8. Adaptation and Resiliency Building Strategies

This Chapter of the *Sea Level Rise Vulnerability Assessment and Adaptation Project* provides a range of adaptation options the City may implement to address existing and future vulnerabilities. The adaptation strategies included within this section are developed specifically with the intent of minimizing damage to projected vulnerabilities identified within Section 6, *Sector Results*, with consideration of recommended strategies within California Coastal Commission (CCC) *Sea Level Rise Policy Guidance* (2018a) and input from stakeholders, special districts, the Coastal Land Use Plan (CLUP)/General Plan Update Committee, and the public. This section identifies both strategies that are programmatic that could be applied regionally and specific strategies that could be applied within targeted areas. Policy approaches to adaptation would be implemented through the certified CLUP/General Plan Update. Other strategies include approaches or projects that are based on regional coordination, planning, and implementation with other organizations. Several of City's adaptation strategies include regional assets outside of its jurisdiction that are of great importance to the City. Such strategies would benefit regional assets (Los Angeles–San Diego–San Luis Obispo Rail Corridor [LOSSAN Corridor] and Union Pacific Railroad [UPRR], U.S. Highway 101 [U.S. 101], Aliso Elementary School, etc.) and successful implementation relies on regional coordination and funding.

The Carpinteria shoreline is characterized by a stretch of sandy coastline transitioning to rugged bluffs that serves as a popular recreational space with a history of development and management. Photo Source: California Coastal Records Project.

A goal of this section is to increase the understanding of the vulnerabilities associated with coastal hazards and encourage consideration of these impacts without creating further vulnerabilities or liabilities. As this is the beginning of the City's process of developing its adaptation responses, many early initiatives are exploratory in nature and aim to identify potential changes or actions to respond to the impacts of concern. Recommendations and next steps are identified within Section 8.6, *Recommendations and Next Steps*, though adaptation measures are subject to change and further refinement over time. The City's adaptation approach outlined within this Chapter is based upon best available science and currently known adaptation practices. However, sea level rise science continues to evolve, and physical coastal conditions are constantly changing. While there remains some uncertainty in the rate and timing of sea level rise, an indeterminate amount of sea level rise is likely to occur. In the future, the City will reevaluate the feasibility and necessity of adaptation options as appropriate, continuing to use best available data, with reference to current state adaptation planning guidance. Additionally, the adaptation strategies identified within this Chapter may evolve or change over time as unknown variables become more certain.

8.1 Planning Principles

An objective of the City is to protect the community and natural resources that make Carpinteria a desirable location to live, work, recreate, and visit. The City's public beach and shoreline are a significant source of the community's quality of life and generate revenue from both community and visitor-recreational activities. Ensuring the City's beaches and shoreline are resilient to sea level rise over time is integral to the City's community character, healthful livability, and economic viability. Through the CLUP/General Plan Update and public outreach process, the City and its residents have identified several priorities to accomplish or balance when planning for adaptation to identified coastal vulnerabilities. Above all, the City and its residents choose to prioritize the following:

- Maintaining the City's small beach town character and high quality of life;
- Maintaining a wide sandy beach offering lateral beach access and a variety of recreational opportunities, such as surfing, paddle boarding, swimming, fishing, birdwatching, beachcombing, tide pooling, and other recreational activities for residents and visitors;
- Maintaining a healthy economy with opportunities for future economic viability;
- Protecting or adapting vulnerable neighborhoods, including the Beach Neighborhood and the Downtown;
- Identifying sustainable funding sources to allow the City to improve coastal resiliency; and,
- Improving regional collaboration and coordination with agencies to maintain, enhance, and protect key resources and critical infrastructure.

Many of the strategies provided in this section are focused on resiliency while balancing the City's priorities for adaptation with the long-term preservation of the public beach, visitor serving facilities, public infrastructure, and land uses. To achieve the appropriate balance, it is important to weigh considerations and achieve consistency with adopted policies and guidance. Guiding goals, principles, policies, and programs that have been considered in the development of policies for addressing rising seas within the City include those of the state's climate adaptation strategy – the *Safeguarding California Plan Update* (California Natural Resources Agency 2018), *Sea Level Rise Policy Guidance* (CCC 2018a), the City's CLUP/General Plan Update, and the California Coastal Act.

With applicable guidance and City priorities in mind, the City developed the following planning principles, with input from the public and other stakeholders. These principles are suggested for incorporation in the City's CLUP/General Plan Update and could be supported by additional policy and implementation guidance:

- Prioritize regional collaboration and coordination in planning for adaptation to sea level rise;
- Facilitate protection of, and assistance to populations vulnerable to coastal hazards;
- Reduce risk of extreme coastal hazards and damage upon vital infrastructure and structures in high-risk areas of the City;
- Maintain flexibility to meet changing conditions;
- Balance approaches to adaptation weighing benefits to costs, economic impacts, and appropriate use of public funds;
- Maintain natural defenses (e.g., sand dunes, marshes, native bluff vegetation) and physical processes (e.g., ecosystem services);
- Prioritize nature-based solutions designed to minimize extensive maintenance over time, avoiding "hard" or "gray" structures to the maximum extent feasible;
- Require new development to plan for coastal storm and sea level rise hazards;
- Develop adaptive measures that are consistent with the CLUP/General Plan and rely upon best available science; and,
- Conserve, maintain, and, when necessary, restore/enhance beaches for habitat value, recreation, and coastal access for the use of future generations.

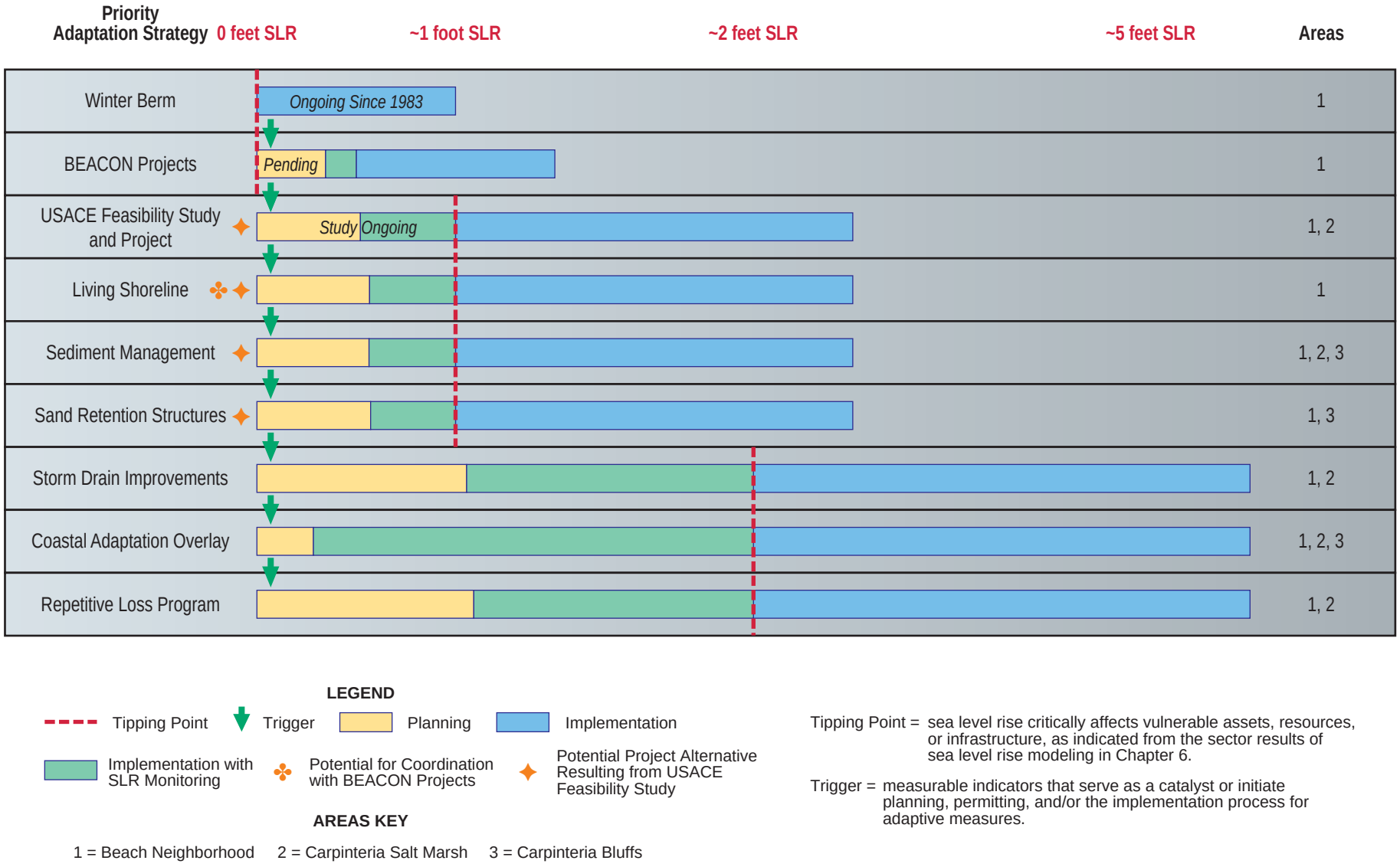
8.2 Priority Measures for Resources and Assets

This section provides a road map for long-term adaptation planning, including identification of both programmatic measures and projects intended to reduce damage to the City from coastal hazards, triggers for implementation of such measures, areas of future study, financing options, and the next steps for the City to further its adaptation planning efforts. It also assists the City and decision-makers in making informed decisions regarding future land use and development. While the City has a long history of addressing coastal hazards, this is

the first focused endeavor by the City to identify possible vulnerabilities to climate-related impacts.

Informed by state adaptation planning guidance and City priorities, the City has developed a hybrid approach to adaptation that is comprised of several complementary adaptation strategies. The City's preferred adaptation approach is to implement a combination of soft and nature-based protection measures, accommodation, and managed retreat concepts, based on potential sea level rise triggers and monitoring (Figure 8-1). This includes beach nourishment, sand dune restoration, sand retention/management, flood management projects, and proactive implementation programs for development and infrastructure in areas at risk to coastal hazards.

Priority adaptation strategies would ultimately be integrated into CLUP/General Plan policies, implementation plans, and/or actions. Managed retreat strategies which relocate existing development out of hazard areas will be considered if the City determines it is necessary and feasible, based on measured data and monitoring of physical conditions. A principle intent of the CLUP/General Plan is to implement policies that ensure permitted development is sustainable from coastal hazards and existing public improvements and development is managed to reduce exposure to coastal hazards. As part of this ongoing CLUP/General Plan Update process, policies will be further developed by stakeholders and public agencies, including further discussions at public workshops and hearings. Adaptation planning for these priority measures is anticipated to require significant regional or multi-jurisdictional coordination and funding. Many adaptation strategies take substantial time to implement. As a result, advanced planning and financing is vital. The City's adaptation approach allows flexibility to choose from an array of adaptation strategies over time as the identified triggers are reached. As indicated within Figure 8-1, the City recommends that planning for each priority adaption measure begin immediately. Next steps identified within this Report include additional study; public outreach; economic analysis; project funding; engineering; permitting, program adoption, and or/construction. These next steps are necessary to understand the feasibility and effectiveness of the identified adaptation measures in this Report, prior to implementation and/or adoption. The City would continue to monitor appropriate triggers such as an increase in sea level elevations, storm exposure and frequency, beach width distance, damages, and erosion distance, and evaluate the effectiveness of a strategy with consideration of social, economic, and environmental effects. Future trigger points will be evaluated and incorporated as more information on planning/modeling is gathered.



Carpinteria Priority Adaptation Strategies Matrix

FIGURE 8-1

Ongoing Programs

Ongoing programs are adaptation strategies that the City has already engaged in and continues to pursue. This includes the Winter Storm Berm Program and the U.S. Army Corps of Engineers (USACE) Storm Damage and Shoreline Protection Feasibility Study (Feasibility Study).

Winter Storm Berm Program

The winter storm berm is a protection device that buffers landward assets from coastal storm damage during the winter storm season. Since 1983, the City has implemented an annual Winter Storm Berm Program to protect beachfront properties along the Carpinteria City Beach from wave action and related flooding during the winter storm season. A sand berm is erected annually and is in place for approximately three months out of the year during the winter storm season, (typically late November until early March the following year), based on storm predictions and beach conditions. Funded by the City and an existing assessment district comprising potentially affected property owners, this ongoing measure reduces the probability of damage to development and infrastructure.

The City-installed seasonal sand berm along the shoreline is in place during the winter season to protect near-shore residences, infrastructure, and Carpinteria City Beach from coastal winter storms.

Historically, large waves generated by Pacific Ocean storms during the winter have caused damage to local beaches and coastal structures. Existing vulnerable buildings include 98 residential parcels in the Beach Neighborhood, as well as public parking and restroom facilities on Ash Avenue. To protect these structures and public infrastructure, every winter the City constructs a seasonal sand berm along the entire City Beach. The seasonal berm is approximately 1,400 feet long. Given an approximate width of 40 feet wide and a height of 12 feet (16 feet above sea level), the berm requires approximately 13,000 cubic yards (cu. yd.) of sand for installation. This material is bulldozed from the upper tidal zone during low tide and placed in the backshore area of the City Beach. The berm is constructed annually prior to the winter storm season and is removed by pushing sand back to the upper tidal zone by Memorial Day the following year (but is often restored at an earlier date). When in place, the berm reduces storm-based erosion of the sandy beach. This in turn maintains a wider sandy beach for recreation and associated

economic benefits in the summer season, by minimizing the loss of sand during the storm season.

Table 8-1. Ongoing Adaptation Strategy - Winter Storm Berm Program

Adaptation Strategy	Winter Storm Berm Program		
Implementation Timeline	Permitting: ongoing	Berm Construction: 1 week annually	Beach Restoration (i.e., Berm Removal): 1 week annually
Trigger	On-going since 1983		
Tipping Point	Existing Coastal Flooding & Beach Erosion Hazards		
Potential Resource/Asset Benefits	• Protection of roadways and infrastructure in the Beach Neighborhood • Protection of up to 98 shoreline residential parcels between Ash Avenue and Linden Avenue from storm damage • Protection of recreation resources and public infrastructure from erosion (City Beach, public parking, bike facilities, and restrooms) between Ash Avenue and Linden Avenue • Retain the Citywide economic benefits of beach recreation for the period during which the berm program is effective • Can refortify in emergency storm situations		
Costs & Impacts	• Annual construction, maintenance, and restoration costs ($35,500) • Less effective over time with increasing rates of sea level rise, particularly over 2 feet, at which coastal storms may overtop the berm or result in severe beach erosion • Temporary displacement of available sandy beach during winter while the berm is in place • Impacts to beachside aesthetics while the berm is in place		
Permitting & Coordinating Agencies	CCC, USACE, California Reigional Water Quality Control Board		
Next Steps	• Continue to implement the Winter Storm Berm Program in the near-term until the berm is no longer effective (i.e., continual flooding and overtoping above the typical berm height), or another adaptation measure replaces the need to implement this program (e.g., living shoreline)		

The costs of installation, maintenance, and removal of the berm are borne by the City and beachfront property owners. Assessment District #5, formed by Resolution No. 3061 on December 14, 1992, levies fees on all shoreline properties immediately adjacent to the City beach frontage to help fund these annual costs. Property-specific assessments are based on fixed costs such as permit compliance and biological monitoring, as well as a variable cost based on the percent of City beach shoreline the respective property occupies.

