AGENDA

Tuesday, January 28, 2020 **6:30 P.M. Open Session**

SPECIAL JOINT MEETING OF CITY COUNCIL AND PLANNING COMMISSION

Council Chambers
211 Hillcrest Avenue
Marina, California

TELECONFERENCE LOCATIONS: [1]

989 Mohawk Lane
Scottdale, AZ 85255

VISION STATEMENT

Marina will grow and mature from a small town bedroom community to a small city which is diversified, vibrant and through positive relationships with regional agencies, self-sufficient. The City will develop in a way that insulates it from the negative impacts of urban sprawl to become a desirable residential and business community in a natural setting. **(Resolution No. 2006-112 - May 2, 2006)**

MISSION STATEMENT

The City Council will provide the leadership in protecting Marina's natural setting while developing the City in a way that provides a balance of housing, jobs and business opportunities that will result in a community characterized by a desirable quality of life, including recreation and cultural opportunities, a safe environment and an economic viability that supports a high level of municipal services and infrastructure. **(Resolution No. 2006-112 - May 2, 2006)**

1. CALL TO ORDER 

2. ROLL CALL & ESTABLISHMENT OF QUORUM: (City Council, Airport Commissioners, Marina Abrams B Non-Profit Corporation, and Redevelopment Agency)

   Council Members: Lisa Berkley, Adam Urrutia, Frank O'Connell, Mayor Pro Tem/Vice Chair Gail Morton, Mayor/Chair Bruce C. Delgado

   Planning Commission Members: Thomas Mann, Jeffrey Weekley, Brian McCarthy, Victor Jacobsen, Katherine Biala, David Bielsker, Chairperson David Burnett,

3. MOMENT OF SILENCE & PLEDGE OF ALLEGIANCE (Please stand)

[1] Note: Pursuant to Government Code Section 54953(b), this meeting will include teleconference participation by Commissioner Kathy Biala from the address above. This Notice and Agenda will be posted at the teleconference location

4. OTHER ACTIONS:

   a. City Council hold a joint public workshop (Workshop #4) with the Planning Commission on the Local Coastal Plan update, receive the draft Local Coastal Land Use and Implementation Plan amendments to address the sea level rise and coastal erosion, and provide direction to Staff

5. ADJOURNMENT:

CERTIFICATION

I, Anita Sharp, Deputy City Clerk, of the City of Marina, do hereby certify that a copy of the foregoing agenda was posted at City Hall and Council Chambers Bulletin Board at 211 Hillcrest Avenue, Monterey County Library Marina Branch at 190 Seaside Circle, City Bulletin Board at the corner of Reservation Road and Del Monte Boulevard before 6:30 p.m. Friday, January 24, 2020

_____

ANITA SHARP, DEPUTY CITY CLERK

City Council, Airport Commission and Redevelopment Agency meetings are recorded on tape and available for public review and listening at the Office of the City Clerk and kept for a period of 90 days after the formal approval of MINUTES.

City Council meetings may be viewed live on the meeting night and at 12:30 p.m. and 3:00 p.m. on Cable Channel 25 on the Sunday following the Regular City Council meeting date. In addition, Council meetings can be viewed at 6:30 p.m. every Monday, Tuesday and Wednesday. For more information about viewing the Council Meetings on Channel 25, you may contact Access Monterey Peninsula directly at 831-333-1267.

Agenda items and staff reports are public record and are available for public review on the City's website (www.cityofmarina.org), at the Monterey County Marina Library Branch at 190 Seaside Circle and at the Office of the City Clerk at 211 Hillcrest Avenue, Marina between the hours of 10:00 a.m. 5:00 p.m., on the Monday preceding the meeting.

Supplemental materials received after the close of the final agenda and through noon on the day of the scheduled meeting will be available for public review at the City Clerk's Office during regular office hours and in a 'Supplemental Binder' at the meeting.

Members of the public may receive the City Council, Airport Commission and Redevelopment Agency Agenda at a cost of $55 per year or by providing a self-addressed, stamped envelope to the City Clerk. The Agenda is also available at no cost via email by notifying the City Clerk at marina@cityofmarina.org

ALL MEETINGS ARE OPEN TO THE PUBLIC. THE CITY OF MARINA DOES NOT DISCRIMINATE AGAINST PERSONS WITH DISABILITIES. CITY HALL AND COUNCIL CHAMBERS ARE ACCESSIBLE FACILITIES.

January 22, 2020 Item No: **4a**

Honorable Mayor and Members of the Marina City Council

Special City Council/Planning Commission Meeting of January 28, 2020

CITY COUNCIL HOLD A JOINT PUBLIC WORKSHOP (WORKSHOP #4) WITH THE PLANNING COMMISSION ON THE LOCAL COASTAL PLAN UPDATE, RECEIVE THE DRAFT LOCAL COASTAL LAND USE AND IMPLEMENTATION PLAN AMENDMENTS TO ADDRESS SEA LEVEL RISE AND COASTAL EROSION, AND PROVIDE DIRECTION TO STAFF

REQUEST:

1. It is requested that City Council hold a joint public workshop with the Planning Commission on the Local Coastal Plan Update, receive draft Local Coastal Land Use and Implementation Plan amendments to address sea level rise and coastal erosion, and provide direction to staff.

BACKGROUND:

The purpose of this fourth and final public workshop is to update the City Council, Planning Commission and the public on the status of the City's efforts to update the Local Coastal Program (LCP). This workshop will focus on the draft Local Coastal Land Use and Implementation Plan amendments to address sea level rise and coastal erosion (**ATTACHMENT 1**). The goal of this workshop is to introduce the draft coastal hazards and sea level rise policies and implementation strategies.

This update is a standalone document. Some deletions and revisions to the City's existing LCP will need to occur as a part of this update to ensure consistency. An example of a policy that would require revision is Policy 22. that states "To discourage new development except for a boat harbor along the Coast which would require seawall, rip rap or other protective structure or regular dredging for maintenance."

Staff will take Council, Commission and public comment and refine the amendments for the adoption hearings. Notices of the workshop were mailed to all property owners within the City's Coastal zone as well as any interested parties.

On March 26, 2019, the City Council and the Planning Commission held the first public workshop to introduce the planning effort and the draft results of the background report. City staff was in regular communication with Coastal Commission staff and a draft of the report was sent to the CCC staff for review and comment. CCC staff reviewed the draft report and provided comments on April 12, 2019. The final version of the background report was posted to the City's website.

On June 13, 2019, the City Council and the Planning Commission held a second public workshop to introduce a rough draft of the City's vision with regard to sea level rise and coastal erosion and goals related to that vision. After discussion, the City Council and Planning Commission provided comments and directed staff to revise the vision and goals statement.

On September 12, 2019, the City Council and the Planning Commission held a third public workshop to introduce draft adaptation strategies and policy changes to improve preparedness, avoid hazards, and examine natural protection measures to reduce the risks projected to occur over time that have been incorporated into the Existing Conditions and Sea Level Rise Issues Report. This adaptation planning process represents the next opportunity for Marina to lead the State and the Country on how to effectively adapt to sea level rise. After discussion, the City Council and Planning Commission provided comments and directed staff to revise the draft strategies and policies.

On November 8, 2019, the final adaptation report was sent to the CCC staff for review and comments and staff continued to work on the draft LCP update. The CCC staff received the draft Coastal Hazards and Sea Level Rise LCP update (draft land use plan and draft implementation plan) on December 20, 2019 for review.

Public outreach is an important and required component of the LCP update. As part of the outreach strategy, the City has contacted major stakeholders, mailed notices of all workshops and hearings, and provided additional opportunities for public comment through surveys on the City's website. In addition, city staff and their consultants had met with the oceanfront landowners found most vulnerable to the effects of sea level rise and coastal erosion.

Next Steps

Next steps for the LCP update include:

- Planning Commission recommendation to City Council on the draft LCP – late February 2020
- City Council approval of the draft LCP – March 2020
- Coastal Commission hearing – any revisions to the plan would be required to be adopted by the City Council.

FISCAL IMPACT:

On November 7, 2017, the City Council adopted Resolution 2017-97 accepting a Local Coastal Program Assistance Grant from the California Coastal Commission to fund an update to the City of Marina Local Coastal Program (LCP).

The resolution accepts a grant reward of $85,685 and appropriated $25,000 in matching funds from the General Fund. The City also agreed to provide an estimated $50,000 in in-kind services.

Through the RFP process, the City selected EMC Planning Group to prepare the LCP Update. On July 5, 2018, the City executed an agreement for consulting services with EMC Planning Group under an existing on-call services agreement for a not-to-exceed amount of $110,685 ($85,685 in grant funding and $25,000 in authorized General Fund dollars).

ENVIRONMENTAL DETERMINATION

The City of Marina determined that the proposed action is not a project as defined by the California Environmental Quality Act (CEQA) (CCR, Title 14, Chapter 3 ("CEQA Guidelines), Article 20, Section 15378). In addition, CEQA Guidelines Section 15061 includes the general rule that CEQA applies only to activities which have the potential for causing a significant effect on the environment. Where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment, the activity is not subject to CEQA. Because the proposed action and this matter have no potential to cause any effect on the environment, or because it falls within a category of activities excluded as projects pursuant to CEQA Guidelines section 15378, this matter is not a project. Because the matter does not

cause a direct or any reasonably foreseeable indirect physical change on or in the environment, this matter is not a project. Any subsequent discretionary projects resulting from this action will be assessed for CEQA applicability.

CONCLUSION:

This request is submitted for City Council and Planning Commission for discussion and direction to staff.

Respectfully submitted,

_____

Christy Hopper
Planning Services Manager
Community Development Department
City of Marina

REVIEWED/CONCUR:

_____

J. Fred Aegerter, AICP
Community Development Director
Community Development Department
City of Marina

_____

Layne P. Long
City Manager
City of Marina

Attachment 1: December 2019 – Draft Local Coastal Land Use and Implementation Plan Amendments

City of Marina Local Coastal Program Land Use Plan

Coastal Hazards and Sea Level Rise

December 20, 2019

Prepared by

EMC Planning Group
Revell Coastal, LLC

CITY OF MARINA LOCAL COASTAL PROGRAM LAND USE PLAN

COASTAL HAZARDS AND SEA LEVEL RISE

PREPARED FOR

City of Marina

Christy Hopper, Planning Services Manager

211 Hillcrest Avenue

Marina, CA 93940

Tel 831. 884.1220

PREPARED BY

EMC Planning Group, Inc.

Revell Coastal, LLC

301 Lighthouse Avenue, Suite C

Monterey, CA 93940

Tel 831.649.1799

Fax 831.649.8399

Polaris Kinison Brown, MS – Principal Planner

kinisonbrown@emcplanning.com

www.emcplanning.com

December 20, 2019

TABLE OF CONTENTS

Appendices

Coastal Hazards and Sea Level Rise

BACKGROUND

The City of Marina is a unique place in California. Presently, the City faces some of the highest rates of erosion in California, and yet it has not placed any shore parallel coastal armoring. With the unique dune topography, inland distance to development, and soon to be reduced erosion rates from the cessation of sand mining, the City of Marina faces minimal exposure to most coastal hazards and sea level rise.

The following are key findings identified as a result of analyses in the *City of Marina 2019 Existing Conditions and Sea Level Rise Issues Report* (Appendix A):

Photo: www.seemonterey.com

- Coastal dune erosion hazards are the biggest threat to the City of Marina, with potentially up to five feet of sea level rise. The primary impact from this erosion is to open space and dune habitats.
- One sewer pump station, one visitor serving resort, one groundwater supply well, an (aging/ phasing out) water treatment facility, and the coastal access and associated parking lot at Marina State Park are the key vulnerabilities in the City to projected coastal erosion.
- With five feet of sea level rise and a one percent annual chance storm, there is a chance that additional areas near the Reservation Road underpass in the City could be temporarily impacted.
- Reduction of erosion rates from cessation of sand mining is expected to reduce the risk of sea level rise impacts to the City.
- No projected erosion impacts to any residential, mixed use, or commercial land uses, were identified.
- Currently the City has no coastal armoring.

The City of Marina is a vibrant, sustainable coastal town and is committed to protecting and preserving its unique natural coastline and its other valued coastal resources (including accessible beaches, visual quality, groundwater, beach and dune habitat, and diverse population of plants and wildlife including threatened and endangered species) in perpetuity to support a local economy and community identity based on coastal tourism, low impact and affordable recreation, and natural habitats.

City of Marian Vision Statement October 2019

Natural dune erosion from large storm waves is the primary hazard challenging the Marina shoreline. Figure 1, Coastal Hazards with Areas of Potential Sea Level Rise, shows the areas of Potential hazards related to projected Sea level rise as unidentified in the report. Dune erosion, however, is a natural process that creates and maintains beaches through time even in the face of sea level rise. As identified in the *Existing Conditions and Sea Level Rise Issues* report, the goal of any adaptation policy or project in Marina should focus on reducing erosion rates, while allowing natural erosion and shoreline

Photo: www.californiabeaches.com

fluctuations to maintain beaches. This Coastal Hazards and Sea Level Rise chapter of the Land Use Plan contains policies to respond to, and to address, coastal hazards in the City's planning and permitting process. Definitions used in this chapter are provided as Appendix B.

SUMMARY OF PUBLIC PARTICIPATION AND OUTREACH

As part of the of the Coastal Hazards and Sea Level Rise update to the City's Local Coastal Program (LCP), the City of Marina developed a robust public outreach program which was submitted to the Coastal Commission staff for approval to ensure consistency with Coastal Act requirements.

The public outreach program included a community questionnaire, community comment forum, individual stakeholder meetings, and a series of joint Planning Commission and City Council study sessions/public workshops. To ensure that stakeholders, interested citizens and agencies were aware of the update process and public meetings, City staff:

- Established email notification lists and identified key links to community cross sections to facilitate information flow and participation.
- Generated and maintained a web page with background documents, meeting schedules, meeting agendas and summaries, frequently asked questions, and other information.

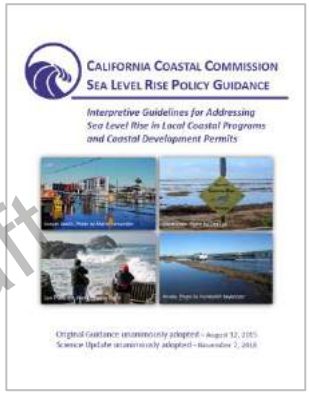
City staff and their LCP update consultants met with individual stakeholders on July 29, 2019. Identified stakeholders included State Parks, the Sanctuary Beach Resort, and Marina Coast Water District (MCWD). The City hosted four public workshops during the update process with focus topics that included: sea level rise and coastal hazards background, vision and goals, adaptation alternatives, and the Draft LCP policy development and implementation.

Marina is a leader in improving coastal resiliency, responding to climate change impacts, and adapting to sea level rise and identified coastal hazard risks in a way that protects both its coastal resources and public safety and welfare.

City of Marian Vision Statement October 2019

COASTAL ACT POLICIES

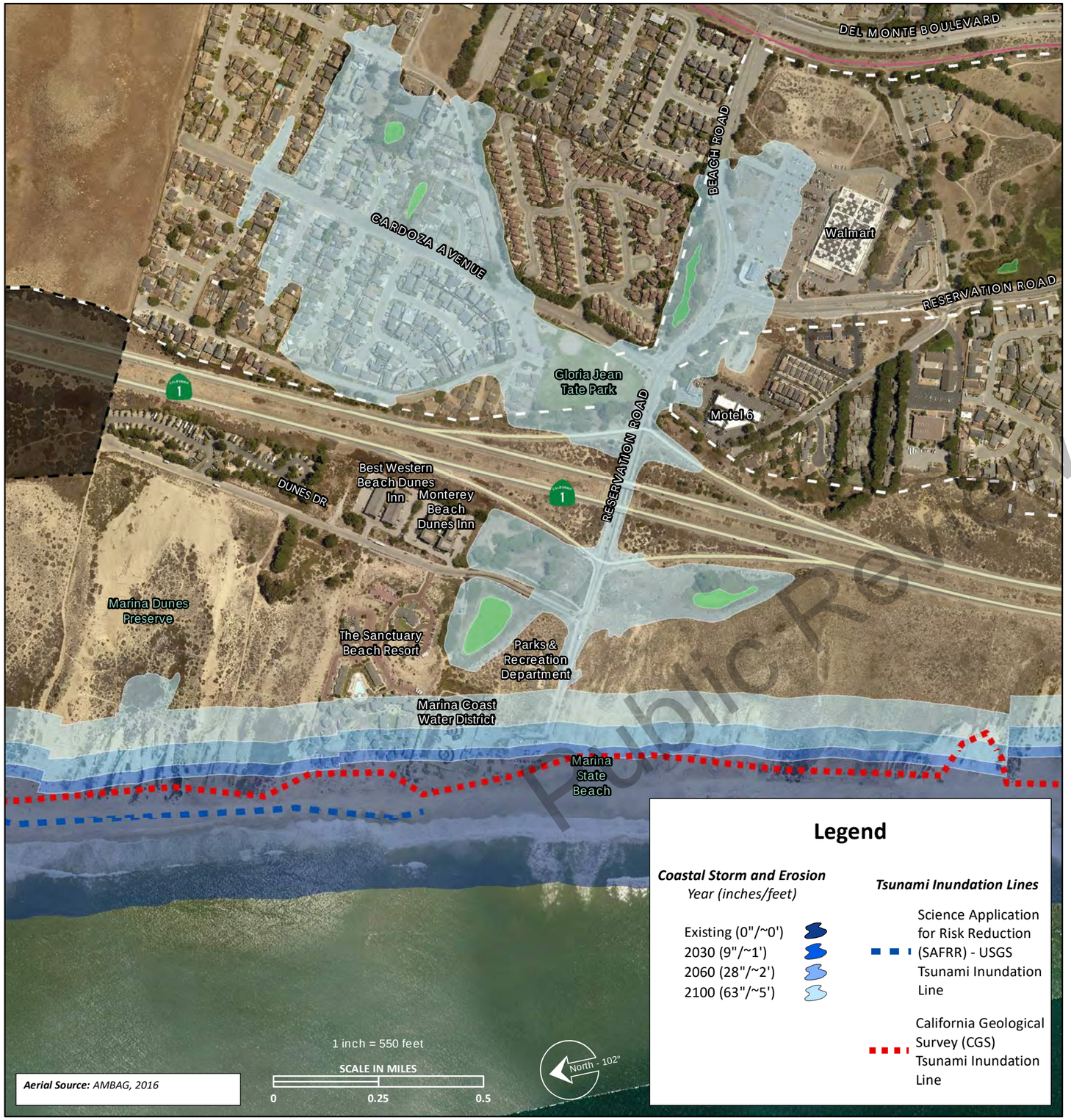
Various parts of the *California Coastal Act* (Coastal Act) support policies in LCP Land Use Plans that address climate change, sea level rise, and coastal hazards. *The California Coastal Commission Sea Level Rise Policy Guidance* (California Coastal Commission updated 2018) provides four guiding principles, many derived directly from the requirements of the Coastal Act, that can be used as a framework by which sea level rise planning can be assessed:



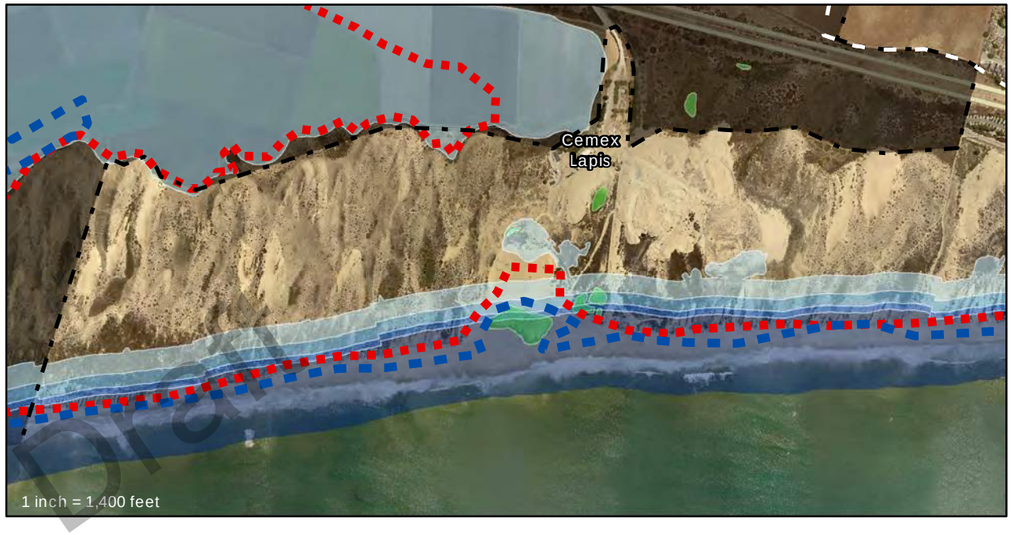
- The use of best available science to guide decisions (Coastal Act Sections 30006.5; 30335.5);
- Minimization of coastal hazards through planning and development standards (Coastal Act Sections 30253, 30235; 30001, 30001.5);
- Maximization of protection of public access, recreation, public views and other coastal resources (Coastal Act Chapter 3 policies); and
- Maximization of agency coordination and public participation (Coastal Act Chapter 5 policies).

Refer to Appendix C, Coastal Act Polices that May be Considered When Evaluating Sea Level Rise and Coastal Hazards for a listing of Coastal Act policies that may be relevant to the City of Marina's sea level rise and coastal hazards considerations.

Figure 1. Coastal Hazards with Areas of Sea Level Rise - Central Marina



North Marina



South Marina

Legend

Coastal Storm and Erosion
Year (inches/feet)

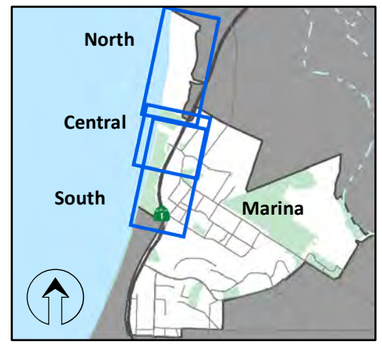
- Existing (0"/~0')
- 2030 (9"/~1')
- 2060 (28"/~2')
- 2100 (63"/~5')

Tsunami Inundation Lines

- Science Application for Risk Reduction (SAFRR) - USGS Tsunami Inundation Line
- California Geological Survey (CGS) Tsunami Inundation Line

Features

- City Boundary
- Coastal Zone Boundary
- Highway
- Railroad
- Seasonal or Permanent Ponds



This side intentionally left blank.

GENERAL PLAN AND OTHER POLICIES

The City's General Plan and 1982 LCP contain some guidance as to community values and what is important in the face of coastal hazards and sea level rise. Relevant policies within these two documents are presented below.

General Plan

General Plan Vision Statement

> Marina desires to grow and mature, along with its image, from a small town, primarily bedroom community, to become a small city which is diversified, vibrant and mostly self-sufficient. The City can and will accomplish this by achieving both the necessary level and diversity of jobs, economic activity, public services, housing, civic life (including culture and recreation), and parks and open space.

General Plan Goals

Specific goals within the City's General Plan that are relevant to the focused LCP update include:

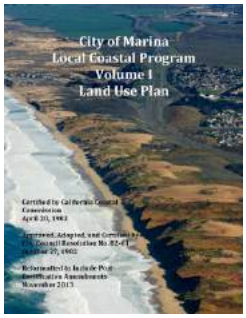
Community Goal 1.18

(2) Community development which avoids or minimizes to the greatest extent possible the consumption or degradation of non-renewable natural resources including natural habitats, water, energy, and prime agricultural land.

(13) Ample opportunities for outdoor recreation for all residents, both within their immediate neighborhoods, elsewhere in the city, and in the immediate environs.

Photo: www.montereybaycahotelspinterest.com

Local Coastal Program



Specific policies within the1982 LCP that are relevant to the focused LCP update include:

Policy 8. To prohibit further degradation of the beach environment and conserve its unique qualities.

Access Component

2. To provide beach access and recreational opportunities consistent with public safety and with the protection of the rights of the general public and of private property owners.

3. To provide beach access in conjunction with the new development where it is compatible with public safety, military security and natural resources protection; and does not duplicate similar access nearby.

LAND USE PLAN POLICIES – COASTAL HAZARDS

Coastal Hazards

HAZ-1. The Marina coastal zone is an irreplaceable resource and its protection and preservation as a natural living shoreline with connections between the ocean, beaches and dunes is a matter of great public importance.

It is the intent of the Local Coastal Program that the City responds to climate change impacts, and adapts to coastal hazard risks in a way that protects and preserves its unique natural coastline,

Photo: Steve Zmak

valued coastal resources, and ensures public safety and welfare.

A history of proactive planning has avoided the construction of any shoreline protective devices. It is the intent of the Local Coastal Program to ensure that no shoreline protective devices are utilized, for new or existing development.

HAZ-2. The City shall continue to gather and develop information on the potential effects of sea level rise and coastal hazards on Marina's shoreline, including identifying the most vulnerable areas, structures, facilities, and resources, with a focus on preserving sensitive coastal resource areas.

Project-specific coastal hazards assessments, as well as updates and amendments to the LCP, shall use the best available science, including estimates of expected sea level rise rates, elevations, and potential resultant impacts. The information gathered should address multiple future time horizons (e.g., 2050, 2100) or multiple sea level rise elevation scenarios, as appropriate and feasible.

HAZ-3. The City of Marina is recognized as a Tsunami Ready City. The City shall identify a warning system and procedures for protection of life and property in coastal areas that are subject to storm and tsunami hazard, including informing visitors to the shoreline and oceanfront hotels of the potential danger of large waves. New development in Marina's coastal zone shall provide evacuation information and preparedness planning as necessary to warn of potential tsunami risks along the shoreline.

Photo: www.cityofmarina.org

HAZ-4. Development shall be sited and designed to minimize risks to life and property and assure stability and structural integrity over the life of the development; and shall and avoid future shoreline protection devices,consistent with **Policy HAZ-6**.

HAZ-5. Development in areas of coastal hazards shall not create nor contribute significantly to erosion, geologic instability, or destruction of the site; shall not substantially alter natural landforms; shall not adversely alter local shoreline sand supply; and shall be developed in a manner consistent with **Policy HAZ-6**.

HAZ-6. Development shall be prohibited from using or requiring shoreline protective devices at any point during the development's life.

Photo: www.seemonterey.com

HAZ-7. Development proposed in potential coastal hazard areas shall be evaluated for potential coastal hazards at the site, based on all readily available information and the best available science. If the initial evaluation determines that the proposed development may be subject to coastal hazards over its lifetime, the following is required:

1) Identification of hazard avoidance strategies that have been prioritized and reflected in the development proposal including, but not limited to, consideration of additional building

heights to reduce footprint, consistent with LCP visual resource and ESHA policies.

2) Preparation of a site specific hazards report by a qualified geologist/engineer /geomorphologist, the purpose of which is to ensure that such development can be built and maintained in a manner consistent with the City's coastal hazards policies and with the greatest protection of coastal resources for the life of the development; and

3) Development will assume all risk and liabilities to coastal hazards and acknowledge that in the future the City may not always be able to guarantee access and infrastructure.

HAZ-8. The City shall encourage removal and restoration of the Marina Coast Water District's former wastewater treatment plant, including when threatened by coastal hazards.

Photo: Coastal Records Project

HAZ-9. As a response to coastal hazards, and notwithstanding other dune ESHA protection policies, the City shall work with State Parks to pursue measures to relocate the existing public parking and

Photo: www.californiabeaches.com

restroom structures at the present location of the Marina State Beach Parking Lot to a site outside of the projected erosion hazard zones to areas closer inland, nearer State Route 1 and consolidated with other facilities, so as to minimize impact and ensure continued public coastal access and recreation utility.

Photo: www.californiabeaches.com

HAZ-10. Planned and existing shoreline access points (including Marina State Beach, the Marina Dunes Preserve, and the Sanctuary Beach Resort) shall be sited, designed, and maintained as to minimize impacts to dune vegetation and avoid contributing to dune erosion.

Photo: www.duneguide.com

This side intentionally left blank.

City of Marina 2019
Existing Conditions and Sea Level Rise Issues Report

APPENDIX

A

FINAL

City of Marina

2019 Existing Conditions and Sea Level Rise Adaptation Report

City of Marina
211 Hillcrest Avenue
Marina, CA 93933

November 2019

CITY OF MARINA CALIFORNIA

REVELL COASTAL
Surf. Sand. Sustainability.

EMC PLANNING GROUP INC.
A LAND USE PLANNING & DESIGN FIRM

CALIFORNIA COASTAL COMMISSION

Contents

Figures

Page

Tables

Page

Executive Summary

Introduction

The 2019 City of Marina Existing Conditions and Sea Level Rise Issues Report (Report) provides a science-based vulnerability assessment that considered potential impacts from coastal hazards exacerbated by various elevations of sea level rise (9 inches, 28 inches, and 63 inches) to a wide range of infrastructure and natural resource sectors. Following extensive geospatial data gathering, an evaluation of potential vulnerabilities identified impacts to five different sectors in the City - Land Use and Parklands, Trails and Access, Water Supply and Wastewater, Roads, Parking, and Bike Routes, and Dune Habitat. The report also identifies potential adaptation strategies to reduce the risk and exposure to these sectors through time while acknowledging the secondary effects of some of these potential strategies.

The City of Marina is a unique place in California. Presently, the City faces some of the highest rates of erosion in California, and yet it has not placed any coastal armoring. The high rates of erosion have largely been caused by the long standing, last remaining coastal sand mine in the United States. In 2017, a monumental settlement agreement between the City, the California Coastal Commission (CCC), the California State Lands Commission (CSLC), and CEMEX, the owner of the sand mine laid out the phased end and remediation to nearly a century of sand mining activities.

With the unique dune topography, inland distance to development and soon to be reduced erosion rates from the cessation of sand mining, the City of Marina faces minimal exposure to most coastal hazards and sea level rise. Coastal dune erosion hazards are the biggest threat to the City of Marina even with up to 5 feet of sea level rise. The primary impact from this erosion will be to open space, recreation, and dune habitats along Marina State Beach. Infrastructure projected to be eroded and damaged include Marina Coast Water District facilities, some portions of the wastewater conveyance system, and the Sanctuary Beach Resort. Most damages to sectors begin to occur from erosion with less than a foot of sea level rise, but escalate to more substantial damages with ~2 feet of sea level rise. With ~5 feet of sea level rise, coastal wave flooding could begin to cause temporary flood impacts inland of Highway 1 during high tides and a rare 1% annual chance (aka 100 year) storm wave events.

Report Overview

Planning Background and Regulatory Setting

This section describes the purpose of the report, the history of the City of Marinas Local Coastal Program (LCP) the planning process that was conducted as part of preparation for the report, and the connection with the State of California sea level rise and adaptation guidance documents including the *California Coastal Commission Sea Level Rise Policy Guidance* document (CCC 2015), the *State of California Sea-Level Rise Guidance 2018 Update* (Ocean Protection Council [OPC] 2018), an update to the *Coastal Commission Sea Level Rise Policy Guidance Document* (CCC 2018) and the *Safeguarding California Plan: 2018 Update* report (California Natural Resources Agency [Cal NRA] 2018).

The key differences between these guidance documents are that the 2018 OPC Guidance lays out broad statewide information, and the CCC Guidance 2018 integrates the OPC 2018 recommendations for use in an updated Coastal Commission planning and permitting process previously laid out in 2015.

Physical Setting

This section characterizes the existing conditions in the City and its setting and climate in the Monterey Bay, including the geology, littoral cell, physical coastal processes as well as reviewing the existing Federal Emergency Management Agency (FEMA) hazards.

Climate Science

The differences between climate "cycles" and climate "change" are provided for background purposes. Projections of climate-induced impacts created by temperature and precipitation patterns, wildfire, extreme event flooding, and sea level rise are provided. In addition, this section describes relevant climate and coastal management related work in the region to foster a regional awareness and potential collaborations with related initiatives in the Monterey Bay Region.

Vulnerability Assessment

This section describes the methods and results of the Vulnerability Assessment. Specific descriptions of the hazard projections and vulnerability assessment methodologies and assumptions used to model and map coastal hazards are presented for use in determining future levels of vulnerability for the various planning horizons (i.e., 2010, 2030, 2060, and 2100)

Potential impacts on urban uses and natural resources are described, based primarily on the coastal erosion hazards as the foundation for the vulnerability assessment. Based on the characteristics of the City's coastline and watersheds and input from the City and public, Revell Coastal analyzed five sectors in the vulnerability assessment. The sector profiles are presented in Appendix A and are discussed in more detail throughout the report:

- Land Use and Parkland
- Trails and Access
- Water Supply and Wastewater
- Roads, Parking, and Bike Routes
- Dune and Beach Habitat

Adaptation Planning

This section describes the both policy and project approaches to adaptation which fall into the following categories – do nothing, protect, accommodate, and retreat. Each approach has its financial costs and benefits, and each has secondary impacts that should be considered. Some adaptation strategies may be maladaptive, reducing short term vulnerabilities while limiting long term adaptation options which are described.

Specific policy and adaptation strategies are highlighted for the City of Marina that focus on reducing erosion rates, maintaining beaches and coastal habitats, and avoiding future hazards that fit within the larger regional Monterey Bay context.

This adaptation planning section identifies some potential pathways through time that reduce risk and accommodate increased levels of sea level and coastal hazards. In considering the lead times needed to plan, permit, finance and implement various adaptation strategies, this section proposes some triggers to catalyst additional adaptation planning for the most vulnerable stakeholders and encourages engagement and participation in regional resiliency planning initiatives.

ES.4 Key Findings

Overall Findings:

The following are key findings identified as a result of analyses in this report:

- Coastal dune erosion hazards are the biggest threat to the City of Marina even with up to 5 feet of sea level rise. The primary impact from this erosion is to open space and dune habitats with temporary impacts to beaches during storm events.
- One sewer pump station, one visitor serving resort, one inactive groundwater supply well, an inactive water treatment facility and district offices for the Marina Coast Water District and the coastal access and associated parking lot at Marina State Park are the key vulnerabilities in the City to projected coastal erosion.
- With 5 feet of sea level rise and a 1% annual chance wave event there is a chance that additional areas near the Reservation Road underpass in the City could be temporarily impacted by wave run up induced flooding during a 1% annual chance wave event.

Vulnerabilities by Planning Horizon

The following is a summary of the resulting vulnerabilities organized by Planning Horizons:

Existing Vulnerabilities

- Dune erosion threatens 49.6 acres of habitat.
- A beach water supply well and control vault are exposed to coastal erosion at Marina State Beach.
- Portions of the parking lot at Marina State Beach are vulnerable to coastal erosion.
- 4 buildings associated with the Marina Coast Water District may be exposed to coastal erosion damages.
- Portions of all of the coastal access trails may be eroded.

2030 Vulnerabilities

(<1 foot of sea level rise)

- Dune erosion threatens an additional 16.3 acres of habitat.
- Two more buildings at the Marina Coast Water District, the Marina State Beach restroom, and the first row of ocean facing buildings at the Sanctuary Beach Resort become vulnerable to coastal erosion.
- More than half of the Marina State Beach parking lot could be vulnerable to coastal erosion.
- The sewer lift station co-located with the restroom at Marina State Beach could also become vulnerable.

2060 Vulnerabilities

(~ 2 feet of sea level rise)

- Dune erosion threatens an additional 32.4 acres of habitat.
- Several fire hydrants associated with the Sanctuary Beach Resort could become at risk.
- ~ 1500 feet of access roads to the Sanctuary Beach resort and the Marina Coast Water District could be impacted by coastal dune erosion.
- Additional structures at the Sanctuary Beach Resort could become at risk.
- Some portions of the coastal dune trail heading south from Marina State Beach parking lot could be eroded.

2100 Vulnerabilities

(~ 5 feet of sea level rise)

- Dune erosion threatens an additional 88.9 acres for a total of 154.1 acres of habitat potentially eroded.
- Several fire hydrants associated with the Sanctuary Beach Resort could become at risk.
- ~ 1500 feet of access roads to the Sanctuary Beach resort and the Marina Coast Water District could be impacted by coastal dune erosion.
- Additional structures at the Sanctuary Beach Resort for a total of 26 buildings could become at risk to coastal erosion.
- The remainder of the coastal dune trail heading south from Marina State Beach parking lot (a total distance of 1300 feet) could be eroded.
- Coastal wave flooding during a 1% annual chance storm could potentially temporarily affect 196 residential parcels, 164 structures in the Cardoza Avenue neighborhood, as well as Gloria Jean Park through wave overtopping of the dunes flowing down Reservation Road.

Positive Findings

- The pending cessation of sand mining and subsequent projected reduction in future erosion and hydraulic connectivity has substantially reduced the potential long term impacts of sea level rise and coastal hazards to the City.
- There are no projected impacts to any residential, mixed use, or commercial land uses from erosion even with up to 5 feet of sea level rise[1].
- The City of Marina currently has no coastal armoring which allows for the continuation of natural coastal and dune processes and maintenance of beach width over time.

[1] The Sanctuary Beach Resort and MCWD properties are zoned Coastal Conservation and Development and Public Facility District.

Definitions, Acronyms, & Abbreviations

Definitions

1% Annual Chance Storm: A single storm wave event with a 1% annual chance of occurring in any given year based on extreme value analysis of historic storms (also referred to as a 100-Year storm event). A wave event of this magnitude on one day does not change the probability of another 1% annual chance event occurring in the same year.

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which minimizes harm or takes advantage of beneficial opportunities.

Coastal Erosion: Loss of sand, sediment, vegetation, or soil in the dunes or cliffs along the coast caused by wave attack. (Erosion can also be caused by wind, but this was not included in this analysis).

Coastal Flooding: Flooding caused by wave run-up that occurs during high tide during a large 1% annual chance storm. The wave run-up typically has a velocity that can cause damage.

Coastal Zone: A regulatory zone established by State Legislature and shown on maps prepared by the California Coastal Commission, and for which the California Coastal Act establishes policies and regulations.

Climate Change: A shift from the normal climate weather patterns associated with a place, whether due to natural causes or as a result of human activity, such as the burning of fossil fuels and the release of greenhouse gases (GHGs).

Environmentally Sensitive Habitat Areas (ESHA): Any area in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments.

Extreme Monthly High Water: Highest tide elevation based on the average elevation of the highest monthly high tide for a 19-year tidal epoch period. This level would be expected to be inundated once a month.

Environmentally Sensitive Habitat Areas (ESHA): Any area in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments. In Marina, ESHA is primarily associated with beach and dune habitats.

Planning Horizon: Within this Report, the span of time outward to the future when sea level rise or other climate-based impacts are projected to occur. This plan cycle is often defined by an agency to analyze and prepare for potential vulnerabilities, define a planning framework with policies focused on physical development of the land, and to manage community services and resources.

