



CITY OF CARMEL-BY-THE-SEA FOREST AND BEACH COMMISSION

Sarah Berling, Kelly Brezoczky, Tamara Michie,
Gerald Montmorency and JC Myers

All meetings are held in the City Council Chambers
East Side of Monte Verde Street
Between Ocean and 7th Avenues

REGULAR MEETING Thursday, March 14, 2024

MEETING 2:30 PM

THIS MEETING WILL BE HELD IN PERSON AND VIA TELECONFERENCE. The public is welcome to attend the meeting in person or remotely via Zoom, however, the meeting will proceed as normal even if there are technical difficulties accessing zoom. The City will do its best to resolve any technical issues as quickly as possible. To view or listen to the meeting from home, you may watch the Youtube Live Stream at: <https://www.youtube.com/@CityofCarmelbytheSea/streams>, or use the link below to view or listen to the meeting via Zoom teleconference:

<https://ci-carmel-ca-us.zoom.us/j/81337685349> Webinar ID: 813 3768 5349 Passcode: 208754

HOW TO OFFER PUBLIC COMMENT: Public comment may be given in person at the meeting, or using the Zoom teleconference module, provided that there is access to Zoom during the meeting. Zoom comments will be taken after the in-person comments. The public can also email comments to yculver@ci.carmel.ca.us. Comments must be received 2 hours before the meeting in order to be provided to the legislative body. Comments received after that time and up to the beginning of the meeting will be made part of the record.

CALL TO ORDER AND ROLL CALL

EXTRAORDINARY BUSINESS

- A. Police Chief's Briefing on Beach Closures and Emergency Funding
- B. Arbor Day/Earth Day/Community Day 2024

PUBLIC APPEARANCES - Under the Brown Act, public comment for matters on the agenda must relate to that agenda item and public comments for matters not on the agenda must relate to the subject matter jurisdiction of this legislative body. Hateful, violent, and threatening speech is impermissible public comment as it disrupts the conduct of the public meeting. This is a warning that if a member of the public attending this meeting remotely violates the Brown Act by failing to comply with these

requirements of the Brown Act the meeting, then that speaker will be muted.

Members of the public are entitled to speak on matters of municipal concern not on the agenda during Public Appearances. Each person's comments shall be limited to 3 minutes, or as otherwise established by the Commission. Matters not appearing on Commission's agenda will not receive action at this meeting but may be referred to staff for a future meeting. Persons are not required to give their names, but it is helpful for speakers to state their names so that they may be identified in the minutes of the meeting.

ANNOUNCEMENTS

CONSENT AGENDA

Items on the consent agenda are routine in nature and do not require discussion or independent action. Members of the Commission or the public may ask that any items be considered individually for purposes of Commission discussion and/ or for public comment. Unless that is done, one motion may be used to adopt all recommended actions.

1. February 8, 2024 Meeting Minutes

ORDERS OF BUSINESS

Orders of Business are agenda items that require City Council, Board or Commission discussion, debate, direction to staff, and/or action.

2. Receive a presentation from Integral Corp./Haro Kasunich & Associates/EMC Planning Group providing the preliminary findings of the Shoreline and Beach Erosion Exposure Modeling, Task 3, and Coastal Hazard and Sea Level Rise Vulnerabilities, Task 4, which are part of the Coastal Engineering Study
3. Receive a presentation by Carmel Cares regarding Project Plans for the Ocean Avenue Medians Landscaping Project
4. Receive a presentation regarding a component of the Urban Forest Master Plan: the Preliminary Tree Species List
5. City Forester's Report for February 2024
6. Public Works Director's Report for February 2024, including an Update on Repairs of the Beach Access Stairs

FUTURE AGENDA ITEMS

ADJOURNMENT

This agenda was posted at City Hall, Monte Verde Street between Ocean Avenue and 7th Avenue, Harrison Memorial Library, located on the NE corner of Ocean Avenue and Lincoln Street, the Carmel-by-the-Sea Post Office, 5th Avenue between Dolores Street and San Carlos Street, and the City's webpage <http://www.ci.carmel.ca.us> in accordance with applicable legal requirements.

SUPPLEMENTAL MATERIAL RECEIVED AFTER THE POSTING OF THE AGENDA

Any supplemental writings or documents distributed to a majority of the Forest & Beach Commission regarding any item on this agenda, received after the posting of the agenda will be available at the Public Works Department located on the east side of Junipero Street between Fourth and Fifth Avenues during normal business hours.

SPECIAL NOTICES TO PUBLIC

In compliance with the Americans with Disabilities Act, if you need special assistance to participate in this

meeting, please contact the City Clerk's Office at 831-620-2000 at least 48 hours prior to the meeting to ensure that reasonable arrangements can be made to provide accessibility to the meeting (28CFR 35.102-35.104 ADA Title II).



CITY OF CARMEL-BY-THE-SEA FOREST AND BEACH COMMISSION Staff Report

March 14, 2024
EXTRAORDINARY BUSINESS

TO: Forest and Beach Commissioners

SUBMITTED BY: Robert Harary, P.E., Director of Public Works

SUBJECT: Police Chief's Briefing on Beach Closures and Emergency Funding

RECOMMENDATION:

Receive an update from the Public Safety Director/Police Chief regarding beach closures and emergency funding.

BACKGROUND/SUMMARY:

At the January 11, 2024 meeting, the Forest and Beach Commissioners requested information about the criteria for deciding when to close beach access stairs prior to storms, coordinating emergencies with Monterey County, and pursuing any available funding sources for emergency repairs. The Director of Public Works suggested that Public Safety Director/Police Chief Paul Tomasi be invited to speak at the February Commission meeting to provide this information and answer any questions.

Specifically, Chief Tomasi will discuss:

1. Process for deciding when to close Carmel Beach for public safety.
2. The process for re-opening beach access stairs.
3. Emergency access to Carmel Beach until the equipment access ramp can be restored.
4. Monterey County Disaster Proclamation in January 2024
5. Potential funding opportunities for beach infrastructure repairs from agencies including the Federal Emergency Management Agency (FEMA), State Office of Emergency Services (OES), or others.

Environmental Evaluation

This action does not constitute a project within the meaning of the California Environmental Quality Act under Public Resources Code Section 21065. It has no potential to cause either a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment and, therefore, does not require environmental review

FISCAL IMPACT:

None.

ATTACHMENTS:



CITY OF CARMEL-BY-THE-SEA FOREST AND BEACH COMMISSION Staff Report

March 14, 2024
EXTRAORDINARY BUSINESS

TO: Forest and Beach Commissioners

SUBMITTED BY: Mary Bilse, Environmental Programs Manager

SUBJECT: Arbor Day/Earth Day/Community Day 2024

RECOMMENDATION:

Receive a report and support the upcoming 2nd Annual Earth & Arbor Day event to be held on Saturday, April 20, 2024 at Devendorf Park from 10 am to 2 pm.

BACKGROUND/SUMMARY:

In September 2022, the Community Activities Department hosted the City of Carmel-by-the-Sea's inaugural Community Day event, which served as a hub for many local community groups to showcase their programs and resources, and for community members to explore volunteer opportunities. A total of 18 community groups participated.

In April 2023, the Public Works and Community Activities Departments hosted the City of Carmel-by-the-Sea's inaugural Earth & Arbor Day event. The creation of this event addresses the City's adopted Climate Adaptation Plan, which calls for the "active engagement and development of partnerships with community stakeholders, local businesses, and residents to achieve steady progress towards the City's climate resilience goals." Link to the Climate Adaptation Plan is found [here](#). A total of 21 groups participated.

Both inaugural events received positive feedback from the community and participating organizations.

The second annual Community Day event was scheduled for September 2023; however, inclement weather caused it to be cancelled. This year, the 2nd Annual Earth & Arbor Day event is scheduled for April 20, 2024, and will be combined with Community Day. A poster has been developed and is shown in **Attachment #1**.

Celebrating Earth Day, Arbor Day, and Community Day in one singular event this year will highlight the intersectionality of community, health, and environmentalism. Sectors of participating groups include: ocean, water, and wildlife conservation (Surfrider Monterey, Big Sur Land Trust, California Department of Fish & Wildlife); public health and safety (Monterey Fire, Monterey County Sheriff's Office, Montage Health Foundation, Carmel CERT); renewable energy and waste management (Solartecture, ReGen Monterey, GreenWaste Recovery); and other community groups and local businesses (Alzheimer's Association,

RANA Nursery, Sunset Cultural Center, The Green Directive, Mad Dogs & Englishmen Bike Shop) and more! This year, we are also collaborating with Good Roots Events who organizes our weekly Farmer's Market. We are working to have local farm vendors host booths at the event, as well.

Similar to last year, the event will take place at Devendorf Park. As of now, 37 organizations are confirmed to participate, excluding the Farmers Market vendors, which is still to be determined. A current list of organizations can be found in **Attachment #2**.

The Forestry Division will also be leading a tree planting ceremony. A 24-inch coast redwood tree (*Sequoia sempervirens*) will be donated by West Coast Arborists. City Forester Justin Ono and his team will plant the tree on the southeast corner of Devendorf Park. Coast redwood is native to the California central coast, and provides several ecological benefits such as: carbon storage, habitat for native species, and water quality filtration. A secondary 24-inch coast live oak tree (*Quercus agrifolia*) in memory of Janice Bradner, who lead the "Downtown Detail" Community engagement program in recent years will also be planted in downtown Carmel.

Advertising for this event will be posted in the "Carmel Pine Cone" in the two weeks leading up to the event. Event information has already been posted on our City website, and a social media kit has been distributed to participating organizations.

Environmental Evaluation

This action does not constitute a project within the meaning of the California Environmental Quality Act under Public Resources Code Section 21065. It has no potential to cause either a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment and, therefore, does not require environmental review.

FISCAL IMPACT:

Advertising in the Pine Cone will be paid for by the Community Activities operating budget.

ATTACHMENTS:

Attachment #1 - Earth and Arbor Day Poster 2024

Attachment #2 - List of Participating Organizations



2ND ANNUAL CITY OF CARMEL-BY-THE-SEA

EARTH & ARBOR DAY

CELEBRATE COMMUNITY + OUR PLANET

**CONNECT WITH LOCAL ORGANIZATIONS DEDICATED TO
ADVANCING THE HEALTH + WELL-BEING OF
PEOPLE + OUR PLANET**

Attachment 1

**SATURDAY, APRIL 20, 2024 10 AM - 2 PM
DEVENDORF PARK, CARMEL
WWW.CI.CARMEL.CA.US**



2nd Annual Carmel-by-the-Sea Earth & Arbor Day Event	
Organization Name	
1	Alzheimer's Association
2	Applied Solar Energy
3	Big Sur Land Trust
4	Bird School Project
5	California Department of Fish & Wildlife
6	California Marine Sanctuary Foundation
7	Carmel Area Wastewater District
8	Carmel Cares
9	Carmel CERT
10	Carmel Chamber of Commerce
11	Carmel Garden Club
12	Carmel Mission Trail Lions Club
13	Communities for Sustainable Monterey County
14	First Night Monterey
15	Frank Ono – Ask an Arborist
16	Friends of Carmel Forest
17	Friends of HML
18	Friends of Mission Trails Nature Preserve
19	Good Roots Events – FM Vendors
20	Green Directive
21	Green Infrastructure Design
22	GreenWaste Recovery
23	Joey Canepa North Dunes
24	Mad Dogs & Englishmen Bike Shop
25	Montage Health Foundation
26	Monterey Audubon Society
27	Monterey County Sheriff's Office
28	Monterey Fire
29	Monterey Peninsula Water Management District (MPWMD)
30	Monterey SEA
31	Nitrocycle
32	RANA Nursery
33	ReGen Monterey
34	Solartecture
35	Sunset Cultural Center
36	Surfrider Monterey
37	West Coast Arborist
Date: March 5, 2024	



CITY OF CARMEL-BY-THE-SEA FOREST AND BEACH COMMISSION Staff Report

March 14, 2024
CONSENT AGENDA

TO: Forest and Beach Commissioners

SUBMITTED BY: Robert M. Harary, P.E., Director of Public Works

SUBJECT: February 8, 2024 Meeting Minutes

RECOMMENDATION:

Approve the February 8, 2024 Meeting Minutes.

BACKGROUND/SUMMARY:

FISCAL IMPACT:

ATTACHMENTS:

February 8, 2024 Meeting Minutes

**FOREST AND BEACH COMMISSION
REGULAR MEETING
Thursday, February 8, 2024**

MEETING TIME 2:30 PM

CALL TO ORDER AND ROLL CALL

PRESENT: Berling, Brezoczky, Michie, Montmorency, Myers
ABSENT: None
STAFF PRESENT: Robert Harary, P.E., Director of Public Works
Justin Ono, City Forester
Yvette Culver, Commission Secretary

PLEDGE OF ALLEGIANCE

Chair Myers led the public in the Pledge of Allegiance

PUBLIC COMMENT

Brian Sours
Melanie Billig
Dale Byrne
Karyl Hall
Nancy Twomey

ANNOUNCEMENTS

Public Works Director Harary announced:

- During the Forester's Report towards the end of this meeting, we will give a preliminary recap of trees lost from the significant storm on Sunday, February 4th.
- Police Chief Tomasi will attend next month's Forest and Beach meeting to review the criteria for when we have to close the beach, how our Police, Public Works, and Fire Departments coordinate with Monterey County Emergency Services during storms, and potential funding sources for shoreline repairs, such as from FEMA.
- At the Climate Committee meeting on February 15th, the results of sea level rise and impacts on the shoreline infrastructure and beach over the next 75 to 100 years will be presented. The same presentation is scheduled for the Forest and Beach meeting in March. However, because this information is so important to understand the future of Carmel Beach, we suggest that you attend the Climate Committee meeting too, if possible.

CONSENT AGENDA

Item 1: January 11, 2024, Meeting Minutes

Commissioner Michie moved to approve the Meeting Minutes for January 11, 2024, seconded by Commissioner Berling, and carried by the following roll call vote:

AYES: Berling, Brezoczky, Michie, Montmorency, Myers
NOES: None

ABSENT: None
ABSTAIN: None

ORDERS OF BUSINESS

Item 2: Receive a Presentation and Consider approval of a Restoration Project along the Scenic Pathway, as proposed by the Leadership Carmel Class of 2024, subject to issuance of an encroachment permit.

Director Harary introduced the fourth class of Leadership Carmel, who will be proposing their Legacy Project. The proposed project name is the Scenic Outlook, Southwest of Eighth Avenue Restoration Project. He stated that the Commission may approve the project subject to staff's issuance of an encroachment permit, approve the project with minor or significant changes, or reject the project. Mr. Harary acknowledged the Directors of Leadership Carmel, Jeanne and Barry Frew, and introduced Katie Jordan and Bibi Lamere who will be presenting the project.

Ms. Jordan and Ms. Lamere presented their Legacy Project and answered questions of the Commission.

PUBLIC COMMENT

Cindy Lloyd

The Forest and Beach Commission moved to approve the Restoration Project along the Scenic Pathway as proposed by the Leadership Carmel Class of 2024 subject to issuance of an encroachment permit, carried by the following roll call vote:

AYES: Berling, Brezoczky, Michie, Montmorency, Myers
NOES: None
ABSENT: None
ABSTAIN: None

Item 3: Receive a presentation of two Urban Forest Master Plan (UFMP) deliverables: Tree Inventory and Species in Carmel-by-the-Sea, and the Tree Canopy and Land Cover Assessment

Director Harary summarized the ongoing development of the Urban Forest Master Plan that Davey Resource Group (DRG) is preparing. As discussed at the January meeting, we will be reviewing major portions of the Plan over the next several meetings rather than trying to digest the whole Plan all at one time.

DRG has about ten technical studies and tasks to complete to support the findings for the Plan. The first task was the Tree Inventory, which included geo-location and condition assessment of 10,000 City trees, which Forester Ono will discuss next. A second major task was the Community Survey that was previously provided to the Commission. Forester Ono will also be presenting the results of a technical study regarding the Tree Canopy and Land Cover Assessment report. There will also be a few more technical studies presented to the Commission before we review the first draft of the overall Plan. The Tree Inventory and Tree Canopy and Land Cover Assessment were attached to the agenda packet.

Commissioner Brezoczky and Chair Meyers suggested that we begin to engage the community in public workshops as these technical reports and survey information come to fruition. Having community buy in on the various technical components that make up the Plan will help us all develop specific strategic policy choices for the future of the urban forest.

City Forester Ono presented the Staff Report and summarized the Tree Inventory of 9,875 City-owned trees broken down by quantities and tree species and answered questions of the Commission.

PUBLIC COMMENT

Melanie Billig
Nancy Twomey
Cindy Lloyd

City Forester Ono then presented the second half of the Staff Report on the assessment of the tree canopy and land cover within the city limits. This included a summary of the environmental benefits of the urban forest, current and potential canopy cover percentages, and overall canopy health. It was emphasized that the report is intended to provide factual information. Whether or not any opinions of the DRG report writers are written or assumed, it is up to the City to set subsequent policy direction. He answered questions of the Commission.