Depending on environmental conditions, the approximate cost of annual berm construction, maintenance, and removal is $35,500. Total District #5 fees were set at $20,656.73 in

January 1997 by a mail ballot and cannot be raised without an affirmative vote of the affected property owners. Therefore, the remainder of the cost, approximately $14,843.27 annually, is contributed to the District by the City.

This berm is not intended to serve as a substitute for private storm protection improvements or flood insurance but can substantially reduce damage. Failure to erect the berm in 1995 led to private property damage exceeding $300,000. Additionally, with sufficient preparation, the City can rebuild and support the existing temporary berm after it experiences large storm events. However, storms can exceed the protection offered by the berm, and the berm is not impervious to being destroyed itself. Though beach front property damage by winter storms with installation of the berm has not been recorded along the City coastline in the past, the possibility remains present even with installation of the berm due to the variability of storms that can occur and potential flooding, wave-attack, and erosion that could occur over time when combined with sea level rise.

USACE Storm Damage and Shoreline Protection Feasibility Study

An independent study is currently being prepared by USACE that could result in a funding opportunity for an adaptation project. As a result of long-term erosion of City beaches (see Section 3.8, *Historic Shoreline Changes and Erosion*), USACE is working with the City to prepare a Storm Damage and Shoreline Protection Feasibility Study that will identify a range of possible measures to address coastal erosion. Analyzing an approximate 0.25-mile section of shoreline between Ash Avenue and Linden Avenue, this Feasibility Study investigates vulnerabilities to structures that may be directly affected by existing shoreline erosion and wave attack during severe storms. Additionally, the Feasibility Study aims to preserve and enhance the biological environment by restoring nesting, feeding, and resting areas for species dependent on sandy beaches.

A reconnaissance study was initially completed in 2007 by United Stated Geological Survey (USGS) to evaluate physical processes and long-term and seasonal changes to the stretch of City beach fronting Sandyland Road (Barnard et al. 2007). The study identified public beach resources and at least 14 residential structures that were under threat from shoreline erosion (City of Carpinteria 2010). The USACE then conducted coastline modeling; however, USACE did not include parameters for anticipated sea level rise. Without any protective measures (including the annual winter storm berm), USACE estimates total damages have a 2018 Net Present Value (NPV) of $21.5 million(USACE 2018). Following this analysis, the USACE narrowed down a final array of alternatives for economic modeling and environmental analysis under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). Potential alternatives for analysis identified by USACE include:

- Continued implementation of the Winter Storm Berm Program to minimize risk of overtopping;

- Beach nourishment to widen the beach;
- Sand retention measures to increase resident time of sand on the beach;
- Cobbles and other sediment management activities;
- Recreational pier as a sand retention device; or
- Offshore submerged or partially submerged breakwater to dissipate wave energy.

Table 8-2. Ongoing Adaptation Strategy – USACE Feasibility Study

Adaptation Strategy	USACE Feasibility Study		
Implementation Timeline (2007 – est. 2020 for study completion)	Study Completion: additional 2 - 5 years	Permitting and Planning for Identified Project: 3-5 years	Construction/Installation of Identified Project: 1-2 years
Trigger	Construction of the Santa Barbara Harbor, due to the downcoast erosion and loss of sediment supply that occurred after its construction (See Section 3.8)		
Tipping Point	Existing Beach Erosion & Coastal Flooding Hazards		
Potential Resource/Asset Benefits	• Federally funded Feasibility Study that will provide additional information about coastal erosion and potential solutions • In-depth economic, environmental, and logistical analysis of potential erosion mitigation alternatives • Source of federal funding for 65 percent of identified project cost that could be used for an adaptation measure • Potential integration with existing and proposed adaptation measures (e.g., annual winter berm, living shoreline) • Provision of benefits to shoreline, assets, and infrastructure between Ash Avenue and Linden Avenue		
Costs & Impacts	• Requires local funding cost share for Feasibility Study project (approximately $2,700,000) • Requires local funding for 35 percent of identified project cost • Dependent on federal staffing, funding, and implementation schedules		
Permitting & Coordinating Agencies	USACE, USFWS, CCC, CLSC, CDFW, RWQCB, County of Santa Barbara		
Next Steps	• Work with USACE towards completion of the Feasibility Study, including facilitating data sharing and integration of Sea Level Rise Vulnerability Assessment and Adaptation Plan findings • Identify project alternative for implementation under this program in coordination with USACE, with consideration of options included in this Report • Identify funding sources for local cost share		

As noted, selection of the USACE alternatives did not initially consider sea level rise; however, the City has an opportunity to work with USACE and select a project alternative that could both address existing coastal erosion and future sea level rise hazards. This Study

is ongoing but relies on available City and federal USACE funds. Federal funding is authorized by the federal Water Resources Development Act and budgeted under the annual USACE work plan budgets. The USACE is currently outlining necessary future steps and identifying anticipated federal funding opportunities. The total budget of the Feasibility Study is estimated to be $5.5 million, with an additional $ 3.1 remaining to be to paid. $1.6 million of this remainder will come from federal funding, and $1.5 million will be paid by local and state sponsors. The City committed $600,000 in December 2017 for this Study (USACE 2018). Following funding, the study would proceed with feasibility modeling and a cost-benefit analysis of potential strategies.

Once an eligible alternative is identified as the project, 65 percent of the cost of a potential adaptation project would be federally funded and the remaining 35 percent would require a local match of funds by the City, regional governmental agencies such as the County Flood Control District, the Beach Erosion Authority for Clean Oceans and Nourishment (BEACON), and/or the State of California (City of Carpinteria 2010). Additionally, sea level rise adaptation planning efforts by the City may represent an in-kind contribution toward the local cost share, depending on the utility of the information within this Report to the Feasibility Study.

As a next step, the City intends to closely coordinate with USACE to integrate relevant findings of this Report into the Feasibility Study. Inclusion of this Report's sea level rise modeling data and City-identified adaptation priorities (e.g., a living shoreline project), would provide an up-to-date framework for continued USACE investigations and project implementation, and could significantly offset ultimate project costs.

Pending Projects

The following programs under BEACON are pending but have not yet been initiated. These projects and programs represent a valuable opportunity for the City to begin early coordination and/or collaboration with BEACON to optimize protection of City resources from coastal hazards. These projects are pending additional funding support through agencies and sources such as the Coastal Conservancy, Ocean Protection Council (OPC), or other grant opportunities.

BEACON - Coastal Regional Sediment Management Plan Update

The Coastal Regional Sediment Management Plan (CRSMP), adopted by BEACON in 2009, includes information on sand supplied to the Santa Barbara Littoral Cell between Point Conception and Point Mugu, including an understanding of erosion hot spots and shoreline protection (see also Section 2.4, *Other Regional Sea Level Rise Planning Efforts*). The CRSMP recommends sediment management strategies in the region, including development of an opportunistic sand placement program, sand rights policies, and changes in regional governance structure that would support better use of coastal sediments. Additionally, the

CRSMP outlines a blueprint for BEACON investments in studies, policies, and capital projects for the next 20 years.

Table 8-3. Pending Adaptation Strategies - BEACON Projects

Adaptation Strategy	BEACON Sediment Management Projects	
Implementation Timeline - Update Coastal Regional Sediment Management Plan (CRSMP)	Technical Study: 1-2 years	Plan Update: 1-2 years
Implementation Timeline - Regional Sediment Management Program	Program Development: 1-2 years	Adoption by Member Agencies: 1-2 years
Trigger	Near-term, based on beach width distance as determined through the CLUP/General PLan Update process	
Tipping Point	Existing Beach Erosion & Coastal Flooding (approximately 0 feet sea level rise)	
Potential Resource/Asset Benefits	• Provision of nourishment opportunities will result in wider beaches and recreational benefits • Provision of beach buffer from coastal storms and protection of shoreline development • Framework for enhanced regional coordination between jurisdictions	
Costs & Impacts	• Multi-agency determination of programs, intended outcomes, coordination, and permitting • Less effective over time with increasing rates of sea level rise	
Permitting & Coordinating Agencies	BEACON member agencies (Cities of Carpinteria, Goleta, Oxnard, Port Hueneme, Ventura, Santa Barbara; Counties of Santa Barbara and Ventura), CCC, USACE, USFWS, CLSC, CDFW, RWQCB	
Next Steps	• Share technical information from Sea Level Rise Vulnerability Assessment and Adaptation Plan with BEACON and member agencies • Work with BEACON to identify funding sources and permitting path • Support BEACON efforts to establish and implement regional programs	

BEACON plans to update the 2009 CRSMP to address several important issues. First, the CRSMP does not include substantive analysis of potential sea level rise and other impacts of climate change that would affect regional sediment distribution. Additionally, the CRSMP lacks specific implementation goals for development of a regional opportunistic sediment use program, as further described below. Finally, the CRSMP does not sufficiently assess the importance of cobbles and muds in regional sediment management. Sediment debris basins in Carpinteria area creeks cause large coarse-grained sediments to drop out before reaching local beaches. However, these materials provide substantial storm buffering capabilities. Opportunities to use debris basin clean outs to improve beach and dune resiliency needs

further evaluation, including examination of sediment fluxes and other conditions that contribute sediment to the coast.

BEACON –Regional Sediment Management Program

As identified above, BEACON is working to develop a regional opportunistic sediment placement program as part of the intended update to the CRSMP. The program would focus on ensuring sediment reaches local beaches through the natural sediment transport process. This program would also establish a program of pre-permitted coastal locations (i.e., receiver sites) within the BEACON region where materials from sediment basins could be opportunistically deposited to augment existing sand supplies.

Proposed Adaptation Strategies

Proposed adaptation strategies are additional measures the City may choose to implement based on known vulnerabilities identified within this Report, dialogue with the community, and coordination with local and state agencies. These strategies are consistent with state guidelines on adaptation and the City's adaptation planning principles developed with input from the community (refer to Section 8.1, *Planning Principles*). Project-level planning, technical study, and coordination with approving agencies would be required for each strategy to further develop and implement the measure. In addition, some of the below strategies may be implemented through or assisted by the above USACE or BEACON planning efforts and programs. This Report also acknowledges that sea level rise science and adaptation practices are dynamic; the City will need to monitor the rate of rising seas and associated coastal hazards and reevaluate adaptation strategies and triggers in the future based on evolving science and technology.

Living Shoreline

A living shoreline is a shoreline management system designed to restore or protect natural shoreline ecosystems through the use of natural resource elements and, if appropriate, manmade elements (State Coastal Conservancy 2017). Improving shoreline resiliency to reduce hazards from coastal flooding and erosion from large storm events may include development of a stabilized (e.g., cobble-based) sand dune complex that would function as a "living shoreline", which would be historic to this region and vegetated with local, native coastal species. As described in Section 3.4, the City once supported a much more extensive wetland and dune system, with sand dunes extending from the mouth of Carpinteria Salt Marsh to the tar pits in the State Beach Park (Grossinger et. al. 2011). Historically, the City's western one mile of shoreline supported a large dune field which buffered low-lying areas from wave attack and flooding. The former dune system has been eroded over the last 90 years, largely due to human impacts (or influences), and the dune system has not recovered.

Table 8-4. Proposed Adaptation Strategy - Living Shoreline

Adaptation Strategy	Living Shoreline		
Implementation Timeline[1]	Planning: 1-2 years	Permitting: 2-3 years	Construction: 1 year
Trigger	Near-term, based on storm frequency and intensity, based on comparisons to historic trends		
Tipping Point	Beach Erosion & Coastal Flooding Hazards (approximately 1 foot sea level rise)		
Potential Resource/Asset Benefits	• Protection of roadways and infrastructure in the Beach Neighborhood • Protection of shoreline residences and short-term rentals between Ash Avenue and Linden Avenue • Protection of recreational resources (Carpinteria State Beach, Linden Field, trails) • Protection of public infrastructure including roadways, public parking, bike facilities, and public restrooms • Restoration of sensitive coastal habitat native to the area • Retention of economic benefits associated with beach recreation and State Beach		
Costs & Impacts	• Construction costs (>$2.2 million[1]) • Moderate ongoing maintenance costs required (roughly $100,000 per year, though costs increase with time) • Less effective over time with increasing rates of sea level rise, particularly as sea level rise nears 5 feet, which may result in more frequent overtopping of an installed dune system • Potential loss of private views		
Permitting & Coordinating Agencies	USACE, USFWS, CCC, Coastal State Lands Commission (CSLC), California State Parks, CDFW, RWQCB, Caltrans		
Next Steps	• Secure funding sources from grants • Modeling and additional study for concept design development • Coordinate with agencies to develop concept design and implementation plan • Public outreach and selection of alternatives		

[1] *Based on Cardiff Beach Living Shoreline in Encinitas, CA. Source: State Coastal Conservancy 2018.*

Carpinteria State Beach includes an existing dune system that is approximately five acres, developed by State Parks and integrated into the Park's 2009 Carpinteria State Beach Interpretation Master Plan. This complex was installed in response to dynamic sand movements during high wind events, which frequently resulted in costly maintenance for State Parks, to prevent future damages to the Park and parking lot. The success of this restoration project, along with the City's existing winter storm berm program, provide evidence of the efficacy of a dune system to protect land uses in the Beach Neighborhood and Carpinteria State Beach.

Reestablishment of the natural dune system is an effective sea level rise adaptation strategy that has been implemented in other jurisdictions facing similar coastal hazard threats within similar southern California community settings (e.g., at Cardiff Beach in the City of Encinitas and at Surfer's Point in the City of Ventura). Dune systems have been documented to reduce coastal storm damage, buffering the shoreline from wave attack during extreme storm events while also providing coastal habitat benefits.

A living shoreline would serve as a green protection strategy to address vulnerable infrastructure, resources, and assets within the Beach Neighborhood and Carpinteria State Beach, including residences, Linden Field, campgrounds, roadways, bikeways, pedestrian facilities, public parking, businesses within the Downtown, public trails, and utility infrastructure. The City contains a one-mile-long stretch of sandy beach between Ash Avenue and Tar Pits Park where a living shoreline could be established (Figure 8-2). This concept may include a cobble core persistent dune system or other engineering alternatives consistent with "living shoreline" principles (Figure 8-3). The City recommends engineering investigations that rely upon local sources of material to the maximum extent feasible (e.g., constructed with cobble acquired from Carpinteria area creeks and/or the County Flood Control District). This adaptation strategy would also require a robust monitoring program, including pre-project monitoring to inform the design and to serve as baseline for post-implementation monitoring. As demonstrated by erosion of dunes at Surfers Point in Ventura or the Devereux Slough in Goleta during major storm events (e.g., El Niño events), a living shoreline would require periodic maintenance. The need for maintenance and reconstruction would likely increase over time with sea level rise.

