City of Carmel-by-the-Sea

Vulnerability Assessment

WORKING DRAFT

April 2021

TABLE OF CONTENTS

I. Introduction

The purpose of the Vulnerability Assessment is to characterize climate hazards that will impact the community and City assets in Carmel-by-the-Sea, to determine our community's major climate vulnerabilities, and to identify work that has already been done to improve community resilience. The Vulnerability Assessment will help provide focus to the City's adaptation planning efforts.

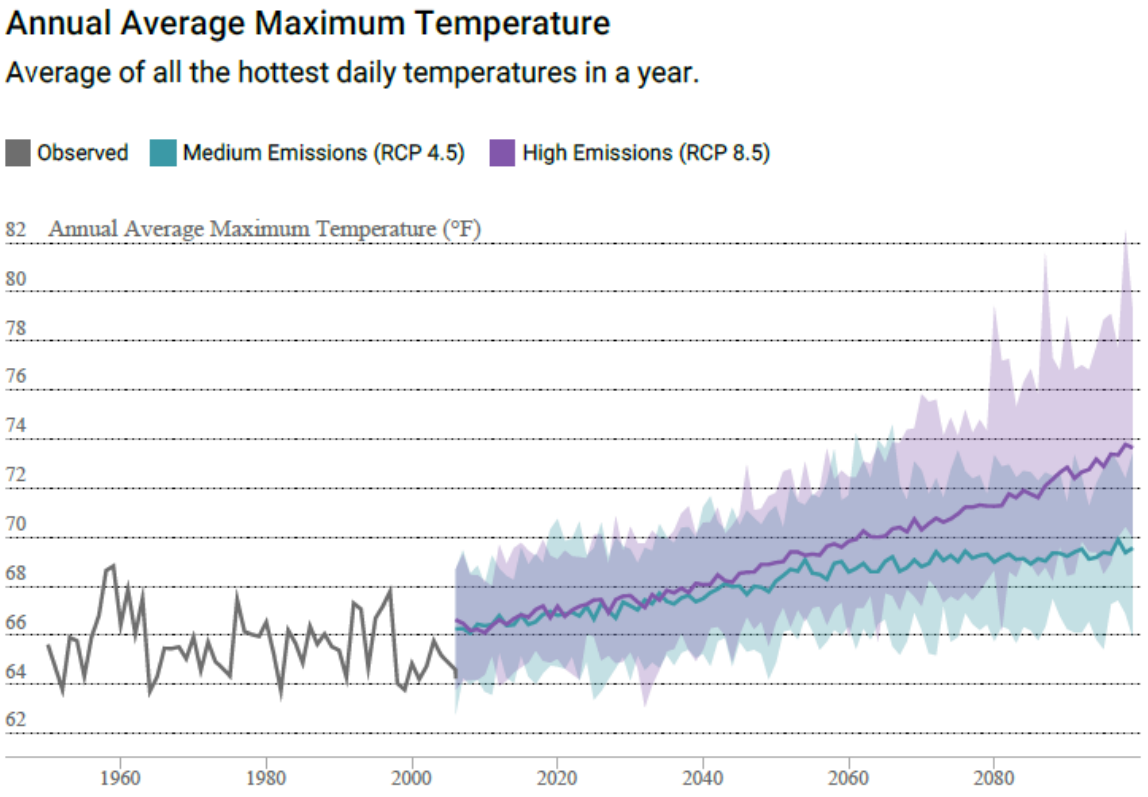
II. Historical Hazards

Historical hazards provide information about existing hazards that may be exacerbated by climate change, as well as potential vulnerabilities of City assets to those hazards. A table of historical hazards assembled from the Multi-Jurisdictional Hazard Mitigation Plan (MJHMP), the National Oceanic and Atmospheric Administration (NOAA) Storm Events Database, and historic records at the Carmel Library, is included in **Appendix A**. Additionally, a map of historic wildland fires in Monterey County from the MJHMP is also included in **Appendix A**.

III. Changing Hazards with Climate Change

Temperatures

According the State's Cal-Adapt modeling tool, overall temperatures are projected to rise in California during the 21st century. However, coastal areas will be less impacted due to the moderating effect of the Pacific Ocean. The current average annual maximum temperature in Carmel-by-the-Sea is 65.6 degrees Fahrenheit (°F). According to the RCP 8.5 model, annual average maximum temperatures in Carmel-by-the-Sea could increase by 3.3°F by mid-century to 68.9°F, and by 6.3 degrees to 71.9°F by the end of the century.



		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	65.6 °F	65.3 - 65.8 °F
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+2.6 °F	68.2 °F	66.7 - 69.6 °F
HIGH EMISSIONS (RCP 8.5)	+3.3 °F	68.9 °F	67.3 - 70.6 °F
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+3.6 °F	69.2 °F	67.3 - 71.5 °F
HIGH EMISSIONS (RCP 8.5)	+6.3 °F	71.9 °F	69.2 - 76.0 °F

The number of extreme heat days, defined as days with daily maximum temperature above 87.9 °F, is also projected to increase to an average of 6 days per year by mid-century, and to an average of 7 to 13 days per year by the end of the century, depending on the emissions scenario.

While the community and essential facilities of Carmel-by-the-Sea should be able to adapt to these gradual temperature changes, local ecosystems will be more adversely impacted by the increased heat.

Drought

In 2014, the State of California, including Monterey County, faced one of the most severe droughts on record. Governor Brown declared a drought State of Emergency in January 2014, and directed State officials to take all necessary actions to prepare for water shortages during what was considered an "unprecedented" drought.

Prior to the 2014 drought, the National Climatic Data Center has recorded no instances of severe drought conditions in the Monterey County forecast zone for the period of 1/1/1996 through 12/31/2013.

According to the 4th California Climate Assessment, even minor fluctuations in rainfall patterns will increase pressure on Monterey County's water resources, which are already over-stretched by the demands of a growing agriculture economy and population. Decreasing spring stream flows, coupled with increasing demand for water resulting from both a growing population and hotter climate, could lead to increasing water shortages.

According to the State's Cal-Adapt modeling tool, research is suggesting that for much of the state, wet years will become wetter and dry years will become drier. Dry years are also likely to be followed by dry years, increasing the risk of drought. While California does not see the average annual precipitation changing significantly in the next 50-75 years, precipitation will likely be delivered in more intense storms and within a shorter wet season. We are already seeing some of the impacts from a shift towards larger year to year fluctuations.

Fog

According to California's 4th Climate Assessment, the formation of coastal fog is very complex and involves highly dynamic ocean, air, and land processes. Ocean upwelling, once thought to drive the formation of coastal fog, is secondary to the global atmospheric circulation pattern that situates a North Pacific zone of atmospheric high-pressure. This air mass generates inversions under which coastal fog forms. The frequency and thickness of summertime fog depends on the location of the high-pressure zone, the strength of the inversion, and sea surface temperatures.

The future of coastal fog under climate change remains uncertain. Long term fog trends over the coastal ocean from ship observations since 1951 show an increase, while fog trends over land show a decrease. The effect of other land surface changes such as forest fires on fog is unknown.

Changes in coastal fog could have a significant impact on coastal ecosystems. Fog provides an important source of water for many coastal plant communities through fog drip, and it also acts to keep moisture in the ecosystem, preventing evaporation and maintaining cooler temperatures during the summer months. Ecosystems such as the coastal redwoods and maritime chaparral are dependent on fog for their survival. A decline in coastal fog could also lead to increased water use and an increased demand for water in the Region due to warmer temperatures and increased evaporation during the summer months. This in turn could lead to increased agricultural and landscape water use.

Wildfires

According to the State's Cal-Adapt modeling tool, the frequency, severity and impacts of wildfires are sensitive to many factors, including development patterns, temperature increases, wind patterns, precipitation change and pest infestations. Therefore, it is more difficult to project exactly where and how fires will burn. Instead, climate models estimate increased risk to wildfires. The information presented below (Annual Average Area Burned) can help inform at a high level if wildfire activity is likely to increase. As we have seen in recent years, much of California, including the Central Coast, can expect an increased risk of wildfire, with a wildfire season that starts earlier, runs longer, and features more extreme fire events.

Annual Average Area Burned

Average of the area projected to be at risk to burning in a year.