PUBLIC COMMENT

Scott Lonagan
Cindy Lloyd
Nancy Twomey

Item 4: Receive a demonstration of TreeKeeper, a digital tree inventory program

City Forester Ono presented a live demonstration of “TreeKeeper,” a digital inventory program used by the Forestry, Parks, and Beach Division. He demonstrated the system’s mapping capabilities, how the system includes attribute data associated with each tree in the program, and how the system can link tree to permits or services associated with individual trees. Forester Ono answered questions of the Commission.

PUBLIC COMMENT

Cindy Lloyd

Item 5: City Forester’s Report for January 2024

City Forester Ono presented the City Forester’s Report for January 2024 as follows:

- The first draft of the UFMP was expected in December but has been delayed to February due to the resignation of a key DRG project team member.
- Forestry crews planted 14 new trees, removed 8 dead/hazardous trees, pruned 14 trees, and removed 1 stump in January
- Overgrown acacia was pruned around the viewing deck at the west end of the Del Mar parking lot.
- Crews pruned overgrown trees and shrubs which were partially blocking views of Stop signs.
- Crews began to clear out a backlog of logs left over by PG&E line clearing crews.
- Crews started driving our new, 2023 Dodge Dakota 1500 trucks which have much larger bed capacity for trees, equipment, and materials versus the older trucks they replaced.
- Tree contractors removed 4 large stumps and 14 dead or dying trees under Task Orders.
- Landscape maintenance work continues to be fully engaged by Town & Country.
- Forestry staff attended a “Navigating Urban Forestry Workshop” sponsored by West Coast Arborists in Menlo Park. Key topics included tree health and using drones and new technology.
- Forestry welcomed back Administrative Analyst Tom Ford from Paternity leave after his wife Michelle gave birth to their baby boy, Jason Sergio Ford, in late November.

Forester Ono also gave a preliminary status of the significant storm on Sunday, February 4th as follows:

- Tracking 106 tree incidents
- 42 City trees fell, plus 8 trees were in active failure and had to be removed

- So far, 49 large limbs fell or had to be removed
- Power lines were taken down at 4 locations, approximately 10-12 houses were damaged, and at least 4 vehicles were damaged

PUBLIC COMMENT

Nancy Twomey
Melanie Billig

Item 6: Public Works Director's Report for January 2024

Director Harary presented the Public Works Report for January 2024 as follows:

City Council actions related to Forestry, Parks, and Beach issues

- Due to cancellation of the February 6th City Council meeting due to storms, the following project will be pushed to the March meeting: Coastal Engineering Study, Phase 2, Amendment No. 1 to the Agreement with EMC Planning/Integral/Haro Kasunich for a fee of \$450,000. As part of this action, staff is requesting Council to reallocate \$100,000 that was included in the Capital Improvement Program for the Coastal Engineering Study Phase 2, to add to funding for the Shoreline Infrastructure Repair Project.

Forestry, Parks, and Beach-related Capital Improvement Projects

- For the Shoreline Infrastructure Repair Project, staff reviewed a draft Request for Proposal to hire an engineering firm with shoreline expertise. Remaining issues to resolve include environmental services scope and availability of plans and reports when the RFP is issued.

Climate Committee meetings and Climate Action and Climate Adaptation Plan implementation

- The \$500,000 Local Coastal Programs (LCP) Grant Agreement was approved by the California Coastal Commission and executed.
- For the Coastal Engineering Study, Phase 1, met with Integral to review preliminary findings of Tasks 3 and 4 associated with sea level rise impacts on the beach and adaptation strategies.

Update on Volunteer Organizations

- Carmel Cares installed a stone paver apron in front of the trash enclosure on the Scenic Pathway near Ninth Avenue.

Miscellaneous Forestry, Parks, and Beach-related Public Works items

- Issued a Purchase Order to Native Solutions (Joey Canepa) to provide oversight of volunteers during weed pulling at the North Dunes Habitat Restoration site.
- Due to a high Cal Am water bill during winter months, we checked water meters, restrooms, irrigation systems, and backflow devices for leaks. Only one leak was found and repaired. A fire hydrant that was struck by a truck resulting in the loss of considerable amounts of water appears to have also contributed to the increased bill.
- 2nd Quarter April 1 - June 30, 2023, Forest Theater Management Report: Activities: 50 rehearsals, and 37 performances and events: "Celebrating the Beatles," "Something Rotten," SLV – Music in the Forest, FTG – Films/" Ride the Cyclone," "What the Constitution Means to Me," and MCTA – "White Knight, Shoes to Tight." Total Attendance: 2,637. Total Facility Fees paid to City \$2,506.
- 3rd Quarter July 1- September 30, 2023, Forest Theater Management Report: Activities: 26 rehearsals, and 44 performances and events: FTG- Films/" Ride-the Cyclone," SLV-Music in the Forest, Puddles Pity Party, Monterey Symphony, PacRep Theatre – "The Addams

Family,” and PacRep Theatre – “Cymbeline.” Total Attendance: 10,917. Total Facility Fees paid to City \$8,247.

- Heavily damaged beach access stairs at Fourth Avenue, Tenth Avenue, Twelfth Avenue, and Martin Way and the equipment access ramp near Eighth Avenue will be closed until further notice.
- Reconstructed the MTNP entry gate at Rio Road using salvaged parts from the old Eleventh Avenue gate and painted the new gate.

PUBLIC COMMENT

None

FUTURE AGENDA ITEMS

- Presentation from Carmel Police regarding the beach closures
- Urban Forest Master Plan Tree Planting Palette
- Coastal Engineering Study, Tasks 3 and 4 regarding Sea Level Rise

ADJOURNMENT

Respectfully submitted,

Yvette Culver, Commission Secretary

Approved by:

JC Myers, Chair



CITY OF CARMEL-BY-THE-SEA FOREST AND BEACH COMMISSION Staff Report

March 14, 2024
ORDERS OF BUSINESS

TO:	Forest and Beach Commissioners
SUBMITTED BY:	Mary Bilse, Environmental Programs Manager
SUBJECT:	Receive a presentation from Integral Corp./Haro Kasunich & Associates/EMC Planning Group providing the preliminary findings of the Shoreline and Beach Erosion Exposure Modeling, Task 3, and Coastal Hazard and Sea Level Rise Vulnerabilities, Task 4, which are part of the Coastal Engineering Study

RECOMMENDATION:

Receive a presentation from Integral Corp./Haro Kasunich & Associates/EMC providing the preliminary findings of the Shoreline and Beach Erosion Exposure Modeling, Task 3, and Coastal Hazard and Sea Level Rise Vulnerabilities, Task 4, which are part of the Coastal Engineering Study, Phase 1.

BACKGROUND/SUMMARY:

At their August 2, 2022 meeting, the City Council adopted the City of Carmel-by-the-Sea's Climate Adaptation Plan and Climate Action Plan under Resolution 2022-064. Council commented that implementation of these Plans is imperative and requested the Climate Committee to continue to oversee implementation of certain projects, including the Coastal Engineering Study.

At the November 2022 meeting, the City Council adopted Resolution 2022-094 awarding a Professional Services Agreement with EMC Planning Group, for a not-to-exceed fee of \$175,000, to conduct the Coastal Engineering Study and Adaptation Planning Project, Phase 1. Key subconsultants for this Study are Integral Corporation and Haro Kasunich & Associates.

To develop the project's scope of work, the Consultant team reviewed the 2001 Coastal Development Permit for Scenic Road Armoring Repairs, 2003 Shoreline Management Plan (Shonman and D'Ambrosio), 2016 Carmel Shoreline Assessment Update, 2016 Assessments of Shoreline Improvements at Carmel Beach (Easton Geology), and the City's 2022 Climate Adaptation and Climate Action Plans.

The Study will be completed in two phases. Phase 1 is City-funded in the current Capital Improvement Plan (CIP), while Phase 2 is now funded by a California Coastal Commission grant of \$500,000.

At the March 4, 2024 meeting, the City Council adopted Resolution 2024-014 authorizing the City Administrator to execute Amendment No. 2 to the Professional Services Agreement with EMC Planning Group, for a not-to-exceed fee of \$450,000, for the Coastal Engineering and Adaptation Planning Project,

Phase 2. Phase 2 will include Hazard Policy review and revisions, public outreach, and adaptation pathway development. Key results of Phase 2 will be brought back to the Climate Committee and/or Forest and Beach Commission in the future.

Phase 1 – Coastal Engineering Study, Phase 1 Status

The consultant team presented their findings of Phase 1, **Task 1, Coastal Engineering Condition Evaluation**, and Phase 1, **Task 2, Shoreline and Beach Change Analysis**, to the Climate Committee on November 16, 2023. Previously, the consultant team presented their findings to the Forest and Beach Commission at the March 2023 and the August 2023 meetings.

The Consultants also prepared a memo, **Task 5 – Policy Review**, summarizing the City's existing coastal hazard policies and identifying recommended updates to the Local Coastal Program to be prepared in Phase 2.

At the February 15, 2024 Climate Committee meeting, the consultant team presented their key findings of Phase 1, **Task 3, Shoreline and Beach Erosion Modeling with Sea Level Rise** and **Task 4, Coastal Hazard and Sea Level Rise Vulnerabilities** to the Committee and the public.

At the March 14, 2024 Forest and Beach Commission meeting, David Revell, PH.D., Principal, and Matt Jamieson, Project Scientist, from Integral Corp, will present their findings of Phase 1, **Task 3, Shoreline and Beach Erosion Modeling with Sea Level Rise** and **Task 4, Coastal Hazard and Sea Level Rise Vulnerabilities (Attachment 1)** to the Commission and the public. Below is a summary of the findings in Tasks 3 and 4:

Task 3 - Shoreline and Beach Erosion Exposure Modeling with Sea Level Rise

The following summarizes the key issues of the Shoreline and Beach Erosion Exposure Modeling with Sea Level Rise. Consultants will present the potential effect of future beach narrowing and cliff and dune erosion hazard extents with sea level rise. The coastal erosion hazard projections include the effect of the existing City's coastal armoring (such as revetments and sea walls) as well one that considers a future without armoring present. The differences will be useful in Phase 2 of the project when examining the implications of various adaptation strategies.

Summer Beach Width Changes (with Armoring)

It is projected that the width of Carmel Beach will narrow between 50 - 60 feet for each foot of sea level rise. Please note that the sea level rise projection years shown below are approximate estimations. Assuming that the location of the backshore does not change, the following average summer beach conditions are projected:

- By 2 feet of sea level rise (2060 – 2080), lateral access to areas south of Twelfth Avenue headland may be obstructed.
- By 3 feet of sea level rise (2070 – 2100), the southern end of Carmel Beach south of Eighth Avenue is projected to be a series of pocket beaches rather than one continuous stretch of dry sand beach. Only during highly recovered conditions will a dry sand beach remain south of Twelfth Avenue.
- By 4 feet of sea level rise (2080 – 2100+), the only continuous dry sand beach remaining will be from the North Dunes sand ramps to Pescadero Canyon. In the south, only two small pockets of dry sand beaches are projected to remain around Eighth Avenue and Eleventh Avenue.
- By 5 feet of sea level rise (2090 – 2100+), only one pocket of dry sand beach around the North Dunes and the Fourth Avenue stairs are likely to remain.

Coastal Cliff and Dune Erosion

For the armored erosion projection, erosion rates are dampened significantly in the near term. However, with increasing sea level rise, the effectiveness of the armoring is reduced, leading to an acceleration in blufftop erosion above the coastal armoring beyond 1 foot of sea level rise.

In the armored scenario, the following is projected:

- By 1 foot of sea level rise (2045 – 2060), the areas with the greatest threat of erosion are the private oceanfront properties near Pescadero Canyon, the dune-backed shore between Fourth and Eighth Avenue, the lower cliffs between Eighth Avenue and Eleventh Avenue, and the unarmored cliffs by Twelfth Avenue.
- By 2 feet of sea level rise (2060 – 2080), erosion rates accelerate as coastal armoring is more likely to be overtopped by larger waves. Areas behind seawalls have projected erosion hazard distances of 20 to 40 feet.
- By 4 feet of sea level rise (2080 – 2100+), the highest erosion distance is projected around Twelfth Avenue, where a combination of factors related to local geology, wave heights, and lack of armoring yield projections of retreat up to 150 feet. Areas of the north dunes around the Del Mar sand ramp also see higher projections of retreat of up to 90 feet, extending to the volleyball courts.

Task 4 – Coastal Hazard and Sea Level Rise Vulnerabilities

The Consultants will provide the preliminary findings of the vulnerability assessment and results by hazard type, sea level rise, coastal bluff and roadway impacts. The assessment will state whether an impact is anticipated in the near-term or long term.

The scope for Task 4 was to determine the bluff-top assets and infrastructure potentially exposed to coastal erosion under armored and unarmored conditions. The vulnerability assessment evaluated erosion hazard exposure to land use and structures, roads and parking, and other infrastructure. For succinctness, results of only the coastal armored scenario are presented below. The full suite of results is included in the draft technical report included as **Attachment 1**.

- Currently, all of the assets and infrastructure along the beach and bluff including 11 coastal access stairways, the Scenic Drive Pathway, and the stormwater drainage network are exposed to erosion. The public restroom adjacent to the Santa Lucia Avenue stairs is exposed to erosion and will face increased threat from coastal wave flooding in the future.
- By 1 foot of sea level rise (2045 – 2060), Scenic Drive is exposed to erosion in 6 locations, largely around Twelfth Avenue and between Tenth and Eighth Avenue. A sewer force main near Martin Way may be exposed, as well as a sewer main between Ninth and Tenth Avenues, and a sewer main under the dunes between Seventh and Eighth Avenues. Waves overtopping the bluff are expected to be more likely along the southern seawall by Santa Lucia Avenue.
- By 2 feet of sea level rise (2060 – 2080), nearly the entire length of Scenic Drive may be exposed to erosion, including most of the underground water and sewer infrastructure. This includes a water main between Eighth and Tenth Avenues. Waves overtopping the bluffs are expected to be more likely between Tenth and Eleventh Avenues.
- Between 2 and 4 feet of sea level rise (2060 – 2100+), 45 homes along Scenic Drive and at Pescadero Canyon are projected to potentially be exposed to erosion. One additional water main under Scenic Drive south of Thirteenth Avenue may be exposed to erosion. One additional sewer force main may be exposed to erosion by Eighth Avenue. The Del Mar parking lot will also be exposed to erosion. Waves overtopping the bluffs are expected to be more likely between Ninth and

Tenth Avenues.

Generally, the sea level rise impacts noted in the above report are based on making no further investments in armoring or adaptation to address the anticipated coastal damages. Clearly, inaction or delayed action may result in costly damages and emergency repairs due to the cumulative effect of sea level rise, wave action, flooding, storms, and coastal erosion.

Phase 2 of the Coastal Engineering Study will include development of sea level rise adaptation strategies, in collaboration with other City departments and community stakeholders, in order to make the City more resilient in the face of rising sea levels. Such efforts may prolong the useful life of Carmel Beach and the shorefront for as long as possible.

Environmental Evaluation

This action does not constitute a project within the meaning of the California Environmental Quality Act under Public Resources Code Section 21065. It has no potential to cause either a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment and, therefore, does not require environmental review.

FISCAL IMPACT:

No direct fiscal impact for this presentation. In November 2022, the City Council awarded a Professional Services Agreement to EMC/Integral/Haro Kasunich, for a not-to-exceed fee of \$175,000, for the first phase of the Coastal Engineering Study, a Capital Improvement Project. Phase 2 of the Coastal Engineering Study has been approved for funding by a non-competitive California Coastal Commission grant of \$500,000.

ATTACHMENTS:

Attachment #1 - Climate Change Vulnerability Assessment, Shoreline and Beach Exposure Erosion Modeling and Coastal Hazard and Sea Level Rise Vulnerability



MEMORANDUM

To: Mary Bilse, Environmental Programs Manager and Robert Harary, Director of Public Works, City of Carmel-by-the-Sea

From: David Revell, Integral Consulting Inc.

Date: February 20, 2024

Subject: Carmel Climate Change Vulnerability Assessment, Shoreline and Beach Erosion Exposure Modeling and Coastal Hazard and Sea Level Rise Vulnerability

Project No.: C3016

EXECUTIVE SUMMARY

Integral Consulting Inc. (Integral) working with EMC Planning and Haro Kasunich and Associates (HKA) have been conducting a Coastal Engineering and Hazard Assessment for the City of Carmel-by-the-Sea (City). The following is a synopsis of the major findings for Task 3, Shoreline and Beach Erosion Exposure Modeling, and Task 4, Coastal Hazard and Sea Level Rise Vulnerability.

The scope of work for Task 3 was to project future beach narrowing and cliff and dune erosion hazard extents with sea level rise. The coastal erosion hazard projections include a future without armoring present and one that considers the effect of the existing City's coastal armoring. The hazard exposure modeling in Task 3 was then used to determine what assets and infrastructure were at risk of coastal erosion in the future under armored and unarmored conditions. The vulnerability assessment evaluated erosion hazard exposure to land use and structures, roads and parking, and infrastructure. The differences between hazard extents and vulnerabilities will be useful in Phase 2 of the project when examining the implications of various adaptation strategies and policy implications.