To implement a living shoreline, the City would need to coordinate with federal, state, and local agencies to acquire necessary permits, including State Parks for any action within or immediately adjacent to Carpinteria State Beach (refer to Table 8-4). Policies supporting this approach and incorporated into the CLUP/General Plan Update would allow the City to facilitate a living shoreline as an adaptation strategy.

Associated costs for a vegetated dune system can widely vary, depending on the existing setting of the system. For instance, new dune construction with imported sand and costs from the design process has been estimated at approximately $100,000 (2018) per acre, which would result in roughly $1 million for the 10 acres of Carpinteria shoreline (Natural Resources Agency 2018). The City of Encinitas, in partnership with California Department of Parks and Recreation, approved and has commenced construction of a 2,900-foot-long dune restoration project in Cardiff State Beach in October 2018, which will cover over 9 acres of beach. The project cost is approximately $2.2 million (roughly $200,000 per acre), or approximately double the cost estimated above (State Coastal Conservancy 2018). Carpinteria City Beach and State Beach would have space to accommodate a living shoreline of similar size (9 acres or more).

Potential Study Area for a Living Shoreline in Carpinteria

FIGURE 8-2

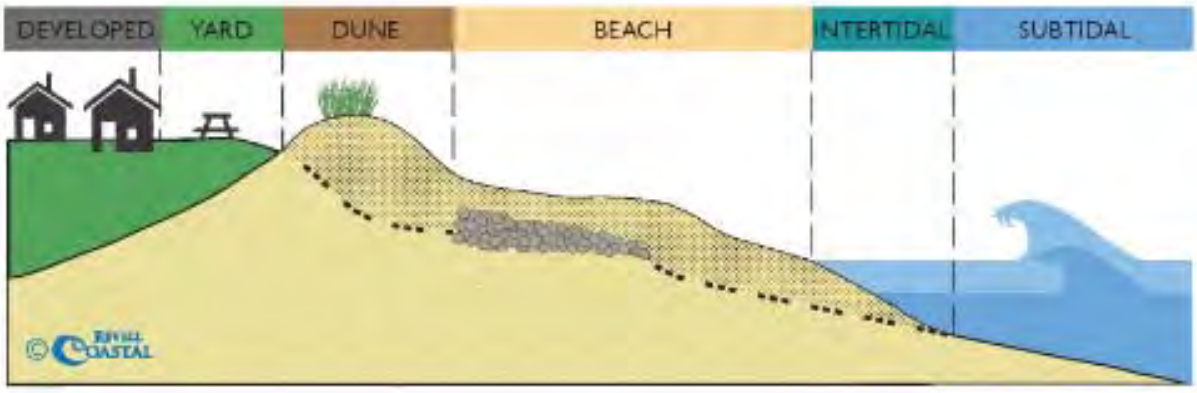


***Figure 8-3**. Example of a dune restoration/living shoreline concept. A cobble-based, vegetated dune complex system is a green and soft shoreline protection approach that would serve as a barrier to coastal flooding and erosion.*

Annual maintenance costs of a dune system is approximately $10,000 (2018) per acre per year, not including the cost of labor for dune maintenance (Natural Resources Agency 2018). If Carpinteria were to implement a vegetated dune system covering 10 acres, this would result in a cost estimate of approximately $100,000 per year for maintenance of a living shoreline. As with other adaptation strategies, costs associated with the establishment and maintenance of these systems would likely increase and would be influenced by the rate of sea level rise.

Dune concept for the Cardiff State Beach living shoreline project, which would utilize dunes instead of rock revetments to ensure protection for the adjacent roadways. Photo Source: California Coastal Conservancy.

Regarding project implementation funding, living shoreline efforts would be eligible for USACE funds following the Feasibility Study. As such, construction of a dune system or similar living shoreline design is an eligible project under a USACE Project Partnership Agreement. In addition, the City has applied for grant funding under the 2019-2020 Caltrans Adaptation Planning grant to further the planning of this adaptation measure. Additional grant opportunities could be obtained for both planning and implementation efforts, including grants from the California Department of Boating and Waterways, the California Coastal Conservancy, and other entities.

Ultimately, the living shoreline adaptation strategy would partially address vulnerabilities to the 43 acres of land area within the City currently vulnerable to existing beach erosion and coastal flooding. This includes an initial 79 residential parcels and 19 structures currently at risk, in addition to 42 open space and recreational parcels such as the State

Beach and campgrounds, and 3 public facility parcels currently at risk. These properties could be subject to private property damages or loss equating to over $8.5 million in the City (2017 value) (refer to Section 6.1, *Land Use and Structures*). These damages are likely to escalate with sea level rise. As a next step, the living shoreline concept requires additional study; as is the nature of dune systems, this protection measure has the potential to be dynamic in the long term and may be adjusted to optimize effectiveness.

Sediment Management

Sediment is nature's adaptation resource and its delivery to the coastal beaches, dunes, and estuaries is instrumental in habitat maintenance and natural defenses. Regional sediment management can augment existing sand and cobble supply to widen beaches and supplement naturally occurring sediment inventories. Wide beaches provide natural defenses against wave attack by dissipating wave energy and buffering the bluffs, dunes, and land uses from erosion. The maintenance of a wide and sandy beach, which can result from management of sediment transport as has naturally occurred historically, has widespread economic and recreational benefits for nearby communities.

The Carpinteria City and State Beach once housed cobbles, which slowed erosion, particularly during the winter season's higher intensity storms and associated wave action.

In the early 1970s, USACE constructed debris basins in the Santa Monica Creek and Carpinteria Creek watersheds to prevent alluvial flooding of the Carpinteria community below and protect floodprone areas downstream (Santa Barbara County Flood Control and Water Conservation District 2017). However, this has created an unintended consequence of intercepting and exporting coastal sediment from the watershed instead of allowing it to flow its natural course to the ocean, thereby replenishing the shoreline. Fifty years after the debris basin installations in Carpinteria, the loss of natural beach cobble quantities is visible. A revised sediment management plan, in coordination with BEACON, to replenish the City's shoreline with currently exported sediment would help to re-nourish the beach and improve coastal resiliency. Adaptation strategies that export sediment from the watershed to sandy beaches to mimic historical natural processes would go a long way to improve coastline resiliency within existing funding levels.

Table 8-5. Proposed Adaptation Strategy - Sediment Management

Adaptation Strategy	Sediment Management		
Implementation Timeline	Planning: 1-2 years	Permitting: 1-2 years	Implementation: Ongoing - 20+ years
Trigger	Near-term, based on a beach width distance, based on comparisons to historic trends		
Tipping Point	Beach Erosion & Coastal Flooding Hazards (approximately 1 foot sea level rise)		
Potential Resource/Asset Benefits	• Provides a native source of beach nourishment • Increases and retains the quantity and quality of sand that is on the beach, potentially increasing the width of the beach • Complements other adaptation strategies including the Living Shoreline, by maintaining beach nourishment • Reduces the rate of sandy beach erosion • Enhances recreational value		
Costs & Impacts	• High ongoing costs (approximately $743,000 to $6 million annually) • Less effective over time with increasing rates of sea level rise, particularly as higher waves and larger storms have the potential to result in greater erosion rates • Sediment transport via truck trips may adversely affect City road networks and create short-term land use conflicts (e.g., noise, recreational access, commercial and residential activities) • Nourishment activities may have adverse impact on existing habitat with disruptive equipment and possible burial • Ecosystem recovery may be inhibited if fill material is too fine or coarse compared to native sand		
Permitting & Coordinating Agencies	USACE, USFWS, CCC, State Parks, CSLC, Caltrans, CDFW, County of Santa Barbara, BEACON member agencies		
Next Steps	• Secure funding sources from grants • Coordination with federal, state, and local agencies • Public outreach		

Development of a regional opportunistic sediment placement program for cobbles and sand with the designation of specific receiver sites (e.g., at Ash Avenue and upcoast at Santa Claus Lane) is a high priority for the City in coordination with other agencies, including the County and BEACON. Regional sediment management is currently described in the BEACON CRSMP and, as noted, updates to the CRSMP to address sea level rise are currently being pursued (refer to *Pending Projects* above). Partnerships with the County Flood Control District and BEACON would be required to ensure successful regional management, including the need for a consistent sustainable funding source and regulatory permit requirements. Changing the approach to local debris basin cleanout activities and the deposition of these materials within the watershed should be investigated, as well as transport to Carpinteria Beach or

other adjacent coastlines, depending on the extent of sediment transport, sediment quality and quantity, and potential regional benefits. Consideration of mud placements in the Carpinteria Salt Marsh should also be investigated to increase sediment discharge from the Marsh that would ultimately elevate the marsh to keep pace with sea level rise and result in increased sediment transport along the coastline.

There are several components to a successful shoreline sediment management program that would benefit the City. This could include the following:

- Work with BEACON to update the CRSMP that includes sea level rise and addresses not only sand, but also cobbles and muds.
- Develop a flexible regional opportunistic sediment placement program that identifies and permits specific placement or receiver locations in and upcoast of the City for appropriate sediment sizes.
- Streamline regulatory approvals with extended permit duration (e.g., 20 years).
- Regulate existing practices that export debris basin sediments out of the watershed.
- Create sustainable local, state, and federal funding programs.

Mechanical sand nourishment, as opposed to natural sand nourishment transported via creek watersheds, is a coastline protection strategy; however, this approach can be costly. Sand-only nourishment projects can require millions of dollars in funding annually with a permit process and regulatory requirements sometimes constituting a substantial portion of project costs. Following the investment of time and resources, large wave events can strip beaches of all past nourishment and can require full replacement of beach nourishment. Additionally, the time at which a storm occurs over the studied span of sea level rise, directly influences the volume of sand needed for replenishment; a storm that occurs at approximately 1 foot of sea level rise would displace less sand and have a smaller re-nourishment cost than a storm event occurring at approximately 5 feet of rise. Finally, sediment nourishment becomes less effective with higher rates of sea level rise due to higher wave action and the potential for higher rates of erosion, particularly during the winter season.

Though sand retention and wave action are variable by beach location and orientation, an illustrative ongoing sediment management program is occurring at Goleta Beach County Park, a 0.74-mile-long beach approximately 20 miles west of the City. Goleta Beach has been subject to periodic nourishment as a permitted sediment receiver site and annual monitoring by the County since 2003. This program helps to maintain the beach's width, which ranged from 100 to 200 feet wide since monitoring commenced in 2003. This regular nourishment ceased in 2011 when regional drought conditions dramatically reduced the supply of sediment requiring disposal by County Flood Control District. Between 2003 and 2011, approximately 533,000 cubic yards of sand sourced from County Flood Control District was deposited on the beach by mechanical methods, with nourishment averaging nearly 55,000 cubic yards per year. This is approximately 14,100 cubic yards of sand

required per 1,000 linear feet of beach. Applying these values to the approximate 1.0-mile length of Carpinteria's beaches, this suggests that maintenance of Carpinteria's beaches via sand nourishment would require approximately 74,300 cubic yards (or 56,806 cubic meters) of sand for annual beach nourishment. The cost of annual nourishment has been estimated at approximately $10 (2010) per cubic meter ($7.64 per cubic yard) for Carpinteria (Department of Boating and Waterways & San Francisco State University 2010), meaning that this strategy would cost approximately $568,000 per year under current conditions. When accounting for sea level rise, nourishment volumes required to keep pace with sea level rise intensely increase, and may require 2 to 8 times the volume of sand and sediment depending on the height of sea level rise (Flick & Ewing 2009). If Carpinteria's coastline required approximately 8 times the amount of sand coverage to ensure adequate nourishment under a high sea level rise scenario, this would necessitate approximately 594,600 cubic yards of sand annually, with an associated cost of nearly 6 million dollars per year for nourishment. This assumes that adequate sand would be available and associated costs do not increase.

Further, permit processes can take several years and the short duration of permits (e.g., 10 years) can require expensive repetitious permit processes for similar projects. Sustainable funding, longer-term permit durations (e.g., 20-year program-level permits), and increased regulatory flexibility should be explored if beach nourishment is to play a major role in sea level rise adaptation.

Similar to the living shoreline adaptation strategy, the sediment management adaptation strategy would reduce vulnerabilities to the 43 acres of land area within the City currently vulnerable to existing beach erosion and coastal flooding and may partially assist to protect portions of the 170 acres projected to be affected by approximately 5 feet of sea level rise. However, as noted, the effectiveness of sediment management will ultimately wane as sea levels rise.

Sand Retention Structures

Sand retention structures can take many forms. The most common is called a groin, a rigid structure built from an ocean shore that interrupts the movement of sediment downcoast. Locally, a groin is in place in neighboring Ventura along the Pierpont Neighborhood. Other types of sand retention structures can include a recreational pier with a dense or impermeable set of support piles near the shoreline. Another form of sand retention is known as headland control in which a headland (e.g., near Tar Pits Park) could be extended seaward to limit sand movement. Larger retention structures may need to have ramps or other public accessways to maintain lateral coastal access. These types of structures would also require potentially complex engineering, permitting, and discretionary review, particularly related to consistency with the Coastal Act and local coastal policies.

Additionally, other structures have sand retention value while reducing the physical disturbance/presence of the structure and associated costs. As described below, these options include a cross-shore structure or headway of rock or cobble that limits sand movement downcoast and an offshore breakwater or reef that retains sand in-place by reducing wave energy before it reaches the beach. Sand retention structures could reduce vulnerabilities to the 546 parcels within the City that would be vulnerable to existing beach erosion and coastal flooding with approximately 2 feet of sea level rise and 256 associated structures and may partially assist to protect portions of the 170 acres projected to be affected by approximately 5 feet of sea level rise. However, as noted, the effectiveness of such structures would ultimately decrease as sea level rises.

