

APPENDIX F

Coastal Resiliency Program



CITY OF HUNTINGTON BEACH

COASTAL RESILIENCY PROGRAM

DRAFT

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ATTACHMENTS

Attachment 1 – Summary of Coastal Resilience Strategies and Implementation Plan

1. INTRODUCTION

As a result of melting land ice, thermal ocean expansion, and coastal land subsidence, global sea levels have been observably rising since 1900; the rate of sea level rise is expected to increase through the twenty first century (NOAA 2015; NRC 2012). As sea levels continue to rise, portions of the City of Huntington Beach (City) and adjacent areas within the General Plan planning area (e.g., the Bolsa Chica Wetlands) will experience more frequent and severe coastal hazards that will test the community’s resilience. The City’s explicit sea level rise priorities are expressed in the Draft General Plan as follows:

Goal HAZ-2. Coastal environments be allowed to accommodate coastal changes and reduce coastal development impacts.

Policy HAZ-2.A. Promote appropriate land uses and development patterns within potential sea level rise flooding areas.

Policy HAZ-2.B. Implement priority measures to reduce and mitigate sea level rise impacts to property and infrastructure.

Policy HAZ-2.G. Increase the City’s understanding of potential vulnerabilities and impacts to infrastructure associated with changes in sea level elevation.

These policies are designed to inform and prepare the community for impacts associated with sea level rise to ensure that a short-term hazard event does not become a long-term community-wide disaster. The Draft General Plan also includes additional policies and programs that enhance coastal resilience in the face of expected sea level rise. Together, these goals and policies are the impetus for preparation of this Coastal Resiliency Program (CRP).

Coastal resilience refers to the ability of a community to “bounce back” after hazardous events such as flooding associated with extreme waves, water levels or runoff.
oceanservice.noaa.gov/facts/resilience.html

The CRP follows the completion of the City of Huntington Beach’s Sea Level Rise Vulnerability Assessment (Vulnerability Assessment) (M&N 2014), which outlines potential impacts from a range of sea level rise scenarios projected to the year 2100. Following guidance in the California Coastal Commission (CCC) Sea Level Rise Policy Guidance Document (CCC Guidance), adopted August 12, 2015, this CRP identifies coastal resilience strategies intended to reduce negative impacts and improve the community’s ability to prepare for, withstand, and recover from extreme coastal events. Strategies focus on improving resilience of the natural and built environments. The CCC Guidance is an advisory document meant to guide preparation of a local coastal program (LCP) or processing of a coastal development permit (CDP).

The City of Huntington Beach intends to complete and adopt the Draft General Plan prior to initiating an update to the LCP. Therefore, the CRP is a “bridge document” that links the General Plan to a future LCP update in an advisory manner that allows both documents to incorporate sea level rise considerations (consistent with CCC Guidance) into the planning process to achieve a common vision for a resilient community in 2040. As a result, some of the recommended



strategies and implementation steps described in this plan are addressed as policies or implementation programs within the Draft General Plan. Others are listed in the CRP, but not included in the Draft General Plan. These latter strategies and actions are more appropriately addressed in a future LCP update.

2. DESCRIPTION OF COASTAL HAZARDS

The Vulnerability Assessment (M&N 2014) analyzed the effects of sea level rise on the City's shoreline and inland waterways using the best available science and data, to determine potential coastal hazard zones in accordance with CCC Guidance. At the time of the study, the best available science for regional sea level rise projections was the publication "*Sea Level Rise for the Coasts of California, Oregon, and Washington: Past, Present and Future*" released by the National Research Council (NRC) in 2012 (CCC 2015, CO-CAT 2013). Sea level rise projections between 0.4 and 2.0 feet by year 2050 were used to map coastal hazards. The CRP summarizes the vulnerabilities identified for the 2050 planning horizon in the vulnerability assessment, as a conservative measure that encompasses the General Plan planning horizon of 2040, and to be consistent with time horizons used by the National Research Council to project future sea levels (CCC 2015).

The following is a brief description of the coastal hazards evaluated in the vulnerability assessment.

- Wave induced erosion and flooding

Over the long-term, rising sea level will cause landward migration (or retreat) of beaches and coastal bluffs. These long term profile changes in combination with an extreme wave event will increase potential for coastal erosion and flooding of assets along the shoreline. A combination of analytical methods and numerical models, described in the vulnerability assessment, were used to develop potential hazard zones for sea level rise projections in 2050.

- Tidal flooding of inland waterways

Sea level rise will impact the extent and frequency of tidal flooding in and around Huntington Harbour, the Bolsa Chica wetlands, and the Huntington Beach wetlands. Tidal flooding potential was evaluated by comparing a future projected water level with the existing coastal structure crest elevations (e.g., top of levees, seawalls, and bulkheads as shown in Figure 1). If the projected water level exceeded the estimated top of coastal structure elevation, then zones of potential flooding were mapped using one-foot contours generated from light detection and ranging (LiDAR) topographic data captured in October 2013.

- Flooding from extreme rainfall events

Sea level rise will increase the risk of flooding from extreme rainfall events in the lower reaches of the regional flood control channels. These channels have low invert elevations, relatively flat slopes, and are controlled at the downstream end by ocean water levels. Numerical modeling was performed to simulate the effects of sea level rise in addition to 100-year return period hydrographs (i.e., an extreme flood event that is expected to occur in a 100 year time period) for several major flood control channels in Huntington Beach. The results indicate sea level rise impacts to the flood profiles are greatest at the downstream end, and taper off in the upstream direction. For sea level rise projections in 2050, the flood profiles remained below the top-of-channel elevations.



The above listed coastal hazards established the criteria used to classify the coastal sea level rise hazard areas. These hazard areas were evaluated by separating the study area into three planning areas:

1. The Northern Planning Area (Huntington Harbour and Sunset Beach Shoreline)
2. The Central Planning Area (Bolsa Chica Wetlands and Bolsa Chica Shoreline)
3. The Southern Planning Area (Huntington Beach Wetlands, Huntington Bluffs, and Huntington Beach Shorelines)

These areas form the basis of the coastal aspect of the composite Sea Level Rise Hazard Areas illustrated in the Natural and Environmental Hazards Element of the Draft General Plan. The sea level rise hazard areas for year 2050 are shown in Figure 2 through Figure 4. These figures identify areas of coastal and inland waterway flooding. The inland flooding areas are separated into tidal and contingent flooding zones, which is based on the change in tidal flood hazards as a result of construction of the Shea Parkside project. The construction of the Shea Parkside project is expected to improve drainage conditions and an existing levee, thereby removing the contingent flooding area from the proposed Sea Level Rise Overlay zone. Therefore, this report does not specifically address vulnerabilities in this contingent flooding zone. If the proposed levee improvements are not implemented as planned, this contingent flooding zone would be vulnerable to tidal flooding in the 2050 time horizon, when sea levels are projected to rise up to 2 feet (NRC, 2012).