Beach Narrowing (Task 3)

- It is projected that the width of Carmel Beach will narrow between 50 and 60 ft for each foot of sea level rise. Assuming that the location of the backshore does not change, the following typical summer beach conditions are projected:
 - By 2 ft of sea level rise, lateral access to areas south of the 12th Avenue headland may be obstructed.
 - By 3 ft of sea level rise, the southern end of Carmel Beach south of 8th Avenue is projected to be a series of pocket beaches rather than one continuous stretch of dry sand beach. Only during highly recovered conditions will a dry sand beach remain south of 12th Avenue.
 - By 4 ft of sea level rise, the only continuous dry sand beach remaining will be from the North Dunes sand ramps to Pescadero Canyon. In the south, only two small pockets of dry sand beaches are projected to remain around 8th Avenue and 11th Avenue.
 - By 5 ft of sea level rise, only one pocket of dry sand beach around the North Dunes and the 4th Avenue stairs is likely to remain.

Coastal Cliff and Dune Erosion (Task 3)

- Considering coastal armoring in erosion projections, erosion rates are dampened significantly in the near term; however, with increasing sea level rise, the effectiveness of the armoring is reduced, leading to an acceleration in blufftop erosion above the coastal armoring beyond 1 ft of sea level rise.
- In the armored scenario, the following is projected:
 - By 1 ft of sea level rise, the areas with the greatest threat of erosion are the private oceanfront properties near Pescadero Canyon, the dune-backed shore between 4th Avenue and 8th Avenue, the lower cliffs between 8th Avenue and 11th Avenue, and the unarmored cliffs by 12th Avenue.
 - By 2 ft of sea level rise, erosion rates accelerate as coastal armoring is more likely to be overtopped by larger waves. Areas behind seawalls have projected erosion hazard distances of 20 to 40 ft.
 - By 4 ft of sea level rise the highest erosion distance is projected around 12th Avenue, where a combination of factors related to local geology, wave heights, and lack of armoring yields projections of retreat up to 150 ft. Areas of the north dunes around the Del Mar sand ramp also see higher projections of retreat of up to 90 ft, extending to the volleyball courts.

Vulnerability Assessment (Task 4)

The scope of work for Task 4 was to determine the bluff-top assets and infrastructure potentially exposed to coastal erosion for both armored and unarmored backshore conditions. The vulnerability assessment evaluated erosion hazard exposure to land use and structures, roads and parking, and utility infrastructure. For succinctness, the results of only the coastal armored scenario are presented here. See Appendix A for a full suite of tables for both the armored and unarmored scenarios.

- Currently, all the assets and infrastructure along the beach and bluff including 10 coastal access stairways, the Scenic Road walkway, and the stormwater drainage network are exposed to erosion. The public restroom adjacent to the Santa Lucia Avenue stairs is exposed to erosion and will face increased threat from coastal wave flooding in the future.
- By 1 ft of sea level rise, Scenic Road is exposed to erosion in six locations, largely around 12th Avenue and between 10th and 8th Avenues. A wastewater force main near Martin Way is exposed, as well as a wastewater main between 9th and 10th avenues, and a wastewater main under the dunes between 7th and 8th Avenues. Waves overtopping the bluff are expected to be more likely along the southern seawall between Santa Lucia Ave and Martin Way.
- By 2 ft of sea level rise, nearly the entire length of Scenic Road is exposed to erosion, including most of the underground water and wastewater infrastructure. This includes a water main between 8th and 10th avenues. Waves overtopping the bluffs are expected to be more likely between 10th and 11th avenues.
- With between 2 and 4 ft of sea level rise, 44 homes along Scenic Road and near Pescadero Canyon are projected to potentially be exposed to erosion. One additional water main under Scenic Road south of 13th Avenue is exposed to erosion. One additional wastewater force main is exposed to erosion by 8th Avenue. The Del Mar parking lot is exposed to erosion. Waves overtopping the bluffs are expected to be more likely between 9th and 10th avenues.

INTRODUCTION

Purpose of This Study

This study is part of the City of Carmel Coastal Engineering and Hazard Assessment, and this technical memorandum serves to complete the deliverables for Task 3, Shoreline and Beach Erosion Exposure Modeling, and Task 4, Coastal Hazard and Sea Level Rise Vulnerability. This technical memorandum projects long-term beach, cliff, and dune erosion with sea level rise, as well as summarizes the risk to public and private

infrastructure and assets. The coastal hazard exposure forecasting was completed using a suite of state-of-the-science models for a range of sea level rise horizons considering a variety of assumptions on historical erosion rates and conditions with and without coastal armoring in place. The vulnerability assessment evaluates the spatial intersection between the projected coastal hazards and the locations of bluff-top infrastructure and assets. Results from the vulnerability assessment are summarized by the likelihood of impact across multiple horizons, near-term (1 ft of sea level rise / 2045–2060), medium-term (2 ft of sea level rise / 2060–2080), and long-term (4 ft of sea level rise / 2080–2100) and are presented in the Task 4 Vulnerability Assessment section.

Study Area

This study focuses on the City-owned portion of Carmel Beach from Pescadero Canyon in the north to Carmel Point in the south. Summaries of hazards and vulnerabilities are organized and divided into four sections, which emerged from the City’s Climate Change Vulnerability Assessment Report (City of Carmel-by-the-Sea 2021). One of the priorities of this report was to identify how adaptation options and strategies along the coast may vary for four distinct planning areas within the City. Results from the hazards modeling and vulnerability assessment will inform the development of adaptation strategies in Phase 2 of this project.

Study Area Sections

- Mostly armored cliffs and bluffs along Scenic Road south of 8th Avenue. Henceforth referred to as **Section 1, South Beach**.
- Unarmored dunes along private property between 8th Avenue and Del Mar Parking Lot. Henceforth referred to as **Section 2, Central Beach**.
- Mostly natural, unarmored North Dunes area. Henceforth referred to as **Section 3, North Dunes**.
- Armored private properties on the cliffs at the north end of the City. Henceforth referred to as **Section 4, North Beach**.

For the sake of brevity, each section in this memo will be referred to by section number and/or its short name, South Beach, Central Beach, North Dunes, or North Beach.

Within each section listed above, erosion projections were conducted on multiple smaller backshore locations. Each of these subsections was organized by their unique orientation, backshore type (armor or unarmored), and backshore characteristics (dune-backed, cliff-backed, vegetated, unvegetated, etc.). In total, 31 separate backshore areas were used to project location-specific erosion hazard zones.

SEA LEVEL RISE

Global sea level rise is a result of human-caused climate change and is driven by the thermal expansion of ocean water and the melting of terrestrial ice as the Earth warms. Global climate models indicate that California will see significant sea level rise during this century, with the exact magnitude depending on factors such as global greenhouse gas emissions and the Earth's energy imbalance, the rate at which oceans absorb heat, land ice melting rates, movement of land-based ice sheets, and local land subsidence or uplift.

According to California's Office of Environmental Health Hazard Assessment, the central coast of California experienced about 8 in. of sea level rise from 1900 to 2020, and the rate is projected to increase over this century (OEHHA 2022). California Ocean Protection Council (OPC) and California Coastal Commission (CCC) both issued guidance documents that are meant to guide local jurisdictions on sea level rise planning. They are:

- State of California Sea-Level Rise Guidance Year 2018 Update, adopted by OPC in 2018
- CCC Sea Level Rise Policy Guidance, certified by the Coastal Commission in 2018.
- Draft State of California Sea Level Rise Guidance: 2024 Science and Policy Update, released in January, 2024¹

Based on this guidance, this study evaluated a range of sea level rise projections under high emissions (RCP 8.5) using a 1) median scenario, representing a 50% probability that sea level rise will reach 2.0 ft by 2100; 2) likely scenario representing a 66% probability that sea-level rise will reach 3.0 ft by 2100 and; 3) a medium-high risk aversion scenario representing a 0.5% probability that sea level rise will reach 3.9 ft of sea level rise by 2080 (Table 1 and Figure 1).

¹ In this draft update, some language from the 2018 report have been updated. "Medium-High Risk Aversion" now corresponds to the "High" scenario, and "Likely" corresponds to the "Intermediate" scenario. This updated language corresponds with NOAA's 2022 Global and Regional Sea Level Rise Scenarios for the United States Report.

Table 1. Probabilistic projections for future sea level rise by year for Monterey.

From OPC 2018 Guidance	Sea Level Rise Rate (ft) Range of Projections		
Year	Median <i>50% probability SLR meets or exceeds...</i>	Likely <i>66% probability SLR meets or exceeds...</i>	Medium-High Risk Aversion <i>0.5% probability SLR meets or exceeds...</i>
2020	0 (baseline)		
2040	0.3	0.5	0.7
2060	0.7	1.1	2.1
2080	1.3	2.0	3.9
2100	2.0	3.0	6.4

Source: OPC Guidance (2018). Projected sea levels using the Monterey tide gauge. Values have been adjusted by shifting the baseline year from 2000 to 2020. All sea level rise rates are referenced to high emissions scenarios.

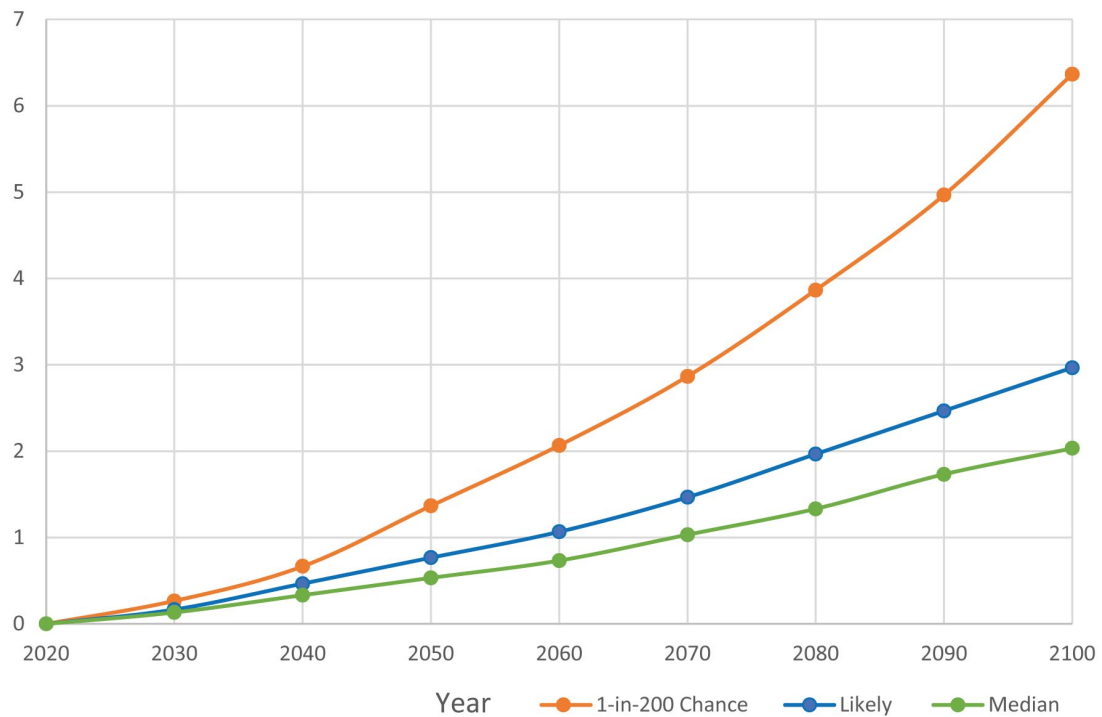


Figure 1. 1-in-200 Chance (Medium-High Risk Aversion), Likely (66% Probability), and Median (50% Probability) rate of sea level rise from 2020 to 2100 under high emissions, based on OPC Guidance (2018, 2024).

COASTAL HAZARDS

This study evaluated the following coastal hazards:

- **Coastal cliff and dune erosion**—includes erosion of the dune-backed areas from 8th Avenue in the south to the volleyball courts in the north, and the cliff-backed sections in the southern and northern sections of the study area.
- **Beach narrowing**—represented by the projected future change in the summer beach widths for each foot of sea level rise.
- **Coastal wave overtopping**—evaluated based on total water level exceedance analysis for above existing coastal armoring and dune and cliff crests along the study area.

Descriptions of these hazards and the forces that influence them are presented below.

Coastal Cliff and Dune Erosion Forces

Coastal erosion is a complex process shaped by various factors resulting in the ongoing retreat of dunes and cliffs. The factors that contribute to erosion encompass marine forces (such as wave energy), terrestrial forces (including rainfall and groundwater flow), and terrestrial conditions (like rock type, grain size, joint density, or the presence of coastal armoring). Together, these elements are the primary influences contributing to coastal cliff and dune retreat.

Two erosion processes occur along the cliff-backed shoreline: the first is erosion of the softer marine terrace deposits (or bluffs) that overlay the sandstone bedrock, and the second involves the long-term erosion of the sandstone bedrock (or cliffs). In conjunction, these processes lead to inland retreat of the bluff-top edge along the cliff-backed shore.

Erosion processes on the dune-backed shoreline are influenced by wind and water, with marine forces such as wave attack being the primary driver of dune crest recession. As waves arrive during winter storms, this wave action can transport sand away from the base of the dune, creating a dune scarp. Over time, a new dune profile will take shape as the slope stabilizes, and accretive forces such as summer waves bring sand to shore and prevailing winds (also known as aeolian transport) bring sand to the dune. If the erosive forces acting upon the dune surpass the constructive accretive forces, the crest of the dune will progressively migrate inland.

Carmel Beach experiences most erosion events in the winter when storms bring intense rainfall and larger waves. During the winter, the sand that is typically on the dry beach during the summer is relocated offshore to form sandbars. For typical winter conditions, these sandbars act as a protective barrier, causing larger waves to break offshore,

dissipating much of their energy before reaching the beach. However, during large storms, there is so much wave energy and elevated water levels that the waves will reach backshore and can contribute to erosion. In a natural, unarmored environment, additional eroded sediment from the backshore would be available to replenish the beach during such events. However, in an armored setting, this source of sediment is not available to counterbalance the increased wave energy.

The erosion forces at work involve a complex interplay of marine and terrestrial factors and conditions. The subsequent sections explore these in more detail.

Marine Forcing

Waves and induced currents are the main primary marine influences on erosion. Elevated wave heights, typically associated with winter storms, contribute to increased run-up and higher total water levels. This results in more wave energy being directed toward the back of the beach. Furthermore, local variability in nearshore geomorphology can concentrate wave energy in specific zones and guide water flow, leading to the acceleration of alongshore currents.

Wave Reflection

Waves that reach the seawalls will reflect off the seawalls and travel seaward. At the seawall, the water particles under the reflected wave will move quickly, mobilize sand, and cause scour at the toe of the structure. The amount of scour is proportional to the height of the wave; the higher the wave, the greater the scour. In Figure 2, waves are crashing into the seawall near Martin Way.



Figure 2. Martin Way Stairs (highlighted in yellow) during the El Niño winter of 2023–24.
Source: City of Carmel, January 2024

Wave Overtopping

When wave run-up reaches coastal armoring structures, especially vertical seawalls, it can elevate water levels and create wave splash over the seawalls (Figure 3). This wave splash water, especially when driven by onshore winds, can saturate the bluff terraces behind the wall, contributing to bluff failure and erosion behind the seawalls. As sea levels rise, wave run up elevations reach a point where the water that is overtopping is not just a vertical splash but rather a wave (or “green water”), that has horizontal momentum and can further accelerate the erosion of the bluff above the coastal armoring structures.



Figure 3. Wave overtopping on a Carmel seawall (see arrow). Note the directional wave and splash along the wall. Source: City of Carmel January 5, 2023

Inshore and Backshore Currents

The study by Rogers E. Johnson and Associates (Johnson 1983) detailed a swift inshore current that moves horizontally along the beach, typically heading southward where elevations are lower. Inshore and backshore currents have been observed in recent events, illustrated in Figure 4. In the initial panel, waves collide with the seawall, reflecting away from it. The water, attempting to escape, is directed around the seawall. These currents with high particle velocities can more effectively mobilize sand away from the beach.



Figure 4. Rip currents moving away from the shore in the cove at 13th Avenue. Left, the cove fills with water from broken waves. Right, an alongshore current develops, channeling water out of the cove and along the seawall to the south. Source: City of Carmel, January 2023

Local Conditions

Outcrops and variability of the backshore will affect how currents develop and where wave focusing occurs. A unique contributing factor for Carmel is the orientation of exposed outcrops of sandstone in the beach area (Figure 5). These outcrops are usually buried by beach sand and are only exposed following significant winter scouring events. The Johnson (1983) study notes that deep channels exist between these outcrops that lie perpendicular to the bluffs. These formations may act to direct and focus water flow toward specific locations on the backshore, producing more severe erosion (Figure 6).



Figure 5. Left: Sandstone outcrop between Santa Lucia Ave and 13th Avenue, winter of 2010. Note the perched beach sand atop the sandstone outcrop to the right (orange circle), an indication of the previous summer's sand levels. Right: A scoured beach in January 2023 near 10th Avenue reveals a channel between sandstone bedrock with a gap oriented at an angle to the backshore. Source: City of Carmel.



