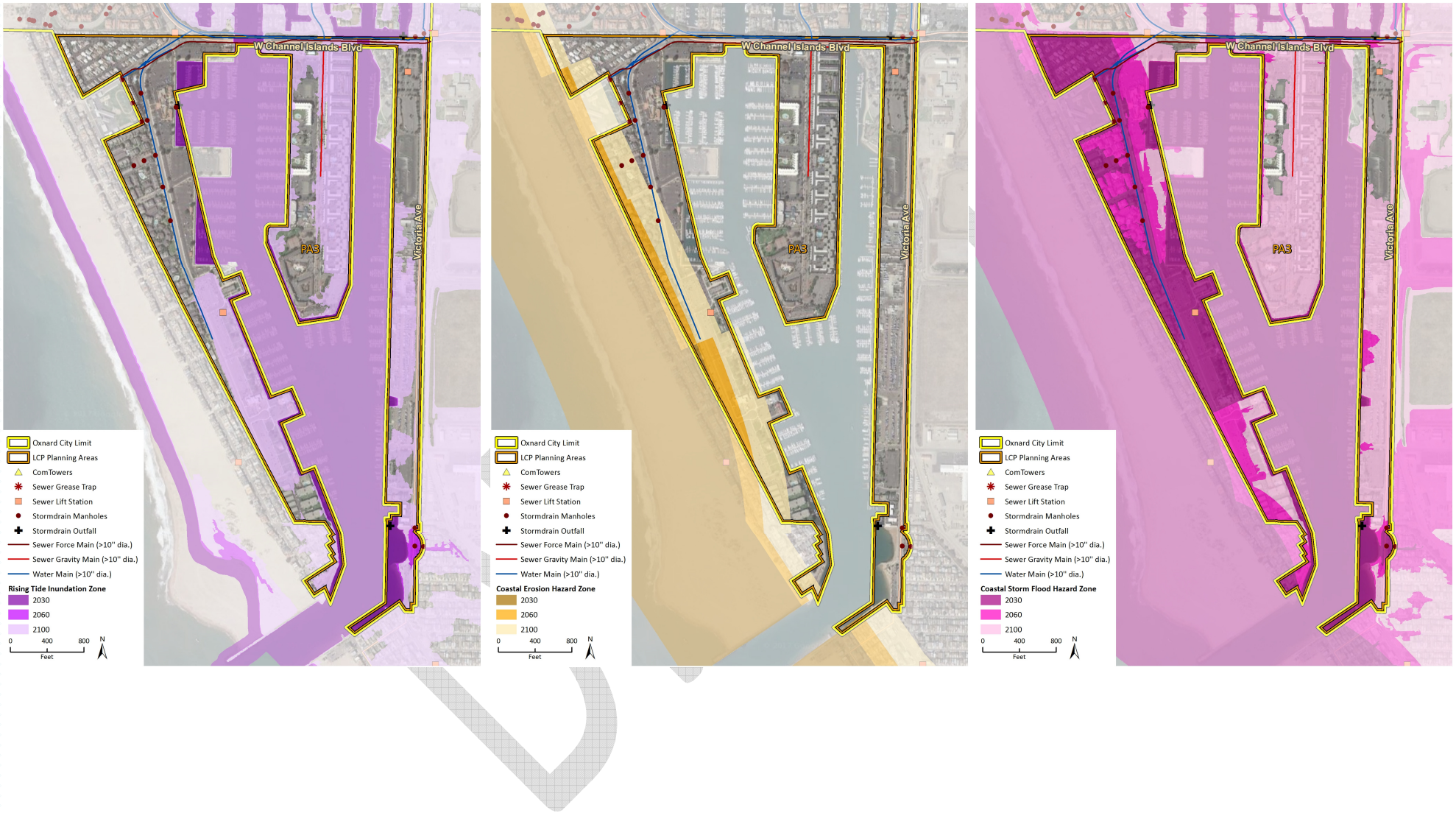


Figure VII-16. Vulnerability of Infrastructure in Planning Area 4 by Planning Horizon

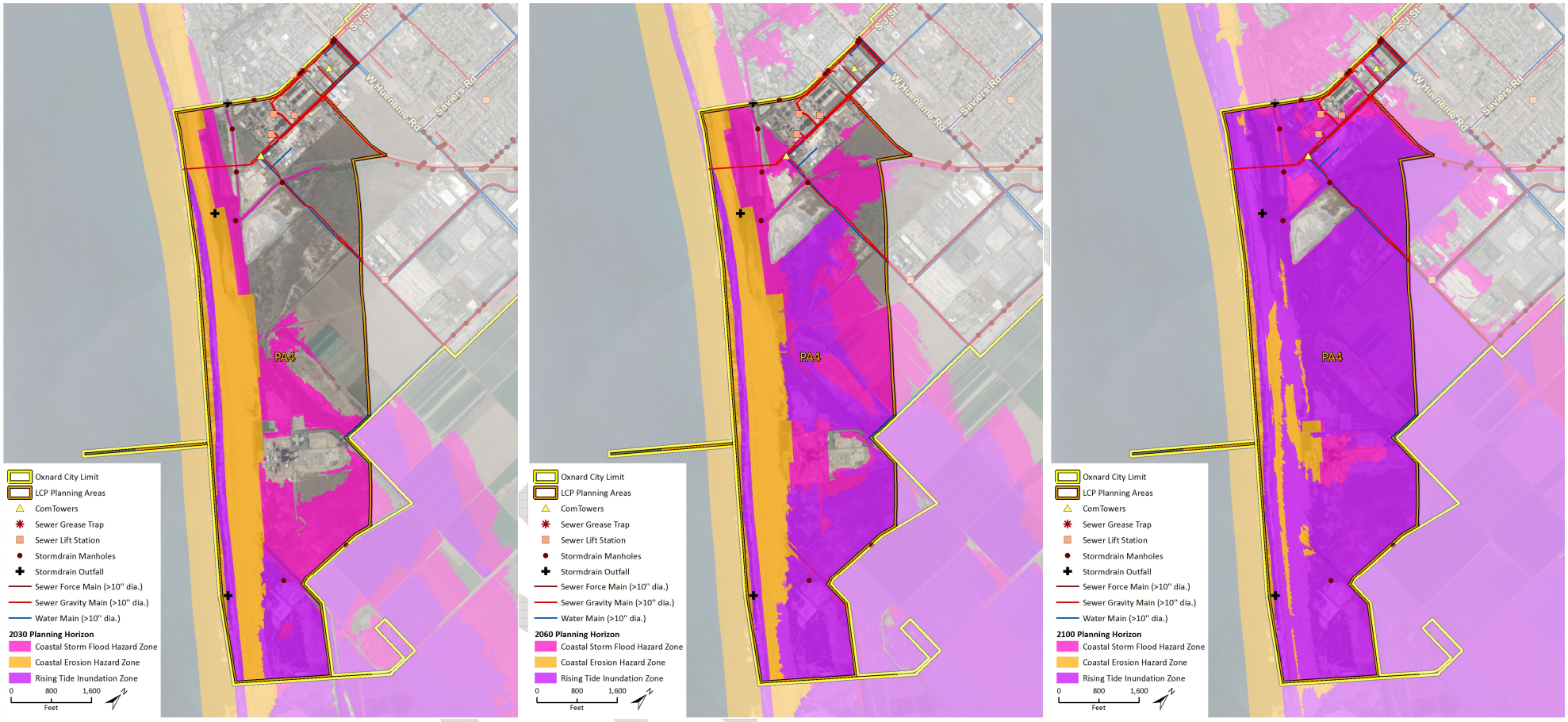
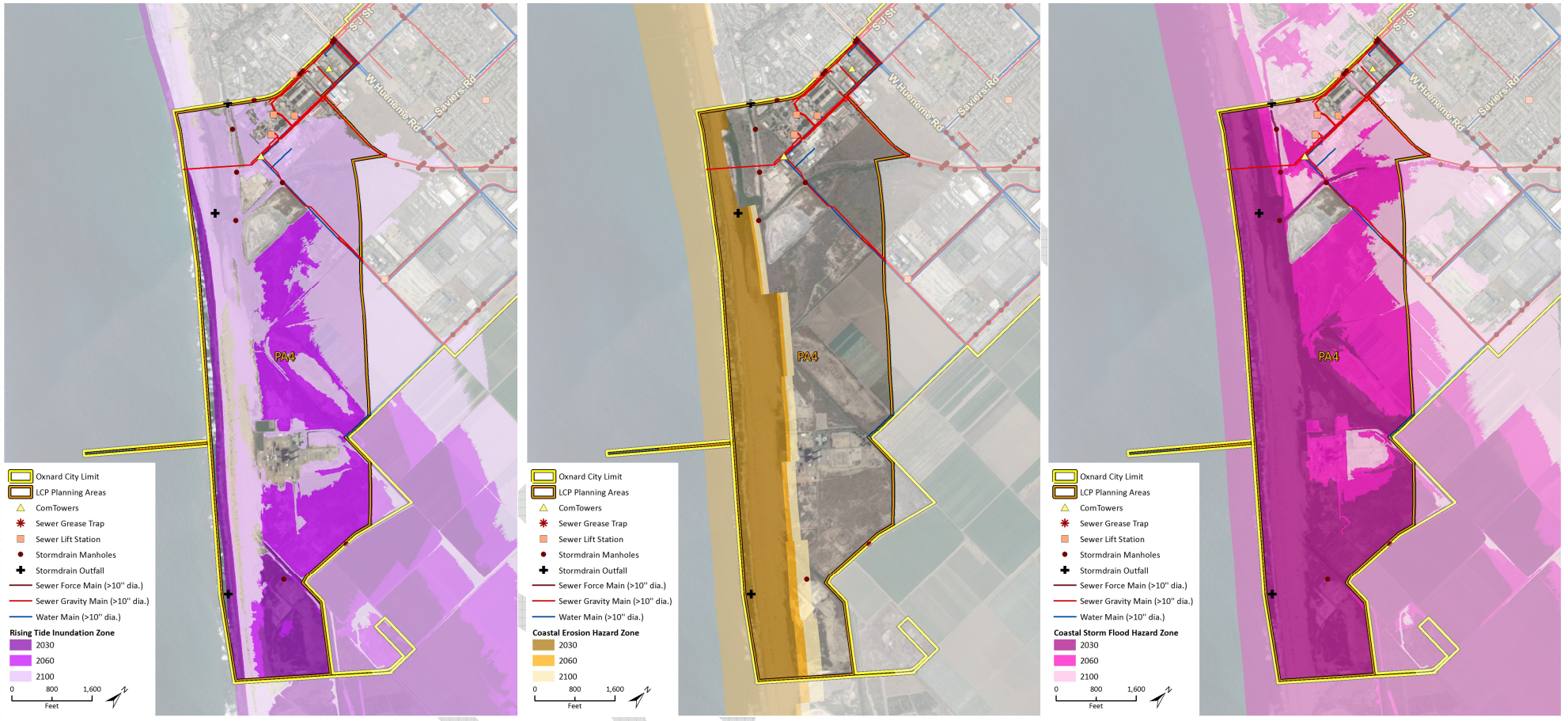


Figure VII-17. Vulnerability of Infrastructure in Planning Area 4 by Coastal Hazard