		30yr Average	30yr Range
Baseline (1961-1990)			
MEDIUM EMISSIONS (RCP 4.5)	-	72.9 acres	69.7 - 78.9 acres
HIGH EMISSIONS (RCP 8.5)	-	77.7 acres	73.1 - 81.1 acres
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+24.7 acres	97.6 acres	93.7 - 103.1 acres
HIGH EMISSIONS (RCP 8.5)	+19.9 acres	97.6 acres	87.6 - 108.8 acres
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+24.1 acres	97.0 acres	91.8 - 106.8 acres
HIGH EMISSIONS (RCP 8.5)	+19.0 acres	96.7 acres	88.2 - 105.4 acres

Stronger Storms

Projections of changes in precipitation in California are more nuanced than projected changes in temperature and have less separation between RCP4.5 and 8.5 scenarios. There is a projected increase of year-to-year variability with wetter days during periods of precipitation, but with fewer total days with precipitation. When combined with higher temperatures, these changes will create significant challenges for the state's water supplies, potentially creating more serious flooding events as well as drier conditions.

Across the Central Coast, projections suggest that the wet season will become shorter and extremely wet and dry years may become more severe, while, on the daily time scale, storm events will become more intense.

Maximum 1-day Precipitation

The maximum daily precipitation amount for each year. In other words, the greatest amount of daily rain or snow (over a 24 hour period) for each year.

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	1.341 inches	1.169 - 1.475 inches
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+0.060 inches	1.401 inches	1.157 - 1.627 inches
HIGH EMISSIONS (RCP 8.5)	+0.111 inches	1.452 inches	1.276 - 1.693 inches
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+0.093 inches	1.434 inches	1.258 - 1.723 inches
HIGH EMISSIONS (RCP 8.5)	+0.187 inches	1.528 inches	1.270 - 1.861 inches

Sea Level Rise

Global sea level rise is driven primarily by thermal expansion caused by the warming of the oceans and the loss of land-based ice such as glaciers and polar ice caps due to increased melting. The Monterey County MJHMP (September 2014) reports that Monterey County may experience an approximate 5-foot (150 cm) rise in sea level by the year 2100.

Figures 1 and 2 are from the USGS Coastal Storm Modeling System and show the inundation zone from 50 cm of sea level rise (mid-century) under normal conditions and during a 20-year storm. The figures indicate that the Carmel bluffs provide an important barrier against sea level rise impacts to property; however, Carmel Beach will continue to become narrower, particularly at the southern end of the bay, as well as the northern end near Pescadero Canyon, and will be inaccessible during and after storms. This phenomenon of beach loss is already happening after large winter storms in Carmel. With 150 cm of sea level rise (end of Century), much of the southern end of the beach will be gone, as well as the northernmost portions, even under normal conditions (Figure 3).

The loss of Carmel Beach will impact not only the recreational resources it provides but it also has the potential to amplify the impacts of hazard events such as storms, as well as coastal erosion. Coastal erosion analysis indicates that retreat rates for the Carmel bluffs average 2-4 inches a year. Sea level rise, combined with amplified coastal erosion would affect the maintenance of the City's coastal facilities, including sea walls, revetments, access stairs, the Scenic pathway, bathrooms, Scenic Road, and utilities including sanitary sewer, water, and stormwater.