The sea level rise hazard areas were developed by combining wave induced and inland waterway flooding model results. These models used the best available sea level rise projections as inputs in conjunction with high resolution topographic data, asset data, and widely accepted engineering methods. The limits of these coastal hazard areas are approximate and based upon estimates and projections about future weather, tidal, ocean, offshore and onshore conditions. The impact of these future conditions on existing or contemplated developments or resources is difficult, complex and based on many assumptions. Accordingly, the model results, overlay areas and asset vulnerabilities are presented solely on the basis of the assumptions accompanying the estimates and projections and subject to the information and data available and used at the time of the study. While it provides a guideline for future planning purposes, it is recommended that the Vulnerability Assessment be updated on a five to ten year basis or as necessary to allow for the incorporation of new sea level rise science, monitoring results, and information on coastal conditions and as the condition of infrastructure and development changes, consistent with the CCC Guidance.

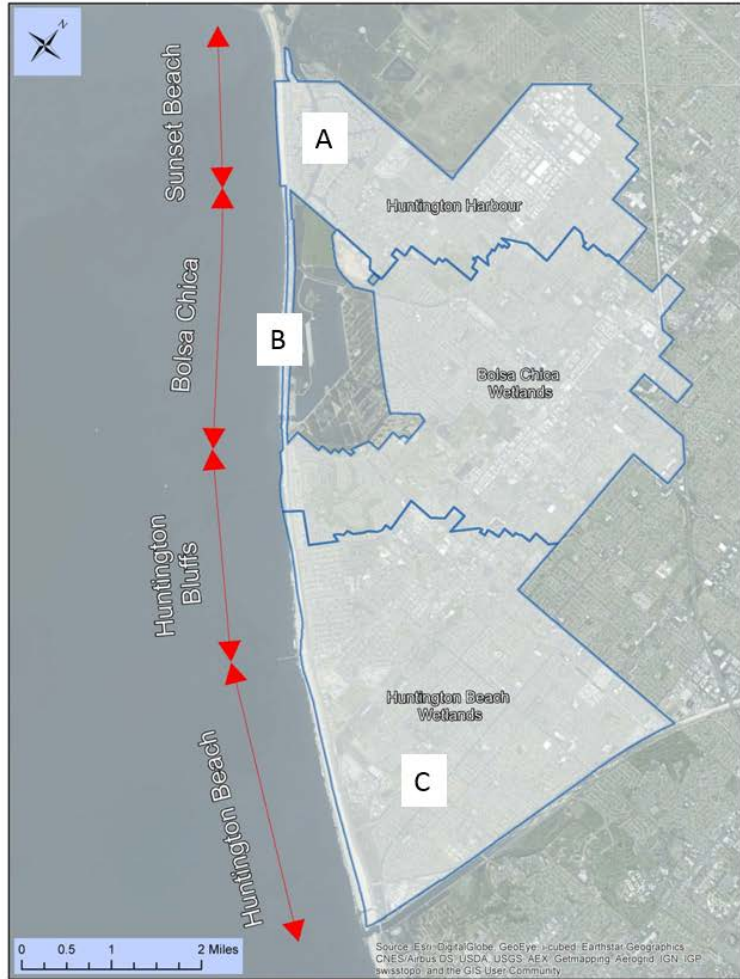


FIGURE 1
EXAMPLES OF INLAND WATERWAY COASTAL STRUCTURE EVALUATED FOR TIDAL FLOODING



FIGURE 2
2050 SEA LEVEL RISE HAZARD AREAS, NORTHERN PLANNING AREA

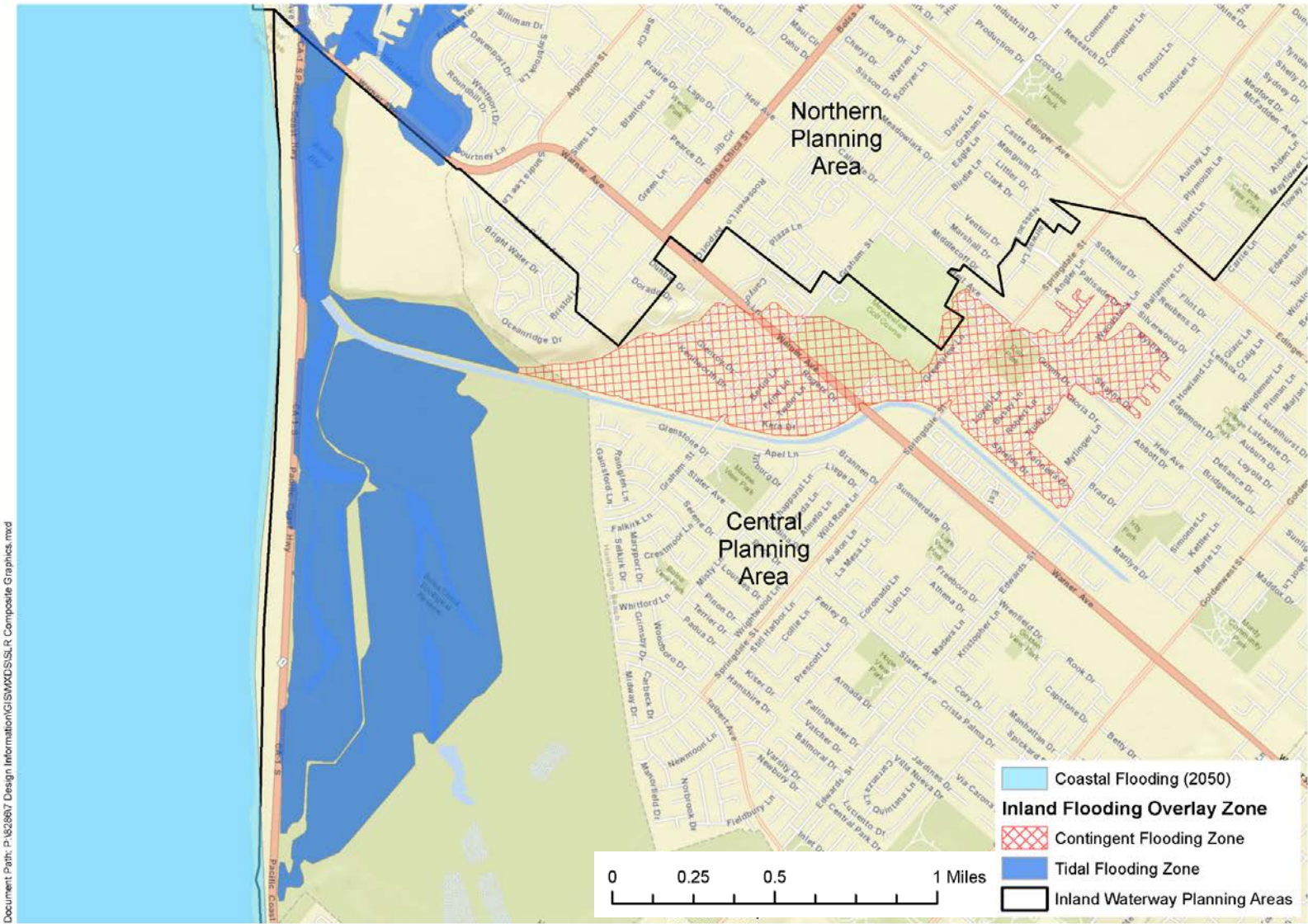


FIGURE 3
2050 SEA LEVEL RISE HAZARD AREAS, CENTRAL PLANNING AREA

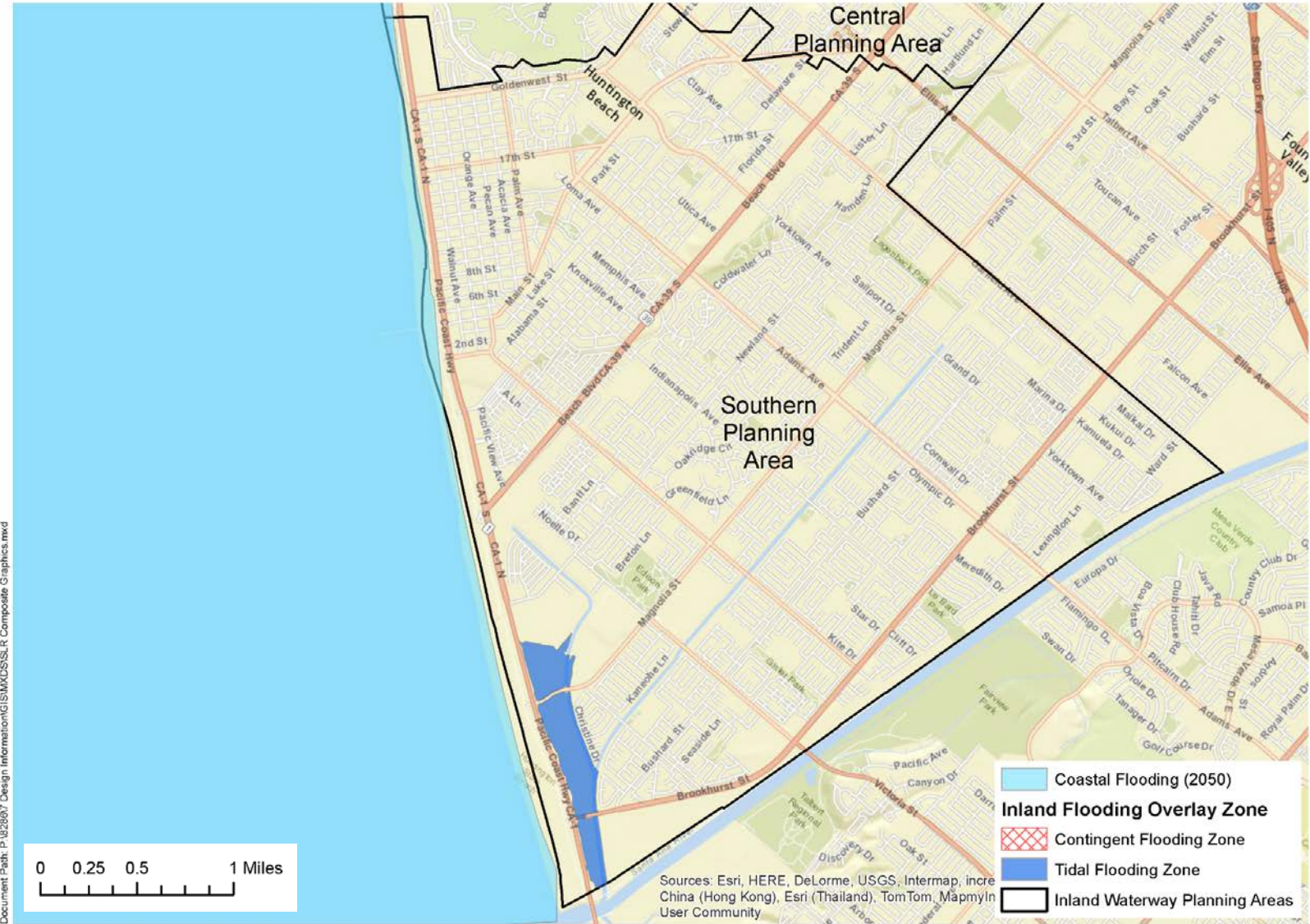


FIGURE 4
2050 SEA LEVEL RISE HAZARD AREAS, SOUTH PLANNING AREA

3. BASIS FOR COASTAL RESILIENCY STRATEGIES

Identification of vulnerabilities in the 2050 time horizon and review of policy guidance from the California Coastal Commission (CCC) and City provide the basis for selection of strategies to improve coastal resilience of the natural and built environments in the City of Huntington Beach. This section explains how the Vulnerability Assessment, the CCC Guidance, and the programs and policies from the Draft General Plan were used to develop the list of coastal resilience strategies presented in Section 4.

3.1. VULNERABILITY ASSESSMENT SUMMARY