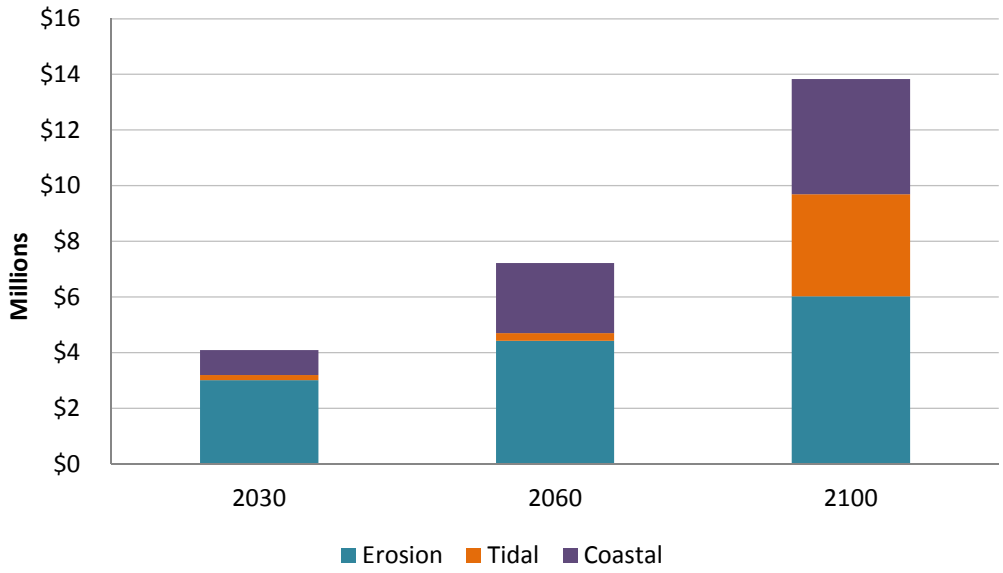
Roads

This analysis examined the removal/demolition costs of roads and also examined the costs of creating new roads as a proxy for the losses involved. Table 8 presents the length of roads impacted and the demolition replacement costs by time period. Figure VII-18 illustrates the economic cost of road removal/replacement over the various time horizons from erosion as well as coastal and tidal flooding.

Table 8. Public Parking Spaces and Length of Roads impacted by SLR and Cost of Road Removal/Replacement

Year	Public Parking Spaces	Road (ft.)	Road (miles)	Valuation	Removal Costs
2030	47	82,909	15.7	$4,000,000	$39,000
2060	130	134,385	25.5	$6,420,000	$4,127,000
2100	259	207,021	39.2	$10,640,000	$10,586,000

Figure VII-18. Economic Value of Road Removal/Replacement



	2030	2060	2100
Erosion	$2,840,000	$3,950,000	$5,180,000
Tidal	$180,000	$300,000	$2,620,000
Coastal	$970,000	$2,180,000	$2,840,000
Total	**$4,000,000**	**$6,420,000**	**$10,640,000**

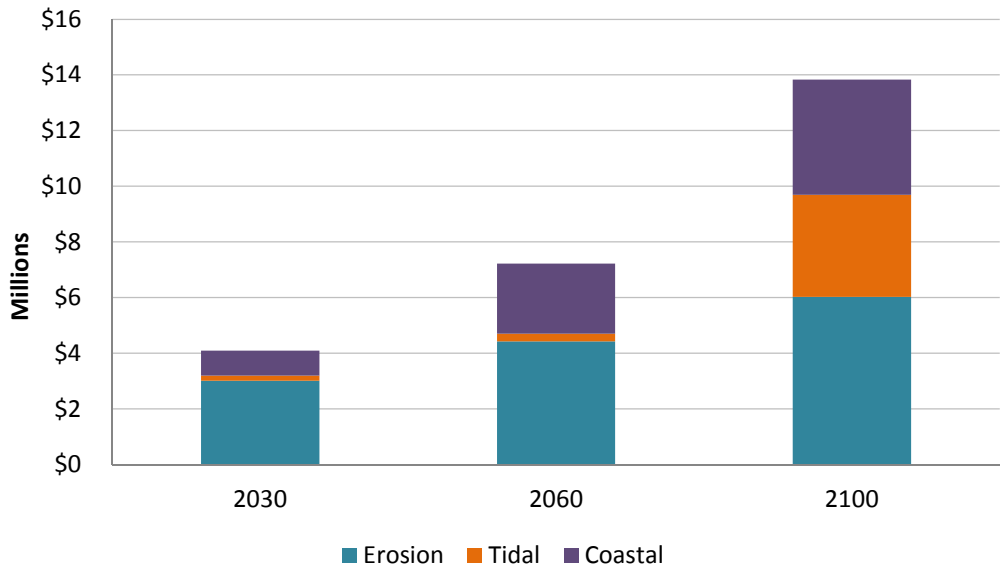
Water/Sewer

To provide an economic value for water and sewage infrastructure, the analysis utilized replacement costs (see Table 2 for the metrics used). Table 9 and Figure VII-19 present the various types of water infrastructure at risk from coastal hazards.

Table 9. Water/Sewer Infrastructure at Risk and Removal/Replacement Costs

Data Type	Year	Sewer Force Mains	Sewer Gravity Mains	Sewer Lift Stations	Storm Drain Manholes	Water Mains	Totals
Metric		Miles	Miles	#	#	Miles	
	2030	1.22	7.2	3	28	5.4	-
Vulnerability	2060	1.68	13.4	3	35	11.9	-
	2100	2.84	22.9	9	46	22.2	-
Replacement	2030	$160,000	$2,270,000	$530,000	$1,100	$1,150,000	$4,111,100
Costs	2060	$400,000	$3,740,000	$530,000	$1,800	$2,550,000	$7,221,800
	2100	$650,000	$6,510,000	$1,460,000	$2,600	$5,210,000	$13,832,600
Removal	2030	$20,000	$350,000	$1,200	$1,100	$180,000	$552,300
Costs	2060	$60,000	$580,000	$1,200	$1,800	$390,000	$1,033,000
	2100	$100,000	$1,010,000	$3,300	$2,600	$800,000	$1,915,900

Figure VII-19. Economic Value of Water/Sewage Infrastructure at Risk



	2030	2060	2100
Erosion	$3,020,000	$4,430,000	$6,030,000
Tidal	$180,000	$280,000	$3,670,000
Coastal	$900,000	$2,510,000	$4,130,000
Total	**$4,100,000**	**$7,220,000**	**$13,830,000**

Hazards

Hazardous materials are defined as items that because of their quantity, concentration, or physical and/or chemical characteristics, pose a hazard to human health and safety or to the environment if released, or any material specified in a local ordinance code (Ventura County 2017). To determine potential impacts due to hazardous materials, this vulnerability study analyzed the presence of Leaking Underground Storage Tanks (LUSTs), hazardous waste businesses, and a superfund site in the city. Several LUSTs, mostly consisting of current or abandoned gas stations that contain hazardous materials that could leak were identified. Not only could increased erosion and coastal flooding exacerbate the risk of these tanks leaking, but increased exposure to high ground water levels could also spread the contaminants much more widely. This study compiled LUST data from the State Water Resources Control Board. The analysis only incorporated LUST sites for which their status was described as "open." Table 10 shows the vulnerability of the open LUSTs by coastal hazard and planning horizon.

Table 10. Vulnerability of Hazardous Businesses and LUSTs by Coastal Hazard and Planning Horizon

Hazard Zones	Planning Horizon	CUPA[6] Facilities (Hazardous Businesses) (No.)	Geotracker (LUSTs) (No.)
Total in City		11	20
All Hazard Zones Combined	**2030**	**0**	**0**
	2060	**0**	**0**
	2100	**1**	**2**
Rising Tide Inundation Zones	2030	0	0
	2060	0	0
	2100	0	0
Coastal Erosion Hazard Zones	2030	0	0
	2060	0	0
	2100	0	0
Coastal Storm Flood Hazard Zones	2030	0	0
	2060	0	0
	2100	1	2

There are two open LUST sites and one hazardous waste business in the Oxnard LCP coastal zone that are projected to be impacted by 2100. As of 2002, the LUST site near the MBGS was in the process of

[6] Ventura County Certified Unified Program Agency/Hazardous Materials Program (CUPA)

being remediated. Another LUST site in the exact same location is also open but inactive (status was last reported in 1965).

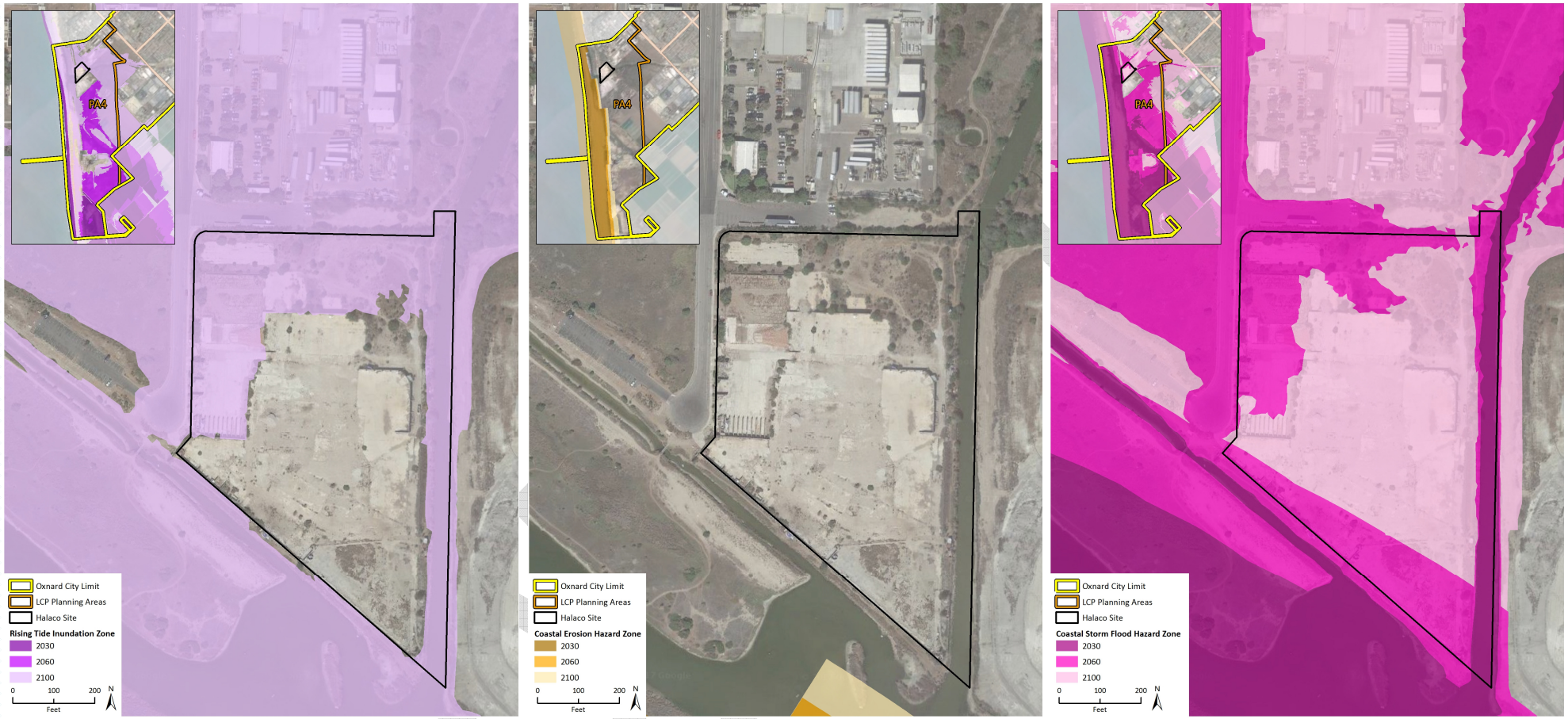
The hazardous waste business is a strawberry farm, which contains a hazardous waste permit due to onsite pesticide use (Ventura County 2017).