Figure 6. Focusing of water flow between the gap in the sandstone formation. This leads to a piling up of water in the gap and subsequently higher erosion. Location: Stairs at northern end of 10th Avenue. Source: City of Carmel, January 2023

Terrestrial Forcing and Conditions

Terrestrial forces include rainfall and groundwater flow, as well as terrain and lithological conditions, including variations in geology, profile elevation, beach slope, folding, faulting, and shoreline orientation. As noted in the Johnson (1983) study, two strong sets of fractures which trend in the northwest direction have allowed waves to selectively attack the backshore along these zones of weakness. This process has helped to form the coves and headlands seen in the southern end of the beach. In addition, there are also anthropogenic factors to consider related to land use patterns, stormwater management, irrigation systems, coastal armoring, and recovery efforts. Human and animal foot traffic along informal shoreline trails, or through vegetated dunes (or bluff-cuts) also contributes to erosion along shoreline bluffs and is a persistent problem for the City (Shonman and D'Ambrosio 2015).

Stormwater Runoff Influence

The City's shoreline is located at the bottom of a hill where stormwater is channeled from the streets above. The City's stormwater discharges onto the beach through 21 outfalls. During the severe El Niño winter of 1982-83, severe winter storms struck Carmel every 10 days, and the heavy rains overwhelmed the City's storm drain system and were a major contributor to bluff-top erosion. Although significant upgrades and improvements to the drain system and catch basins were made between 1983 and 1988 following the El Niño storms, the ability of the stormwater system to channel water effectively will be affected by sea level rise, coastal erosion processes, and increases in high-intensity rainfall events due to climate change (Shonman and D'Ambrosio 2003).

Erosion Response

The erosion response of the cliff-backed bluffs and the dunes and beach are different. Bluff erosion occurs episodically, and the bluff does not recover without intervention. In contrast, the sandy beach will recover between storm events as smaller waves bring sand back to the shore. Given enough time and favorable winds, sand dunes can also recover as the beach sand is blow into the dunes. Predominantly sandy areas, like dunes and the beach, will erode gradually over time, while predominantly rocky areas, like the cliffs and bluffs, will erode episodically over time. Figure 7 depicts the different types of erosion depending on the backshore type.

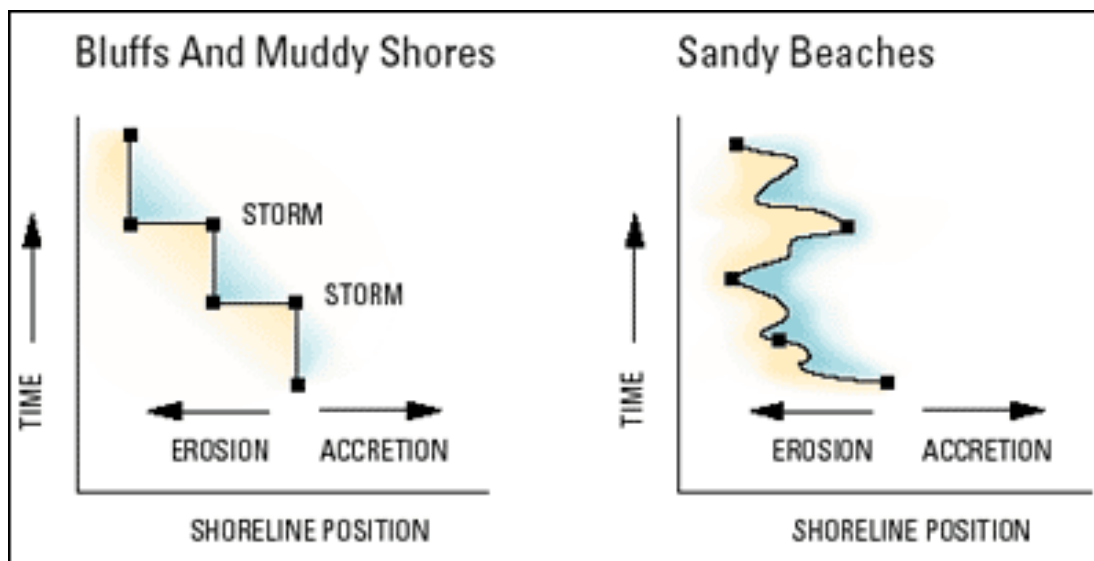


Figure 7. Bluff erosion occurs episodically and only moves inland while sandy beaches can erode during storms and recover during calmer wave conditions time. Image from the U.S. Geological Survey.

Beach Narrowing

The effect of sea level rise will be the landward migration of the shoreline. On average, Carmel Beach has an offshore slope of approximately 50:1 to 60:1,² meaning every foot of sea level rise will result in a 50- to 60-ft landward progression of the shoreline.

It is important to understand that coastal armoring protects what is behind the armor, at the cost of the fronting beach. With increasing sea levels, it is only a matter of time before beaches in front of hard armoring structures will disappear. This is a phenomenon known as coastal squeeze or passive erosion.

Dune Erosion and Scarping

During storm events, the dunes along Carmel Beach can experience substantial erosion. Wave run-up, especially during elevated tides, allows wave energy to reach the backshore and impact the base of the dune. This can result in the removal of sand, leaving a steep dune scarp (Figure 8). The extent of dune erosion at a specific location is influenced by factors such as beach slope, dune vegetation, and, crucially, the location of buried riprap that protects the dune toe from erosion.

² From the 15-m isobath to the toe of the cliff, dune, or coastal armor.

Following significant erosion, the recovery of Carmel's dunes occurs gradually, facilitated by smaller waves and wind bringing sand back over an extended period. However, because of the longer recovery time of dune systems, they are especially susceptible to increased storm frequencies and sea level rise. Elevated water levels with sea level rise will allow wave erosion processes to act farther up on the beach profile causing an evolution of the dune profile farther inland.



Figure 8. Dune scarp at Del Mar Sand Ramp. The yellow hatched line represents the previous summer's beach profile. Dune scarping can have a significant impact on beach access. Source: City of Carmel, January 2023

Bluff Terrace Erosion

Bluff terrace erosion is primarily due to two natural processes: 1) wave attack eroding the sandstone bedrock and undermining the bluff, and 2) terrace slumping. Rainfall and saturated soils can cause gullying and slumping that contribute to the recession of the bluff. Slumping can also accelerate erosion of the underlying sandstone during large failure events. Note that as bluffs erode, debris accumulates at the base of the cliff, which can provide some temporary protection from wave attack.

DATA AND ANALYSIS METHODS

This section summarizes this assessment's methodology and approaches for assessing sea level rise and coastal hazard vulnerabilities.

Coastal Modeling Parameters

The extent of coastal erosion is represented as the landward migration of the bluff or dune crest. Coastal erosion is episodic, not constant, making it difficult to estimate the eroded position of the cliff top for any given time and location. This study projects the average retreat rates associated with a series of these episodic events over time to yield projections for the average bluff or dune crest position in the future.

The models for cliff erosion rely on simplifications of reality and relate cliff retreat to factors such as wave impacts, sea level rise, historical erosion rates, and cross-shore profile geometry. Detailed below are the data sets that contributed to these model parameters. The short-term impacts of these seasonal processes vary spatially, and the processes occur across long time scales; thus, they are extremely hard to predict both spatially and temporally.

Coastal models require historical erosion rates to project future erosion rates. They also require additional parameters to determine terrestrial and marine forcing, including the following:

- **Geomorphic:** bluff-top elevation, contact elevation between terrace and cliff, toe elevation, foreshore beach slope
- **Waves:** total water levels.

Determination of Erosion Rates

Location-specific erosion rates are an important factor in determining erosion projections and were needed given the detailed scale of this study. Unfortunately, data were not available to support an accurate location-specific historical erosion rate assessment and literature was cited to determine average erosion rates across the entirety of Carmel Beach. To arrive at a location-specific erosion rates, the average erosion rates from the literature were adjusted to take into account varying local conditions. For a more detailed explanation of average historical erosion rates and maximum observed failure distances, refer to the Task 2 Report: Shoreline and Beach Change Analysis: Seasonal and Long Term.

An upper and lower bound of potential erosion rates were determined to reflect a more likely and worst-case condition and to account for uncertainty in both spatial accuracy and confidence in the cited literature. The Johnson (1983) study documented locations and extents of failures and computed a long-term erosion rate from 1908 to 1982, and determined that the bluffs eroded between 0.3 and 0.7 ft/yr with an average of 0.4 ft/yr. It should be noted that erosion occurs episodically, not on an average annual basis, and

maximum failure distances may reach as far as 30-40 feet, as documented in Johnson (1983) study following the 1982-83 El Niño winter.

To represent a lower bound, this study adjusted the average lower bound to 0.2 ft/yr, which is an average between the erosion rate found for the Pebble Beach Golf Course section of beach (0.1 ft/yr) and the lower bound reported by Johnson (0.3 ft/yr). To represent a worst case, this study used the average of 0.7 ft/yr found by Johnson (1983).

Location-Specific Historical Erosion Rates

To determine site-specific erosion rates for the entire shoreline, the historical erosion rates of 0.2 ft/yr (likely), 0.4 ft/yr (best, representing an average), and 0.7 ft/yr (worst case) were multiplied by an adjustment factor, which was determined based on geological conditions, geomorphic factors, locations with accelerated nearshore currents and historical observations of failures. Projections of erosion using these historical rate assumptions are discussed in the Task 3, Hazard Model Findings section, below.

A site-specific adjustment factor was informed from reports of geological conditions from the Johnson (1983) study, the James C. Reynolds and Associates (Reynolds 1986) soil investigation report noting bluff contact elevations, Carmel Shoreline Assessment Fall 2014 to Summer 2016 (Carmel-by-the-Sea 2016), and from observations made in the field by the Haro Kasunich & Associates, Inc. and Integral team in 2023. These reports and field observations provided a spatially explicit reference for the geological and terrestrial conditions that may contribute to higher erosion rates in certain areas, such as noted locations of jointing, faulting, fractures, and sandstone platforms that may focus wave energy, as well as areas that experience more significant beach scouring. Elements that may inhibit erosion were also factored in, such as the presence of a sandstone platform that may deflect wave energy, a more sheltered shoreline orientation, the presence dune vegetation, and areas that experience less beach scouring. Consideration was also given to the contact elevation of the more erosion-prone terrace deposits. This information was also verified by failure observations that were compiled from site-specific studies, including from Johnson (1983, 1997), and assessments from Shonman and D'Ambrosio (2015). The range of assumed location-specific erosion rates are shown in Figure 9.

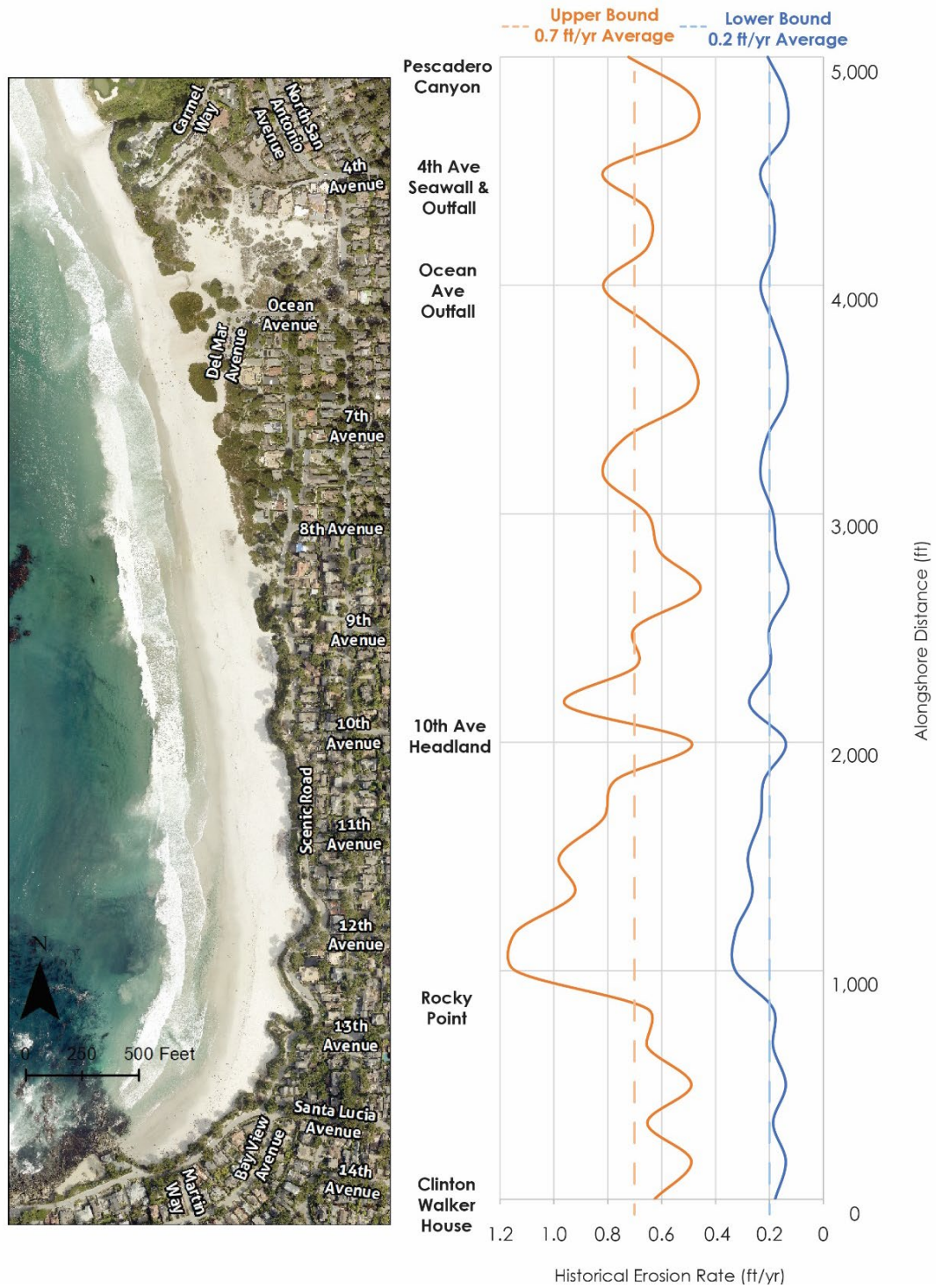


Figure 9. The range of historical erosion rates estimated in this study, which are used to derive future erosion projections by accelerating these rates with sea level rise.

Geomorphic Data (Elevation and Slopes)

Digital elevation models (DEMs) were used to develop cross-shore profiles, which inform the elevations of important cliff and dune features. These data were sourced from the National Oceanic and Atmospheric Administration (NOAA) Digital Coast website and the Association of Monterey Bay Area Governments (AMBAG). Elevation models considered in this study included the following surveys: Federal Emergency Management Agency (FEMA) 2018 (Spring), U.S. Geological Survey (USGS) 2016 (Spring), California ARRA 2010/11 (Winter), AMBAG 2010 (Summer), U.S. Army Corps of Engineers NCMP 2009 (Fall), USGS 1998 (Spring), USGS 1997 (Fall), as well as the USGS CoNED Topobathy from the Coastal National Elevation Database (multiple dates from 2008 to 2015).

Cliff and Dune Feature Locations

Locations of the following cliff features was determined: the toe of the cliff or armoring structure, the top of the armoring structure or the contact between the cliff and the bluff terrace, and the crest of the bluff at the landward edge. These features were manually digitized from high-resolution aerial photographs from EagleView (2022) provided by the City and verified using the 2018 and 2016 lidar DEMs, as well as oblique images from the California Coastal Records Project. The height of all coastal armoring was further verified from site observations as documented in the tables provided in Task 1, Coastal Engineering Assessment.

Cliff Top Elevations

The elevation of the top of the cliff was determined just inland (2 m) of the observed cliff-top location to account for potential positional inaccuracies in the DEMs. Elevations for each transect were determined using available DEMs for each year, and outliers were removed from the data set.

Bluff Contact and Top of Armor Elevations

The contact elevation between the more erosion-resistant sandstone or coastal armoring and the less erosion-resistant terrace was determined using an average elevation from all available data sets while filtering bias errors due to vegetation. The contact elevation was determined manually through interpretation of the change in slope in the DEMs as well as aerial image interpretation. Contact elevation depths were verified with the Reynolds (1986) assessment. Note that the sandstone bedrock dips below an area of dunes at 8th Avenue and reemerges just shoreward of the beach volleyball courts. For the dune-backed sections where the sandstone bedrock is buried by dune sand, a linear interpolation between the known locations of the southern and northern contact

elevations was used. This interpolated location is important because once dune erosion reaches this location, then the erosion processes shift to cliff erosion processes.

Cliff Toe Elevations

The elevation of the cliff or armor toe was determined just seaward (5 m) of the observed toe location to account for seasonal changes in beach elevation, which can affect the horizontal toe position. Toe elevations were determined for both winter/spring and summer/fall. For these modeling purposes, the average winter/spring elevation was used, as this season is typically most erosive, and beach sand levels are the lowest. This elevation was calculated from the average of the three lowest elevations found among the available DEMs. The lowest toe elevations were typically found in the 1998 spring (following the El Niño Winter) and 2010 summer surveys, with the 2016 spring and 2018 spring surveys also contributing.

Nearshore Waves and Total Water Levels

Wave properties, including wave height and period, were derived from unpublished data from the USGS (Hegermiller et al. 2017). The time series of nearshore waves along the central California coast, including hindcasted data for 1980–2010 and projected data for 2010–2100, were developed using downscaled regional models. Each subunit in the study area was linked to a nearshore wave data location, with a total of nine wave data points referenced.