Table 8-6. Proposed Adaptation Strategy - Sand Retention Structures

Adaptation Strategy	Sand Retention Structures		
Implementation Timeline	Planning: 3-4 years	Permitting: 4-5 years	Construction: 3-8 years
Trigger	Near- to Mid-term, based on sea level rise elevation and beach width distance, as indicated by a change from historic trends		
Tipping Point	• Beach Erosion & Coastal Flooding (approximately 2 feet sea level rise)		
Potential Resource/Asset Benefits	• Physically maintain existing land area with associated infrastructure • Capture sand drift within retention structures • Prevent loss of sand and associated habitats along shoreline • Potentially increase effectiveness of winter berm or living shoreline improvements, depending on placement • Potentially provide recreational opportunities along physical structures		
Costs & Impacts	• Construction costs • High ongoing maintenance costs required • Less effective over time with increasing rates of sea level rise, unless the installed structures are modified or heightened over time • Potential loss or alteration of public views • Disruption of natural sand drift along coastline • Alteration to wave energy, potential associated loss of coastal access and recreational opportunities (e.g., surfing)		
Permitting & Coordinating Agencies	California State Parks, CCC, CSLC, County of Santa Barbara, USFWS, CDFW		
Next Steps	• Coordination with state and adjacent jurisdictions on project feasibility • Modeling, engineering, and additional environmental investigations required • Extensive public outreach • Identify and secure funding sources from public agencies or grants		

Cross-shore Sand Retention Structures/Headways

A cross-shore rock revetment has been implemented in Plum Island, Massachusetts, to retain sand and protect vulnerable neighborhoods from beach erosion. Photo Source: City of Newburyport.

Sediment transport along the Carpinteria shoreline is predominantly from west to east. In areas with dominant along coast sediment transport, cross-shore sand retention structures tend to trap sand upcoast of the retention structure in what is called a "fillet" and are often used to widen beaches and provide more natural defenses to coastal wave hazards. While a stone revetment may provide more suitable habitat for shorebirds and other coastline species, cobble can be utilized to provide a stable base for dune placement and maintain public access to the beach, as described above for *Living Shoreline* (Komar & Allan 2010). Both rock revetments and cobble are appropriate materials to dissipate wave energy, though cobble can be more effective at reducing sand placement loss (Komar & Allan 2010). Though these protection options may be challenging to design consistent with the Coastal Act and local coastal policies, they may be options to consider for sand and sediment retention along the City's shoreline.

Specific design considerations must be examined to avoid downcoast impacts resulting from the interruption of sand transport caused by the cross-shore structure. This typically involves beach nourishment both up and down drift of the retention structure to prevent loss of sand to downcoast beaches, emphasizing the need for regional coordination for such projects. As these types of projects result in potential regional changes to sediment, adjacent jurisdictions would need to be involved in the process; extensive outreach to these jurisdictions would be required along with a technical feasibility study to determine cost-benefits, structural design, funding, and processing requirements. The process would also involve agency permitting and environmental review.

Offshore Breakwater/Reefs

Erosion and coastal flooding are often caused by large waves running up the beach. If the wave energy can be reduced before it reaches the coast, then less beach erosion and flooding would occur. Carpinteria Reef already provides some natural defense in reducing wave energy by causing some waves to break farther offshore. However, as an adaptation strategy, engineered offshore structures could further dissipate wave energy. Offshore structures can reduce wave energy as it reaches the shore to reduce sand movement from the beach and, as a result, slow sand transport along the shoreline, acting as retention structures. The most common form of offshore structure is an offshore breakwater (e.g., Ventura or Channel

Islands Harbor), or a multi-purpose reef which may provide shoreline protection, recreational benefits and habitat benefits (e.g., Natural Shoreline Infrastructure oyster reef projects in San Francisco Bay) (The Nature Conservancy 2017). These structures can be designed to mimic nature-based solutions that are made of natural material (rock) and can replicate natural rocky structures offshore. Regarding offshore artificial reefs, both natural (e.g., recycled shell, gravel) and manmade (e.g., concrete, aggregates) materials can be used to construct artificial reef elements. Prior Natural Shoreline Infrastructure oyster reef projects in San Francisco Bay have used concrete "Reef Ball" installations, which cost approximately $500 to $550 (2018) per linear foot in a direct line, and between $700 to $1,000 (2018) per linear foot when arranged to accommodate a denser installation pattern (California Natural Resources Agency 2018). These options would similarly require initial outreach with adjacent jurisdictions, followed by an extensive feasibility study to determine the permit path and potential regional impacts.

Storm Drain Improvements

Formerly natural bottom Franklin Creek has been channelized within a concrete box channel to convey stormwater runoff to Carpinteria Salt Marsh. When combined with storm surges, Franklin Creek can contribute to localized flooding.

Within the City, the Franklin, Santa Monica, Carpinteria Creeks, and 316 storm drain inlets and outfalls that discharge to the nearest body of water all rely upon gravity flow for storm water drainage. A major infrastructure challenge associated with sea level rise is the need for efficient rapid drainage of storm water; however, the existing storm drain system lacks the elevation requirements necessary for a gravity flow system to accommodate current and projected storm events. Additionally, storm water is not diverted to the Carpinteria Waste Water Treatment Plant (WWTP) for treatment and no pumps exist to convey storm water. Within the Beach Neighborhood, some storm drains are located down-gradient from outfall locations, at a lower elevation than necessary for gravity flow, which is a problem that becomes exacerbated during high tide storm events when outfalls can be inundated. Presently, the existing infrastructure is not always able to accommodate all storm water flow, which can flood portions of the Beach Neighborhood and Downtown. As sea levels rise, greater portions of the system may not drain during high tides and during more of the tide cycle, which in turn may increase storm water flood depths and frequency. Culverts and pipes may also create back flows of ocean water into the neighborhoods.

Table 8-7. Proposed Adaptation Strategy - Storm Drain Improvements

Adaptation Strategy	Storm Drain Improvements		
Implementation Timeline	Planning: 3-4 years	Permitting: 4-5 years	Construction: 2-10 years
Trigger	Near- to Mid-term, based on sea level rise elevation		
Tipping Point	Coastal flooding & tidal inundation (approximately 2 feet sea level rise)		
Potential Resource/Asset Benefits	• Accommodate stormwater and inundation • Remove storm water from low-lying areas during rain events, and from future tidal inundation • Reduces the duration of flooding during storm water or tidal events • Can be relatively adaptable to higher volumes of water during pump replacements		
Costs & Impacts	• Construction/replacement costs (up to $4 million) • High ongoing maintenance costs required, and frequent maintenance checks to ensure operational reliability during storm or tidal inundation events • Requires reliable energy to operate during events		
Permitting & Coordinating Agencies	County Flood Control District, CCC, CSLC, Caltrans		
Next Steps	• Establish a Citywide Capital Improvement Program (CIP) to incorporate "Green Street" and storm water infrastructure in public right of way improvement projects to increase permeable surfaces and support improved drainage/storm water runoff/infiltration through the City • Evaluate the need to replace existing culverts that may contribute to coastal hazards • Investigate the use of pumps to move water out of areas affected by future tidal inundation areas • Public outreach • Secure construction and operational funding sources (e.g., assessment district, public agencies, etc.)		

The City recommends investigation of the use of storm water pumps and/or lift stations (pumps) to move water out of the Beach Neighborhood. Investigation should be focused along inland portions of Ash Avenue and Linden Field, which experience tidal inundation with areas of ponded flood waters from rainfall event storm water runoff. As tidal inundation increases with sea level rise, even without heavy rainfall or runoff events, the use of pumps to move water out of the lower-elevation areas could be investigated. The use of pumps is moderately adaptable, as the pumping capacity could be increased or improved over time when the pumps need to be replaced. As the necessary volume of water to be pumped increases, operational and maintenance costs would likely escalate over time. Additional challenges for the operation of storm water pump systems can include accommodating the large amounts of fibrous material and solids that often accompany storm water.

Accommodation for storm drain improvements could be integrated into the City's Capital Improvements Program (CIP). The action item would have the intent of improving storm water runoff, reducing tidal inundation, and accommodating larger volumes of storm or tidal water that have the potential to inundate vulnerable areas of the City. The range of options for consideration under the CIP action item should also include potential tide gates, mud flaps, and creek alterations that could be utilized as preventative measures before storm water or tidal effects can reach the storm drain systems (e.g., inlets, outfalls).

For the City, the storm water infrastructure that is vulnerable includes approximately 6 outlets, 3 outfalls, and 1.0-mile of storm drains, which would likely require a moderately sized storm water infrastructure installation. Examination of precedent storm water infrastructure projects that have included the installation or replacement of storm water pumps, lift stations, and associated maintenance results in a variety of associated costs. The installation of a comparative moderate size pump or lift station systems can range from $3 to $4 million, with replacement projects estimated at $100,000 to $3 million (California Division of Financial Assistance 2011; City of Huntington Beach 2018).

Coastal Adaptation Overlay

Overlay zoning is a regulatory tool that places a special zone district over an existing base zone with additional regulations and incentives. The overlay zone identifies special provisions in addition to or instead of the base zone given special circumstances to promote planning for orderly development and to provide protection of the public's health, safety, and general welfare.

Consistent with the Sea Level Rise Policy Guidance (CCC 2018), a Coastal Adaptation Overlay could provide a flexible ongoing and long-term strategy for the City to address land use and infrastructure vulnerabilities that could become at risk from coastal hazards affected by sea level rise in the future. Currently, other types of hazard overlay zones already exist within the City, such as FEMA floodplain management zones, which serve to reduce potential risks to development and infrastructure within the hazard zone. The Coastal Adaptation Overlay, in the near term, could increase awareness of potential hazards through real estate disclosures, provide for specific considerations of those hazards in land use and infrastructure planning processes. Based on the projected time of exposure, siting and construction standards may be applied including, but not limited to, increased setbacks, relaxed building heights, limitations on habitable first floors, and use of flexible construction methods (e.g. movable foundations) based upon site specific technical studies. Over time additional regulations could be implemented as the City determines appropriate responses to hazard avoidance. In the long term, the Coastal Adaptation Overlay could help inform future expectations for coastal development located in geographic areas at risk of coastal hazards and sea level rise.

Implementation of a Coastal Adaptation Overlay Zone could address potential risks to private property, reduce liability for the City, and accomplish multiple adaptation objectives. The purpose of the Coastal Adaptation Overlay Zone could be to minimize risks to life and property and manage and protect important resources and services from the adverse effects of sea level rise. For example, an overlay zone would define the nature, intensity, scale, uses, and location of suitable development within projected hazard areas. An important aspect of this overlay is that it may be able to provide more flexibility in design and/or use than is currently permitted by the base zone regulations. Standards for increased heights or mixed uses could also be incorporated into the overlay zone to respond to changing sea level rise conditions. As determined necessary and appropriate, the Coastal Adaptation Overlay Zone could also provide a framework to transition at-risk development away from coastal hazards and/or could implement the concepts of managed retreat over time, by including standards for gradual relocation of development away from the increasingly hazardous surf and coastal flooding areas.

Table 8-8. Proposed Adaptation Strategy - Coastal Adaptation Overlay Zone

Adaptation Strategy	Coastal Adaptation Overlay Zone		
Implementation Timeline	Planning: 1-2 years	Adoption: 2-3 years	Implementation: 30+ years
Trigger	Near-term, based on sea level rise elevation and lead time for adoption and implementation		
Tipping Point	Erosion & Coastal Flooding Hazards (approximately 2 feet sea level rise)		
Potential Resource/Asset Benefits	• Minimizes risks to life and property • Allow landowners` to redevelop residential properties in a way that minimizes damage from potential coastal hazards • Informs the community about projected hazards • Minimizes “coastal squeeze”1 and the loss of public beach		
Costs & Impacts	• Private costs of property damage and repairs • Over time, potential loss in property taxes and TOT • In the long term, potential loss of housing and short-term rentals in the Beach Neighborhood		
Permitting & Coordinating Agencies	CCC, State Parks, Special Districts (Carpinteria School District)		
Next Steps	• Monitor coastal flooding frequency and sea level rise elevation • Public workshops to distrubite information and provide input • Establish overlay zone based on projected coastal hazard mapping and best available science • Develop a Repetitive Loss Program consistent with CCC Residential Adaptation Policy Guidance (2018) • Adopt an ordinance including standards and procures that apply to the overlay • Consider integration with assessment district for reliant services wtihin the overlay zone • Integrate program framework into future cycles of Plan updates		

[1] *Coastal squeeze = loss of the beach due to the migration of the mean high tideline and fixed development that prevents the migration of the beach and intertidal area.*

The boundaries of a Coastal Adaptation Overlay Zone would correspond to best available science of projections of hazards. In addition, the boundaries of the Coastal Adaptation Overlay Zone should be reviewed periodically (e.g., every 5 to 10 years) to incorporate emerging scientific understanding of sea level rise and coastal hazards, as well as regional approaches to adaptation planning. Examples of adaptation strategies that may be explored in the future could include overwater or floating structures. Ultimately, the Coastal Adaptation Overlay Zone would address vulnerabilities to the 380 acres and 23 percent of land area within the City projected to be vulnerable to coastal hazards with approximately 5 feet of sea level rise. This includes 769 residential parcels, 20 commercial parcels, and 10 industrial parcels. These properties could be subject to private property damages or loss equating to over $346 million (refer to Section 6.1, *Land Use and Structures*).

The Coastal Adaptation Overlay Zone would define policy considerations and establish required processes triggered by actions. Such requirements may include:

- Provision of a Notice to Property Owner at the time of transfer of real property to future buyers within the Coastal Adaptation Overlay Zone of coastal hazard related development requirements. Such requirements could include, but are not limited to, building coverage, height, raised floors, or other adopted strategies. This disclosure would also inform interested buyers of potential hazards (e.g., erosion, flooding, inundation, possible intrusion onto public trust lands, etc.) as a result of climate-induced impacts, such as sea level rise.
- Submittal of site-specific Coastal Hazard and Sea Level Rise reports as part of a Coastal Development Permit application. The reports would evaluate specific risks for proposed structural development or for exterior expansions of habitable space in existing development, identify design requirements to ensure compliance with health and safety codes, and estimate the life expectancy of the development.
- Authority to implement necessary development requirements (e.g., increased base floor elevations, building heights, development setbacks, use of perimeter foundations, etc.) within the Coastal Overlay Zone would be based on findings of the Coastal Hazard and Sea Level Rise reports and/or compliance with planning and building codes for new structural development, including additions to habitable space.
- An indemnification agreement between the City and prospective applicants acknowledging coastal hazard risks and owner-assumption of damages resulting from development proposed in the Coastal Adaptation Overlay Zone.
- The City's CIP could include a provision to investigate and identify eligible roads within the Coastal Adaptation Overlay Zone that could be elevated or relocated. This study would also identify priority road segments, schedules, and methods (e.g., additional pavement improvements during established road resurfacing activates).
- The City and residents could consider creation or modification of an assessment district to address costs of special public services or improvements.

- Consistent with Coastal Commission guidance, the Coastal Adaptation Overlay may establish a prohibition of seawalls and hard armoring along the City and State Beaches.
- The planned/expected life of development and redevelopment could be standardized. The following table is provided as a recommended life of development based on state guidance and other jurisdictional policy approaches (Table 8-9). Coastal Development Permits may be required to include analysis of the effects of sea level rise and coastal hazards, identify and incorporate adaptation strategies into the project, and discuss the adaptive capacity of the development as part of the application process.