Sea Level Rise: The worldwide average rise in mean sea level, which may be due to a number of different causes, such as the thermal expansion of sea water and the addition of water to the oceans from the melting of glaciers, ice caps, and ice sheets. In contrast, relative sea level rise is the global average adjusted to local conditions based on tectonic uplift, subsidence from groundwater, or oil and gas development (See Chapter 3 of CCC 2015).

Sector: A category of natural or built resources, such as building structures, wastewater infrastructure, beach access, and sensitive biological resources.

Sector Profile: A summary or description of existing sector resources that may be impacted by future sea level rise and coastal hazards.

Threshold: A specific time or sea level rise elevation when vulnerabilities escalate rapidly.

Tidal Inundation: Flooding caused during predictable monthly high tides that occur at least once a month.

Trigger: A catalyst for additional steps of adaptation planning leading to implementation based on a monitored condition (i.e. the distance of the dune crest from a structure).

Vulnerability Assessment: Within this Report, the process of identifying, quantifying, and prioritizing (or ranking) potential exposures, threats, and values (intrinsic and economic) of resources and infrastructure in an area or a system.

Acronyms and Abbreviations

CCC	California Coastal Commission
CDP	Coastal Development Permits
City	City of Marina
CoSMoS	Coastal Storm Modeling System (USGS)
CSLC	California State Lands Commission
EPA	Environmental Protection Agency
ESHA	Environmentally Sensitive Habitat Areas
ESRI	Environmental Systems Research Institute
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GCM	Global Climate Model
GHG	Greenhouse Gas
GP	General Plan
GIS	Geographic Information System
IPCC	Intergovernmental Panel on Climate Change
LCP	Local Coastal Program
LiDAR	Light Detection and Ranging
LUP	Land Use Plan
MCWD	Marina Coast Water District
MHW	Mean High Water
MSL	Mean Sea Level
NAVD88	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
OPC	Ocean Protection Council
RCP	Relative Concentration Pathways
Report	2019 Existing Conditions and Future Vulnerability Assessment
SLR	Sea Level Rise
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

Report, Map, & Data Disclaimer

The data utilized for purposes of this Report was collected from various sources and is not to be construed as "legal description." This Report is advisory and not a regulatory or legal standard of review for actions that the City of Marina or the California Coastal Commission may take. This Report is part of an ongoing process to understand and prepare for future coastal hazards as a result of climate change. Substantial uncertainties associated with modeling and projecting future hazards and their potential impacts exist.

Although we strive to review all resource sector and infrastructure data received, we cannot verify the location or completeness of all spatial data. For this reason, Revell Coastal LLC cannot accept responsibility for any errors, omissions, or positional accuracy, and therefore, there are no warranties which accompany this product. Users of the information displayed in maps are strongly cautioned to verify all information.

1. Planning Background & Regulatory Setting

1.1 Introduction

The California Coastal Act requires local governments in the state's Coastal Zone to create and implement Local Coastal Programs (LCPs). Each LCP consists of a Coastal Land Use Plan and an Implementation Plan. Using the California Coastal Act, the California Coastal Commission (CCC) and local governments manage coastal development, including addressing the challenges presented by coastal hazards like storms, flooding, and erosion. Sea level rise and the changing climate present new management challenges with the potential to significantly threaten many coastal resources, including both natural and public access. One of the CCC's priority goals is to coordinate with local governments, such as the City of Marina (City), to complete a LCP in a manner that addresses sea level rise.

In order to address sea level rise and associated hazards in the City's LCP project, the City and its consultant team prepared this 2019 City of Marina Existing Conditions and Sea Level Rise Issues Report (Report). The purpose of this report is to provide technical analysis using climatic modeling to support the City's effort to incorporate a range of coastal and climate change hazards into the City's planning and regulatory processes. This information will assist the City in making more informed decisions regarding land use and development standards from the project level to the plan level.

The purpose of this vulnerability assessment and adaptation planning is to improve community resilience and help the City to revise and certify the LCP and Updated General Plan consistent with State and Federal law. Under Coastal Act, purpose of LCP is to conserve coastal dependent uses.

1.2 Location

The City of Marina is located on the Pacific Ocean in Central California on the Monterey Bay in Monterey County. The City is situated along California Highway 1 (Highway 1), the major coastal highway running the length of the state. Marina is approximately 100 miles south of San Francisco and 370 miles north of Los Angeles.

The Coastal Zone and City boundaries are seen in Figure 1-1, *City of Marina Overview*, along with neighboring jurisdictions. The City covers 9.8 square miles, which is comprised of 8.9 square miles of land, and 0.9 square miles of water. The City limits also contains approximately 9.2 square miles of coastal water area in Monterey Bay. The adjacent jurisdictions include the following: City of Sand City, County of Monterey, and the Monterey Bay National Marine Sanctuary.

Situated behind sandy dunes adjacent to the Monterey Bay National Marine Sanctuary, the City is an area of exceptional natural beauty. A portion of the City, 1.6 square miles, and its 3.2-mile Pacific shoreline, is within the California Coastal Zone. The Coastal Zone boundaries are shown in Figure 1-1Figure 1-1.

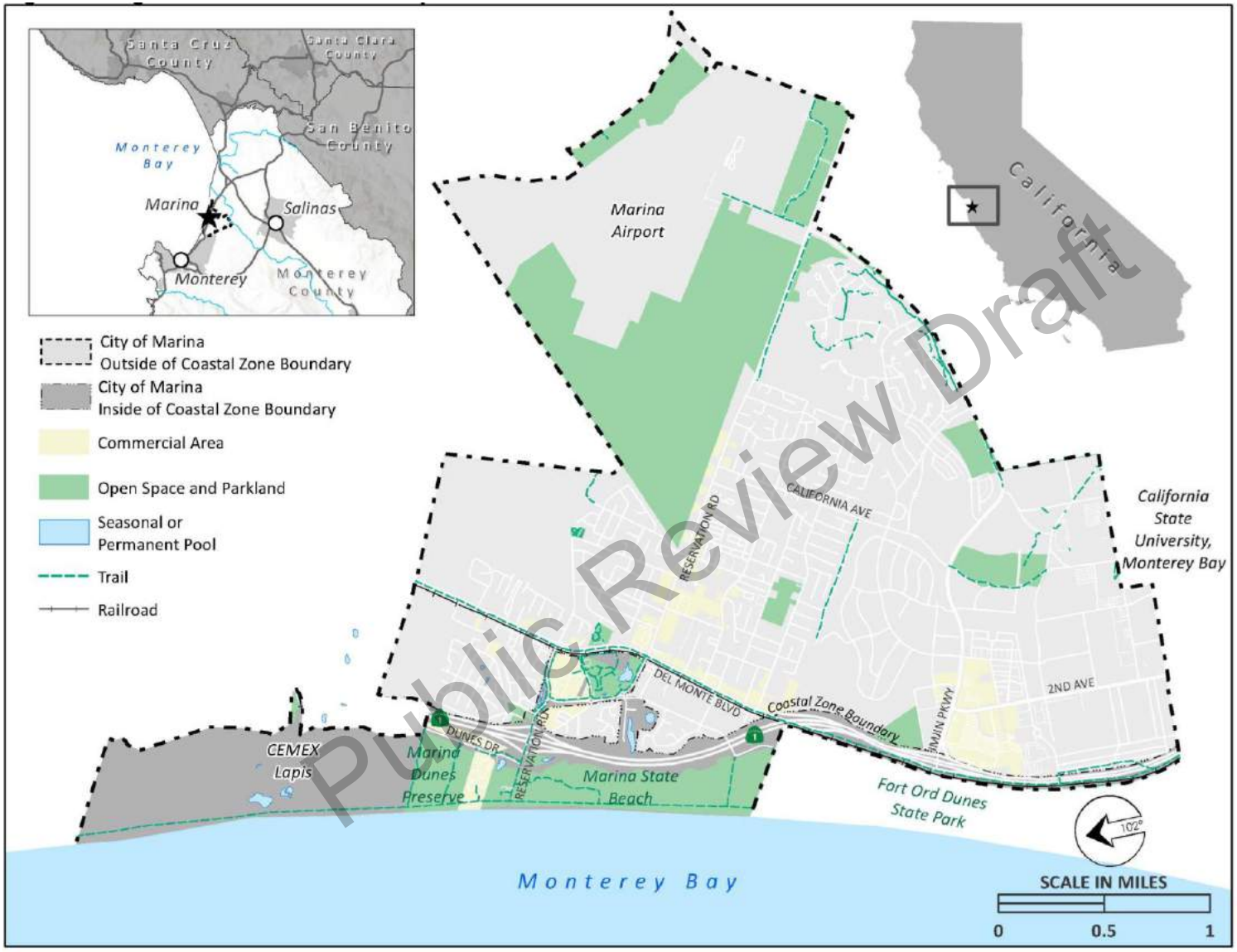


Figure 1-1. City Overview

Currently, the City's resident population is approximately 20,000 persons. Historically, the military has been a significant driver of life and livelihood in Marina, which is located adjacent to the former Fort Ord. The City's predominant land use is residential, reflective of the City's previous role as a bedroom community to the former Fort Ord military base and now to the California State University Monterey Bay. Retail corridors and commercial development are located around Reservation Road, Del Monte Boulevard and Imjin Parkway. There is also significant visitor-serving development off Dunes Dr., with three hotels and an RV park.

Stormwater runoff from the built environment is generally accommodated by small (< .5 acre) retention basins known as percolation ponds. As the soils in Marina are characterized by fine- to medium-grained sands, the soils have a high percolation rate, so instead of gravity feeding stormwater to the nearest body of water, the percolation ponds serve to absorb and dissipate excess runoff.

Marina's six main perennial and vernal pools are not only important as a biotic resource, they are also an integral part of the city's stormwater drainage system.

1.3 The History of Marina's Local Coastal Program

The California Coastal Commission certified the City's LCP in 1982. Various amendments were adopted over the years until 2009. The City of Marina goal is to update to its LCP for certification by the California Coastal Commission to address, at minimum, coastal erosion, sea level rise, land uses within the zone, updated maps, and verification of the coastal boundary.

Various amendments were adopted over the years until 2009 and are listed below:

- Certified by the California Coastal Commission April 20, 1982
- Approved, Adopted, and Certified by City Council Resolution No. 82-61 October 27, 1982
- Amended by Resolution No. 88-71 (October 11, 1988), 89-22 (June 20, 1989), and 89-52 (September 5, 1989)
- Approved by Coastal Commission via LCP No. 1-88 (Major) (October 10, 1989)
- Amended by Resolution No. 2001-118 (October 16, 2001)
- Approved by Coastal Commission via LCP No. 1-01 (Major) (November 14, 2001)
- Amended by Resolution No. 2007-268 (November 20, 2007)
- Approved by Coastal Commission via LCP No. MAR-MAJ-1-07-Part 1 (April 10, 2008)

The City of Marina originally proposed a $300,000 grant to the CCC which included a $75,000 local match to do a comprehensive update to the LCP. However, following a settlement agreement between the CCC, SLC, City of Marina, and CEMEX, the City was awarded $85,685 Local Assistance Grant by the California Coastal Commission on August 9, 2017 to prepare an update to the LCP that focused on integrating a vulnerability and risk assessment and adaptation report to address the effects that sea level rise could have on coastal resources along the Marina shoreline.

In addition, the City is working with the CCC as part of a settlement agreement with CEMEX to close the last remaining coastal sand mine in the United States, which has had a major regional impact on the rates of coastal erosion. The erosion rates on the Marina shoreline were identified by the USGS in 2006 as some of the highest erosion rates in California (Hapke et al 2006). The cessation of sand mining was listed as the highest priority Coastal Regional Sediment Management Plan prepared for the Association of Monterey Bay Area Governments in 2008. In 2017, the CCC developed a settlement and termination agreement with the CEMEX sand mine to phase out (aka close) and remediate the CEMEX sand mine. The

CCC agreed to partner with the City to assist in an update to appropriate zoning and policies and redefine the vision of the City for the reuse of the CEMEX site once the sand mine ceases operations and completes the consensus remediation plan (CCC 2017).

1.4 LCP Planning Process

In August 2015, the CCC adopted the *Sea Level Rise Policy Guidance* to aid public agencies in preparing for sea level rise in LCPs and regional strategies, and to assist applicants preparing coastal development permit (CDP) applications. The 2015 CCC policy guidance document outlines specific issues that policymakers and developers may face as a result of sea level rise, such as extreme events, challenges to public access, increased vulnerabilities, and compliance/consistency with the California Coastal Act. The policy guidance document also lays out the recommended planning steps for public agencies to follow in their efforts to incorporate sea level rise into their planning strategies and regulatory context, and to reduce vulnerabilities and inform sea level rise adaptation planning efforts (Figure 1-2). In April of 2018, the State Ocean Protection Council finalized an update to their *State of California Sea-Level Rise Guidance* document that follows this same methodology (OPC 2018) but provides an interpretation of the updated scientific projects which estimates the probabilities for sea level rise at future time horizons (Table 1-1). The CCC integrated the OPC 2018 recommendations into the updated *Coastal Commission Sea Level Rise Policy Guidance Document* (CCC 2018).

The purpose of this vulnerability assessment is to complete Steps 1-3 shown below and provide initial input on Step 4. The 2018 CCC policy guidance document places a strong emphasis on incorporating coastal hazards and sea level rise into LCP planning and using "soft" or "green" adaptation strategies, which mimic or enhance natural processes and defenses, rather than "gray" or "hard" engineering strategies, such as seawalls and riprap. The following are specific steps outlined in the 2018 CCC policy guidance document:

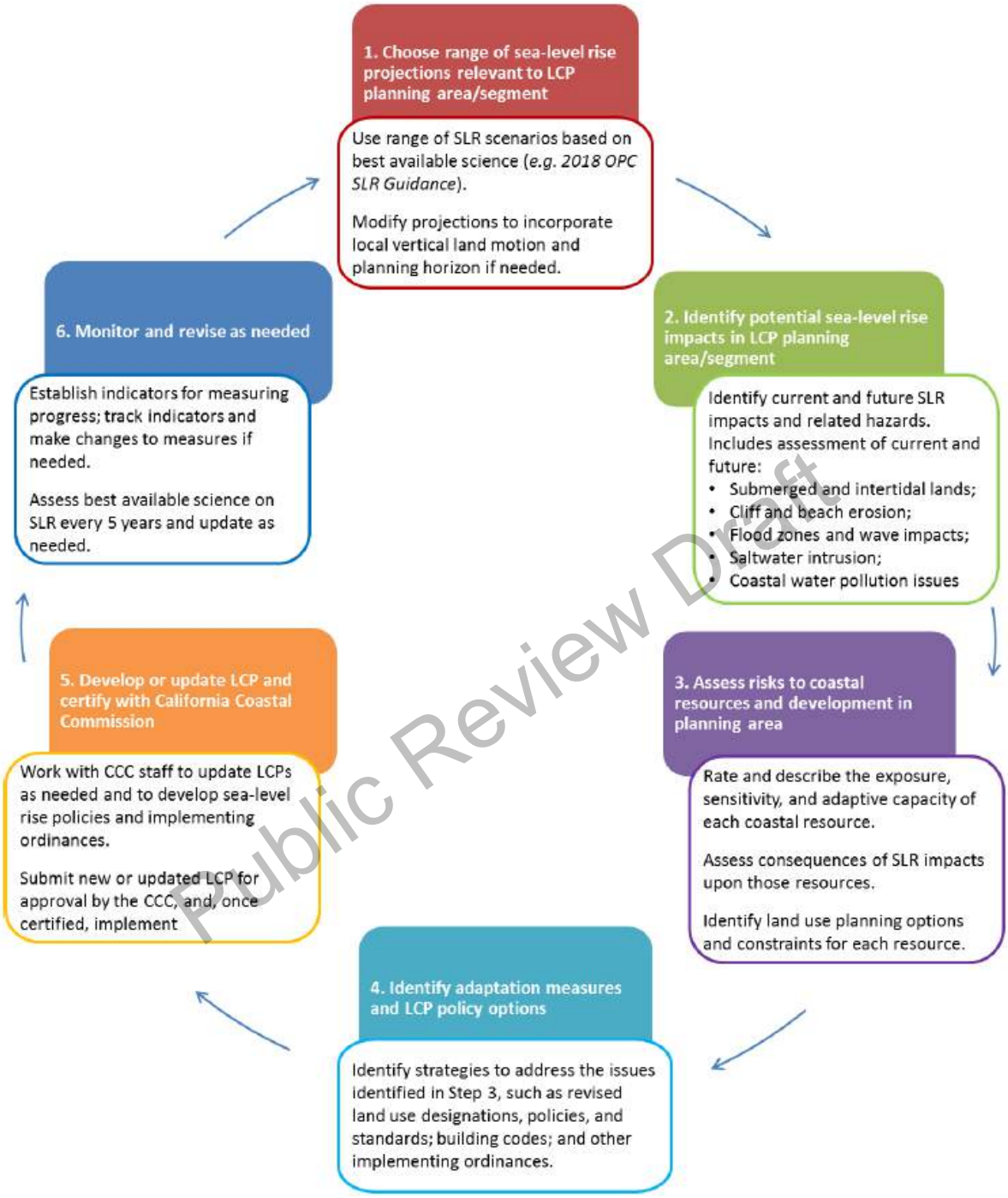


Figure 1-2. California Coastal Commission Guidance for Including Sea Level Rise into Local Coastal Programs (CCC 2018).

Step 1. Establish the Projected Sea Level Rise Ranges

Consistent with the CCC policy guidance, the City evaluated a range of scenarios, including a high sea level rise scenario with an estimated 63 inches by 2100 as based on available Coastal Resilience coastal hazard

modeling which relied on the sea level rise projections from the National Research Council (NRC) *Report on Sea Level Rise* (NRC 2012). This sea level rise scenario was considered a high, though not worst case scenario,[2] and was used in regional *County of Monterey and Santa Cruz Coastal Resilience Project* (Coastal Resilience model) to map projections of existing and future coastal hazards. The City has selected 2030, 2060, and 2100 as the planning horizons for this Report because they align with the available modeling completed in 2014 to support coastal management, planning, and LCP updates in the County. 2010 represents the "existing conditions", or baseline for future monitoring because it was the most recently flown light detection and ranging (LiDAR) topographical map available for the coastal hazard mapping. The 2100 time frame is the furthermost (or most distant) planning horizon since this is the last year that the coastal hazard models are available and is close to the ~75-year economic life of a structure. However, it should be noted that more recent science has assigned probabilities of future sea level rise occurring by certain time horizons (Table 1-1). The most recent science also included an H++ worst case or "extreme risk aversion" scenario which projected ~5 feet of sea level rise occurring by 2070 and ~10.1 feet by 2100 (OPC 2018). The CCC updated their sea level rise guidance in 2018 and recommended three levels of potential risk to evaluate – "low risk aversion" for areas and assets likely to be vulnerable regardless of uncertainties, "medium-high risk aversion" which included projects with greater consequences and/or a lower ability to adapt; and the "extreme risk aversion" scenario for projects with little to no adaptive capacity that would be irreversibly destroyed or significantly costly to repair, and/or would have considerable public health, public safety, or environmental impacts should that level of sea level rise occur (CCC 2018). This study relied on sea level rise projections from the Coastal Resilience Model which largely follow the "medium risk adverse" sea level rise elevations and represent the best available science. The exceedance probabilities columns in Table 1-1 illustrate the potential for these sea level rise projections to occur by the projected year in time based on OPC 2018.

Table 1-1. Sea level rise elevations used in the hazard modeling incorporated into the vulnerability assessment compared with the latest scientific ranges.

Model/year	SLR - in			Exceedance Probability		
	2030	2060	2100	2030	2060	2100
Coastal Resilience - High[1]	**9**	**28**	**63**	**0.50%**	**>5%<67%**	**>5%<67%**
Low Risk Aversion[2]	5	16.8	39.6	67%	67%	67%
Med-High Risk Aversion[2]	9.6	31.2	82.8	0.50%	0.50%	0.50%
Extreme Risk Aversion (H++)[2]	12	45.6	121.2	NA	NA	NA

[1]*ESA PWA 2014*
[2]*OPC 2018*

Step 2. Identify Potential Impacts from Sea Level Rise

Based on the coastal hazard modeling from the 2014 Monterey Bay Sea Level Rise Vulnerability Assessment Report (ESA PWA 2014), the range of potential hazards evaluated for the City included dune erosion, coastal wave flooding and tidal inundation. Given the topography, exposure and jurisdictional

[2] Worst case scenario is the H++ scenario which projects 10.1 feet by 2100 and is discussed further in Section 4, *Climate and Sea Level Rise Science*.

boundaries and setting of the City, tidal inundation was determined not to be a risk to the City with up to 5 feet of sea level rise. The most dominant hazard affecting the City is coastal dune erosion, and with 5+ feet of sea level rise, there is a slight possibility of episodic impacts from coastal wave flooding. A summary of the key decisions, coastal hazard model interpretation and sea level rise scenario selection, as well as the sectors and measures of impact are documented in Appendix A.

Step 3. Assess the Risks and Vulnerabilities to Coastal Resources and Development

The following sectors were determined to experience some form of existing or future risk and related vulnerability to sea level rise (e.g., dune erosion and/or coastal flooding):

- Land Use and Parklands
- Trails and Access
- Water Supply and Wastewater
- Roads and Bike Routes
- Dune and Beach Habitat

Step 4. Identify Adaptation Measures

The City anticipates conducting additional work on adaptation strategy development during future public education, outreach, and decision-maker engagement efforts. The process will consider the full range of potential adaptation measures such as beach nourishment, shoreline protection including living shorelines/beach sand dune restoration, groins, managed relocation, and shoreline management. The process will identify triggers and evaluation criteria to determine approach and measure success of the various strategies and evaluate whether the strategies could be considered long-term maladaptation. A thorough cost benefit analysis of the various adaptation strategies is also recommended as an important decision-making tool.

1.5 Safeguarding California

The Safeguarding California Plan: 2018 Update (California Natural Resources Agency [Cal NRA] 2018) describes the State's climate change adaptation plan and actions state agencies are taking to adapt communities, infrastructure, services, and the natural environment to climate change. This Plan outlines several programmatic and policy responses as well as examples of adaptation projects. In addition, the Plan includes metrics for monitoring and evaluation. Seven overarching principles provide the framework for this plan:

- Consider climate change in all functions of government;
- Partner with California's most vulnerable populations to increase equity and resilience through investments, planning, research, and education;
- Support continued climate research and data tools;
- Identify significant and sustainable funding sources to reduce climate risks, harm to people, and disaster spending;
- Prioritize natural infrastructure solutions that build climate preparedness, reduce greenhouse gas emissions, and produce other multiple benefits;
- Promote collaborative adaptation processes with federal, local, tribal, and regional government partners; and

- Increase investment in climate change vulnerability assessments of critical built infrastructure systems.

1.6 OPC 2018 Policy Guidance Update

In March 2018, the California Natural Resources Agency and OPC released an updated State of California Sea-Level Rise Guidance including eight (8) preferred sea level rise planning and adaptation approaches:

- Adaptation planning and strategies should prioritize social equity, environmental justice, and the needs of vulnerable communities;
- Adaptation strategies should prioritize protection of coastal habitats and public access;
- Adaptation strategies should consider the unique characteristics, constraints, and values of existing water-dependent infrastructure, ports, and Public Trust uses;
- Consider episodic increases in sea level rise caused by storms and other extreme events;
- Coordinate and collaborate with local, state, and federal agencies when selecting sea level rise projections; where feasible, use consistent sea level rise projections across multi-agency planning and regulatory decisions;
- Consider local conditions to inform decision making;
- Include adaptive capacity in design and planning; and
- Assessment of risk and adaptation planning should be conducted at community and regional levels, when possible.

2. Existing Conditions Physical Setting

2.1 Climate

Episodic winter storms with cool foggy summers and warm "Indian summer" fall seasons characterize the Mediterranean climate of this region. August temperatures average about 68° Fahrenheit while January temperatures average about 58° F. Precipitation is variable but averages about between 16.12 and 21.33 inches across the city depending on which rain gauge is considered. Rainfall primarily occurs in the winter months, with actual rainfall amounts varying widely depending on tropical moisture in the subtropical Pacific. El Niño conditions can increase this subtropical moisture; many of the wettest years on record occurred during El Niño years.

2.2 Geology

The City of Marina is situated in Central California coast on the southern portion of the Monterey Bay. The City spans a 3.2-mile portion of sandy dune-backed shoreline of Monterey Bay.

The dunes of Southern Monterey Bay clearly visible along the Marina coastline have been created during multiple lower sea level rise stands in the Pleistocene (>12,000 years ago) and the Holocene (<12,000 years ago) when the Salinas River was at a steeper gradient and discharged much more sediment to the coast (Cooper 1967). During these relatively cold geologic periods, when much of the ice was frozen in ice, sea levels were hundreds of feet lower and the shoreline was several miles west at the continental shelf. During these ice age/ low sea level times, wind transport blowing over a much larger width of the coastal plain formed the sand dunes. As sea level rose during the interglacial time period, coastal erosion occurred until the next ice age and created a unique set of sand dunes in California that show two sets of dunes formed over the last two ice ages (Figure 2-1).

Figure 2-1. Photo of the dunes in the City of Marina, note the color differences between the older Pleistocene (darker/redder) dunes and the more recent Holocene dunes.

2.3 Littoral Cell and Sediment Budget

The City of Marina is in the Southern Monterey Bay Littoral Cell, which is bounded at the north by the Monterey Bay Submarine Canyon and at the south by Point Piños on the Monterey Peninsula. This cell is subdivided into smaller segments; the North sub-cell that extends from the Monterey Submarine Canyon and Elkhorn Slough south to the Salinas River; the Central sub-cell extends from the Salinas River south to Sand City; the South sub-cell extending from Sand City to Monterey Harbor or Wharf 2; and the West sub-cell extends from Monterey Harbor to Point Piños (Patsch and Griggs, 2007; Thornton, 2016). The City of Marina is in the Central sub-cell, where the main sources of sediment to the SMB Littoral Cell, are erosion of coastal dunes and discharge of sediment from the Salinas River.

The Salinas River is the main river source of sand to the SMB Littoral Cell. Over the years, the volume of beach compatible sand delivered by the Salinas River has been reduced due to upstream dams, the diversion of the river mouth to its current location, and current management activities at the river mouth. Estimates of the current volume of sand supplied to the SMB Littoral Cell annually range from 50,000 to 273,000 cy/yr. Not all river sand will go south into the Central Sub-cell given the typical current directions in the winter when the river delivers most of the sand. Estimates are that ~27% of the Salinas River sand will be transported south, resulting in an estimated supply to the Central sub-cell of river sand volume ~74,000 cy/yr. (Thornton 2016).

Beaches experience seasonal cycles during which winter storms may remove significant amounts of sand, creating steep, narrow beaches. In the summer, gentle waves return the sand, widening beaches and creating gentle slopes. Because there are so many factors involved in coastal erosion, including human

activity, sea-level rise, seasonal fluctuations, and climate change, sand movement will not be consistent year after year in the same location.

Beach and sand dunes are dynamic systems with an active exchange of sand into and off of the dunes. Sand dunes provide a reservoir of sand that is eroded onto the beach during large wave events and then rebuild from onshore wind transport (called aeolian transport) during times of beach accretion or lower levels of sea level. The dunes in the SMB Littoral Cell are actively eroding and little build-up has been observed in recent decades. Annual average dune erosion rates range from about 3 to 6 feet, with an estimated loss of dune sand of about 200,000 cy/yr. (Thornton 2016). These erosion rates are in excess of the rates of erosion that can be attributed to solely to sea level rise. The southern Monterey Bay has over a century-long history of sand mining, which exacerbates coastal erosion (Thornton et al 2006) and has led to some of the highest erosion rates in California (Hapke et al 2006). The large volumes of dune sand eroded each year provide sand that is removed from current sand mining (Thornton 2006; Thornton 2016).

2.4 Coastal Processes

The coastal processes of tides, waves, and ocean currents shape the coastline of the City of Marina.

Tides - The tides in Monterey are mixed, predominantly semi-diurnal and are composed of two low and two high water levels of unequal heights per 24.8 hour tidal cycle. Typically, the largest tide ranges in a year occur in late December to early January. A tide recorder has been in continuous operation at Monterey on Wharf #2 since 1964.

Maximum tide elevations are due to astronomical tide, wind surge, wave set-up, density anomalies, long waves (including tsunamis), climate related El Niño, and Pacific Decadal Oscillation events. On longer time scales, sea level rise becomes increasingly important.

Waves – The waves that approach Marina are characterized by three dominant modes. The northern hemisphere waves typically are generated by cyclones in the north Pacific during the winter and bring the largest waves (up to 25 feet). The southern hemisphere waves are generated in the Southern Ocean during summer months and produce smaller waves with longer wave periods (> 20 seconds), depending on the swell direction, many of these waves are blocked by the Monterey Peninsula. Local wind waves are generated throughout the year either as a result of storms coming ashore during the winter, or strong sea breezes in the spring and summer (Storlazzi and Field 2000).

Rip Currents - The near-normal approach of waves along the southern Monterey Bay shoreline is conducive to rip current generation and maintenance (Thornton et al., 2007). Rip currents create holes in the near shore sandbars and cause waves to break sooner on nearshore bars, while the same waves travel less impeded in the deeper rip channels. This results in higher wave run up on the beach in the deeper rip channels which can create erosional hotspots and higher rates of storm induced dune erosion.

Longshore transport – changes in wave approach angles and seasonal wind patterns transport sand to the North and the South and redistribute sand along the littoral cell. The net longshore transport is to the north and eventually sand is lost into the Monterey Submarine Canyon.

2.5 Existing Hazards

FEMA Flood Insurance Rate Maps (FIRMs) delineate coastal and creek flood hazards as part of the regulatory National Flood Insurance Program. This program requires very specific technical analysis of watershed and nearshore characteristics, topography, channel and beach morphology, hydrology, and hydraulic modeling to map the extent of existing watershed–related, and wave run-up related flood hazards. These maps, representing existing 100-year and 500-year flood hazards (1 percent annual chance of flooding and 0.2 percent, respectively) are known as the FIRMs and determine the flood extents and flood elevations across the landscape.

Existing Coastal Hazards

Coastal erosion and coastal flooding are caused by large storm waves coupled with high tides. FEMA recently updated the regulatory FIRM maps delineating the coastal high velocity wave hazard zone, but the revised FIRM maps do not include coastal erosion or sea level rise in the regulatory mapping of coastal hazards. These new maps became effective on June 21, 2017 (Panels 06053C0181H, 06053C0183, 06053C0191H FEMA 2017). (Figures 2-2, A, B,C).

Table 2-1 below shows the range of FEMA-modeled coastal wave storm flood hazard zones.

Table 2-1. FEMA Coastal Base Flood Elevations for Shoreline Segments in Marina City Limits

Shoreline Segment	Base Flood Elevation (NAVD88)
North Terminus of Dunes at Salinas River Mouth to CEMEX Lapis Facility	18 feet
CEMEX Lapis Facility to Reservation Road	21 feet
Reservation Rd to County Boundary near Lake Court	23 feet

FEMA repetitive loss data shows that there have not been any parcels in Marina with multiple claims against the National Flood Insurance Program.

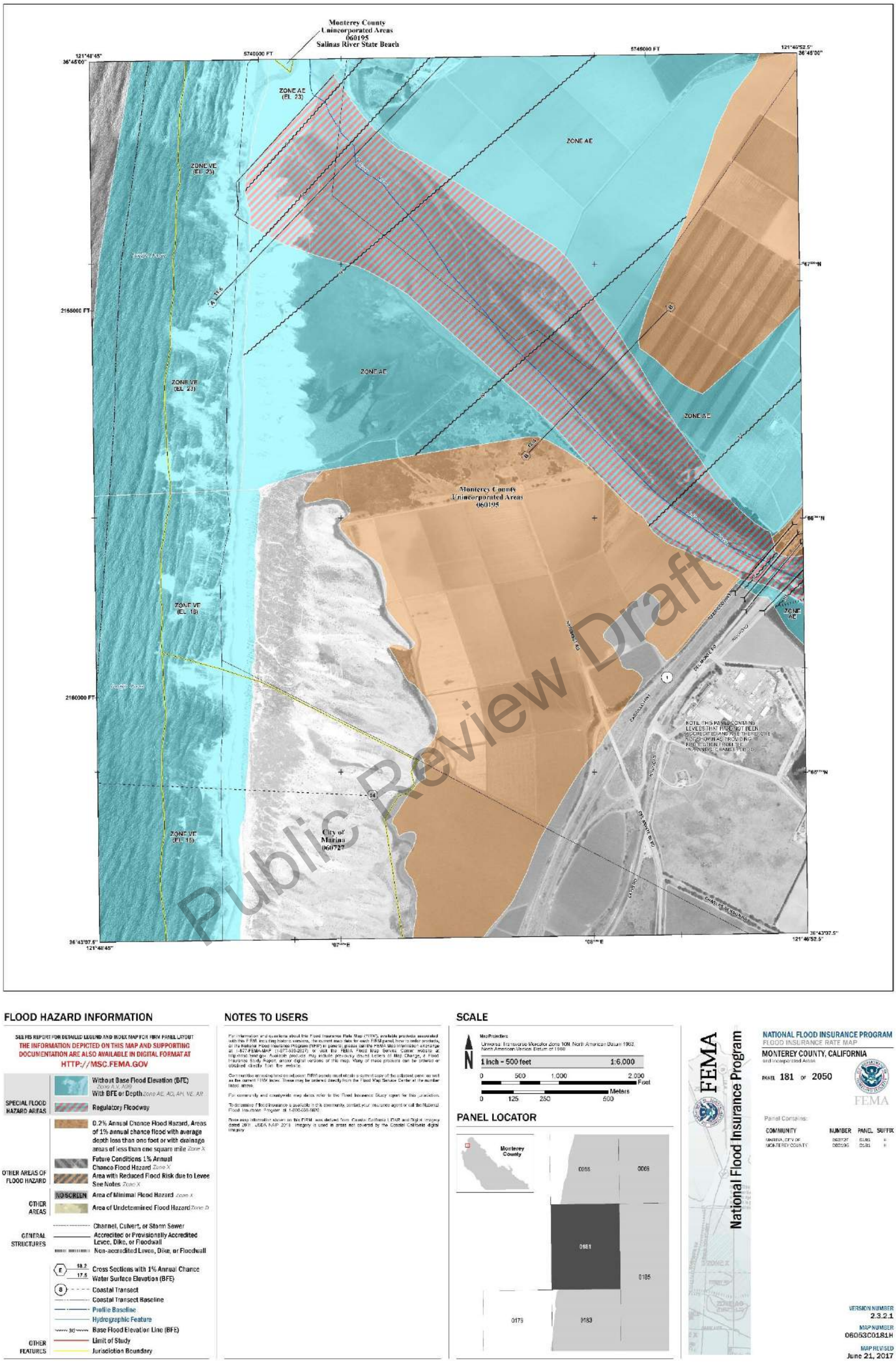
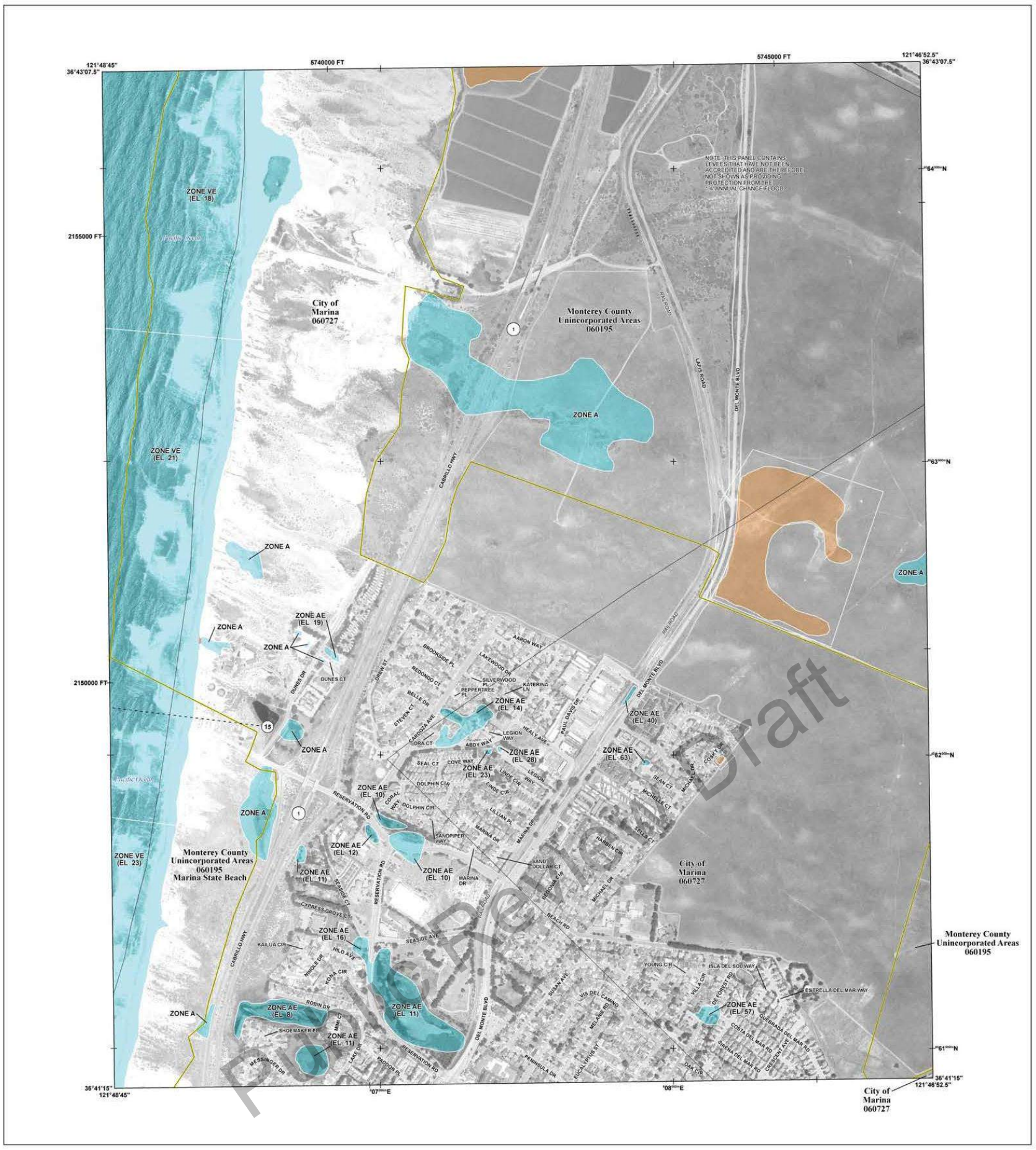


Figure 2-2-A. Extents of FEMA Flood Mapping in the City of Marina



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT HTTP://MSC.FEMA.GOV

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) Zone A,V, A99
- With BFE or Depth Zone AE, AO, AH, VE, AR
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
- Future Conditions 1% Annual Chance Flood Hazard Zone X
- Area with Reduced Flood Risk due to Levee See Notes Zone X

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard Zone X
- Area of Undetermined Flood Hazard Zone D

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Accredited or Provisionally Accredited Levee, Dike, or Floodwall
- Non-accredited Levee, Dike, or Floodwall
- 18.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
- Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)

OTHER FEATURES
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was derived from Coastal California LIDAR and Digital Imagery dated 2011. USDA NAIP 2010 imagery is used in areas not covered by the Coastal California digital imagery.