An important measure of coastal hazards is the total water level elevation, which is the combined effect of wave run-up height, storm surge, tides, and sea level elevations. For a more detailed discussion of total water level, please see Integral's Task 2 report, *Shoreline and Beach Change: Seasonal and Long Term*. For this analysis, total water levels were determined by combining the highest astronomical tide (HAT), CoSMoS Waves, and a wave run-up using the Stockdon et al. (2006) wave run-up equation.

The total water levels were calibrated using FEMA's flood hazard elevation levels by matching the total water level at each transect to the FEMA flood hazard elevation. To ensure the total water levels matched the flood hazard elevation levels, the foreshore slopes of the transects were adjusted. The final range of slopes was between 6/100 and 14/100 ($\tan\beta = 0.06 - 0.14$).

Cliff and Dune Erosion Projection Methods

Erosion projections assume that sea level rise will elevate wave energy, intensifying its impact on cliffs, dunes, and armor, and ultimately leading to heightened retreat rates. Peer-reviewed models, described in more detail below, rely on assumptions linking cliff

retreat to sea level rise, wave energy, historical cliff behavior, and cross-shore profile geometry. The CoSMoS cliff forecasting tool relies on five different models from Limber et al. (2018). However, not all models within the CoSMoS cliff forecasting tool were appropriate for the study area. This study used two models hand-picked to match the hard rock geologic conditions of the study area, which are detailed below.

Several different scenarios are modeled: 1) unarmored and armored, and 2) high, medium, and low assumptions on historical erosion rates. The erosion model projects erosion distances at 1-year time steps. Erosion distances are mapped in approximately 20-year time periods: 2020–2040 (0–1 ft sea level rise), 2040–2060 (1–2 ft sea level rise), and 2060–2080 (2–4 ft sea level rise). While period of time is used for the erosion modeling, all results are reported by level of sea level rise.

Exceedance Model (Cliff-backed shorelines with Armoring)

This model uses historical erosion rates to project cliff retreat using methods described in ESA (2016), Revell et al. (2011), and Limber et al. (2018). It presumes that the wave energy reaching the bluff will cause the bluff retreat rate to accelerate beyond historical levels. Wave energy reaching the bluff is modeled as the amount of time the total water level exceeds the contact between the terrace and the sandstone, also called “exceedance hours.” With sea level rise, the retreat rate will increase proportionally to the increase in exceedance hours. As total water levels were calculated assuming elevated tides and scoured beach profiles, exceedance hours were divided by 4 to account for hours of high wave run up occurring during high tides in the mixed semi-diurnal tide regime (two high and two low tides of unequal height daily). One erosion hazard zone representing the best estimate of future erosion hazards was developed.

Trenhaile Model (Cliff-backed shorelines without armoring)

This model presumes that the distance between wave breaking and the cliff toe (surf zone length) will drive cliff retreat and is described in Trenhaile (2000) and Limber et al. (2018). A shorter surf zone will increase the wave energy available to reach the backshore, and sea level rise will reduce surf zone length and lead to an acceleration of erosion into the future. Unlike the exceedance model described above, this model does not consider the presence of armoring along the backshore. Three erosion hazard zones representing a range of estimates of future erosion hazards was developed.

Dune Erosion Model (Dune-backed shorelines)

This model was conducted using a geometric model of foredune erosion due to sea level rise (Komar et al 1999, Revell et al 2011). This model projected that the dune would intersect the underlying cemented beach deposits and more erosion-resistant sandstone

between 2045 and 2060 (or one foot of sea level rise). After one foot of sea level rise, the dominant erosion mode was modeled as a hard cliff-back coast (see Trenhaile model, described above).

Beach Narrowing Projection Methods

A Bruun-type model was used to estimate coastal recession by assuming the conservation of sediment and an equilibrium profile shape.³ This model shifts the beach profile upward and landward by a distance determined by sea level rise and the geometry of the profile. The baseline for a typical summer beach is the 75th percentile beach location as determined from analysis of the CoastSat data record from 1984 to 2021 and is described in more detail in Task 2. For this analysis, it is assumed that the current armored backshore toe of the cliff or dune location does not retreat inland with sea level rise. This model can be considered a “hold the line” scenario and represents what changes to the beach may occur if the coastal armoring is maintained and no additional adaptation strategies are implemented in the future.

Model Caveats and Disclaimer

The cliff erosion model projections show a band of potential erosion. It is highly unlikely that all of this erosion would occur simultaneously, rather multiple cliff failures would occur along the coast in different locations. The cliff erosion models used in this study do not account for the evolution of nearshore slopes over time, including the beach and shore platform, which are likely to evolve as sea levels rise and erosion forcing conditions change. Additionally, the efficacy of coastal armoring over time and when or if failure of these structures will occur is not considered.

Small variations in initial parameter values can lead to significant variations in model predictions as they are multiplied over long time scales. As a result, the uncertainty in erosion rate projections generally increases over time.

Finally, the future holds many uncertainties that may influence erosion, ranging from potential changes in precipitation, temperature, wave climate, frequency and magnitude of precipitating storm events, and anthropogenic contributions and responses to erosion. Due to the highly uncertain nature of these processes, caution should be used with all erosion projections.

³ The conservation of sediment assumption in the Bruun model was justified in Task 2 findings of a stable sand volume in the nearshore system.

Given these disclaimers, however, all efforts have been made to utilize the best available science and methods and carefully document uncertainties. These results represent the state of the practice in coastal cliff erosion projections.

Vulnerability Assessment Methods

The vulnerability assessment analyzes the spatial intersection (or overlay) of the coastal erosion hazard zones with the assets and infrastructure data sets. The study team overlaid all available parcels, structures, roads, and infrastructure data sets with the coastal erosion hazard zones to quantitatively assess both the number and amount of assets affected. For each resource sector, individual data sets had particular reporting criteria, including number, length, and area affected. Data sets were queried, and summary statistics of assets affected were calculated by sea level rise elevation (see Appendix A for tabular results). Results were collated into tables and are interpreted in the Task 4, Vulnerability Assessment, section below. Because of the sensitive nature of utility and infrastructure data, and to respect the privacy of individual residents and landowners, this study does not map the locations of vulnerable assets.

Asset Data

The study team considered and collected all available geospatial asset data from the City, County, and cross-jurisdictional agencies such as CalAm Water and the Carmel Area Wastewater District. The team obtained the most up-to-date data directly from the source at the time of evaluation and performed quality assurance on the data.

TASK 3 HAZARD MODEL FINDINGS

This section provides the analysis and modeling results in the forms of tables of total water levels with sea level rise by backshore section, maps displaying erosion hazard zone projections, and maps of beach narrowing.

Total Water Level Findings

This section reports the progression of total water levels with sea level rise. High total water levels allow wave energy to reach the backshore, overtop coastal armoring and accelerate erosion, and these values are related to how much erosion accelerates in the erosion scenario with armoring. This analysis assumes that the future wave climate is comparable to the historical wave climate and that total water level changes are based primarily on influences from sea level rise. Modeling of total water levels assumes that current backshore location and height of armoring remain consistent throughout the future, and that no additional adaptation strategies are implemented.

Table 1. The percentage of time total water level exceeds the top of armor or sandstone and terrace contact elevation (left) and if total water levels exceed the crest (right) for each sea level rise level. Green indicates very little (<3%), yellow indicates low (3–10%), orange indicates medium (10–20%), and red indicates high levels of exceedance time (>20%). Areas are listed from south to north.

Location <i>From south to north</i>	Water Levels above the Top of Armoring or Sandstone Cliff <i>Percentage of days* that the contact elevation is exceeded</i>			Water Levels above the Crest of the Bluff or Dune <i>Does wave splash exceed crest elevation? (YES or NO)</i>		
	Sea Level Rise Horizon, feet (years)			Sea Level Rise Horizon, feet (years)		
	1 (2045– 2060)	2 (2060– 2080)	4 (2080– 2100+)	1 (2045– 2060)	2 (2060– 2080)	4 (2080– 2100+)
Section 1 South Beach						
Martin Way to Santa Lucia Ave (Seawall)	4%	8%	21%	YES	YES	YES
Santa Lucia Ave to 13th Ave (Seawall)	6%	16%	23%	YES	YES	YES
13th Ave Headland (Seawall)	1%	3%	10%	YES	YES	YES
13th Ave Cove (Seawall)	4%	10%	22%	NO	NO	NO
13th Ave to 12th Ave (Riprap)	22%	25%	25%	NO	NO	NO
13th Ave to 12th Ave (Seawall)	<1%	<1%	2%	NO	YES	YES
13th Ave to 12th Ave (Unarmored Cliff with Riprap around SW Drain)	2%	5%	17%	NO	YES	YES
13th Ave to 12th Ave (Unarmored Cliff)	14%	21%	25%	NO	NO	YES
12th Ave Cove (Unarmored Cliff)	<1%	1%	5%	NO	NO	NO
12th Ave Cove (Revetment)	1%	2%	6%	NO	NO	NO
12th Ave to 11th Ave (Revetment)	1%	1%	4%	YES	YES	YES
11th Ave to 10th Ave (Buried Revetment)	15%	20%	24%	YES	YES	YES
10th Ave Headland (Seawall)	13%	19%	24%	YES	YES	YES
10th Ave to 9th Ave (Buried Revetment)	24%	25%	25%	YES	YES	YES
9th Ave to 8th Ave (Buried Revetment)	25%	25%	25%	YES	YES	YES
8th Ave Stairs (Buried Revetment)	12%	24%	25%	NO	NO	NO
Section 2 Central Beach						
8th Ave (Buried Revetment under Vegetated Dune)	<1%	3%	23%	NO	NO	YES
8th Ave to 7th Ave (Vegetated Dune)	<1%	<1%	4%	NO	NO	NO
7th Ave (Vegetated Dune)	0	0	<1%	NO	NO	NO
Southern Sand Ramp (Dune)	0	0	0	NO	NO	NO
7th Ave to Ocean Ave (Vegetated Dune)	0	0	0	NO	NO	NO

Location <i>From south to north</i>	Water Levels above the Top of Armoring or Sandstone Cliff <i>Percentage of days* that the contact elevation is exceeded</i>			Water Levels above the Crest of the Bluff or Dune <i>Does wave splash exceed crest elevation? (YES or NO)</i>		
	Sea Level Rise Horizon, feet (years)			Sea Level Rise Horizon, feet (years)		
	1 (2045– 2060)	2 (2060– 2080)	4 (2080– 2100+)	1 (2045– 2060)	2 (2060– 2080)	4 (2080– 2100+)
Del Mar Parking Lot (Dune)	0	0	0	NO	NO	NO
Section 3 North Dunes						
Ocean Ave (Buried Revetment under Vegetated Dune)	0	0	0	NO	NO	NO
Ocean Ave (Vegetated Dune)	0	0	0	NO	NO	NO
Northern Sand Ramp (Dune)	0	0	0	NO	NO	NO
Ocean Ave to 4th Ave (Vegetated Dune and Cliff)	0	0	0	NO	NO	NO
Ocean Ave to 4th Ave (Vegetated Dune and Cliff)	0	0	0	NO	NO	NO
Ocean Ave to 4th Ave (Seawall)	0	0	0	NO	NO	NO
4th Ave Stairs (Vegetated Dune and Cliff)	0	0	0	NO	NO	NO
Section 4 North Beach						
4th Ave to Pescadero Canyon (Unarmored Cliff)	0	0	0	NO	NO	NO
4th Ave to Pescadero Canyon (Seawall)	18%	24%	25%	NO	NO	YES

Note: *Percentage of days are tallied by decadal range. The decal ranges used assume a high emissions and medium-high risk aversion sea level rise scenario with 1 ft of sea level rise by the 2040s, 2 ft of sea level rise by the 2060s, and 4 ft of sea level rise by the 2080s.

For the South Beach section, by 1 ft of sea level rise, total water levels during a 100-year storm event are often up to 3 feet or more over the terrace contact elevation. By 2 ft of sea level rise, the total water level is often greater than 5 ft over the crest in most sections.

For the Central Beach section, the total water level is expected to be higher than the crest only at the southernmost areas near 8th Avenue. As elevations rise toward the north, total water levels are not projected to exceed the dune crest or bluff contact elevation by four ft of sea level rise.

The North Dunes and North Beach do not see total water levels higher than the bluff contact or crest elevation except for the low-lying area near Pescadero Canyon. In this area, the total water levels are projected to be 5 ft greater than the top of armor elevation for all sea level rise horizons and projected to be higher than the bluff crest by 4 ft of sea level rise.

Cliff and Dune Erosion Hazard Findings

This section provides maps of the erosion hazard zones (Figures 12 through 16). The maps are organized by the with and without armoring scenarios and split into the north (including the North Dunes, North Beach, and Central Beach), central (including the Central Beach and South Beach), and south (including South Beach) areas. For the with armoring scenario, a range of future erosion probabilities are presented. For the armored erosion projection, only a best estimate scenario relying on a range of erosion baselines and future conditions is presented. For the armored scenario, erosion rates are dampened significantly in the near term due to limited wave splash above the crest of the armoring structures; however, with increasing sea level rise, the effectiveness of the armoring is reduced, leading to more green water horizontal wave run up velocities and an acceleration in bluff-top erosion above the coastal armoring in future.

Hazards Zone Disclaimer

The maps and associated analyses in this section are intended as planning tools to illustrate projected hazard exposure with sea level rise. The contributors and sponsors of this product do not assume liability for any injury, death, property damage, or other effects of erosion or flooding.

Although every effort was made to review all resource sector and infrastructure data used in this study, neither the City nor its consultant, Integral, can verify the completeness of all spatial data. For this reason, we do not accept responsibility for any errors, omissions, or positional inaccuracies. Users of the data displayed in the maps are strongly cautioned to verify all information.

Coastal Cliff and Dune Erosion Projection Without Armoring - North Carmel Beach

1 ft of SLR (2045 - 2060)

2 ft of SLR (2060 - 2080)

4 ft of SLR (2080 - 2100+)

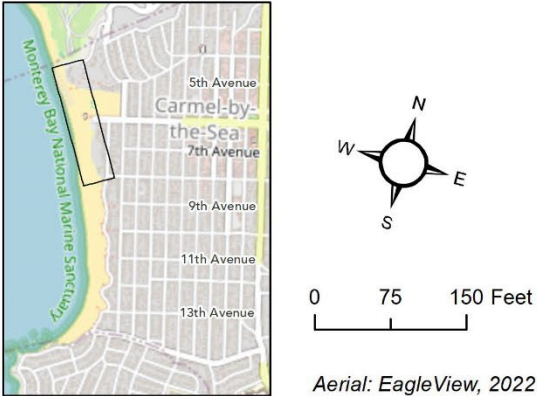
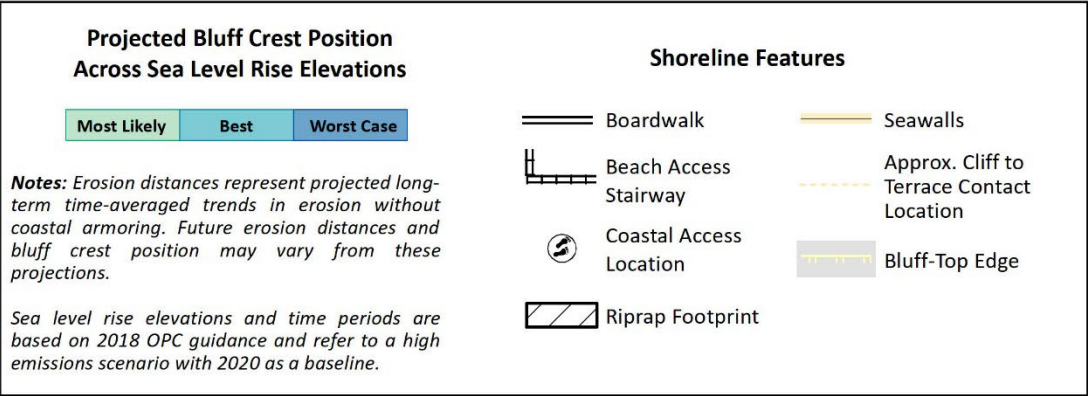


Figure 10. Map of dune and cliff erosion for the northern beach. Displays erosion hazards without armoring. Hazard zones represent three bands of certainty, most likely, based on the assumption of a low average erosion rate (0.2 ft/yr), best, based on the assumption of an average erosion rate (0.4 ft/yr), and worst case, based on the assumption of a high average erosion rate (0.7 ft/yr).

Coastal Cliff and Dune Erosion Projection Without Armoring - Central Carmel Beach

1 ft of SLR (2045 - 2060) 2 ft of SLR (2060 - 2080) 4 ft of SLR (2080 - 2100+)



Figure 11. Map of dune and cliff erosion for the central beach. Displays erosion hazards without armoring. Hazard zones represent three bands of certainty, most likely, based on the assumption of a low average erosion rate (0.2 ft/yr), best, based on the assumption of an average erosion rate (0.4 ft/yr), and worst case, based on the assumption of a high average erosion rate (0.7 ft/yr).