Figure 1: 50 cm of Sea Level Rise, No Storm

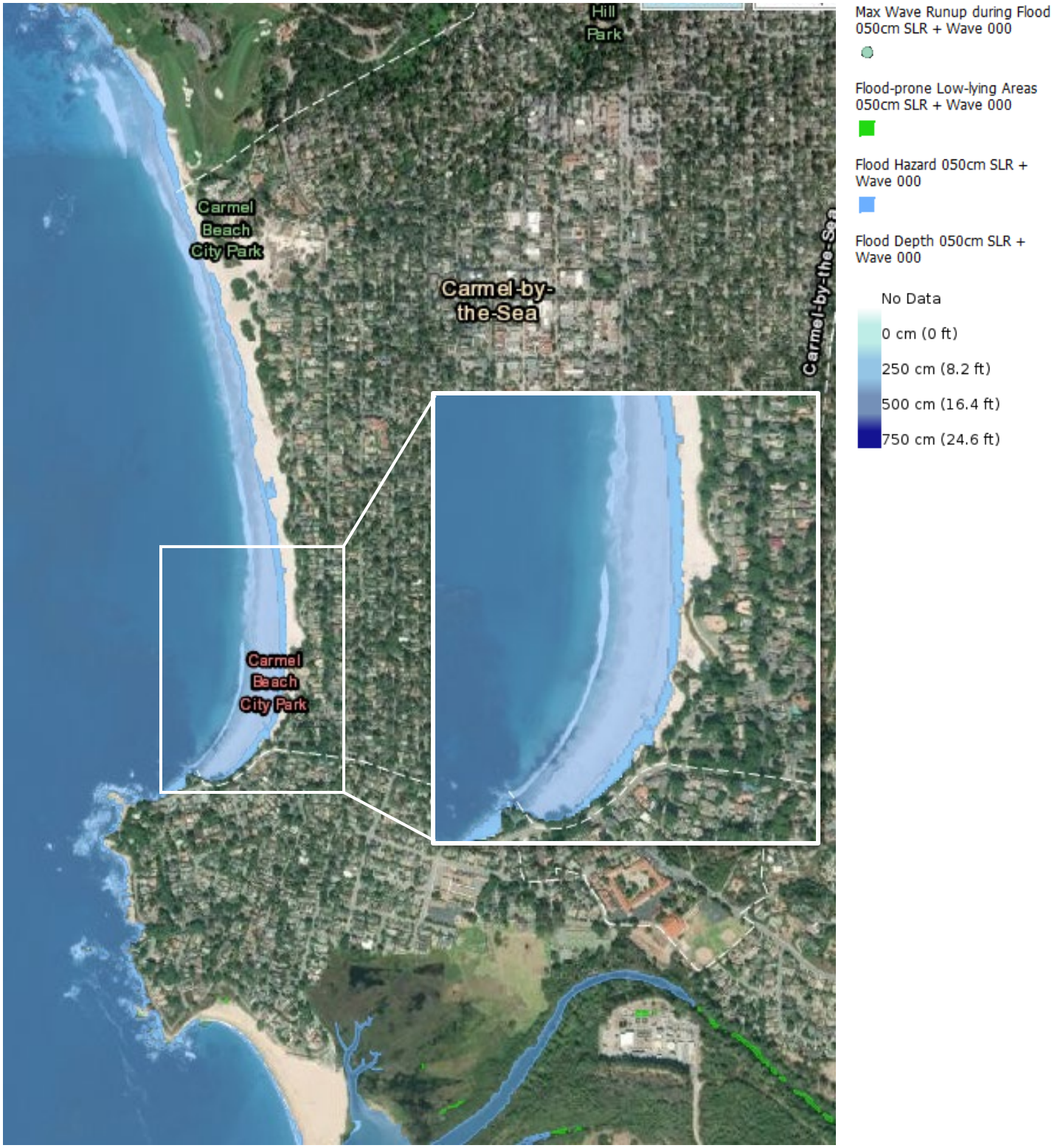


Figure 2: 50 cm of Sea Level Rise, 20-year Storm

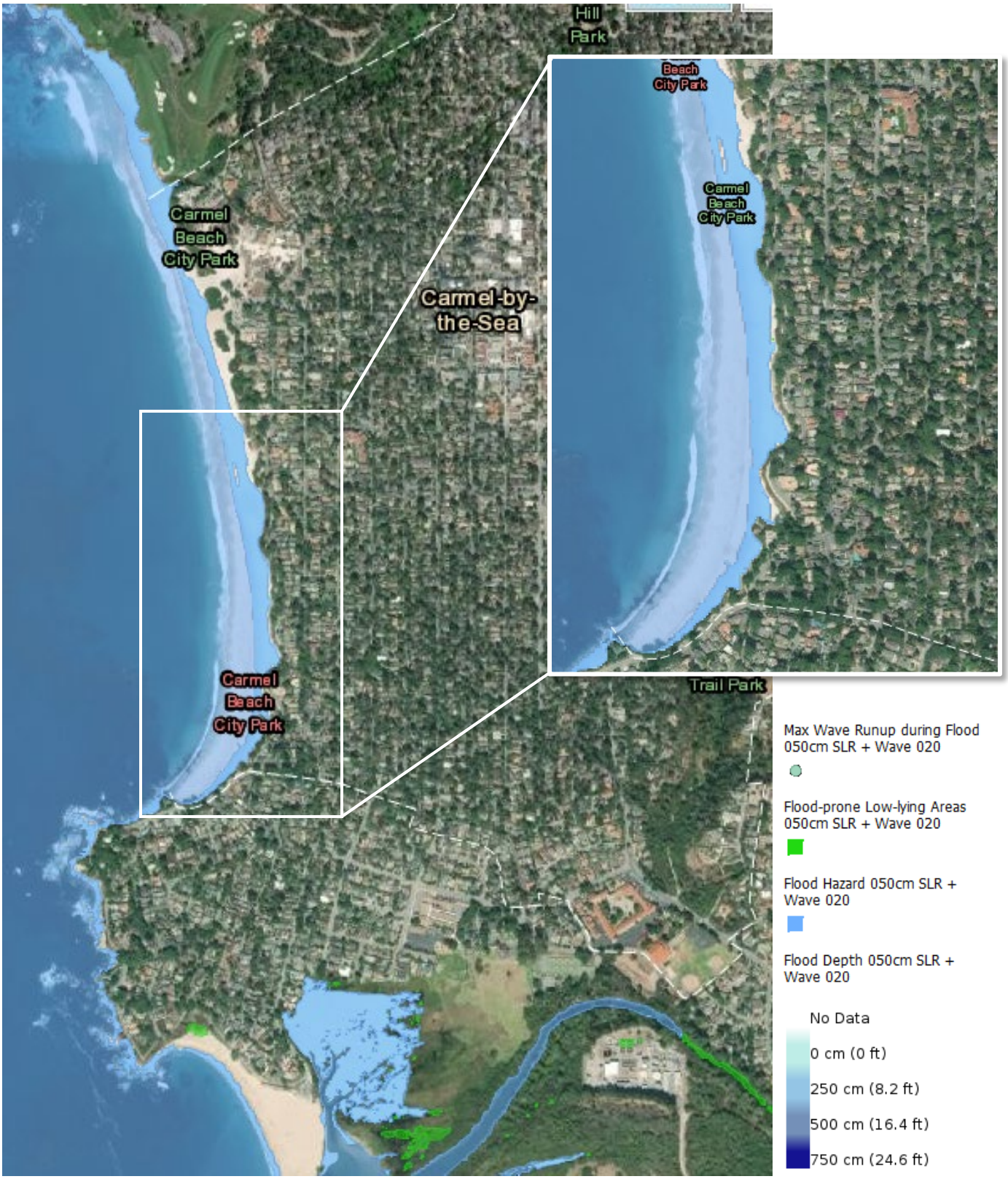
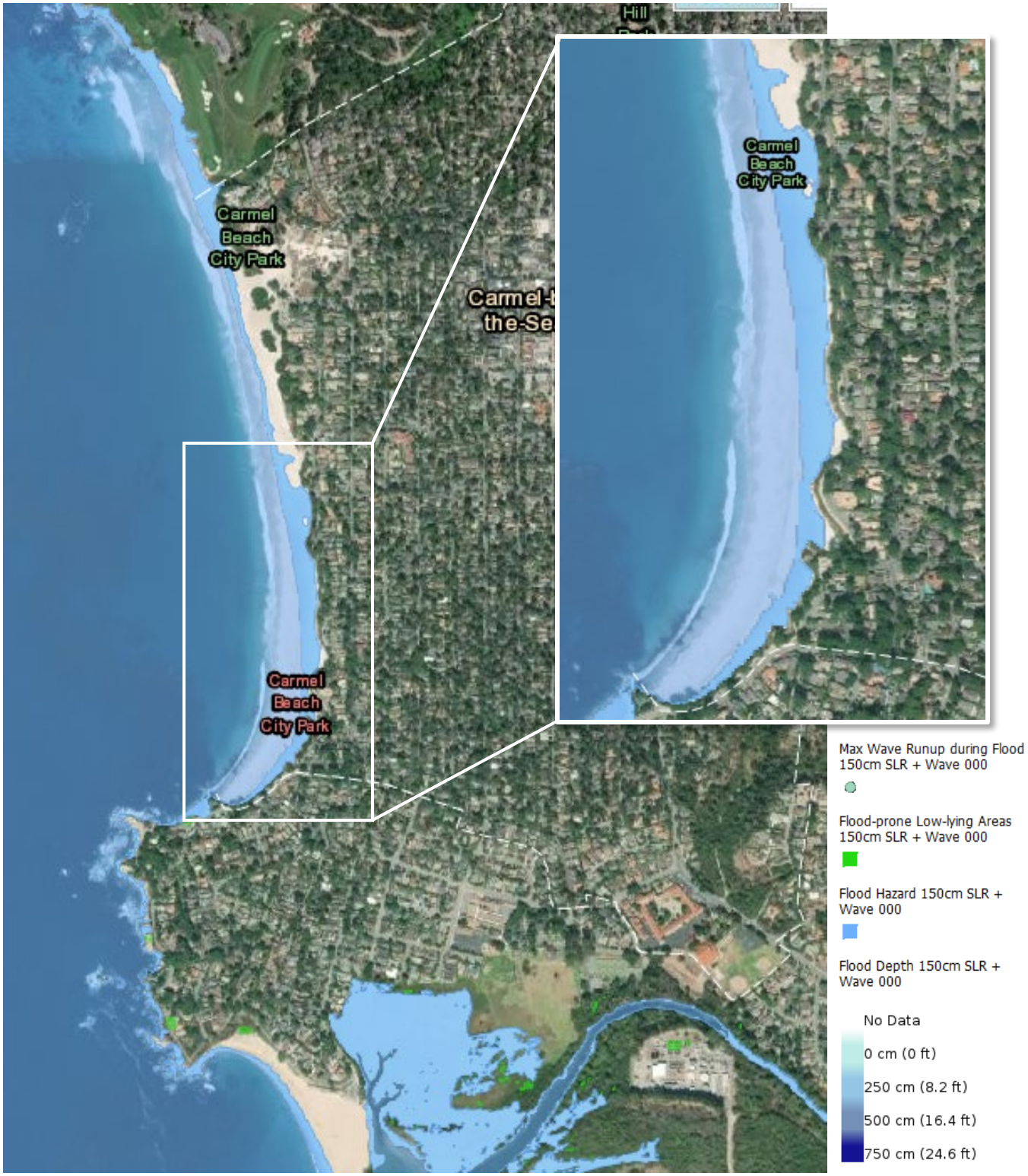


Figure 3: 150 cm of Sea Level Rise, No Storm



IV. Hazard Ranking

Based on the information provided by historical hazards, as well as projected changes from climate change, several climate effects will significantly impact Carmel over the coming years. Climate hazards are ranked in the table below by the timeframe of their impacts, with hazards that are already causing significant observable impacts in orange and those with potentially significant impacts into the future in yellow. Hazards in yellow have a longer planning time horizon. Hazards for which we do not have enough data yet are shown in grey.

- Orange: already causing significant observable impacts
- Yellow: significant mid- to long-range impacts
- Grey: not enough data

Stronger Storms
Wildfires
Sea Level Rise
Drought
Increased Temperature
Fog Changes
Ocean Warming

V. Vulnerable City Assets and Populations

(Description and map of vulnerable assets to be included later)

	Priority Hazards						
Priority Assets at Risk	**Sea Level Rise**	**Ocean Warming**	**Wildfires**	**Stronger Storms**	**More Droughts**	**Increased Temperature**	**Fog changes**
Natural Assets							
Mission Trail Nature Preserve	X		X	X	X	X	X
North Dunes	X				X	X	X
Urban Forest			X	X	X	X	X
Marine Sanctuary		X		X	X	X	X
Carmel Beach	X	X		X			X
Community							
Persons with disabilities			X	X	X	X	
Elderly Population			X	X	X	X	
Visitors	X	X	X	X			
Local Businesses	X	X	X	X		X	

Priority Assets at Risk	Priority Hazards						
	Sea Level Rise	**Ocean Warming**	**Wildfires**	**Stronger Storms**	**More Droughts**	**Increased Temperature**	**Fog changes**
Utilities							
Water Supply (Drought Tolerance)			X		X	X	
Electrical Energy Transmission (Electric Vehicles, safety power shutoffs, outages)			X	X		X	
Sanitary Sewer System	X			X			
PG&E/communication underground infrastructure (gas, cable)	X		X				
Storm drainage system	X			X			
Regional Infrastructure							
Wastewater Treatment Facility	X			X		X	
Transportation Infrastructure	X		X	X			
Hospital and emergency medical care facilities			X	X		X	
Landfill & Waste Management				X			
Local Infrastructure							
Scenic coastal trail, public restrooms and beach access infrastructure	X		X	X		X (visitors)	X
Coastal roadways and parking	X			X		X (visitors)	
Seawalls and revetments	X			X			
Other city streets				X			
Private property (including many second homes)	X		X	X		X	

VI. Existing Strategies and Policies for Adaptation

The City has several existing documents that provide guiding policies and strategies that will help address elements of climate change adaptation. A summary of recommended projects in those documents that will help reduce the City's vulnerability to climate change is presented below, by primary hazard type.