SCALE

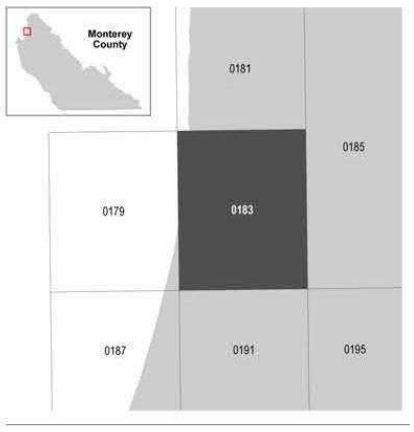
Map Projection:
Universal Transverse Mercator Zone 10N; North American Datum 1983; North American Vertical Datum of 1988

1 inch = 500 feet 1:6,000

0 500 1,000 2,000 Feet

0 125 250 500 Meters

PANEL LOCATOR



FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP
MONTEREY COUNTY, CALIFORNIA
and Incorporated Areas

PANEL 183 OF 2050

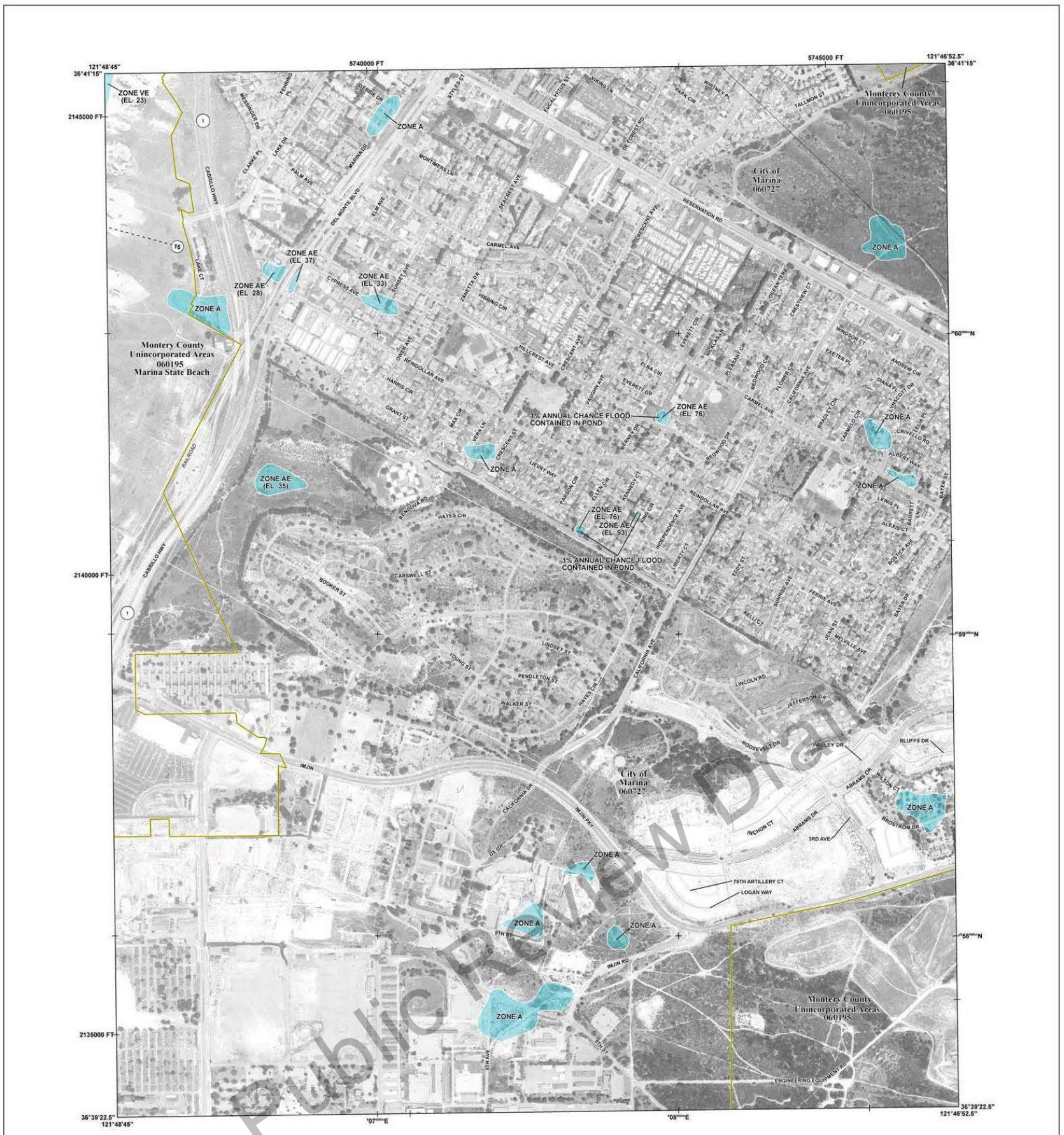
FEMA

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARINA, CITY OF	060727	0183	H
MONTEREY COUNTY	060195	0183	H

VERSION NUMBER 2.3.2.1
MAP NUMBER 06053C0183H
MAP REVISED June 21, 2017

Figure 2-2-B. Extents of FEMA Flood Mapping in the City of Marina



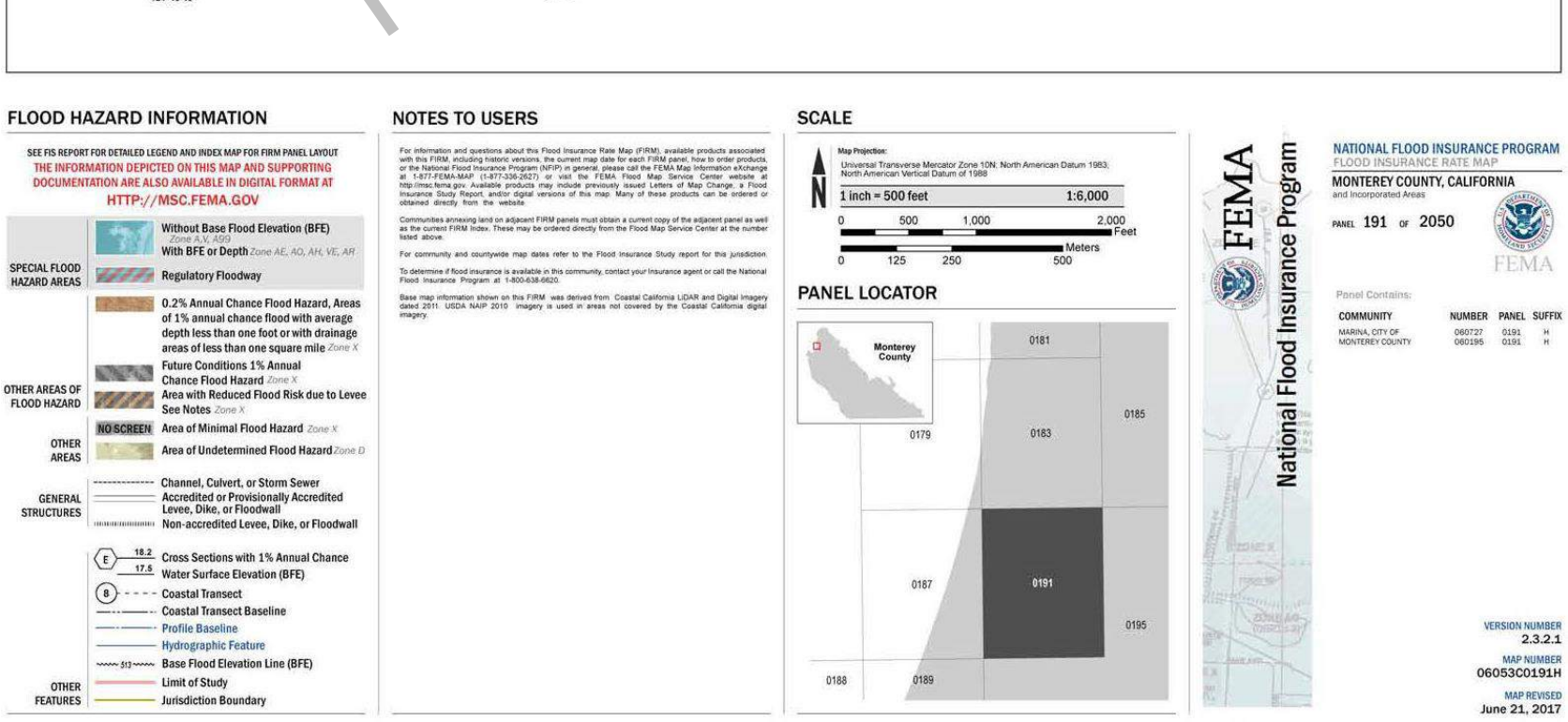


Figure 2-2-C. Extents of FEMA Flood Mapping in the City of Marina

2.6 Tsunami Wave Hazards

Tsunamis that could potentially affect the Marina coast can be generated by either distant earthquakes or nearby source locations. According to the California Geological Survey, a local source of tsunamis could include a Monterey Canyon landslide, and distant sources could include massive subduction zone earthquake triggered tsunamis from the Pacific Northwest Cascadia fault, the Aleutians, Chile, Japan, Marianas, or the Kuril Islands (California Geological Survey 2009; Figure 2-3). Tsunamis are rare events, and it should be noted that there is extreme uncertainty associated with predicting the probability or recurrence interval of any tsunami affecting Marina due to a lack of long-term known occurrences in the historical record. Tsunamis have been recorded at Monterey Harbor as far back as 1840, and generally coincide with nearby earthquakes that may trigger submarine landslides. Distant sources have also been recorded with the 1957 and 1964 Aleutian Islands Tsunamis and the 2011 Tohoku Japan Tsunami. Two statewide models have been developed to predict the potential extent of tsunami wave runup, the 2013 USGS SAFRR model, which is based on a distant-source (Aleutian Islands) megathrust earthquake event (M_w 9.1), and the 2009 California Geological Survey model, which is based on an ensemble of potential source events tailored to the Marina Coast. In both cases, the projected extent of tsunami wave run-up does not pass beyond the crest of the dunes and does not threaten any coastal development or infrastructure (Figure 2-4). Neither model has any run-up elevation associated with the potential event, or potential coastal erosion and the coarse mapping resolution does not allow for an easy determination of the elevation extent with recent topography. As a result, it is not possible to reliably project these models into future sea level rise scenarios. However, given the existing hazard mapping, tsunamis do not seem to be a major coastal hazard to the City of Marina.

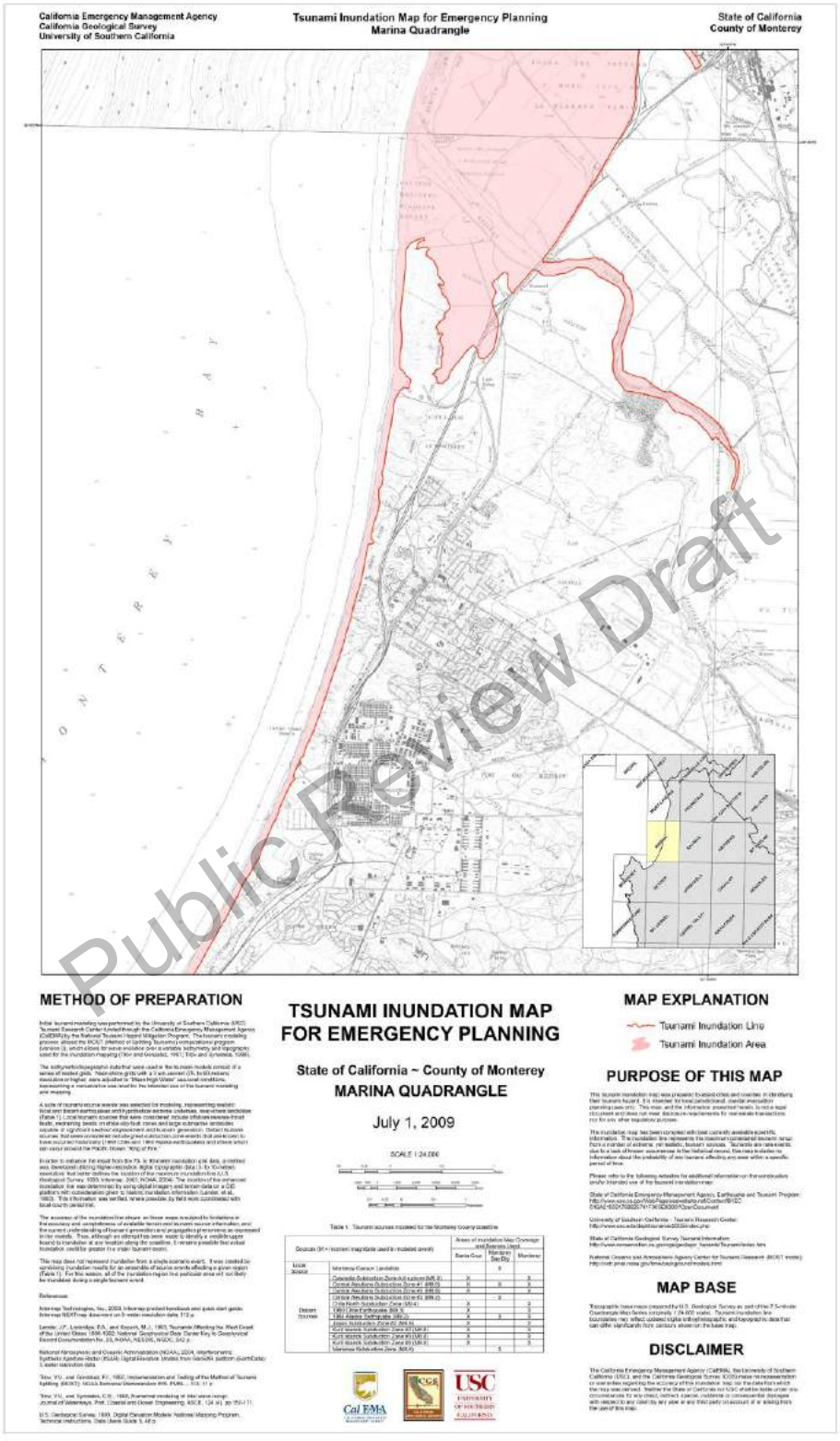


Figure 2-3. California Geological Survey Tsunami Inundation Map, July 2009

Figure 2-4. Tsunami Hazards Extents

2.7 Habitats

Within the City of Marina, there are a wide variety of dune and beach habitats that contain a large number of endemic species and high plant diversity. The Monterey Dunes once contained over 50 native plant species, but that has now been reduced by a combination of factors including human disturbance, erosion, sand-mining, and encroachment form non-native species such as iceplant and Holland dune grass (Dorell-Canepa 2005). Many of these habitats are considered sensitive and home to several sensitive and endangered species.

Special Status and Notable Dune Species of Concern:

Plants:

- Seaside Painted Cup *(Castilleja latifolia ssp. Latifolia)*
- Monterey Spine Flower *(Chorizanthe pungens var. pungens)*
- Eastwood's Ericameria *(Ericameria fasciculate)*
- Coast Wallflower *(Erysimum ammophilum)*
- Menzies' Wallflower *(Erysimum menziesii)*
- Coastal Dunes Milk Vetch *(Astragalus tener var. titi)*
- Dune Gilia *(Gilia tenuiflora var. arenaria)*
- Wild Buckwheat *(Eriogonum latifolium)* *
- Wild Buckwheat *(Eriogonum parvifolium)* *
- Bush Lupine *(Lupinus ssp.)* +

Animals:

- Smith's Blue Butterfly *(Shijimiaeoides enoptes smithi)*
- Globose Dune Beetle *(Coelus globosus)*
- Black Legless Lizard *(Anniella pulchra nigra)*
- Salinas Kangaroo Rat *(Dipodomys Heermanni Goldmani)*
- Western Snowy Plover *(Charadrius nivosus nivosus)*

** only within the range of Smith's Blue Butterfly.*
+ only within the range of the Black Legless Lizard.

Environmentally Sensitive Habitat Areas (ESHAs) are defined by the California Coastal Act Section 30107.5 as any area in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments. These areas are to be protected against significant disruption of habitat quality and only uses consistent with those habitats are allowed. Development near ESHAs are required to be designed to prevent impacts and degradation of the site (Section 30240).

As important bioclimatic variables are altered due to climate change, species that previously inhabited the Marina dunes may become stressed and face increasing difficulty in finding suitable habitat. Species with restricted ranges are acutely sensitive to changes in abundance, distribution, and timing of growth or life stages and will require intervention to continue living in these altered biological systems (California Office of Environmental Health Hazard Assessment 2013). Some species may shift up the coast to find temperature and precipitation thresholds more conducive to their individual species life history, however the dynamics at play that will determine which species may become better adapted to Marina's future climate is uncertain.

2.8 Human Alterations to the Shoreline

The shoreline in the City of Marina has been altered by several different activities. These human alterations have changed the natural functioning of the system. While most jurisdictions in California have varying levels of coastal armoring, the City of Marina has no coastal armoring. Sand mining is the main category of human alteration which has affected the overall coastline, erosion rates and coastal hazard extents along the City of Marina.

Sand Mining

Southern Monterey Bay has been one of the most intensively mined shorelines in the United States. The sand is valuable due to its high silica content and is used for a variety of purposes including packing for water well casings, filtration, sandblasting, and foundation and surface finishing (Combellick and Osborne 1977). Over a century long history of sand mining has exacerbated coastal erosion (Thornton et al 2006) and led to some of the highest erosion rates in California (Hapke et al 2006). On June 6, 2017, the City Council of the City of Marina adopted a resolution finding that the existing CEMEX dredge pond extraction operation constituted a public nuisance which opened the regulatory door for the CCC and the State of California to pressure CEMEX through possible enforcement actions to develop a settlement agreement to close the CEMEX sand mine, the last coastal sand mine in the United States by December 31, 2025. The section below is a history of the CEMEX sand mine largely excerpt and summarized from the CCC Staff Report for the Settlement Agreement.[3]

Historically, sand mining began in 1906 near the mouth of the Salinas River. In the 1940s, intensive drag line mining extracted sand from the beach itself at 5 different locations in the SMB Littoral Cell. By 1925, a rail line was placed through the CEMEX property, and a drag-line shovel attached to a railroad car extracted sand from the dunes in the areas adjacent to the rail lines; and a beach hoist, a drag-line attached to a structure on the upper beach, extracted sand from the beach. Extraction during this time occurred with little to no processing of the sand after extraction.

In 1959 beach mining ceased, and circa 1960, a dredge was installed to extract dune sand via a manmade pond located approximately 1400 feet inland of the ocean. Processing of the extracted sand also began during this time period. A wet sand sorting facility ("wet plant") was installed on the property in 1959, and in late 1960 a sand drying and sorting facility ("dry plant") was installed. Circa 1964, "objectionable material" was reached at the inland dredge pond, and mining at the inland dredge pond ceased. At that time the inland dredge pond was about 200 feet wide by 300 feet long, with a depth of 38 feet. Circa 1965, the dredge was moved to the beach, near its current location, and its operation resulted in the creation of a new dredge pond. Since the dredge was placed on the beach, the combined mechanism of the dredge and the anthropogenic dredge pond continued to siphon sand from the ocean washed onto the beach by winter waves, and the extraction of sand from the beach continues to present day.

In the 1960s, extraction of sand from the ocean occurred in 5 other locations throughout southern Monterey Bay via use of an ocean dragline. The Army Corps of Engineers determined that these mines required authorization pursuant to the Rivers and Harbors Act, and although initially it granted such authorizations, later, when the first authorizations expired, the Army Corps determined that the coastal sand mines were causing erosion and stopped issuing permits for coastal sand mines using drag-lines. As the required permits were no longer being issued by the Army Corps, all of the mining operations in the

[3] https://documents.coastal.ca.gov/reports/2017/7/th22/th22-7-2017-report.pdf

City of Marina using a drag-line had ceased by 1986, and the last drag-line mining operation in Monterey Bay, which was occurring in Sand City, ceased by 1990. However, the Army Corps of Engineers did not regulate the Marina sand mine dredge pond, which did not use a drag line into the ocean. Once the other sand mines were closed the Marina sand mine escalated production and the erosion hotspot shifted to the north (Thornton et al 2006). CEMEX, the current property owner, acquired the property in 2005, and since that time has used the sand mine property for extraction of beach sand via a floating hydraulic dredge, and the processing, storage, and sale of that sand on the upland portion of the property (Figure 2-5 and Figure 2-6).

As the sand mining increased, the rate of coastal erosion also increased leading to some of the highest erosion rates in the State of California. (Hapke et al 2006). It has been projected that once sand mining stops, that the rates of erosion could reduce to between a 70% reduction or even a change to mild accretion (Thornton et al 2006, PWA 2008, ESA PWA 2014, Thornton 2016).

Figure 2-5. Existing dredge pond mining operation (October 2014) Courtesy of the CCC

Figure 2-6. Existing dredge pond mining operation following a major winter storm (December 2015) Courtesy of the CCC

3. Climate Science

3.1 Climate Cycles

Climate change is not to be confused with climate cycles, which also operate independently of human-induced climate change. Some of these climate cycles occur at long time periods and are related to the orbit of the earth around the sun, the tilt of the earth on its axis, and precession (subtle shift) of the earth's orbit. These Milankovitch cycles occur at approximately 41,000, 120,000, and 400,000 years and are responsible for the Glacial and Interglacial Ages observed in the geologic record.

Some of these climate cycles are shorter; the most commonly known cycle is the El Niño/La Niña cycle, which is related to changes in equatorial trade winds and shifts in ocean temperatures across the Pacific Ocean. An El Niño brings warmer water to the Eastern Pacific, and this shift in ocean temperatures elevates sea level rise by about a foot above predicted tides in the Monterey Bay. These warmer ocean temperatures can increase evaporation, resulting in more atmospheric moisture and often substantially more precipitation. The 1982–1983 and 1997–1998 El Niños have caused both river and coastal flood damages across the Monterey County region. The January 1983 wave event is considered to be one of the largest coastal wave storm events recorded in the Monterey Bay.

Another climate cycle that impacts the Monterey Bay area is the Pacific Decadal Oscillation (PDO), which is an approximately 25–30-year cycle that changes the distribution of sea surface temperatures across the Pacific. Its effects were first noticed by fishery researchers in Washington (Mantua et al. 1997). The result of this ocean temperature shift is largely a shift in the jet stream. During the warm phase, the jet stream changes the storm track toward the south, affecting both the wave direction (increase in wave energy into the Monterey Bay) and precipitation. At present, the index has been on the cool side, which tends to lead to less precipitation in Monterey. One other implication of the PDO is that the rate of sea level rise is reduced in the Eastern Pacific (off the U.S. West Coast). Recent PDO research indicates that a shift in the PDO would likely result in much more rapid rise in sea levels off the U.S. West Coast than has been seen in the last three decades (Bromirski et al. 2011).

3.2 Climate Change

Human-induced climate change is a consequence of increased greenhouse gas emissions from the burning of fossil fuels that accumulate in the atmosphere and insulate the earth from outgoing long-wave radiation. As this atmospheric emissions blanket gets thicker, more heat is trapped in the earth's atmosphere, warming the earth and triggering a series of climate changes related to different feedback mechanisms. Once set in motion, many of the climate change feedbacks take centuries to millennium to stabilize.

Worldwide, there are multiple Global Climate Models (GCMs) which attempt to project future climate variables by modeling the earth, ocean, and atmospheric dynamics and interactions based on assumptions of global future population growth and global levels of GHG emissions. The modeling assumptions of future geopolitical response to addressing GHG emissions is called the relative concentration pathways (RCP). The two RCP scenarios included in the climate projections are RCP 4.5, which assumes global

emissions peak in 2040 and then begin to decline, and the RCP 8.5, which assumes emissions peak around 2100 and then decline.

3.3 Climate Projections: Scientific Overview

Substantial research in California is currently underway to effectively downscale climate change models and to project various human-induced climate change impacts at a local scale. By analyzing the outputs of these downscaled models, the City can better understand the range of likely climate impacts specific to the Monterey Bay Region. Several of the key climate change impacts are likely to include increased temperature, uncertainty in precipitation changes, decreased wildfire, and sea level rise. The section summarizes recent scientific data and relevant studies which form the basis of recent climate hazard understanding in Marina.

Sea Level Rise

Globally, sea levels are rising as a result of two factors 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 rise in sea levels. The second factor contributing to eustatic (global) sea level rise is the additional volume of water added to the oceans from the melting of mountain glaciers and ice sheets on land. It is predicted that if all of the ice were to melt on earth, ocean levels would rise by approximately 225-265 feet above present-day levels. The rate at which sea levels will rise is largely dependent 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 uncertainties associated with the rate at which ice melt occurs is largely responsible for the wide variation in sea level rise projections in the latter half of this century (i.e., between 2050 and 2100).

Sea level rise can increase flood risks in low-lying coastal areas and areas bordering rivers. A 5-foot increase in water levels caused by sea level rise, storms, and tides is estimated to affect 499,822 people, 644,143 acres, 209,737 homes, and $105.2 billion of property value in California coastal areas (Climate Central 2014) based solely on increasing tidal elevations. If one considers future large coastal storm events on top of increasing elevation of high tide, this estimate is likely low.

The time scales for sea level rise are related to complex interactions between the atmosphere and the oceans and the lag times associated with the stabilization of greenhouse gases in the atmosphere with the dissolution of those gases into the ocean. The Intergovernmental Panel on Climate Change (IPCC) has published scientific evidence that demonstrates that, due to the greenhouse gases already released into the atmosphere, the sea levels will be rising for the next several thousand years. Given this long-term perspective, it is not a question of if sea level rise will happen, but when it will happen.

Much of the scientific advancement in recent years has been in understanding the contribution and rate of ice melt to global sea levels. It has also revealed the potential for extreme sea level rise resulting from rapid acceleration of ice melt as noted above under the RCP 8.5 scenario. In general, the higher the GHG emissions, the higher the temperature, the more rapid the ice melt, and the higher the rate of sea level rise.

Relative (Local) Sea Level Rise

Sea level rise is not the same everywhere around the world. Because of local differences in tectonic uplift; subsidence caused by oil, gas, and groundwater extraction; and saltwater intrusion, the land itself is moving vertically. The difference between the local land motion and the global rise of sea level gives the relative sea level rise that will determine the magnitude of local sea level rise impacts. The Monterey Tide Gauge, which reports the local sea level rise rate at 1.48 millimeters/year with a 95% confidence interval of +/- 0.86 mm/year based on monthly mean sea level data from 1973 to 2017 which is equivalent to a change of 0.49 feet in 100 years. (Figure 3-1). Since the tide gauge was installed in the mid-1970s, the relatively short time period of record leaves high range in the confidence intervals for the relative sea level rise calculations from the tide gauge.

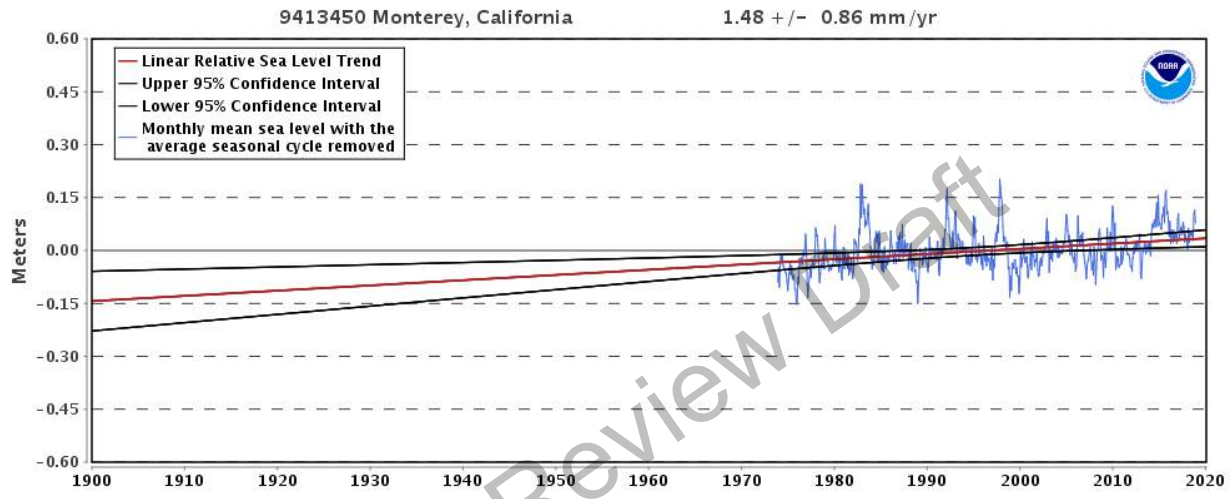


Figure 3-1. Tide Record and Sea Level Rise Trend from Monterey Tide Gauge (NOAA Station 9413450)

2016-2018 California 4th Climate Assessment and Projections

Biannually, the California Energy Commission (CEC) funds climate assessments to better understand the impacts of climate on various natural resource and urban settings. As an initial integral part of the 4th Climate Assessment, Scripps Institution of Oceanography at the University of California, San Diego was commissioned to develop a new suite of climate projections reflecting the latest scientific publications and global level emission reduction pledges made at the 2015 IPCC Paris climate change convention.

The downscaled climate model projections include the entire suite of climate variables including temperature, wildfire risk, precipitation, and sea levels. The modeling included assumptions on population growth, and future global political response to addressing GHGs called the RCP. The modeling included assumptions on population growth and future global political response to addressing GHGs and used RCP 4.5 and RCP 8.5 as described above. Future climate scenarios are compared to the historic time period from 1961-1990. Four GCM models were identified by the State for use in the 4th Climate Assessment work.

- HADGEM2-ES (Warm/Dry)
- CNRM-CM5 (Cool/Wet)
- CanESM2 (Average)
- MIROC5 (Compliment)

Results for key climate variables for the Marina area were extracted from the downscaled California models (**Error! Reference source not found.**). The results shown in **Error! Reference source not found.** are the average of all four of the State-prioritized GCM models and assume the Business as Usual (BAU) emissions scenario (RCP 8.5) and a medium population growth. RCP 8.5 is considered an extreme scenario with a low probability (0.5% chance) of occurring by 2100 as shown in Table 4-2 below. A brief discussion of the implications to Marina is included below.

Table 3-1. Results from the California 4th Climate Assessment for Key Climate Variables

Category	Threshold	Units	Observed Historical Record (1961-1990)	2030	2060	2090
Extreme Heat	>89.3°F	days	4	6	10	18
Temperature	Average Maximum	°F	67.1	69.6	71.9	74.4
Temperature	Average Minimum	°F	47.0	49.6	51.8	54.7
Precipitation	Annual Total	inches	13.0	14.5	14.4	16.0
Wildfire	Annual average	hectares	33.2	31.8	32.5	31.5

Scenario - RCP 8.5 (Emissions continue to rise under business as usual and plateau around 2100).
Using a 20-yr running average (2020-2039, 2050-2069, 2080-2099).
Future predictions are comprised of ensemble averages from four models selected by California's Climate Action Team Working Group.

Temperature

Overall average maximum temperatures in Marina are projected to rise by 7.3°F by 2090 as shown in Table 3-1. These projections differ depending on the time of year and the type of measurement (highs vs. lows), all of which have different potential effects to the state's ecosystem health, agricultural production, water use and availability, and energy demand. Extreme heat has been defined for the Marina area as 89.3°F for the time of year between April and October. Extreme heat during this baseline time period averaged 4 days per year. There are wide ranges between the available climate models, however in general, the extreme heat projections show not only an increase in the number of days expected to exceed the extreme heat threshold, but also their occurrence both earlier and later in the season. Near the end of the century long periods may meet heat wave conditions.

Precipitation

In Marina, the average of the models' precipitation projections shows an increase in total annual precipitation. However, among the four chosen models, precipitation projections are not consistent over the next 80 years. Some individual models show a decrease and others show an increase. Uncertainty around the future trend of precipitation is high. The Mediterranean seasonal precipitation pattern is expected to continue, with most precipitation falling during the winter from North Pacific storms. However, even modest changes could have a significant impact as California ecosystems as they are conditioned to historical rainfall and temperature patterns. Increased seasonal and inter-annual rainfall

variability as well as increased temperature could lead to significant soil moisture stress on plant life, and place significant burden on nearly fully utilized freshwater resources.

Wildfire Risk

As the devastating Soberanes Fire in 2016 and Basin Complex fire of 2008 attests, wildfire is a serious hazard in Monterey County and for the City of Marina. The historical average return interval between large wildfires (> 10,000 ac) in Monterey County is 7.3 years, with a minimum return interval as short as 1 year, and a maximum as long as 16 years. The greatest potential wildfire risk to the City of Marina is from the Bureau of Land Management's Fort Ord National Monument, which is in close proximity to the southern end of the city. Severe weather conditions could make this landscape consisting of fuel-rich maritime chaparral and oak woodlands highly susceptible to wildfire outbreak (Monterey Fire Safe Council 2010). Several studies have indicated that the risk of wildfire will increase with climate change. While the models differ, there is a general pattern for wildfires in California to start earlier in the season, continue later in the year, and occur with increasing frequency.

Sea Level Rise

The 4th Climate Assessment scenarios take a new approach and carefully quantify each contributing factor to global sea level rise and assign a probability of occurrence based on the scientific uncertainties associated with each factor. The new resulting sea level rise projections for California are the first to identify probabilities for future levels of sea level rise (Cayan et al 2016). The new sea level rise numbers are summarized in a scientific summary which was written to be more approachable for policy making (OPC 2018). Overall, the sea level rise projections in 2018 are lower than the NRC 2012 projections, except for the high emissions (RCP 8.5) 2100 scenario. In addition, recent scientific work has identified the potential for an extreme sea level rise scenario caused by runaway ice melt. This scenario is called the H++ scenario and projects 10.1 feet of sea level rise by 2100 for the Monterey Bay region. The State's Ocean Protection Council has used these scientific updates to develop revised sea level rise planning guidance and has included the associated probabilities of sea level rise for the Monterey tide gauge. The CCC has updated their sea level rise guidance to account for these changes. The difference between these two guidance documents is that the OPC Guidance lays out broad statewide scientific information, and the CCC Guidance integrates those recommendations for use in Coastal Commission planning and permitting processes. These projections are summarized in Table 3-2 below.

Sea level rise scenarios used in this analysis were selected consistent with the CCC's 2015 Sea Level Rise Policy Guidance (CCC 2015) and consistent with the more recent results from the California 4th Climate Change Assessment (OPC 2018; Table 3-1). Projections of future climate change impacts came from a variety of sources including Cal Adapt and Scripps Institution of Oceanography.

Monterey can expect between 5 and 10 inches of sea level rise by 2030, between 12 and 31 inches by 2060, and between 28 and 63 inches by 2100 (Table 3-3). Table 3-3 shows the elevation of sea level rise used in the coastal hazard modeling (top row) and the relative probability of occurrence by the time horizon (OPC 2018). Note that the extreme worst case "extreme risk aversion" scenario for Monterey Bay is for 10.1 feet by 2100 (Table 3-2).

Table 3-2. Probabilistic Projections of Sea Level Rise for Monterey (OPC 2018)

		Probabilistic Projections (in feet) (based on Kopp et al. 2014)				H++ scenario (Sweet et al. 2017) *Single scenario
		MEDIAN	LIKELY RANGE	1-IN-20 CHANCE	1-IN-200 CHANCE	
		50% probability sea-level rise meets or exceeds...	66% probability sea-level rise is between...	5% probability sea-level rise meets or exceeds...	0.5% probability sea-level rise meets or exceeds...	
			Low Risk Aversion		Medium - High Risk Aversion	Extreme Risk Aversion
High emissions	2030	0.4	0.3 - 0.5	0.6	0.8	1.0
	2040	0.6	0.4 - 0.8	0.9	1.2	1.7
	2050	0.8	0.5 - 1.1	1.3	1.9	2.7
Low emissions	2060	0.9	0.5 - 1.2	1.5	2.3	
High emissions	2060	1.0	0.7 - 1.4	1.8	2.6	3.8
Low emissions	2070	1.0	0.6 - 1.4	1.9	3.0	
High emissions	2070	1.3	0.9 - 1.8	2.3	3.4	5.1
Low emissions	2080	1.2	0.7 - 1.7	2.3	3.8	
High emissions	2080	1.6	1.1 - 2.3	2.9	4.4	6.6
Low emissions	2090	1.3	0.8 - 2.0	2.7	4.6	
High emissions	2090	2.0	1.3 - 2.8	3.5	5.5	8.2
Low emissions	2100	1.5	0.9 - 2.3	3.1	5.5	
High emissions	2100	2.3	1.5 - 3.3	4.3	6.9	10.1
Low emissions	2110*	1.6	1.0 - 2.4	3.3	6.1	
High emissions	2110*	2.5	1.7 - 3.4	4.4	7.2	11.9
Low emissions	2120	1.7	1.0 - 2.7	3.8	7.3	
High emissions	2120	2.8	2.0 - 4.0	5.2	8.5	14.0
Low emissions	2130	1.9	1.1 - 3.0	4.2	8.3	
High emissions	2130	3.1	2.2 - 4.5	5.9	9.9	16.4
Low emissions	2140	2.0	1.1 - 3.2	4.7	9.5	
High emissions	2140	3.5	2.4 - 5.1	6.7	11.3	18.9
Low emissions	2150	2.1	1.1 - 3.6	5.3	10.8	
High emissions	2150	3.8	2.6 - 5.7	7.6	12.9	21.8

Table 3-3. Sea Level Rise Scenarios by Planning Horizon (adapted from NRC 2012, ESA PWA 2014, OPC 2018)

Model/year	SLR - in			% Probability		
	2030	2060	2100	2030	2060	2100
Coastal Resilience - High[4]	**9**	**28**	**63**	**0.50%**	**>5%<67%**	**>5%<67%**
Low Risk Aversion[5]	5	16.8	39.6	67%	67%	67%
Med-High Risk Aversion[5]	9.6	31.2	82.8	0.50%	0.50%	0.50%
Extreme Risk Aversion (H++)[5]	12	45.6	121.2	NA	NA	NA

[4] ESA PWA 2014

[5] OPC 2018, CCC 2018

3.4 Other Regional Sea Level Rise and Coastal Management Initiatives

Currently, there are a wide variety of scientific investigations studying and modeling the impacts of coastal hazards, climate change, and adaptation economics for the Monterey region. The studies discussed below demonstrate the most promise and focused applicability to the City of Marina. In addition, there are currently, multiple regional planning initiatives to integrate the impacts of coastal hazards, climate change, and sea level rise into local planning documents. Many local jurisdictions are updating their LCPs with the intent of moving toward adaptation planning in the Santa Cruz and Monterey Bay region.