Table 8-9. Proposed Expected Life of Development and Redevelopment

Type of Development	Life Expectancy
New Development*	
Auxilary structures, coastal dependent amenties	5-25 years
Commercial or Industrial Development	75-100 years
Residential Development	75-100 years
Critical facilities – (water supply, wastewater, transportation corridors)	100-150 years
Major redevelopment (>50 percent)**	
Auxilary structures, coastal dependent amenties	10-20 years
Commercial or Industrial Development	25 years
Residential Development	50 years
Critical facilities – (water supply, wastewater, transportation corridors)	75 years
Minor redevelopment (<50 percent)**	
Auxilary structures, coastal dependent amenties	5-10 years
Commercial or Industrial Development	15 years
Residential Development	20 years
Critical facilities – (water supply, wastewater, transportation corridors)	25 – 50 years

Critical facilities should consider the extreme H++ scenario (9.8 feet by 2100) for sea level rise planning.
**These values are based on the Draft Residential Adaptation Planning Guidance, Model Policy A.2 approach to redevelopment and may be refined based on State guidance (CCC 2018).*
***This 50 percent threshold is based on existing General Plan Safety Element Objective S-4 Implementation Policy 14, which states, "All new construction or reconstruction, additions and remodels that have a valuation exceeding 50 percent of the valuation of the existing structure, shall be constructed to be protected from wave action."*

Benefits of the Coastal Adaptation Overlay Zone include the provision of additional adaptation options for properties within defined coastal hazard areas without negotiating on a case-by-case basis. Providing an overlay zone provides clarity and certainty and avoids the need for developers to seek costly and time-consuming variances for projects that are designed to avoid or accommodate sea level rise hazards but may not be consistent with existing zoning or development standards. An overlay also provides the City with a mechanism to implement comprehensive programs and policies associated with future land use and sea level rise hazards, as necessary, such as a repetitive loss program (see below).

Costs associated with this strategy assumed by the City would be largely administrative, including adoption of a zoning amendment and formal actions by the governing bodies. Adoption of a Coastal Adaptation Overlay Zone may present political challenges within the community that result in delays in adoption and implementation, including economic, social, and legal uncertainties. Implementation of a Coastal Adaptation Overlay Zone would require City planners to have detailed technical knowledge of sea level rise hazards and current projections, as well as local building and engineering requirements to address such hazards. Additional regulations for development and redevelopment within the overlay zone add a layer of requirements to the development review process and may increase time and expense for both developers and for agencies involved in the development approval process.

Repetitive Loss Program

The primary objective of a repetitive loss program is to reduce damage to private property, injury or loss of life, demand on emergency services, and disruption to public services caused by frequent flooding and associated damages. The Federal Emergency Management Agency (FEMA) operates a nationwide repetitive loss grant program authorized under the National Flood Insurance Act of 1968 with the intent of eliminating or reducing the long-term risk of flood damage. FEMA defines repetitive loss as any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. In addition, single family properties (consisting of one to four residences) that have incurred four or more separate flood-related damage claims totaling over $20,000 are considered “Severe Repetitive Loss” under FEMA. A repetitive loss property may or may not be insured by the NFIP. Currently, there are over 122,000 repetitive loss properties nationwide. FEMA may act on severe repetitive loss properties, including acquisition, demolition, or relocation of flood prone structures and deed restricting property for open space uses in perpetuity (FEMA 2018).

Under a repetitive loss program, a property that repeatedly experiences substantial damages from storms and coastal flooding within a given period may not be permitted to redevelop. It is important to note, however, that the City’s intent is to combine this adaptation strategy with other protection strategies, such as a living shoreline and beach nourishment, which could provide an additional buffer for private development from coastal hazards in the near-term. Nonetheless, in the mid to long term and with higher elevations of sea level rise, protection strategies may be less effective and could result in loss or damage to private property. In addition, in the long term, the City may experience a loss of housing units and short-term rentals, resulting in economic losses to the City in the form of tax revenue and transient occupancy tax (TOT) from hotels and short-term rentals. Prior to implementation of a repetitive loss program, the City would continue to monitor triggers such as storm frequency and sea level rise and evaluate the effectiveness of this measure with consideration to social, economic, and environmental effects.

As a mid-to-long term adaptation strategy, the City may choose to implement a repetitive loss program that allows properties subject to repetitive loss to be downsized, moved away from the shoreline, or in extreme cases with frequent and severe damages, may even grant the City, State, or other public agency the right of first refusal to purchase the property and restrict for open space uses. Any such program would be designed to be consistent with FEMA's repetitive loss program. In accordance with the CCC *Draft Residential Adaptation Guidelines* (2018), the City could choose to adopt a policy within the CLUP/General Plan Update that provides a mechanism for such a program to be developed when necessary and appropriate based on the increase of coastal hazards.

Table 8-10. Proposed Adaptation Strategy - Repetitive Loss Program

Adaptation Strategy	Repetitive Loss Program		
Implementation Timeline	Program Development: 1-2 years	Adoption: 1-2 years	Program Implementation: 30+ years
Trigger	Near to Mid-term, based on storm damage frequency and severity		
Tipping Point	Erosion, Coastal Flooding, and Inundation Hazards (approximately 2 feet sea level rise)		
Potential Resource/Asset Benefits	• Minimizes risks to life and property • Minimizes "coastal squeeze"[1] and the loss of public beach		
Costs & Impacts	• Private costs of property damage and repairs • Over time, potential loss in property taxes and TOT • In the long term, loss of housing and short-term rentals in the Beach Neighborhood		
Permitting & Coordinating Agencies	FEMA, Cal OES, CCC		
Next Steps	• Monitor coastal flooding frequency and sea level rise elevation • Develop a Repetitive Loss Program consistent with CCC *Residential Adaptation Policy Guidance* (2018) • Integrate program framework into future cycles of Plan updates		

[1] *Coastal squeeze = loss of the beach due to the migration of the mean high tideline and fixed development that prevents the migration of the beach and intertidal area.*

Currently, 79 residential structures are vulnerable to damage and flooding from coastal hazards; an additional 164 residential structures become vulnerable with approximately 1 foot of sea level rise, 234 additional residential structures become vulnerable with approximately 2 feet of sea level rise, and 264 additional residential structures become vulnerable with approximately 5 feet of sea level rise, for a total of 769 structures (refer to Table 6-1). This translates to over 45 acres of residential land uses. It is anticipated that over time, sea level rise would result in repetitive loss to at least a portion of these structures.

8.3 Regional Assets and Multi-Jurisdictional Coordination

Several of the critical facilities and assets within the City that are vulnerable to sea level rise are managed by other local, state, and federal agencies. These include UPRR, U.S. 101, Carpinteria State Beach, the WWTP, and Aliso Elementary School. Adaptation measures for these assets or facilities requires coordination, collaborative regional solutions, and partnerships with adjacent and affected jurisdictions and entities, including the County of Santa Barbara, University of California Natural Reserve System, California State Lands Commission (CSLC), CCC, BEACON (and member jurisdictions), State Parks, USACE, the California Governor's Office of Emergency Services (Cal OES), and FEMA; infrastructure and transportation providers, such as Caltrans (District 5), UPRR, Metropolitan Transit District (MTD), and LOSSAN; and special districts including the Carpinteria Unified School District (CUSD), Carpinteria Valley Water District (CVWD), and WWTP.

Good adaptation planning is collaborative, considering interconnected ecological, social, political, and economic systems. Partnerships and dialogue between the City and agencies would be essential in developing and implementing sound regional adaptation strategies. Through coordination with other jurisdictions and agencies, the adaptation planning process aims to improve coordination and leverage local resources to minimize vulnerabilities and impacts associated with sea level rise.

UPRR Corridor

The UPRR railroad corridor runs south of U.S. 101 and through the City, including all three Study Areas; Beach Neighborhood (Area 1), Carpinteria Salt Marsh (Area 2), and Carpinteria Bluffs (Area 3) (see also, Section 8.4, Neighborhood Area Specific Approaches). At its closest, the corridor is approximately 290 feet landward of the mean high water (MHW) tideline along the Carpinteria Bluffs.

Future railroad track improvements by the LOSSAN Rail Corridor Agency provide substantial opportunities for each of the Study Areas in the City. UPRR intends to construct an additional railroad track at the Carpinteria Station by 2023. A 0.4-mile segment of track will be elevated on a platform, and a pedestrian

UPRR plans to elevate 0.4 mile of track at the Carpinteria Station. These improvements provide an opportunity to address storm-based flooding vulnerabilities.

underpass will be constructed. Efforts to expand and raise the track are intended to increase pedestrian safety and expand train service provision in the region. Despite the inclusion of an underpass, this track elevation provides an opportunity to address storm-based flooding vulnerabilities. This project would impact 16 percent of existing railway within the City (LOSSAN Rail Corridor Agency 2018). LOSSAN has proposed a budget of $31.9 million for this project, the majority of which would be funded by the California Transit and Intercity Rail Capital Program ($30.3 million)(LOSSAN Rail Corridor Agency 2018). This program is intended to reduce state GHGs through improvements to public transportation systems. In addition to this project, there are several other opportunities for LOSSAN to protect rail infrastructure from the impacts of sea level rise and coastal storms.

Area 1: Beach Neighborhood

City and LOSSAN coordination of planned rail infrastructure improvements could provide significant opportunities to address storm-based flooding vulnerabilities to the railroad, which are projected to occur with approximately 5 feet sea-level rise by 2100 (refer to Figure 1-3). Elevation of the 0.4-mile segment of railroad within the Downtown provides an opportunity for integration of stormproof design elements that could enable segments of the railroad to function as a berm-like structure that could potentially protect the railroad and landward infrastructure from tidal inundation and coastal flooding, including structures and roadways in the Downtown.

Area 2: Carpinteria Salt Marsh

City and LOSSAN coordination could provide options to study and protect railroad tracks and nearby sensitive habitats in this Study Area. Strategic elevation of the track on causeways and bridges over creek inlets could allow upland wetland transgression into open spaces while protecting those portions of track from tidal inundation and high-water levels resulting from potentially simultaneous coastal and fluvial flooding associated with the Franklin Creek corridor. Alternatively, elevating the track on berms of cobble or other protective materials could potentially serve to protect the tracks while also providing protection to Aliso Elementary School and other developed uses adjacent to the railroad tracks. Additional modeling integrating coastal and fluvial flooding would inform agencies of preferred designs to address both coastal hazards and fluvial flooding associated with the creek corridor.

Area 3: Carpinteria Bluffs and Concha Loma Neighborhood

The rail tracks along the Carpinteria Bluffs are at risk of sea level rise and bluff erosion and may be realigned further inland in the future to protect the tracks and preserve marine ESHA.

The rail tracks along the Carpinteria Bluffs are the most seaward infrastructure at risk from sea level rise and coastal storms. Typical protective features of this portion of the railroad include cobble and hard armoring measures, which could protect the tracks as well as blufftop habitats, trails, and open space but would not allow potential landward migration of marine Environmentally Sensitive Habitat Areas (ESHA). Continuing to protect the tracks using this method would also reduce near- to mid-term bluff erosion, although loss of sandy beach due to scouring would be expected to occur. Protection measures may severely limit or eliminate public lateral beach access over time, submerge rocky intertidal and beach habitats, and result in degradation of the Seal Rookery and haulout area. Alternatively, the track could be realigned further inland to protect the tracks from cliff erosion and inundation while preserving marine ESHA. Financial and logistical challenges of negotiating private property easements along this section of the shoreline could be prohibitive.

In addition to strategy-specific challenges of implementation, coordination and financing of these adaptation measures would be a significant given the 351-mile LOSSAN Corridor travels through six counties, and is governed by the LOSSAN Rail Corridor Agency, an 11-member Board of Directors composed of elected officials representing rail owners, operators, and planning agencies along the rail corridor.

Despite such challenges, the City would pursue opportunities to coordinate with the LOSSAN Rail Corridor Agency and other regional jurisdictions to maintain and improve this important transportation corridor. The adaptation strategies chosen for these sections of railroad would play an important role in determining the rate and extent of bluff erosion, loss of public open space and trails, damage to existing development and/or impacts to beaches and ESHA. By establishing effective partnerships with these agencies, the City could ensure that a well-designed adaptation approach for the railroad synergistically protects important infrastructure such as recreational trails, downtown development, and residential neighborhoods.

U.S. 101

U.S. 101 and Carpinteria Avenue Southbound Exit 87B (pictured above) could be exposed to flooding during a storm when combined with approximately 5 feet of sea level rise or more. The City should continue to work with Caltrans to identify adaptation concepts.

The U.S. 101 corridor bisects the City, serves as the primary regional access route, and is under the jurisdiction of Caltrans. With approximately 5 feet of sea level rise, a nearly 1,500-foot section of the corridor, north of the Carpinteria Salt Marsh could be flooded during a large coastal storm event. The combined extent of flooding from a 1% annual chance storm and approximately 5 feet of sea level rise could be greater when combined with increased rainfall and creek runoff from Santa Monica, Franklin, and Carpinteria Creeks. Under the current worst case (H++) scenario, damage would occur earlier than 2100, and as soon as 2070, and may be more frequent and severe. Since U.S. 101 is subject to flooding with approximately 5 feet of sea level rise, significant economic cost to implement adaptive strategies and physical improvements are expected, as well as secondary socioeconomic costs to commuters, commerce, and travelers (e.g., delayed transport of goods and services, lost work days, alternative travel expenses, etc.). Significant coordination and collaboration between Caltrans and the City would be required to ensure protection from coastal hazards, particularly flooding. Caltrans has begun work statewide on sea level rise vulnerability assessments; however, District 5 is not scheduled to begin work for several more years.

The City has been awarded funding from Caltrans under the 2017-2018 Adaptation Planning Grant Program and has commenced investigations involving transportation policy and infrastructure adaptation planning (see Appendix E); initial data and concepts are incorporated into this Report. The scope of the Adaptation Planning Grant includes additional analysis of sea level rise impacts to transportation infrastructure with the City, impacts to vulnerable populations within the City, and the identification of adaptation strategies to build resiliency within the transportation network. In the long term, this may include capital improvements to improve drainage and conveyance beneath the U.S. 101 corridor, elevating the segment of U.S. 101 that is vulnerable to flooding impacts, or identifying alternative routes in case of closures. This grant award and the efforts of this Report serve as the first step towards planning for adaptation and/or protection of regional transportation services in coordination and collaboration with Caltrans. The City would need to continue to coordinate with Caltrans to efficiently facilitate such adaptation measures.

Carpinteria Sanitary District Wastewater Treatment Plant

The WWTP would be vulnerable to coastal flooding and inundation with approximately 5 feet of sea level rise. The City recommends coordination with CSD to identify potential capital improvements that will build resiliency.