After identifying coastal hazards described in Section 2, the Vulnerability Assessment evaluated vulnerabilities and risks for a range of asset categories. The Vulnerability Assessment highlighted the planning areas and asset categories at risk of impacts due to sea level rise.

The assets evaluated included transportation infrastructure (streets, roadways, parking lots), buildings (public & private), stormwater infrastructure, wastewater infrastructure, energy infrastructure, ecosystems, beaches, and coastal access and recreation facilities. The items evaluated in this report represent a best available inventory of assets at the time of this study; additional assets may be identified as part of future updates. The vulnerability of a given asset was determined by considering factors such as exposure, sensitivity and adaptive capacity to sea level rise impacts. A qualitative risk assessment was performed to account for the magnitude of impact (consequence) and the likelihood of that impact occurring (probability). The purpose of the risk assessment was to identify planning areas with important assets at risk in relatively short planning horizons (2030 to 2050).

Exposure: the degree to which a system or asset is exposed to SLR.

Sensitivity: the degree an asset would be impaired by the impacts of SLR.

Adaptive Capacity: the ability of an asset to respond to SLR, to moderate potential damages, to take advantage of opportunities, and to cope with the consequences.

The Northern Planning Area is considered a priority due to the large number of important assets at high risk of sea level rise-related impacts in 2050. Important assets in the Central and Southern Planning Areas are also at risk of sea level rise-related impacts in 2050. Potential projects that implement the strategies in this document may be phased based on the importance of assets at risk, availability of staff resources, and funding opportunities. Phasing and prioritization may change over time as result of the periodic reassessment of the City's vulnerability to sea level rise. A summary of vulnerabilities are provided in Table 1 below and described in more detail under each asset category in Section 4. The coastal resilience strategies presented in Section 4 are focused on addressing these asset vulnerabilities.