STRONGER STORMS

a. Storm Drain Master Plan

The Storm Drain Master Plan was completed in 2020. The master plan identifies current system capacity, condition, and maintenance issues. The master plan also identifies 17 projects to restore the system's ability to handle a 10-year 24-hour storm without localized flooding in various locations in the City. The projects are shown on the map below (Figure 4) and listed, with cost estimates in Table 1. Modeling of a 16% increase in storm intensity that could be associated with Climate Change showed that, with the system upgrades outlined in the plan, most of the system could handle the increased storm intensity, with some localized flooding in Mission Trail Nature Preserve, the northeast part of the City, the 4th Avenue drainage, and the southwest near Santa Lucia Avenue. There is greater risk for flooding for larger storms as the city's drainage system was only designed for 10-year, 24-hour storms.

Figure 4: Map of Storm Drain Master Plan Projects

Table 1: Storm Drain Improvement Projects

Priority	Asset Name	Estimated Cost[1]
High Priority	Mission Street Bypass	$820,000
	Forest Hill Park – Emergency Repair	$130,000
	Santa Rita 1	$220,000
	High Priority Total	**$1,170,000**
Medium Priority	Junipero	$800,000
	Rio Road 1	$2,420,000
	Santa Rita 2	$170,000
	Ocean Ave	$250,000
	Santa Fe	$490,000
	Carpenter	$270,000
	11th and San Antonio	$400,000
	2nd and Monte Verde	$830,000
	Forest Hills Park - Realignment	$700,000
	Medium Priority Total	**$6,330,000**
Low Priority	2nd Avenue	$150,000
	5th and Junipero	$660,000
	Mission Trail Preserve Projects	$940,000
	Camino del Monte	$30,000
	Dolores	$20,000
	Rio Road 2	$140,000
	Lasuen	$460,000
	Low Priority Total	**$2,400,000**
Grand Total		**$9,900,000**

[1]Includes Contingencies (40%). 2020 Construction cost only. Construction cost includes mobilization, traffic control, trench, and surface restoration. Does not include costs associated with permitting, land acquisition, or other unforeseen special circumstances.

Implementation Status: Initiated. Staff is seeking funding to design and construct some priority repairs. Implementation included in the City's 5-year Capital Improvement Plan.

b. Mission Trail Stream Stability Study

The Stream Stability Study was completed in 2019 to determine factors contributing to channel instability in Mission Trail Nature Preserve, to determine the stability of drainage improvements in the Preserve, and to recommend actions to restore the stream and habitat conditions in the riparian corridor. The study identified eight projects to restore natural hydrology and stream stability in the Preserve. The projects are shown on Figure 5 below and listed in Table 2.

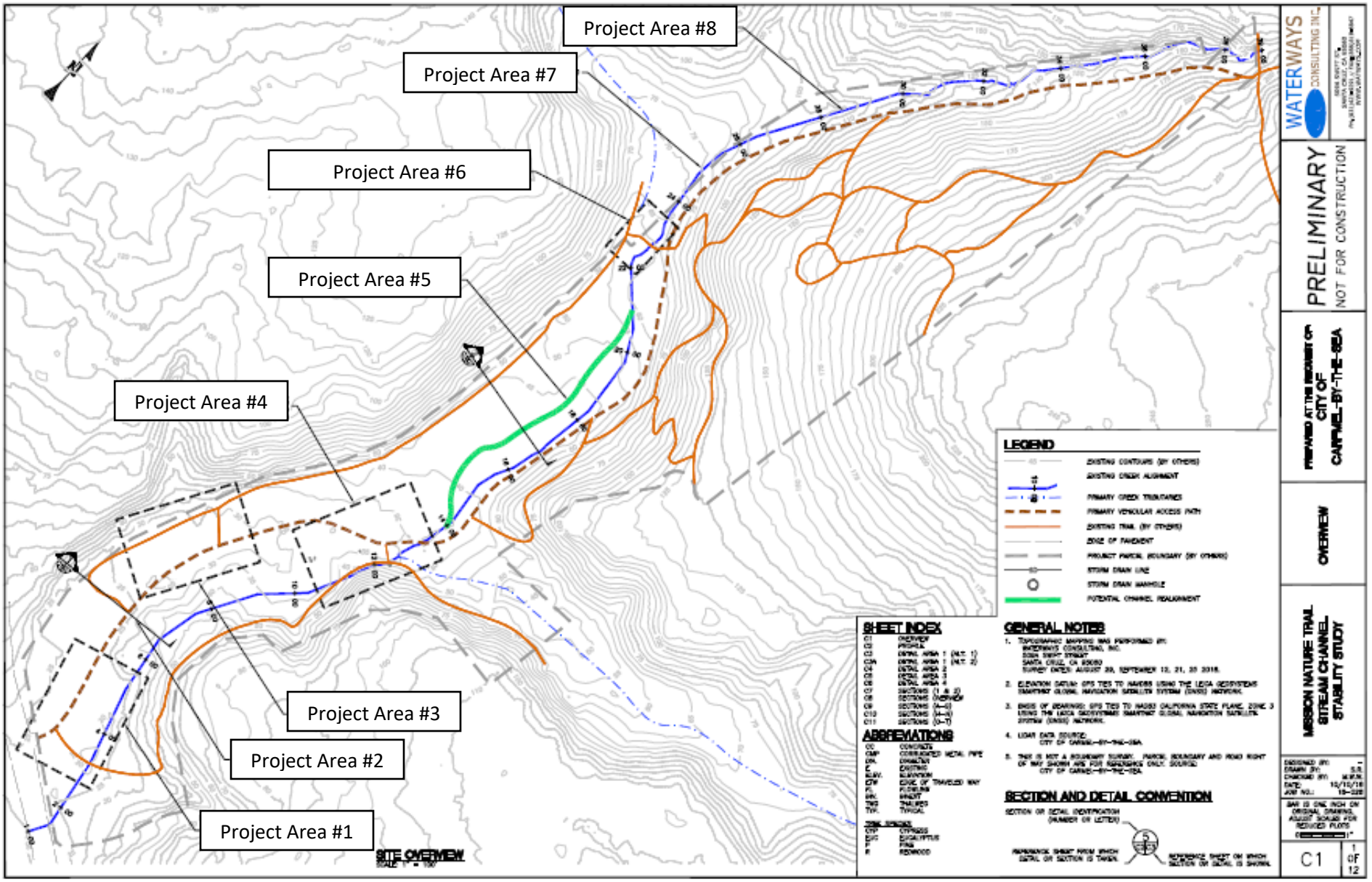
Table 2: Mission Trail Stream Restoration Projects

PROJECT AREA	PROJECT COMPONENTS	APPROXIMATE COSTS	
		DESIGN	IMPLEMENTATION & ESTABLISHMENT
1 (Alt 1)	RAISE ENTRANCE ROAD, INSTALL NEW CULVERT BELOW ENTRANCE ROAD, CONSTRUCT OPEN SWALE TO CREEK	$17,000	$90,000
1 (Alt 2)	RAISE ENTRANCE ROAD, INSTALL NEW CULVERT BELOW ENTRANCE ROAD, CONSTRUCT PIPE TO CREEK	$17,000	$95,000
1 (Alt 3)	RAISE ENTRANCE ROAD, INSTALL NEW CULVERT BELOW ENTRANCE ROAD	$15,000	$75,000
2	CONSTRUCT APPROX. 100 LF PEDESTRIAN BOARDWALK	$8,000	$40,000
3	INSTALL CULVERT OR ROCKED FORD AND REALIGN TRIBUTARY DRAINAGE, INSTALL SMALL DITCH CULVERT AND PERFORM DITCH MAINTENANCE	$7,500	$22,500
4	DEMOLISH PORTION OF EXISTING FORD, RESTORE DOWNSTREAM REACH OF CHANNEL, REALIGN TRAIL, CONSTRUCT PEDESTRIAN BRIDGE, RESTORE OLD TRAIL ALIGNMENT	$17,500	$100,000
5	REALIGN APPROX. 700 LF OF CHANNEL. RESTORE OLD CHANNEL BED, REVEGETATE DISTURBED AREAS	$27,500	$300,000
6	REPLACE EXISTING UNDERSIZED BRIDGE, RESTORE DOWNSTREAM CHANNEL AND ARMOR REACH TO PREVENT FURTHER INCISION UPSTREAM	$25,000	$230,000
7	REMOVE EXISITING WEIR, LOWER CHANNEL, STABILIZE NEW CHANNEL BED AND BANKS	$9,500	$30,000
8	PERFORM BOUNDARY SURVEY, DETAILED TOPOGRAPHY, GEOLOGIC & GEOTECHNICAL INVESTIGATION. PRIORITIZE A PHASED REPAIR PLAN, AND PREPARE PRELIMINARY AND FINAL DESIGNS FOR GRADE CONTROL.	$50,000	N/A

Other hazards addressed: drought (increased stormwater infiltration and wetland restoration)

Implementation Status: *Initiated*. Grant application for design and construction of Projects 1-3 is in the process of being submitted to the Per Capital Grant Program (non-competitive).