Coastal Cliff and Dune Erosion Projection Without Armoring - South Carmel Beach

1 ft of SLR (2045 - 2060) 2 ft of SLR (2060 - 2080) 4 ft of SLR (2080 - 2100+)



Figure 12. Map of dune and cliff erosion for the southern beach. Displays erosion hazards without armoring. Hazard zones represent three bands of certainty, most likely, based on the assumption of a low average erosion rate (0.2 ft/yr), best, based on the assumption of an average erosion rate (0.4 ft/yr), and worst case, based on the assumption of a high average erosion rate (0.7 ft/yr).

Coastal Cliff and Dune Erosion Projection With Armoring - North Carmel Beach
1 ft of SLR (2045 - 2060) 2 ft of SLR (2060 - 2080) 4 ft of SLR (2080 - 2100+)



Figure 13. Map of dune and cliff erosion for the northern beach. Displays erosion hazards with armoring. Hazard zones in areas where armoring is not present rely on the ‘without armoring’ scenario using the assumption of an average erosion rate (0.4 ft/yr).

Coastal Cliff and Dune Erosion Projection With Armoring - Central Carmel Beach



Figure 14. Map of dune and cliff erosion for the central beach. Displays erosion hazards with armoring. Hazard zones in areas where armoring is not present rely on the ‘without armoring’ scenario using the assumption of an average erosion rate (0.4 ft/yr).

Coastal Cliff and Dune Erosion Projection With Armoring - South Carmel Beach



Figure 15. Map of dune and cliff erosion for the southern beach. Displays erosion hazards with armoring. Hazard zones in areas where armoring is not present rely on the 'without armoring' scenario using the assumption of an average erosion rate (0.4 ft/yr).

Coastal Cliff and Dune Erosion Projection With Armoring



Figure 16. Map of dune and cliff erosion for the entire beach. Displays erosion hazards with armoring. Hazard zones in areas where armoring is not present rely on the ‘without armoring’ scenario using the assumption of an average erosion rate (0.4 ft/yr).

Beach Narrowing Findings

In response to rising sea levels, Carmel Beach will narrow over time without any additional adaptation strategies (Figures 17 and 18). Beaches with no armoring may migrate landward with sea level rise as cliffs and dunes erode naturally. However, if landward migration is inhibited by armoring, beaches will narrow and likely be permanently inundated (Table 2) at some point in the future. This is a phenomenon known as coastal squeeze or passive erosion. A narrative of beach narrowing can be found below in the Task 4, Vulnerability Assessment section.

Table 2. Typical summer dry sand beach remaining with each foot of sea level rise

Sea Level Rise Elevation (ft)	Acres of Dry Sand Beach (typical summer)	Percentage
0	34.2	100%
1	27.4	80%
2	20.7	61%
3	14.1	41%
4	7.6	22%
5	2.6	8%

Notes: The baseline year for sea level rise 2020. Summer dry sand beach acreage is representative of the 75 percentile beach width from 1984 to 2021.

How to Interpret the Hazard Maps

The maps of beach narrowing with sea level rise represent a typical summer beach. Actual summer beach widths may vary. Beach widths are constrained by the current position of backshore toe and are reflective of a “hold the line” scenario.

Summer Beach Width Change Projection - North Carmel Beach



Summer Beach Width Change Projection - South Carmel Beach

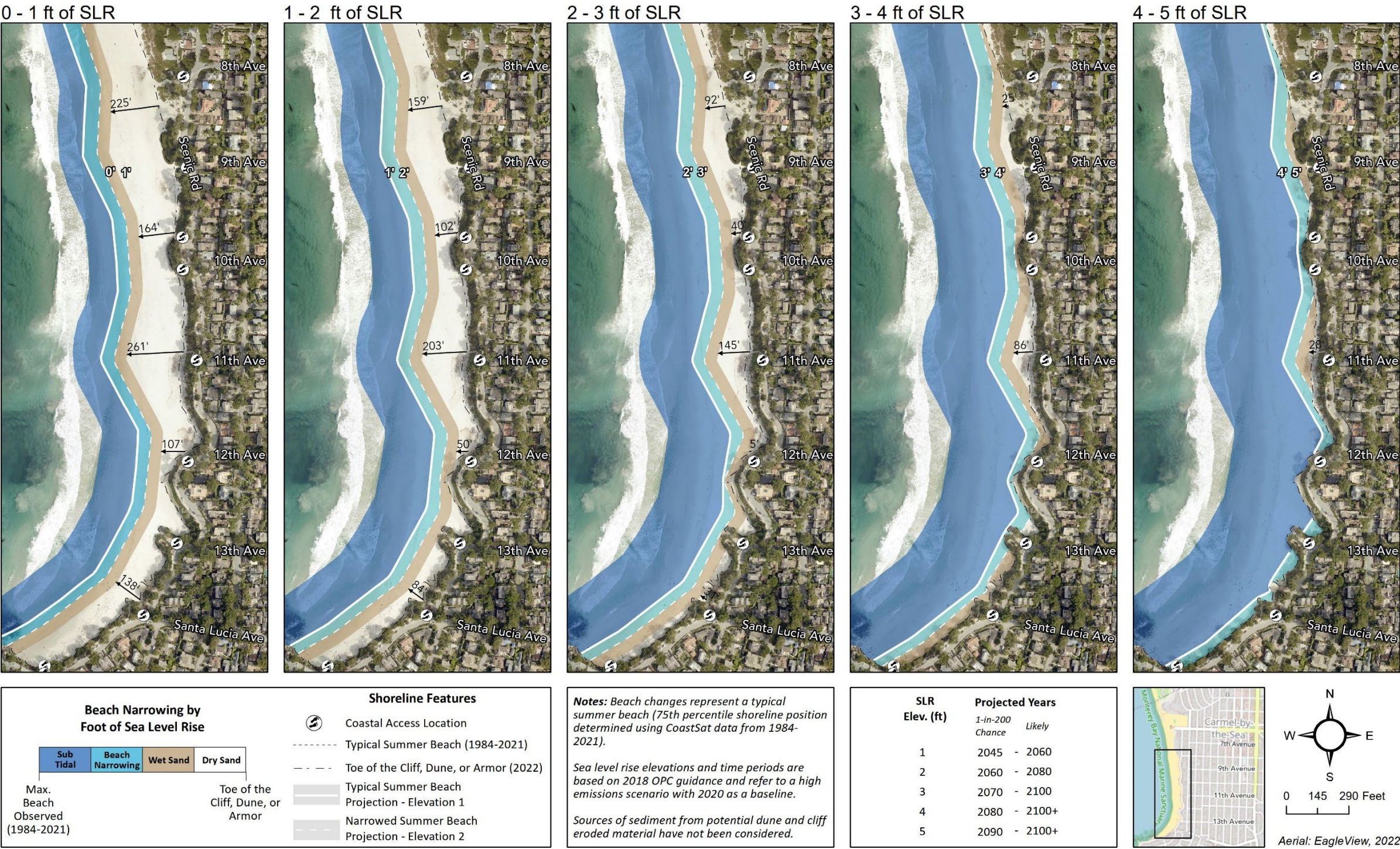


Figure 18. Summer dry sand beach loss in the southern beach between 0 to 5 ft of sea level rise.

TASK 4 VULNERABILITY ASSESSMENT

This section provides a narrative of vulnerabilities to sea level rise by each section of the City's shoreline. The focus of this assessment is on the direct exposure of City infrastructure, property, and structures to coastal erosion and sea level rise. This assessment does not consider the wide range of cascading impacts associated with climate change.

Section 1 South Beach—Scenic Road from 8th Avenue to Martin Way

This section of shoreline is composed of mostly armored cliffs along Scenic Road south of 8th Avenue and extends for ~0.6 mile. The contact elevation between the sandstone cliff and the softer terrace is lower in the north and rises toward the south, before dropping once more around 13th Avenue. This section experiences the most significant variability in seasonal beach width change.

The area between 9th Avenue and 11th Avenue has a FEMA base flood elevation of 31 ft, which is higher than other locations along Carmel Beach (24 ft in the south and 16 ft in the north). The Johnson (1983) study notes that the area around 10th to 12th Avenue is a possible fault zone and reports erosion of 25–40 ft here following the 1982-83 El Niño winter. These factors led to the assumption of a higher historical erosion rate for this section and yielded a higher erosion projection in the future.

The South Beach area is primarily residential, and a pedestrian pathway runs along this ocean-facing side of Scenic Road at the top of the bluff, which is a popular destination for locals and tourists.

Section 1 Vulnerabilities

Current Vulnerabilities

There is a restroom near Santa Lucia Avenue located along the bluffs (Figure 19). The base of the restroom is located at ~24 ft NAVD 88, which is at the same elevation of the FEMA base flood elevation for this area. This restroom will face an increased exposure to coastal wave flooding with sea level rise. The Johnson (1983) study notes that the rock stairway adjacent to this bathroom was almost destroyed in the 1982-83 El Niño storms.



Figure 19. Restroom at Santa Lucia Avenue.

Between 9th and 11th avenues, the FEMA 100-year coastal wave hazard zone extends to the residential properties on Scenic Road; however, none of the homes are exposed. Analysis shows total water level aligns with the FEMA base flood elevations, and additionally shows the potential for wave splash to exceed the bluff crest of the armored coastline between 13th Avenue and Martin Way.

The Scenic Road walkway, which abuts the bluff top edge, is vulnerable to erosion. Erosion could threaten the pathway and related amenities such as benches and signage, and safety features such as crib walls, guardrails, and handrails. The bluffs between 9th and 10th are especially prone to immediate erosion hazards as the contact elevation of the less erosion resistant bluff terrace and dune sands is much lower. Note that significant erosion of this walkway has occurred in the past, as documented in the Johnson (1983) study following the 1982-83 El Niño winter. Erosion distances from that series of winter storm events are depicted in Table 3.

Table 3. Observations of historical erosion events from the 1982-83 El Niño winter.

Observed Erosion from the Johnson 1983 Survey	Location
Loss of 20 ft of bluff	North of 8th Avenue
Loss of 30 ft of bluff	Between 8th and 9th Avenues
Loss of 40 ft of bluff	Between 9th and 10th Avenues
Loss of 25 ft of bluff	Between 10th and 11th Avenues
Loss of 30 ft of bluff	Near Santa Lucia Avenue

The stormwater drainage network, which is often buried beneath the bluff terrace and the cliff to drain stormwater to the beach, is likely to be exposed to storm wave flooding and erosion (Figure 20). Failure of a storm drain can also exacerbate erosion from terrestrial scouring during rain events.



Figure 20. Stormwater drainage near 13th Avenue.

There are ten beach access stairways that lead to the beach, and all of these stairways are vulnerable to wave attack, scouring and undercutting of their foundations, and coastal erosion. In addition, the failure of a stairway can exacerbate erosion of surrounding bluffs. Breakaway stair designs such as those just north of 10th Avenue can greatly reduce the potential for stairway failures to contribute to erosion.



Figure 21. Stairway at Santa Lucia Avenue. Note damage to the railing from past storms.

1 ft of Sea Level Rise (2045–2060)

By 1 ft of sea level rise, and without any adaptation measures, the typical summer dry sand beach could be reduced by 20%. Beach narrowing will be experienced most acutely south of 12th Avenue where typical beach widths are much narrower.

The areas with the greatest exposure to erosion include the armored cliffs between 8th Avenue and 11th Avenue and the unarmored cliffs around 12th Avenue. As erosion accelerates, this exposes the Scenic Road roadway to erosion in six probable locations between 8th Avenue and 12th Avenue.

A wastewater force main located under the Scenic Road walkway near Martin Way is likely exposed to erosion, as well as a wastewater main under Scenic Road between 9th Avenue and 10th Avenue, and a sewer main under the dunes near 8th Avenue.

Wave uprush and overtopping of the bluff crest is expected to occur more frequently along the southern seawall between Santa Lucia Avenue and Martin Way, and between 8th Avenue and 11th Avenue.

2 ft of Sea Level Rise (2060–2080)

By 2 ft of sea level rise, and without any adaptation measures, the typical summer dry sand beach could be reduced by 40%, and a loss of lateral beach access to areas south of the 12th Avenue headland may occur in the summer. The coastal erosion hazard modeling indicates that erosion rates will begin to accelerate as coastal armoring is more likely to be

overtopped by higher levels of wave splash and wave run up due to elevated water levels. Many areas behind the coastal armor have erosion hazard distances projected to be between 20 to 40 ft. Nearly the entire length of Scenic Road would then be exposed to erosion, including most of the underground water and wastewater infrastructure. By 2 ft of sea level rise, a water main under Scenic Road between 8th Avenue and 10th Avenue may become exposed. In the without armoring scenario, four homes between 9th and 12th Avenues are potentially exposed to erosion.

Wave splash and overtopping of the bluff crest are expected to be more severe between 9th and 10th avenues and may now be experienced between 12th to 13th avenues. In a without armoring scenario, four oceanfront homes would be exposed to erosion.

4 ft of Sea Level Rise (2080–2100+)

By 4 ft of sea level rise, and without implementation of any adaptation measures, the typical summer dry sand beach could be reduced by 80%, and only two small pockets of beach are projected to remain, one 1.5-acre pocket beach around 8th Avenue stairs, and one 1.5-acre pocket beach around 11th Avenue stairs.

Some of the highest erosion distances are projected between 10th and 12th Avenue, where a combination of factors related to wave exposure and local geology⁴ yield projections of retreat up to 150 ft.

Between 2 and 4 ft of sea level rise, 42 oceanfront homes along Scenic Road may be exposed to erosion hazards. In the without armoring scenario, 53 homes, for a total of 57, are potentially exposed to erosion. Coastal erosion may threaten the wastewater and water laterals, as well as other utilities that connect with these homes. One additional water main location under Scenic Road south of 13th Avenue could become exposed to erosion, and one additional sewer force main location could become exposed to erosion near 8th Avenue.

Wave uprush and overtopping the bluff crest is expected to be more severe between 9th Avenue and 10th Avenue and may now be experienced at the higher cliffs by 12th Avenue. Along the lower cliffs between Santa Lucia Avenue and Martin Way, and north of 10th Avenue, wave splash above the bluff crest could exceed 5 ft turning that overtopping into a green water wave with more erosion potential.

⁴ The Johnson (1983) study noted that this area may be part of an old fault zone which has more shattered and weakened the rock

Section 2 Central Beach—Private Property Area from Del Mar Parking Lot to 8th Avenue

The central beach extends alongshore for approximately 0.2 mile and is characterized by densely vegetated dunes known as the Del Mar Dunes, which are home to dune scrub habitat and the black legless lizard, a species of concern (City of Carmel 2010). Atop the rear dune are private homes. Although no riprap armoring is visible, armoring is mapped in the City's Shoreline Management Plan (2004) under the dunes at 8th Avenue. The sandstone bedrock is overlaid by dunes throughout this section, and it is assumed that the contact elevation between the sandstone bedrock and the sand and terrace soils is lower in the south and rises in the north around the Del Mar parking lot. Two coastal access sand ramps are located in this section. The intention of sand ramps is to provide coastal access and allow for access for those with limited mobility.

Section 2 Vulnerabilities

Current Vulnerabilities

Dune erosion was observed in this area during the winter storms of 2022-23 (Figure 22). The Johnson (1983) study notes that the dunes near 8th Avenue eroded 30 ft and formed a 14 ft-high scarp during the 1982-83 El Niño winter. Dune erosion hazards between 0 and 1 ft of sea level rise are projected to cause erosion of 30 to 40 ft in this area, corresponding with the severe winter storm erosion observed in the Johnson study.

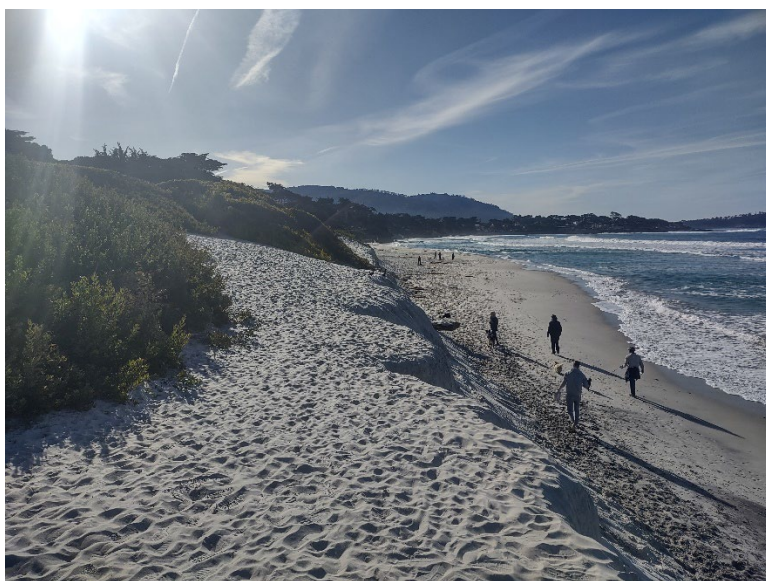


Figure 22. A view looking south over the Del Mar Dunes. A dune scarp is evident along the sand ramp and the dunes. January 2023.

This shoreline section has less immediate bluff-top development than other areas of the City and faces fewer immediate vulnerabilities for the oceanfront homes due to wider setback distances. However, dune erosion and wave flooding could threaten the private coastal accessways, as well as the two coastal access sand ramps south of the Del Mar parking lot and the stairway at 8th Avenue. In addition, the City's stormwater drainage system is vulnerable to dune erosion, and this section also contains private stormwater drain pipes that are exposed to erosion (Figure 23).