**TABLE 1
RISK ASSESSMENT BY PLANNING AREA**

Asset Category	Asset Vulnerabilities to Sea Level Rise in 2050 Time Horizon		
	Northern Planning Area	Central Planning Area	Southern Planning Area
Transportation Infrastructure	Safety hazard and service interruptions due to tidal flooding in Harbour and Sunset Beach areas	Safety hazard and service interruptions due to tidal flooding along PCH	Safety hazard and service interruptions due to tidal flooding at Brookhurst Street near PCH
Residential, Commercial, and Public Buildings	Building damage from tidal flooding around Harbour & Sunset Beach	None identified	Building damage from coastal flooding near HB Pier
Stormwater Infrastructure	None identified	None identified	None identified
Wastewater Infrastructure	Increased Infiltration & inflow, damage to pump stations	None identified	None identified
Energy Infrastructure	Flood damage to ground level & underground infrastructure and exposed connections	None identified	None identified
Ecosystems	None identified	Altered wetland habitats (Bolsa Chica)	Altered wetland habitats (Talbert & Magnolia marshes)
Beaches Recreation & Public Access	Increased erosion	Increased erosion, damage to trails along Bluffs	Increased erosion

3.2. STRATEGIES FROM CCC SEA LEVEL RISE POLICY GUIDANCE

The CCC Guidance is an advisory document designed to assist with developing sea level rise policy in the Coastal Zone consistent with the Coastal Act. The CCC Guidance provides a list of best practice adaptation strategies¹ that involve modifications to land use plans, regulatory changes, project modifications, or permit conditions that focus on avoidance and minimization of risk to coastal hazards and the protection of coastal resources. The list of strategies in the CCC

¹ The term “adaptation strategies” is used in the CCC Guidance. Elsewhere in this document the term coastal resilience strategies is used. Although the terminology is different, the strategy objectives are consistent.



Guidance is not intended to be a checklist for which each option must be addressed, nor is it an exhaustive list of all possible adaptation strategies. The CCC Guidance strategies are grouped into the following coastal resource categories:

- A. Coastal Development and Hazards
- B. Public Access and Recreation
- C. Coastal Habitats, Environmentally Sensitive Habitat Areas (ESHA), and Wetlands
- D. Agricultural Resources
- E. Water Quality and Supply
- F. Archaeological and Paleontological Resources
- G. Scenic and Visual Resources

The CCC Guidance-related strategies listed in Section 4 reflect those that are most relevant based on the vulnerability assessment findings. The City or the CCC may wish to consider other strategies from the guidance. Not all strategies presented will be adopted by the City as part of the Draft General Plan or future LCP update. Rather, the strategies are presented for consideration by the City and community stakeholders when drafting goals, programs and policies in these planning documents.

3.3. STRATEGIES FROM THE DRAFT GENERAL PLAN

The Draft General Plan includes goals, policies, and programs to address the challenges associated with coastal hazards, sea level rise, and a changing coastal environment. These goals, policies, and programs are consistent with the California Coastal Act and the CCC Guidance. The policies are intended to help vulnerable areas become more resilient and ensure that new development is planned appropriately, and protect existing beach and wetland resources. Relevant goals, policies and programs from the Draft General Plan that are pertinent to the Coastal Resiliency Program are included in Section 4.

4. COASTAL RESILIENCE STRATEGIES

This section outlines strategies for improving resilience of the natural and built environments in the Huntington Beach planning area, with a focus on vulnerabilities identified at the 2050 time horizon. Coastal resilience strategies presented in this section are based on the vulnerability assessment findings, CCC Guidance, and the Draft General Plan. The section begins with relevant General Plan goals presented for context; coastal resilience strategies are then listed by asset categories in which vulnerabilities were identified.

Draft General Plan goals related to coastal resilience are listed below. The policies and programs that support these goals are listed under the relevant asset category in Sections 4.1 to 4.7.

- Goal HAZ²-2. Coastal environments accommodate coastal changes and reduce coastal development impacts.
- Goal HAZ-3. Residents, businesses, visitors, and resources are adequately protected from risks associated with flood and tsunami hazards.
- Goal HAZ-8: Community members are well informed and equipped to make their homes and businesses more resilient to natural and environmental hazards, and to rapidly and successfully recover from them.
- Goal ERC³-3. Maintain the recreational and cultural identity of the beach while improving and enhancing the overall habitat value of coastal areas.
- Goal ERC-7. Wetland areas that serve as important biological resources for threatened and endangered birds, fish, and other species are protected and restored.
- Goal ERC-8. Coastal dunes and habitat resources remain resilient to potential impacts of encroaching development, urban runoff, and possible sea level rise.
- Goal ERC-17. Observing best stormwater management practices in construction and operation of new projects and existing land uses improves water quality of polluted water bodies.
- Goal PSI⁴-7. The flood control system supports permitted land uses while preserving public safety.

Some of the strategies in both the CCC Guidance and Draft General Plan reference documents are very similar. In these cases, strategies from both documents are listed to highlight consistency between the documents.

² HAZ refers to the Natural and Environmental Hazard element of the Draft General Plan

³ ERC refers to the Environmental Resources and Conservation element of the DRAFT General Plan

⁴ PSI refers to the Public Services and Infrastructure element of the Draft General Plan

4.1. GENERAL STRATEGIES

General coastal resilience strategies apply to the community as a whole and include strategies that either address vulnerabilities outside of a specific asset category, or that address vulnerabilities in multiple asset categories. The source document reference number is listed in parentheses after each coastal resilience strategy. The implementation of these strategies is discussed in Section 5.

Draft General Plan Strategies:

- Potential Sea Level Rise Hazard Area: Amend the Zoning Code/Local Implementation Program to establish a Sea Level Rise Hazard Zone. Explore opportunities to voluntarily encourage new development projects to locate outside of the Sea Level Rise Hazard Area. Identify preferred strategies to help existing property owners in the hazard area to improve resiliency to sea level rise, and ensure that funding mechanisms are available to support resiliency efforts.(Program HAZ-P.3)
- Convene neighborhood specific coastal resiliency task forces, or utilize existing neighborhood specific groups and committees to vet and implement resilience strategies that balance the diverse stakeholder interests. Prioritize neighborhoods with highly vulnerable communities and assets such as Huntington Harbour and Sunset Beach and include community members, City staff, and relevant stakeholders such as Caltrans, SCE, Sunset Beach Sanitary Districts, HOAs, and the County of Orange. (Program HAZ-P.35)
- Provide sufficient warning and evacuation assistance to community members impacted by coastal flooding events. (Policy HAZ-2.F)
- Increase the City’s understanding and funding for public improvements with respect to potential vulnerabilities and impacts to infrastructure associated with changes in sea level elevation. (Policy HAZ-2.G)

CCC Guidance Strategies:

- Establish a hazard overlay zone to identify areas where coastal flooding is possible within the 2050 time horizon. (A.1 from CCC Guidance)
- Identify zones that require a more rigorous sea level rise hazards analysis: Specify areas where a closer analysis of sea level rise is necessary at the permit application stage to avoid or minimize coastal hazards and impacts to coastal resources. Ensure that the most up-to-date information on sea level rise is incorporated in such analyses. (A.1a from CCC Guidance)
- Limit new development in hazardous areas: Restrict or limit construction of new development in zones or overlay areas that have been identified or designated as hazardous areas to avoid or minimize impacts to coastal resources and property from sea level rise impacts. (A.4 from CCC Guidance)

4.2. TRANSPORTATION INFRASTRUCTURE

2050 Vulnerability Assessment Summary – Transportation Infrastructure

Even minor amounts of flooding on the roads can result in a safety hazard potentially causing significant traffic delays, impacting emergency service response times and impeding evacuation routes. Maintenance and repair requirements would also increase after significant flooding, but the primary impact is disruption of service. Under sea level rise projections in 2050, the following main roads would be periodically flooded during King Tides and seasonally high water levels:

- Pacific Coast Highway (PCH) between Anderson Street and the main entrance to Bolsa Chica State Beach
- Warner Avenue between PCH and Brightwater Drive
- Edinger Avenue west of Saybrook Lane
- Saybrook Lane between Edinger Avenue and Heil Avenue
- Numerous residential streets in the Huntington Harbour and Sunset Beach communities.
- Brookhurst Street north of PCH

CCC Guidance Strategies:

- Plan and design transportation systems to accommodate anticipated sea level rise impacts: Ensure that transportation networks are designed to function even if the highest projected sea level rise amount occurs. Efforts to realign, retrofit, and/or protect infrastructure should be coordinated with Caltrans, local public works/transportation agencies, and LCP planning efforts. Individual projects will be implemented through CDPs. (A.32 from CCC Guidance)
- Retrofit existing transportation infrastructure as necessary: In instances where relocation is not an option, repair damage and/or retrofit existing structures to better withstand sea level rise impacts. For example, use stronger materials, elevate bridges or sections of roadways, and build larger or additional drainage systems to address flooding concerns. (A.32a from CCC Guidance)
- Build redundancy into the system: Provide alternate routes, as possible, to allow for access to, from and along the coast where sections of roadways may become temporarily impassible as a result of coastal hazards. Ensure that alternate route information is provided to residents and visitors to coastal areas. (A.32b from CCC Guidance)

4.3. RESIDENTIAL, COMMERCIAL, AND PUBLIC BUILDINGS

2050 Vulnerability Assessment Summary – Residential & Commercial Buildings

Significant tidal flooding of residential and commercial properties would be expected in and around Huntington Harbour and Sunset Beach during King Tides and seasonally high water levels. Sea level rise projections for 2050 would likely overtop long reaches of the seawalls and bulkheads lining Huntington Harbour and many other locations without seawalls significantly increasing the extent of tidal flooding.

In 2050 sea level rise could potentially flood areas east of the Bolsa Chica wetlands, where high water levels could overtop an earthen levee between the East Garden Grove Wintersburg Channel and Bolsa Bluffs. However, construction planned for the Shea Homes Parkside project includes an elevated and improved levee that would reduce the potential for tidal flooding in this area. Due to these improvements, this area is shown as a contingent hazard zone in Figure 3 and is not addressed in this program.

Along the coast, development along the back beach near the Huntington Beach Pier will be vulnerable to coastal flooding by the 2050 time horizon. These include the Huntington Pacific Beach House condominiums north of the pier, public restroom buildings and commercial buildings on both sides of the pier.

Draft General Plan Strategies:

- Promote appropriate land uses and development patterns within potential sea level rise hazard areas identified on the Sea Level Rise Hazard Area map. (Policy HAZ-2.A)
- Provide information to property owners about the risks associated with coastal erosion and flooding and encourage them to take adequate steps to prepare for these risks. (Policy HAZ-2.E)
- Flood and Sea Level Rise Hazard Mitigation: During development review, determine if any structures meant for human habitation are to be constructed within the 100-year flood plain or in the Sea Level Rise Hazard Area. If necessary, evaluate each structure's safety from flood and sea level rise-related hazards, and recommend remedial actions, including changes to building design and siting, drainage infrastructure, and low-impact development features. This evaluation should include mention of the structure's likely economic lifespan, and whether sea level rise may threaten the structure at any point during its lifespan. New development projects should conduct a soil analysis to determine if there is an elevated potential for ponding or runoff, and if needed, improved drainage and low-impact development strategies should be included in the project design. (Program HAZ-P.21)

CCC Guidance Strategies:

- Consider Transfer of Development Rights programs (TDR): Restrict development in one area ("sending area") and allow for the transfer of development rights to another area more appropriate for intense use ("receiving area"). LCPs can establish policies to implement a TDR program to restrict development in areas vulnerable to sea level rise and allow for

the transfer of development rights to parcels with less vulnerability to hazards. A TDR program can encourage the relocation of development away from at-risk locations, and may be used in combination with a buy-out program. (A.5b from CCC Guidance)

- Evaluate impacts from flood protection measures: Require new development within the overlay zone to evaluate potential impacts to adjacent or nearby properties from all proposed structural flood protection measures to ensure that these measures will not create adverse direct and/or cumulative on-site or off-site impacts. (A.8c from CCC Guidance)
- Limit basements and first floor habitable space: In areas located within a sea level rise overlay zone, revise residential building standards to prohibit habitable space at elevations subject to wave/flood risk. Specifically address potential impacts of basements on long-range adaptation options such as landward relocation or removal. (A.8d from CCC Guidance)
- Real estate disclosure: Sellers of real estate within a sea level rise overlay zone shall disclose permit conditions related to coastal hazards, or property defects or vulnerabilities, including information about known current and potential future vulnerabilities to sea level rise, to prospective buyers prior to closing escrow. (A.11 from CCC Guidance)

4.4. STORMWATER INFRASTRUCTURE

Summary of 2050 Vulnerabilities to Stormwater Infrastructure

Rising sea levels will increase the downstream controlling water surface elevation of flood control channels and storm drain systems that discharge into tidally-influenced waterways. This will reduce flood conveyance capacity and could result in drainage backing up and flooding upland areas that feed into the storm drain system.

- Reduced capacity in the lower reaches of the regional flood control channels such as Bolsa Chica Channel (C02), East Garden Grove Wintersburg Channel (C05), Huntington Beach Channel (D01), and Talbert Channel (D02).
- Reduced capacity of local storm drain systems that flow under gravity to a tidally influenced water body.
- Underground storage vaults may also be subject to increased buoyancy forces with higher groundwater levels.
- Areas serviced by pump stations may be vulnerable to reversal of flow through the discharge pipes and a reduction in capacity due to increased discharge pressure head.
- Increased coastal flooding of storm drain outfalls on the beach could result in drainage backing up and flooding upland areas that feed into the storm drain system.

Draft General Plan Strategies:

- Maintain, upgrade, and expand existing public storm drains and flood control facilities and coordinate with the County to improve County storm drain and flood control facilities within the planning area. (Policy PSI-7.B)

- Flood Control Infrastructure: Employ natural, on-site drainage strategies such as low-impact development to minimize the amount of stormwater that flows into pipes or conveyance systems. Work to improve the flood infrastructure in Huntington Beach through the following actions: In coordination with OC Flood and the US Army Corps of Engineers, retrofit and improve existing flood control infrastructure, and identify needs for new infrastructure. Conduct/expand routine maintenance and upgrades to City-owned drainage infrastructure to clear blocked storm drains, upgrade infrastructure to accommodate an increased volume of stormwater, secure additional funding, and maximize system efficiency and minimize system overload during periods of heavy rainfall. (Program HAZ-P.16)
- Maintain water quality by requiring new development projects to employ innovative and efficient drainage technologies that comply with federal and state water quality requirements and reduce runoff and water quality impacts to downstream environments. (Policy ERC-17.B)
- Prioritize investment in green stormwater infrastructure that restores natural landscapes before employing other management solutions. (Policy ERC-17.E)