2008 Coastal Regional Sediment Management Plan for Southern Monterey Bay

In 2008, Philip Williams and Associates completed a Coastal Regional Sediment Management Plan, which identified what is known about sand supplied to the coast between Wharf 2 in Monterey and the Monterey Submarine Canyon, including new understanding of the sediment budget, causes of erosion hot spots, the impact of sand mining, and shoreline armoring. Recommendations from this plan include new ways to manage sediment, including development of an opportunistic sand placement program, sand rights policies, and changes in regional governance structure, which would support better use of coastal sediments.

2010 Technical Evaluation of Erosion Mitigation Alternatives

Between 2008 and 2010, Philip Williams and Associates (PWA) working with the Southern Monterey Bay Coastal Erosion Working Group and the Monterey Bay National Marine Sanctuary conducted a study evaluating potential erosion mitigation alternatives. This project took a holistic approach looking at both the engineering feasibility, the technical effectiveness, and the net economic benefits to over 20 different erosion mitigation strategies (aka adaptation strategies). Key findings were to stop sand mining and avoid coastal armoring to maximize the long term economic benefits to the region. While the study did not directly include sea level rise, this study led the way to the 2014 Monterey Bay Sea Level Rise Vulnerability Study and the 2016 Adapt Monterey Bay studies.

2014 Monterey Bay Sea Level Rise Vulnerability Study

This modeling effort projects the impacts of coastal erosion and coastal flooding for the Monterey Bay, extending from Año Nuevo Point to Wharf 2 in Monterey. A technical methods report presents technical documentation of the methods used to map erosion and coastal flood hazards under various future climate scenarios (ESA PWA 2014). The climate-change–exacerbated coastal hazard modeling considered different scenarios of sea level rise, wave climate, and sand mining. This study and model outputs provide much of the hazard identification used in support of the City's vulnerability assessment. Results of the various modeling scenarios are available at the TNC Coastal Resilience Mapping portal.

2016 Adapt Southern Monterey Bay

This study is an update to the economic and physical analysis conducted in the 2010 Technical Evaluation of Erosion Mitigation Alternatives. The overall project evaluates a range of adaptation strategies and compares the benefits of having a beach versus protecting upland property. The approach includes improved coastal hazard modeling resulting from implementation of various adaptation strategies and improved economic analysis that includes accounting for the value of storm damage reduction to upland properties, recreational benefits, and ecosystem services. Some of the economic analyses showed the benefits of dune restoration and opportunistic sediment placement at reducing erosion in Marina.

2015 The Nature Conservancy's Coastal Resiliency Mapping Tool

The Coastal Resiliency Mapping Tool by The Nature Conservancy has been developed for geographies around the world to visualize the extent and magnitude of sea level rise and coastal hazards. The web mapping application provides an interactive visualization tool[6]. This tool allows users to explore the risks of different scenarios of coastal hazards—such as sea level rise, storm surges, and inland flooding—at a variety of spatial scales. In addition, it provides access to coastal hazard model projection data and the technical documentation of the modeling.

2016 Monterey and Santa Cruz County Vulnerability Assessment

Consistent with the CCC's emphasis on crafting regional approaches to sea level rise and funded by the Ocean Protection Council to Monterey County, this project is evaluating future vulnerabilities to sea level rise to Santa Cruz and Monterey County. The project includes improved coastal confluence modeling of Soquel Creek (Capitola) and the old Salinas River (Moss Landing). Focus areas of interest were Capitola and Moss Landing.

2017 FEMA Pacific Coastal Flood Mapping

FEMA is currently updating the Pacific Coastal 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. The project incorporates regional wave transformation modeling and new run-up methods to revise the effective flood insurance rate maps for coastal flood hazard zones. This included revisions to the VE (wave velocity), AE (ponded water), and X (minimal flooding) zones. The revised maps became effective in 2017.

2017 CEMEX/ CCC Settlement Agreement

On July 13, 2017, the CCC (working with and on behalf of the City of Marina) and CEMEX reached a Consent Settlement Agreement to close the CEMEX Sand Mine in Marina, the last coastal sand mine in the United States. The CEMEX sand mine used a hydraulic dredge to mine sand from a pond at the back of the beach. The Settlement agreement laid out a program to phase out the sand mining activities by December 31, 2020 and conduct remediation on the site including a regrading and seeding plan by December 31, 2021 and completion of the full Remediation Plan by December 31, 2025. At that point, the property could be

[6] Web link: maps.coastalresilience.org/California

purchased by a government entity or non-profit with limitations on the types of future land uses. Currently the City of Marina and CCC are working on changes to the land use designation in the LUP.

2017 Dune Restoration at Salinas River State Beach

Sand dunes, in their natural state, buffer coastal erosion and minimizing ocean induced flooding, while providing critical habitat to many special status species. Sand dune systems in the Monterey Bay provide a natural barrier that protects thousands of acres of low lying communities, agricultural lands, and wetlands resources from winter storms. Small breaches in the dunes could allow ocean flooding of vast areas of the Salinas Valley. In many areas, invasive plants have reduced important ecological and storm buffering functions. The Central Coast Wetlands Group at Moss Landing Marine Labs, with funding from the State Coastal Conservancy, is restoring areas of the Salinas Beach State Park to reduce the vulnerability of two breach points in the dune complex by restoring native vegetation and improving the natural adaptive capacity of these coastal dunes as a proof of concept for future adaptation projects.

2019 City of Monterey Opportunistic Use Program

The City of Monterey on behalf of the coastal communities in the Southern Monterey Bay Littoral Cell is developing an opportunistic sand use program. The program is intended to streamline the placement of clean, beach compatible sediments from upland sources (e.g. construction projects, flood control) on the beaches of Monterey at designated locations to reduce potential erosion impacts, improve coastal resiliency, and maintain dune and beach habitats. The proposed receiver sites in the City of Marina are located at the end of Reservation Road and at the CEMEX property. The CEQA review document is currently out for public review and any projects would then be approved by the City leveraging the CEQA and design work already completed.

Central Coast Climate Collaborative

The Central Coast Climate Collaborative is an organization of 6 counties that is fostering a regional dialog to share information and best practices on climate change impacts, leverage regional adaptation efforts, attract funding, and improve resiliency across the Central Coast.

2019 USGS CoSMoS 3.1.

USGS has been developing the Coastal Storm Modeling System (CoSMoS) to provide projections of coastal flood hazards and cliff erosion using a state of the art numerical and statistical downscaling of Global Climate Model (GCM) projections. The intent is to provide region-specific, consistent information on coastal storm and sea level rise 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 sea level rise scenarios to produce hazard projections for every 9.8 inches (0.25 meters) of sea level rise. Results map a dynamic wave run-up extent (differing from FEMA and Coastal Resilience maximum wave run-up) and account for various sea level rise, storm frequencies, and uncertainties. An interactive web mapping portal shows the results of the hazard data at Our Coast Our Future[7].

Results of CoSMoS were not available at the time of this analysis, however based on previous experience and review of draft data products, CoSMoS results do not explicitly project long term coastal dune erosion.

[7] Map portal at: www.ourcoastourfuture.org

4. Vulnerability Assessment Methods

4.1 Introduction

This chapter summaries the projected vulnerabilities from sea level rise and coastal hazards for the City of Marina. First, there is an overview of the methodologies used to assess existing and projected vulnerabilities from coastal hazards including the geospatial data collection, identification of coastal hazards, and a summary of the results. Decisions on the sea level rise scenarios, sector selection, hazard models, and measures of impacts were made in concert with the City, CCC and the consultant team, and are documented in Appendix A.

This report considered several primary data sources for coastal hazards:

- Coastal hazards modeling analysis results (ESA PWA 2014).
- FEMA effective flood maps (FEMA 2017).
- Spatial and locational data available from the City of Marina, Association of Monterey Bay Area Governments (AMBAG), and Environmental Systems Research Institute (ESRI).

Projections of future coastal hazards and sea level rise were modeled as part of a separate project completed during the Monterey Bay Sea Level Rise Vulnerability Assessment (ESA PWA 2014). Substantial research in California recently published as part of the 4th California Climate Change Assessment has effectively downscaled climate change and to project various human-induced climate change impacts at a local scale (See Section 3).

4.2 Sector Geospatial Data and Exposure Selection

With input from the City, and following guidance from the CCC and the consulting team's experience in other jurisdiction, potential sectors were identified to be considered for analysis as well as the measures of impact for each sector that were available and deemed useful (Table 4-1). Data collection efforts began with available City data and expanded to include Monterey County data, CCC, and available regional (AMBAG), State, Federal, and open source public data libraries. In some cases, older data such as structures were updated by drawing from open source datasets such as Bing Maps building footprint data and using standard digitizing from the most recent available aerial from AMBAG. All data was checked for topological fidelity (spatial relationships), spatial accuracy, and accuracy of tabular data (attributes).

Initially the data collection phase collected, reviewed, and analyzed the full range of potential sectors below. Once the geospatial sector data were evaluated with the coastal hazard modeling exposure for the unique setting in the City of Marina, it was determined that only the following **BOLD** sectors were worth further vulnerability evaluation from potential coastal erosion and sea level rise impacts. For non-assessed sectors a brief description follows the sector. Results of the full vulnerability analysis are shown in Section 4-4.

Sectors Evaluated: (Sectors in **bold** are described in the Sector Profiles Results)

- **Land Use and Parklands**
- **Roads, Parking and Bike Routes**
- **Coastal Trails and Public Access**
- **Water Supply and Wastewater**
- **Sensitive Dune Habitats**
- Public Transportation – limited to coastal flooding 2100
- Storm Water – limited exposure, majority of stormwater captured in percolation ponds
- Community Facilities and Critical Services – no exposure
- Hazardous Material Storage – no erosion exposure, limited to coastal flooding 2100

Table 4-1. Description of Available Geospatial Data: Potential Resource Sectors, Measures of Impacts, and Data Sources

Sector	Sub-Sector	Measures of Impacts	Data Source
Land Use Parcels and Structures	Commercial	# of parcels, acreage of parcels, # of structures, square feet of structures	Parcels – County Assessors Structures – AMBAG with Input from Revell Coastal and Open Source Datasets
	Institutions and Government	# of parcels, acreage of parcels, # of structures, square feet of structures	
	Open Space and Recreation	# of parcels, acreage of parcels, # of structures, square feet of structures	
	Residential	# of parcels, acreage of parcels, # of structures, square feet of structures	
	Mining *	# of parcels, acreage of parcels, # of structures, square feet of structures	
Roads, Parking, and Bike Routes	Roads	length of road	County Open Data Portal, Open Street Map
	Parking Lots	# of lots, acreage of lots	Revell Coastal with Input from City of Marina Planning Department
	Bike Routes	length of bike routes	Revell Coastal with Input from Ord Reuse Authority, Open Street Map
Coastal Trails and Public Access	Coastal Access and Trails	# of access points, length of trail by type	Revell Coastal with input from CCC and the City of Marina Planning Department, Open Street Map

Table 4-1. Description of Available Geospatial Data: Potential Resource Sectors, Measures of Impacts, and Data Sources

Sector	Sub-Sector	Measures of Impacts	Data Source
Water Supply and Wastewater Infrastructure	Stormwater Infrastructure	# of drop inlets, # of outfalls, length of drains	MCWD, Second Nature, City of Marina Planning Department
	Wastewater Infrastructure	# of lift stations, # of manholes, length of pipes	MCWD
	Water Supply Infrastructure	# of control valves, # of pressure regulators, # of water meters, # of fire hydrants, # of pump stations, # of manholes, # of ground water wells, length of pipes	MCWD
Sensitive Dune Habitats	Environmentally Sensitive Habitat	area and types of habitats (Date Unknown)	City of Marina Planning Department
Stormwater	Stormwater Infrastructure	# of drop inlets, # of outfalls, length of drains	MCWD, Second Nature, City of Marina Planning Department
Public Transportation	Public Transportation	length of: bus routes, railroad lines; # of bus stops	MST and the City of Marina Planning Department
Community Facilities and Critical Services	Community Facilities	# of: government, religious, lodges, other cultural buildings	Revell Coastal with input from County Planning Department
	Critical Services	# of: police, fire, school, medical, communication, water treatment facilities	Revell Coastal with input from County Planning Department
Hazardous Materials Sites	Geotracker ESI Reporting Sites (Hazardous Business Materials Storage)	# of sites	State Water Resources Control Board
	U.S. Environmental Protection Agency (EPA) Small Quantity Generators (SQGs)	# of sites	EPA
	Cleanup Program Active Sites	# of sites	EPA

4.3 Vulnerability Assessment Methodology

The vulnerability assessment involves spatial analysis on the geospatial sector data acquired from a wide variety of sources. The sector data, sea level rise, and model selection decisions were made with input from the City and the consultant team and are documented in Appendix A. In addition, efforts were made to obtain data directly from CCC staff in order to identify the appropriate resource sectors and measures of impact. All spatial data was evaluated for accuracies (Table 4-1).

All geospatial analysis was conducted in ArcGIS. For each resource sector and measure of impact, the respective data set was queried for intersection with the coastal hazard modeling data. From these spatial queries, summary statistics were calculated by sea level rise elevation) for each measure of impact by each type of coastal hazard.

Vulnerability points (e.g. bus stops) and line features (e.g. roads) are determined by the spatial intersection of the various coastal hazard horizons with the various resource/infrastructure assets. Vulnerability counts for smaller polygons with specific categories (e.g. structures) are determined by dissolving the entire polygon with attributes from the first (i.e. lowest) coastal hazard horizon intersection. Meaning, if a structure was eroded across multiple horizons, only the first instance was documented. Vulnerability for larger polygons (e.g. dune habitats, where the area affected across horizons is a relevant statistic) was determined in the same manner as points and lines. Results are collated into a master vulnerability table and summarized in the sector profiles found in Section 4-4, *Sector Profiles*. The complete vulnerability table of results is found in Appendix B.

Coastal Hazard Modeling

The modeling work for the 2014 Monterey Bay Sea Level Rise Vulnerability Assessment Project included modeling of the following coastal processes:

- **Short-Term Coastal Erosion:** Short-term coastal erosion based on the largest historic storm wave event in the Monterey buoy record.
- **Long-Term Coastal Erosion:** Long-term coastal changes caused by erosion related to sea level rise and historic trends in erosion. For this vulnerability assessment, the long term coastal erosion projections considered a 70% reduction in the historic long term erosion rates due to the cessation of sand mining[8].
- **Coastal King Tide Flooding:** Based on an expected monthly recurrence. – **No exposure**
- **Coastal Flooding:** Flooding caused by waves associated with a 1% annual chance storm event, including run-up, overtopping and filling of low lying areas.

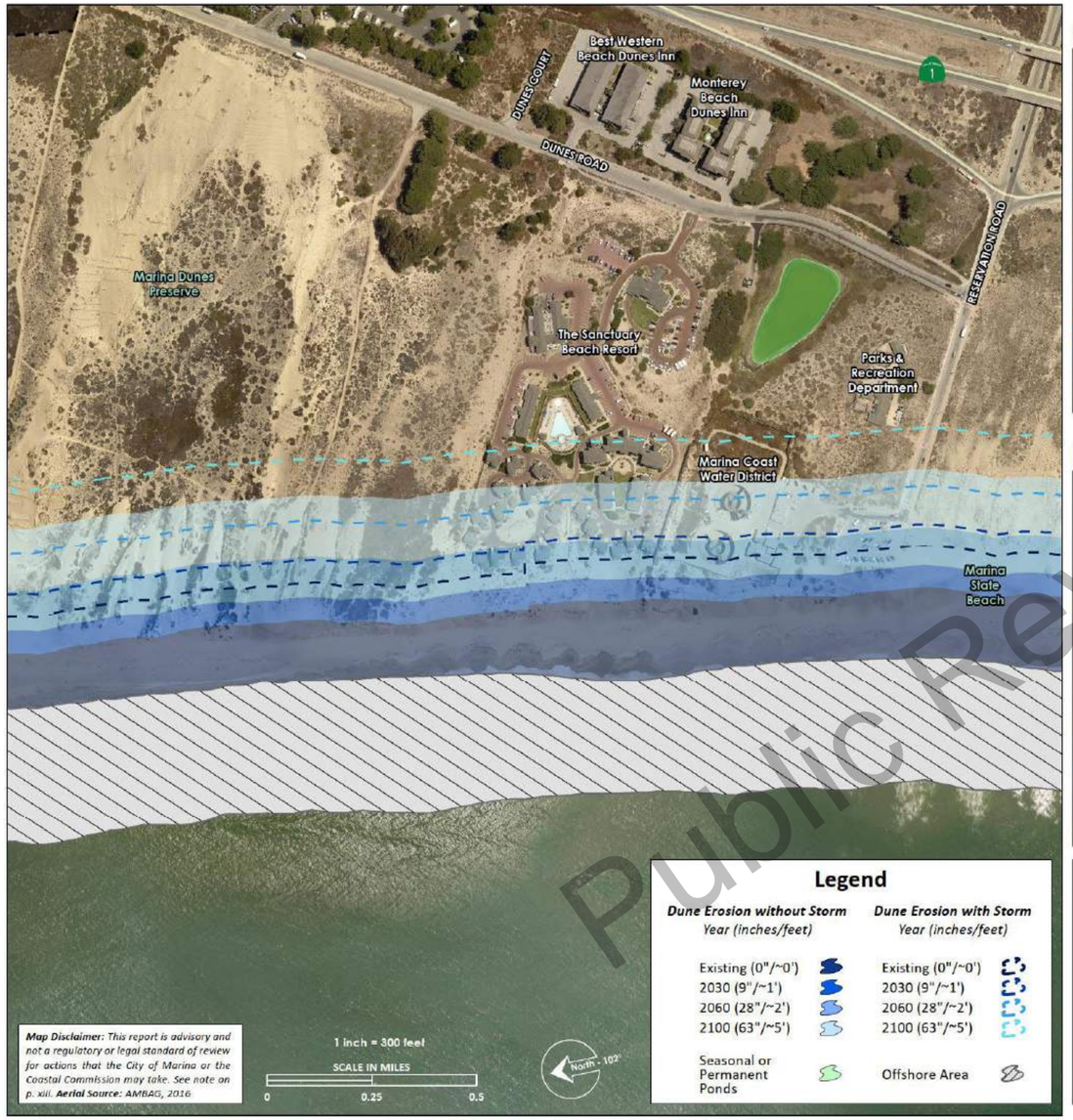
Based on the spatial extents of projected future coastal hazards and sector data, the vulnerability assessment focused primarily on long term (from sea level rise) and episodic dune erosion from a large storm wave erosion event.

[8] Reduction of erosion rates based on input from Dr. Ed Thornton in 2008 as part of the Southern Monterey Bay Coastal Regional Sediment Management Plan and integrated into the "without sand mining scenario" modeled in ESA PWA 2014

Coastal Dune Erosion

Dune Erosion. The coastal dune erosion hazard modeling considered a short-term response based on the erosion from a 100-year storm wave event. For long-term dune erosion, two components—projected long-term erosion caused by historic trends in shoreline change (as a proxy for sediment supply) and accelerated by sea level rise—were mapped separately (Figure 4-1; Table 4-2). For this vulnerability assessment, the long term coastal erosion projections considered a 70% reduction in the historic long term erosion rates due to the cessation of sand mining (PWA 2008, ESA PWA 2014).

Central Marina - Dune Erosion Comparison



South Marina

North Marina

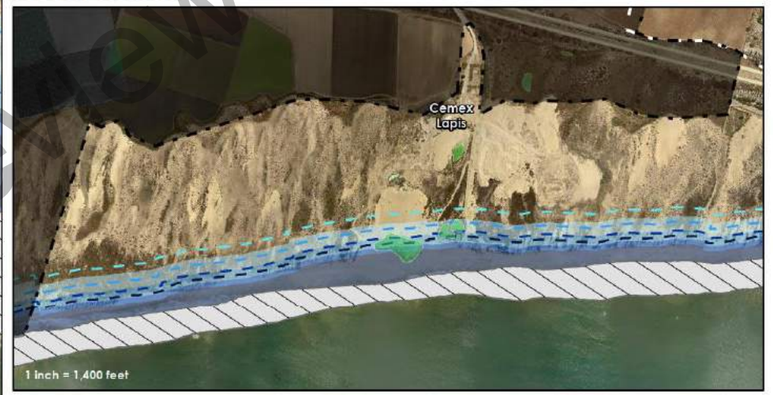


Figure 4-1. Projected Long Term and Storm Induced Coastal Erosion with 5 Feet of Sea Level Rise and Considering the Cessation of Sand Mining and the Subsequent Change to Coastal Erosion Trends

In modeling for both types of dune erosion, inland extents were projected using a geometric model of dune erosion originally proposed by Komar et al. (1999) and applied with different slopes to make the model more applicable to sea level rise (Revell et al. 2011). This method is consistent with the FEMA Pacific Coast Flood Guidelines for storm-induced erosion (FEMA 2005). One of the sea level rise scenarios modeled in 2014 included projections that assumed reduced erosion from the cessation of sand mining. After consultation with the City and Coastal Commission, this modeling scenario was selected for as the coastal erosion hazard projections used in the modeling.

Table 4-2. Projected Erosion Distances Through Time

Horizon	Long term erosion distance (feet)	Storm induced erosion distance (feet)	Total erosion distance (feet)
0" Sea Level Rise (Present)	165.8	97.5	263.3
9" Sea Level Rise (~2030)	225.8	96.9	322.7
28" Sea Level Rise (~2060)	333.3	95.4	428.7
63" Sea Level Rise (~2100)	492.5	99.4	591.9

Distance as measured from shoreline.
Average distance from 5 transects from Marina Dunes Preserve to Marina State Beach.

Coastal Storm Flooding

The coastal storm flood modeling from the Monterey Bay Coastal Resilience Project was consistent with FEMA's Pacific Coastal Flood Guidelines (FEMA 2005, ESA PWA 2014). The high tide coastal storm flood modeling was integrated with the coastal erosion hazard zones. Every 10 years, erosion projections were made and the coastal storm flood model considered areas that were eroded during this time period and thus exposed to wave flooding through enhanced hydraulic connectivity. For the coastal storm flooding, the storm of record was used—the largest historic storm event that occurred during 18 years of wave buoy data available at the time of the 2014 modeling study.

There was however one caveat with this coastal storm flooding modeling which was that the coastal flood extents did not consider the without sand mining reduction in coastal erosion. As a result of the reduced coastal erosion from the cessation of sand mining, there was a corresponding reduction in the inland extents of erosion and number of hydraulic connections caused by breaching of the dunes. The reduced erosion and hydraulic connections decreased the volume and extents of coastal storm wave flooding which were adjusted to the sole hydraulic connection along Reservation Road under Highway 101. The coastal flood layer extends inland to all hydraulically connected areas below the 25 foot contour line (Figure 4-2).

For more detail on the coastal flood hazard delineation please see Appendix A.

Figure 4-2. Projected Extent of Coastal Flood Hazards with 5 Feet of Sea Level Rise and a Major Storm Wave Event

Sensitive Biological Beach and Dune Resources

All habitats will be affected by climate change. Beach and dune habitats are all identified as Environmentally Sensitive Habitat Areas (ESHA) under the Coastal Act. While current ESHA has not been mapped, all coastal erosion in Marina affects dune and beach habitats. Landscape connectivity between dunes and beaches provide a critical corridor for species to escape landward during storm wave events, as well as sand to be delivered to beaches. A simple GIS analysis of acreages on dated and generalized mapped dune or beach habitats provide an initial investigation of the potential exposure of beach and dune habitats, but this process does not provide good accuracy of estimations for habitat vulnerability or complex ecological interactions, habitat fragmentation, changing physical processes, and other climate variables.

Beaches in the City are largely classified as open space and are an important part of the community identity. Detailed mapping of beaches and their seasonal and intra-annual fluctuations has not been studied extensively. However, given the lack of any coastal armoring in the City, as dune erosion occurs during large storm events and sea level rise over time moving the toe of the dunes inland, then beaches should be naturally maintained into the future. This allowance of continuing dune erosion and acceptance of beach fluctuations allows the ecology and recreational uses that depend on this connection between beach and dune habitat to be maintained in the future. Under current and future conditions, during large storm events, access and beach recreational use may be hazardous, but the lack of armoring promotes a habitat connectivity which allows species to retreat landward during such erosive storm events.

Beaches and other coastal ecosystems have many other benefits not quantified or incorporated in this Report, such as the ability to buffer storm waves, filter water, and provide recreation and habitat. The City should consider the loss or degradation of sensitive biological beach and dune resources when evaluating different adaptation options.

5. Sector Vulnerability Results

The key findings for each impacted sector are summarized below by sea level rise elevation and approximate planning horizon below. Each sector profiles includes a map color coded by the projected elevation of potential impact. On the other side of the sector profiles is a summary of the specific vulnerabilities to coastal dune erosion by sea level rise elevation and likely planning horizon and includes a discussion of the existing conditions, key findings and adaptation recommendations.

Each sector has its own profile, complete with a color coded vulnerability map and two-page summary of findings. They are as follows:

- Land Use and Parklands
- Trails and Access
- Water Supply and Wastewater
- Roads and Bike Routes
- Dune Habitat

The overview section provides a summary of the key findings for each resource sector over time. The existing and future vulnerabilities sections highlights what is potentially vulnerable today and projected to be at risk in the future from coastal erosion, and coastal wave flooding for each sea level rise elevation/ planning horizon[9]. Results in each sector profile are reported based on what becomes potentially exposed and vulnerable with a certain amount of sea level rise. If nothing is reported with additional sea level rise over that time frame, then no additional vulnerabilities are reported.

The ~5 feet of sea level rise by 2100 scenario identifies both what becomes vulnerable between ~2 and ~5 feet of sea level rise, as well as the cumulative totals for all planning horizons.

The adaptation section mentions a few potential adaptation strategies. This section will evolve as additional workshops and dialogs are held with the City and key stakeholders. The criteria for prioritizing adaptation measures include feasibility, implementation and maintenance costs, and community acceptance.

The most vulnerable areas of Marina are found on the ocean side of Highway 1 off of Reservation Road (Figure 5-1).

[9] Tidal inundation and groundwater daylighting were also considered but deemed to be not critical coastal hazards due to the topography and exposure.

Figure 5-1. Overview of threatened areas of Marina off Reservation Road. Credit: Coastal Records Project

5.1 Land Use and Parkland

Figure 5-2. Central Marina Dune Erosion, Land Use, Structures, & Parkland

LAND USE

Overview

Land uses in the City of Marina are categorized by: (1) commercial and mixed, (2) institutional, (3) mining*, (3) open space (4) residential and common, (5) vacant, and (6) visitor serving. To identify land uses vulnerable to SLR and coastal hazards, this study evaluated the land uses exposed to the projected ***coastal dune erosion hazard*** extents. Coastal erosion could cause substantial damages to structures and cause a permanent reduction in parcels size.

While there are many more parcels and structures in the entire City, this analysis only considered parcels and land uses that were within or near close proximity to projected coastal hazards which included:

- **22 parcels**
- **274 acres of parcels**
- **32 structures**

No residential developments fell within projected coastal erosion hazard zones even with 5' of SLR.

Note: Parcels and structures are reported to be impacted at the first exposure to coastal erosion hazards. Acres of parcels are reported to include the portion of those parcels that are vulnerable at each hazard horizon. Results shown in each planning horizon are additional land uses that become exposed at that elevation of sea level rise.

Existing Vulnerabilities

Coastal Erosion (Parcels (first instance)/Acres/Buildings (first instance)

Institutional	Mining	Open Space	Visitor Serving
2/6.6 acres/4	2/71.6 acres/0	16/71.9 acres/0	1/6.1 acres/0

Visitor Serving – The ocean fronting parcel at the Sanctuary Beach Resort
Mining – Two parcels comprising the CEMEX Lapis property. The dredge ponds are exposed
Open Space – 16 parcels comprising the Marina Dunes Preserve and Marina State Beach
Institutional – Four buildings and one parcel at the Marina Coast Water District Facility. The City owned parcel comprising the State Parks beach access parking lot and the Marina Coast District Offices.

Future Vulnerabilities

9 inches (~1 foot) by ~2030

Coastal Erosion (Parcels/Acres/Buildings)

Institutional	Mining	Open Space	Visitor Serving
0/.9 acres/3	0/12.1 acres/0	0/9.0/7 acres/0	0/0.8 acres/9

Visitor Serving – Nine ocean fronting hotel room buildings at The Sanctuary Beach Resort
Institutional – Two buildings at the Water District Facility. The restroom at the Reservation Road Parking Lot.

28 inches (~2 feet) by ~2060

Coastal Erosion (Parcels/Acres/Buildings)

Institutional	Mining	Open Space	Visitor Serving
0/1.5 acres/1	0/21.6 acres/0	0/17.1/7 acres/0	1/1.4 acres/9

Visitor Serving – Another parcel at the Sanctuary Beach Resort including eight hotel room buildings and one comfort station
Institutional – One building at the Marina Coast Water District Facility.

63 inches (~5 feet) by ~2100

Coastal Erosion (Parcels/Acres/Buildings)

Institutional	Mining	Open Space	Visitor Serving
0/2.3 acres/0	0/33.4 acres/0	0/26.1 acres/0	0/2.2 acres/6

Visitor Serving – An additional six hotel room buildings at The Sanctuary Beach Resort

Adaptation Strategies

Range of Strategies:

Manage – Relocate development from the hazardous areas along shoreline. Restore native dune vegetation.

Accommodate – Increase setbacks, and foundation standards to facilitate elevating or relocating structures.

Protect – Implement regular opportunistic nourishment, to widen and increase the elevation of beach and dunes as "green" protection. Nourish beach with cobbles or cobble berms to provide more robust natural protection.

Secondary Impacts:

Secondary impacts from "Green" protection through beach and dune nourishment will depend on the frequency and volume of sand placement. Over time, it should be anticipated that there will be an increasing expense associated with more frequent maintenance with higher levels of SLR. "Gray" techniques using revetments would provide protection, but could negatively impact beach and dune habitats, natural processes and coastal access.

Potential Next Steps

Policy:

- Develop a policy to prioritize beaches and deny any shoreline protective devices.
- Develop policies to encourage relocation of threatened facilities and structures.
- Consider delineating a current primary and secondary Environmentally Sensitive Habitat Area which prioritizes landscape connectivity between the ocean, beach and dunes over isolated dune habitats to allow for inland relocation.
- Coordinate regionally with State Parks, Marina Coast Water District and the Sanctuary Beach Resort to adapt to escalating coastal erosion hazards
- Downzone the portions of the CEMEX sand mine property to be consistent with the 2010 City General Plan and preclude future development in hazardous areas.
- Encourage the use of opportunistic sand placements to reduce future erosion rates

Projects

- Develop an opportunistic sand use program

Monitoring:

Work with vulnerable stakeholders to monitor rates of sea level rise, erosion of dune crest, wave flooding depth, extents, and frequency of overtopping on roads and parking lots.

Summary of Findings

Total Cumulative Number of Parcels/Acreages/Number of Structures at Risk from Erosion with 5' of SLR

Institutional	Mining	Open Space	Visitor Serving
2/11.3 acres/8	2/138.6 acres/0	16/124.8 acres/0	2/10.5 acres/24

Currently, the Marina Coast Water District, Marina State Beach, CEMEX sand mine and the Sanctuary Beach Resort are all exposed to coastal erosion. **With 1' of SLR**, these erosion impacts increase the exposure to structures at the Sanctuary Beach Resort, MCWD, and Marina State Beach **With 2' of SLR**, the entire Marina Coast Water District facility could be damaged. **With 5' of SLR**, a total of 22 parcels and 285 acres could be eroded including 154.1 acres of dune habitat and open space. Projected erosion could also damage 24 buildings at the Sanctuary Beach Resort.

5.2 Trails and Access

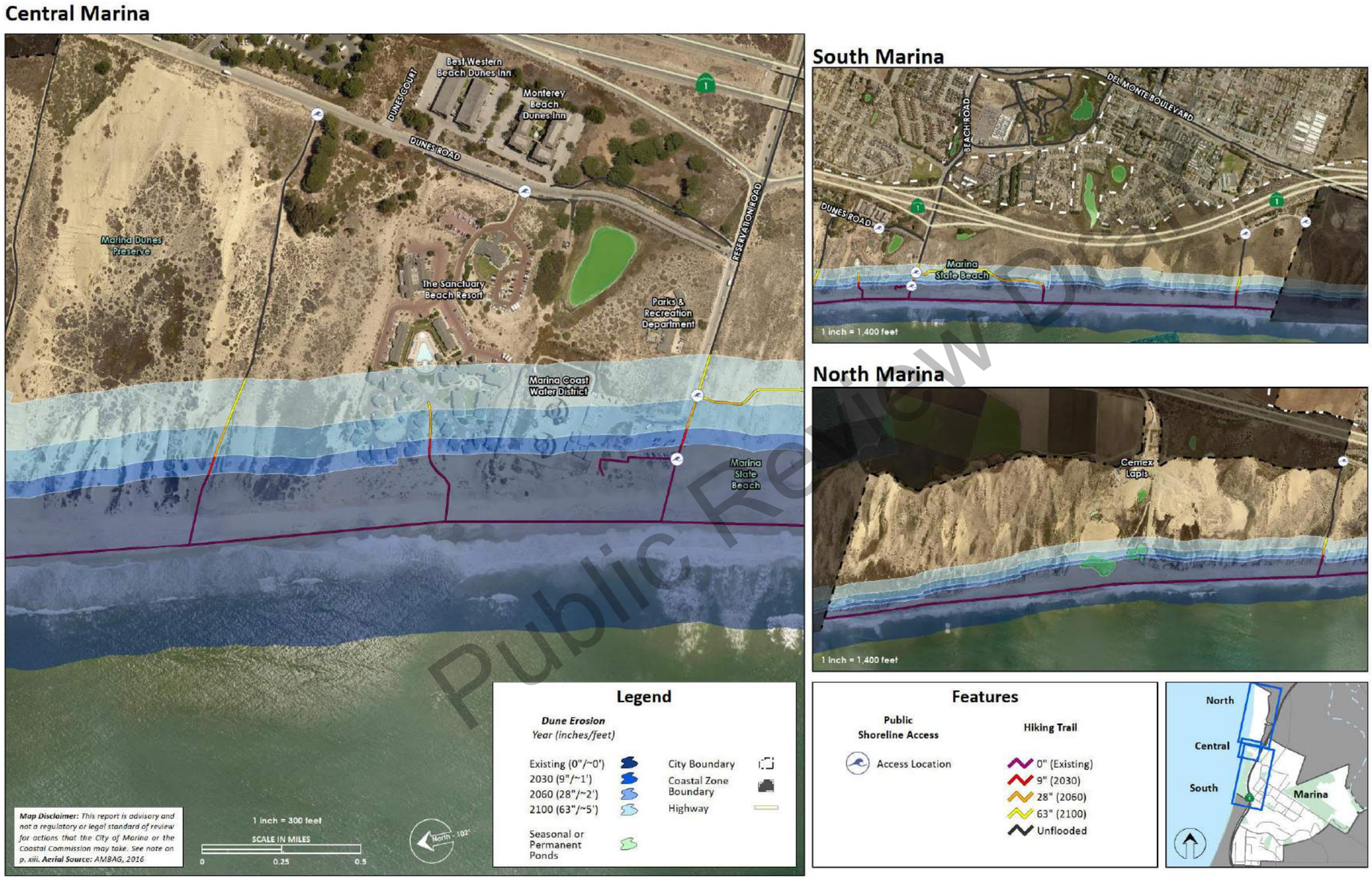


Figure 5-3. Central Marina Dune Erosion, Trails & Coastal Access

TRAILS AND BEACH ACCESS

Overview

To identify coastal access ways and trails potentially vulnerable to coastal erosion and SLR hazards, this study evaluated the following:

- **7 Vertical Coastal Access Points**
- **3.2 Miles of Lateral Beach Access**
- **1.22 Miles of Coastal Access Trail**
- **35.79 Miles of Walking Trail**

The City has a wide variety of trails throughout the extensive dune system. Some trails provide vertical beach access through the dunes and others provide access along the crest of the dunes observing the ocean and the dune habitats and species. Part of this trail system is a part of the California Coastal Trail, a network of trails visioned to run the length of the California Coast.

Existing Vulnerabilities

Coastal Erosion

- Vertical Coastal Access– 1,913 feet
- Lateral Beach Access – 3.2 miles
- Hiking Trails – 0

Vertical Coastal Access: All of the vertical coastal accesses are exposed to coastal erosion.

Lateral Coastal Access: All 3.2 miles (100%) of lateral access along City beaches are vulnerable to coastal flooding and erosion rom a 100-year wave event, but generally recover post-storm.

Trails: No coastal dune hiking trails are susceptible to existing coastal erosion hazards.

Future Vulnerabilities

9 inches (~1 foot) by ~2030

Coastal Erosion

- Vertical Coastal Access– ~375 feet
- Lateral Beach Access – no additional
- Hiking Trails – 0

Vertical Coastal Access: Additional portions of the vertical coastal accesses are exposed to coastal erosion.

Lateral Coastal Access: All 3.2 miles (100%) of lateral access along City beaches are vulnerable to coastal flooding and erosion from a 100-year wave event, but generally recover post-storm.

Trails: No coastal dune hiking trails are susceptible to coastal erosion hazards.

28 inches (~2 feet) by ~2060

Coastal Erosion

- Vertical Coastal Access– ~550 feet
- Lateral Beach Access – no additional
- Hiking Trails – ~1000 feet

Vertical Coastal Access: Additional portions of the vertical coastal accesses are exposed to coastal erosion.

Lateral Coastal Access : All 3.2 miles (100%) of lateral access along City beaches are vulnerable to coastal flooding and erosion from a 100-year wave event, but generally recover post-storm.

Trails: About 1000 feet of dune hiking trails may be susceptible to coastal erosion hazards.

63 inches (~5 feet) by ~2100

Coastal Erosion

- Vertical Coastal Access– ~550 additional for a total of ~0.6 miles with ~5 ft of SLR
- Lateral Beach Access – no additional for a total in the City of ~ 3.2 miles with ~5 ft of SLR
- Hiking Trails – an additional ~1300 feet for a total of ~0.4 miles with ~5 ft of SLR

Vertical Coastal Access: Additional portions of the vertical coastal accesses are exposed to coastal erosion.

Lateral Coastal Access: All 1.65 miles (100%) of lateral access along City beaches are vulnerable to coastal flooding and erosion from a 100-year wave event, but generally recover post-storm.

Trails: About 1000 feet of dune hiking trails may be susceptible to coastal erosion hazards.

Adaptation Strategies

Range of Strategies:

Manage – Relocate trails from the hazardous areas along shoreline. Develop a policy to prioritize beaches and deny any shoreline protective devices.