Figure 5: Mission Trail Stream Stability Projects



c. Opportunities to build on Existing Storm Mitigation Strategies:

- Upsize SDMP improvements, especially when making repairs in the lower reaches of watersheds, to handle larger storms.
- Consider incorporating green infrastructure in street and sidewalk projects to reduce runoff volumes into the City's storm drain system.
- Earmark CIP funding for design, permitting, and implementation of storm drain repairs. Include strategies in 2021 MJHMP for potential regional funding.
- When designing projects recommended in the Stream Stability Study, size improvements to handle larger storms.
- Earmark CIP funding for design, permitting, and implementation of stream stability study projects. Include strategies in 2021 MJHMP and Integrated Regional Watershed Management Program (IRWMP) for potential regional funding.

SEA LEVEL RISE

a. Shoreline Management Plan (2003)

The Shoreline Management Plan provides an overview of the many resources of the Carmel coastline and management policies for long-term maintenance and enhancement of coastal resources. The Shoreline Management Plan includes information on erosion processes along the shoreline and the City's existing shoreline protection structures. A long-term coastal bluff erosion analysis was conducted by Johnson (1984), who analyzed aerial photographs from 1908 to 1983, and indicated that the coastal bluff was eroding at an average rate of 0.4 feet/year in the north and 0.3 to 0.7 feet/year in the southern portion. Aerial photograph analysis indicated some periods of extreme bluff erosion, including the loss of at least 20 feet of bluff near 13th Avenue and near Martin Way between 1968 and 1970.

Approximately 50% of the City's shoreline protection structures are seawalls. Most of Carmel's seawalls have held up well over the years. One seawall built in 1978 failed, apparently due to poor design. Since 1978, the City has used rock revetments to protect nearly one quarter of its shoreline.

Shoreline Management Plan Policies supporting sea level rise adaptation:

- Pursue scientific studies that document physical processes occurring at Carmel Beach (e.g. sediment transport, sand bar dynamics, influences from the Carmel Bay offshore canyon).

- Limit development along the Carmel shoreline to facilities that support passive and active recreational activities, beach access, bluff protection and protection of infrastructure. Bluff protection and protection of infrastructure shall be permitted only when required to protect existing structures that are in danger from erosion.

- Discourage any further incursion of recreational activities into the North Dunes habitat. Sensitive resources in the North Dunes habitat area shall be protected.

- Protect the fragile dunes and sensitive plants in the Del Mar Dunes and North Dunes against any significant disruption of habitat values.

- Maintain records of sand moved and the volumes needed to cover each revetment. When revetments fail or need to be substantially reconstructed, consider vertical seawalls as an alternative.
- Construct new shoreline armoring in areas previously unprotected only when required to protect existing structures in danger of erosion and when designed to eliminate or mitigate adverse impacts on local shoreline sand supply.
- Obtain and maintain an accurate digitized map of the Carmel shoreline to develop the City's beach management and maintenance policies. Analyze historic beach trends using aerial photo analysis and other available tools. Update topographic information at least every 5 years and analyze shoreline changes to facilitate early identification of erosion hot spots, sand losses/gains, migration of revetments, and other long-term impacts.
- Place a series of permanent surveyed benchmarks inland of the bluffs running the length of Carmel Beach for long-term monitoring.
- Protect public access, Scenic Road, and the aesthetic character of the coast be maintaining existing seawalls and engineered revetments. When any existing seawalls or revetments need to be replaced or substantially reconstructed, review other beach management strategies and determine the best balance among objectives for access, aesthetics, and protection of coastal resources. Protect the natural character and features of the Del Mar and North Dunes by prohibiting the construction of any new shoreline protective structures unless required to protect existing structures in danger of erosion.
- Sand and bluff profiles shall be surveyed in 2003 and 2005 to establish a baseline. Thereafter, a set of san profiles shall be taken at five-year intervals, beginning in 2010 to establish an on-going record of shoreline trends on Carmel's beaches and bluffs. For each set of profiles, measurements shall be taken at mid-winter (lowest sand level), at spring (prior to sand redistribution activities), at early summer (after sand redistribution), and in the early fall (before offshore retreat).
- After each 5-year period of monitoring beach sand elevations, review available data to make preliminary determinations on the effects of seawall structures and sand redistribution activities.
- If data indicate that the beach has been losing sand over time, investigate options for beach nourishment using offshore deposits or other sources matching Carmel Beach sand.

b. Geotechnical Inspection of Carmel Beach Shoreline Improvements (2016) and 2016 Shoreline Assessment Update

Inspections of the City's shoreline infrastructure was conducted in the winters of 2015 and 2016 by Easton Engineers. The inspection noted that the shoreline improvements were in acceptable condition with relatively minor repairs required. The Inspection results included the recommendations shown

below in Table 3. Additional recommendations were included in the 2016 Shoreline Assessment Update and are included in Table 4.

Table 3: Recommendations from the Geotechnical Inspection of Carmel Beach Shoreline Improvements (2016)

Location	Recommendation
4th Avenue Outfall	Replacement of the outfall structure should be considered in the next few years, with a focus on how drainage can be appropriately released in a non-erosive manner. Additional recommendations: Prevent public access atop the structure and inspect the outfall structure when the beach is scoured and the structure's base is exposed.
10th Avenue Stairs Retaining Wall and Revetment	Settled portions of revetment should be restacked. Stairs, walls, and and revetments should be inspected when the beach is scoured.
10th Avenue Retaining Wall	Wall footing appears in good condition. Inspect when the beach is scoured.
Revetment south of 11th Avenue Stairs	Downcoast third of the revetment should be monitored. Additional large rip rap should be added to the downcoast third of the revetment and this portion keyed into bedrock and restacked to a more stable configuration.
Unprotected bedrock at 12th Avenue outfall	Inspect location when the beach is scoured so the base of the bluff is exposed. To protect the base of the bluff from undercutting, rip-rap revetment may be extended downcoast to a point just beyond the storm drain outfall.
Cove North of 13th Avenue Point	The wall's footing and repaired areas should be monitored and infilled with concrete as needed to help prevent further undermining. Remaining undercuts should be filled. Where constructed on potentially unstable material, the footing of the retaining wall should be underpinned. Restack fugitive rip-rap.
Retaining wall just north of 13th Avenue Point	Footing is significantly undermined and should be protected from further erosion by restacking the seaward revetment or constructing a deepened footing.
Rip-rap at Santa Lucia Stairs	The blufftop should be monitored for continued signs of erosion. The toe of the revetment should be monitored when the sand is scoured.
Seawalls between Santa Lucia & Martin Way	Wall segment A footing should be protected from further undermining by constructing a deepened footing or a rip-rap revetment across the areas of concern. The undercut, exposed portions of the footing should at a minimum be infilled with structural concrete to prevent further undermining. A deepened footing along the entire A through F wall segments will improve the stability and longevity of the walls. Alternatively, a rip-rap revetment along the base of the walls will help prevent continued undermining.
Martin Way Stairway	A concrete pedestal or piers should be constructed at the base of the stairs to support the stairs.

Table 4: Recommendations from the 2016 Carmel Shoreline Assessment Update

Location	Recommendation
Revetments: Unstable Rip Rap	Carmel's shoreline revetments should be regularly monitored (especially after the end of the storm season); perched riprap should be re-stacked and exposed revetments covered with redistributed sand whenever feasible.
Revetments: Migrated Riprap (12th & 13th Ave. Coves)	The re-stacking of migrated riprap should be conducted the next time conditions allow. This will best be accomplished if conducted during low sand conditions. Such work has been conducted in the past, but usually during periods of significant sand scour, a condition that is often accompanied by strong waves and a narrowing of Carmel Beach. This operation should be conducted with the advice of a qualified geotechnical specialist. It should be planned in advance so that all necessary preliminary steps (including funding, permits, and contracts) can be in-place of ahead of time, increasing the chances that it will be completed before the high sand level returns.
Stairways: general	The extensive list of stairway repairs recommended in the Graebe report (dated March 2, 2015) should be addressed as soon possible.
Shoreline Landscape Barriers (SLBs)	The Shoreline Landscape Barriers should be redesigned during FY 2016/2017, and rebuilt as soon as feasible. Their design should conform with Carmel's design traditions, and the new barriers should be able to be maintained, repaired and replaced by staff. The installation and locations of the new SLBs should be coordinated with the re-surfacing of the Pathway and re-vitalization of the Carmel bluff-top landscape. Because people often trampled landscape vegetation to walk over to the SLBs, it has been suggested that new barriers be placed within 12-18" of the Pathway.
Monitoring Program	An effective monitoring program should be developed to be conducted by City staff as they work along the shoreline. This program would take advantage of the skills of staff as well as their familiarity with the Carmel shoreline. If done correctly, it will encourage staff to report conditions that are not necessarily in their direct area of responsibility. Asking staff to be alert for conditions of concern as they work along the shore would serve as a "force multiplier," greatly expanding the City's ability to address conditions at an early, more manageable, stage.
Stairway Closures	To protect the safety of those who use Carmel's shoreline stairways, the City should employ effective methods for closing these access ways when conditions warrant. Such methods should involve physical barriers, clearly worded signage and enforcement. City staff should also focus on re-opening the stairways to public use, once safer conditions return.