CCC Guidance Strategies:

- Include sea level rise in stormwater management plans and actions: LCPs should include sea level rise and extreme storms in stormwater management plans and actions. CDPs for stormwater infrastructure should consider sea level rise. (E.2 from CCC Guidance)
- Increase capacity of stormwater infrastructure: Actions to reduce impacts from higher water levels could include widening drainage ditches, improving carrying and storage capacity of tidally-influenced streams, installing larger pipes and culverts, adding pumps, converting culverts to bridges, creating retention and detention basins, and developing contingency plans for extreme events. Encouraging and supporting these types of efforts upstream may also be important. (E.2a from CCC Guidance)
- Use green stormwater infrastructure to the maximum extent feasible: Employ natural, on-site drainage strategies to minimize the amount of stormwater that flows into pipes or conveyance systems. These strategies include low impact development, green roofs, permeable pavements, bioretention (e.g., vegetated swales, rain gardens) and cisterns. LCPs can include policies that require green infrastructure be used whenever possible in lieu of hard structures. Incorporate sea level rise and extreme storms into the design. (E.2b from CCC Guidance)

4.5. WASTEWATER INFRASTRUCTURE

2050 Vulnerability Assessment Summary – Wastewater Infrastructure

At the 2050 planning horizon, wastewater collection systems (lift stations, pipes and manholes) are vulnerable to flooding.

- Flooding could damage equipment and instrumentation at lift stations.
- Increased inflow and infiltration (I&I) into the collection system could potentially impact capacity at lift stations and treatment facilities.
- Underground storage vaults may also be subject to increased buoyancy forces with higher groundwater levels. Buoyancy forces could damage vaults, equipment and instrumentation, increasing the risk of wastewater spills.

CCC Guidance Strategy:

- Site and design wastewater disposal systems to avoid risks from sea level rise: Ensure that these systems are not adversely affected by the impacts of sea level rise over the full life of the structure and ensure that damage to these facilities would not result in impacts to water quality or other coastal resources. Avoid locating new facilities in hazardous areas if possible. If complete avoidance is not possible, minimize elements of the system that are in hazardous areas (for example, locate the main facility and components sensitive to flooding on higher ground and only place flood-proofed or flood-resilient facilities in potentially hazardous areas), and design any facilities in hazardous areas to withstand worst-case scenario sea level rise impacts. (A.28 from CCC Guidance)

4.6. ENERGY INFRASTRUCTURE

2050 Vulnerability Assessment Summary – Energy Infrastructure

At the 2050 planning horizon, gas and electrical infrastructure are vulnerable to damage from tidal flooding in the Huntington Harbour and Sunset Beach communities.

- Ground-level and underground electrical infrastructure could be damaged by flooding that may cause power outages.
- Exposed gas and electrical connections are also vulnerable to damage from flooding that could result in leaks or service interruptions.

Draft General Plan Strategies:

- Resilient Critical Facilities: Require all new critical, essential, or high-occupancy buildings, including public safety buildings, be sited, designed, and constructed so as to minimize damage and maximize continuation of key functions during and after a geologic and seismic hazard event. Prepare an inventory of City-owned facilities that may be vulnerable to seismic and geologic hazards, particularly facilities that serve vital functions. Coordinate with utility companies and districts to conduct reviews of power lines, key surface streets, natural gas pipelines, and other critical infrastructure not owned by the City. Use this

inventory to pursue funding to retrofit vulnerable City-owned facilities, and work with other organizations to support retrofits of non-City-owned infrastructure. (Program HAZ-P.14)

CCC Guidance Strategies:

- Plan ahead to preserve function of critical facilities: Addressing sea level rise impacts to critical facilities and infrastructure will likely be more complex than for other resources and may require greater amounts of planning time, impacts analyses, public input, and funding. To address these complexities, establish measures that ensure continued function of critical infrastructure, or the basic facilities, service, networks, and systems needed for the functioning of a community. Programs and measures within an LCP could include identification of critical infrastructure that is vulnerable to SLR hazards, establishment of a plan for managed relocation of at-risk facilities, and/or other measures to ensure functional continuity of the critical services provided by infrastructure at risk from sea level rise and extreme storms. Repair and maintenance, elevation or spot-repair of key components, or fortification of structures where consistent with the Coastal Act may be implemented through CDPs. (A.26 from CCC Guidance)
- Apply high sea level rise projections for siting and design of critical facilities: Given the planning complexities, high costs, and potential impacts resulting from damage, there is reason to be particularly cautious when planning and designing new critical facilities and/or retrofitting existing facilities. Ensure that critical facilities are designed to function even if the highest projected amounts of sea level rise occur and that sites with hazardous materials are protected from worst-case scenario sea level rise impacts. (A.27 from CCC Guidance)

4.7. ECOSYSTEMS

2050 Vulnerability Assessment Summary – Ecosystems

Estuary and coastal wetland ecosystems, which provide habitat for many endangered and threatened species, are highly vulnerable to sea level rise.

- Sea level rise will alter wetland hydrology by increasing the elevation of the freshwater-saltwater interface which could impact the type of habitats in the area (CNRA, 2014).
- Relatively mobile flora will adapt by migrating vertically and/or horizontally, but some flora will be unable to adaptively migrate due to slow reproductive cycles or physical habitat constraints (Maier, 2013). Adequate space is also required for the landward migration of flora.
- Intertidal and subtidal ecosystems may also be affected by changes to water depth and sunlight penetration as a result of sea level rise.

Draft General Plan Strategies:

- Promote land use changes and development patterns that conserve coastal resources and minimize bluff and coastal erosion. (Policy HAZ-2.C)

- Create, improve, and/or acquire areas that enhance habitat resources and identify, prioritize, and restore as habitat key areas of land that link fragmented wildlife habitat, as funding and land are available. (Policy ERC-6.A)
- Support land acquisition, conservation easements, or other activities undertaken by landowners to create and preserve habitat linkages that support the integrity of ecosystems. (Policy ERC-6.B)
- Protect important wetland areas in the planning area through land use regulation or public ownership and management. (Policy ERC-7.A)
- Maintain and enhance existing natural vegetation buffer areas surrounding riparian habitats and protect these areas from new development. (Policy ERC-7.B)
- Sustain the biological productivity of coastal waters and maintain healthy populations of species of marine organisms adequate to support long-term commercial, recreational, scientific, and educational purposes. (Policy ERC-8.A)
- Promote the improvement of tidal circulation in the Bolsa Chica Wetlands, Huntington Harbour, Huntington Beach Wetlands, and Anaheim Bay and minimize impacts to sand migration, aesthetics, and usability of the beach area. (Policy ERC-8.B)
- Prohibit development that jeopardizes or diminishes the integrity of sensitive or protected coastal plant and animal communities, accounting for expected changes from sea level rise. (Policy ERC-8.C)
- Development Standards for Coastal Protection: Create standards prohibiting all development, including additions or revisions to existing structures, that jeopardizes or reduces the biological integrity of sensitive coastal plant and animal communities, including all protected species. Work with coastal property owners and project applicants to amend project designs and identify mitigation activities that allow development to proceed while continuing to protect coastal biological communities. All restrictions on development should consider the future condition of biological communities with the effects of sea level rise over the anticipated lifetime of the structure. (Program ERC-P.29)
- Marine Biological Productivity Coordination: Coordinate with federal, state, and regional agencies and jurisdictions to sustain the biological productivity of coastal waters and maintain healthy populations of marine species. Work to provide viable population sizes and genetic diversity to ensure long-term survival of the species, and to support long-term commercial, recreational, and educational purposes as viable. (Program ERC-P.35)
- Tidal Circulation Coordination: Work with surrounding jurisdictions to improve the tidal circulation in the Bolsa Chica Channel, Huntington Harbour, the Huntington Beach Wetlands, and Anaheim Bay. Coordinate to minimize construction of features that impact natural sand migration and littoral drift within the San Pedro Littoral Cell. Develop ways to improve tidal circulation while also supporting increased biological integrity of coastal habitats, and improving the aesthetics and recreational viability of coastal areas. (Program ERC-P.36)