Accommodate –Regrade eroded dune scarps, particularly in the spring, to continue to provide vertical access

Protect – Implement an opportunistic sand use program, to augment sand supply, widen and increase the elevation of beach and dunes as "green" protection. Nourish beach with cobbles or cobble berms to provide more robust natural protection. Restore native dune vegetation.

Secondary Impacts:

Secondary impacts from "Green" protection through beach and dune sand nourishment will depend on the frequency and volume of sand placement. Over time, it should be anticipated that there will be an increasing expense associated with more frequent maintenance with higher levels of SLR. "Gray" techniques using revetments would provide protection, but would negatively impact beach and dune habitats, natural processes, recreation and coastal access.

Potential Next Steps

Policy

- Coordinate with State Parks on shoreline management to maintain beach access
- Develop a long-range plan for the California Coastal Trail.
- Monitor the remediation of the CEMEX mine
- Align the CEMEX zoning in the LCP to be consistent with the City's General Plan

Projects

- Develop a trail and access plan through the CEMEX property
- Relocate portions of trails exposed to erosion.

Monitoring

- Monitor erosion of dune crest, wave flooding depth, extents, and frequency of overtopping on the State Beach parking lot.

Summary of Findings

Currently, all the vertical coastal access points and all lateral coastal trails are vulnerable to coastal erosion and coastal flooding, and more than half of them are vulnerable to tidal inundation. **With 1' and 2' of SLR,** additional vertical access may be impacted. **With 5' of SLR,** all vertical access trails, lateral coastal access along beach and all bluff top coastal trails and those within Carpinteria Salt Marsh Park are vulnerable to coastal erosion, coastal flooding, and tidal inundation.

Thresholds: With 2' of SLR, coastal erosion impacts beaches, hiking trails, and dunes erosion may impact lateral and vertical access trails.

5.3 Wastewater and Water Supply

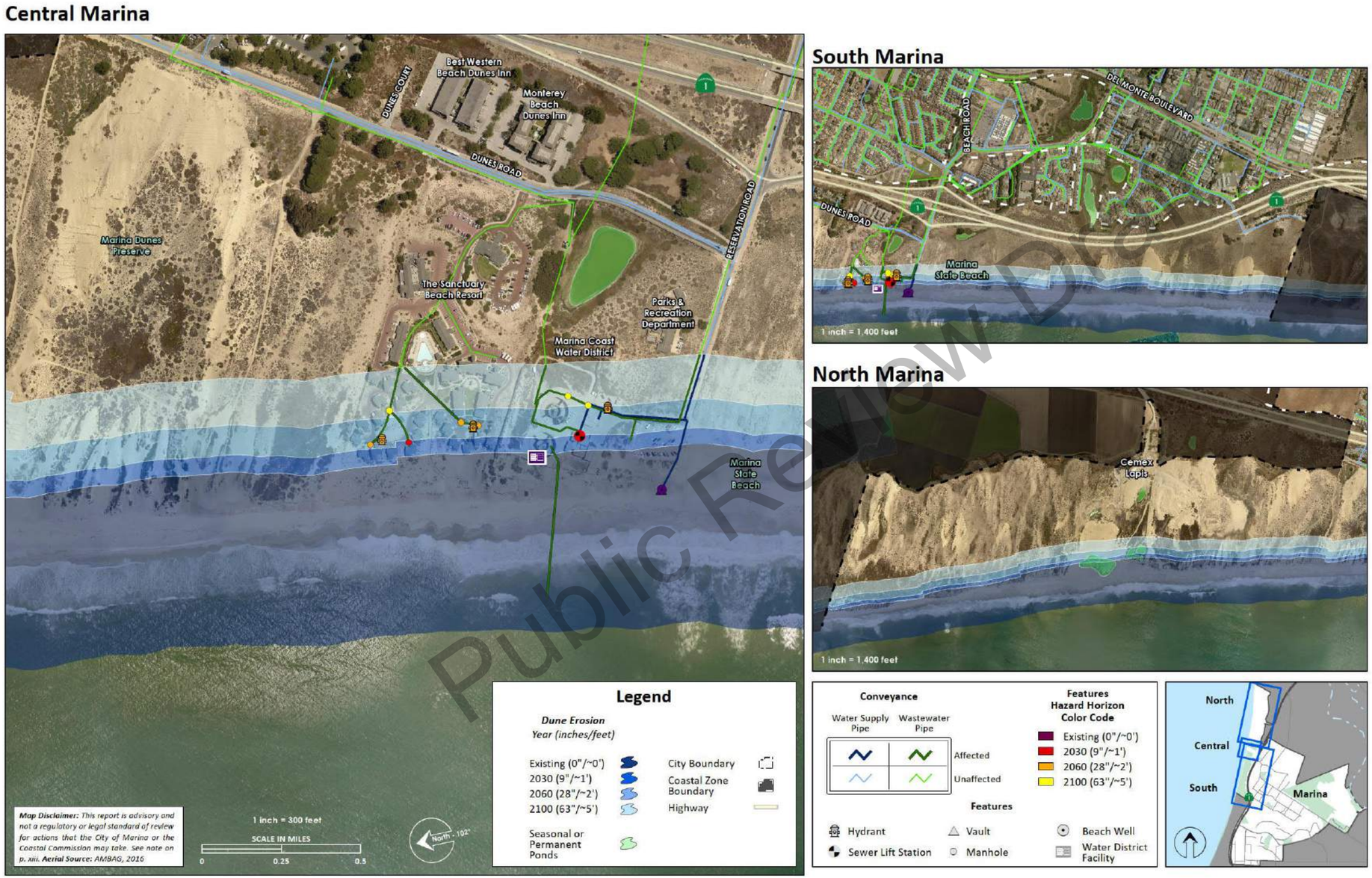


Figure 5-4. Central Marina Dune Erosion, Wastewater and Water Supply

WATER SUPPLY AND WASTEWATER

Overview

To identify water supply infrastructure potentially vulnerable to dune erosion and SLR, this study evaluated the following:

- **107 Miles of Water Supply Pipes**
- **921 Hydrants**
- **31 Control Valves**
- **14 wastewater pump stations**
- **92 Miles of Wastewater Pipes**
- **4 Groundwater Wells**

The City's water supply system is managed by the Marina Coast Water District (MCWD) and maintained by pressure regulators, hydrants, and control valves that distribute water through pipes to connect to ~33,000 customer base. Currently the water comes from the Salinas Valley Groundwater Basin, and the City is in development of a required Groundwater Sustainability Plan. In the 1990s, the MCWD installed a desalinization test well in the beach with permits from the California State Land Commission. The well was capped and is inactive and the permits have lapsed.

Historically, the City treated its wastewater at the current location of the MCWD offices which still has two remnant tanks and offshore discharge infrastructure with no removal plans. This MCWD treatment facility was closed in the 1990s when the regional Monterey One Water (formerly the Monterey Regional Water Pollution Control Agency),wastewater facility opened which collects and treats wastewater from across the Southern Monterey Bay area. The main treatment facility is just outside of the City of Marina near the Salinas River, and outside of projected coastal hazard zones. The plant treats to a secondary state treatment standard and produces about 60% of its treated wastewater as recycled water.

Existing Vulnerabilities

Coastal Erosion (Water Supply/Wastewater)

- Pipes – <175 feet / ~500 feet
- Hydrants/ Vaults – 0/1
- Sewer Pump Stations/ Manholes – 0/0
- Wells / Treatment facility – 1/1

Water Supply: The MCWD offices, one **inactive** desalinization intake well, some water supply pipe, and a control vault (photo right) is currently vulnerable to coastal erosion.

Wastewater: No active wastewater infrastructure is vulnerable, but the old offshore discharge pipe is vulnerable to coastal erosion.

Future Vulnerabilities

9 inches (~1 foot) by ~2030

Coastal Erosion (Water Supply/Wastewater)

- Pipes – <65 / <65 feet
- Hydrants/ Vaults – 0/0
- Sewer Pump Stations/ Manholes –1/1
- Wells / Treatment facility – 0/0

Water Supply: No additional impacts to water supply are projected, although additional MCWD offices may be impacted.

Wastewater: A pump station co-located with the restroom at Marina State Beach may become exposed. One of the remnant treatment tanks, an additional 130 feet and a manhole access could be vulnerable to coastal erosion.

28 inches (~2 feet) by ~2060

Coastal Erosion (Water Supply/Wastewater)

- Pipes – ~575 feet / ~1,000 feet
- Hydrants/ Vaults – 3/0
- Sewer Pump Stations/ Manholes – 0/3
- Wells / Treatment facility – 0/0

Water Supply: Three water supply hydrants, two at the Sanctuary Beach Resort and one at Marina State Beach, as well as an additional 500+' of supply pipeline may become exposed to coastal erosion.

Wastewater: The second remnant wastewater treatment tank and an additional 2000+ feet of wastewater collection pipe may be exposed to coastal erosion.

63 inches (~5 feet) by ~2100

Coastal Erosion (Water Supply/Wastewater)

- Pipes – an additional of ~180 feet / ~1000 feet for a total of ~1,000/2600 feet of pipe with ~5 feet of SLR
- Hydrants/ Vaults - an additional 0/0 for a total of 3/1 with ~5 feet of SLR
- Sewer Pump Stations/ Manholes – an additional 0/3 for a total of 1 pump station and 7 manholes with ~5 feet of SLR
- Wells / Treatment facility –1 inactive desalinization well and 1 inactive treatment facility with ~ 5 feet of SLR

Water Supply: Additional pipeline and 3 hydrants may become exposed to coastal erosion.

Wastewater: An additional ~1000 feet of wastewater collection pipe may be exposed to coastal erosion.

Adaptation Strategies

Range of Strategies:

Manage – Relocate remnant wastewater and water supply infrastructure from erosion areas. Evaluate the foundation and consider relocation of the MCWD offices. Develop a policy to prioritize beaches and deny any shoreline protective devices.

Accommodate – Increase setbacks for new infrastructure.

Protect – Implement an opportunistic use program, to widen and increase the elevation of beach and dunes as "green" protection. Nourish beach with cobbles to provide more robust natural protection. Restore native dune vegetation.

Secondary Impacts:

Secondary impacts from "Green" protection through beach and dune nourishment will depend on the frequency and volume of sand placement. Over time, it should be anticipated that there will be an increasing expense associated with more frequent maintenance with higher levels of SLR. "Gray" techniques using shoreline protective devices would provide infrastructure protection, but would negatively impact beach and dune habitats, natural processes, recreation, and coastal access.

Potential Next Steps

Policy:

- Provide input to MCWD on current draft water supply, sewer and recycled water master plans to ensure SLR is considered.
- Develop policies to promote water conservation and increase reclaimed water use and availability.
- Coordinate regionally with MCWD to adapt the water supply and wastewater systems to future demands and include climate change into the Integrated Water Resource Management and Sustainable Groundwater Management Act plans.
- Ensure adequate long-term water supplies for the lifetime and intended use of development prior to permitting.
- Restrict development of new water supply wells including potential desalinization wells in hazardous areas.

Projects:

- Specific projects should be identified in other water supply planning documents such as updates to the Salinas Valley Groundwater Basin Master Plan.
- Develop an opportunistic sand use program

Monitoring:

Support MCWD efforts to develop an monitoring wells to evaluate the salinity intrusion into the aquifer.

Summary of Findings

Currently, one one inactive desalinization supply well and the old wastewater outfall are vulnerable to coastal erosion, and coastal erosion could damage the Marina Coast Water District offices. **With 1' of SLR,** a sewer pump station located at the Marina State Beach restroom and one remnant wastewater treatment tank may be vulnerable to coastal erosion. **With 2' of SLR**, the second remnant wastewater treatment tank and 3 water supply hydrants could be affected. **With 5' of SLR,** coastal erosion impacts could impact water supply and wastewater to the Sanctuary Beach Resort.

Threshold: With 2' of SLR, the MCWD district offices, both remnant wastewater treatment tanks, pipes, hydrants, and inactive desalinization well and control vault for water supply become substantially vulnerable to coastal erosion hazards.

5.4 Roads, Parking, and Bike Routes

Figure 5-5. Central Marina Dune Erosion, Roads & Parking

ROADS, PARKING, AND BIKE ROUTES

Overview

To identify coastal dune erosion impacts to roads, parking lots and bike routes potentially vulnerable to climate change, coastal erosion and SLR, this study evaluated:

• 100.9 Miles of Roads • 3 Parking Lots • 12.9 miles of Bike Routes

Roads in Marina are largely managed by the City of Marina public works department. There are also several access roads that are managed by other entities. The Sanctuary Beach Resort manages and maintains its access roads, and the State Parks maintains the access road to the Marina Coast Water District facility.

State Parks manages the Marina State Beach parking lot and coastal access amentities which is currently being undermined (photo left).

The City has many miles of bike routes throughout the City which connect the City to the rest of Monterey Bay, primarily along Dunes Drive. The bike route also travels to the coast along Reservation Road.

Existing Vulnerabilities

Coastal Erosion

Roads – <150 feet
Parking Lots – 1 lot with 0.12 acres
Bike Routes - 0

Roads: Small portions of the road network in the Sanctuary Beach Resort are the most vulnerable to coastal erosion.

Parking: Portions of the Marina State Beach parking lot is vulnerable to coastal erosion.

Bike Routes: No portion of any of the bike routes are at risk to coastal erosion.

Future Vulnerabilities

9 inches (~1 foot) by ~2030

Coastal Erosion

- Roads – <300 feet
- Parking Lots – 1 lot with 0.24 acres
- Bike Routes - 0

Roads: A few hundred feet of Reservation Road near Marina State Beach may be vulnerable to coastal erosion.

Parking: Potential erosion damages to Marina State Beach Parking doubles in acreage.

Bike Routes: No portion of any of the bike routes are at risk to coastal erosion.

28 inches (~2 feet) by ~2060

Coastal Erosion

- Roads – ~1130 feet
- Parking Lots – 1 lot with 0.13 acres
- Bike Routes - <175 feet

Roads: Over a thousand feet of Reservation Road near Marina State Beach may be vulnerable to coastal erosion.

Parking: Potential damages to Marina State Beach Parking from coastal erosion increase in acreage.

Bike Routes: A small portion of the bike route along Reservation Road is at risk to coastal erosion.

63 inches (~5 feet) by ~2100

Coastal Erosion

- Roads – an additional ~1,200 feet of road for a total exposure of 2800 feet (1/2 miles) with ~5 feet of SLR.
- Parking Lots – 1 lot at Reservation Road is likely to have been lost for a total of ~0.5 acres of parking.
- Bike Routes – additional 330 feet of the Reservation Road route could be eroded for a total of ~500 feet with ~ 5 feet of SLR

Roads: A few hundred additional feet of Reservation Road near Marina State Beach and more of the Sanctuary Resort access roads may be vulnerable to coastal erosion.

Parking: No additional damages, but the Marina State Beach parking lot is likely eroded.

Bike Routes: Additional portions of the bike route along Reservation Road is at risk to coastal erosion.

Adaptation Strategies

Range of Strategies:

Manage – Relocate roads and parking lots from the hazardous areas along shoreline. Develop a policy to prioritize beaches and deny any shoreline protective devices.

Accommodate – Increase setbacks for new roads and parking lots.

Protect – Implement an opportunistic sand use program, to augment sand supply, widen and increase the elevation of beach and dunes as "green" protection. Nourish beach with cobbles or cobble berms to provide more robust natural protection. Restore native dune vegetation.

Secondary Impacts:

Secondary impacts from "Green" protection through beach and dune sand nourishment will depend on the frequency and volume of sand placement. Over time, it should be anticipated that there will be an increasing expense associated with more frequent maintenance with higher levels of SLR. "Gray" techniques using revetments would provide protection, but would negatively impact beach and dune habitats, natural processes, recreation and coastal access.

Potential Next Steps

Policy:

- Coordinate with State Parks and Marina Coast Water District on shoreline management, coastal access, and parking.
- Identify potential locations for relocation of coastal dependent facilities.
- Update the Local Hazard Mitigation Plan (LHMP) to identify preferred adaptation strategies to reduce impacts to road, parking, and bike routes.

Projects:

- Develop an opportunistic sand use program
- Realign, or relocate access roads, parking lots, and bike routes to increase resiliency and maintain access.
- Plan for the eventual landward retreat of the parking lot, bathroom, and access road at Reservation Road.

Monitoring:

- Monitor erosion of dune crest, wave flooding depth, extents, and frequency of overtopping on roads, parking lots, and bike routes along identified potentially vulnerable areas.

Summary of Findings

Currently, coastal dune erosion does not substantially impact roads or bike routes. The parking lot at Marina State Beach may be partially affected. **With 1' of SLR,** minor erosion damages in the Sanctuary Beach Resort and about half of the Marina State Beach parking lot could erode during a large wave event. **With 2' of SLR,** coastal erosion impacts escalate and affect access roads in the Sanctuary Beach Resort and to the Marina Coast Water District. All of the Marina State Beach Parking lot could be affected. **With 5' of SLR,** road impacts from erosion could also impact portions of Reservation Road.

Threshold: With 2' of SLR, coastal erosion impacts affect access roads to the Sanctuary Beach Resort, and Marina Coast Water District as well as affecting the entire Marina State Beach parking.

5.5 Dune Habitat

Within the City, sand dunes and beaches defined as ESHA are found along the entire Marina shoreline. Coastal dune erosion could impact the greatest acreage of dune ESHA through time. However, the impacts of climate change extend beyond sea level rise and would affect temperature, precipitation, droughts, and wildfire risk; for more information see Section 3.3. The specific habitat data available for the City is dated and so precise characterization or location of sensitive flora and fauna species is not currently possible.

Table 5-1. Sensitive Dune Habitat Directly Influenced by Coastal Hazards and Sea Level Rise

Hazard	Acres of Dune Erosion
Existing Vulnerabilities	49.6
2030	16.3
2060	32.4
2100	55.86
Cumulative Total	**154.1**

The dune erosion could potentially affect the following sensitive species.

Special Status and Notable Dune Species of Concern:

Plants:

- Seaside Painted Cup *(Castilleja latifolia ssp. Latifolia)*
- Monterey Spine Flower *(Chorizanthe pungens var. pungens)*
- Eastwood's Ericameria *(Ericameria fasciculate)*
- Coast Wallflower *(Erysimum ammophilum)*
- Menzies' Wallflower *(Erysimum menziesii)*
- Coastal Dunes Milk Vetch *(Astragalus tener var. titi)*
- Dune Gilia *(Gilia tenuiflora var. arenaria)*
- Wild Buckwheat *(Eriogonum latifolium)* *
- Wild Buckwheat *(Eriogonum parvifolium)* *
- Bush Lupine *(Lupinus ssp.)* **+**

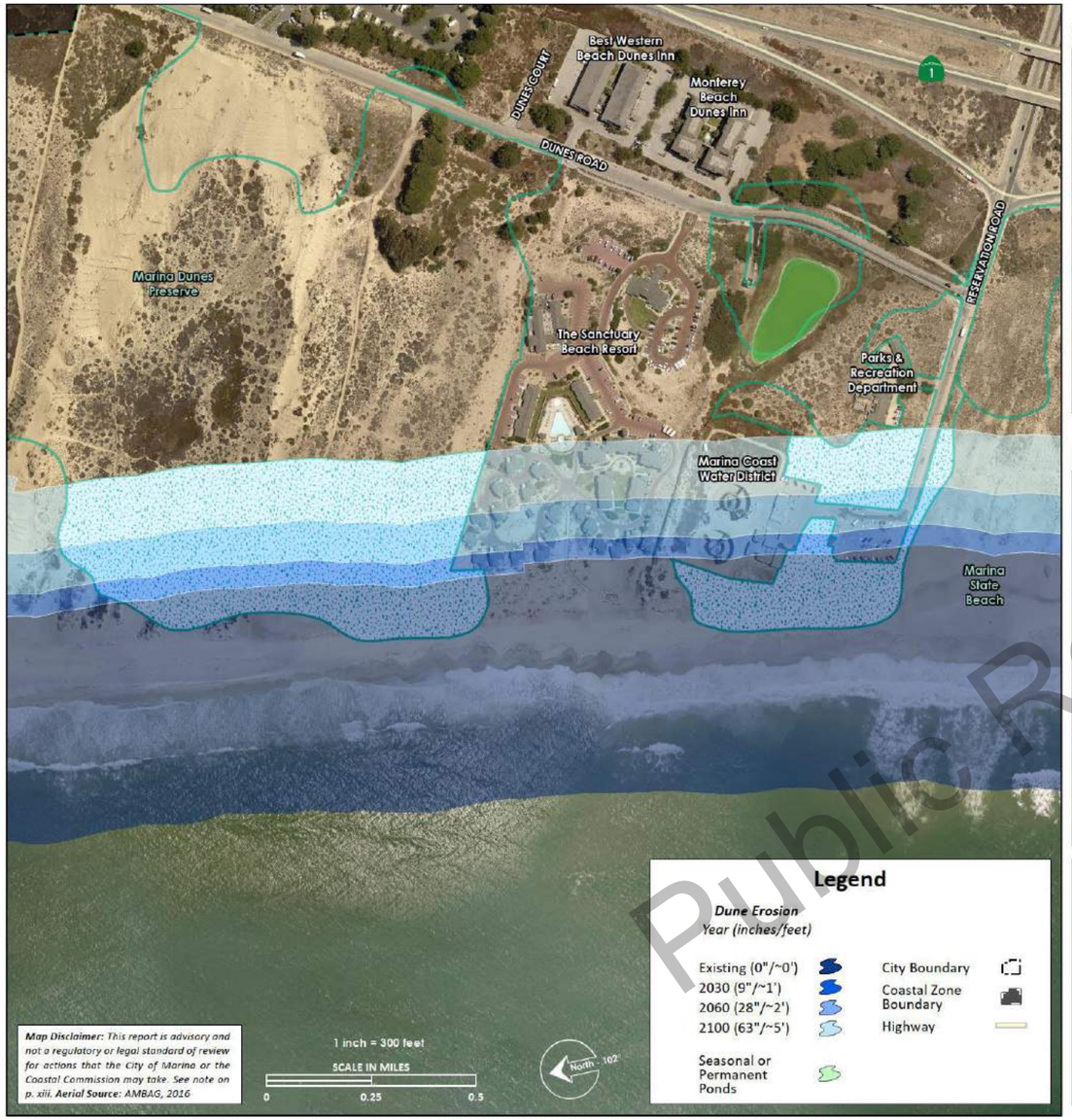
Animals:

- Smith's Blue Butterfly *(Shijimiaeoides enoptes smithi)*
- Globose Dune Beetle *(Coelus globosus)*
- Black Legless Lizard *(Anniella pulchra nigra)*
- Salinas Kangaroo Rat *(Dipodomys Heermanni Goldmani)*
- Western Snowy Plover *(Charadrius nivosus nivosus)*

** only within the range of Smith's Blue Butterfly.*
***+** only within the range of the Black Legless Lizard.*

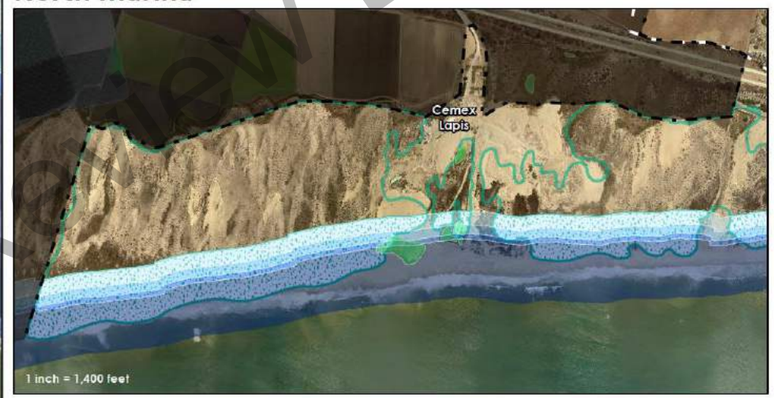
Reporting acreages of vulnerable ESHA may misrepresent habitat vulnerability. Quantitatively predicting future habitats is challenging as there is a complex interplay of variables that cause habitats to evolve. As coastal hazards and SLR progress, habitats may disappear from current location (e.g., dune erosion) if strategies are implemented to protect landward resources or migrate landward if there is adaptation (e.g., dune restoration or beach nourishment or managed retreat).

Central Marina



South Marina

North Marina



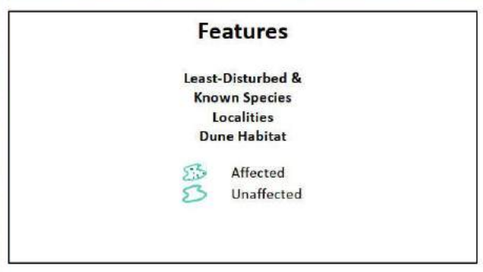


Figure 5-6. Central Marina Dune Erosion, Habitat

5.6 Coastal Flooding with 5 feet of Sea Level Rise

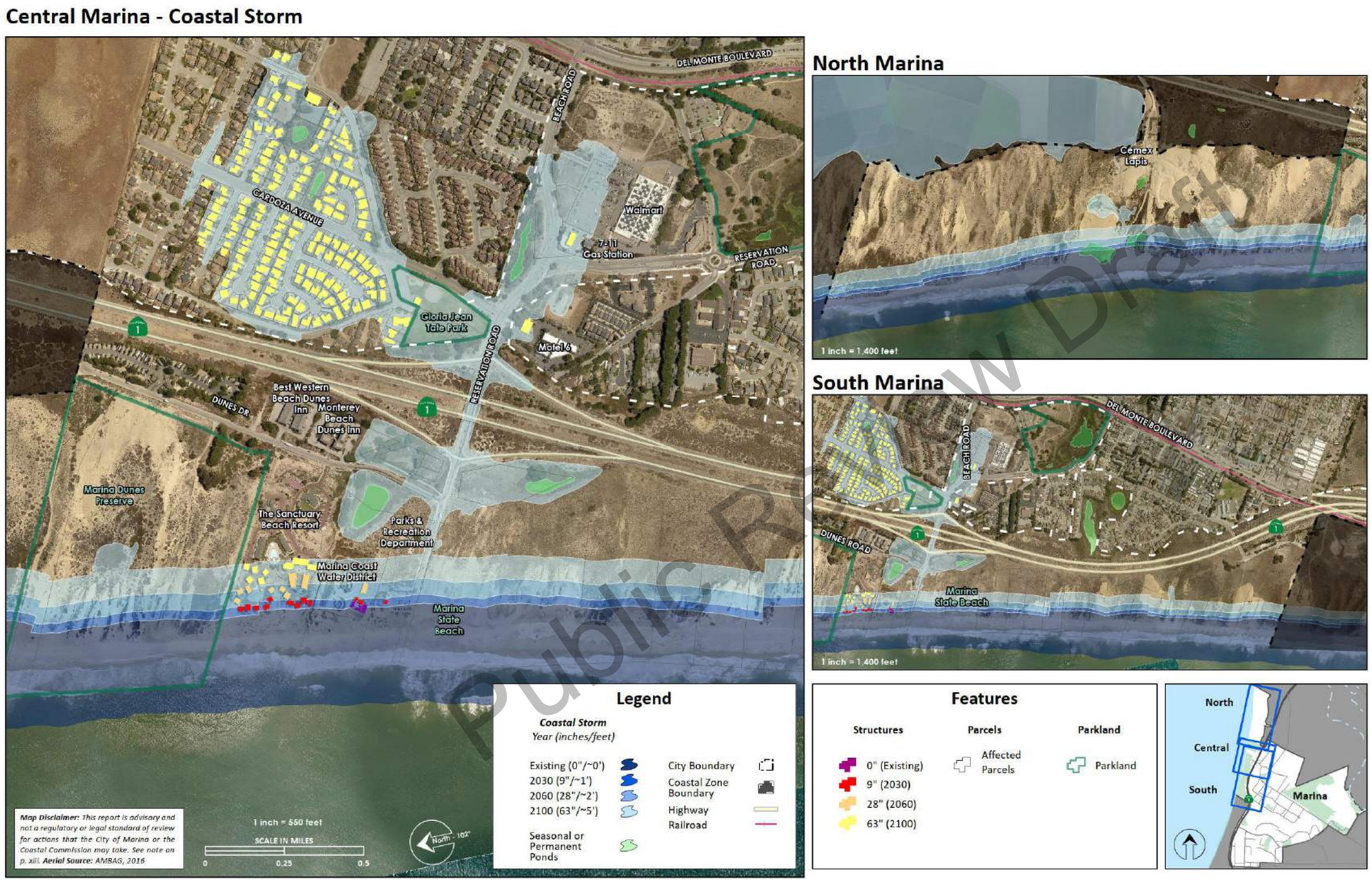
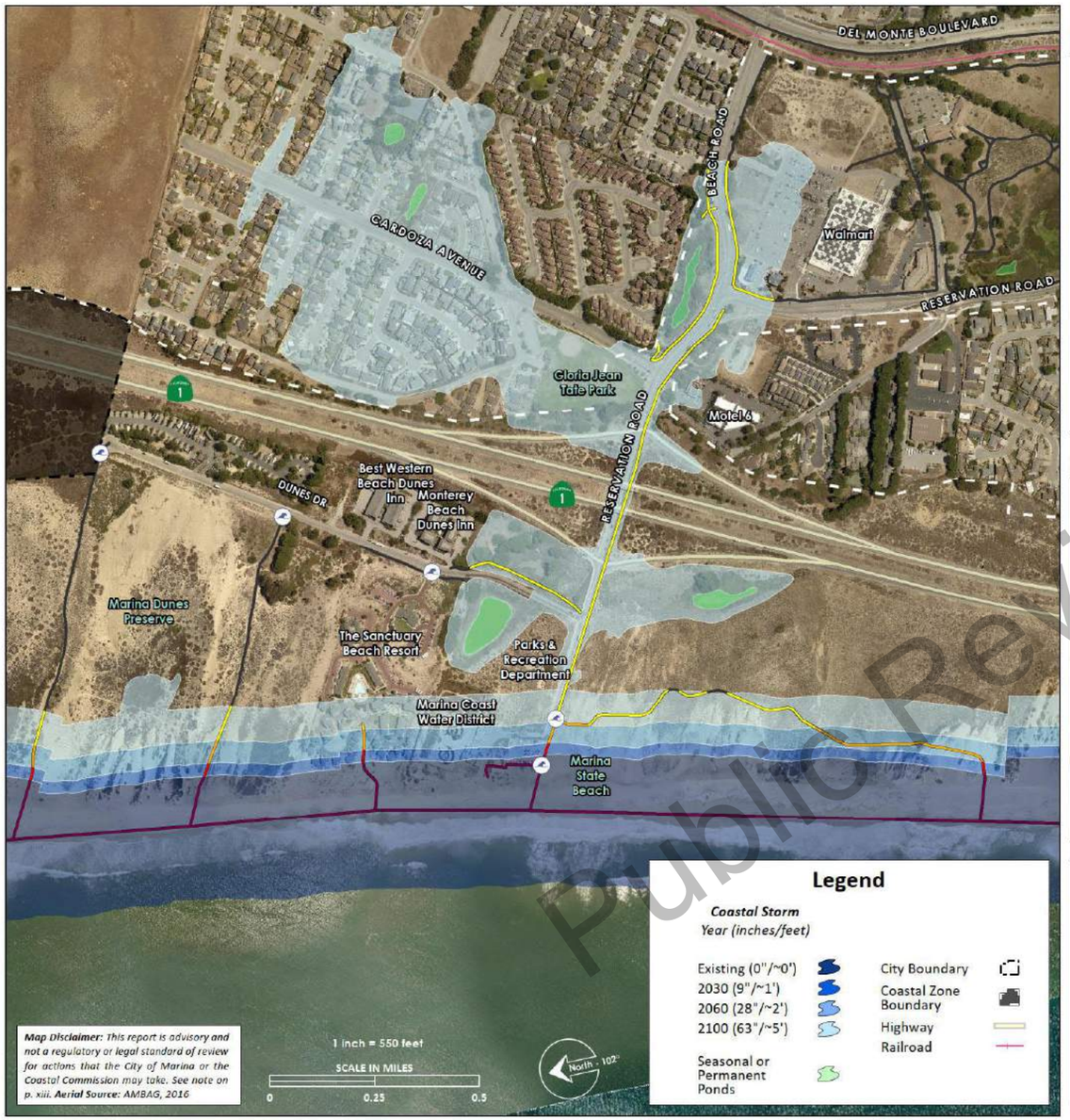
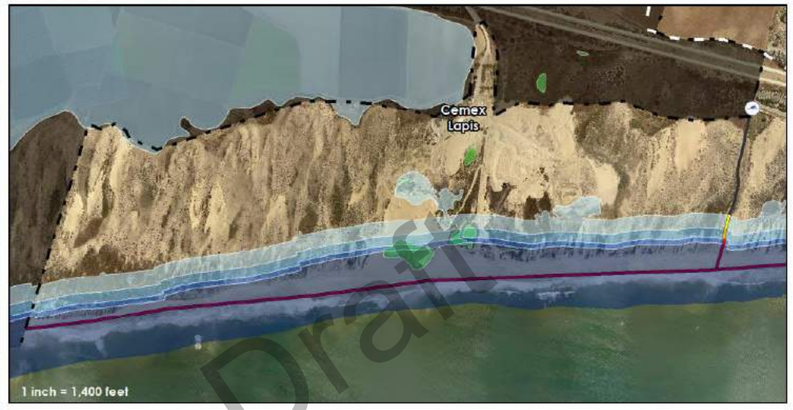


Figure 5-7. Central Marina Coastal Storm, Land Use, Structures, & Parkland

Central Marina - Coastal Storm



North Marina



South Marina

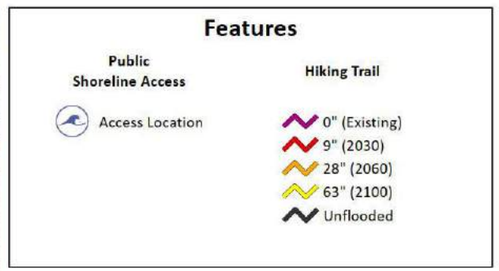
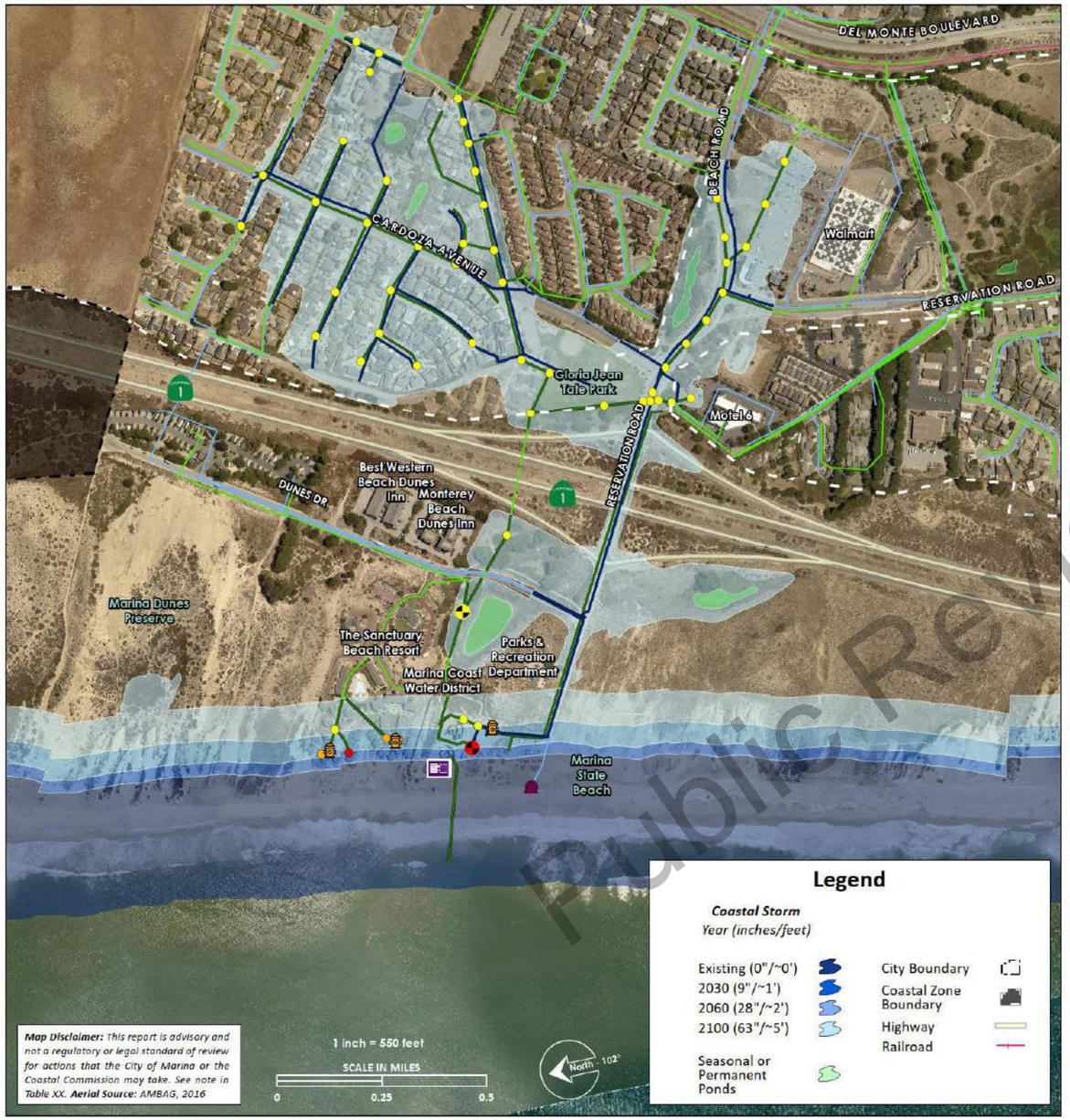


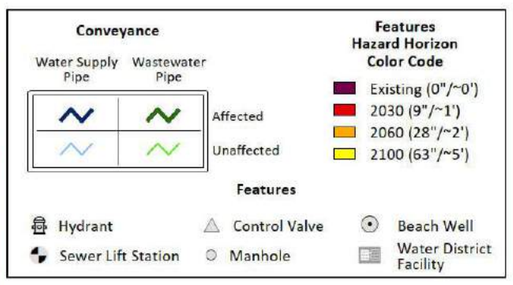
Figure 5-8. Central Marina Coastal Storm, Trails & Coastal Access