The EPA Halaco Superfund site, is located in the Oxnard coastal zone in Planning Area 4. Halaco Engineering Company operated a secondary metal smelter at the site from 1965 to 2004, recovering aluminum, magnesium, and zinc from dross, castings, cans, car parts, and other scrap metal. The map inset in Figure VII-20 shows that the eastern edge of the Halaco site is projected to be impacted by coastal storm flooding by 2030. As coastal flooding impacts increase over time, the north and south boundaries of the site are projected to be impacted by 2060 and the entire site would be subject to coastal flooding by 2100. Rising tide inundation would also impact the entire Halaco site by 2100. Erosion is not project to impact the Halaco site in any time horizon. In addition, the surrounding Ormond Beach wetlands are projected to become vulnerable to coastal hazards by 2030. The site includes an 11-acre area containing the former smelter and an adjacent 26-acre waste management area where wastes were deposited. The Halaco site also includes portions of the Ormond Beach wetland area. During its 40 years of operation, Halaco produced a large quantity of waste (i.e., slag) containing residual metals from the smelting process. From about 1965 to 1970, Halaco discharged waste into unlined settling ponds in or adjacent to the Oxnard Industrial Drain. From about 1970 to 2002, Halaco deposited wastes into unlined earthen settling ponds east of the smelter.

EPA is evaluating cleanup options for contaminated soils, sediments, and groundwater at the site, including reuse of the waste materials and excavation of contaminated soils and sediments in less contaminated parts of the site. Cleanup activities may be needed at the smelter property, the waste management area, the Nature Conservancy property, the lagoon area, and to address contaminated groundwater. A cleanup proposal is expected in 2017 or 2018. EPA currently expects cost of cleanup to be in the tens of millions (EPA 2017). Clean-up of the site is a priority because coastal hazard impacts to the Halaco site could result in the release of toxic chemicals into the surrounding environment. This could potentially impact surrounding water quality, the ecosystem health of the wetlands, the health of the surrounding industrial workers, and planned Ormond Beach restoration efforts.

Figure VII-20. Vulnerability of Halaco Superfund Site in Planning Area 4 by Planning Horizon

Figure VII-21. Vulnerability of Halaco Superfund Site in Planning Area 4 by Coastal Hazard



Large-Scale Power Plants

There are three large-scale natural gas electric generation power plants in the Oxnard coastal zone: 1) NRG OBGS, 2) NRG MBGS, and 3) SCE MPP. The future and vulnerability of these three facilities is discussed below:

NRG OBGS (located in Planning Area 4 - Ormond Beach)

The 1970's vintage 1,500 MW-rated OBGS with two boiler units should cease operations by December 31, 2020 to comply with the State Water Quality Control Board 2010 OTC National Pollutant Discharge Elimination System (NPDES) compliance regulations, and NRG has indicated to the California Public Utilities Commission (CPUC) that there will be no proposal to repower the facility that would require CPUC and Energy Commission approvals. It is possible the OBGS will continue to operate after 2020 and potentially be fined for violating the Clean Water Act. It is possible the OBGS facility will remain in place indefinitely as there are no NRG-announced plans to decommission and demolish the two power generation boiler units, two stacks, and offshore outfall pipeline. If the OBGS is decommissioned after 2020, SCE will have a major transmission line to the OBGS and the OBGS switchyard with no apparent purpose. The OBGS is clearly within the FEMA 100-year coastal flood plain, which greatly limits reuse of the site for a significant energy facility or other use. The OBGS site could potentially be used for a battery storage system (BESS) and/or solar power generation if the facilities meet applicable FEMA FIRM regulations due to be adopted in 2017 or 2018. Or because this facility is on property surrounded by wetlands and dunes owned by the State Coastal Conservancy (CCC 2016), it could be incorporated into the Ormond Beach restoration area, if acquired by State Coastal Conservancy or TNC. The site, located in Planning Area 4, is at an increasing risk of coastal storm flooding and/or wave run up damage as sea level gradually rises. It is possible that a severe coastal event could result in contamination of the ocean if OBGS soil and/or structures are pulled into the ocean by retreating waves. It is important to note, however, that restoration of Ormond Beach will provide SLR mitigation in the form of a natural buffer for a large portion of the Planning Area 4 that exists inland of Ormond Beach. This would reduce the SLR impacts and site-specific mitigation for other infrastructure in the planning area such as Halaco, OBGS, and the industrial properties.

NRG MBGS (located in Planning Area 1 - McGrath-Mandalay)

The 1950's vintage 510 MW-rated MBGS with two boiler units (Units 1 and 2) should cease operations by December 31, 2020 to comply with the State Water Quality Control Board 2010 OTC NPDES compliance regulations. The MBGS Unit 3 single gas-turbine peaker was added in the 1970's and would continue to operate after 2020. In 2014, in response to a SCE solicitation for capacity in the Big Creek/Moorpark service sub-area that stretches from Moorpark to Goleta and includes the Oxnard area, NRG applied to the CEC to replace Units 1 and 2 with a 262 MW single-turbine unit with a 182-foot

exhaust stack in a vacant three-acre area on the MBGS facility grounds. As of December 2017, the CEC application process was suspended when the two assigned CEC commissioners indicated they would vote to deny the NRG application. Portions of the MBGS site, located in Planning Area 1, could potentially be used for a BESS and/or solar power generation if the facilities meet applicable FEMA FIRM regulations due to be adopted in 2017 or 2018, and City LCP policies and zoning regulations. The western and northern edges of the MBGS site are at an increasing risk of coastal storm flooding and/or wave run-up damage as sea level gradually rises. It is possible that a severe coastal event could result in contamination of the ocean if MBGS soil and/or structures are pulled into the ocean by retreating waves. The concrete beach discharge structure has visible deterioration and is regularly flooded during coastal storm and very high tides.

SCE MPP (located in Planning Area 1 - McGrath-Mandalay)

The SCE McGrath 45 MW peaker plant was put into service in 2013 for an expected operating life of 25 years and would be removed around 2040 unless its permits were extended. The MPP is located further from the coastal dune and Pacific Ocean than the adjacent MBGS, but is adjacent to the Edison cooling canal that is subject to tidal and storm surges. The MPP site, located in Planning Area 1, has an additional approximately five acres of vacant land that is remediated from its previous use as an oil tank farm for the MBGS. If SCE were to expand the MPP or introduce other energy facilities on the vacant area such as a BESS unit, SCE would have to meet applicable FEMA FIRM regulations due to be adopted in 2017or 2018 and/or City LCP policies and zoning regulations.

Figures VII-22 through VII-25 show the location of the three large-scale power plants within the city of Oxnard and their vulnerability to coastal hazards. The NRG MBGS, SCE MPP, and the NRG OBGS are all vulnerable to coastal hazards in 2030, 2060, and 2100. The SCE MPP has an expected operating life of 25 years and would be removed around 2040 unless its permits were extended.

Figure VII-22. Vulnerability of the NRG Mandalay Beach Generating Station (MBGS) and the Southern California Edison McGrath Peaker Plant (SCE MPP) by Planning Horizon

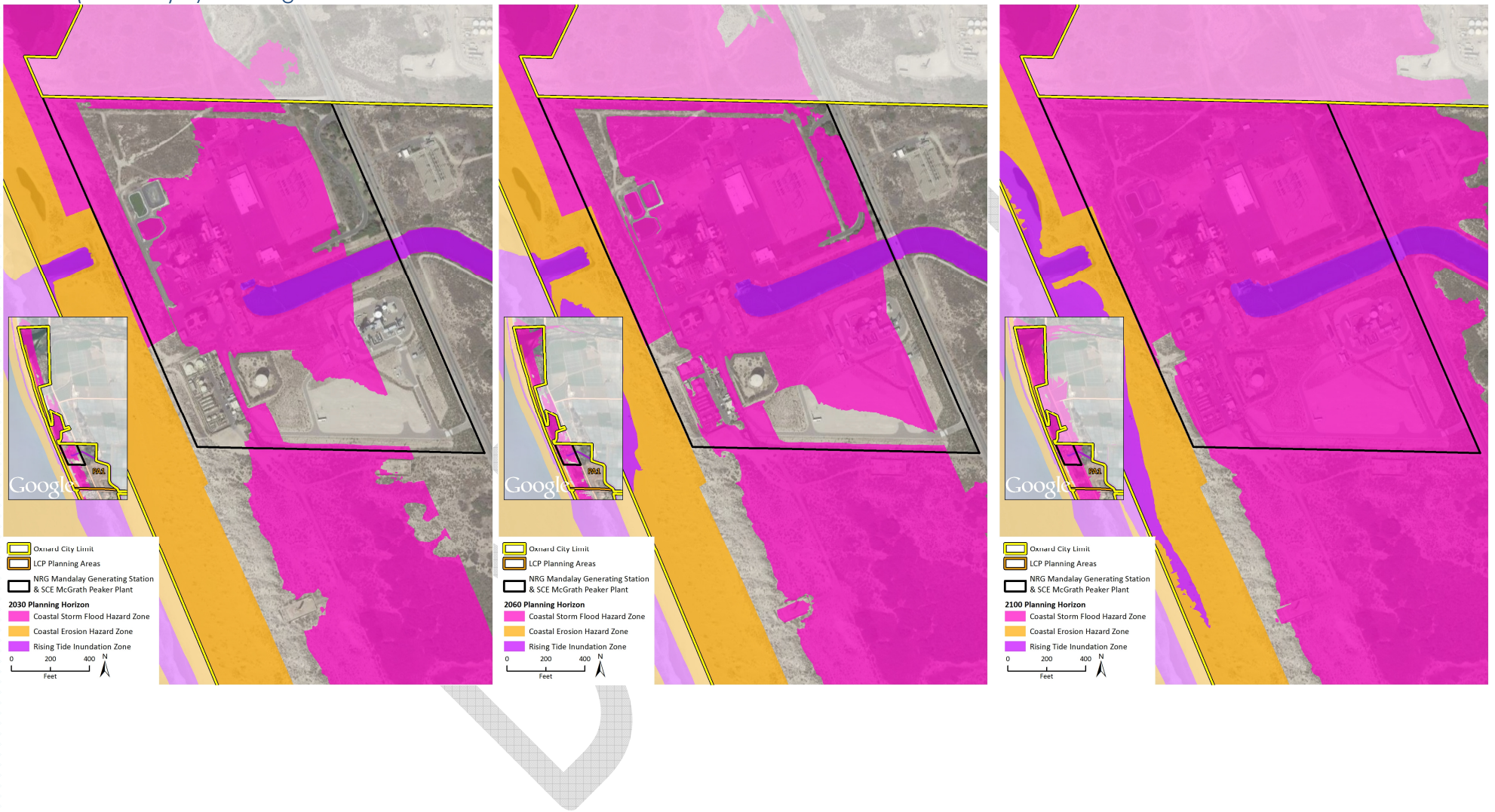


Figure VII-23. Vulnerability of the NRG Mandalay Beach Generating Station (MBGS) and the Southern California Edison McGrath Peaker Plant (SCE MPP) by Coastal Hazard