CCC Guidance Strategy:

- Use ecological buffer zones and/or increase the size of buffers: Buffer zones are intended to protect sensitive habitats from the adverse impacts of development and human disturbance. Establish ecological buffers and provide guidance on how to establish or adjust these buffers to accommodate sea level rise. (C.2 from CCC Guidance)

4.8. BEACHES, RECREATION & PUBLIC ACCESS

2050 Vulnerability Assessment Summary – Beaches, Recreation & Public Access

- Beaches throughout the city are vulnerable to significant erosion as a result of any future increases in sea level rise.
- Public access facilities (parking lots, pedestrian and bike paths) along the existing bluffs between Goldenwest Street and Seapoint Street are currently vulnerable to slope failures and bluff erosion. These processes are expected to increase with sea level rise, resulting in more frequent maintenance requirements and impacts to facility usage.
- Bike trails, pedestrian trails and beach parking lots are located along the back beach areas and will be vulnerable to flooding and inundation during coastal storms.

Draft General Plan Strategies:

- Promote land use changes and development patterns that conserve coastal resources and minimize bluff and coastal erosion. (Policy HAZ-2.C)
- Continue to support beach sand replenishment projects located north of the planning area that will support sand deposition on beaches in the planning area. (Policy HAZ-2.D)
- Maintain the beach and ocean as natural recreational resources, not only for the City but also for the Southern California region (Policy ERC-3.A)
- Maintain the current high level of recreational access to the coast and its recreational facilities and continue to provide resources that improve accessibility to the beach for all users. (Policy ERC-3.B)
- Coastal Access and Recreation: Continue to provide a high degree of access to the coast, and identify opportunities to equitably improve coastal access for all community members using varied modes of transportation. Ensure that all Huntington Beach community members and visitors have reasonable access to an array of active and passive coastal recreational uses, and consider providing additional recreational uses in other locations to improve access without diminishing existing uses or coastal biological integrity. (Program ERC-P.31)
- Shore Stabilization and Beach Management: Promote the use of soft shore stabilization strategies such as vegetated dunes, beach nourishment, and marsh restoration as an alternative to shore-armoring projects (e.g., seawalls, jetties, breakwaters). Allow for shore armoring only in instances where soft stabilization is insufficient to prevent a potential health hazard or significant structural damage. Identify opportunities to replace shore

armoring with soft stabilization features. Continue to coordinate with other regional coastal communities, particularly upshore communities, to support a regional strategy for beach nourishment and sediment management. This strategy should allow for anticipated changes to sea levels and minimize the use of shore armoring. (Program HAZ-P.15)

CCC Guidance Strategies:

- Prepare a shoreline management plan: Address vulnerabilities due to coastal flooding. Identify short and long-term policy and management goals, funding opportunities and monitoring to ensure effectiveness and success. Short-term goals may involve developing emergency protection guidelines for seasonal sand berm building. A long-term goal may include advocating for increased federal beach nourishment projects at Surfside-Sunset Beach to reduce shoreline retreat due to sea level rise. (A.3 from CCC Guidance)
- Monitor the existing shoreline protection structure: Periodically monitor shoreline protection structures such as those along the existing bluffs for structural damage, excessive scour, or other impacts from coastal hazards or sea level rise. Ensure that the structures remain within their initial footprint and that they retain functional stability. (A.21 from CCC Guidance)
- Re-assess impacts and need for existing armoring over time: Reassess the impacts from the shoreline protection device at specific trigger points, including when substantial improvement or redevelopment of the structure requiring protection is proposed, or when existing armoring is being modified or expanded. Reassessment should consider the effect any significant improvement to a structure requiring protection will have on the length of time the protective device will remain, and if the existing armoring is still required, acknowledge that it is authorized to protect the existing structure only. (A.22c from CCC Guidance)



5. IMPLEMENTATION OF COASTAL RESILIENCY PROGRAM

The strategies outlined in Section 4 provide a comprehensive menu of options to increase the City's coastal resiliency. This section describes how these coastal resiliency strategies could be used in support of the General Plan update, as well as for future coastal planning efforts. Attachment 1 provides detail regarding the relationship between specific coastal resilience strategies and the plans listed below. The strategies in Section 4 should be evaluated and discussed further by the City's decision makers and stakeholders to determine the most appropriate strategies for implementation.

5.1. GENERAL PLAN UPDATE

The General Plan Update is an important step toward incorporating sea level rise into the planning process supporting the vision for a sustainable and resilient community in 2040. Coastal resilience strategies in Section 4 with General Plan cross-references will become City policy and programs with adoption of the General Plan. Many of these policies and programs will be geared toward a better understanding of potential vulnerabilities, sharing this information with the community and working on strategies for reducing risk and improving resilience within the sea level rise hazard zones.

5.2. LOCAL COASTAL PROGRAM UPDATE

Following the General Plan Update, the City intends to comprehensively update its Local Coastal Program to ensure it is consistent with the General Plan Update and current California Coastal Commission guidance. Coastal Resiliency strategies in Section 4 with cross references to "CCC Guidance" represent best practices for addressing sea level rise as presented by the Coastal Commission. Inclusion of these strategies in the LCP update, along with inclusion of General Plan strategies as applicable, would illustrate consistency with the California Coastal Act, per CCC's most current guidance.

5.3. SHORELINE MANAGEMENT PLAN

The City could develop a comprehensive shoreline management plan (SMP) and funding strategy to improve resilience to coastal storms in the short term and reduce impacts from sea level rise over the long term. The SMP could include specific projects or actions that are particular to each section of coastline such as seasonal sand berm building in Sunset Beach and monitoring of revetments rip rap and bluff retreat along the Huntington Bluffs. Coastal resilience strategies that could be implemented by the SMP are identified in Attachment 1.