Other hazards addressed: Storms

Implementation Status: *Partially initiated.* Public Works closes stairways to the public when hazardous conditions exist. Essential repairs to the stairs have been made. A landscape design was created and approved by the Planning Commission that incorporated restoration of the shoreline landscape barriers.

c. Carmel Area Wastewater District Sea Level Rise Study

CAWD conducted a Sea Level Rise study for their wastewater treatment facility in 2018. According to CAWD's study, the sea level rise projections do not identify new hazards to the WWTP of greater concern than the 100-year flood risks that CAWD has previously planned for. However, increased storm intensities as well as higher sea levels may increase the base flood elevations. According to the study, increased storm intensity, as well as sea level rise, will not detrimentally effect the CAWD WWTP before the year 2062 under the"Extreme Risk Aversion" scenario. The study also identified facility retrofits needed to maintain operations of essential infrastructure (See Appendix ___). This will allow for 40 years of continued operation in the existing location while evaluating options of future improvements to increase flood resiliency vs. relocating the WWTP. Long term options for the facility seem to be:

- Retreat up Carmel Valley
- Pump to Monterey One Water

d. Opportunities to build on Existing Sea Level Rise Strategies:

- Reinstate beach sand monitoring program described in the Shoreline Management Plan.
- Implement structural monitoring program and do follow-up monitoring post-storm to identify additional footing stability issues.
- Earmark CIP funding for design, permitting, and implementation of repairs. Include strategies in 2021 MJHMP for potential regional funding.
- Reach out to local researchers (e.g. CSUMB) or other sources to conduct Carmel Cove sand supply dynamics analysis.
- Hire a coastal engineer with experience in planning for climate change to conduct:
    - Further assessment of the risks to our coastal assets, including sea walls, revetments, bluffs, stairs and access, public bathrooms, parking areas, drainage infrastructure, and utilities.
    - Determine adaptation measures and LCP policy options.
        - Prioritize adaptations and projects that protect and maintain public resources and beach access, and the viability of the community and tourism.
        - Determine how the options and strategies along the coast are different for the:
            - Mostly natural, unarmored North Dunes area
            - Mostly armored bluffs along Scenic Road south of 8th Avenue
            - Unarmored dunes along private property between 8th Avenue and Del Mar Avenue
            - Armored private properties on the bluffs at the north end of the City (Pescadero Canyon area).
        - Evaluate feasibility and phasing, the use of thresholds for when different elements of these strategies are implemented. For example, maintaining

armory or other defenses up to a point, but then if a threshold is reached, embracing a new bluff line and different adaptive measure.

- Update Shoreline Management Plan and LCP based on results of coastal engineering analysis.

DROUGHT

a. Forest Management Plan (2000)

The Forest Management Plan establishes a broad set of goals and policies for management of the City's urbanized forest. Some policies of the Forest Management Plan are beneficial to drought and wildfire mitigation, and provide other adaptation benefits:

- Promote undergrounding of utilities where feasible and with minimum detriment to the root systems of trees.
- Monitor tree pest and disease problems and take appropriate measures to minimize their impact.
- Plant native Monterey pine seedlings of different genotypes to maximize resistance to diseases and make these seedlings available to the public.
- Establish and implement a procedure for removal of invasive vegetation.
- Maximize retention of surface water on each site through site design and use of best management practices.
- Where feasible, direct street runoff to open-space areas on public property for percolation into the soil.
- Implement development standards that minimize runoff and the amount of area paved with impervious surfaces.
- Require approval of landscape plans for drought tolerance and trees by the Forestry department on new construction.

Other hazards addressed: Storms, wildfire

Implementation Status: *Initiated.* Requirements for stormwater infiltration, drought tolerance, and trees on private property are in place in the municipal code and are enforced by City staff. The City Forester monitors tree pest and disease problems. Invasive vegetation removal is an on-going task.

b. Integrated Regional Water Management Plan

The Monterey Peninsula, Carmel Bay, and South Monterey Bay Integrated Regional Water Management Plan (IRWMP) was updated in 2019. Integrated regional water management in California is established as a way to increase regional self-sufficiency by encouraging local water resource managers to take a proactive role in solving water management problems through collaboration with stakeholders to create innovative strategies and effective actions to achieve water management objectives. The Monterey Peninsula Regional Water Management Group (RWMG), the body responsible for the development and implementation of the IRWM Plan, includes 17 local agencies and organizations, including the City. The Monterey Peninsula IRWM Plan region is approximately 350 square miles and includes the coastal cities of Carmel-by-the-Sea, Del Rey Oaks, Monterey, Pacific Grove, Sand City, and Seaside. Also included are the unincorporated portions of

Monterey County in Carmel Valley, Pebble Beach, the Carmel Highlands, the Laguna Seca area, and a portion of the Ord Community.

The IRWMP has the following prioritized regional objectives, which support climate change resilience:

- Improve regional water supply reliability through environmentally responsible solutions that promote water and energy conservation. Protect the community from drought and climate change effects with a focus on interagency cooperation and conjunctive use of regional water resources.
- Protect and improve water quality for beneficial uses consistent with regional community interests and the RWQCB Basin Plan through planning and implementation in cooperation with local and state agencies and regional stakeholders.
- Ensure that flood protection strategies are developed and implemented through a collaborative and watershed-wide approach and are designed to consider climate change effects and maximize opportunities for comprehensive management of water resources.
- Ensure that erosion management strategies are developed and implemented through a collaborative and watershed-wide approach and are designed to consider climate change effects.
- Develop watershed scale management strategies, considering climate change effects and maximizing opportunities for comprehensive management of water resources.
- Preserve the environmental health and well-being of the Region's streams, watersheds, and the ocean by taking advantage of opportunities to assess, restore and enhance these natural resources when developing water supply, water quality, and flood protection strategies. Seek opportunities to conserve water and energy, and adapt to the effects of climate change.
- Adapt the region's water management approach to deal with impacts of climate change using science-based approaches, and minimize the regional causal effects related to water resources.
- Identify an appropriate forum for regional communication, cooperation, and education. Develop protocols for encouraging integration and reducing inconsistencies in water management strategies between local, regional, State, and Federal entities.

The IRWMP identified the high priority adaptation strategies included in Table 5 below. Additionally, within the City of Carmel-by-the-Sea, the following three projects were submitted as concept proposals for inclusion in the IRWMP and potential future grant funding:

- **Carmel-by-the-Sea Pilot Wet-Dry Weather Diversion Program:** The goal of this project is to capture and treat runoff to substantially reduce the pollutants that enter the Carmel Bay ASBS. This project proposes to install a diversion facility at the City's 4th Avenue and Ocean Avenue storm drains, which capture most of the residential areas on the north side of the City and the downtown area. These diversion facilities would capture dry weather, first flush and small storm runoff from approximately 170 acres (approximately 50% of the City's watersheds that drain directly to the Pacific Ocean at Carmel Beach). Runoff captured would flow to the sanitary sewer collection system and ultimately to the Carmel Area Wastewater District's Wastewater Treatment Plant where the water would be treated and beneficially reused for irrigation of landscape at the Pebble Beach property.

- **Forest Hill Park Creek Restoration**: The goal of this project is to reduce erosion of the drainage channel that flows through Forest Hill Park on the north side of the City of Carmel-by-the-Sea and provide sediment capture to improve water quality flowing to the Carmel Bay ASBS from the City's largest watershed. The restoration would consist of rerouting and stabilizing the creek channel, which is eroding and impacting tree roots, slopes and nearby pedestrian walkways. Reducing sediment loads that flow into the storm drain system and to Carmel Bay from the City will also reduce heavy metals that bind to sediments such as lead and particulate copper.
- **Park Branch Library-Devendorf Rainwater Capture**: The goals of this project are to harvest and use dry weather flows and storm water from the Park Branch Library site for irrigation of neighboring Devendorf Park. This project also proposes to install permeable pavement at the Park Branch Library to allow storm water to infiltrate into the ground instead of running off in the street. This project could be integrated with the proposed Sixth Avenue / Devendorf Park Plaza.