Central Marina - Coastal Storm



North Marina

South Marina



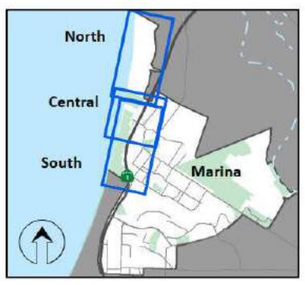
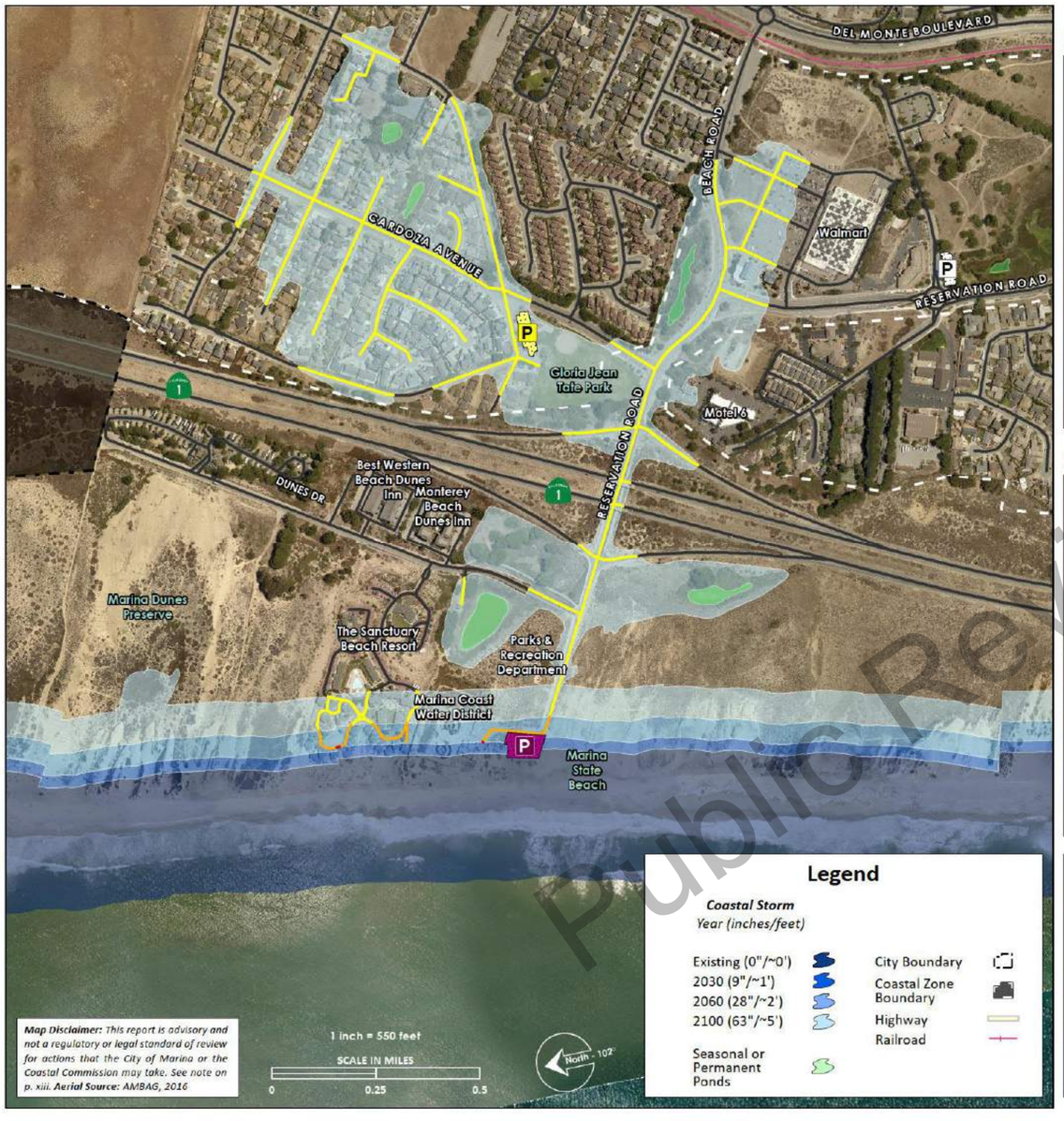


Figure 5-9. Central Marina Coastal Storm, Wastewater and Water Supply

Central Marina - Coastal Storm



North Marina

South Marina

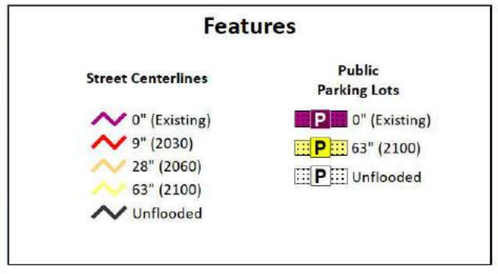
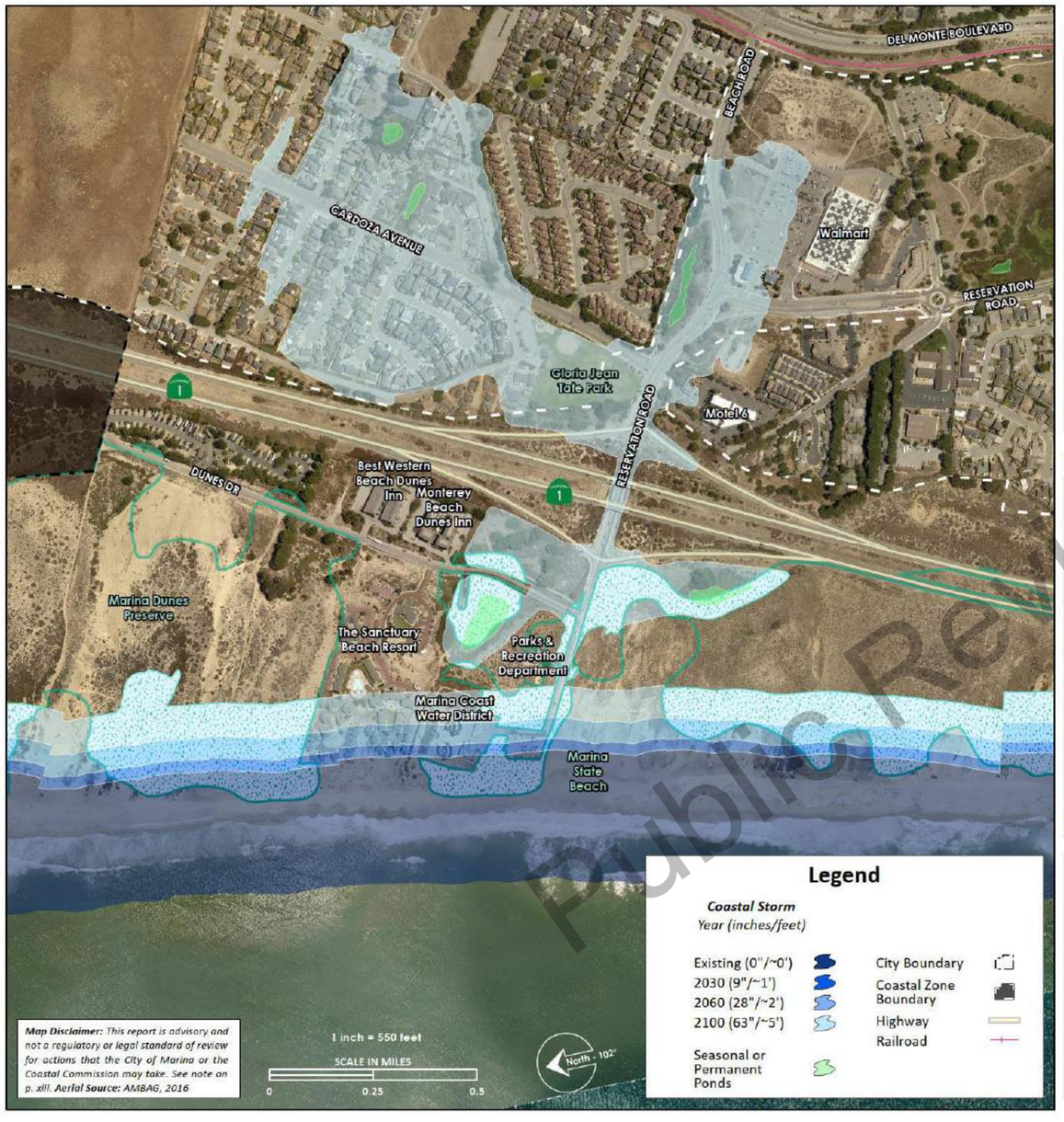


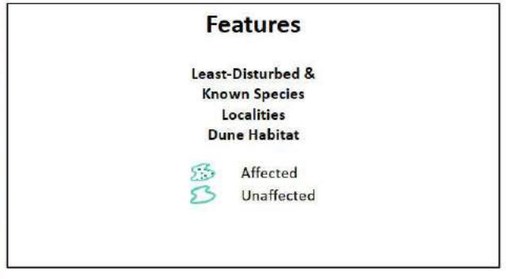
Figure 5-10. Central Marina Coastal Storm, Roads and Parking

Central Marina - Coastal Storm



North Marina

South Marina



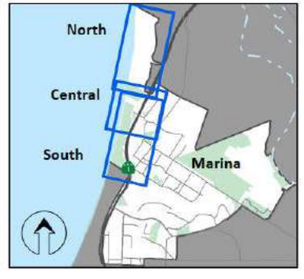


Figure 5-11. Central Marina Coastal Storm, Habitat

COASTAL FLOODING WITH >5 FEET OF SEA LEVEL RISE

Overview

This summary of impacts focuses on potential exposure of each of the potential sectors to coastal wave flood hazards that could be caused by a 1% annual chance storm wave event after ~5 feet of sea level rise and related coastal erosion of the dunes described in previous sector vulnerability results. Such a futuristic event may cause temporary flooding for ~2 hours during peak high tides with the main hydraulic connection from the ocean into the City along the Reservation Road underpass.

There is virtually no chance that any amount of sea level rise less than 5' would cause coastal wave flooding beyond what is discussed in the coastal erosion related impacts in the City of Marina. As such these results should be considered as a long term outlook to guide City wide adaptation policies and development standards. More details about the coastal wave flood modeling are found in Appendix A and summarized in Section 3.

Land Use (Parcels/Buildings/Acres)

Land uses are categorized by: (1) residential, (2) commercial and mixed use, (3) open space, (4) mining, (5) institutional, (6) vacant, and (7) visitor serving.

Number of Parcels/Acreages/Number of Structures at Risk from Coastal Flooding with 5' of SLR

Residential	Commercial & Mixed Use	Open Space	Mining	Institutional	Vacant	Visitor Serving
196/25.3acres/152	3/2.9acres/1	0/12.7 acres/0	0/9.7 acres/0	2/2.4 acres/3	13/4.4 acres/0	1/0.6 acres/1

- **Residential** – Neighborhood of primarily single family homes off of Cardoza Ave. Residential parcels comprise approximately 44% of all parcels vulnerable to coastal flooding with >5 feet of sea level rise.
- **Visitor Serving** – The Denny's / Motel 6 Property.
- **Mining** – CEMEX Lapis Property
- **Open Space** – Gloria Jean Tate Park and various Percolation Ponds, Vernal Pools, and Permanent Ponds
- **Institutional** – Two places of worship and the Gloria Jean Tate Park comfort station

Roads, Parking, Bike Routes

- Roads – 3.0 miles of road, primarily along Reservation Road
- Parking Lots – 1 lot of 0.3 acres at Gloria Jean Tate Park (assumes that the Marina State Beach lot had eroded)
- Bike Routes – 1.2 miles of bike route

Trails and Beach Accesses

- Hiking Trails – 0.9 miles of walking trail and footpaths.

Water Supply and Wastewater

- Pipes – 2.5 miles of water mains / 2.7 miles of wastewater gravity and force mains
- Hydrants – 21
- Sewer Pump Stations/ Manholes – 1/48
- Wells / Treatment facility – 0/0

Beaches and Dunes

- Least Disturbed – 7.92 acres
- Potential and Known Rare Plant Species Location – 3.75 acres
- All Dune Habitats – 11.7 acres
- All Beach Habitats – variable depending on season

Adaptation Strategies

Range of Strategies:

Manage - Transfer vulnerable development out of hazard zones, consider real estate disclosures, develop a policy to prioritize beaches and deny any shoreline protective devices.

Accommodate – Retrofit structures during major remodels to increase elevation. Amend City building code and zoning ordinance to increase base floor elevation and building heights to occur over time.

Protect – Implement an opportunistic sand use program, to augment sand supply, widen and increase the elevation of beach and dunes as "green" protection. Nourish beach with cobbles or cobble berms to provide more robust natural protection. Restore native dune vegetation. Consider a horizontal levee and additional elevation along Cardoza Ave to reduce flooding potential.

Secondary Impacts: Secondary impacts from "Green" protection through beach and dune sand nourishment will depend on the frequency and volume of sand placement. Over time, it should be anticipated that there will be an increasing expense associated with more frequent maintenance with higher levels of SLR. "Gray" techniques using revetments would provide protection, but would negatively impact beach and dune habitats, natural processes, recreation and coastal access.

Potential Next Steps

Policy

- Allow increases to base floor elevation or movable foundation standards for new development.
- Develop real estate disclosure requirements to inform homebuyers of the risk of living adjacent to the coast.

Projects

- Develop an opportunistic sand use program
- Encourage dune restoration

Monitoring

- Monitor dune crest erosion as well as frequency, duration and depth of flood impacts.

Summary of findings

Projections of coastal erosion associated with ~5 feet of sea level rise after a reduction of erosion rates from cessation of sand mining project coupled with a 1% annual chance wave event are projected to possibly cause temporary flooding impacts to all sectors during a high tide wave event. In addition to impacts from coastal erosion previously described, the coastal flooding impacts could potentially cause temporary flooding around high tide in the residential neighborhood near Cardoza Ave and along the Reservation Road Corridor up to the Walmart Parking lot.

6. Adaptation

6.1 Introduction

The City of Marina helped lead the United States in improving coastal resiliency to coastal hazards when it took a major leadership role in declaring that the last beach sand mine in the Country was accelerating coastal erosion and did not have a grandfathered right to be a public nuisance. As the sand mining stops in the near future, erosion rates will be reduced providing more time to adapt to sea level rise and coastal erosion hazards. However, this is the first focused endeavor by the City to identify possible responses to climate change impacts, including adaptation strategies and policy changes to improve preparedness, avoid hazards, and examine natural protection measures to reduce the risks projected to occur over time. This adaptation planning process represents the next opportunity for Marina to lead the State and the Country on how to effectively adapt.

Marina must consider a range of options to adapt to the identified risks in their adaptation strategy toolbox. Keeping a range of options on the table helps to ensure that the City retains maximum flexibility in determining how best to carry out its long-term vision for the community. Adaptation strategies come in two primary forms, policy changes and specific projects. Considering a range of options is prudent as our understanding of climate science continues to improve in terms of both its predictive capabilities and its ability to identify the most probabilistic local scenarios. Adaptation strategies also span between a green and grey approach. A green approach utilizes more natural processes and landforms such as sand dunes, while a grey approach uses a more traditional engineering approach such as imported rock or concrete to build seawalls.

Adaptation to climate change involves a range of small and large adjustments to natural and/or human systems that occur in response to already experienced or anticipated climate change impacts. Adaptation planning involves a wide range of policy, programmatic, and project-level measures that can be implemented in advance of the potential impacts; or reactively, depending on the degree of preparedness and risk tolerance. The vulnerability assessment provides full disclosure and a scientific based understanding of the City's specific risks, thresholds or projected timing of impacts, and physical processes responsible for causing the risk, now and in the future. Individual adaptation measures will take time to implement to go from planning through permitting and financing and so prioritized adaptation strategies should have triggers tied to easily measurable metrics that catalyst the next phase of adaptation planning before projected damages are realized. Effective adaptation planning should enhance community resilience to hazards and natural disasters.

Successful implementation of any adaptation strategy will require communicating the issues and proposed responses to the community. Community education and outreach will be important aspects of the adaptation planning effort. An informed community is also more likely to implement programs and make decisions that reflect its knowledge of the projected changes and enable the community to contribute to developing a prosperous and affordable City in the face of climate change.

Maladaptation, in contrast to adaptation, is a trait that is (or will become) more harmful than helpful. An example of maladaptation is the levee system for the City of New Orleans in Louisiana. While the levees

provided short-term adaptation and allowed communities to remain in areas below sea level, they actually increased the long-term vulnerability, both by providing a false sense of security and underestimating the impact that storm events could cause.

Ideally, this adaptation plan will lead to dedicated funding for implementation, and updates to the LCP that reflect a community vision based on updated climate science and an understanding of future risks. Ultimately this plan should protect the community, its economic drivers, and natural resources that continue to make Marina a desirable location to live, work, play, and visit.

6.2 Adaptation Planning

Adaptation planning requires considering the vision of the community, its tolerance for risk to each vulnerable sector and taking effective and timely action to alleviate the anticipated range of consequences. Successful adaptation requires education of residents, homeowners, and business owners as well as visioning to identify the appropriate path forward. The adaptation pathway will not be a straight line, as different strategies will accommodate different elevations and rates of sea level rise. The vulnerability assessment identified **thresholds** of impacts when various sectors will be affected. The key vulnerabilities identified in the City of Marina include Marina State Beach, Marina Coast Water District, The Sanctuary Beach Resort, and ESHA associated with sandy dune and beach habitat.

While a selected adaptation measure may reduce the risk to one sector, I may cause issues in another sector or lead to unintended secondary consequences. The most important secondary consequences that the City must consider is the impact of the various strategies on the long-term health of the beaches. Erosion is a natural process that only becomes a hazard when development or infrastructure get in the way. Erosion helps to supply sand to the coast and maintain beaches as long as there is adequate sand supply and no hardening of the backshore.

Marina has yet to permit any coastal armoring and as a result, Marina's beaches serve as a buffer that protects sensitive dunes and provide substantial recreational opportunities and revenues for the City as well as help to define community identity. Good adaptation planning must consider secondary impacts and how different adaptation measures used to alleviate a vulnerability in one sector interact with the other adaptive measures that may negatively affect other sectors in developing a sustainable community adaptation strategy. Marina currently has healthy beaches accessible year-round and based on past coastal management decisions and land use planning, has a chance to maintain beaches that could drive a thriving coastal eco-tourism economy into the future.

Good adaptation planning is also "collaborative", considering interconnected ecological, social, political, and economic systems. Adjacent jurisdictions, including but not limited to Monterey County, City of Monterey and other jurisdictions represented in AMBAG, the Central Coastal Climate Collaborative and inland jurisdictions whose land uses and flood control activities may reduce the supply of sand to the coast, particularly from the Salinas River, must all be engaged to achieve regional solutions. Overall this planning process will leverage local resources and help avoid unintended secondary consequences to and from neighboring jurisdictions.

Risks can be addressed by reducing vulnerability or exposure. Historically, the City has been very proactive in planning development away from coastal hazards and thus have few vulnerabilities. To continue along this proactive trajectory, strategies that avoid hazards, improve habitats and

infrastructure resilience, enhance shoreline management and sand supply while gradually relocating vulnerable developments can all help to accomplish adaptation objectives.

Fortunately for Marina there is not a lot at risk and so it is possible to avoid major City expenses on adaptation.

6.3 Maladaptation

Maladaptation is a trait that is (or has become) more harmful than helpful, in contrast to adaptation, which is more helpful than harmful. One of the most significant concerns with maladaptation is that it reduces incentives to adapt while simultaneously diminishes the capacity to adapt in the future. Maladaptation occurs when efforts intended to "protect" communities and resources result in increased vulnerability, often realized indirectly or too late after a direction has been set. For instance, previously unaffected areas can become more prone to climate-induced hazards if the system that is being altered is not sufficiently understood. Likewise, if too much focus is placed on one time period—either the future or the present—effects on the other can be ignored, resulting in an increased likelihood of impacts from climate-induced hazards. Avoiding maladaptation is critical to a successful climate adaptation strategy. To do so, the City must first be able to make informed decisions based on an accurate vulnerability assessment, and to determine its own level of tolerance to risk and vulnerability. Flexibility and a precautionary approach are key to avoiding maladaptation in the adaptation planning process.

Adaptation measures that reduce the ability of people and communities to address and respond to climate change over time are called maladaptation. Maladaptation has several characteristics that help identify when it is occurring.

- May result in sustained or increased hazardous conditions;
- May result in additional vulnerabilities, and loss of property and resources;
- May create a more rigid system with a false sense of security and severe consequences;
- May increase GHG emissions; and/or
- Reduces incentives to adapt

One maladaptive strategy that Marina must address is the potential construction of shoreline protection devices which will result over time in the loss of beaches, coastal access and beach habitats. Specific risks and consequences of shoreline protective devices are described below in Section 6.6.

6.4 Challenges and Opportunities

Adaptation planning is a challenging undertaking and a single jurisdiction cannot adapt to climate changes on its own. A successful process requires regional dialogue and likely state and federal partnerships to identify, fund, and implement solutions. Challenges range from acquiring the necessary funding for adaptation strategies, communicating the need for adaptation to elected officials and staff, and gaining commitment and support from federal and state government agencies to address the realities of local adaptation challenges. Lack of resources from state and federal agencies make it difficult for cities to make significant gains in adaptation on their own due primarily to lack of funding. Regional partnerships and dialogue between adjacent jurisdictions, Santa Cruz and Monterey Counties, and regional organizations such as AMBAG, will be essential in developing and implementing sound regional adaptation strategies.

6.5 Protect, Accommodate, and Retreat

According to the CCC, sea level rise adaptation generally falls into five main categories: do nothing, protect, accommodate, retreat, or a hybrid approach. These approaches are described below.

The Do Nothing Approach

Choosing to "do nothing" or following a policy of "non-intervention" or "wait and see" may be considered a form of adaptation. However, in most cases, the strategies for addressing sea level rise hazards will require proactive planning to balance protection of coastal resources with development. Fortunately in the City of Marina the lack of a highly urbanized overdeveloped coastline allows for more do nothing approach and is more similar to a managed retreat strategy.

The Protection Approach

Protection strategies employ some sort of engineered structure or other measure to protect existing development (or other resources) in its current location without changes to the development itself. Protection strategies can range from "grey" to "green" and include both "hard" and "soft" measures. A "grey", "hard" approach is usually an engineered structure and can be located either alongshore such as a seawall, revetment, or offshore breakwater, or cross shore (i.e., shore-perpendicular) such as a groin, groin field, or jetty. Cross shore structures tend to work better in more unidirectional longshore transport environments and are unlikely to be effective along the Marina shoreline where they would likely stabilize permanent rip currents and accelerate erosion in those locations (ESA PWA 2012).

Although the California Coastal Act provides for potential protection strategies for "existing development" (i.e., California Coastal Act Section 30235; CCA 1977), it also directs that new development be sited and designed to not require future protection that may alter a natural shoreline. It is important to note that most protection strategies are costly to construct, require increasing maintenance costs, and have secondary consequences to recreation, habitat, and natural defenses. Many of the engineering or grey protection strategies are forms of maladaptation, especially if applied as a long-term solution.

A "soft" protection approach may be to nourish beaches, while a "green", "soft" approach may be to restore sand dunes. Dune restoration is currently being tested at Salinas River State Beach as a form of adaptation (see Section 3.4). The Monterey Opportunistic Nourishment Program with two proposed receiver sites along the Marina Shoreline is another suitable "green" adaptation approach which attempts to mimic natural sediment delivery processes.

Sediment Management

Sediment is natures adaptation resource. Beaches and dunes have long survived sea level rise without human interference. Sediment management is another option to combat erosion by building wider beaches and higher sand dunes that can take many forms. Large scale beach nourishment, dredge disposal, and opportunistic sand placement are all possible sediment management strategies that mimic or enhance sand supply in a more natural protection approach. However, sediment management can be costly, require routine maintenance and ongoing sand supplies for larger projects can become scarce over time. Impacts and effectiveness of sediment management scale with the volume of sand and the frequency and method with which sand is placed.

Large scale beach nourishment, commonly practiced on the East Coast, dredges offshore sand deposits and place it on the beach enhancing recreation and natural defenses. While substantial sand deposits greater than (100 feet thick) are available off of the Salinas River Delta (Figure 6-1), due to the lack of a suitable dredge with capacity to handle the large wave conditions on the U.S. West Coast, and extremely high mobilization costs make offshore sediment supply difficult and expensive to acquire. In addition, the Monterey Bay National Marine Sanctuary prohibits dredging and dredge disposal in its jurisdiction (below mean high water) making this infeasible from a regulatory standpoint at present. Changes to these rules must be approved by Congress. Presently, there are ongoing Sanctuary discussions that are considering revisions to some of these rules to better support ecologically sensitive adaptation practices, but there has been no resolution as of the writing of this plan.

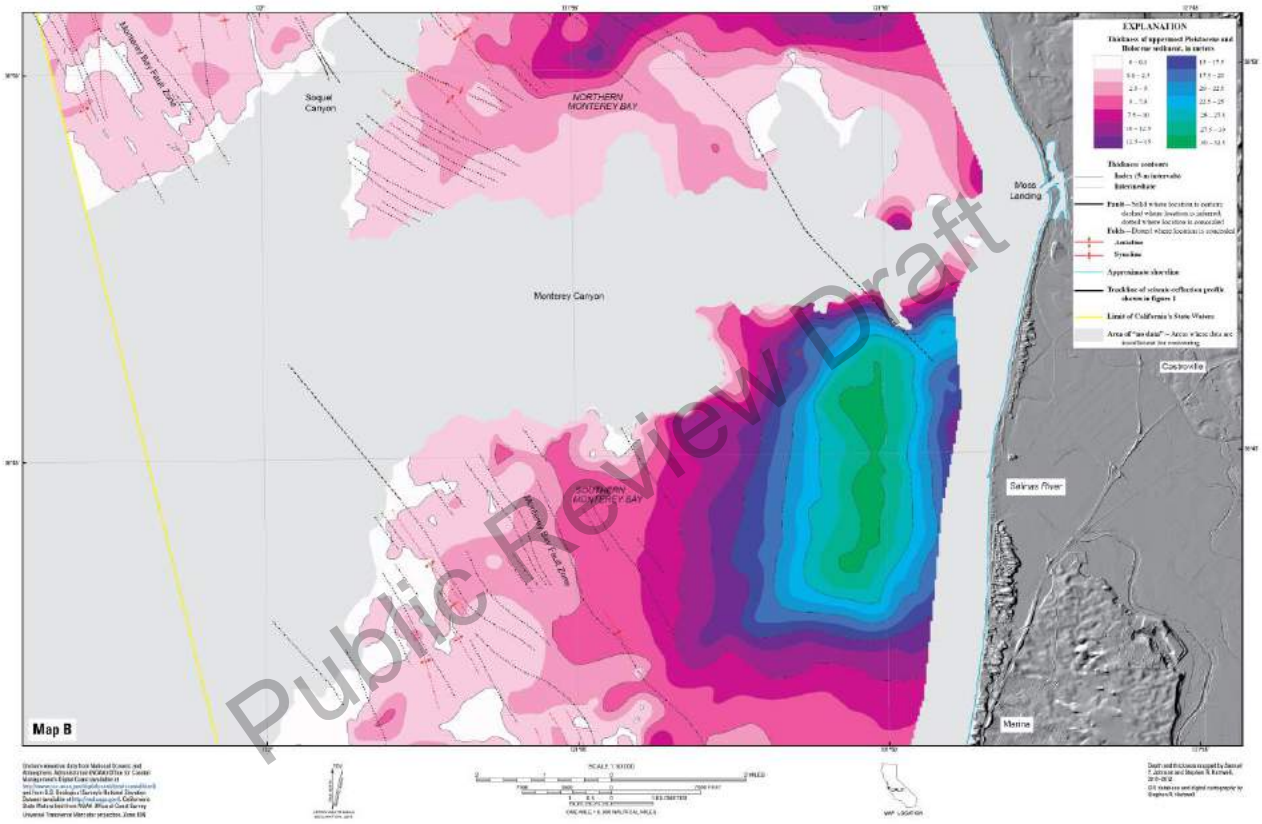


Figure 6-1. California Seafloor Mapping. Source: USGS California State Waters Map Series Data Catalog

The applicability of dredge disposal for Marina is minimal although efforts by the Monterey Harbor District may supply some limited sand into the overall system over time, although any immediate direct effects are unlikely to be observed in Marina.

A more probable and likely source of sediment is from opportunistic nourishments (See Section 3.4) associated with development projects, flood control maintenance projects, and other opportunistically acquired sources. Implementation of the regionally designed City of Monterey opportunistic nourishment program at the City level should be a high priority, particularly with placement (or receiver) sites identified at Reservation Road and the existing CEMEX sand mine property.

The Accommodation Approach

Accommodation strategies employ methods that modify existing areas or design new developments or infrastructure to decrease hazard risks and therefore increase the resiliency of development to the impacts of sea level rise. On a community-scale, accommodation strategies include many of the land use designations, zoning ordinances, or other measures that require the above types of actions, as well as strategies such as clustering development, relaxing building height restrictions in less vulnerable areas, or requiring mitigation actions to provide for protection of natural areas. On an individual project scale, these accommodation strategies include actions such as elevating structures, performing retrofits, or using materials to increase the strength of development such as to handle additional wave impacts, building structures that can easily be moved and relocated, or using additional setback distances to account for acceleration of erosion.

The Retreat Approach

Retreat strategies prioritize proactive approaches to relocate or remove existing development out of hazard areas and limit the construction of new development in vulnerable areas. For example, at the Marina State Beach, the parking lot as it eroded could be reconstructed on the vacant land inland of the existing parking lot with construction phased based on the need. Other retreat strategies include creating land use designations and zoning ordinances that encourage building in less hazardous areas, or gradually remove and relocate existing development such as the CEMEX sand mine, or that promote conservation and passive recreation uses. Rezoning of potentially impacted properties currently zoned Coastal Conservation and Development could be better aligned with the existing General Plan[10] zoning by downzoning some oceanfront properties such as the existing CEMEX property to be Open Space and Passive Recreation. . Acquisition and buy-out programs, transfer of development rights programs, and removal of structures are examples of strategies designed to encourage retreat.

The Hybrid Approach

For purposes of implementing the California Coastal Act, no single category or even specific strategy should be considered the "best" option as a rule. Different types of strategies will be appropriate in different locations and for different hazard management and resource protection goals, and potentially different time horizons. The effectiveness of different adaptation strategies will vary across both spatial and temporal scales. In many cases, a hybrid approach that uses strategies from multiple categories will be necessary, and the suite of strategies chosen may need to change over time. Nonetheless, it is useful to think about the general categories of adaptation strategies to help frame the discussion around adaptation and the consideration of land use planning and regulatory options in the City.

6.6 Secondary Impacts

Almost all adaptation strategies have secondary impacts associated with them. Some of these impacts are associated with construction or escalating maintenance costs. Other impacts can degrade ecology or limit recreational opportunities. Finally, others can affect community aesthetics or property values. Often one of the most controversial impacts is associated with the long-term preservation of a beach, which often

[10] General Plan was adopted in 2000 and updated in 2010

pits private and public interests against each other with strong overtures to social justice and community inequality.

Some of these are minor issues, such as short-term habitat impacts following removal of infrastructure or undergrounding of overhead power lines. Others can be quite confounding and expensive, such as the burial of beaches under rocks following construction of revetments, or a retrofit to a critical infrastructure component. Another example is the potential impacts to visual resources associated with accommodation strategies that elevate buildings or shoreline protection through increased height limits to protect against elevated levels of flooding.

Many communities have relied on setbacks in an effort to reduce hazard risk, and some are currently experimenting with establishing setback lines that are based on modeled predictions of where the new coastline will be in the future. Setbacks alone could be considered potentially maladaptive because they eventually lead to structures being at risk.

Shoreline Protective Devices

Shoreline Protective Devices (e.g., seawalls, revetments, groins, etc.) can adversely affect a wide range of other coastal resources and uses that the California Coastal Act protects (California Coastal Act 1977). They often impede or degrade public access and recreation along the shoreline by occupying beach area or tidelands and by reducing shoreline sand supply.

Presently there is no shoreline protection within the City, however, given that these shoreline protective devices are often placed under emergency response, they remain a threat to beaches in the City of Marina. Protecting the back of the beach through shoreline protective devices ultimately leads to the loss of the beach as sea level rise and coastal erosion continues adjacent to unarmored sections. Shoreline protective devices therefore raise serious concerns regarding consistency with the public access and recreation policies of the California Coastal Act. Such structures can also be placed in coastal waters or tidelands and harm marine resources and biological productivity, which is in conflict with California Coastal Act Sections 30230, 30231, and 30233. In addition, while California Coastal Act Section 30235 allows for shoreline protective devices in certain circumstances when designed to eliminate or mitigate adverse impacts on local shoreline sand supply, shoreline protective devices can degrade the scenic qualities of coastal areas and alter natural landforms, which may create conflicts with Section 30251. Finally, by halting or disrupting landscape connectivity, structures can prevent the inland migration of intertidal and beach species during large wave events. This disruption can prevent intertidal habitats, beaches, and other low-lying habitats from advancing landward as sea levels rise over the long-term as well as stop wind-blown (aeolian) dune formation.

Figure 6-2. The former officers club at Stillwell Hall on Ford Ord. (A) Revetment reduced erosion but resulted in the loss of the beach (2002). (B). Following removal of the revetment and equilibrating erosion, the beach returned as the dune eroded (2005). Photos courtesy of the California Coastal Records Project

It is important to note that shoreline protection devices such as seawalls and revetments have several inevitable secondary impacts:

Placement Loss

Wherever a hard structure is built, there is a footprint of the structure (Figure 6-2 top). The footprint of this structure results in a loss of coastal area known as placement loss. This inevitable impact can bury the beach beneath the structure and reduce the usable beach for recreation or habitat purposes. For example, a 20-foot high revetment may cover up to 40 feet of dry sand beach. A vertical seawall or sheet pile groin typically has a smaller placement loss than a revetment or rubble mound groin.

Passive Erosion

Wherever a hard structure is built along a shoreline undergoing long-term net erosion, the shoreline will eventually migrate landward to (and potentially beyond) the structure. The effect of this migration will be the gradual loss of beach in front of the seawall or revetment as the water deepens and the shore face moves landward. While private structures may be temporarily saved, the public beach is lost. This process of passive erosion is a generally agreed-upon result of fixing the position of the shoreline on an otherwise eroding stretch of coast and is independent of the type of seawall constructed. Passive erosion will eventually destroy the recreational and habitat beach area unless this area is continually replenished. Excessive passive erosion may impact the beach profile such that shallow areas required to create breaking waves for surfing are lost (Figure 6-2). One of the best examples of these secondary impacts is illustrated by the example at Stillwell Hall.

Limits on Beach Access

Depending on the type of structure, impacts to beach access vary. Typically, vertical beach access (ability to get to the beach) can be impacted unless there are special features integrated into the engineering design of the individual structure, however as passive erosion occurs (see above), lateral beach access is usually impacted.

Active Erosion

Refers to the interrelationship between coastal structures and beach, whereby due to wave reflection, wave scouring, and enhanced "end effect" erosion and other coastal processes, the shoreline protection may actually increase the rate of loss of beach in front of the structure and escalate the erosion rate along adjacent unprotected sections of the coast. Active erosion is typically site-specific and dependent on sand input, wave climate, specific design characteristics, and other local factors.

Ecological Impacts

Scientific studies have documented a loss of ecosystem services, loss of habitat, and reduction in biodiversity when seawall-impacted beaches were compared to natural beaches. Given the negative impacts of hard solutions, more attention is being focused on the implementation and resulting effectiveness of soft solutions. Soft options often include sediment management aspects such as sand dunes, cobble placement, and/or beach nourishment. Often maintenance costs can be higher than the hard solutions unless nearby sediment sources are abundant. Some soft options are considered “living shorelines” or natural infrastructure (e.g., dune restoration), as they restore or enhance existing habitat, and if done correctly should be self-sustaining, meaning minimal maintenance costs. These “soft” or “green” solutions tend to mimic natural processes and can help lessen erosion and flooding while also providing habitat, water filtration, and recreational opportunities.

Sediment Management

Secondary impacts from sediment management vary depending on the volume, frequency, and method of sediment placing, but typically result in substantially degraded sandy beach ecosystems, temporary changes to flooding, changes to surfing resources, and limiting recreational use. In general, the bigger or more frequent the sand placements, the larger the impact to the sandy beach ecosystem and recreation. The opportunistic nourishment program proposed by the City of Monterey for the Southern Monterey Bay

region addresses many of these secondary impacts through seasonal activity, placement locations, and volume restrictions (ESA 2019).

Horizontal Levees

Horizontal levees are a form of natural green infrastructure that has been applied elsewhere, most notably in San Francisco Bay. The concept is usually part of a marsh restoration strategy in which the marsh slope is increased to provide higher elevations near the back of the marsh. This provides a natural levee while also providing marshes room to migrate vertically in elevation upslope. Secondary impacts could be related to costs or changing of existing habitat in exchange for future habitats.

6.7 Adaptation Strategies for Marina

Natural dune erosion from large storm waves is the primary hazard challenging the Marina shoreline. Dune erosion, however, is a natural process that creates and maintains beaches through time even in the face of sea level rise. Dune erosion, wide beaches, and development policies which have largely avoided hazards have proven effective. The imminent stopping of the CEMEX sand mine should also buy more time to adapt by reducing erosion rates. However, the goal of any adaptation policy or project in Marina should focus on reducing erosion rates, while allowing natural erosion and shoreline fluctuations to maintain beaches.

An overarching adaptation strategy in Marina will need ongoing community education and will need to take a variety of approaches that include both policy changes and adaptation projects. These approaches will evolve through time and likely range from enhancing natural protection strategies, accommodation, and retreat, as the sea level rise impacts exceed the various strategies' capacity to reduce the vulnerabilities of the most vulnerable sectors. Where most applicable, triggers which identify the need to catalyst further adaptation planning and implementation are identified below. Many of these will need to be revisited as the cessation of sand mining and as a reduction of erosion rates occur in the future.

Specific adaptation approaches were categorized into policies and projects (Figure 6-3). Triggers identified in the figures below are based on estimated lead times needed to catalyst planning for future adaptation measures.