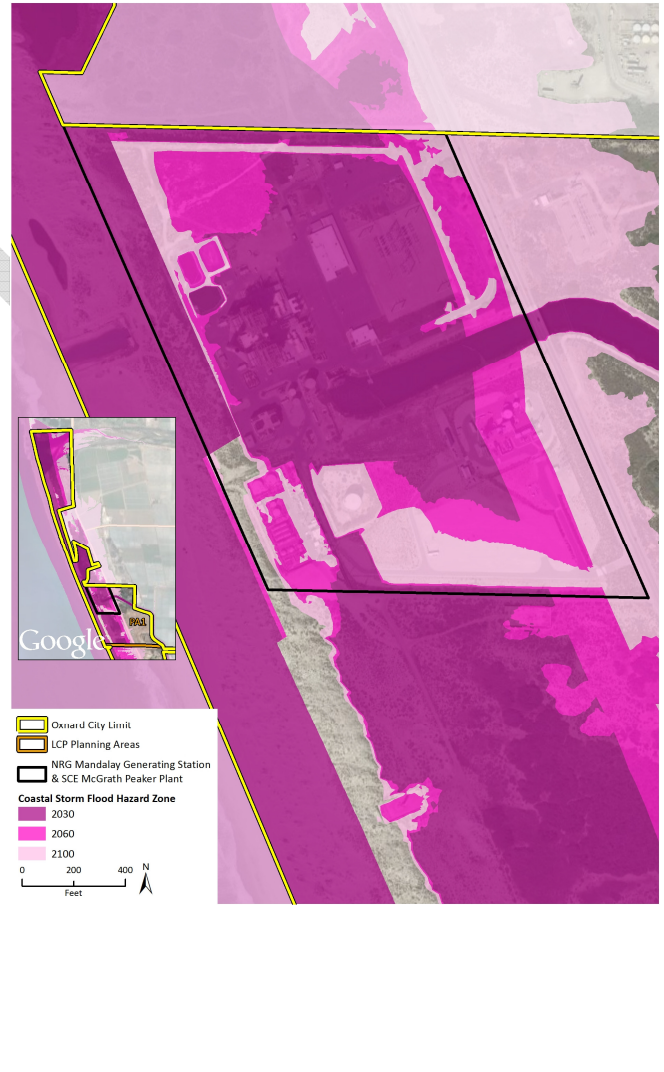


Figure VII-24. Vulnerability of the Ormond Beach Generating Station (OBGS) by Planning Horizon

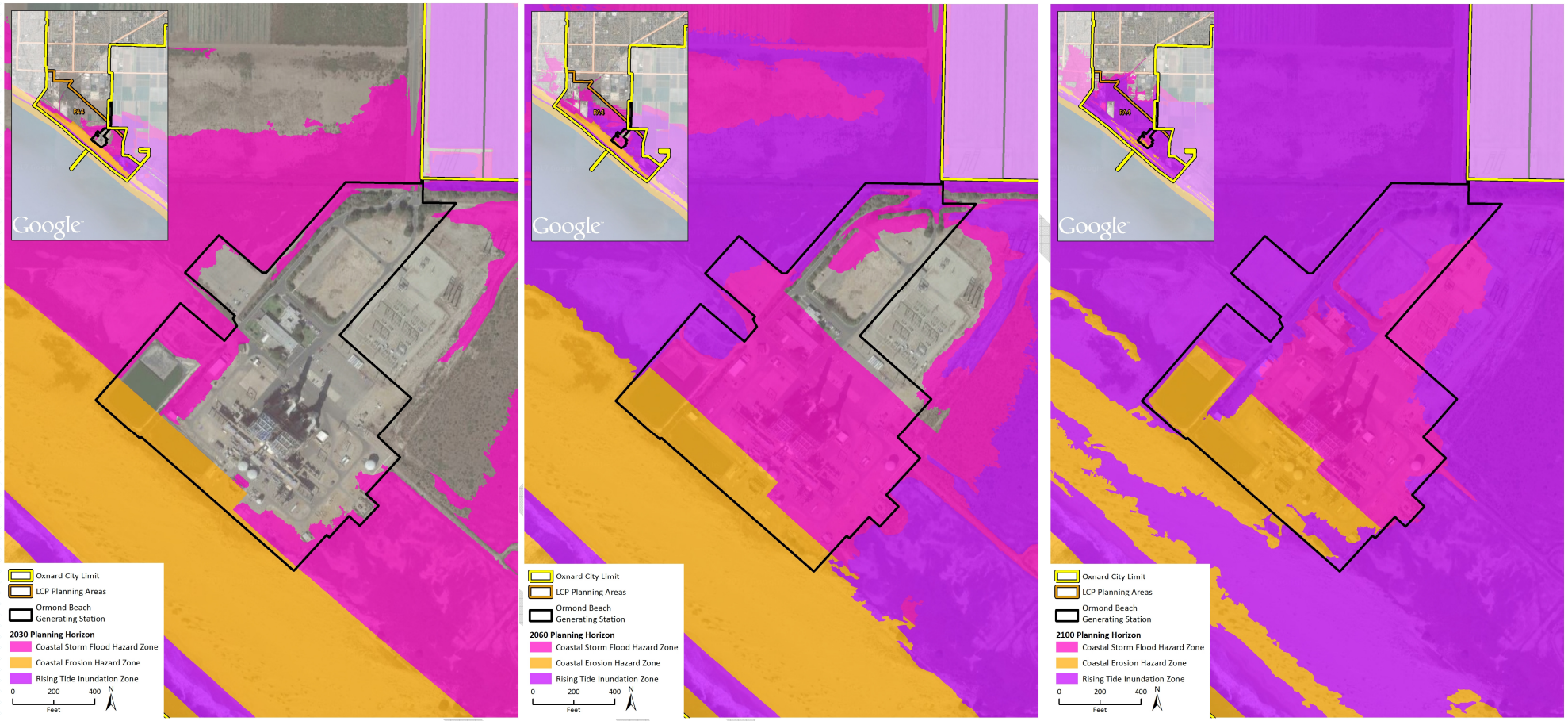
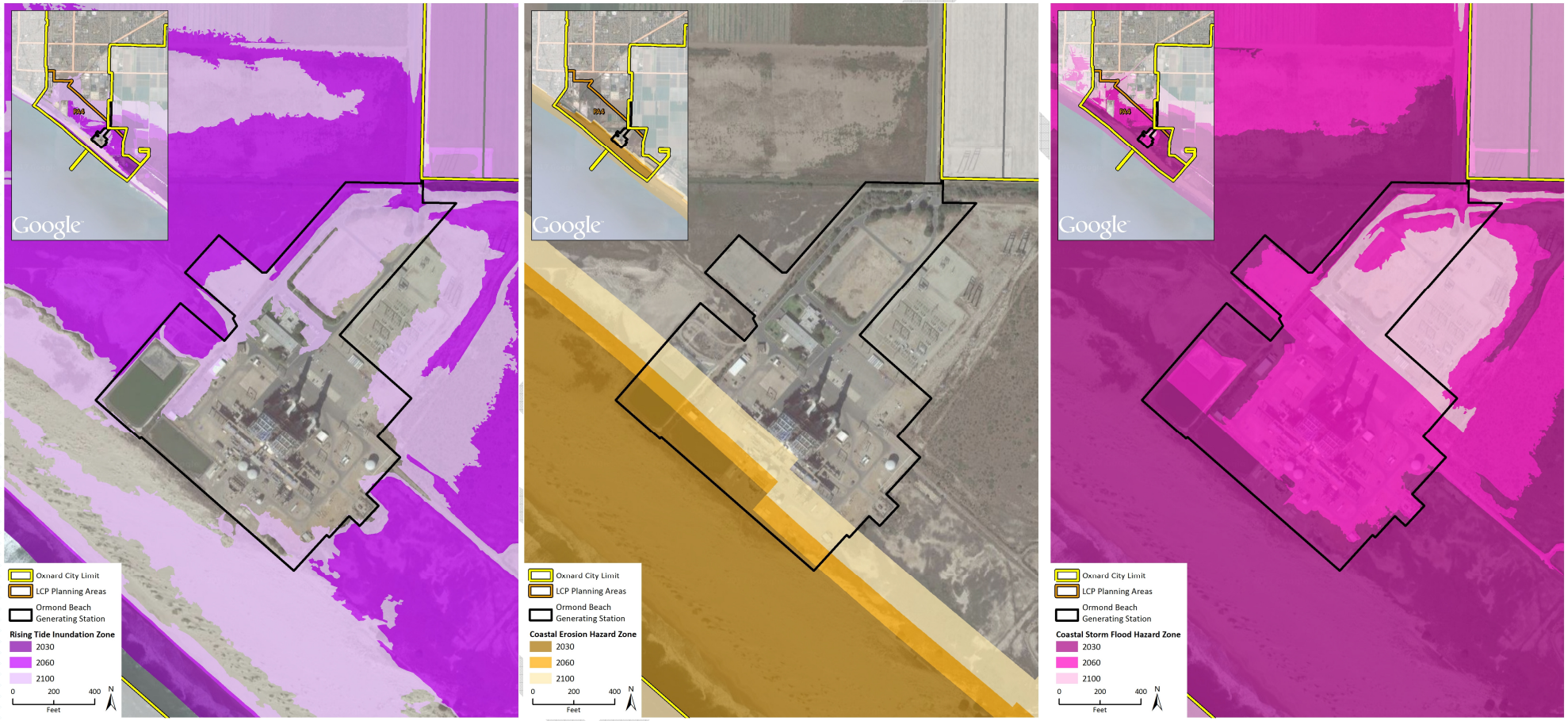


Figure VII-25. Vulnerability of the Ormond Beach Generating Station (OBGS) by Coastal Hazard



Residential Land

Residential land use accounts for over half the city and a majority of acreage in Planning Area 2. Oxnard contains a mix of residential land uses with low, low-medium, medium, medium, high, and high densities in addition to mobile home parks. The coastal zone contains the spectrum of these housing types with two mobile home parks, gated communities (e.g. The Colony) and waterway communities found in and north of the Channel Islands Harbor. Table 11 shows the acreage of residential land use in the City of Oxnard that is susceptible to coastal hazards under the various time horizons. -Table 11 shows the acreage of residential land use in the City of Oxnard that is susceptible to coastal hazards.