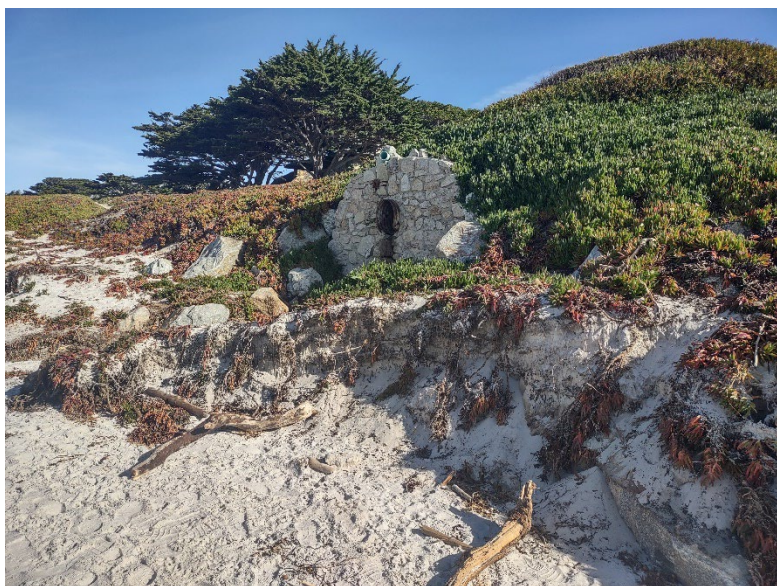


Figure 23. Stormwater drain near 8th Avenue fronted by an eroded scarp following winter storms in 2023. Note the riprap boulder on the bottom right.

A gravity sewer line runs from the Del Mar Parking lot to 8th Avenue in front of the oceanfront homes along Scenic Road. This sewer line is located just inland of the dune crest and may be vulnerable to erosion. The depth and condition of the sewer line is unknown; however, exposure and potential failure could cause untreated wastewater to enter nearby homes, and or cause environmental harm to the nearby dune, beach, and ocean habitats.

1 ft of Sea Level Rise (2045–2060)

The foredune area is vulnerable to erosion, and this study projects up to 40 ft of recession with 1 ft of sea level rise. The sand ramps found in this section and Section 3 (North

Dunes) are constructed of bulldozed sand and buried drift logs (Shonman and D'Ambrosio 2003). With accelerating sea level rise, erosion scarping may become more frequent occurrences and the integrity of the sand ramps may be at risk as erosion threatens to expose the buried drift log core.

2 ft of Sea Level Rise (2060–2080)

By 2 ft of sea level rise, and without any adaptation measures, the dune erosion process may shift toward cliff erosion processes as the foredune retreats inland and contact with the underlying cemented beach deposits and sandstone occurs. The threat of coastal storm waves overtopping the dunes and threatening the homes along the backdune remains unlikely. By 8th Avenue, a wastewater lift station located at ~24.5 ft may be exposed to storm wave flooding (Figure 24). A sewer main under the dunes between 7th Avenue and 8th Avenue could be exposed to dune erosion although the condition of the underlying revetment is not well understood presently.



Figure 24. Wastewater lift station near 8th Avenue.

4 ft of Sea Level Rise (2080–2100+)

By 4 ft of sea level rise, and without any adaptation measures, a collection of three homes around Scenic Road and 8th Avenue are exposed to erosion. Under a more severe erosion scenario (worst case), an additional five homes, for a total of eight, could be threatened by erosion between 8th Avenue and Ocean Avenue.

Section 3 North Dunes Area from 4th Avenue to Del Mar Parking Lot

The North Dunes section is a mostly natural, unarmored area that provides numerous recreational opportunities for the public. The section is 0.1 mile long and begins at the public access stairway at 4th Avenue in the north end and extends to the Del Mar parking lot to the south. The northern half of this shoreline section is characterized by a heavily vegetated cliff and bluff. A concrete stormwater discharge outfall is located just south of the 4th Avenue coastal access stairway. The remainder of this section is more open, with clusters of vegetated dunes and trees that extend back to San Antonio Avenue, nearly 1,000 ft from the swash zone. This section is home to a range of dune habitats, including Tidestrom's lupine, a federally and state-listed endangered plant species, and the California black legless lizard, a species of special concern in the state (City of Carmel 2010). The southern portion of this section has a heavily used public bathroom, four popular sand volleyball courts, and a bluff-top viewing platform.

Section 3 Vulnerabilities

Current Vulnerabilities

The bluff-top viewing platform at Ocean Avenue is vulnerable to dune erosion, as is the coastal access stairway at 4th Avenue. A stormwater outfall and seawall just south of 4th Ave is likely exposed to erosion. The Task 1 Coastal Protection Assessment identified this seawall as being a high priority for repair.



Figure 25. Seawall and outfall just south of the 4th Avenue Stairway.

1 ft of Sea Level Rise (2045–2060)

This dune backed shoreline is susceptible to significant dune erosion, and this study projects between 15 and 30 ft of recession with 1 ft of sea level rise, and 0.18 acre of North Dunes Habitat area exposed to erosion. Large storm events could cause additional dune erosion and scarping. Coastal access at the northern sand ramp could be impacted unless a consistent supply of sand is maintained.

2 ft of Sea Level Rise (2060–2080)

By 2 ft of sea level rise, and without any adaptation measures, this dune-backed area may transform into a cliff-backed shoreline restricting access to the beach. An additional 0.33 acre of dune habitat would be exposed to erosion, for a total of 0.52 acre.

4 ft of Sea Level Rise (2080–2100+)

By 4 ft of sea level rise, and without any adaptation measures, an additional 0.64 acre of dune habitat is exposed to erosion, for a total of 1.16 acres.

The Del Mar parking lot could be exposed to coastal erosion. In the unarmored and worst-case erosion scenario, the public restroom and the beach volleyball courts are also likely exposed to erosion.

Two water storage tanks located near the Del Mar parking lot and may also be exposed to erosion. While the exact spatial locations were not available, maps referenced in the Shoreline Management Plan (2003) show that both likely fall within the erosion hazard zone.

With no additional adaptation implementation, this is one of the last areas of Carmel Beach that can expect to maintain a dry sand beach with up to 5 ft of sea level rise.

Section 4 North Beach—Private Properties from Pescadero Canyon to 4th Avenue

The North Beach is a 400-ft stretch of coast that makes up the very northern portion of the City Beach study area and consists of private properties on top of the bluffs. The bluff increases in elevation from about 20 ft near to Pescadero Canyon to approximately 50 ft just north of the 4th Avenue stairway. The upland area of this section is composed of just two oceanfront private parcels. The northern parcel maintains its own seawall and the southern parcel is unarmored.

Section 4 Vulnerabilities

Current Vulnerabilities

A private seawall (Figure 26) is vulnerable to wave attack and overtopping.

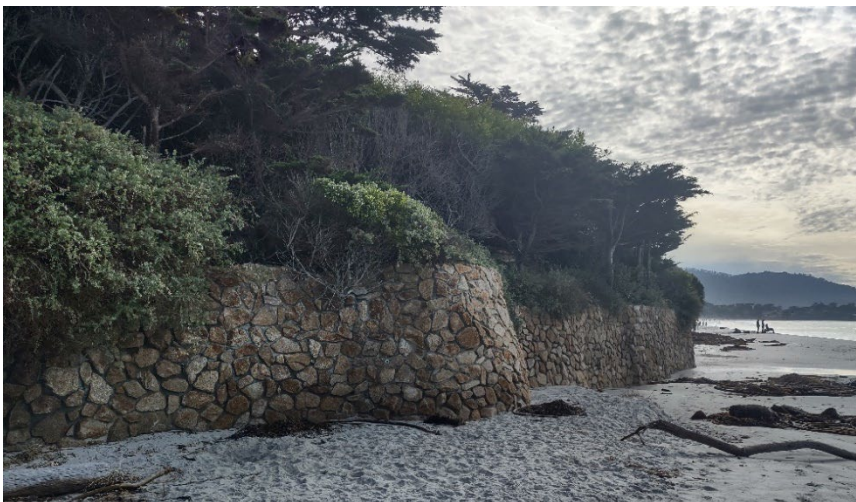


Figure 26. Privately owned seawall near Pescadero Canyon.

1 ft of Sea Level Rise (2045–2060)

In the armored erosion scenario, wave uprush and splash along this seawall are above the top of the armor height, yielding an erosion distance of 30 ft by 1 ft of sea level rise. Erosion distances are only projected to be just over 20 ft along the higher unarmored property due to the higher cliff and bluff terrace contact elevation.

2 ft of Sea Level Rise (2060–2080)

By 2 ft of sea level rise, and in a without armoring scenario, one home is potentially vulnerable to erosion.

4 ft of Sea Level Rise (2080–2100+)

By 4 ft of sea level rise, and in a with armoring scenario, both homes are potentially vulnerable to coastal erosion.

With no adaptation implementation, this is one of the last areas of Carmel Beach that can expect to maintain a dry sand beach with up to 5 ft of sea level rise.

REFERENCES

- City of Carmel-by-the-Sea. 2010. Del Mar Master Plan. January 14.
- City of Carmel-by-the-Sea. 2016. Carmel Shoreline Assessment Fall 2014 to Summer 2016. June 30.
- City of Carmel-by-the-Sea. 2021. Climate Change Vulnerability Assessment. July.
- ESA. 2016. Santa Barbara County Coastal Resiliency, Phase 2 Technical Methods Report. Prepared for the County of Santa Barbara. July 1.
- Hegermiller, C.A., A. Rueda, L.H. Erikson, P.L. Barnard, J.A.A. Antolinez, and F.J. Mendez. 2017. Controls of multimodal wave conditions in a complex coastal setting. *Geophysical Research Letters* 44:(24). <https://doi.org/10.1002/2017GL075272>
- Johnson. 1983. Phase 1 Erosion Protection, Carmel Beach, Carmel-by-the-Sea, California. Rogers E. Johnson and Associates. August 15.
- Komar, P.; McDougal, W.G.; Marra, J.J., and Ruggiero, P., 1999. The rational analysis of setback distances: Applications to the Oregon Coast. *Shore and Beach*, 67(1), 41-49.
- Limber, P.W., P.L. Barnard, S. Vitousek, L.H. Erikson. 2018. A model ensemble for projecting multidecadal coastal cliff retreat during the 21st century. *Journal of Geophysical Research: Earth Surface* 2018. <https://doi.org/10.1029/2017JF004401>
- NOAA. 2022. Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities along U.S. Coastlines. National Oceanic and Atmospheric Administration.
- OEHHA. 2022. Indicators of Climate Change in California. The California Environmental Protection Agency's Office of Environmental Health Hazard Assessment.
- OPC and CCC. 2018. State of California Sea-Level Rise Guidance 2018 Update. California Ocean Protection Council and California Coastal Commission.
- OPC and OST. DRAFT: State of California Sea Level Rise Guidance: 2024 Science and Policy Update. California Ocean Protection Council and California Ocean Science Trust. January.
- Revell, D.L., R. Battalio, B. Spear, P. Ruggiero, and J. Vandever. 2011. A methodology for predicting future coastal hazards due to sea-level rise on the California coast. *Climatic Change* 109:S251-S276 doi: 10.1007/s10584-011-0315-2.

Carmel Climate Change Vulnerability Assessment, Tasks 3 and 4
February 20, 2024
Page 48 of 56

Reynolds. 1986. Soil Investigation for Carmel Beach Phase 2 Improvements. James C. Reynolds and Associates. January.

Shonman, D., and G. D'Ambrosio. 2003. Carmel-by-the-Sea Shoreline Management Plan, September.

Shonman, D., and G. D'Ambrosio. 2015. Carmel Shoreline Assessment. April 15.

Stockdon, H.F., Holman, R.A., Howd, P.A. and Sallenger Jr, A.H. 2006. Empirical parameterization of setup, swash, and runup. *Coastal Engineering* 53(7): 573-588.

Trenhaile, A.S. 2000. Modeling the development of wave-cut shore platforms. *Marine Geology*, Volume 166, Issues 1-4, 2000, Pages 163-178, ISSN 0025-3227, [https://doi.org/10.1016/S0025-3227\(00\)00013-X](https://doi.org/10.1016/S0025-3227(00)00013-X).

ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

backshore	Extreme inland limit of the beach
basal unit	Lower geologic formation of the cliff (sandstone in Carmel)
bluff	Soft unconsolidated materials found in the marine terrace deposits
bluff contact	Location where the bluff meets the cliff
bluff top	Location where there is an identifiable break from the steeper cliff and bluff to the gently sloping inland areas
cliff	Hard consolidated rock under the bluff
CoSMoS	Coastal Storm Modeling System (USGS)
DEM	Topographic Digital Elevation Model
dry sand beach	The portion of the beach that is landward of the mean high water mark
dunes	Areas where wave action and onshore winds have led to sand deposition, located landward of the beach
erosion (coastal)	Can refer to either beach narrowing or cliff retreat. For cliffs, this refers to the long-term loss or removal of land due to coastal or terrestrial processes. For beaches, this may refer to either the long-term, short-term, or localized (see scouring) removal of sediments from the beach.
FEMA	Federal Emergency Management Agency
green water	Occurs when waves break onto or over the coastal armoring and the overtopping volume is relatively continuous
NAVD 88	North American Vertical Datum of 1988 (NAVD 88). The vertical control datum used for surveying.
NOAA	National Oceanic and Atmospheric Administration
scour (beach)	Process by which waves and currents remove sediment from the beach (usually localized)
shoreline	Typically where water meets the land. In this report, it refers to the wet/dry line
splash	Occurs when waves break seaward of the coastal armoring, or where the armoring is high in relation to the wave height, and overtopping is a concentrated stream of water droplets

Carmel Climate Change Vulnerability Assessment, Tasks 3 and 4
February 20, 2024
Page 50 of 56

toe of the cliff	Location where the dry sand beach meets the base of the cliff
total water level	The combined effect of wave run-up height, storm surge, tides, and sea level elevations
USGS	U.S. Geological Survey

ACKNOWLEDGEMENTS

Integral Consulting, Inc.

- David L. Revell, Ph.D., Project Director
- Matt Jamieson, GIS and Project Manager
- Ashley Ellenson, Ph.D., Coastal Scientist
- Rae Taylor-Burns, Ph.D., Coastal Scientist

Haro Kasunich & Associates, Inc.

- Moses Cuprill, P.E., Senior Coastal Engineer
- Mark Foxx, P.E., Coastal Engineer

EMC Planning Group, Inc.

- Anastazia Aziz, AICP, Principal
- Esme Wahl, Associate Planner

City of Carmel-by-the-Sea

- Robert Harary, P.E., Director of Public Works
- Mary Bilse, Environmental Programs Manager
- Javier Hernandez, Project Manager
- Rob Culver, Public Works Superintendent

APPENDIX A. SECTOR VULNERABILITY FINDINGS

This section provides a series of tables indicating the extent of hazard impacts to land Use and structures, roads and parking, and utilities and infrastructure. Findings are organized by the two erosion hazard zone scenarios, one for a **with** coastal armoring where erosion rates are reduced, and one for a **without** coastal armoring scenario, where erosion is modeled without consideration of armoring. A best estimate on future erosion rates are reported for both. Both scenarios are reported using the best estimate for

Land Use and Structures

Parcels

Reported as noncumulative area across horizons

Parcels	With Coastal Armoring Scenario				
Parcel Type	Existing (Bluff and Beach)	SLR (ft)			Total
		1	2	4	
Public (sq ft)	290,913	42,358	45,179	43,338	421,787
Residential (sq ft)	20,764	4,713	15,397	152,622	193,496

Parcels	Without Coastal Armoring Scenario				
Parcel Type	Existing (Bluff and Beach)	SLR (ft)			Total
		1	2	4	
Public (sq ft)	290,913	49,645	39,009	42,243	421,809
Residential (sq ft)	20,764	4,713	26,206	201,011	252,694

Reported as the number of parcels at the first instance of contact with the hazard zone

Parcels	With Coastal Armoring Scenario				
Parcel Type	Existing (Bluff and Beach)	SLR (ft)			Total
		1	2	4	
Public	9				9
Residential	3		29	40	72

Parcels	Without Coastal Armoring Scenario				
Parcel Type	Existing (Bluff and Beach)	SLR (ft)			Total
		1	2	4	
Public	9				9
Residential	3		38	33	74

Buildings

Reported as the number of structures at the first instance of contact with the erosion hazard zone

Buildings	With Coastal Armoring Scenario			
Building Type	SLR (ft)			Total
	1	2	4	
Public Restroom	1			1
Residences*		0	43	44

Buildings	Without Coastal Armoring Scenario			
Building Type	SLR (ft)			Total
	1	2	4	
Public Restroom	1			1
Residences*		5	54	59

**Excludes garages and the wastewater lift station structure (included in the wastewater section building)*

Roads

Roads and Parking	With Coastal Armoring Scenario		
	SLR (ft)		
	1	2	4
Scenic Road (ft)*	702	3,113	3,463
Ocean Ave Parking Lot (sq ft)*			2,149
Scenic Road (sq ft)*	2,864	56,877	96,067