The WWTP is located immediately north of Carpinteria State Beach and adjacent to Carpinteria Creek. The WWTP is an essential service that provides needed wastewater treatment services to the City and supplements or offsets heavily relied upon imported water supplies with recycled water capabilities. The WWTP would be subject to coastal flooding and inundation with approximately 5 feet of sea level rise. Further, seawater infiltration into sewer lines could result in potential complications or damages to the WWTP facility. The City recommends further coordination with Carpinteria Sanitary District (CSD) to identify and develop of mid- to long-term improvements to reduce coastal hazard risks, including installation of a fortified flood control wall along Carpinteria Creek, additional elevation and setbacks of any new facilities, and installation of back-flow protection devices. The City will continue to coordinate with the CSD regarding findings of this Report, as the CSD's current investigations to treat and distribute recycled water from the WWTP should consider future sea level rise hazards.

Aliso Elementary School

Aliso Elementary School serves approximately 400 students in the CUSD, ranging from kindergarten through fifth grade. The school is potentially subject to coastal flooding with approximately 2 feet or more of sea level rise, with potential flood damages increasing substantially with approximately 5 feet of sea level rise. Coastal hazards could be further exacerbated considering a higher H++ scenario (with ~5 feet of SLR occurring as soon as 2070), reducing the period to adapt Aliso Elementary School facilities from coastal hazards and rising sea levels. Further, Aliso Elementary School is already vulnerable to FEMA identified fluvial flood

Aliso Elementary School is near the Carpinteria Salt Marsh and could be subject to coastal hazards with approximately 2 feet or more of sea level rise.

hazards (see Appendix C); future coastal hazards exacerbated by sea level rise may increase these potential risks.

A variety of cost and benefit trade-offs between adaptation strategies exist and are essential to understand to help decision-makers determine the most effective policies and project-level adaptation strategies to implement. For Aliso Elementary School, such adaptation strategies may include both on- and offsite measures and regional approaches.

Protection

Protection strategies may include raising flood walls along Franklin Creek, increasing the elevation of the UPRR tracks, or installing floodgates at Franklin Creek, which would act as a dike to protect the school. Such actions would require CUSD coordination with other agencies such as the City, County Flood Control District, or UPRR. It should be noted that the LOSSAN project to double track the railroad east of Franklin Creek could potentially be designed to include raising the elevation of tracks; if this could be extended west of Franklin Creek, it may provide additional protection to Aliso Elementary School.

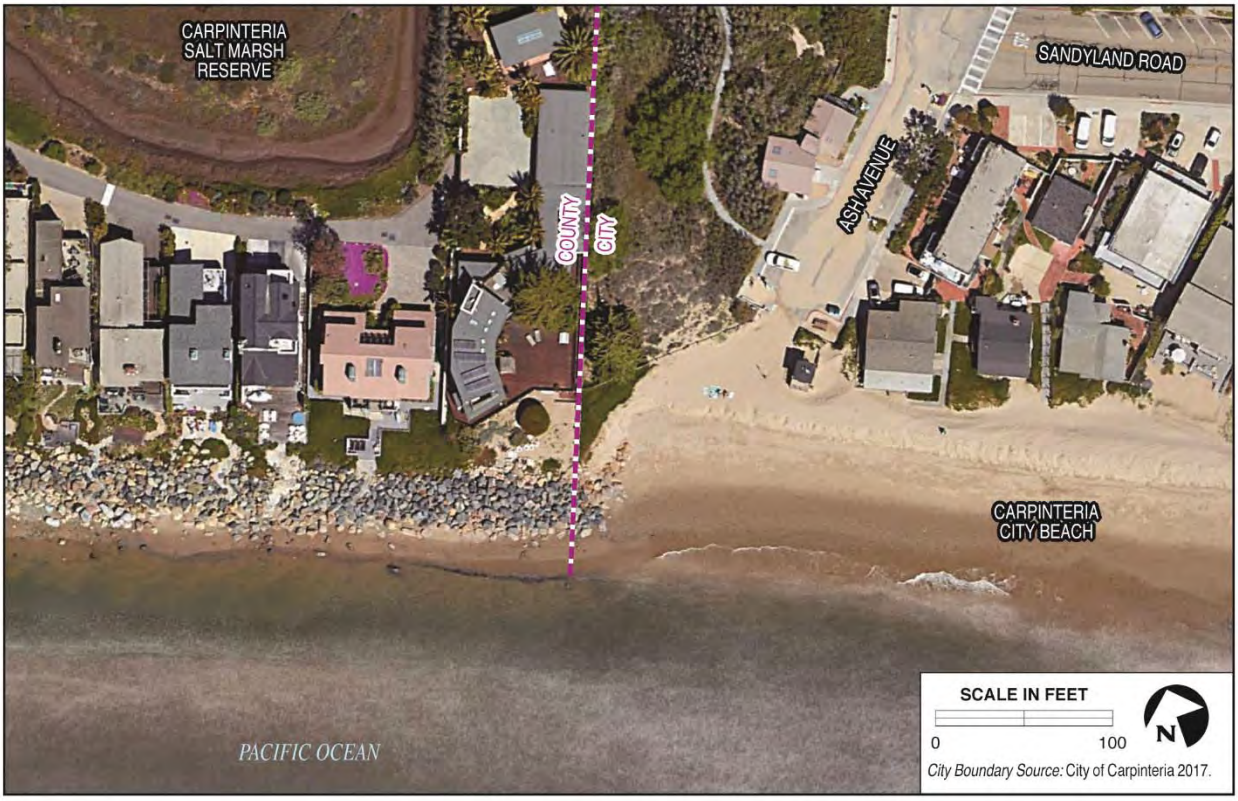
Accommodation

Potential adaptation options could include raising the finished floor elevations of existing or new structures above the elevation of projected flooding from the 1% annual chance storm event, as well as flooding associated with projected monthly tidal flooding at a greater frequency. Redevelopment of school structures onsite (e.g., elevating buildings, moving modular structures to higher elevations onsite, providing two-story clustered buildings, etc.) could be explored as the school considers renovations.

Next steps would include continued coordination between the City and CUSD to discuss the long-term approach for Aliso Elementary School. This would include continued discussions with the community and decision-makers about the potential pros and cons of each adaptation strategy for the School, and to reduce hazard risks and guide the selection of future adaptation strategies.

Sandyland Revetment

Presently there are minimal shoreline revetments within the City; however, the City experiences some impacts to Carpinteria City Beach at Ash Avenue as a result of the rock revetment fronting Sandyland Cove located within the County of Santa Barbara (refer to Figure 3-7; Figure 8-4). Coastal process research in Carpinteria has identified an erosion hotspot at Ash Avenue located at the end of the Sandyland revetment within the City



Approximate Sandyland Cove Revetment
City – County Boundary

FIGURE 8-4

jurisdiction (Barnard et al 2010). Presently, approximately 10 to 15 feet of the approximately 2,800-foot-long rock revetment, or less than one percent, is placed on the City Beach within City jurisdiction. This small segment interacts with waves during most high tides in the winter. This wave and revetment interaction causes accelerating erosion and is increasing the alongshore current velocities and scour potential along the revetment on Carpinteria City Beach (see Section 3.8, Historic Shoreline Changes and Erosion) Alteration, relocation, or removal of the revetment could reduce this erosion hotspot that primarily affects a small portion of the City Beach and Beach Neighborhood. As Sandyland Cove is largely within Santa Barbara County, any alterations to the revetment would need to be processed by the County in coordination with the City, in addition to the CCC and Sandyland Cove Homeowners Association (HOA). However, alteration of the revetment may result in significant changes and cost and may expose homes to wave attack or damage or potentially increase flooding in areas adjacent to the Carpinteria Salt Marsh.

8.4 Area Specific Approaches

This section is organized using a spatial approach, which outlines regional strategies and adaptation measures focused within the following three Areas:

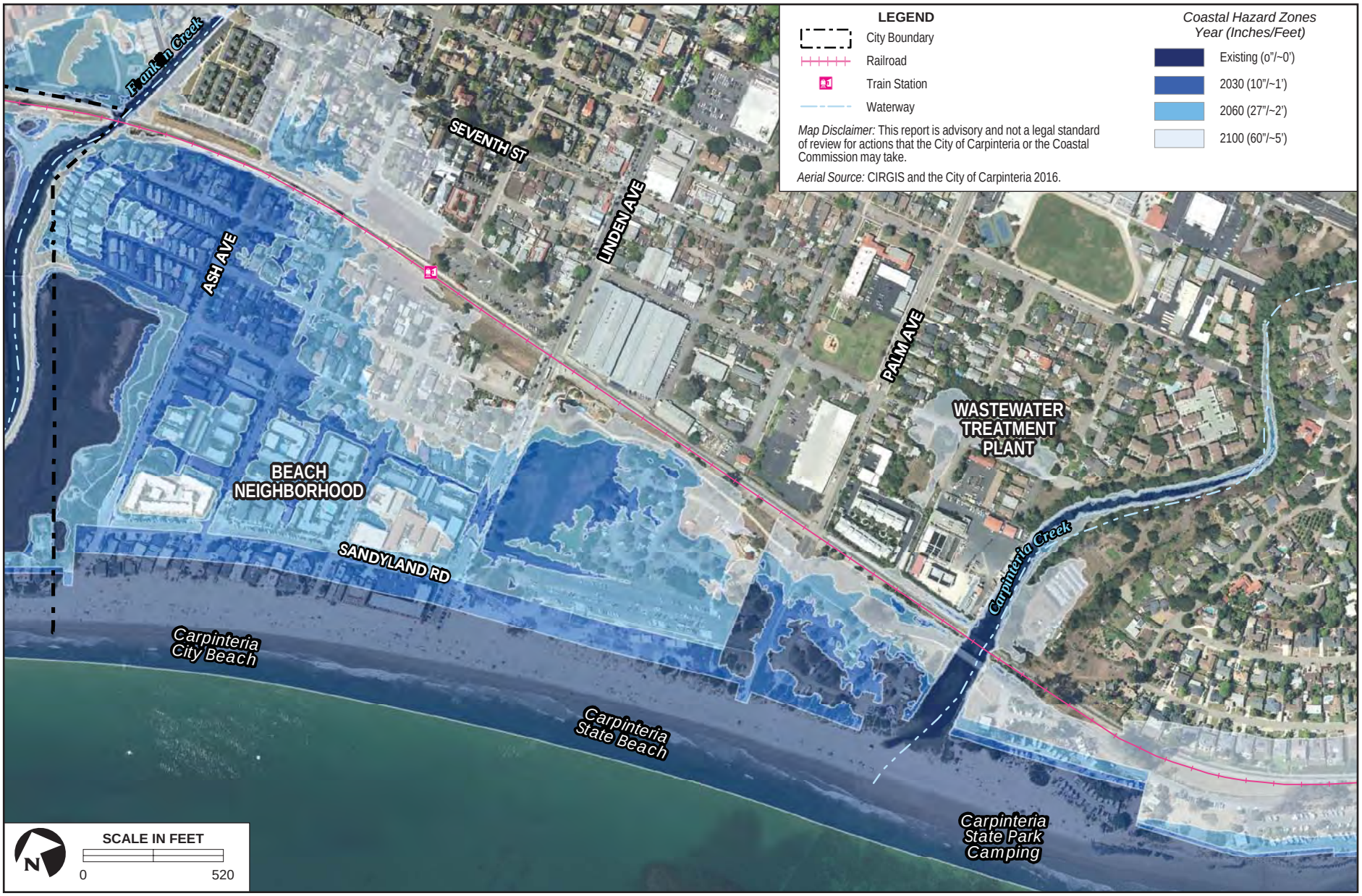
- **Area 1:** Beach Neighborhood (Ash Avenue to Carpinteria Creek)
- **Area 2:** Carpinteria Salt Marsh (includes Aliso Elementary School, Franklin Creek, and Carpinteria Avenue)
- **Area 3:** Carpinteria Bluffs and Concha Loma Neighborhood (Tar Pits Park, the Concha Loma neighborhood, and Carpinteria Bluff properties)

These three Areas are analyzed separately as the City's coastline contains three diverse coastal environments that provide separate planning challenges and key issues. These include urban beachfront backshore type (Area 1 – Beach Neighborhood; Figure 8-5), urban estuary backshore type (Area 2 – Carpinteria Salt Marsh; Figure 8-6), and urban bluff top backshore type (Area 3 – Carpinteria Bluffs and Concha Loma Neighborhood; Figure 8-7). Consideration towards the backshore landscapes and development intensity within each Area is an important factor in the success of an adaptation strategy. Adaptation strategies that the City could pursue to address vulnerabilities within each Study Area are presented below.

Area 1: Beach Neighborhood

Linden Avenue provides several public parking spaces for coastal access. With approximately 5 feet of sea level rise, the roadway and associated parking spaces could be lost to erosion or damaged by both episodic and periodic tidal flooding.

Area 1 is defined by the extent of potential hazards associated with the sandy beach and dune backshore environment, including beach erosion, coastal flooding, wave attack and runup, and tidal inundation. The Beach Neighborhood, Downtown, and Carpinteria State Beach and Campgrounds are landward of the one-mile length of sandy shoreline and are highly vulnerable to sea level rise and effects of coastal flooding and erosion (Figure 8-5). Important infrastructure and buildings in the Beach Neighborhood are exposed to coastal flooding, coastal erosion, and tidal inundation over time. Beach Neighborhood is seaward of the UPRR and includes the Linden Avenue Downtown corridor and the WWTP. Containing hundreds of residential units, including up to 218 short-term rental units, this Area is an important source of revenue to the City, garnering an approximate $1.9 million dollars in TOT revenues annually. Dozens of free public parking spaces on public streets and road ends and numerous



Area 1 – Beach Neighborhood

FIGURE 8-5

bicycle facilities are present along roads within the Beach Neighborhood. Carpinteria State Beach is located adjacent to the Neighborhood and provides 213 campsites and recreational open space. The natural sand beaches that line this section of coast provide substantial recreational opportunities; they are a resource that helps shape the community's identity. The beaches also draw 1,000,000 visitors annually (California State Parks 2017), thus providing significant revenue for the City. Linden Avenue serves as one of the City's primary routes to the coast, is a hub of commercial activity, and includes a popular bike route, pedestrian facilities, and parking for coastal access. In addition, the Beach Neighborhood provides 41 affordable housing units (approximately 22.7 percent of low- and very-low-income housing units in the City), and the 213 campsites within Carpinteria State Park provide the largest source of low-cost visitor accommodations near the coast within Santa Barbara County.

Resources within the Beach Neighborhood and Carpinteria State Beach are at varying risks to coastal threats, depending on location and sea level rise (Table 8-11).