Table 11. Vulnerability of Oxnard Residential Land Uses by Coastal Hazard and Planning Horizon[7]

Hazard Zones	Planning Horizon	Mobile Home Park (Acres)	Residential Low (Acres)	Residential Low Medium (Acres)	Residential Medium (Acres)	Residential Medium High (Acres)
	Total in City	238	3,710	724	531	254
All Hazard Zones Combined	**2030**	**26**	**325**	**86**	**22**	**41**
	2060	**26**	**310**	**79**	**20**	**38**
	2100	**33**	**306**	**78**	**19**	**37**
Rising Tide Inundation Zones	2030	26	325	86	22	41
	2060	25	310	79	20	38
	2100	24	306	78	19	37
Coastal Erosion Hazard Zones	2030	2	0	0	0	0
	2060	3	0	0	0	0
	2100	6	0	0	0	0
Coastal Storm Flood Hazard Zones	2030	13	0	0	0	0
	2060	26	0	0	0	0
	2100	33	0	0	0	0

Most of the existing residential land uses susceptible to coastal hazards are present in Planning Areas 2 and 3. The Northshore residential project in Planning Area 1, which is entitled but not yet constructed, is

[7] Residential areas located in unincorporated county areas, such as Silver Strand, Hollywood Beach and Port Hueneme, were not included.

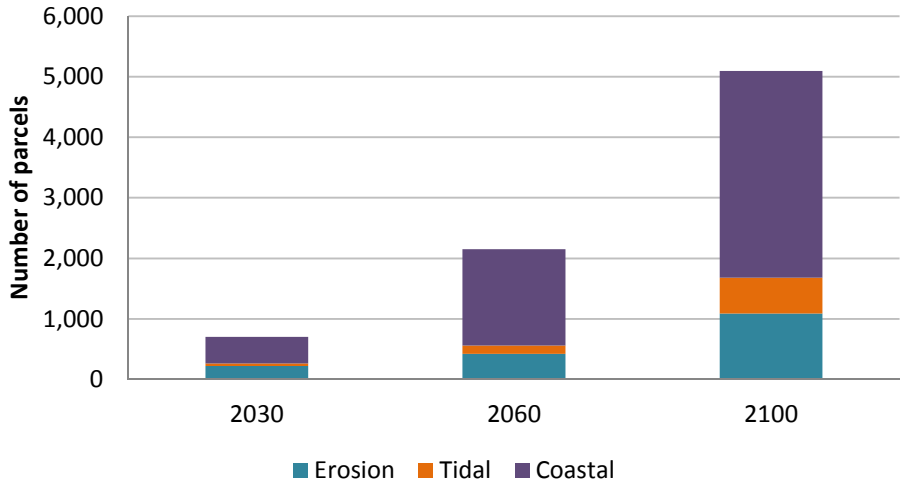
not projected to be impacted. Most of the residential land use in Planning Area 2 would be impacted by 2030, except for an eastern area along Victoria Avenue that would be impacted by 2100.

Estimates of Economic Losses

Many parcels and assets have already become vulnerable to erosion and tidal flooding. Economists see these as sunk costs that must be excluded from any analysis aimed at informing future decision making. It was, therefore, important to the analysis to measure the change or increase in parcel vulnerability between now and 2030 rather than include the total amount of land, assets, and property that will have become vulnerable to SLR from some arbitrarily chosen point in the past.

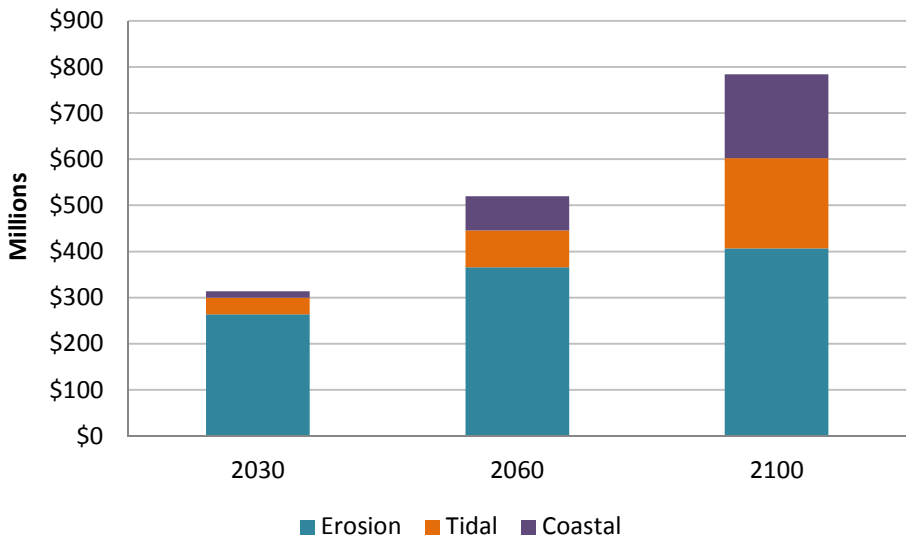
Figure VII-26 presents the number of residential parcels subject to erosion, tidal inundation, and coastal storm flooding by each planning horizon. As expected, the number of parcels increases significantly over time. Figure VII-27 shows the economic (market) value impact to residential uses due to projected coastal hazards. The parcels are mostly affected by coastal flooding and there is a large increase in damage by all coastal hazards between 2030 and 2060. Erosion causes heaviest damages to residential units due to the high value oceanfront homes and loss of land value. Additionally, tidal flooding impacts increase substantially (approximately 3-fold) between 2060 and 2100.

Figure VII-26. Total Number of Oxnard Residential Parcels Subject to Coastal, Tidal and Erosion Losses



	2030	2060	2100
Erosion	221	422	1,088
Tidal	41	136	592
Coastal	441	1,591	3,413
Total	**703**	**2,149**	**5,093**

Figure VII-27. Economic Value of Vulnerable Residential Parcels



	2030	2060	2100
Erosion	$263,950,000	$365,900,000	$406,990,000
Tidal	$36,050,000	$79,940,000	$195,420,000
Coastal	$14,020,000	$73,530,000	$181,180,000
Total	**$314,020,000**	**$519,370,000**	**$783,590,000**

The economic analysis was also conducted based on the information on the type of residential property. Table 12 breaks down economic losses by type of residential units. Table 12 shows that single-family dwellings (SFDs) account for 88 percent of the losses in 2030, declining to 74 percent by 2100. Consequently, the economic damages to single-family residences are greater than all other residential property types combined. There are also a significant number of "vacant" parcels included here. These are parcels that are zoned for future residential development, which would, therefore, increased the value of these vulnerable parcels.

Table 12. Economic Value of Oxnard Residential Property at Risk

	2030		2060		2100	
	Value	Pct.	Value	Pct.	Value	Pct.
Apartment	$3,070,000	1.0%	$5,720,000	1.1%	$8,300,000	1.1%
Condominium	$5,580,000	1.8%	$50,560,000	9.7%	$108,310,000	13.8%
Duplex	$2,900,000	0.9%	$6,410,000	1.2%	$8,350,000	1.1%
Hotel	-	-	$15,560,000	3.0%	$17,620,000	2.2%
Manufactured Home	-	-	$130,000	0.0%	$510,000	0.1%
Mobile Park	$2,930,000	0.9%	$3,220,000	0.6%	$3,550,000	0.5%
Single-Family	$277,360,000	88.3%	$400,570,000	77.1%	$579,530,000	74.0%
Time Share	-	-	-	-	$790,000	0.1%
Vacant	$10,880,000	3.5%	$14,190,000	2.7%	$15,700,000	2.0%
Residential	$11,310,000	3.6%	$23,010,000	4.4%	$40,910,000	5.2%
Total Residential	$314,030,000	100.0%	$519,370,000	100.0%	$783,570,000	100.0%

If the City of Oxnard does not implement an LCP adaptation strategy and these parcels are subjected to future flooding, the City and/or property owners will also accrue demolition or removal costs. The analysis assumed costs of $10 per square foot for removing single-family residences and $20 per square foot for multiple-family residences. The total cost of demolition or removal is estimated to be over $71 million by 2100 (Table 14). This is a high cost to demolish damaged properties and property owners would be responsible for demolition cost. The City should take steps to clarify the timeframes by which a damaged structure should be removed or demolished.

Table 13. Costs of Demolishing/Removing Residential Structures

Type	2030	2060	2100
Erosion	$6,117,000	$9,149,000	$10,789,000
Tidal	$1,436,000	$3,430,000	$10,753,000
Coastal	$12,409,000	$33,211,000	$49,879,000
Total	**$19,961,000**	**$45,791,000**	**$71,421,000**

Figure VII-28. Vulnerability of Residential Areas in Planning Area 2 by Planning Horizon

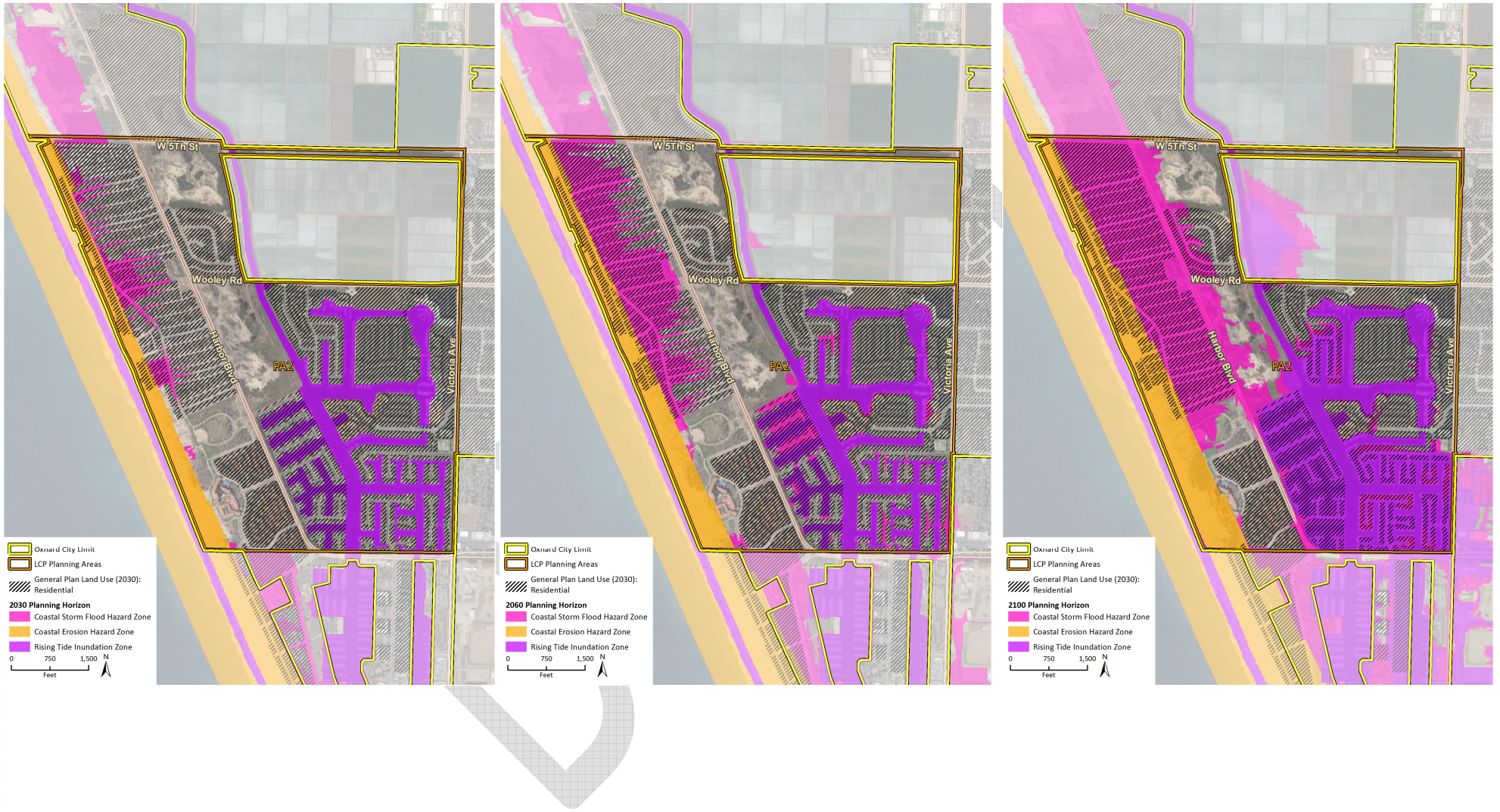


Figure VII-29. Vulnerability of Residential Areas in Planning Area 2 by Coastal Hazards