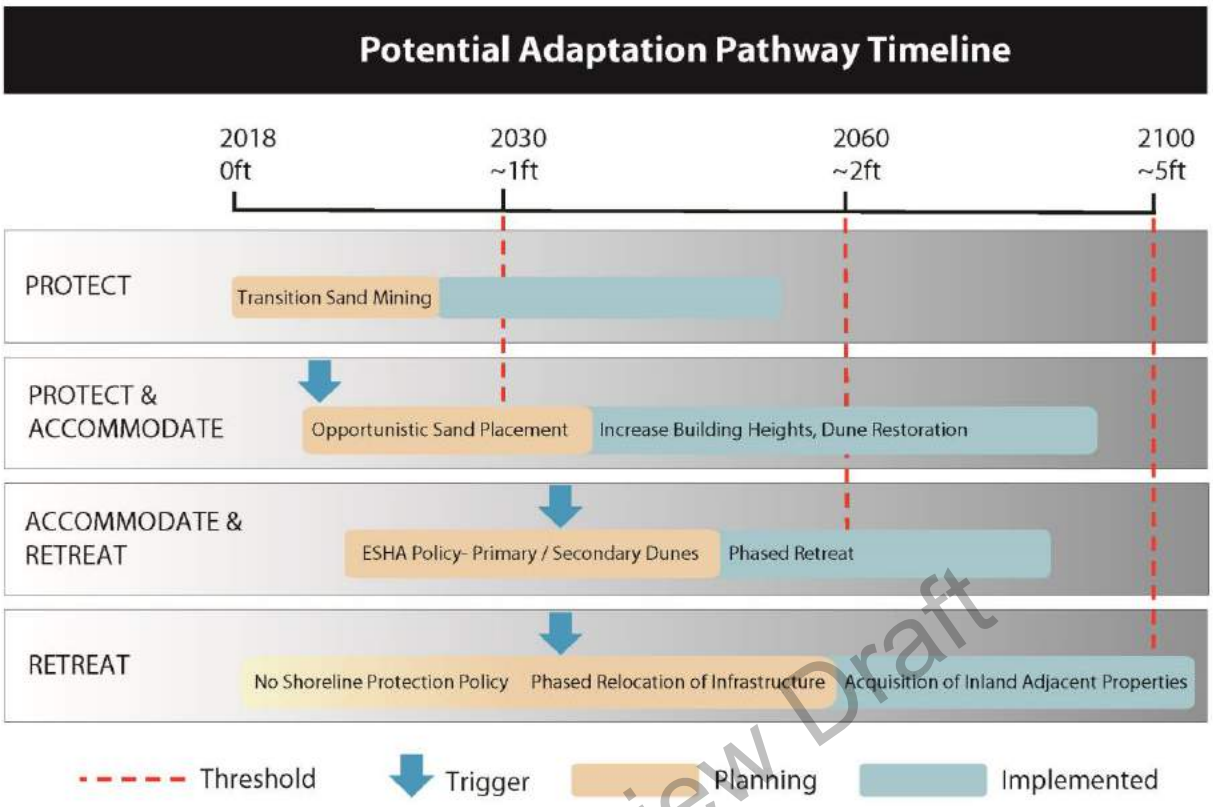


Figure 6-3. Example of a Potential Adaptation Pathway and Triggers for Sea Level Rise Accommodation

Policy Approaches

Potential adaptation strategies identified from professional experience were distilled into the following list largely based on informational community workshops on the vulnerability assessment, community online surveys, and discussions with the most affected stakeholders. A strong sentiment was expressed by the City Council and Planning Commission to avoid the use of any shoreline protective devices in the future.

First, completion of the sand mining remediation plan should be followed closely to ensure compliance with the mine closure and remediation plan as well as to engage with any prospective buyer of the property to encourage alignment with the City's vision.

Second, as part of adaptation education, a real estate disclosure for coastal hazards and sea level rise should be attached to any parcel identified within the coastal erosion hazard zone. Such a disclosure should acknowledge the risk, lay out additional technical studies required for proposed developments, accept liability for any future development or redevelopment, and inform the owner that the City may not always provide access to said parcels.

Third, a policy should be developed to clearly state that coastal armoring will not be permitted within the City of Marina. This policy would protect beaches for perpetuity within the City and continue the coastal management leadership tradition that the City has championed with its role in terminating the sand mine.

Fourth, in order to support recreation, access and visitor serving accommodations the City should consider means to allow for relocation or redevelopment of existing facilities and infrastructure away from coastal erosion areas without taking all development rights. The challenge arises that much of the coastal zone is designated as ESHA. Development of policies related to ESHA should support the relocation goals. One approach may be to map ESHA habitats as a primary and secondary ESHA based on the health of the habitat, landscape connectivity, and the proximity to the beach. The Land Use Plan currently identifies that the highest priority ESHA should be:

1. Habitat for all identified plant and animal species which are rare, endangered, threatened, or are necessary for the survival of an endangered species.
2. Vernal ponds and their associated wetland vegetation. The Statewide Interpretive Guideline for Wetlands and Other Wet Environmentally Sensitive Habitat Areas (California Coastal Commission, February 14, 1981) contains technical criteria for establishing the inland boundary of wetland vegetation.
3. All native dune vegetation, where such vegetation is extensive enough to perform the special role of stabilizing Marina's natural sand dune formations.
4. Areas otherwise defined as secondary habitat that have an especially valuable role in an ecosystem for sensitive plant or animal life., as determined by a qualified biologist approved by the City [Resolution No. 2001-118 (October 16, 2001); approved by CCC November 14, 2001].

In addition, it is recommended that another primary ESHA criteria include a prioritization for habitat connectivity between the ocean, beach, and dune habitats. This landscape connectivity is critical for sensitive species to find refuge during storm events.

Secondary ESHA could be previously disturbed areas or infill fragmented habitats that are not widely connected to the dune system areas. The secondary habitat area will be presumed to include the following, subject to more precise determination upon individual site investigation:

1. The potential localities of rare and endangered plant and animal species.
2. Any area within 100 feet of the landward boundary of a wetland primary habitat area.

A policy stating that some limited development on secondary ESHA for relocation to maintain or protect primary ESHA habitat and balance all coastal resources should be considered.

Fifth, aligning related City plans is also an important adaptation step. The 2010 City update to the General Plan changed the zoning of the CEMEX property. The current Zoning is Coastal Conservation and Development, while the current General Plan Land Use designation is Habitat Reserve. A rezoning of this property to Open Space to align the zoning with the General Plan and policies in the General Plan should be pursued. The City's Capital Improvement Plan should also be updated to consider specific dune erosion impacts and measures to avoid hazard exposure.

Sixth, the City could update their Local Hazard Mitigation Plan with identified adaptation strategies which would allow for federal FEMA dollars to be used for adaptation planning.

Finally, regional collaboration with partners across Southern Monterey Bay, in particular State Parks and the Marina Coast Water District, who are all engaged in various planning efforts that the City should participate in to ensure that any impacts to sediment supply or facility upgrades consider sea level rise

and the City's beaches. Specifically, the City should closely participate in the Marina State Beach Master Plan update, as well as the MCWD Water, Sewer and Recycled Water Master Plans.

Project Approaches

The two prioritized adaptation projects aim at increasing sand supply and stabilizing the sand dunes with the intent of reducing dune erosion rates.

First, an opportunistic sand use program which allows for the placement of beach and dune compatible sands on City beaches should be considered. The City of Monterey on behalf of the coastal communities in the Southern Monterey Bay Littoral Cell have been developing an opportunistic sand use program. The program is intended to streamline the placement of clean, beach compatible sediments from upland sources (e.g. construction projects, flood control) on the beaches of Monterey at designated locations to reduce potential erosion impacts, improve coastal resiliency, and maintain dune and beach habitats. The proposed receiver sites in the City of Marina are located at the end of Reservation Road and at the CEMEX property. The City should consider adoption of the program and associated environmental documents.

Second, dune restoration takes many forms but is focused on improving the native dune vegetation as well as providing a vegetation stabilization of the dune both of these efforts increase the resilience of the dunes to erosion and reduce the overall rate of erosion and should be a high priority. As dune restoration projects are planned and implemented, thought should be given to possible relocation locations to avoid restoring an area that may be needed in the near future to maintain the ocean, beach, dune ESHA connectivity. Some examples of this are described in further detail below as applied to the specific managers of the most vulnerable sectors.

6.8 Potential Adaptation Approaches for the Identified Vulnerabilities

State Parks

Marina State Beach faces dune erosion and stormwater induced erosion to the parking lot and is projected to be substantially eroded in the future (Figure 6-4). Discussions with State Parks identified likely approaches to be pursued. State Parks has a general policy to not armor the coast and there is no intent to pursue that action. The implementation of any of the potential strategies would be laid out in an updated Parks Master Plan. The City should follow that process and provide comments and feedback to insure consistency with City priorities.

Figure 6-4. Parking lot erosion at Marina State Beach (July 2019)

Near term

- Address erosion caused by with stormwater runoff and sand clogging of the storm drains
- Control public access near erosion hotspots and prioritize area for restoration

Medium Term

- Identify an alternative location to relocate the restroom and parking lot with the most promising location near the old restroom location and the State Parks storage facility closer to Highway 101.
- Focus dune restoration efforts away from potential alternative locations

Possible triggers – frequency of overtopping onto parking lot, erosion of dune crest to within 5 feet of the parking lot. The distance between the dune crest and the parking lot was identified as a low cost monitoring approach that could be integrated into existing staff assignments. Monitoring would occur periodically and particularly following any major erosion event.

Marina Coast Water District

The Marina Coast Water District facility was a former wastewater treatment plant that was decommissioned in the 1990s when the regional wastewater treatment plant was opened. Presently there are two tanks that have no remediation or removal plan. In addition, the facility was a former desalination test location and currently has an inactive capped well located under the beach and rarely exposed. The permit status with the CSLC was unknown at time of discussion with current MCWD staff in July of 2019. Access to the facility is through Marina State Beach parking lot and so coordination with State Parks, the City and MCWD was identified as an important step in adaptation to future erosion hazards. The buildings that are identified as vulnerable are primarily used as district offices and conference rooms. Another MCWD facility is located nearby in Fort Ord.

Near term

- Identify the foundation of the district buildings
- Begin monitoring dune crest to building foundation distance
- MCWD is currently working on several plans related to water supply, sewer and recycled water master plans for the District. The City and MCWD should coordinate closely to ensure that sea level rise is factored into these planning documents.

Medium term

- Regional coordination key with State Parks and the City to identify needs, alternate locations and adaptation strategies

Possible triggers –erosion of dune crest to within a certain distance of the buildings. The distance between the dune crest and the parking lot was identified as a low cost monitoring approach that could be integrated into existing staff assignments. Monitoring would occur periodically and particularly following any major erosion event.

Sanctuary Beach Resort

The Sanctuary Beach resort was identified to have vulnerable structures with small amount of sea level rise. The resort has multiple owners with timeshare owners (Wyndham) set farther back than resort hotel guests that front the ocean and are thus anticipated to be affected sooner. The ocean front rooms generate the most revenue. The original permits required some dune habitat conservation and allowed for additional development in some of the infill locations. Room renovations occur on a 5-7 year timeline.

Discussions with the management of the Sanctuary Beach resort discussed possible relocation of future approved developments to areas outside of the projected hazard zones, perhaps with a change in building heights to allow for similar occupancy in fewer buildings. Potential locations were discussed which included areas that were required dune habitat conservation that are effectively fragmented habitats in the resort. Additional discussions were had about the concept of primary and secondary ESHA with the highest value habitat and priority maintaining the ocean, beach, dune connectivity. The City encourages participation in the LCP update and sea level rise planning process.

6.9 Possible Funding Mechanisms

As part of the next steps, the City should identify, evaluate and pursue all feasible potential sources of revenue for funding the City's shoreline management policies.

Adaptation to sea level rise may require substantial community investment, long term financing plan and diversified approach to begin generating revenues to cover the costs of adaptation strategy implementation. While very few funding sources are specifically focused on sea level rise adaptation, the reduction of risk is a high priority for many funding opportunities. The financing plan should be planned in advance and include identification of milestones and priorities/criteria to support the decision-making process for expenditures. Potential sources of funding that could be explored may include, without limitation:

- FEMA Hazard Mitigation Assistance Programs to support community resiliency;

- FEMA Pre-Disaster Mitigation Grant Program;
- Regional Sediment Management and opportunistic sand funding sources;
- Government grants (e.g., Federal Land and Water Conservation Fund, USACE, SCC, State Tidelands Oil Revenue Fund, Santa Barbara and Ventura Harbor mitigation funds, State Parks Bond, Open Space Bond Act, Park Land Bond Act, etc.);
- Bond financing;
- Parking revenues, beach fees, etc.;
- Two percent of the existing, and any dedicated increases in, the transient occupancy tax, sales tax, or other dedicated taxes;
- Environmental mitigation fees (paid by third parties such as Caltrans, port districts, utility companies, developers, etc.); and
- Funds from other parties responsible for loss of sand on the beach utilizing assessment districts or other equitable funding mechanisms.

The City may also consider establishing an "Adaptation Account" which will serve as the primary account where all funds generated pursuant for future resiliency building programs will be held. The City should invest the Adaptation Account funds prudently and expend them for purposes outlined in the Resiliency Plan including, without limitation:

- Sand replenishment and projects;
- Updating the mean high tide line survey;
- Preparation of shoreline surveys and monitoring programs;
- Opportunistic beach nourishment programs;
- Public recreation improvements;
- Repair and replacement of beach access infrastructure; and
- Insurance premiums.

The City may use the funds in the Adaptation Account, subject to the restrictions of any terms of the funding sources, to pay for projects such as beach sand replenishment, public recreation and public beach access improvement projects, feasibility and impact studies, operating expenses, insurance, and litigation; and to pay to conduct surveys and monitoring programs. Some potential resiliency building programs and funding mechanisms that can be further explored are described below.

Infrastructure Financing Districts

California passed a bill in September 2014 allowing cities and other entities to create enhanced infrastructure financing districts. This allows incremental property tax revenues to be devoted to a specified purpose such as a fund for cleanup, infrastructure, parks and open space, transportation, or other things that could be applied to a variety of adaptation approaches. With the passage of Assembly Bill 313 and Senate Bill 628, the requirements for establishing these districts have been streamlined. The intent of this bill was to fill the local funding void left by the dissolution of the redevelopment agencies. Basically, the City establishes an Economic Infrastructure Financing District, develops a business plan

with priority projects (e.g. infrastructure, adaptation, etc.), then can draw funds from changes in local tax revenues occurring as part of a redevelopment or rezone or apply for grant funds.[11]

Dedicated Sales or Transient Occupancy Tax Increase

ToT Increase – ToT from hotel stays and short-term vacation rentals already provides a source of General Fund revenues for the City. A dedicated increase in ToTs (e.g. 2 percent for sand) could be reserved for specifically for adaptation approaches that maintain the City Beaches and Open Spaces.

Sales Tax Increase – The City of Del Mar (San Diego County) recently instituted a 1 percent sales tax increase that is used as a dedicated source of funding for coastal resiliency building. Marina may consider this approach or coordinate on a County-wide approach such as a quality of life initiative to generate local revenues to be used to finance long-term coastal resiliency strategies.

Hazard Mitigation and Pre-Disaster Assistance

As there is overlap between LCP planning and LHMP as both address a potential range of hazards in a given City. Cal OES' Hazard Mitigation Planning Division and FEMA's Hazard Mitigation Assistance grant programs provide significant opportunities to adapt by reducing or eliminating potential losses to the City's assets through hazard mitigation planning and project grant funding. Much of the funding of specific projects must be tied to an approved Local Hazard Mitigation Plan. An update to the LHMP could add sea level rise and climate change related hazards in order to make adaptation projects eligible for federal funding. Currently, Cal OES and FEMA have three grant programs: Hazard Mitigation Grant Program, Pre-Disaster Mitigation, and Flood Mitigation Assistance. Total value in each of the grants varies annually based on federal funding authorization, but typically each is in the 10s to 100s of million dollars.

Impact Mitigation Fees or In Lieu Fees - Sand Mitigation and Public Recreational Impact Fees

Impact mitigation or in lieu fees are another way to generate monies for adaptation measure implementation. Certain structured fees could be established to generate revenues for: **1)** covering the necessary planning of, technical studies for, design of, and implementation of adaptation strategies, or **2)** developing an emergency cleanup fund to be able to respond quickly and opportunistically following disasters. Disasters, through a different lens, are opportunities to implement changes.

There are currently two structured fees that the CCC uses to address the impacts of shoreline protection - sand mitigation fees and a Public Recreation fee. The sand mitigation fee is a fee intended to mitigate for the loss of sand supply and loss of recreational beaches in front of structures. The Public Recreation Fee addresses impacts to the loss of public recreation based upon the loss of beach area physically occupied by the coastal structure. An additional fee for ecosystem damages is under consideration by the CCC which could assess a fee based on the cost of restoration or replacement value of the damaged habitat. While multiple jurisdictions have developed these types of in lieu fees associated with permits for shoreline protective devices, the limited development potential and proposed City policy approach of avoiding shoreline protective devices may limit the ability to derive substantial revenues to the City.

[11] For more information on Enhanced Infrastructure Financing Districts, see http://www.eifdistricts.com/.

Sand Mitigation Fee – Such a fee would mitigate for actual loss of beach quality sand which would otherwise have been deposited on the beach. For all development affecting sand supply, a Sand Mitigation Fee could be collected by the City to be used for sediment management purposes. The mitigation fee could be deposited in an interest-bearing account designated by the City Manager in lieu of providing sand directly to replace the sand that would be lost due to the impacts of any proposed protective structure. Consideration of sand volumes lost over time should factor into whether actual sand placement is preferred or whether the volume/$ should be retained until a substantial volume can be contributed. The methodology used to determine the appropriate mitigation fee has been approved by the CCC. The funds should solely be used to implement projects which provide sand to the City's beaches, not to fund other public operations, maintenance, or planning studies.

Public Recreation Fee – Similar to the methodology established by the CCC for the sand mitigation fee, the CCC is in the process of developing a methodology for calculating a statewide public recreation fee. Until such time as an approved methodology for determining this fee has been established, and the methodology and payment program has been incorporated into the LCP through an LCP amendment, the City could collect a $1,000 per linear foot interim fee deposit. In the interim period, CCC will evaluate each project on a site-specific basis to determine impacts to public access and recreation, and additional mitigation may be required.

Public Recreation Fees must be expended for public access and public recreation improvements as a first priority and for sand replenishment as secondary priorities where an analysis done by the City determines that there are no near-term, priority public recreation or public access projects.

California Infrastructure and Economic Development Bank

The California Infrastructure and Economic Development Bank (IBank) was created in 1994 to finance public infrastructure and private development that promote a healthy climate for jobs, contribute to a strong economy, and improve the quality of life in California communities. IBank has broad authority to issue tax-exempt and taxable revenue bonds, provide financing to public agencies, provide credit enhancements, acquire or lease facilities, and leverage State and Federal funds. IBank's current programs include the Infrastructure State Revolving Fund Loan Program, California Lending for Energy and Environmental Needs Center, Small Business Finance Center, and the Bond Financing Program.[12]

Green Bonds

Bonds are debt instruments that allow governments and other entities to borrow money from investors and repay that investment over a certain time at a certain rate. Government bonds often remain tax exempt, meaning the interest that investors earn is tax exempt. Bonds are a very traditional and familiar platform for financing public infrastructure and government programs, and recently the market has developed "green" bonds to finance green adaptation infrastructure.

[12] For more information on IBank, see http://www.ibank.ca.gov/.

California Department of Fish and Wildlife – 2019 Proposition 1 & Proposition 68 Grant Opportunities

CDFW has announced funding opportunities for multi-benefit ecosystem restoration and protection projects under both Proposition 1 (Water Quality, Supply, and Infrastructure Improvement Act of 2014) and Proposition 68 (California Drought, Water, Parks, Climate, Coastal Protection, and Outdoor Access for All Act of 2018). This grant funding opportunity makes available funds for public agencies for planning activities that lead to specific on-the-ground implementation projects, funds for implementation activities (e.g., construction and monitoring) of restoration and enhancement projects, and funds for acquisition or purchases of interests in land or water. These funds could easily support City adaptation approaches of dune restoration, purchase of open space and or Coastal Trail planning.

Cultural, Community and Natural Resources Grant Program – Proposition 68

Following passage of the California Drought, Water, Parks, Climate, Coastal Protection, and Outdoor Access for All Act of 2018 (Proposition 68), $40 million has been appropriated to the California Natural Resources Agency for competitive grant funds that protect, restore, and enhance California's cultural, community, and natural resources. Funding under this program is available to local agencies and other eligible applicants for projects qualifying under a number of categories including resource protection, enhancement of park, water, and natural resources, and improvement of community and cultural venues or visitor centers.

California Department of Transportation Adaptation Planning Grant Program

As part of production of this Report, the City received adaptation planning grant funds from Caltrans under their Transportation Planning Grant Program for FY 2018-2019. Caltrans has recently announced another $6 million is available for eligible climate change adaptation planning for FY 2019-2020. Further grant funding through the Caltrans Transportation Adaptation Planning Grant Program is available for projects or programs relating to:

- Climate vulnerability assessments;
- Extreme weather event evacuation planning;
- Resilience planning;
- Transportation infrastructure adaptation plans;
- Natural and green infrastructure planning;
- Integration of transportation planning considerations into existing plans;
- Evaluation of or planning for other adaptation strategies; and/or
- Developing educational resources, trainings and workshops for local jurisdictions and transportation service provides.

7. Preparers

This report was prepared by the following individuals:

Revell Coastal, LLC

- David L. Revell, PhD, Project Director
- Matt Jamieson, MFA

City of Marina

- Christine Hopper, Planning Services Manager
- Alex Barton, Planner

EMC Planning

- Polaris Kinison Brown

8. References

Bromirski, P.D., A.J Miller, R. E. Flick, and G. Auad 2011. Dynamical suppression of sea level rise along the Pacific coast of North America: Indications for imminent acceleration. *Journal of Geophysical Research*, Vol. 116, C07005, doi:10.1029/2010JC006759, 2011

California Coastal Commission (CCC 2015). Final Sea Level Rise Policy Guidance. San Francisco, CA. Adopted August 12, 2015. Available: http://www.coastal.ca.gov/climate/slrguidance.html

California Coastal Act. 1977. https://www.coastal.ca.gov/coastact.pdf

California Coastal Commission 2017. Staff report on the Settlement Agreement of the CEMEX Sand Mine. CCC-17-CD-02. July 13,2017.

California Coastal Commission (CCC 2018). Updated Sea Level Rise Policy Guidance; Science Update. San Francisco, CA. Adopted November 7, 2018. Available: https://documents.coastal.ca.gov/assets/slr/guidance/2018/0_Full_2018AdoptedSLRGuidanceUpdate.pdf

California Geological Survey (CGS 2009), State of California, 2009. Tsunami Inundation Map for Emergency Planning, Marina Quadrangle, Monterey County; produced by California Emergency Management Agency, California Geological Survey, and University of Southern California – Tsunami Research Center; dated July 1, 2009, mapped at 1:24,000 scale.

California National Research Agency. 2018. Safeguarding California Plan: 2018 Update.

California Office of Environmental Health Hazard Assessment. 2013. Indicators of Climate Change in California. Available: http://oehha.ca.gov/multimedia/epic/pdf/ClimateChangeIndicatorsReport2013.pdf

City of Marina, 2013. The City of Marina Local Coastal Land Use Plan. Prepared by Ironside and Associates. Certified by California Coastal Commission on April 30, 1982, as amended through 2008. Available: https://www.ci.marina.ca.us/DocumentCenter/View/4490.

Climate Central. 2014. Surging Seas Available: http://sealevel.climatecentral.org/ssrf/california

Combellick, R.A., Osborne, R.H., 1977. Sources and petrology of beach sands from southern Monterey Bay, California. J. Sediment. Petrol. 47 (2), 981±987.

Cooper, W.S. 1967. Coastal Dunes of California. Memoir 104 of the Geological Society of America. 131pp.

Cayan et al 2016. Probabilistic Scenarios of Sea Level Rise along the California Coast: A product of the California 4th Climate Assessment.

Dorrell-Canepa, Joey. 2005 Dune Habitat Restoration Plan Marina Dunes Preserve, Marina, California. Prepared for the Monterey Peninsula Regional Parks District. December, 2005.

ESA 2019. Monterey Bay Opportunistic Beach Nourishment Program: Initial Study/Mitigated Negative Declaration. Prepared for the City of Monterey. January 2019.

ESA PWA 2014. Southern Monterey Bay Coastal Hazard Modeling and Vulnerability Assessment – Technical Methods Report. Prepared for The Monterey Bay Sanctuary Foundation. June 16, 2014.

ESA PWA. 2012. Evaluation of Erosion Mitigation Alternatives for Southern Monterey Bay, Report prepared for the Monterey Bay Sanctuary Foundation and the Southern Monterey Bay Coastal Erosion Working Group. May 2012. Available: http://montereybay.noaa.gov/research/techreports/tresapwa2012.html.

Federal Emergency Management Authority (FEMA). 2005. Final Draft Guidelines for Coastal Flood Hazard Analysis and Mapping for the Pacific Coast of the United States. Oakland, CA. Prepared for the U.S. Department of Homeland Security. Available: http://www.fema.gov/media-library-data/840f98e4cb236997e2bc6771f04c9dcb/Final+Draft+Guidelines+for+Coastal+Flood+Hazard+Analysis+and+Mapping+for+the+Pacific+Coast+of+the+United+States.pdf.

Federal Emergency Management Agency (FEMA), 2017. Digital Flood Insurance Rate Map Database, Monterey County, CA. DFIRM panels 06053C0181H, 6053C0183H, and 06053C0191H effective 6/21/2017. https://www.fema.gov/national-flood-hazard-layer-nfhl

Hapke, C., D. Reid, D. Richmond, P. Ruggiero, and J. List 2006. National Assessment of Shoreline Change, Part 3: Historical Shoreline Change and Associated Land Loss Along Sandy Shorelines of the California Coast. Santa Cruz, California: U.S. Geological Survey Open-file Report 2006-1219, 79p.

Hapke, C. and D. Reid 2007. National Assessment of Shoreline Change, Part 4: Historical Coastal Cliff Retreat along the California Coast. Santa Cruz, California: U.S. Geological Survey Open-file Report 2007-1133, 57p.

Komar, P.D., W.G. McDougal, J.J. Marra, and P. Ruggiero, (1999). The rational analysis of setback distances: applications to the Oregon Coast. Shore and Beach 67(1):41-49.

Mantua, N.J. and S.R. Hare, Y. Zhang, J.M. Wallace, and R.C. Francis 1997: A Pacific Interdecadal Climate Oscillation with Impacts on Salmon Production. Bulletin of the American Meteorological Society, 78, pp. 1069-1079.

Monterey Fire Safe Council. November, 2010. Monterey County Community Wildfire Protection Plan.

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.

California Ocean Protection Council (OPC). 2017. State of California Sea Level Rise Guidance Document, 2018 Update. Accessible at: http://www.opc.ca.gov

Philip Williams & Associates (PWA) 2008. 2008 Coastal Regional Sediment Management Plan for Southern Monterey Bay. Prepared for Association of Monterey Bay Area Governments.

Revell, D.L., R.Battalio, B. Spear, P. Ruggiero, and J. Vandever, (2011). A Methodology for Predicting Future Coastal Hazards due to Sea-Level Rise on the California Coast. Climatic Change 109:S251-S276. DOI 10.1007/s10584-011-0315-2.

Safeguarding California Plan: 2018 Update. California's Climate Adaptation Strategy January 2018. Available: http://resources.ca.gov/docs/climate/safeguarding/update2018/safeguarding-california-plan-2018-update.pdf

SAFRR Tsunami Modeling Working Group, 2013, Modeling for the SAFRR Tsunami Scenario—Generation, propagation, inundation, and currents in ports and harbors, chap. D, in Ross, S.L., and Jones, L.M., eds., The SAFRR (Science Application for Risk Reduction) Tsunami Scenario: U.S. Geological Survey Open-File Report 2013–1170, 136 p. Available: http://pubs.usgs.gov/of/2013/1170/d/.

Storlazzi, C.D. and M.E. Field :2000. Sediment distribution and transport along a rocky, embayed coast: Monterey Peninsula and Carmel Bay, California. Marine Geology 170 (200) 289-316.

Thornton, E.B., Sallenger, A.H., Conforto Sesto, J., Egley, L.A., McGee, T., Parsons, A.R., 2006. Sand Mining Impacts on Long-Term Dune Erosion in Southern Monterey Bay, Marine Geology, 229 (1-2) 45-58.

Thornton, E.B., Sallenger, A.H., MacMahan, J.H., 2007. Rip Currents, Cuspate Shorelines and Eroding Dunes, Marine Geology, 240 (1-4), 151-167.

Thornton, E.B., 2016. Temporal and spatial variations in sand budgets with application to southern Monterey Bay, California, Marine Geology 382:56–67.

Appendix A. Key Decisions of Scenarios and Hazards

Purpose

The purpose of this memorandum is to decide with City decision-makers on technical assumptions and key decisions needed to conduct the City of Marina Sea Level Rise Vulnerability Assessment. This includes key assumptions regarding coastal hazards, sea level rise scenarios, models, and resource sectors. These assumptions were selected to ensure that the project aligns with City LCP goals as well as achieve consistency with the California Coastal Commission Sea Level Rise Policy Guidance. Data collection work has been largely completed and this is the final step before the vulnerability assessment.

Key decisions

Scenarios and Hazards

High Sea Level Rise, See Table A-1

Dune Erosion without Sand Mining and a 100-year Wave Storm, (Current, 9 inches ~ 2030, 28 inches ~2060, 63 inches ~2100.

Coastal Wave Flooding 2100 (revised based on interpretation of existing modeling to 25' contour based on hydraulic connectivity under Reservation Road Highway 101 Underpass Figure A-1).

Modeling to use

Coastal Resilience Monterey Bay

The project area only has one available model of coastal hazards at a scale suitable for planning purposes the Monterey Bay Coastal Resilience Hazard Models (ESA PWA 2014). This model has data availability for each hazard in a GIS format suitable for analysis (closed polygon shapefiles). In general, it has been found that the Coastal Resilience model for existing conditions has accurately represented historic storm impacts in other jurisdictions (i.e. Oxnard, Carpinteria, Monterey County, Ventura County, Santa Barbara County, Cities of Monterey, Santa Cruz, and Santa Monica) where it has been applied to similar vulnerability assessments based on a local peer review of observed existing conditions flood potential with documented historic storm flooding. Regionally, this is the model in use by Santa Cruz and Monterey Counties, as well as the Cities of Monterey, Santa Cruz, Capitola, and the Moss Landing Community.

Sector Categories considered

- Land Use
- Roads and Parking
- Public Transportation (Bus, Bike)
- Wastewater
- Water Supply
- Storm Water and Percolation Ponds
- Coastal Trails and Public Access
- Public Facilities
- Sensitive Biological Resources
- Hazardous Material Storage

Sector Categories selected

- Land Use and Parkland
- Trails and Access
- Water Supply and Wastewater (we can drop stormwater, no drains or percolation ponds affected by erosion)
- Roads and Bike Routes
- Dune Habitat

Sea Level Rise Scenarios

As a result of the comparative analysis and needs of the City, the Coastal Resilience Modeling was selected for use in the Vulnerability Assessment. The Coastal Resilience model uses sea level rise and time horizon estimates of 9 inches by 2030, 28 inches by 2060, and 63 inches by 2100. Based on the guidance from the CCC Sea Level Rise Policy Guide to evaluate a "range of possible scenarios", the following sea level rise elevations were selected to be included in the Vulnerability Assessment (Table 1 – gray shading). As the science of sea level rise improves, additional information has become available which provides approximate probabilities of sea level rise for various times in the future (Griggs et al 2017). Unfortunately, both of the available models have utilized other elevations of sea level rise than those in the Griggs report, so the relative probabilities of the Coastal Resilience modeling occurring at that specific time in the future is shown in Table A-1 for comparison.

Table A-1. High Sea Level Rise Scenarios for the Monterey Bay

Model/year	SLR - in			% Probability [13]		
	2030	2060	2100	2030	2060	2100
Coastal Resilience - High	**9**	**28**	**63**	**<0.5%**	**>5%<67%**	**>5%<67%**
Science Range - Low	5	12	28	67%	67%	67%
Science Range - High	10	31	83	0.5%	0.5%	0.5%

Bold shaded row is the model proposed for use in the vulnerability analysis (also used in Monterey)
Science range is assuming the current emissions trend or business as usual (RCP 8.5)

13 OPC 2018 State of California Sea-Level Rise Guidance 2018 Update.

Coastal Hazards

The project reviewed the full suite of coastal hazards including dune erosion, coastal wave flooding, tidal inundation and potential groundwater daylighting. However, after coastal hazard model interpretation and discussions with the City, only two different coastal hazards affected by Sea Level Rise were selected for detailed evaluation in the Vulnerability Assessment.

- **Coastal Erosion** – permanent loss of land from potential dune erosion.
- **Coastal Wave Flooding 2100** – adjusted to 25' contour as hydraulically connected through the Reservation Road underpass. This could potentially occur as an episodic coastal wave flood impacts from a 100-year wave storm event in 2100 with 5' of sea level rise and an end to sand mining. This has a low probability of occurrence.

Coastal Erosion

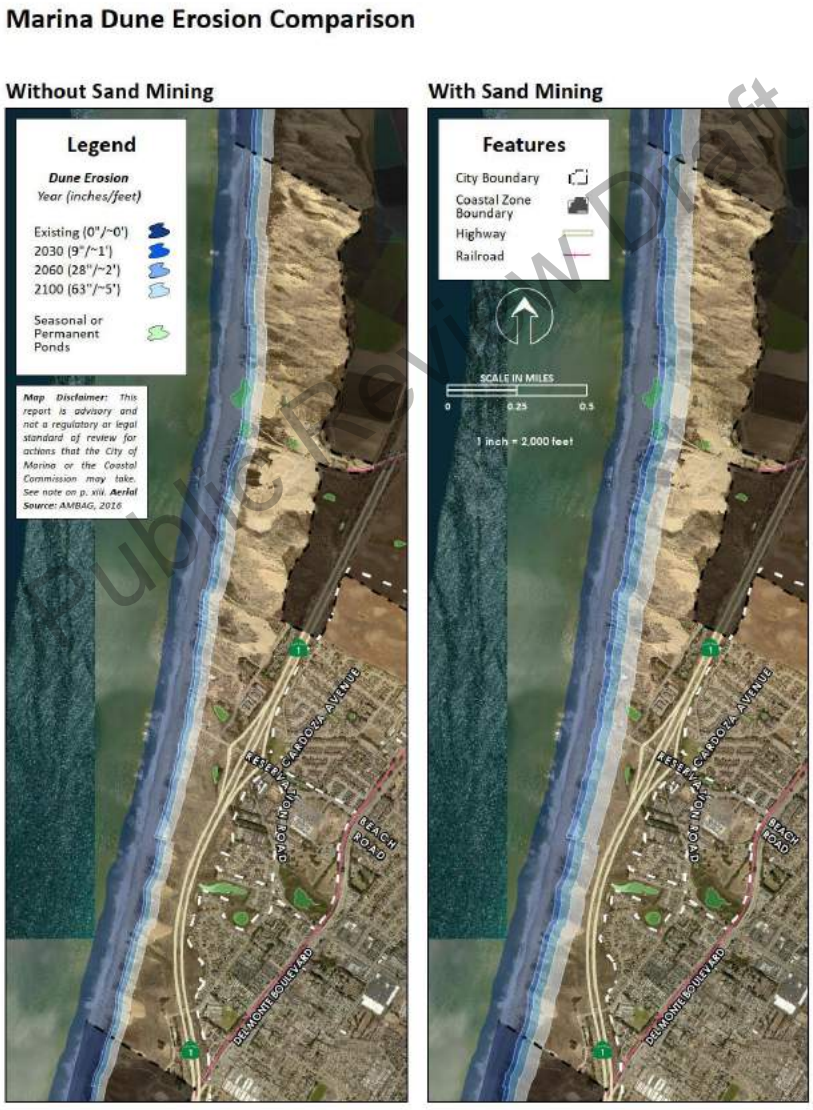


Figure A-1. Marina Dune Erosion Comparison

Coastal Wave Flood Model Interpretation

The available Coastal Resilience modeling for coastal dune erosion and coastal flooding without sand mining showed reduced coastal erosion over the existing conditions (i.e. with sand mining) erosion hazards. Upon detailed review of the model results and the technical methods report14, it was identified that the mapped coastal wave flood hazard extents from a 1% annual chance storm were dependent on the with sand mining erosion scenario.

The reliance of the coastal wave flooding on the coastal erosion rates with sand mining resulted in an over prediction of the potential extent of coastal wave flooding as mapped in the TNC Coastal Resilience Portal. Once this discrepancy was realized, the model results were further evaluated for potential flow pathways and hydraulic connectivity in the future. It was determined as a result of the evaluation that under a without sand mining erosion scenario the erosion extent and hydraulic connectivity would be reduced. When coupled with a 1% annual chance storm and ~5 feet of sea level rise (~2100), that the potential coastal wave storm flooding exposure was reduced to a narrower hydraulic connectivity under the Reservation Road underpass under Highway 1. Using a combination of the revised FEMA FIRM maps, updated topographic data, geomorphic interpretation, and historic ecology, the 2100 coastal wave flood extent was revised to show a reduced extent of episodic coastal flooding with ~5 feet of sea level rise.

The comparison between the with and without sand mining coastal wave flooding extents are shown below (Figure A-2). Considering the coastal dune erosion from a 1% annual chance storm and ~5 feet of sea level, coastal wave flooding during such an event must overtop road elevations of nearly ~45' on Reservation Road and contribute enough volume of water from waves to fill the 2100 coastal wave flooding map extents. This remains a highly unlikely event at 2100, but the vulnerability analysis shows potentially substantial escalation of coastal wave flooding impacts to the City. Results of the Coastal Wave Flood Hazard exposure are shown in Section 5.

[14] ESA 2014. Monterey Bay Sea Level Rise Vulnerability Study: Technical Methods Report. Prepared for the Monterey Bay Sanctuary Foundation with funding from the CA Coastal Conservancy.