Table 8-11. Summary of Vulnerabilities in Area 1

Sea Level Rise	Area 1 - Vulnerabilities
~0 feet	Residences located adjacent to the beach, bikeways, and public access and parking facilities are currently at risk from wave run-up, erosion and inundation from periodic coastal storms.
~1 foot	Storm flooding and tidal inundation could inundate most roadways within the Beach Neighborhood, including roads between Ash, Linden, and 4th Street. Residences within this area are vulnerable to severe damage from flooding and inundation. State Beach camping facilities would be vulnerable to erosion from a large singular storm event, as would nearby bikeway facilities.
~2 feet	Road ends and adjacent housing units on Ash, Holly, Elm, and Linden Avenues become exposed to potential damage resulting from beach and dune erosion. Additionally, the entire Beach Neighborhood and State Beach parking facilities would be subject to coastal flooding from wave run-up under large storm events. Periodic inundation under extreme monthly high tides could also occur 500-feet landward from the nearest residences.
~5 feet	Entirety of Beach Neighborhood would be at risk of inundation from Extreme Monthly High Water tides as well as flooding resulting from a large storm. Erosion of the seaward dunes and beach could also occur, which would result in increased vulnerability to these threats.

The City recommends pursuing the following strategies to help protect valuable resources within Beach Neighborhood and the State Beach:

Protection

- **Winter Storm Berm Program:** Continue to implement the annual winter storm berm program along the City Beach in the near term while monitoring rates of sea level rise and storm frequency**.**
- **Living Shoreline:** Design and construct a living shoreline to function as a permanent storm berm that will replace the annual winter berm and protect the Beach Neighborhood by the time approximately 1 foot of sea level rise has occurred. The efficacy of this project may decrease at sea level rise scenarios of approximately 2 feet and greater, particularly as sea level rise nears 5 feet, which may result in more frequent overtopping of an installed dune system.

The berm protects residences and other important infrastructure and is funded by the City and an Assessment District of effected landowners.

- **USACE Feasibility Study:** Once an effective measure is identified, pursue funding opportunities to implement the program as soon as possible.
- **BEACON Projects**: Once cost-effective sediment management strategies have been identified, work with regional partners to implement these programs as soon as possible.
- **Sediment Management Program:** In coordination with BEACON, establish a sediment management program in the near term and identify sediment sources for regular beach nourishment prior to approximately 1 foot of sea level rise.
- **Sand Retention Structures:** Assess the potential of sand retention structures to increase beach width, as well as the downcoast consequences that could result. These measures are more appropriate for utilization before approximately 2 feet of sea level rise has occurred and should be implemented by the time approximately 1 foot of sea level rise has occurred, unless the installed structures are modified or heightened over time. Further study is warranted prior to implementation.

Sand from Carpinteria City Beach abuts Ash Avenue and serves as a buffer from wave attack and run-up damaging and eroding the roadway. Adaptation strategies that increase beach sand can result in continued and enhanced protection of important resources in the Beach Neighborhood.

Accommodation

- **Coastal Adaptation Overlay Zone:** Prepare and adopt a coastal adaptation overlay zone within the Beach Neighborhood that contains measures such as coastal hazard related

development requirements (e.g., raised floors, setbacks) and infrastructure investment priorities. Initial planning efforts for this strategy should occur in the near-term as part of the CLUP/General Plan Update, and this overlay should be adopted by the time approximately 1 foot of sea level rise has occurred.

- **Storm Drain Improvements:** Improve water pumps within storm water drains in the Beach Neighborhood to reduce the threat of flooding from storms and tidal inundation. This is an adaptive measure that could be monitored as necessary over time to address changing conditions. While not currently necessary, planning should begin with approximately 1 foot of sea level rise, and implementation should occur with approximately 2 feet of sea level rise.

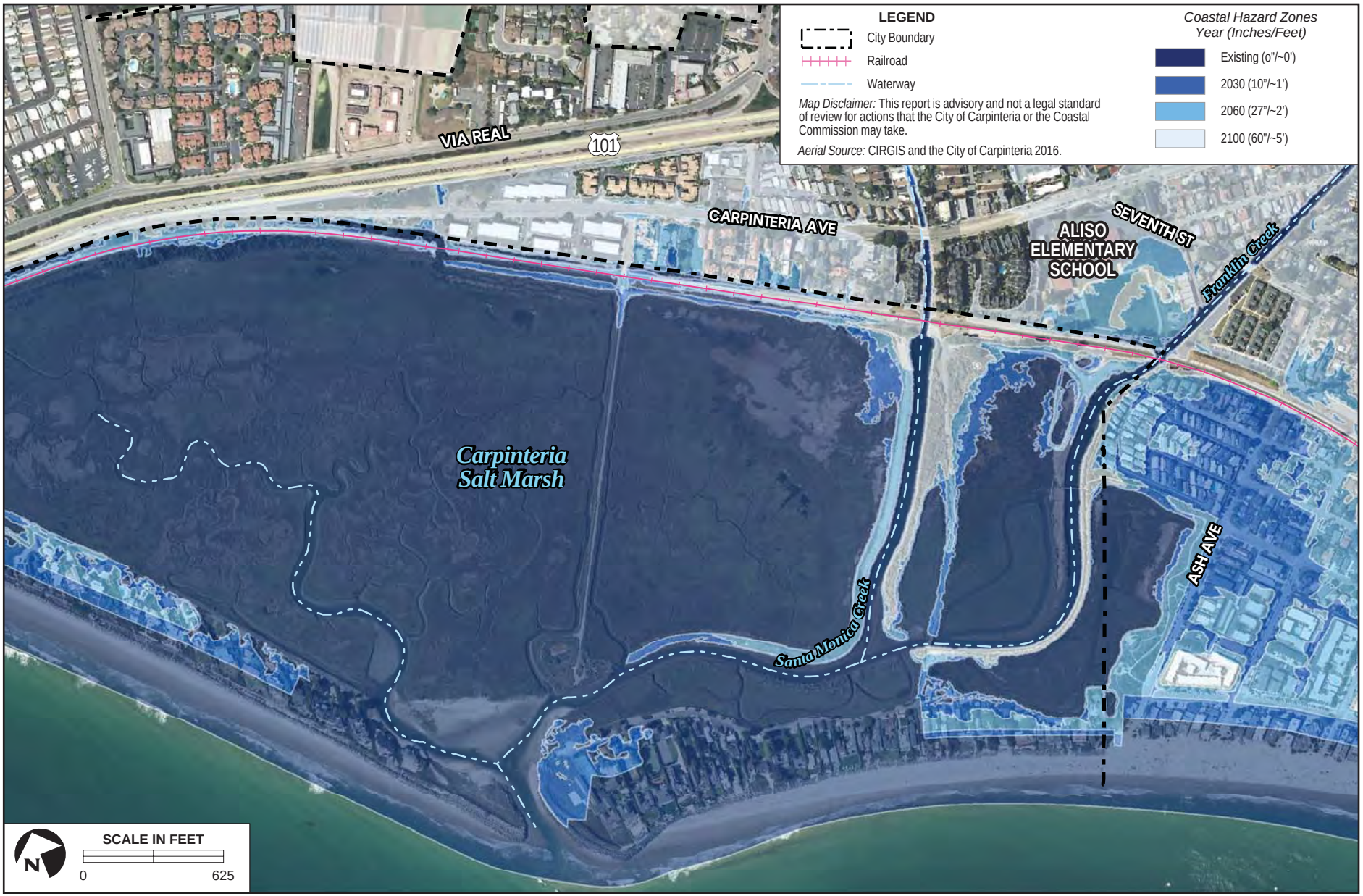
Managed Retreat

- **Coastal Adaptation Overlay Zone:** Prepare and adopt a coastal adaptation overlay zone within the Beach Neighborhood that includes provisions for key infrastructure and land uses to be relocated and may contain development measures such as requirements for a site specific coastal hazard analysis and sea level rise reports for new development, construction standards for removable foundations, an indemnification agreement acknowledging coastal hazards, etc.; this overlay should be adopted by the time approximately 1 foot of sea level rise has occurred.
- **Repetitive Loss Program:** Consider developing and adopting development requirements that correlate with a property's vulnerability to coastal threats.

Area 2: Carpinteria Salt Marsh

Carpinteria Salt Marsh, located within Santa Barbara County, is adjacent to residences, Aliso School, UPRR, and local roadways and infrastructure within the City.

Area 2 is defined by its vulnerability to hazards associated with the estuarine and riverine backshore environment. Area 2 is located to the north of the Carpinteria Salt Marsh and includes lands and assets which lie between U.S. 101, UPRR, and Holly Avenue (see Figure 8-6). This Area contains up to 70 acres of residential units, including mobile homes and affordable housing units. Additionally, the area contains Aliso Elementary School, U.S. 101 and UPRR, a segment of the Carpinteria Avenue commercial corridor, Salt Marsh Park, and the Salt Marsh Trail.



Area 2 – Carpinteria Salt Marsh

FIGURE 8-6

Table 8-12. Summary of Vulnerabilities in Area 2

Sea Level Rise	Area 2 - Vulnerabilities
~0 feet & ~1 foot	While fluvial flooding from nearby creeks is currently a threat to Area 2, existing threats from sea level rise and coastal storms are minimal. While storm drain inlets and outfalls are affected by high tide levels, this mostly impacts repair timelines and is unlikely to substantially increase the risk of storm drain backup and flooding.
~2 feet	The parking lot and recreational areas of Aliso Elementary School could be exposed to coastal flooding. Sections of UPRR would also be impacted, as well as several residences. Additional storm drain infrastructure would be subject to potential flooding, which would temporarily affect maintenance and repair access to pipes during storm events.
~5 feet	Aliso Elementary School could be exposed to coastal flooding during extreme monthly high tides and large storms. Over 100 residential buildings would be subject to tidal inundation and coastal wave flooding, as well as potentially simultaneous fluvial flooding. Vulnerable transportation infrastructure within this Area include a 1,500-foot segment of U.S. 101 and the on-ramp to Carpinteria Avenue at exit 87B, as well as roadway segments including 7th, 8th, and 9th Streets and Carpinteria, Ash, and Holly Avenues. Businesses along Carpinteria Avenue could be impacted by flooding and damages.

While threats to Area 2 from coastal sea level rise and storms were assessed, modeling and analysis of flood threats from Santa Monica and Franklin Creeks were outside of the scope of this Report. Given that runoff from these creeks could backup storm drain systems and result in a confluence of coastal and fluvial flooding, the actual area of flooding has the potential to be greater under all scenarios.

The City recommends pursuing the following strategies to address potential threats of sea level rise, coastal storms, and concurrent fluvial flooding on this Area:

Protection

- **Elevate UPRR:** Work with UPRR to identify opportunities that would elevate the track onto a berm of cobble or similar material to protect rail infrastructure and consider design elements that could effectively act as a levee to protect Aliso Elementary School and adjacent residences. Coordination between the City and UPRR is essential and can result in an optimum protection design with shared investigations, outreach, permitting, and financing. These agencies should begin planning before approximately 1 foot of sea level rise and complete construction before approximately 2 feet of sea level rise.

Accommodation

- **Coastal Adaptation Overlay Zone:** Prepare and adopt a coastal adaptation overlay zone within this Area that contains measures including coastal hazard related development requirements (e.g., raised floors, setbacks) and infrastructure investment priorities. This overlay should be adopted by the time approximately 1 foot of sea level rise has occurred.
- **Storm Drain Improvements:** Water pumps within storm water drains in the Area should be improved in coordination with the County Flood Control District to reduce the threat of water from storms and tidal inundation. This measure is adaptive and can be moderated as necessary to address given sea level conditions. While not immediately necessary, planning should begin by approximately 1 foot of sea level rise and improvements should occur by approximately 2 feet of sea level rise. The City should include these improvements in a Citywide CIP.
- **Channel Improvements:** Coordinate with the County Flood Control District to increase the flow capacity of Franklin and Santa Monica Creeks to reduce the possibility for confluence of coastal and fluvial flooding. Planning should begin by approximately 1 foot of sea level rise, and improvements should be completed by approximately 2 feet of sea level rise. The City should include these improvements in a Citywide CIP.

Managed Retreat

- **Repetitive Loss Program:** Consider developing and adopting development requirements that correlate with a property's vulnerability to coastal threats. As the City continues to experience sea level rise (approximately 2 feet and greater), this may be an important tool for encouraging more sustainable development adjacent to the Carpinteria Salt Marsh and in other areas especially vulnerable to coastal resources.

Area 3: Carpinteria Bluffs

Area 3 extends eastward from the Carpinteria Creek along the coastline. Approximately 1.8 miles of railroad traverse the bluffs along Area 3. Development in Area 3 includes residences within the Concha Loma Neighborhood, as well as commercial research facilities and former oil and gas processing infrastructure within Bluffs 0 (Figure 8-7). Along the western coastline of this Area, Carpinteria State Beach has 136 campsites located along the beach with restroom and parking facilities. Area 3 also contains extensive swathes of open space, trails, and ESHA. Natural habitats include a rookery for harbor seals, as well as ecosystems that support species such as coastal sage scrub and white-tailed kites.

Currently, trails and UPRR tracks along the Carpinteria Bluffs are vulnerable to damage if a large coastal storm event (i.e., 1% annual chance storm) were to result in cliff failure.

Area 3 is characterized by its vulnerability to coastal bluff erosion. Although the 700 feet of hard armoring protects landward infrastructure, these measures will not be sufficient in the long term and most of Area 3 remains unarmored.

Table 8-13. Summary of Vulnerabilities in Area 3

Sea Level Rise	Area 3 - Vulnerabilities
~0 feet	Significant portions of open space and trails are currently vulnerable to cliff erosion, including 15.6 acres of cliff and the harbor seal rookery. 80 camp sites within the Carpinteria State Beach are also vulnerable to erosion, as well as 0.1 mile of UPRR.
~1 foot	An additional 56 campgrounds would be vulnerable. Along the bluffs, 3.8 acres of cliffs as well as additional length of trails would be at risk. Additional UPRR tracks would also be threatened.
~2 feet	Additional segments of the Carpinteria Bluffs Trail, restrooms.
~5 feet	2.71 additional acres of this Area could be lost to cliff erosion. Infrastructure along the Carpinteria Bluffs could be extremely vulnerable to cliff erosion with potentially 1.4 miles of UPRR, and approximately 3.6 miles of trails within the State Park, Tar Pits Park and along the Bluffs at risk. Erosion of the bluffs in the eastern portion of the City could affect over 1,336 feet of 4th Street within the State Park if no adaptive actions are taken.

Area 3 – Carpinteria Bluffs and Concha Loma Neighborhood

FIGURE 8-7

The City recommends pursuing the following strategies to address the potential threats of sea level rise and cliff erosion in this Area:

Protection

- **Sediment Management Program:** As part of a sediment management program, consider placement of cobbles along the base of the bluffs to help dissipate wave energy and reduce coastal bluff erosion. Establish a sediment management program and identify sediment sources for regular beach nourishment prior to approximately 1 foot of sea level rise.
- **Sand Retention Structures:** Assess the potential of sand retention structures to increase beach width, which could slow the rate of erosion. These measures are more appropriate before approximately 2 feet of sea level rise has occurred and should be implemented by the time approximately 1 foot of sea level rise has occurred. Further study to determine feasibility of such structures is necessary, including investigation of a preliminary design or engineering concept, a cost-benefit analysis, and funding mechanisms. Environmental review and planning approvals requiring Coastal Act consistency would be necessary for project implementation.