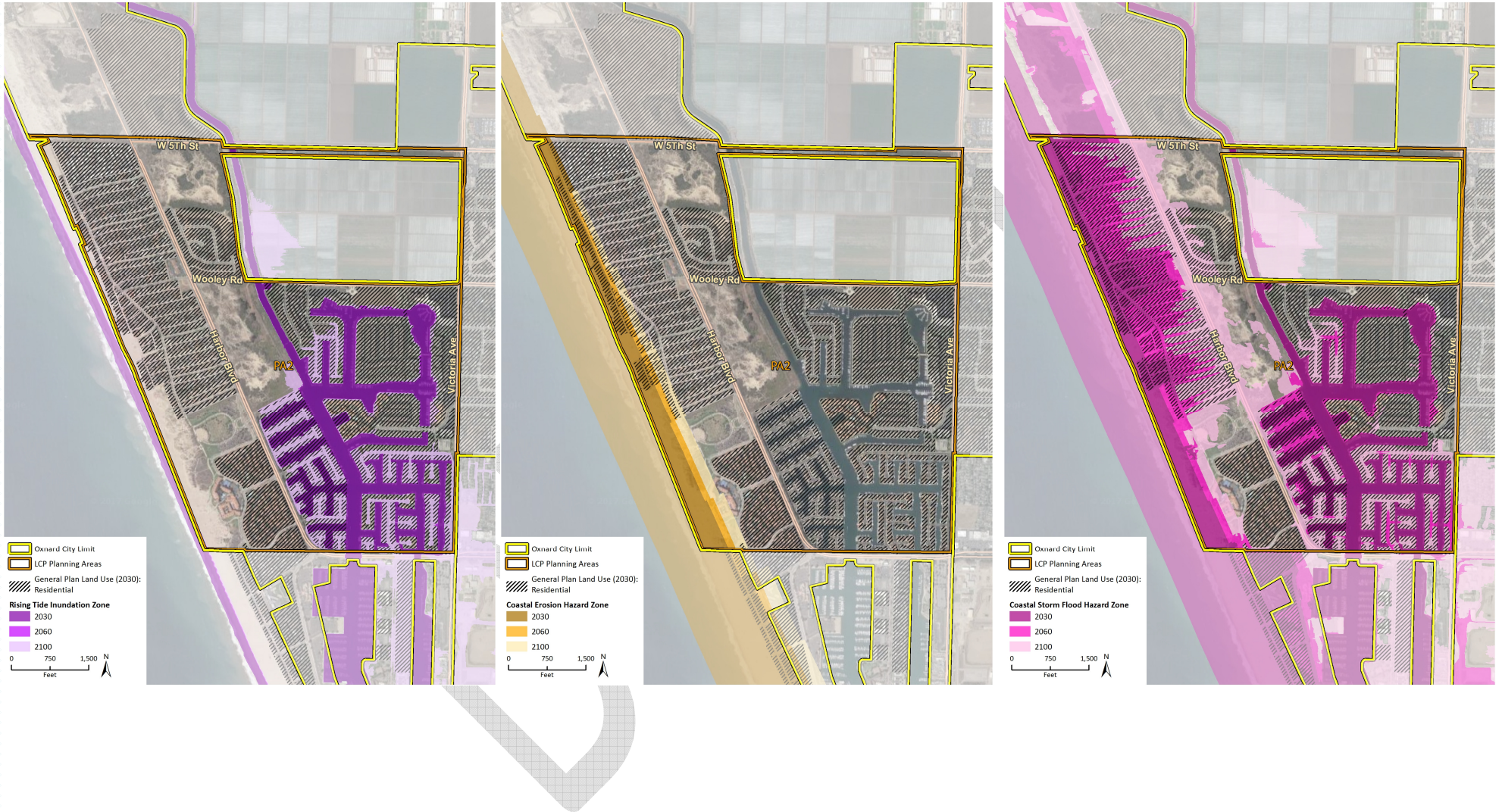


Figure VII-30. Vulnerability of Residential Areas in Planning Area 3 by Planning Area

Figure VII-31. Vulnerability of Residential Areas in Planning Area 3 by Coastal Hazard

Commercial Land

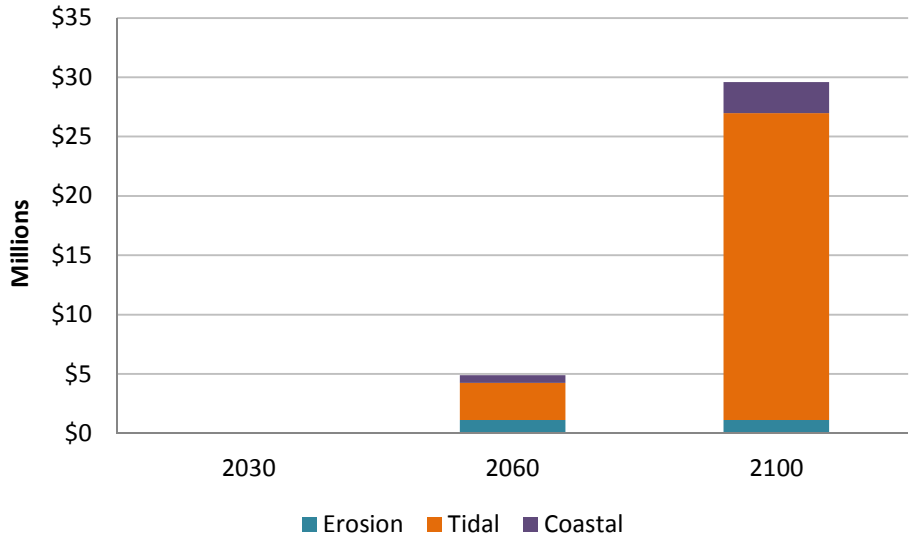
Types of commercial land uses in the City of Oxnard include convenience, neighborhood, community, general, regional, office, and central business district. The economic analysis evaluated the commercial and industrial parcels by usage. Table 14 presents the evaluation of commercial and industrial parcels vulnerable to coastal hazards. Figure VII-32 shows the economic impact to all commercial and industrial parcels by type of projected coastal hazard. By 2030, these sectors are relatively un-impacted by projected coastal hazards. By 2060 and 2100, however, tidal flooding will become a considerable threat. In particular, by 2100 approximately half of the manufacturing properties in the city will be impacted. Prior to 2060, most vulnerability pertains to the Shopping Center at the Seabridge Marina on S. Victoria Ave. After 2060, major manufacturing properties are clearly the largest commercial and industrial sector impacted within the 2100 time horizon. These types of parcels are almost completely owned by New-Indy Containerboard LLC. By comparison, economic losses related to industrial and commercial property are small relative to the economic losses of the residential properties. It is important to note, however, that restoration of Ormond Beach will provide SLR mitigation in the form of a natural buffer for a large portion of the Planning Area 4 that exists inland of Ormond Beach, including the commercial properties. This could reduce the SLR impacts and site-specific mitigation needed for commercial properties in the planning area.

Table 14. Economic Value of Commercial/Industrial Property at Risk[8]

	2030		2060		2100	
	Value	Pct.	Value	Pct.	Value	Pct.
Commercial Condominium	-	-	-	-	$90,000	0.3%
Major Shopping Center	-	-	$3,130,000	64.0%	$5,720,000	19.3%
Retail	$30,000	33.3%	$310,000	6.3%	$3,430,000	11.6%
Shopping Center	-	-	$360,000	7.4%	$3,560,000	12.0%
Small Office	$60,000	66.7%	$1,090,000	22.3%	$1,220,000	4.1%
Major Manufacture	-	-	-	-	$15,440,000	52.2%
Mini Warehouse	-	-	-	-	$140,000	0.5%
Total	**$90,000**	**100%**	**$4,890,000**	**100%**	**$29,600,000**	**100%**

[8] This does not include the economic value of the large-scale power plants.

Figure VII-32. Economic Value of Vulnerable Commercial/Industrial Parcels



	2030	2060	2100
Erosion	$0	$1,120,000	$1,120,000
Tidal	$0	$3,130,000	$25,860,000
Coastal	$90,000	$640,000	$2,620,000
Total	**$90,000**	**$4,890,000**	**$29,600,000**

Oxnard Municipal Properties

Most of the City's municipal buildings are located in the center of the city, far from coastal hazards. Therefore, almost all of the City-owned property in the hazard zone are un-developed and do not have assessed values. Valuation of these parcels can be challenging. In most cases these are properties owned by the City, County or other government entity. As this study focused on City vulnerabilities, only relevant City properties were evaluated, including undeveloped land. Fortunately, the vast majority of the parcels in the coastal hazard zone in Oxnard are undeveloped. Undeveloped properties were valued at the cost of conservation easements ($0.30 per sq. ft.) based on recent sales data in California. Some of these properties are wetland areas within the Ormond Beach area. Even though these properties are consistently inundated, they were included into the analysis at the conservation easement value.

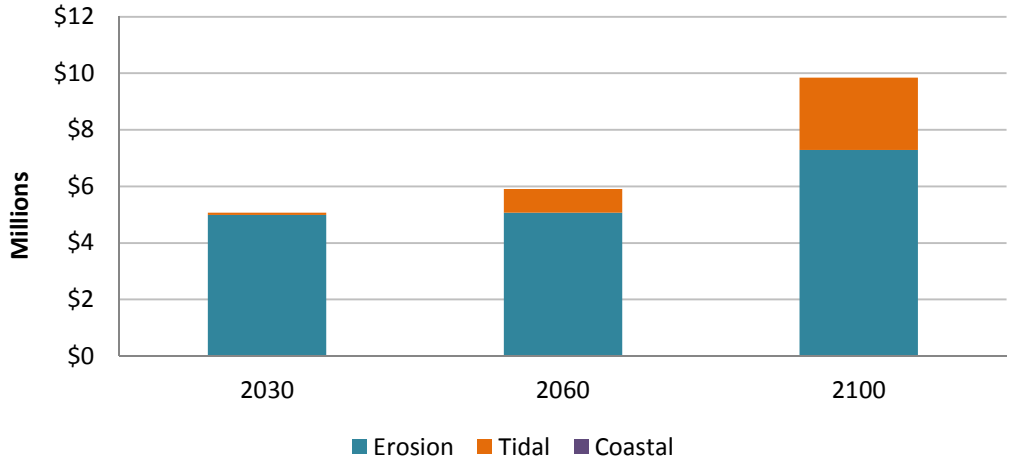
A few of the parcels are entitled for residential development. These were valued at the average for other residential property at risk, $125 per sq. ft. Table 15 presents the analysis of government-owned and undeveloped parcels vulnerable to coastal hazards.