Table 5: IRWMP High Priority Climate Adaptation Strategies

ADAPTATION RESPONSE STRATEGIES TO THE EFFECTS OF CLIMATE CHANGE		
Climate Change Effects	**Adaptation and Response Strategies**	**Initial Actions**
Rangelands are expected to be drier	Prepare fire reduction strategies to protect watershed lands using ecologically sustainable strategies. Implement adaptation strategies to conserve California's biodiversity.	N/A
Domestic landscaping water needs will be higher	Integrate land use and climate adaptation planning	Education Incentive programs Demonstration programs Grey water Xeriscaping Expand water supplies (purple pipe) and storage Aquifer management
Decrease in local rainfall	Promote community resilience to reduce vulnerabilities: Food sustainability Implement water conservation and supply management efforts Manage watersheds, habitat, and vulnerable species	Education Incentive programs Demonstration programs Grey water Xeriscaping
Sea level rise and higher groundwater extraction will lead to increased rates of seawater intrusion	Prepare a regional sea level rise adaptation strategy Promote working landscapes with ecosystem services Integrate land use and climate adaptation planning	Education Incentive programs Demonstration programs Grey water Xeriscaping Expand water supplies (purple pipe) and storage Aquifer management Expand agriculture water conservation programs

Adaptation Response Strategies To The Effects Of Climate Change		
Climate Change Effects	**Adaptation and Response Strategies**	**Initial Actions**
Droughts will be more frequent and severe	Implement adaptation strategies to conserve California's biodiversity. Educate, empower, and engage citizens regarding risks and adaptation Integrate land use and climate adaptation planning Promote community resilience to reduce vulnerabilities	Human safety response Education Incentive programs Demonstration programs Grey water Xeriscaping Expand water supplies (purple pipe) and storage Aquifer management Expand agriculture and urban water conservation programs
Lower seasonal surface flows can lead to higher pollutant concentrations	Manage watersheds, habitat, and vulnerable species	Minimize non-point source pollution Buffers
Changes in storm intensity will increase sediment loading in many systems	Prepare fire reduction strategies to protect watershed lands using ecologically sustainable strategies	Erosion control on farms and creeks Buffers
Channel stability will be impacted from higher storm flows causing additional turbidity	Provide guidance on protecting critical creek/river ecosystems and development	Erosion control on creeks Wastewater and stormwater infrastructure vulnerability analysis
Sea level rise will impact current estuary brackish water interface towards more marine systems	Implement adaptation strategies to conserve California's biodiversity	Retain freshwater in watershed Habitat migration Buffers Erosion control
Regional levees will provide less protection during higher storm flow events	Support essential data collection and information sharing Manage watersheds, habitat, and vulnerable species Prepare a regional sea level rise adaptation strategy	Refurbish or expand levees or tide gates (upgrade priority infrastructure) Map/inventory infrastructure

Adaptation Response Strategies To The Effects Of Climate Change		
Climate Change Effects	**Adaptation and Response Strategies**	**Initial Actions**
Natural creeks throughout the region and managed conveyance within the Carmel Valley will see higher flow rates leading to increased erosion and flooding	Manage watersheds, habitat, and vulnerable species	Refurbish or expand levees or tide gates(upgrade priority infrastructure) Map/inventory infrastructure
Coastal levees and control structures will be undersized to manage the combined influences of higher flow events and sea level rise	Support essential data collection and information sharing Prepare a regional sea level rise adaptation strategy	Refurbish or expand levees or tide gates(upgrade priority infrastructure) Map/inventory infrastructure/levee locations and WCS, ownership Phase II task 5 activity 3 - ecosystem services - be aware of services available Elevations of levees and sea walls - maybe with PWA-management strategies USGS elevation data
State recommendations suggest no new critical facilities be built within the 200-year flood plain(DWR 2008, DWR 2009b, CNRA2009)	Integrate land use and climate adaptation Planning	Work with Monterey County and cities, Coastal Commission (local jurisdiction)
Migration patterns and species distribution will change	Establish a system of sustainable habitat Reserves	Reduce migration impediments (dams, etc.) Compile data on species distribution Primary focus species - amphibians, waterfowl, salmonids, redwoods, tide water gobies Maintain habitat corridors - contiguous areas Fish and Game - wildlife adaptation plan - vulnerability for key species for each region
Invasive species populations will expand	Habitat/ecosystem monitoring and adaptive management	What are the invasive species and their ranges? Will they expand, be introduced? How are the habitats shifting (awareness)? Ecological adaptation investigation and strategy

Adaptation Response Strategies To The Effects Of Climate Change		
Climate Change Effects	**Adaptation and Response Strategies**	**Initial Actions**
Coastal wetland systems are especially vulnerable to the combined influences of climate change	Establish regional policies to protect critical habitats Provide guidance on protecting critical coastal ecosystems and development	Identify critical habitats and ecosystems Integrate ecosystem management Regulatory mechanisms dedicated to protecting future locations of these areas Inventory of wetlands currently
Some locally unique species such as coastal redwoods and giant kelp are susceptible to changes in certain locally favorable climate variables (fog duration, coastal upwelling)	Manage watersheds, habitat, and vulnerable species	Identify how they will be impacted - What are the changes? USGS study outcome - get a better handle on modeling fog changes in climate change

c. Opportunities to build on Existing Drought Mitigation Strategies:

- Update the Forest Management Plan to (1) address transitioning the urbanized forest to tree species that can withstand the projected temperatures of the second half of the century, and (2) include planting guidelines to improve tree health, (3) incorporate tree species that have greater wildfire resistance, and (4) include landscaping guidelines that reduce wildfire hazard on private property.
- Encourage stormwater infiltration features as part of street CIP projects to reduce runoff volume and increase groundwater infiltration.
- Provide information and incentives for residential water use reduction.

WILDFIRE

a. Mission Trail Nature Preserve Master Plan

The Mission Trail Nature Preserve Master Plan has some policies that can be beneficial to maintain the short- and long-term health of the Preserve's ecosystems in the face of climate change. These policies can make the Preserve more resilient to increased heat, drought, and wildfires:

- O5-25: Preserve and enhance the vegetative diversity in Mission Trail Nature Preserve consisting of Monterey pine forest, central coast willow riparian forest, wet meadow, coast live oak woodland, redwood, box elder, cottonwood, coastal terrace prairie.
- O5-31: Maintain natural drainage patterns except where erosion or human safety problems may be created. Encourage/allow the channelized ditch to revert to a more natural channel in order to enhance the park's wetlands (riparian forest, wet meadow) and natural character.
- Prepare annual maintenance plans for habitats within the Preserve. Encourage native vegetation to reestablish on sites previously mowed, cut, or invaded by exotic species.

Other hazards addressed: drought, temperature

Implementation Status: *Initiated.* Many elements of the Mission Trail Nature Preserve Master Plan, including enhancing native habitats and site hydrology, have been initiated and are currently in progress. The City has been working with its private non-profit partners on invasive species and fire fuel removal throughout the Preserve.

b. Mission Trail Nature Preserve Baseline Biological Assessment

The Mission Trail Nature Preserve Baseline Biological Assessment was completed in 2016 and includes an implementation plan for the maintenance and enhancement of the various habitats of the Preserve. This is the primary guiding document for habitat restoration projects in the Preserve.

Implementation Status: *Initiated.* Many elements of the Mission Trail Nature Preserve Baseline Biological Assessment, including weed removal and improving the site hydrology, have been initiated and are currently in progress. The City has been working with its private non-profit partners on invasive species and fire fuel removal throughout the Preserve.

c. Building Code / Zoning Code

(to be added later)

d. Defensible Space Inspection Program

Community wildfire preparedness is supported by Monterey Fire's Defensible Space Inspection Program and coordination with surrounding fire prevention organizations to limit fire and wildfire risk through planning, prevention, and mitigation. CalFire's Fire & Resource Assessment Program (FRAP) and Fire Hazard Severity Zone (FHSZ) maps are available online with information on forest assessment, fire severity zones, and defensible space. Monterey Fire personnel have inspected and graded all Carmel parcels as pass, pending, or fail. Grading criteria are evolving as knowledge on fire spread is developed. Current criteria are based on dry fuel accumulation, spark arrestors, and overhanging tree limbs.

e. Opportunities to build on Existing Wildfire Mitigation Strategies:

- Update the Forest Management Plan to (1) address transitioning the urbanized forest to tree species that can withstand the projected temperatures of the second half of the century, and (2) include planting guidelines to improve tree health, (3) incorporate tree species that have greater wildfire resistance, and (4) include landscaping guidelines that reduce wildfire hazard on private property.
- Update the Mission Trail Nature Preserve Master Plan to consider the potential impacts of climate change and to reduce wildfire risk for neighboring private properties. Incorporate Best Practices into an annual maintenance plan, including cost estimates for implementation and revenue sources for implementation.
- Collaborate with Monterey Fire on its inspection and outreach efforts to reduce fire risks. Help spread information at critical times to increase resident awareness and knowledge of how to reduce wildfire risk and prepare for emergencies.
- Update City Planning guidelines to reflect and/or not conflict with current California codes (CBC Chapter 7 & CRC R337) in the Very High Fire Hazard Severity (VHFHS) Zone. Incorporate defensible space design in landscaping guidelines.