Accommodation

- **ESHA Adaptation Plan:** Prioritize the long-term preservation of key ESHA sites such as the Carpinteria Harbor Seal Rookery through incorporation of policies in the CLUP/General Plan, and coordinate with other jurisdictions to identify ways to develop a long-term plan for the seal rookery with consideration to sea level rise. A plan should be in place by the time approximately 1 foot of sea level rise has occurred.

Managed Retreat

- **Coastal Adaptation Overlay Zone:** Prepare and adopt a coastal adaptation overlay zone within the Area that contains measures including increased bluff setback requirements. Bluff setback requirements may be established by updating the setback calculation methodology based on the expected sea level rise with consideration of the life of the structure and site specific hazards analysis (see Table 8-6). This overlay will be evaluated as part of the City's current CLUP/General Plan update and should be adopted before approximately 1 foot of sea level rise has occurred.

8.5 Funding Mechanisms

Adaptation planning is a challenging undertaking and the City cannot adapt to sea level rise on its own. A successful adaptation plan requires regional dialog and state and federal

partnerships to identify, fund, and implement solutions. Challenges include 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. Potential sources of funding that could be explored are described below.

Establishment of a Shoreline Account

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

- Sand and cobble replenishment and retention studies and projects;
- Opportunistic beach nourishment programs and development of stockpile locations;
- Updating the mean high tide line survey;
- Preparation of other shoreline surveys and monitoring programs;
- Public recreation improvements;
- Repair and maintenance of shoreline protection systems (such as the winter storm berm or a living shoreline) subject to reimbursement by the affected and/or non-compliant property owners; and
- Repair and replacement of beach access infrastructure.

The City may use the funds in the Shoreline Account, subject to the restrictions of any terms of the funding sources, to pay for projects such as beach sand replenishment and retention structures, public recreation and public beach access improvement projects, feasibility and impact studies, operating expenses, 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.

Expand Existing Assessment District and/or Establish New Coastal Hazard Assessment or Geologic Hazard Abatement District

Assessment districts are common funding mechanisms for utilities, such as water supply and utility providers. Coastal Hazard Assessment Districts (CHADs) and Geologic Hazard and Abatement Districts (GHADs) are also opportunities for beach and bluff front property owners to establish an assessing entity to implement one or more of the priority adaptation strategies described above. CHADs provide a potential means for future renovations or

improvements to flood control structures, including future alterations that may be necessary because of sea level rise. By accumulating a funding reserve for future maintenance and rehabilitation, a CHAD can provide the financial resources necessary for potential future expansion, maintenance, or repairs of flood or erosion control structures. Further, because of the relative safety of CHAD revenues (CHADs are typically financed through the collection of supplemental tax assessments), CHADs can borrow from lenders or issue bonds with very attractive credit terms. A CHAD or GHAD should be established to better assess hazards and fund improvements for issues that affect a larger regional area, resulting in greater reserves of funding and often improved maintenance or repair services. Given the threat from coastal hazards extends well beyond the City, the possibility exists for establishment of a CHAD or GHAD that includes particularly at-risk areas of the City, as well as threatened adjacent unincorporated communities or neighborhoods.

Infrastructure Financing Districts

As of September 2014, California law allows 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 these bills was to fill the local funding void left by the dissolution of the redevelopment agencies. Basically, the City would establish an Economic Infrastructure Financing District, develop a business plan with priority projects (e.g., infrastructure, adaptation, etc.), and then draw funds from changes in local tax revenues occurring as part of a redevelopment or rezone or apply for grant funds.[1]

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 this TOT (e.g., 2 percent for sand) could be reserved for specifically for adaptation approaches that maintain the City Beaches and Open Spaces. Presently the TOT rate is 12 percent; a potential increase of 2% percent could yield an additional $400,000 annually. A regionally coordinated increase in TOT to provide regional funding for coastal improvements, maintenance, or repairs could also be coordinated with other jurisdictions in the County.

Sales Tax Increase: The City may consider this approach or coordinate on a Countywide approach such as a quality of life initiative to generate local revenues to be used to finance long-term coastal resiliency strategies. The City of Del Mar (San Diego County) recently

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

instituted a one percent sales tax increase that is used as a dedicated source of funding for coastal resiliency building.

Hazard Mitigation and Pre-Disaster Assistance

There is overlap between LCP planning and Local Hazard Mitigation Plan (LHMP) as both address a potential range of hazards in a given City. California Governor's Office of Emergency Services' (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 LHMP, which in the City's case was updated in 2017 and approved by FEMA as an annex to the larger Santa Barbara County Multi-jurisdictional Hazard Mitigation Plan (MJHMP). Another update would be required to add sea level rise and climate change related hazards to the MJHMP 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. The total value in each of the grants vary 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 – a Sand Mitigation Fee 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.

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 involving the construction of a bluff retention device, a Sand Mitigation Fee could be collected by the City to be used for sediment management purposes. The fee could be deposited in an interest-bearing account designated by the City in lieu of providing sand directly to replace the sand

that would be lost due to the impacts of any 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 in past cases. 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 used by the CCC for the Sand Mitigation Fee, the CCC has used a methodology for calculating a statewide public recreation fee. The City could include such a methodology in the CLUP/General Plan Update and develop administrative processes consistent with CCC guidance, including development of impact mitigation fees for public access and recreation, proposing a public recreation/access project in lieu of payment of Public Recreation Fees to provide a direct recreation and/or access benefit to the general public, and project prioritizations.

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.[2]

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.

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

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

Recently, California Department of Fish and Wildlife (CDFW) has announed funding opportunities for multi-benefit ecosystem restroation 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). These grant funding opportunities 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.

Cultural, Community and Natural Resources Grant Program – Proposition 68

Following passage of the California Drought, Water, Paks, 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 Fiscal Year (FY) 2018-2019. Caltrans has recently announced an additional $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.

8.6 Recommendations and Next Steps

This section signals the beginning of the City's efforts to begin to build coastal resiliency and adapt to sea level rise by reducing risks and exposure to coastal hazards. Reviewing current City programs and policies associated with sea level rise risk reduction such as those around shoreline protection is the first step to identify immediate adjustments to alleviate or eliminate risks. Where adjustments to current practices will not sufficiently address the risks, then more substantial actions must be identified and should be implemented within the CLUP/General Plan Update. This effort will be ongoing in the coming years as our understanding of the variables involved in climate science continues to improve.

Financing Strategy

It is imperative that the City develop a coastal hazard improvements and financing strategy to address sea level rise hazard impacts. However, implementation of resiliency-building and adaptation policies, plans, and programs will take substantial time and investment to reduce risk to the City. The impacts of climate change such as sea level rise and increased coastal erosion and flooding will require extensive and ongoing coordination with federal, state, and regional agency partners, investment in community resiliency, and a financial program to be able to ensure that the City's long-term community vision is maintained now and in the future.

As next steps, the City would identify, evaluate, and pursue all feasible potential sources of revenue for funding within Section 8.5, *Funding Mechanisms*. The costs of priority adaptation strategies would be allocated and shared in proportion to the benefits realized by the affected parties, including the public, the City, and the beachfront and bluff property owners, respectively. The City's financing strategy could include the following:

- Coordinate with the County and cities of Santa Barbara and Goleta to explore sustainable local funding sources for shoreline management and adaptation measures such as uniform increases in TOT, local bond measures, changes to the County Flood Control District's Benefit Assessment program to include shoreline management, etc.
- Actively continue to seek state and federal funding for expedited implementation of priority adaptation strategies and prioritize the creation of a wider beach and a beach profile that can feasibly be established and maintained on City beaches for shoreline protection and recreation benefits.

- Work with the League of California Cities, BEACON, and the County to lobby state and federal legislators to create sustainable long-term funding programs for adaptation planning and capital improvements, including beach nourishment.
- Support formation of a CHAD and/or GHAD.

Future Technical Study

This Report generates information about potential hazards to the City from sea level rise and associated erosion and flooding damages. Given the significant vulnerabilities identified in this Report, the City may consider a more detailed analysis of certain hazards or site-specific study to inform implementation of an adaptation strategy. Therefore, this Report recommends additional study to support City adaptation planning efforts prior to implementation of the above adaptation measures. Specifically, the following issues warrant further investigation.

- **Additional Hazard Modeling:** This effort could include fluvial flood hazards and modeling hazards with adaptation in place (e.g., a living shoreline). Such modeling would inform design and implementation of adaptation measures and show the effectiveness of a particular measure. Site-specific modeling should also be conducted to determine potential sea level rise impacts on a parcel level for specific development proposals.
- **Cost-Benefit Analysis:** This Report could not precisely quantify specific values or cost estimates for priority adaptation strategies. Modeled physical responses to the potential strategies could be evaluated to determine potential economic trade-offs, fiscal impacts, and changes to tax revenues over time. Cost-Benefit Analysis would show which strategies would be more cost effective and yield greater benefits.
- **Critical Infrastructure Master Plans:** This Report identifies infrastructure that may be vulnerable to coastal hazards, including transportation, water and sewer, and storm water, but does not identify the cost or specific condition and maintenance needs of this infrastructure. Future coastal hazards, especially erosion, may require realignment or relocation of infrastructure. Even a small length of eroded pipeline may necessitate removal or relocation. Critical Infrastructure Master Plans can identify these segments and address issues of land acquisition/right-of-way, potential upgrades, and timing for such capital improvements considering sea level rise.
- **Improved Recreational Amenity Data:** A full analysis of the impact from beach and campsite erosion, as well as an analysis of the impacts of flooding on recreation, parking, and access to hotels and short-term vacation rental properties is recommended. Specific locations of camp sites and amenities would improve the analysis. This Report indicates that Carpinteria's beaches would erode, which could significantly impact future public recreational opportunities unless the beaches are allowed to transgress. This Report also indicates that a number of multi-family units, and many short-term vacation rentals, are also at risk to coastal erosion and coastal flooding, which may affect recreational use and

demand. Finally, both City and State parking lots near both beaches are subject to periodic flooding. As parking is impacted, future recreation, and associated spending and tax revenues for the City may be expected to show a corresponding decrease depending on the adaptation strategies implemented.

- **Oil and Gas Infrastructure Analysis:** The City has a large number of legacy oil wells within the City limits as well as the 55-acre Bluffs 0, which is anticipated to be decommissioned and redeveloped in the future. The potential exposure for the City from oil spills, or the leakage of oil or other hazardous materials into groundwater, is significant, and the costs of mitigation after leakage has occurred will almost certainly be much higher than if proactive remediation and closure of the site were to be initiated. The dispersal mechanism of the hazardous materials has also not been considered. This Report recommends that a more extensive analysis of the potential liabilities and the costs of mitigation for potential release of hazardous materials be completed.
- **Future Development of Bluffs 0:** The 55-acre Bluffs 0 parcel is relatively safe from future coastal hazards and represents a potential opportunity for the City and County. The site is in a highly desirable area which could potentially be redeveloped (following remediation of soil and groundwater resources) into property which would generate economic activity and taxes for the City, County, and State. For example, this site could be used to expand coastal camping and recreational opportunities. It could also potentially become part of a larger redevelopment effort in the City to relocate key aspects of the community to higher ground. This Report recommends a further investigation of the potential economic, social, and land use opportunities of developing this site with uses that could be lost to future coastal hazards elsewhere in the City, as well as potential costs and Citywide impacts should the site not be remediated.
- **ESHA:** The vulnerability of ESHA is limited based on available habitat mapping data and does not consider the evolution of habitats. Additional work could be completed to evaluate the potential impacts of the full suite of climate change variables (e.g. temperature, precipitation, drought and sea level rise) to provide a better understanding of the potential future impacts to ESHA.
- **Short-term Vacation Rental TOT Revenues:** The loss of short-term rentals near the beach could result in a significant loss in TOT for the City and warrants additional refined further investigation.

Public Outreach

The City will continue to solicit input, comments and feedback from the public, agencies, and interested parties on these proposed adaptation strategies. Successful implementation of any adaptation strategy requires communication of vulnerabilities, potential adaptation trade-offs, costs, and alternatives.

Multi-Agency Coordination

Adaptation planning for priority strategies is anticipated to require significant regional or multi-jurisdictional coordination and funding. The City cannot adapt to the impacts of sea level rise alone given the regional and global effects of sea level rise and the commensurate need to have regional or larger-scale adaptation strategies. The City will need to address coastal hazards by establishing collaborative regional solutions and partnerships with adjacent and affected jurisdictions and entities. The City should take the following actions to work with local, regional, state, and federal agencies.

- Establish and actively coordinate with regional partners on a regular basis to promote essential regional adaptation strategies and pursue cost-sharing agreements. Such agencies should include, but are not limited to, Santa Barbara and Ventura counties, BEACON, and cities (e.g., Santa Barbara, Goleta, Ventura, and Oxnard).
- Lobby state and federal legislators to implement legislation that requires California Public Utilities Commission (CPUC) and UPRR coordination with local jurisdictions on sea level rise and adaptation planning, protection of coastal habitats, and preservation of public lateral and vertical coastal accesses.
- Continue to coordinate with the CUSD on adaptation planning and initiate a joint-study to further investigate hazard risks and additional adaptation strategies for Aliso Elementary School.
- Continue to coordinate with the CSD and CVWD on adaptation planning for critical facilities, including the WWTP and future recycled water facility.
- Continue to coordinate with Caltrans on agency-specific vulnerability assessments and future planning/implementation of key infrastructure, such as U.S. 101.
- Continue to coordinate with the County Flood Control District to investigate and pursue installation of tide gates, flaps, coffer dams, or other flood control systems at strategic creek and culvert locations to manage floodwaters.

Monitoring Sea Level Rise and Triggers

Implementing adaptation measures will require coordination, planning, permitting, engineering, and financing. Each strategy will have a certain lead time from initial concept to implementation that varies depending on the scale and type of strategy, and the amount of sea level rise that the strategy can accommodate. Once the strategies are prioritized, then conservative estimates of lead times before implementation will be developed as part of this program. These lead times should then inform policy triggers that are then monitored through measurable objectives (see section 7.5, *Triggers and Monitoring*) to act as a catalyst for the planning process.

- Install a local tide gauge as part of the City's efforts to conduct sea level rise monitoring.

- Support the twice yearly (May and October) USGS shoreline transect profile monitoring program to monitor the health of the beach over time, including the active dissemination of results and their implications to regional shoreline management agencies. Integrate long-term shoreline and beach profile data into monitoring programs that include measurable policy triggers.