Table 15. Economic Value of Undeveloped and City-Owned Property at Risk

	2030		2060		2100	
	Value	Pct.	Value	Pct.	Value	Pct.
Board of Equalization	$70,000	1.4%	$70,000	1.2%	$70,000	0.7%
City Property	$3,170,000	62.4%	$3,350,000	56.7%	$6,260,000	63.5%
Undedicated	-	-	-	-	$20,000	0.2%
Undeveloped	$1,840,000	36.2%	$2,490,000	42.1%	$3,510,000	35.6%
Total	**$5,080,000**	**100.0%**	**$5,910,000**	**100.0%**	**$9,860,000**	**100.0%**

Figure VII-33 shows the economic impact to all undeveloped and city-owned property caused by each projected coastal hazard. Overall, these losses are relatively small compared to other property losses in the city. Even by 2100, these losses are valued at less than $10 million.

Figure VII-33. Economic Value of Undeveloped and City-Owned Property at Risk



	2030	2060	2100
Erosion	$4,990,000	$5,070,000	$7,290,000
Tidal	$80,000	$840,000	$2,560,000
Coastal	$0	$0	$0
Total	**$5,070,000**	**$5,910,000**	**$9,850,000**

The City of Oxnard Public Works Department provides water and wastewater treatment to the entire city and certain areas in the adjacent unincorporated County of Ventura. The wastewater treatment facility is located at 6001 Perkins Road and has a nominal dry-weather daily treatment capacity of 31.7 million gallons. Effluent is discharged through an ocean outfall. Some of the plants facilities are over 50 years old and in need of repair or replacement. The entire facility is located with the coastal zone and an office building is the closest structure to the Pacific Ocean and Ormond Lagoon. Public Works is in the process of reviewing preliminary designs and cost estimates to either reconstruct deficient facilities within the existing site behind an approvable storm surge/wave run protection structure allowed for pre-1970's structures or condemn a small industrial park just north of the existing facility for new

facilities and gradually remove the most vulnerable facilities. Once a decision is made, Public Works would implement the approved plan within five years, well before expected SLR intensifies the vulnerability of that portion of the treatment plant closest to the Ormond Lagoon and Pacific Ocean.

Channel Islands Harbor

A majority of Planning Area 3, is located in Oxnard but is owned and operated by the County of Ventura as Channel Islands Harbor. The County unincorporated areas of Hollywood Beach and the Silver Strand are near the harbor and not included in the analysis. Channel Islands Harbor is a significant economic asset to the City. As discussed in the background section, Channel Islands Harbor was built as a recreational harbor in the 1960s and 1970s on 310 acres with approximately 2,150 boat slips, marina facilities, restaurants, sport fishing facilities, and shops.

Figures VII-34 and VII-35 show Channel Islands Harbor's susceptibility to coastal hazards. As shown, most of Channel Islands Harbor will be susceptible to tidal inundation hazards by 2030, which continues through 2100. The waterway communities north of Channel Islands Harbor in Planning Area 2 show impacts starting in 2060 with the complete southern area of the community impacted by 2100.

Figure VII-34. Vulnerability of Channel Islands Harbor by Planning Horizon

Figure VII-35. Vulnerability of Channel Islands Harbor by Coastal Hazard

The Ventura County Harbor Department provided the following information regarding the Channel Islands Harbor's annual income for the year 2016 (Table 16a and 16b). However, the full impact of the harbor not only includes the direct income provided, but also the indirect and induced (aka "multiplier") effects on the City and County economies. Table 17 provides estimates of the full economic impact of Channel Islands Harbor on Ventura County. Overall, Channel Islands Harbor generates $120.9 million in economic activity and 825 jobs generated over $57 million in local wages and benefits.

Table 16a. Income Statement for Channel Islands Harbor

Income Type	Amount
Gross Income from Private Parties	$52,706,000
County Gross Income	$2,413,000
Anticipated near term	$14,500,000
Total	**$69,619,000**

Table 16b. Economic Impacts of Channel Islands Harbor

Impact Type	Employment	Labor Income	Output
Direct Effect	451.7	$38,570,000	$69,620,000
Indirect Effect	131	$7,540,000	$17,270,000
Induced Effect	242.4	$11,060,000	$34,090,000
Total Effect	**825.1**	**$57,170,000**	**$120,970,000**

These impacts can also be divided into different economic sectors. Table 17 shows the total economic impact of Channel Islands Harbor by sector. Unsurprisingly, transportation and support activities generate the highest economic values.

Table 17. Economic Impacts of Channel Islands Harbor by Sector

Description	Employment	Labor Income	Output
Transportation and support activities	461.8	$39,430,000	$71,180,000
Real estate establishments	17.3	$300,000	$3,870,000
Offices of health practitioners	15.9	$1,250,000	$2,280,000
Food services and drinking places	31.6	$750,000	$2,190,000
Nondepository credit intermediation	10	$850,000	$1,690,000
Couriers and messengers	11.8	$740,000	$1,610,000
US Postal Service	13.5	$1,310,000	$1,510,000
Employment services	32.1	$980,000	$1,370,000
Services to buildings and dwellings	14.7	$420,000	$1,140,000

Harbor infrastructure, such as bulkheads, revetments and seawalls, would also be vulnerable to coastal hazards and would need to be maintained or replaced in the future with additional funding. However, costs associated with harbor infrastructure was not included due to the availability at the time of this report. Additionally, *Channel Islands Harbor Public Works Plan* provides policy direction for development and retrofitting in Channel Islands Harbor.

VIII. Conclusions

A significant portion of Oxnard's vitality is dependent on coastal access of the community, the operation of coastal infrastructure, highly-valued ecological areas, and recreational and commercial opportunities. Because of the city's unique geographic location, geomorphology, and dependence on coastal resources, the city is particularly vulnerable to the effects of climate-induced coastal hazards and their associated impacts, ranging from coastal flooding to dune erosion to inland flooding when the regional storm system cannot drain to the ocean. This report assesses Oxnard's vulnerability to current and future SLR to assist the City in updating the LCP and in making better informed decisions regarding coastal land use and development applications (e.g., coastal development permits, land use permits).

Vulnerability and Economic Impact by Planning Horizon

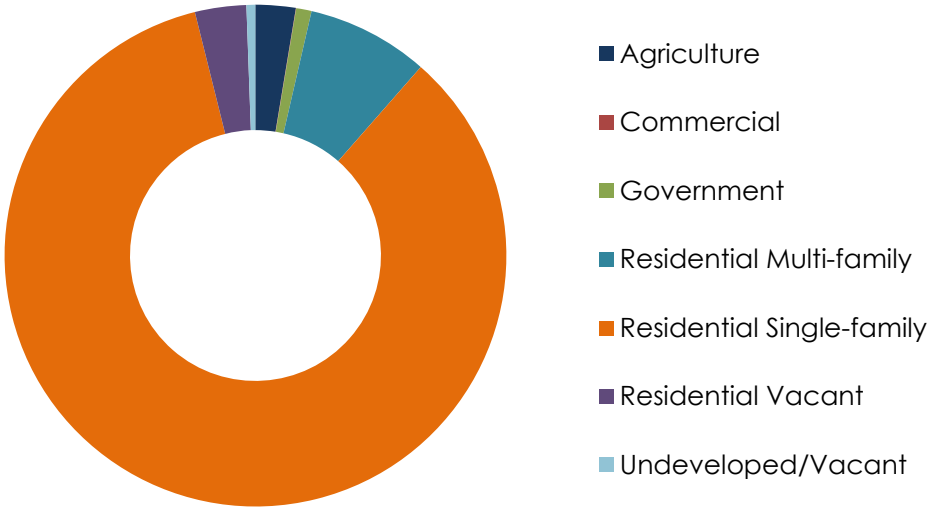
Oxnard's coastal zone has a wide range of land uses. Consequently, prioritizing where to start investing in protection against climate change and SLR can prove to be challenging. The following graphs show what Oxnard's potential economic losses are by planning year horizon. By knowing what resources are the most at risk at each planning horizon, the City can strategize what actions should be taken sooner and how to continue to incorporate the rapidly changing science regarding climate change and SLR.

Vulnerability by 2030

Many of Oxnard's coastal resources are projected to be impacted by coastal hazards by 2030. Among the impacted resources, the largest sector (whose economic value was evaluated) is single-family residential units. Homes in Planning Area 2 (Oxnard Shores area) and Planning 3 (Channel Islands Harbor area) are highly susceptible to coastal hazards, mostly due to rising tide inundation. The Oxnard Shores mobile home park is also susceptible to erosion and coastal storm floods by 2030. By 2030, losses in this sector total approximately $277,360,000, due to the high value of the coastal homes. This accounts for 85 percent of the economic losses in 2030.

The second largest vulnerable economic sector is multi-family residential units, whose losses total approximately $25,790,000. By 2030, losses in other sectors are around 10 million or below, considerably less compared to the single- and multi-family residential sector.

Figure VIII-1. Distribution of Economic Losses by 2030



Oxnard's beaches and coastal dune areas are susceptible to coastal storm flooding as early as 2030. Two resources located near the coastal dunes include McGrath State Beach and large-scale power plants. Since McGrath State Beach is already subject to coastal and estuary tidal flooding, plans to relocate the park campgrounds are in place. California State Parks has estimated that campground relocation out of the flood zone will cost approximately $11.5 million (City of Ventura 2014). The power plants in Planning Area 1, MBGS and SCE MPP, are mainly susceptible to coastal storm floods. In Planning Area 4, the proximity of the OBGS to the shoreline makes it susceptible to coastal erosion, tidal flooding and coastal storm flooding by 2030.

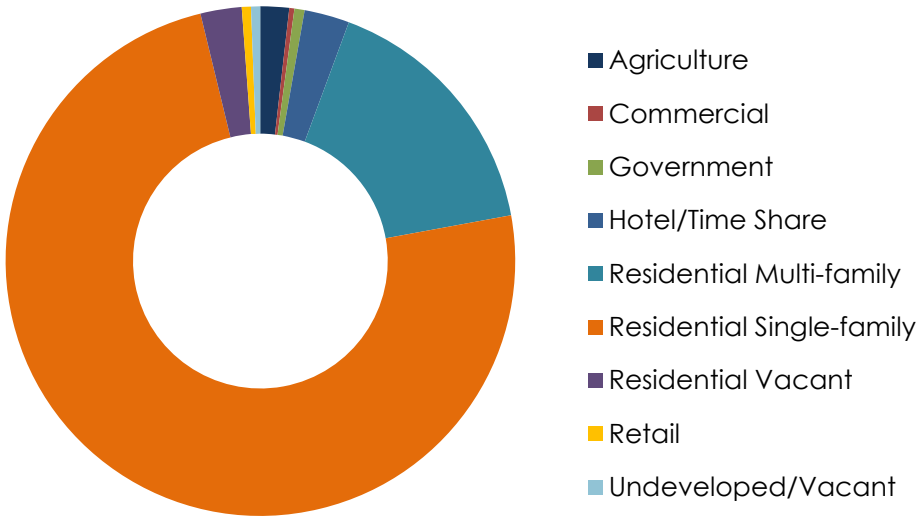
All storm drain outfalls are project to be impacted by 2030 due to coastal storm flooding. The compromise of the coastal outfalls can cause storm drains throughout the city to back up, which would cause damage to the sewer and storm drain system outside of the coastal hazard zone. Other infrastructure in the sewer network such as force mains, gravity mains, lift stations, and manholes are most susceptible to coastal erosion. The economic impact of sewer network damage in the coastal zone

is approximately $4,100,000 by 2030. There is no loss estimate of citywide storm drain “backup” scenario.