Figure A-2. Comparison between the coastal resilience with sand mining caused erosion affecting coastal wave flooding and the revised coastal wave flooding projections based on reduced erosion and hydraulic connectivity

Appendix B. Vulnerability Tabular Results

SECTOR										
METRIC	# of Parcels (instance of parcel on first instance)									
TYPE	Commercial	Common	Institutional	Mining	Mixed	Open Space	Residential	Vacant	Visitor Serving	Total
SUB-TYPE										
UNITS	count	count	count	count	count	count	count	count	count	count
Total within City										
Cumulative										
Erosion										
Existing conditions	0	0	2	2	0	16	0	0	1	21
9 in	0	0	2	2	0	16	0	0	1	21
28 in	0	0	2	2	0	16	0	0	2	22
63 in	0	0	2	2	0	16	0	0	2	22
Total	0	0	8	8	0	64	0	0	6	86
Worst Case Coastal Storm										
60.2 in	2	1	2	0	1	12	196	13	1	228
Total	2	1	2	0	1	12	196	13	1	228

Non-Cumulative

Erosion										
Existing conditions	0	0	2	2	0	16	0	0	1	21
9 in	0	0	0	0	0	0	0	0	0	0
28 in	0	0	0	0	0	0	0	0	1	1
63 in	0	0	0	0	0	0	0	0	0	0
Total	0	0	2	2	0	16	0	0	2	22
Worst Case Coastal Storm										
Storm Alone w/ 63in	2	1	2	0	1	12	196	13	1	228

sq ft and acres of Parcels (p

Commercial		Common		Institutional		Mining		Mixed	
sq ft	acres	sq ft	acres	sq ft	acres	sq ft	acres	sq ft	acres
0	0.00	0	0.00	287,551	6.60	3,116,584	71.55	0	0.00
0	0.00	0	0.00	324,753	7.46	3,642,875	83.63	0	0.00
0	0.00	0	0.00	390,149	8.96	4,583,774	105.23	0	0.00
0	0.00	0	0.00	490,043	11.25	6,038,931	138.64	0	0.00
0	0.00	0	0.00	1,492,495	34.26	17,382,164	399.04	0	0.00
107,973	2.48	5,499	0.13	102,460	2.35	422,675	9.70	16,312	0.37
107,973	2.48	5,499	0.13	102,460	2.35	422,675	9.70	16,312	0.37

0	0.00	0	0.00	287,551	6.60	3,116,584	71.55	0	0.00
0	0.00	0	0.00	37,202	0.85	526,291	12.08	0	0.00
0	0.00	0	0.00	65,396	1.50	940,899	21.60	0	0.00
0	0.00	0	0.00	99,894	2.29	1,455,157	33.41	0	0.00
0	0	0	0	490,043	11.25	6,038,931	138.64	0	0
107,973	2.48	5,499	0.13	102,460	2.35	422,675	9.70	16,312	0.37

portion of parcel on each instance)

Open Space		Residential		Vacant		Visitor Serving		Total	Total
sq ft	acres	sq ft	acres	sq ft	acres	sq ft	acres	sq ft	acres
								226,189,665	
3,132,956	71.92	0	0.00	0	0.00	263,357	6.05	6,537,262	150.08
3,556,043	81.64	0	0.00	0	0.00	298,915	6.86	7,523,864	172.73
4,299,550	98.70	0	0.00	0	0.00	361,177	8.29	9,273,708	212.90
5,436,589	124.81	0	0.00	0	0.00	455,449	10.46	11,965,860	274.70
16,425,137	377.07	0	0.00	0	0.00	1,378,898	31.66	35,300,693	810.40
554,423	12.73	1,103,280	25.33	190,110	4.36	27,487	0.63	2,530,220	58.09
554,423	12.73	1,103,280	25.33	190,110	4.36	27,487	0.63	2,530,220	58.09

3,132,956	71.92	0	0.00	0	0.00	263,357	6.05	6,537,262	150.08
423,087	9.71	0	0.00	0	0.00	35,558	0.82	986,602	22.65
743,508	17.07	0	0.00	0	0.00	62,262	1.43	1,749,844	40.17
1,137,038	26.10	0	0.00	0	0.00	94,272	2.16	2,692,152	61.80
5,436,589	124.81	0	0	0	0	455,449	10.46	11,965,860	274.70
554,423	12.73	1,103,280	25.33	190,110	4.36	27,487	0.63	2,530,220	58.09

# of Buildings (instance of building on first instance)						
Commercial or Services	Institutional	Residential		Visitor Serving		Total
Commercial	Institutional	Residential	Residential Out Building	Visitor Serving	Visitor Serving Out Building	
count	count	count	count	count		count
						5,878
0	4	0	0	0	0	4
0	7	0	0	9	0	16
0	8	0	0	17	1	26
0	8	0	0	23	1	32
0	27	0	0	49	2	78
1	3	152	1	1	0	158
1	3	152	1	1	0	158

0	4	0	0	0	0	4
0	3	0	0	9	0	12
0	1	0	0	8	1	10
0	0	0	0	6	0	6
0	8	0	0	23	1	32
1	3	152	1	1	0	158

sq ft of Buildings (entire building on first instance)							Parkland		
Commercial or Services	Institutional	Residential		Visitor Serving		Building Area Grand Total			
Commercial	Institutional	Residential	Residential Out Building	Visitor Serving	Visitor Serving Out Building				
sq ft	sq ft	sq ft	sq ft	sq ft	sq ft	total sq ft	count	sq ft	acres
						16,712,965	24		
0	1,358	0	0	0	0	1,358	1	589,854	13.54
0	3,035	0	0	6,457	0	9,491	1	674,646	15.49
0	5,207	0	0	18,037	293	23,537	1	825,626	18.95
0	5,207	0	0	33,117	293	38,617	1	1,059,259	24.32
0	14,807	0	0	57,610	587	73,004	4	3,149,385	72.30
3,612	4,732	343,222	536	3,011	0	355,113	1	219,402	5
3,612	4,732	343,222	536	3,011	0	355,113	1	219,402	5.04

0	1,358	0	0	0	0	1,358	1	589,854	13.54
0	1,677	0	0	6,457	0	8,134	0	84,792	1.95
0	2,172	0	0	11,580	293	14,046	0	150,979	3.47
0	0	0	0	15,080	0	15,080	0	233,633	5.36
0	5,207	0	0	33,117	293	38,617	1	1,059,259	24.32
3,612	4,732	343,222	536	3,011	0	355,113	1	219,402	5.04

Roads					Public Transportation					Sewer					
length of roads		Parking			# of bus stops	length of routes by type				# of lift/pump stations	length of force mains		length of gravity mains		# of manholes
						bike	bike	bus	bus						
ft	miles	count	sq ft	acres	count	ft	miles	ft	miles	count	ft	miles	ft	miles	count
585,308	110.85				112	68,102	12.90	155,479	29.45	14	22,987	4.35	464,519	87.98	1,453
147	0.03	1	5,087	0.12	0	0	0.00	0	0.00	0	0	0.00	504	0.10	0
438	0.08	1	15,713	0.36	0	0	0.00	0	0.00	1	4	0.00	563	0.11	1
1,569	0.30	1	21,527	0.49	0	168	0.03	0	0.00	1	203	0.04	1,440	0.27	4
2,749	0.52	1	21,527	0.49	0	498	0.09	0	0.00	1	357	0.07	2,257	0.43	7
4,903	0.93	4	63,853	1.47	0	667	0.13	0	0.00	3	564	0.11	4,764	0.90	12
15,863	3	1	12,831	0	1	6,122	1	3,632	1	1	246	0	13,773	3	48
15,863	3.00	1	12,831	0.29	1	6,122	1.16	3,632	0.69	1	246	0.05	13,773	2.61	48
147	0.03	1	5,087	0.12	0	0	0.00	0	0.00	0	0	0.00	504	0.10	0
291	0.06	0	10,626	0.24	0	0	0.00	0	0.00	1	4	0.00	59	0.01	1
1,130	0.21	0	5,814	0.13	0	168	0.03	0	0.00	0	199	0.04	877	0.17	3
1,181	0.22	0	0	0.00	0	330	0.06	0	0.00	0	154	0.03	816	0.15	3
2,749	0.52	1	21,527	0.49	0	498	0.09	0	0	1	357	0.07	2,257	0.43	7
15,863	3.0	1	12,831	0.29	1	6,122	1.16	3,632	1	1	246	0.05	13,773	2.61	48

Water Supply						Stormwater			
length of water mains		Water Treatment Buildings (former WDR)	# of wells	# of vaults	# of hydrants	length of storm drain pipe		# of storm drains	# of perc ponds (pond locations not lots)
ft	miles	count	count	count	count	ft	miles	count	count
564,077	106.83	1	4	?	921	41,562	7.87	568	76
173	0.03	1	1	1	0	0	0.00	0	0
236	0.04	1	1	1	0	0	0.00	0	0
832	0.16	1	1	1	3	0	0.00	0	0
1,013	0.19	1	1	1	3	0	0.00	0	0
2,255	0.43	4	4	4	6	0	0.00	0	0
12,955	2	0	0	0	21	2,774	1	25	10
12,955	2.45	0	0	0	21	2,774	0.53	25	10

173	0.03	1	1	1	0	0	0.00	0	0
63	0.01	0	0	0	0	0	0.00	0	0
596	0.11	0	0	0	3	0	0.00	0	0
181	0.03	0	0	0	0	0	0.00	0	0
1,013	0.19	1	1	1	3	0	0	0	0
12,955	2.45	0	0	0	21	2,774	1	25	10

Public Access									Hazardous Materials Sites
# of access locations	length of trail								# of sites by type
	VERTICAL BEACH ACCESS		LATERAL (BEACH)		ALL OTHER DEDICATED WALKING TRAIL		TOTAL OF ALL TYPES OF TRAIL		UST (Underground Storage Tank)
count	ft	miles	ft	miles	ft	miles	ft	miles	count
7	6,458	1.22	8,710	1.65	165,628	31.37	180,796	31.37	
1	1,913	0.36	16,880	3.20	0	0.00	10,623.51	2.01	0
1	2,282	0.43	16,880	3.20	0	0.00	10,991.86	2.08	0
1	2,827	0.54	16,880	3.20	1,012	0.19	12,548.95	2.38	0
2	3,365	0.64	16,880	3.20	2,289	0.43	14,363.57	2.72	0
5	10,387	1.97	67,519	12.79	3,301	0.63	48,527.89	9.19	0
0	0	0	0	0	4,808	1	4,808	1	1
0	0	0.00	0	0.00	4,808	0.91	4,808.43	0.91	1

1	1,913	0.36	16,880	3.20	0	0.00	10,623.51	2.01	0
0	368	0.07	0	0.00	0	0.00	368.35	0.07	0
0	545	0.10	0	0.00	1,012	0.19	1,557.09	0.29	0
1	538	0.10	0	0.00	1,277	0.24	1,814.62	0.34	0
2	3,365	0.64	16,880	3.20	2,289	0.43	14,364	2.72	0
0	0	0	0	0	4,808	0.91	4,808	0.91	1

Sensitive Habitat					
Dunes - Least Disturbed		Dunes - Potential & Known Rare Plant Species Localities		Dunes - of all types	
sq ft	acres	sq ft	acres	sq ft	acres
20,062,766	461	1,380,966	32	21,443,731	492
2,065,026	47.41	95,930	2.20	2,160,956	50
2,763,633	63.44	105,736	2.43	2,869,369	66
4,138,465	95.01	142,433	3.27	4,280,899	98
6,452,177	148.12	262,093	6.02	6,714,270	154
15,419,301	353.98	606,192	13.92	16,025,494	368
345,123	8	162,783	4	507,915	12
345,123	7.92	162,783	3.74	507,915	12
2,065,026	47.41	95,930	2.20	2,160,956	49.61
698,607	16.04	9,807	0.23	708,413	16.26
1,374,833	31.56	36,697	0.84	1,411,530	32.40
2,313,712	53.12	119,660	2.75	2,433,371	55.86
6,452,177	148.12	262,093	6.02	6,714,270	154.14
345,123	7.92	162,783	3.74	507,915	11.66

APPENDIX

B

Land Use Plan Definitions

The following terms are used in the City of Marina Coastal Hazards and Sea Level Rise Chapter:

- **Adaptation:** Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which minimizes harm or takes advantage of beneficial opportunities.
- **Armor:** To fortify a structure or topographical feature to protect it from the effects of wave action, erosion and other natural forces (e.g., constructing a wall to armor the base of a sea cliff), or to construct a feature (e.g., a seawall, dike, or levee) to protect other resources (e.g., development or agricultural land) from flooding, erosion, or other hazards. The term soft armoring refers to a non-permanent, relatively short-term armoring (e.g., temporary sand bags, vegetated berms).
- **Climate Change:** A shift from the normal climate weather patterns associated with a place, whether due to natural causes or as a result of human activity, such as the burning of fossil fuels and the release of greenhouse gases (GHGs).
- **Coastal Act:** The California Coastal Act of 1976, California Public Resources Code §30000 et seq., as amended.
- **Coastal Erosion**: Loss of sand, sediment, vegetation, or soil in the dunes or cliffs along the coast caused by wave attack. Erosions may also be caused by wind although this was not analyzed as part of the erosion estimates for the Marina coastline.
- **Coastal Hazard:** Including, but not limited to erosion, episodic and long-term shoreline retreat and coastal erosion, flooding, storm waves, tsunami, landslides, bluff and geologic instability, and the interaction of same, and all as impacted by sea level rise.
- **Coastal Resource:** A general term used to refer to those resources addressed in Chapter 3 of the California Coastal Act, including the ocean, beaches, wetlands, agricultural lands, and other coastal habitats; certain types of coastal development; public access and recreation opportunities; cultural, archaeological, and paleontological resources; and scenic and visual resources. Coastal resources also include but are not limited to public access and public access facilities and opportunities, recreation areas and recreational facilities and opportunities (including for recreational water-oriented activities), lower cost visitor serving facilities (including lower cost accommodations), coastal-dependent and coastal-related uses, public views, natural landforms, marine resources, watercourses (e.g., rivers, streams, creeks, etc.), and their related corridors, water bodies (e.g. wetlands, estuaries, lakes, etc.), and their related uplands, groundwater resources, biological resources, environmentally sensitive habitat areas, agricultural lands and archeological and paleontological resources.

- **Coastal Zone:** That land and water area of the State of California from the Oregon border to the border of the Republic of Mexico, specified on the maps identified and set forth in Section 17 of that chapter of the Statutes of the 1975-76 Regular Session enacting this division, extending seaward to the state's outer limit of jurisdiction, including all offshore islands, and extending inland generally 1,000 yards from the mean high tide line of the sea. In significant coastal estuarine, habitat, and recreational areas it extends inland to the first major ridgeline paralleling the sea or five miles from the mean high tide line of the sea, whichever is less, and in developed urban areas the zone generally extends inland less than 1,000 yards. The Coastal Zone does not include the area of jurisdiction of the San Francisco Bay Conservation and Development Commission, established pursuant to Title 7.2 (commencing with §66600) of the Government Code, nor any area contiguous thereto, including any river, stream, tributary, creek, or flood control or drainage channel flowing into such area.

- **Development:** The term "development" is defined in the Coastal Act and is synonymous with "new development." The term is broadly defined to include (among others) proposed construction of buildings, or divisions of land. Specifically, in compliance with Public Resources Code §30106, "development" means "on land, in or under water, the placement or erection of any solid material or structure; discharge or disposal of any dredged material or of any gaseous, liquid, solid, or thermal waste; grading, removing, dredging, mining, or extraction of any materials; construction, reconstruction, demolition, or alteration in the size of any structure, including any facility of any private, public, or municipal utility; change in the density or intensity of use of land, including subdivision in compliance with the Map Act, and any other division of land, except where the land division is brought about in connection with the purchase of the land by a public agency for public recreational use; change in the intensity of use of water, or of access to water; and the removal or harvesting of major vegetation other than for agricultural purposes, and kelp harvesting."

  For purposes of these Coastal Hazards policies, "development" shall be synonymous with "new development," and includes additions to existing structures (whereby these policies apply only to the addition itself and not the entire structure) as well as redevelopment (whereby these policies apply to the entire structure as if it were new).

  See also "Redevelopment."

- **Environmentally Sensitive Habitat Area (ESHA):** Any area of land or water in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments (Public Resource Code §30107.5). In the Marina coastal zone, these areas include, but are not limited to, all beach and dune

habitat, including dunes that are disturbed/degraded, or existing in isolated fragments and all wetland and watercourse habitats.

- **Feasible:** Capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors.
- **Land Use:** The purpose for which land or a structure is designed, arranged, intended, occupied, or maintained.
- **Land Use Plan (LUP):** The Land Use Plan is defined as "the relevant portion of a local government's general plan, or local coastal element which are sufficiently detailed to indicate the kinds, location, and intensity of land uses, the applicable resource protection and development policies and, where necessary, a listing of implementing actions." (Public Resource Code §30108.5)
- **Local Coastal Program (LCP):** An LCP is a program for the use of property within the Coastal Zone. An LCP includes "the Land Use Plan, land use regulation maps, and specific implementing regulations such as coastal resource protection standards, which have been adopted by the local government and certified by the California Coastal Commission to implement the provisions and policies of the Coastal Act by the local governments." (Public Resource Code §30108.6).
- **Natural Disaster:** A natural event such as a flood, earthquake, or hurricane that causes great damage or loss of life.

- **Public Access:** The right or privilege of citizens to visit or view an area or resource.
- **Redevelopment:** A structure shall be considered redeveloped, when such development consists of alteration of 50 percent or more of the major structural components, including exterior walls and roof structure of such development. See also "Development."
- **Repair and Maintenance:** Repair and maintenance activities are defined by the California Code of Regulations (CCR). CCR § 13252(b) states that unless destroyed by natural disaster, the replacement of 50 percent or more of a structure is not repair and maintenance under Coastal Act Section 30610(d) but instead constitutes a replacement (or redeveloped) structure requiring a coastal development permit.

  See also "Development" and "Redevelopment"
- **Sea Level Rise:** Gradual and long-term elevation of sea level can change, both globally and locally, due to (a) changes in the shape of the ocean basins, (b) changes in the total mass of water and (c) changes in water density. Factors leading to sea level rise under

global warming include both increases in the total mass of water from the melting of land-based snow and ice, and changes in water density from an increase in ocean water temperatures and salinity changes. Relative sea level rise occurs where there is a local increase in the level of the ocean measured over time at established/representative local tidal gauges relative to the land, which might be due to ocean rise and/or land level subsidence.

- **Sensitive Coastal Resource Areas:** An area in which the coastal resources, including scenic qualities and the views of scenic landscapes, and/or biological resources, are considered especially valuable.
- **Shoreline Protective Device**: Constructed features, including but not limited to, seawalls, revetments, breakwaters, groins, dune stabilization devices, and piers/caisson foundation systems built in a way, and for the purpose of, protecting land or structures or other features against sea level rise, erosional forces and other coastal hazards.
- **Significant Adverse Environmental Impact**: A substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project, including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance. An economic or social change by itself shall not be considered a significant effect on the environment. A social or economic change related to a physical change may be considered in determining whether the physical change is significant. (CEQA Guidelines, 14 California Code of Regulations §15382).
- **Wetland:** Defined by §30121 of the Coastal Act as "lands within the Coastal Zone which may be covered periodically or permanently with shallow water and include saltwater marshes, freshwater marshes, open or closed brackish water marshes, swamps, mudflats, and fens." The definition of wetland is further detailed by §13577 (b)(1) of the California Code of Regulations as land where "the water table is at, near, or above the land surface long enough to promote the formation of hydric soils or to support the growth of hydrophytes, and shall also include those types of wetlands where vegetation is lacking and soil is poorly developed or absent as a result of frequent and drastic fluctuations of surface water levels, wave action, water flow, turbidity or high concentrations of salts or other substances in the substrate. Such wetlands can be recognized by the presence of surface water or saturated substrate at some time during each year and their location within, or adjacent to, vegetated wetlands or deep-water habitats."

APPENDIX

C

Coastal Act Policies Relevant to Sea Level Rise and Coastal Hazards

Appendix C. Coastal Act Polices that May be Considered When Evaluating Sea Level Rise and Coastal Hazards

Article	California Coastal Act Section	Topic	Policy
Legislative Findings Relating to Sea Level Rise			
NA	Section 30006.5	Legislative findings and declarations; technical advice and recommendations)	The Legislature further finds and declares that sound and timely scientific recommendations are necessary for many coastal planning, conservation, and development decisions and that the commission should, in addition to developing its own expertise in significant applicable fields of science, interact with members of the scientific and academic communities in the social, physical, and natural sciences so that the commission may receive technical advice and recommendations with regard to its decision making, especially with regard to issues such as coastal erosion and geology, marine biodiversity, wetland restoration, the question of sea level rise, desalination plants, and the cumulative impact of coastal zone developments.
Public Access and Recreation			
2 Public Access	Section 30210	Access; recreational opportunities; posting	In carrying out the requirement of Section 4 of Article X of the California Constitution, maximum access, which shall be conspicuously posted, and recreational opportunities shall be provided for all the people consistent with public safety needs and the need to protect public rights, rights of private property owners, and natural resource areas from overuse.
2 Public Access	Section 30211	Development not to interfere with access	Development shall not interfere with the public's right of access to the sea where acquired through use or legislative authorization, including, but not limited to, the use of dry sand and rocky coastal beaches to the first line of terrestrial vegetation.
2 Public Access	Section 30212	New development projects)	(a) Public access from the nearest public roadway to the shoreline and along the coast shall be provided in new development projects except where: (1) it is inconsistent with public safety, military security needs, or the protection of fragile coastal resources, (2) adequate access exists nearby, or (3) agriculture would be adversely affected. Dedicated accessway shall not be required to be opened to public use until a public agency or private association agrees to accept responsibility for maintenance and liability of the accessway.
2 Public Access	Section 30214	Implementation of public access policies; legislative intent	(a) The public access policies of this article shall be implemented in a manner that takes into account the need to regulate the time, place, and manner of public access depending on the facts and circumstances in each case including, but not limited to, the following: (1) Topographic and geologic site characteristics. (2) The capacity of the site to sustain use and at what level of intensity. (3) The appropriateness of limiting public access to the right to pass and repass depending on such factors as the fragility of the natural resources in the area and the proximity of the access area to adjacent residential uses.

Article	California Coastal Act Section	Topic	Policy
			(4) The need to provide for the management of access areas so as to protect the privacy of adjacent property owners and to protect the aesthetic values of the area by providing for the collection of litter. (b) It is the intent of the Legislature that the public access policies of this article be carried out in a reasonable manner that considers the equities and that balances the rights of the individual property owner with the public's constitutional right of access pursuant to Section 4 of Article X of the California Constitution. Nothing in this section or any amendment thereto shall be construed as a limitation on the rights guaranteed to the public under Section 4 of Article X of the California Constitution. c) In carrying out the public access policies of this article, the commission and any other responsible public agency shall consider and encourage the utilization of innovative access management techniques, including, but not limited to, agreements with private organizations which would minimize management costs and encourage the use of volunteer programs.
3 Recreation	Section 30220	Protection of certain water-oriented activities	Coastal areas suited for water-oriented recreational activities that cannot readily be provided at inland water areas shall be protected for such uses.
3 Recreation	Section 30221	Oceanfront land; protection for recreational use and development	Oceanfront land suitable for recreational use shall be protected for recreational use and development unless present and foreseeable future demand for public or commercial recreational activities that could be accommodated on the property is already adequately provided for in the area.
3 Recreation	Section 30223	Upland areas	Upland areas necessary to support coastal recreational uses shall be reserved for such uses, where feasible.
Wetlands and Environmentally Sensitive Resources			
NA	Section 30121	Definition of "Wetland" [1]	"Wetland" means lands within the coastal zone which may be covered periodically or permanently with shallow water and include saltwater marshes, freshwater marshes, open or closed brackish water marshes, swamps, mudflats, and fens.
NA	Section 30107.5	Definition of "Environmentally sensitive area"	"Environmentally sensitive area" means any area in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments.
4 Marine Environment	Section 30231	Biological productivity; water quality	The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored…
4 Marine Environment	Section 30233	Diking, filling or dredging; continued movement of sediment and nutrients	(a) The diking, filling, or dredging of open coastal waters, wetlands, estuaries, and lakes shall be permitted in accordance with other applicable provisions of this division, where there is no feasible less environmentally damaging alternative, and where feasible mitigation measures have been provided to minimize adverse environmental effects…
5 Land Resources	Section 30240	Environmentally sensitive habitat areas; adjacent developments	(a) Environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on those resources shall be allowed within those areas. (b) Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited

Article	California Coastal Act Section	Topic	Policy
			and designed to prevent impacts which would significantly degrade those areas, and shall be compatible with the continuance of those habitat and recreation areas.
Marine Resources			
4 Marine Environment	Section 30230	Marine resources; maintenance	Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.
4 Marine Environment	Section 30231	Biological productivity; water quality	The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment, controlling runoff, preventing depletion of ground water supplies and substantial interference with surface waterflow, encouraging waste water reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams.
4 Marine Environment	Section 30233	Diking, filling or dredging; continued movement of sediment and nutrients	(a) The diking, filling, or dredging of open coastal waters, wetlands, estuaries, and lakes shall be permitted in accordance with other applicable provisions of this division, where there is no feasible less environmentally damaging alternative, and where feasible mitigation measures have been provided to minimize adverse environmental effects… (d) Erosion control and flood control facilities constructed on watercourses can impede the movement of sediment and nutrients that would otherwise be carried by storm runoff into coastal waters. To facilitate the continued delivery of these sediments to the littoral zone, whenever feasible, the material removed from these facilities may be placed at appropriate points on the shoreline in accordance with other applicable provisions of this division, where feasible mitigation measures have been provided to minimize adverse environmental effects. Aspects that shall be considered before issuing a coastal development permit for these purposes are the method of placement, time of year of placement, and sensitivity of the placement area. (Amended by: Ch. 673, Stats. 1978; Ch. 43, Stats. 1982; Ch. 1167, Stats. 1982; Ch. 454, Stats. 1983; Ch. 294, Stats. 2006.)
Coastal Development			
4 Marine Environment	Section 30235	Construction altering natural shoreline	Revetments, breakwaters, groins, harbor channels, seawalls, cliff retaining walls, and other such construction that alters natural shoreline processes shall be permitted when required to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion, and when designed to eliminate or mitigate adverse impacts on local shoreline sand supply. Existing marine structures causing water stagnation contributing to pollution problems and fishkills should be phased out or upgraded where feasible.

Article	California Coastal Act Section	Topic	Policy
6 Development	Section 30250	Location; existing developed area	(a) New residential, commercial, or industrial development, except as otherwise provided in this division, shall be located within, contiguous with, or in close proximity to, existing developed areas able to accommodate it or, where such areas are not able to accommodate it, in other areas with adequate public services and where it will not have significant adverse effects, either individually or cumulatively, on coastal resources. In addition, land divisions, other than leases for agricultural uses, outside existing developed areas shall be permitted only where 50 percent of the usable parcels in the area have been developed and the created parcels would be no smaller than the average size of surrounding parcels. (b) Where feasible, new hazardous industrial development shall be located away from existing developed areas. (c) Visitor-serving facilities that cannot feasibly be located in existing developed areas shall be located in existing isolated developments or at selected points of attraction for visitors. (Amended by Ch. 1090, Stats. 1979.)
6 Development	Section 30251	Scenic and visual qualities	The scenic and visual qualities of coastal areas shall be considered and protected as a resource of public importance. Permitted development shall be sited and designed to protect views to and along the ocean and scenic coastal areas, to minimize the alteration of natural land forms, to be visually compatible with the character of surrounding areas, and, where feasible, to restore and enhance visual quality in visually degraded areas...
6 Development	Section 30253	Minimization of adverse impacts	New development shall do all of the following:: (a) Minimize risks to life and property in areas of high geologic, flood, and fire hazard. (b) Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.
Public Works Facilities			
NA	Section 30114	Public work facilities	Public works facilities include: (a) All production, storage, transmission, and recovery facilities for water, sewerage, telephone, and other similar utilities owned or operated by any public agency or by any utility subject to the jurisdiction of the Public Utilities Commission, except for energy facilities. (b) All public transportation facilities, including streets, roads, highways, public parking lots and structures, … (c) All publicly financed recreational facilities, all projects of the State Coastal Conservancy, and any development by a special district.

Article	California Coastal Act Section	Topic	Policy
Greenhouse Gas Emissions Reduction			
6 Development	Section 30250(a)	Location, existing developed areas states	(a) New residential, commercial, or industrial development, except as otherwise provided in this division, shall be located within, contiguous with, or in close proximity to, existing developed areas able to accommodate it or, where such areas are not able to accommodate it, in other areas with adequate public services and where it will not have significant adverse effects, either individually or cumulatively, on coastal resources. In addition, land divisions, other than leases for agricultural uses, outside existing developed areas shall be permitted only where 50 percent of the usable parcels in the area have been developed and the created parcels would be no smaller than the average size of surrounding parcels.
6 Development	Section 30252	Maintenance and enhancement of public access	The location and amount of new development should maintain and enhance public access to the coast by (1) facilitating the provision or extension of transit service, (2) providing commercial facilities within or adjoining residential development or in other areas that will minimize the use of coastal access roads, (3) providing non-automobile circulation within the development, (4) providing adequate parking facilities or providing substitute means of serving the development with public transportation, (5) assuring the potential for public transit for high intensity uses such as high-rise office buildings, and by (6) assuring that the recreational needs of new residents will not overload nearby coastal recreation areas by correlating the amount of development with local park acquisition and development plans with the provision of onsite recreational facilities to serve the new development.
6 Development	Section 30253(d)	Minimization of adverse impacts)	New Development shall: (d) Minimize energy consumption and vehicle miles traveled….

TABLE OF CONTENTS

Coastal Hazards and Sea Level Rise Implementation Plan

Notes: *Highlighted policy references indicate which policy is implemented (this is a temporary tracking convention). May consider adding this as a new "Coastal Hazards" section to the existing IP after Habitat Protection section or (and probably preferred) add a header in the Existing IP referencing this as a standalone document. Language in the City's current IP regarding protective structures (i.e., page 3 on) will need to be deleted.*

COASTAL HAZARDS AND SEA LEVEL RISE

Purpose

In order to protect and preserve Marina's natural coastline and valued coastal resources, to ensure public safety and welfare from coastal hazards, to maintain consistency with the LCP's Land Use Plan (LUP), and to ensure no shoreline protective devices are utilized in the future, development shall conform to all applicable Land Use Plan Coastal Hazards and Sea Level Rise policies and the following requirements. (HAZ-1)

Coastal Hazard Evaluation Updates

A. The City shall review the existing coastal hazards sea level rise vulnerability assessment at least every ten years after certification of the LCP (and in response to significant storm events resulting in erosion). The evaluation shall summarize the current state of the science on the potential rates and effects of sea level rise and coastal hazards on Marina's shoreline, including a review of the Monterey tide gage, changes in topography, erosion rates following cessation of the CEMEX sand mine and any more recent coastal hazard modeling that may identify vulnerable areas, structures, facilities, and resources, with a focus on sensitive coastal resource areas. The review evaluation will result in a determination as to whether there is a need to modify policies or implementation in order to better address the impacts of sea level rise and other coastal hazards, particularly those related to coastal erosion. It will also identify current status of measurable triggers such as the distance of the dune crest to existing development. Updates to the LCP, including through any vulnerability assessment, shall use the best available science for estimates of expected sea level rise and potential resultant impacts. This evaluation should consider new data, models and information but should determine the best available science based on expertise HAZ-2.

Regional Considerations

A. Within two years of certification of the Coastal Hazards and Sea Level Rise update of the LCP, the Marina Fire Department shall update the *City of Marina Tsunami Incident Response Plan* to clearly identify a warning system and procedures for protection of life and property in coastal areas that are subject to storm and tsunami hazard, including means of informing visitors to the shoreline and oceanfront hotels of the potential danger of large waves and evacuation routes. (HAZ-3)

B. The City shall work with the Marina Coast Water District to identify appropriate adaptation strategies to avoid dune erosion hazards and support their efforts to pursue options for removal of the Marina Coast Water District's former wastewater treatment plant and restoration of the site. (HAZ-8)

C. The City shall work with State Parks to consider and pursue options such as, grants or recreation bond measures, update of the *Marina State Beach Master Plan* and to relocate the existing State Parks parking and restroom structures and infrastructure at the present location to a site outside of the projected erosion hazard zones, consistent with LUP requirements. (HAZ-9)

D. Planned and existing shoreline access points must be sited, designed, maintained, and relocated as necessary to minimize impacts to dune vegetation from human impacts, runoff, and wind erosion and avoid contributing to dune erosion. (HAZ-10)

Development Considerations

A. Existing or new development in areas subject to tsunami hazards shall prepare a tsunami preparedness plan that describes evacuation procedures, evacuation route signage, and other protocols for addressing a potential tsunami event. Within one year of certification of the Coastal Hazards and Sea Level Rise update of the LCP, the City shall adopt an ordinance or resolution requiring existing development to prepare such a plan. (HAZ-3)

B. Development in shall be sited and designed to minimize risks to life and property and assure stability and structural integrity over the life of the development. (HAZ-4)

C. Development shall not create or contribute significantly to erosion, geologic instability, substantially alters natural landforms, or adversely alters local shoreline sand supply. Adverse alterations to sand supply may include, but are not limited to, accelerated erosion, loss of sand beach area through physical encroachment, obstruction of new beach formation in areas where the bluff/shoreline would have otherwise naturally eroded, or increased the loss of sand-generating bluff/shoreline sediments that would have entered the sand supply system absent the development. (HAZ-5)

D. Shoreline protective devices are prohibited in the Marina coastal zone. (HAZ-6)

E. As a condition of approval for the issuance of all Coastal Development Permits for any development that at some point during its lifetime may be subject to coastal hazards, the Applicant shall record a deed restriction against the properties involved in the application that acknowledges the property and development may be subject to coastal hazards, that access to the development may be affected, that shoreline protective devices are prohibited to protect such property and development, and that waives any right that may exist to construct such shoreline protective devices. Property owners in the future facing coastal erosion agree to remove threatened development and restore affected areas, if necessary, subject to the requirements to prepare a removal and restoration plan. This, or similar language, should be included in a waiver and as conditions of approval, including waiving any responsibility of the City to maintain any property, access, or structures at risk to coastal hazards.(HAZ-6)

F. New development will assume all risk and liabilities related to coastal hazards and acknowledge that the City will not guarantee future access and infrastructure to hazard impacted areas as identified on Figure 1 of the LCP Land Use Plan. (HAZ-7, #4)

G. Repair and maintenance, renovations, activities and safety improvements that do not result in an addition to, or enlargement or expansion of, the object of such repair or maintenance activities shall not require a coastal development permit with the exception of those classes of repair and maintenance that involve a risk of a significant adverse environmental impact as identified in 17.43.070 Exemptions (D).

H. Any existing structures that are substantially destroyed by fire, earthquake, tsunami or other natural disaster may be reconstructed substantially as it was prior to such destruction as identified in 17.43.070 Exemptions (G) subject to current building standards and including 50 year erosion setbacks.

Applications for All Development Potentially Subject to Coastal Hazards

The following shall be required for any application for development within the City of Marina Coastal Zone:

A. **Initial Coastal Hazards Assessment.** The applicant shall request an initial site assessment screening from the City, so that City staff may determine whether the site may be subject to coastal hazards over its lifetime (generally over at least the next 50 years).

   The screening shall include a review of CDPs issued, or applied for, at the subject site and immediate vicinity; and be based on all readily available information and the best available science including technical reports, resource maps, aerial

photographs, site inspections, and the coastal hazard map in the City's LCP Land Use Plan (Figure 1, Coastal Hazards with Areas of Sea Level Rise). Maps can be used as a resource for identification of coastal hazard areas; however, absence of mapping cannot alone be considered absence of hazards, and local site conditions must be examined at the time of coastal permit application using the best available science and topography. (HAZ-7)

B. **Coastal Hazards Report.** Where the initial site assessment reveals that the proposed development is mapped within the City's LCP Land Use Plan Figure 1(Coastal Hazards with Areas of Sea Level Rise), and/or otherwise may be subject to coastal hazards over the next 50 years, a site specific Coastal Hazards Report (Report) shall be prepared. The Report shall at a minimum provide for the following:

1. **Report Purpose.** The Report shall be prepared by a qualified geologist/engineer/geomorphologist to ensure that such development can be built and maintained in a manner consistent with the City's coastal hazards policies and with the greatest protection of coastal resources for the life of the development, including no future construction of shoreline protective devices. (HAZ-7, #3)

   The Report shall use the best available science to identify the potential impacts of erosion, episodic and long-term shoreline retreat and coastal erosion, flooding, storm waves, tsunami, landslides, bluff and geologic instability, and the interaction of same, and all as impacted by sea level rise over the life of the development. The information gathered should address multiple future time horizons (e.g., 2050, 2100) or multiple sea level rise elevation scenarios, as appropriate and feasible. The Report shall recommend any mitigation measures or modifications to the project that are needed to ensure that the project is consistent with all applicable Land Use Plan Coastal Hazards and Sea Level Rise policies. (HAZ-2)

2. **Report Content**. The Report shall, at a minimum, contain the following sections:

   a. Summary

   b. Geology of the Project Area

   c. Wave, Tide, and Current Trends of Sea Level Rise

   d. Erosion Trends and Storm Impacts in and around the Project Area

   e. Seasonal Beach Profiles and Trends

   f. Existing and Future Projections of impacts from Coastal Hazards on the Proposed Project

g. Potential Adaptation or mitigation Strategies to Avoid Coastal Hazard Impacts

h. Description of Strategies that Have Been Identified and Prioritized to Avoid or Minimize Coastal Hazard Impacts

i. Secondary Adaptation Impacts (discussion of any potential secondary or adjacent impacts of adaptation strategies on ESHA, adjacent properties or coastal resources)

j. Conclusions and Recommendations

k. Coordination with Other Agencies, Groups, or Consultants

l. Report Preparer's Qualifications

k. References

3. **Coastal Hazards Analysis.** The Report shall at a minimum document the following addressing existing conditions, near-term (3 to 5 years) conditions, and future time horizons (e.g., 2050, 2100) or multiple sea level rise elevation scenarios based on the latest State Guidance (currently CCC and OPC 2018 (HAZ-2)

a. Regional and local geologic setting, including topography, geomorphology, natural landforms, soil/rock types, thickness of soil or depth to bedrock, and other relevant properties such as erosion potential.

b. Information about potential coastal hazards at the site, including normal and maximum tide elevations, wave conditions (including maximum expected wave height, storm surge and frequency/magnitude of wave/tidal surge), total water level elevation (including storm wave runup from a 100-year event during an El Niño and spring high tide, and potential erosion that could occur from long term sea level rise and extreme storm related erosion).

c. Long-term average annual erosion rates.

d. Recession of the dune crest associated with a one percent annual chance total water level and associated episodic or rapid erosion, based on recent observations from the project site or nearby areas of comparable geology.

e. Alterations to landforms, or local shoreline sand supply caused by the development. (HAZ-5)

f. Ground and surface water conditions and variations, including hydrologic changes caused by the development (e.g., introduction of sewage effluent and irrigation water to the groundwater system, and alterations in surface drainage) as well as potential changes to extent and duration of elevated groundwater daylighting.

g. Existing conditions, expectations for the near-term (three to five years) changes to the site, considering current erosion rates and related conditions (including wave and storm conditions), changes to the erosion and geomorphology from the cessation of the CEMEX sand mining, and projections of longer term changes from sea level rise.

h. Effect of the proposed development (including siting and design of structures, septic system, landscaping, drainage, and grading) and impacts of construction activity on the stability of the site and the adjacent area.

4. **Mitigation of Coastal Hazards Analysis.** The Report shall include a detailed analysis of strategies incorporated into the project, and any feasible alternative options, to avoid identified erosion/site stability hazards and ESHA. Strategies include, but are not limited to, consideration of additional building heights to reduce footprint, consistent with LCP visual resource and ESHA policies, and construction of suitable foundations that allow for structures to be relocated (HAZ-7, #1). At a minimum the analysis shall include the following:

   a. Evaluation of alternatives, that avoid hazards for proposed development, and/or relocation of any threatened structures; technical feasibility and an estimate of expected costs to be borne by the property owner to relocate; partial removal of threatened elements, with a clear analysis and estimate of how this would be accomplished; and site drainage controls and native plant revegetation.

   b. A combination of different proposed development alternatives should be considered to avoid identified erosion/site stability hazards when appropriate(e.g. use of erosion resistant vegetation, surface water controls, periodic sand nourishment, or the use of incremental adaptation responses tied to identified triggers, such as erosion measures or specific storm event impact).

   c. Identification of potential mitigation measures to address identified coastal resource impacts in each case.