MULTI-HAZARD

a. General Plan Safety Element

The Environmental Safety Element focuses on reducing human injury, loss of life, property damage, and the economic and social dislocation caused by natural and human-made hazards. The policies included in this element are intended to provide a framework to address natural and human induced hazards through prevention and emergency response. This element seeks to guide the continuous development of preventative measures that address existing and potential hazards, while also providing contingent emergency response procedures in the instance of a local or regional emergency.

The following issues were identified as relevant to the City of Carmel-by-the-Sea and are

addressed in the Goals, Objectives, and Policies and Supporting Information sections.

- Earthquakes
- Landslides
- Drainage/Flooding
- Fire
- Tsunami
- Disaster Preparedness

The following policies from the safety element relate to storms, wildfire, sea level rise, drought, and increased temperatures:

- P8-7 Ensure that water, gas, and sewage utilities serving critical facilities are in good condition and are engineered to withstand damage from disasters.
- P8-14 Educate the public regarding seismic, geologic, flood, fire, tsunami, and other potential disasters, by preparing periodic news articles for local media outlets, such as Carmel Pine Cone.
- P8-16 Encourage property owners to retrofit older structures with fire detection and/or warning systems.
- P8-17 Avoid and discourage locating public structures and utilities in high severity fire hazard zone.
- P8-18 Ensure adequate water supply for fire emergencies.
- P8-19 Encourage new development located in or adjacent to fire hazard areas to incorporate fire preventative site design, access, landscaping and building materials, and other fire suppression techniques.
- P8-20 Control excessive buildup of flammable vegetative material on vacant lots and within and adjacent to high severity fire hazard zones (such as Mission Trails and Pescadero Canyon – refer to Figure 8.4), especially following wet springs.
- P8-30 Reduce flooding hazards in areas with flooding potential by improving drainage and minimizing the alteration of natural drainage and natural protective barriers that accommodate or channel floodwaters.

b. Multi-Jurisdictional Hazard Mitigation Plan

The following projects were included in the 2016 Multi-Jurisdictional Hazard Mitigation Plan for the City of Carmel-by-the-Sea:

Action No.	Description	Ranking / Priority	Admin. Department	Potential Funding	Timeframe	Benefit-Costs	Narrative Update/ Explanation
1	Identify hazard-prone critical facilities and infrastructure and carry out acquisition, relocation, and structural and nonstructural retrofitting measures as necessary.	Priority / High	Planning and Building	HMGP and PDM Grants	Ongoing	This action will help ensure that the community/critical facilities can operate in some capacity before, during, and after the disaster.	The City has retained an engineering firm to assist in project management of Public Services Department hazard evaluation. The City will also be retaining an engineering consultant to evaluate the City's revetments and other shoreline protection structures in the next year or two.
2	Develop a sustained public outreach program that encourages consistent hazard mitigation content. For example, consider publishing tsunami inundation maps in telephone books, wildland fire defensible space tips with summer water bills, and the safe handling and disposal of hazardous waste and chemicals with garbage bills.	Priority / High	City Clerk	General Funds, HMGP, and PDM Grants	0-1 years	A mitigation outreach program will help build and support local capacity to enable the public to prepare for, respond to, and recover from disasters.	The City has installed new tsunami warning signs along shoreline areas and beach access points. The City will be revamping its website in the next few years and can add information on hazard mitigation such as wildland fire prevention actions, evacuation routes, and hazardous waste disposal.
3	Develop an unreinforced masonry grant program that helps correct earthquake-risk non-masonry building problems, including chimney bracing and anchoring water heaters.	Priority / High	Planning and Building	General Funds, HMGP, and PDM Grants	0-3 years	This action will prevent future residential and nonresidential losses of unreinforced masonry buildings in the future. The retrofitting of unreinforced masonry buildings is a high priority for the State of California.	The City has not had adequate staff resources to implement this program yet. The City is in the process of addressing staffing needs, so progress on this program may be feasible in the next 2-3 years.

Action No.	Description	Ranking / Priority	Admin. Department	Potential Funding	Timeframe	Benefit-Costs	Narrative Update/ Explanation
4	Continue to conduct current fuel management programs and investigate and apply new and emerging fuel management techniques.	Priority / High	Fire	General Funds and PDM Grant	Ongoing	The probability of future damage from wildland fires could be high if this mitigation action is not implemented.	The City has provided for fuel management on City owned lands and will provide that service annually. Staff will explore the use of goats as a new method to do this work to improve the fuel management in steeper terrain areas.
5	Develop and provide funding and/or incentives for defensible space measures (e.g., free chipping day, free collection day for tree limbs).	Priority / High	Fire	General Funds, HMGP, and PDM Grants	Ongoing	The potential cost of this mitigation action seems reasonable for the size of the problem and its likely benefits.	Due to staff and fund shortages, this item has not been implemented. The City has provided, and will continue to provide, inspection, information, and enforcement of fuel management on private property as appropriate.
6	Work with the Utility Companies (especially PG&E) to build and strengthen relationships to improve communication regarding emergency situations and develop an emergency response plan that includes all emergency responders and 911 communications.	Priority / Moderate	Public Safety/PD	General Funds	Ongoing	As this action would consist primarily of communication and planning activities, the benefits of this project would far outweigh its minimal costs.	New action for 2014-2019.

c. Opportunities to build on Existing Multi-Hazard Mitigation Strategies:

- The City has an opportunity in 2021 to provide an updated list of projects to include in the MJHMP Update. The City should include a comprehensive list of projects based on its existing plans, as well as identified gaps in this Vulnerability Assessment.

VII. Vulnerability Scoring Matrix

The vulnerability scoring matrix incorporates the potential threat of a climate hazard with the existence of current policies to help mitigate hazards to vulnerable assets and populations. The matrix can help prioritize planning for vulnerable assets that have not yet been addressed by City policies or projects.

Color coding:
- Already causing significant observable impacts
- Mid- to long-range impacts
- Not enough data

YES — Some policy/action initiated
NO — No policy/action initiated

Priority Assets at Risk	Priority Hazards						
	Sea Level Rise	**Ocean Warming**	**Wildfires**	**Stronger Storms**	**More Droughts**	**Increased Temperature**	**Fog changes**
Natural Assets							
Mission Trail Nature Preserve	X		YES	YES	YES	YES	X
North Dunes	**NO**				YES	**NO**	X
Urban Forest			**NO**	YES	YES	**NO**	X
Marine Sanctuary		X		X	X	X	X
Carmel Beach	YES	X		YES			X
Community							
Persons with disabilities			**NO**	**NO**	**NO**	**NO**	
Elderly Population			**NO**	**NO**	**NO**	**NO**	
Visitors	**NO**	X	**NO**	**NO**			
Local Businesses	**NO**	X	**NO**	**NO**		X	
Utilities							
Water Supply			YES		YES	YES	
Electrical Energy Transmission (Electric Vehicles, safety power shutoffs, outages)			**NO**	**NO**		**NO**	
Sanitary Sewer System	YES			X			

Priority Assets at Risk	Priority Hazards						
	Sea Level Rise	**Ocean Warming**	**Wildfires**	**Stronger Storms**	**More Droughts**	**Increased Temperature**	**Fog changes**
PG&E/communication underground infrastructure (gas, cable)	**NO**		**NO**				
Storm drainage system	YES			YES			
Regional Infrastructure							
Wastewater Treatment Facility	YES			YES		X	
Transportation Infrastructure	YES		YES	YES			
Hospital and emergency medical care facilities			X	X		X	
Landfill & Waste Management				YES			
Local Infrastructure							
Scenic coastal trail, public restrooms and beach access infrastructure	YES			YES		**NO** (visitors)	X
Coastal roadways and parking	**NO**			YES		**NO** (visitors)	
Seawalls and revetments	YES			YES			
Other city streets				YES			
Private property (including many second homes)	**NO**		YES	YES		X	