Vulnerability by 2060

Even though single- and multi-family residential uses continue to be the largest vulnerable asset, hotel uses become vulnerable. The economic loss of hotels in 2060 is approximately $15,560,000. Also the commercial shopping center at the Seabridge Marina on S. Victoria Ave becomes susceptible to tidal flooding in 2060. The economic impact due to commercial losses is approximately $4,890,000 by 2060. Vulnerability of infrastructure such as roads, sewer structures, and water mains doubles by 2060.

Figure VII-2. Distribution of Economic Losses by 2060



Vulnerability by 2100

After 2060, major manufacturing properties become the largest commercial and industrial sector impacted within the 2100 time horizon. These economic losses are approximately $29,600,000. These types of parcels are almost completely owned by New-Indy Containerboard LLC. By comparison, however, economic losses related to industrial and commercial property are small relative to the economic losses of the residential properties.

Figure VIII-3. Distribution of Economic Losses by 2100

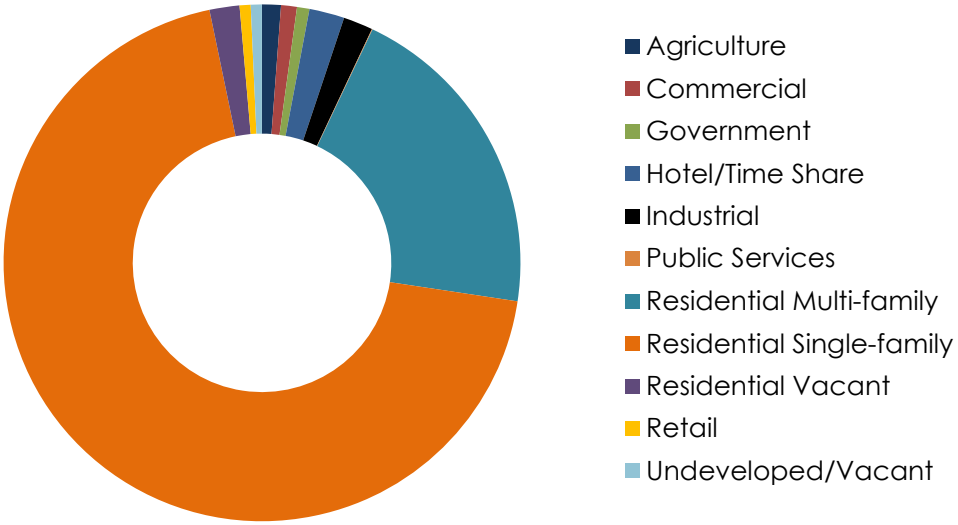


Table 18 summarizes the results presented in this analysis. These costs will be incurred by a variety of entities in Oxnard and the type of cost will differ by body or entity. Therefore, the type of cost and to who it could be incurred by should be taken in consideration in future planning deliberations. The City of Oxnard has a significant amount of property at risk due to coastal and tidal flooding, as well as erosion. By far the most significant category, in terms of economic losses loss, is residential property. The impact to residential property due to property damages, in all three planning horizons, amount to over 90 percent of the damages. Most of these costs would be incurred by private citizens could include residential structure damage or loss of structure.

Table 18 also provides estimates of the economic value of the two beaches within city limits (McGrath State Beach and Oxnard Shores) as well as Channel Islands Harbor. Most of these costs would be incurred by the public and could include loss of public access and recreational resources provided by the beach and the harbor. In addition, this report has estimated the costs to the City and other entities due to losses in property and infrastructure. These 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.

Table 18. Summary of Potential Damages to the City of Oxnard

Item	2030	2060	2100
Residential Property (SFDs)	$277,360,000	$400,570,000	$579,530,000
Other Residential Property	$36,660,000	$118,800,000	$204,060,000
Commercial/Industrial Property	$90,000	$4,890,000	$29,600,000
City Property	$5,070,000	$5,910,000	$9,850,000
Other Property	$8,460,000	$10,490,000	$12,560,000
Infrastructure: Roads	$4,000,000	$6,420,000	$10,640,000
Infrastructure: Water/Sewer	$4,100,000	$7,220,000	$13,830,000
Total	**$335,740,000**	**$554,300,000**	**$860,070,000**

Item	Annual Value
Beach Recreation[9]	$4,403,800
Channel Islands Harbor[10]	$120,970,000

[9] Time horizon predictions for recreation value are dependent upon beach width projections which are not included in this analysis. Beach width projections and recreation value by time horizon will be provided in the adaptation analysis.

[10] Time horizon predictions for Channel Islands Harbor are dependent on site specific economic information. For this analysis, economic information was extracted from the Harbor's operating expenses and revenues. A more detailed analysis of future impacts and adaptation strategies for the Harbor will be provided in the adaptation analysis.

IX. Next Steps

The next step to help the City plan for the future is to analyze what adaptation strategies would provide the most protection against climate change and SLR. Adaptation to climate change involves a range of policies and mitigation measures to respond to the climate change impacts already being experienced and adaptation measures designed to reduce future climate change impacts. These policies and measures can be taken in advance of potential impacts or react depending on the degree of preparedness and the willingness to tolerate risk. With a solid understanding of the City's coastal hazards specific risks and the physical processes responsible for causing the risk; the City can effectively develop these adaptation measures.

References

Beach Erosion Authority for Clean Oceans and Nourishment (BEACON). 2009. *Coastal Regional Sediment Management Plan Central Coast from Pt. Conception to Pt. Mugu.* Available online: http://www.dbw.ca.gov/csmw/pdf/CRSMP_Report_FINAL_30Mar2011.pdf

California Coastal Commission (CCC). 2013. *Local Coastal Program Update Guide*. Available online: https://documents.coastal.ca.gov/assets/lcp/LUPUpdate/LCPGuidePartI_Full_July2013.pdf

_____.2015. Sea Level Rise Policy Guidance. Available online: http://documents.coastal.ca.gov/assets/slr/guidance/August2015/0_Full_Adopted_Sea_Level_Rise_Policy_Guidance.pdf.

StateCoastal Conservancy. 2015. *Strategic Plan 2013-2018*. December 6, 2012. Updated June 25, 2015. http://scc.ca.gov/webmaster/reports/SCC-Strategic-Plan-Update-2015.pdf

_____. 2016. "Ormond Beach Coastal Restoration And Public Access Plan Request for Services, September 2016."

California Department of Finance. 2016. *E-1 Population Estimates for Cities, Counties, and the State — January 1, 2015 and 2016*. Available online: http://www.dof.ca.gov/Forecasting/Demographics/Estimates/E-1/

California Department of Parks and Recreation. 2015. "McGrath State Beach." Available online: http://www.parks.ca.gov/?page_id=607.

California Energy Commission (CEC). 2009. Climate Change Scenarios and Sea Level Rise Estimates for California - 2008 Climate Change Scenarios Assessment - Final Report. Available online: http://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2009-014-F

Center for Clean Air Policy. 2011. *The Value of Green Infrastructure for Urban Climate Adaptation*. Available online: http://ccap.org/assets/The-Value-of-Green-Infrastructure-for-Urban-Climate-Adaptation_CCAP-Feb-2011.pdf

ESA PWA .2013. *Coastal Resilience Ventura* – Technical Report for Coastal Hazards Mapping. Prepared for the Nature Conservancy, 7/31/2013, 59 pgs. Available online: http://maps.coastalresilience.org/ventura/methods/CRV_Hazards_Mapping_Technical_Report.pdf

Intergovernmental Panel on Climate Change (IPCC). 2007. "Summary for Policymakers." *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

_____. 2014. "Summary for Policymakers." *Climate Change 2014, Mitigation of Climate Change*. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

National Research Council (NRC). 2012. *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future*. National Academy Press: Washington, D.C.

National Oceanic Atmosphere Administration (NOAA). 2017. National Center for Environmental Information. Available online: https://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/global-historical-climatology-network-ghcn

Ocean Protection Council (OPC). 2017. *Rising Seas in California: An Update on Sea Level Rise Science*. http://www.opc.ca.gov/webmaster/ftp/pdf/docs/rising-seas-in-california-an-update-on-sea-level-rise-science.pdf

Oxnard, City of. 2011. City of Oxnard General Plan. Available online: https://www.oxnard.org/city-department/development-services-4/planning/2030-general-plan/

Pacific Institute. 2009. *The Impacts of Sea-Level Rise on the California Coast.* A paper from the California Climate Change Center, May 2009.

Patsch and Griggs. 2006. *Littoral Cells, Sand Budgets, and Beaches: Understanding California S Shoreline*. Available online: http://www.dbw.ca.gov/csmw/PDF/LittoralDrift.pdf

Revell, D.L., Battalio, R., Spear, B., Ruggiero, P., and Vandever, J. 2011. *A Methodology for Predicting Future Coastal Hazards due to Sea-Level Rise on the California Coast.* Climatic Change 109:S251-S276.

Ventura County. 2008. *Channel Islands Harbor Public Works Plan*. Available online: http://vcportal.ventura.org/HARBOR/docs/PWP%20%20Final%203rd%20Amendment%2008-25-10%20for%20website.pdf

_____.2017. "Hazardous Materials Business Plan Program." Available online: http://www.vcrma.org/envhealth/cupa/hmbp.html

U.S. Army Corps of Engineers (USACE). 2011. *Sea-Level Change Considerations for Civil Works Programs*. US Army Corps of Engineers, EC 1165-2-212.

U.S. Census Bureau. 2010 Census Summary Files. Available online: https://www.census.gov/2010census/data/

U.S. Environmental Protection Agency (U.S. EPA). 2017. "Halaco." Available online: https://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/ViewByEPAID/CAD009688052

Ventura, City of. 2014. *Santa Clara River Estuary: Flood Management Options for McGrath State Beach*. Available online: http://www.cityofventura.net/files/file/public-works/water/McGrath%20Flood%20Management%20Plan%20Report%2020140828%20Item%2016%20LARWQCB%20Mtg.pdf

Walsh, J., D. Wuebbles, K. Hayhoe, J. Kossin, K. Kunkel, G. Stephens, P. Thorne, R. Vose, M. Wehner, J. Willis, D. Anderson, S. Doney, R. Feely, P. Hennon, V. Kharin, T. Knutson, F. Landerer, T. Lenton, J. Kennedy, and R. Somerville, 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. Ch. 2: Our Changing Climate. J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 19-67. Doi: 10.7930/J0KW5CXT.