6. REFERENCES

- California Coastal Commission (CCC), 2015. Sea Level Rise Policy Guidance. Adopted August 12, 2015.
- California Natural Resources Agency (CNRA). 2014. Safeguarding California: Reducing Climate Risk.
- City of Huntington Beach, 2015. Key Policies Memorandum, DRAFT Huntington Beach General Plan Update. June 2015.
- Coastal and Ocean Working Group of the California Climate Action Team (CO-CAT). 2013. State of California Sea Level Rise Guidance Document, March 2013 Update.
- Maier, L. April 2013. Future Impacts of Sea Level Rise on Coastal Wetland Ecosystems: An Overview.
- Moffatt & Nichol,. 2014. City of Huntington Beach Sea Level Rise Vulnerability Assessment. December 2014.
- National Oceanic and Atmospheric Administration (NOAA). 2015. "Is Sea Level Rising?" <http://oceanservice.noaa.gov/facts/sealevel.html>.
- National Research Council of the National Academies (NRC). 2012. Sea Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future.



ATTACHMENT 1: SUMMARY OF COASTAL RESILIENCE STRATEGIES AND IMPLEMENTING PLANS

Reference Code	Description	Implementing Plan		
		General Plan Update	Local Coastal Program Update	Shoreline Management Plan
General Strategies				
HAZ-P.3	Sea Level Rise Hazard Areas	●		
HAZ-P.35	Convene neighborhood-specific task forces, or utilize existing neighborhood specific groups and committees.	●		
HAZ-2.F	Provide sufficient warning and evacuation assistance to community members impacted by coastal flooding events.	●		
HAZ-2.G	Increase the City's understanding of potential vulnerabilities and impacts to infrastructure associated with changes in sea level elevation.	●		
A.1	Establish a hazard overlay zone		●	
A.1a	Identify zones that require a more rigorous sea level rise hazards analysis		●	
A.4	Limit new development in hazardous areas		●	
Transportation Infrastructure				
A.32	Plan and design transportation systems to accommodate anticipated sea level rise impacts and pursue additional funding		●	
A.32a	Retrofit existing transportation infrastructure as necessary		●	
A.32b	Build redundancy into the system		●	
Residential, Commercial, and Public Buildings				



Reference Code	Description	Implementing Plan		
		General Plan Update	Local Coastal Program Update	Shoreline Management Plan
HAZ-2.A	Promote appropriate land uses and development patterns within potential sea level rise hazard areas identified on the Sea Level Rise Hazard Areas map.	•		
HAZ-2.E	Provide information to property owners about the risks associated with coastal erosion and inundation and encourage them to take adequate steps to prepare for these risks.	•		
HAZ-P.21	Flood and Sea Level Rise Hazard Mitigation	•		
A.5b	Consider Transfer of Development Rights programs		•	
A.8c	Evaluate impacts from flood protection measures		•	
A.8d	Limit basements and first floor habitable space		•	
A.11	Real estate disclosure		•	
Stormwater Infrastructure				
PSI-7.B	Maintain, upgrade, expand, and gradually naturalize existing public storm drains and flood control facilities and coordinate with the County to improve County storm drain and flood control facilities within the city.	•		
HAZ-P.16	Flood Control Infrastructure: Coordinate with OC Flood and US Army Corps of Engineers to improve existing infrastructure, and identify needs for new infrastructure. Conduct routine maintenance and upgrades to City-owned drainage infrastructure.	•		
ERC-17.B	Maintain water quality by requiring new development projects to employ efficient drainage technologies to reduce runoff and water quality impacts to downstream environments.	•		
ERC-17.E	Prioritize investment in green stormwater infrastructure that restores natural landscapes before employing other management solutions.	•		
E.2a	Increase capacity of stormwater infrastructure		•	
E.2b	Use green stormwater infrastructure to the maximum extent feasible		•	
Wastewater Infrastructure				



Reference Code	Description	Implementing Plan		
		General Plan Update	Local Coastal Program Update	Shoreline Management Plan
A.28	Site and design wastewater disposal systems to avoid risks from sea level rise		•	
Energy Infrastructure				
HAZ-P.14	Resilient Critical Facilities: Require all new critical facilities be sited, designed, and built to minimize damage and maximize continuation of key functions during and after a hazard event. Pursue funding to retrofit vulnerable City-owned facilities, and work with other organizations to support retrofits of non-City-owned infrastructure.	•		
A.26	Plan ahead to preserve function of critical facilities		•	
A.27	Apply high sea level rise projections for siting and design of critical facilities		•	
Ecosystems				
HAZ-2.C	Promote land use changes and development patterns that conserve coastal resources and minimize bluff and coastal erosion.	•		
ERC-6.A	Create areas that enhance habitat resources and restore key areas of land that link fragmented wildlife habitat, as funding and land are available.	•		
ERC-6.B	Support land acquisition, conservation easements, or other activities undertaken by landowners to create and preserve habitat linkages	•		
ERC-7.A	Protect important wetland areas in the planning area through land use regulation or public ownership and management.	•		
ERC-7.B	Maintain and enhance existing natural vegetation buffer areas surrounding riparian habitats and protect these areas from new development.	•		
ERC-8.A	Sustain the biological productivity of coastal waters and maintain healthy populations of species of marine organisms.	•		
ERC-8.B	Promote the improvement of tidal circulation in the Bolsa Chica Wetlands, Huntington Harbour, Huntington Beach Wetlands, and Anaheim Bay	•		



Reference Code	Description	Implementing Plan		
		General Plan Update	Local Coastal Program Update	Shoreline Management Plan
ERC-8.C	Prohibit development that jeopardizes or diminishes the integrity of sensitive or protected coastal plant and animal communities, accounting for expected changes from sea level rise	•		
ERC-P.29	Development Standards for Coastal Protection: Create standards to minimize development that jeopardizes or reduces the biological integrity of sensitive coastal plant and animal communities	•		
ERC-P.35	Marine Biological Productivity Coordination: Coordinate with federal, state, and regional agencies and jurisdictions to sustain the biological productivity of coastal waters and maintain healthy populations of marine species	•		
ERC-P.36	Tidal Circulation Coordination: Work with surrounding jurisdictions to improve the tidal circulation in the Bolsa Chica Channel, Huntington Harbour, the Huntington Beach Wetlands, and Anaheim Bay.	•		
C.2	Use ecological buffer zones and/or increase the size of buffers		•	
Beaches, Recreation and Public Access				
HAZ-2.C	Promote land use changes and development patterns that conserve coastal resources and minimize bluff and coastal erosion	•	•	•
HAZ-2.D	Continue to support beach sand replenishment projects located north of the planning area that will support sand deposition on beaches in the planning area.	•	•	•
ERC-3.A	Maintain the beach and ocean as natural recreational resources, not only for the City but also for the Southern California region	•		
ERC-3.B	Maintain the current high level of recreational access to the coast and its recreational facilities and continue to provide resources that improve accessibility to the beach for all users.	•		



Reference Code	Description	Implementing Plan		
		General Plan Update	Local Coastal Program Update	Shoreline Management Plan
ERC-P.31	Coastal Access and Recreation: Continue to provide a high degree of access to the coast, and identify opportunities to equitably improve coastal access for all community members using varied modes of transportation.	•	•	•
HAZ-P.15	Shore Stabilization and Beach Management	•	•	•
A.3	Prepare a shoreline management plan		•	•
A.21	Monitor existing shoreline protection structures			•
A.22c	Re-assess impacts and need for existing armoring over time			•