Roads and Parking	Without Coastal Armoring Scenario		
	SLR (ft)		
	1	2	4
Scenic Road (ft)*	1,497	3,226	3,475
Ocean Ave Parking Lot (sq ft)			2,149
Scenic Road (sq ft)*	6,432	70,762	98,517

* Lengths and areas are cumulative across sea level rise horizons. Length of Scenic Road is measured from the oceanfront curb

Utilities and Infrastructure

Stormwater

Stormwater	With Coastal Armoring Scenario				
	Existing (Bluff)	SLR (ft)			Total
		1	2	4	
CDS Separator	2			1	3
Inlets	1	3	10	11	25
Junctions	1		1		2
Manholes	3		2	2	7
Outfalls	17	2		2	21
Culverts		1	1	1	3
Drains (ft)*	1,391	1,888	2,891	3,581	

Stormwater	Without Coastal Armoring Scenario				
	Existing (Bluff)	SLR (ft)			Total
		1	2	4	
CDS Separator	2			1	3
Inlets	1	7	11	7	26
Junctions	1		1		2
Manholes	3		2	2	7
Outfalls	17	2		2	21
Culverts		1	1	1	3
Drains (ft)*	1,391	2,034	2,940	3,590	

**Lengths are cumulative across sea level rise horizons. Does not include private stormwater infrastructure.*

Wastewater

Wastewater Infrastructure	With Coastal Armoring Scenario			
	SLR			Total
	1	2	4	
DCO (cleanout)	1			1
Manhole		5	4	9
Pump Station			1	1
Sewer Main (ft)*	381	2,155	4,164	
Forced Main (ft)*	51	479	805	

Wastewater Infrastructure	Without Coastal Armoring Scenario			
	SLR			Total
	1	2	4	
DCO (cleanout)	1			1
Manhole	1	4	5	10
Pump Station			1	1
Sewer Main (ft)*	406	2,564	4,390	
Forced Main (ft)*	338	553	805	

**Lengths are cumulative across sea level rise horizons*

Water

Water	With Coastal Armoring Scenario		
	SLR (ft)		
	1	2	4
Hydrants	1	0	0
Water Main (ft)*	0	439	1,870

Water	Without Coastal Armoring Scenario		
	SLR (ft)		
	1	2	4
Hydrants	2	0	2
Water Main (ft)*	0	737	2,072

**Lengths are cumulative across sea level rise horizons. Does not include two water storage tanks located near the Del Mar Parking Lot. Water irrigation pipes are not included*



CITY OF CARMEL-BY-THE-SEA FOREST AND BEACH COMMISSION Staff Report

March 14, 2024
ORDERS OF BUSINESS

TO: Forest and Beach Commissioners

SUBMITTED BY: Thomas C. Ford, Administrative Analyst

SUBJECT: Receive a presentation by Carmel Cares regarding Project Plans for the Ocean Avenue Medians Landscaping Project

RECOMMENDATION:

Receive a presentation by Carmel Cares regarding Project Plans for the Ocean Avenue Medians Landscaping Project, and provide any final adjustments prior to Staff submitting these plans for an Encroachment Permit for construction.

BACKGROUND/SUMMARY:

At the August 10, 2023 Forest and Beach Commission meeting, three landscape design concepts were presented for the Ocean Avenue Medians. There was Commission consensus and direction to staff to proceed with Design Option #3 as developed by Carmel Cares.

The plans for the selected design have been fleshed out with Forestry and other Public Works staff since that time, and the final proposed landscaping plans will be presented at this meeting. The presentation slides are enclosed at **Attachment 1**.

Barring any significant modifications, Staff will promptly compile the information presented and submit it for a no-fee construction Encroachment Permit. The work is anticipated to start in April, and is anticipated to be completed this Fall 2024. Installation will begin in the median between Lincoln and Dolores Streets, then continue eastward, and conclude with the most westward median island between Monte Verde and Lincoln Streets which served as the prior pilot project.

By default, the City is prepared to maintain the Ocean Avenue Medians after project completion; however, sharing this responsibility with volunteers is strongly encouraged.

FISCAL IMPACT:

The cost per island for implementation is estimated to be \$17,350. After adding 15% to account for future price increases and/or contingencies, a more conservative \$20,000 estimate per island would bring the project total to \$100,000.

The Public Works/Forestry Division budget has allocated \$25,000 to this "Beautification" project in the current Fiscal Year 2023/24. Staff will request another \$25,000 for funding in the next FY 2024/25 budget as well. These funds may only be used for construction materials (including plants, boulders, and irrigation supplies). Carmel Cares and other donors will pay for the installation and any other required expenses.

ATTACHMENTS:

Attachment 1 - Presentation of Ocean Ave Medians Landscaping Plans

Elevating the Aesthetics and Biodiversity of the Ocean Avenue Medians in Carmel-by-the-Sea

Updated 2/9/23 - 2/9/24

Alan Wheat Consulting
wheatlandscaping@gmail.com
(831) 238-3424



Overview

- Project Purpose
- Site Analysis/Priorities
- Incorporating Sustainable Practices
- Fostering Biodiversity with Native Plant Selection
- Bridging Art and Nature in the Landscaping Design
- The Role of Landscaping in Enhancing Civic Pride and Identity
- Designing for Year-round Appeal and Seasonal Variations
- Implementing and Maintaining for Long-term Success
- Thank You and Q&A

Project Purpose

- In this presentation, we will discuss the importance of landscaping design for the Ocean Avenue medians and how it can elevate the aesthetics and safety of the downtown area. We will also explore various design elements and strategies to create an inviting and visually appealing environment that reflects the unique character of the community while supporting wildlife .

Site Analysis/Priorities

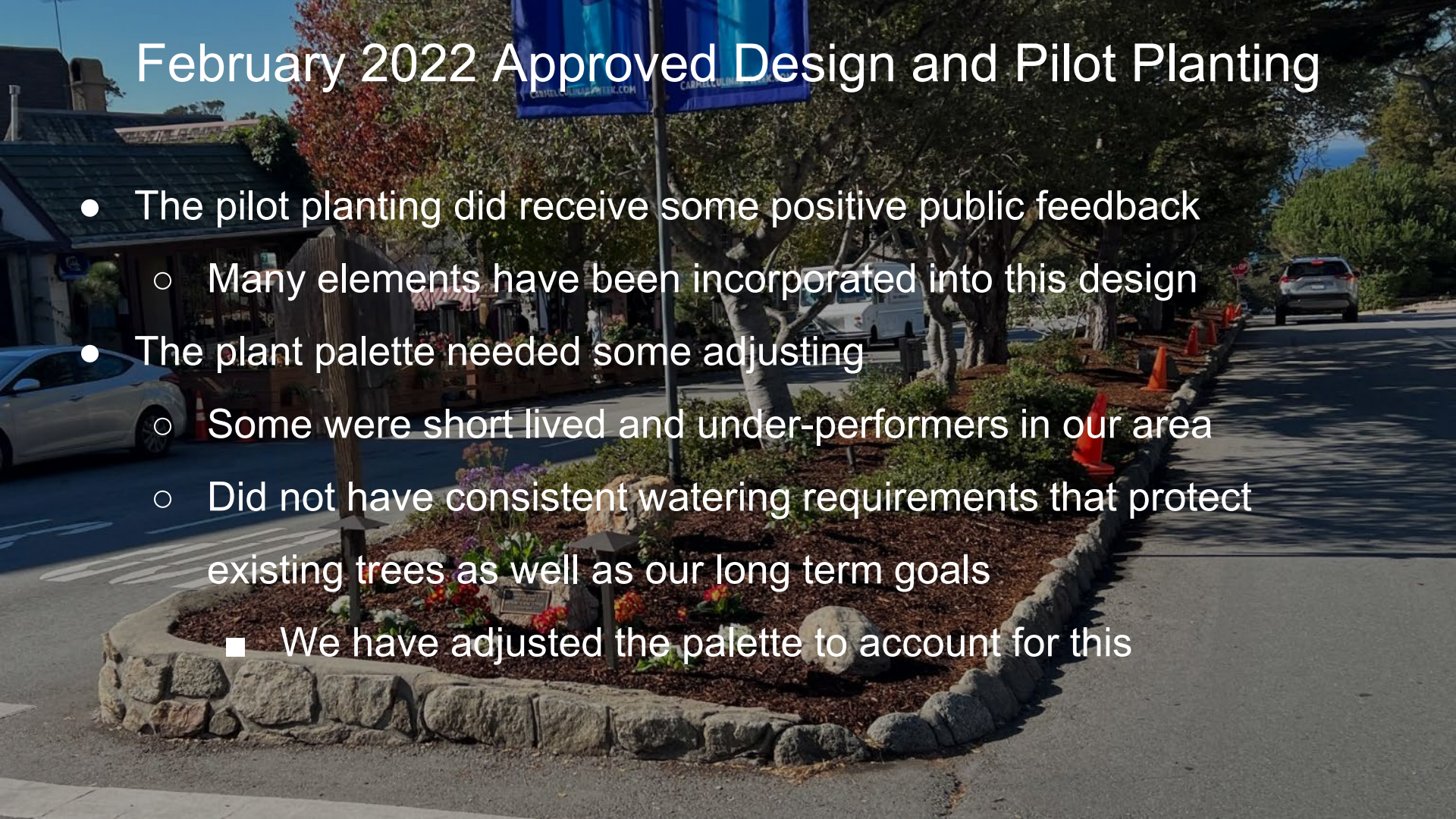
- Safety concerns of pedestrians crossing over medians
- Visibility for motorists
- Color at ends for enhanced beauty
- Maintain visibility from opposite side for business exposure
- Banners need to remain and be accessible for rotation
- Many existing plantings are old, past prime, or poor species
- Tree work necessary for visibility, tree health, and new understory
- Some trees have bad wounds from trucks and fungal disease
They should be removed to preserve health of other trees

Landscaping Goals

- Deter jaywalking with boulders and plants
- Use low growing and high color with long bloom periods at ends
- Properly thin existing trees to allow filtered light for understory
- Plant selections that streamline maintenance and water needs
- Plants should handle high soil temperatures, not impede tree roots
- Recommend mostly local CA native plants to support wildlife through our changing climate
- Ideally we integrate with proper street trees on the sidewalks

February 2022 Approved Design and Pilot Planting

- The pilot planting did receive some positive public feedback
 - Many elements have been incorporated into this design
- The plant palette needed some adjusting
 - Some were short lived and under-performers in our area
 - Did not have consistent watering requirements that protect existing trees as well as our long term goals
 - We have adjusted the palette to account for this



Why we should be planting local native plants

- Require less soil preparation than traditional plantings
- Require less water to establish and little after being established
- Benefit existing native pines and oaks by planting their natural neighbors
- Supply native birds and butterflies with larvae, nectar, seeds, and nest materials
- Ocean Ave connects Forest Theater and MTNP habitat planting to the North Dunes and Scenic Pathway habitats, establishing a consistent native corridor for wildlife and beauty - "Pollinator Pathway"
- Carmel is one of the most beautiful cities. Why not enhance its beauty by using plants that naturally should be here?
- Sets a example of plant community landscapes for residents and visitors

Wildlife Corridor

- Provides transition zones from one wildlife habitat to another
- ❖ Wildlife corridors provide traveling avenues for wildlife species between two habitat areas.
- ❖ Ocean Avenue would connect the MTNP and Forest Theater to the North Dunes and Scenic Pathway.
- ❖ In the future, large medians and eastments, Forest Hill Park, and other areas could also be developed with native plants, increasing biodiversity throughout the city for humans and wildlife.



Locally Sourced Boulders



Median Ends

- *Erigeron glaucus*, Seaside Daisy
- *Epilobium* 'Callistoga', California Fuchsia
- *Verbena* 'de la mina', Santa Cruz Island Verbena
- *Carex tumulicola*, Berkeley Sedge *



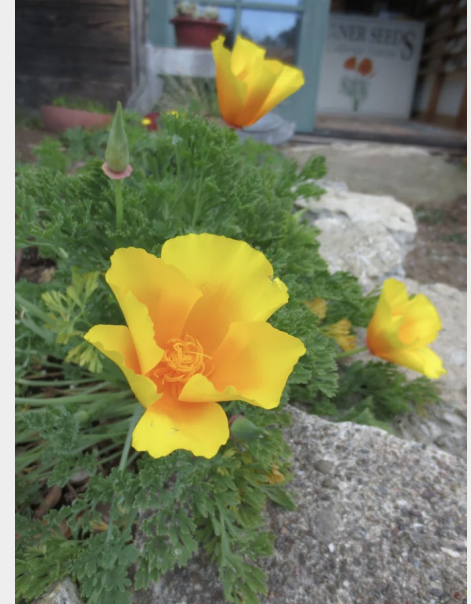
Living Fence Mix

- *Frangula californica* 'Leather leaf', California coffeeberry
- *Ceanothus* 'Yankee Point'
- *Ribes viburnifolium*, Catalina Perfume
- *Ribes sanguineum*, Woodland currant
- *Salvia leucophylla*, Pt. Sal



Highlights - Spread over walls, boulder pockets

- *Clinopodium douglasiana*, Yerba Buena
- *Eschscholzia maritima*, California Beach Poppy
- *Huechera maxima*, Alum Root



Low Mix

- *Salvia spathacea*, Hummingbird sage
- *Carex tumicola*, Berkley sedge
- *Arctostaphylos* 'Emerald Carpet'



Lincoln->Dolores Median Plant Mix

Median Ends, low profile for visibility, long bloom period showing off at the ends.

1. *Erigonon glaucus*, Seaside Daisy
2. *Epilobium* 'Callistoga', California Fushia
3. *Carex tumulicola*, Berkley Sedge
4. *Verbena* 'de la mina', Santa Cruz Island verbena

Low mix

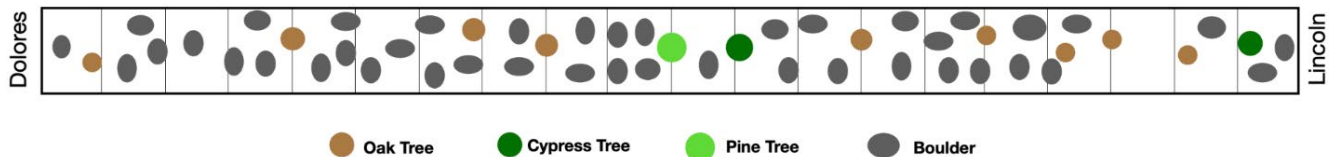
10. *Salvia spathacea*, hummingbird sage
11. *Carex tumulicola*, Berkley sedge
12. *Arctostaphylos* 'Emerald Carpet'

Living Fence Mix

5. *Frangula californica* 'Leather leaf', California coffeeberry
6. *Ceanothus* 'Yankee Point'
7. *Ribes sanguineum*, Woodland currant
8. *Ribes viburnifolium*, Catalina island perfume
9. *Salvia leucophylla*, Pt. Sal

Highlights, spread in cool locations, boulder pockets, cascade over walls

13. *Clinopodium douglasiana*, Yerba Buena
14. *Eschscholzia maritima*, California Beach Poppy
15. *Huechera* maxima, Alum Root



Sample Photos



Sample Photos



Median Rendering



Median Rendering



Materials Requirement

Plants	Number	Size
Ribes Sanguineum	10	5g
Ribes viburnifolium	40	1g
Frangula (Rhamnus) 'Leatherleaf	25	5g
Carex tumulicola	200	4"
Salvia spathacea	25	1g
Erigeron glaucus	75	1g
Eschscholzia maritima	25	1g
Epilobium canum	15	1g
Verbena de la Mina	20	1g

Plants Total	
200 4"	\$1,000
200 1g	\$1,600
45 5g	\$1,300
Total	\$3,900

Materials Requirement

Boulders	
Size	Quantity
2' x 3'	16
2' x 4'	15
1' x 4'	6
1 1/2' x 5'	3
15 Tons Total	\$3,750
Delivery	\$2,000
Total	\$5,750

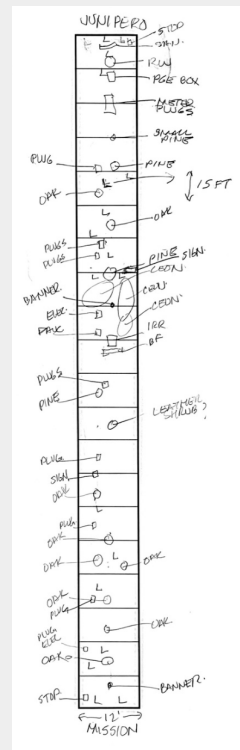
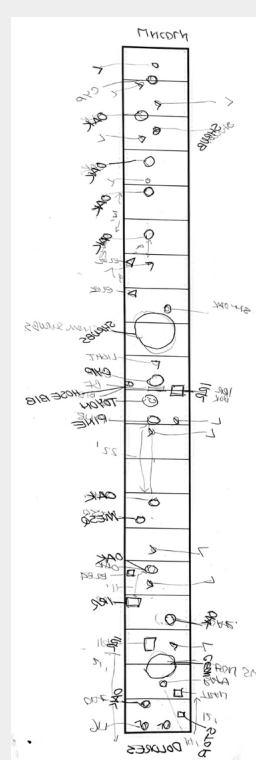
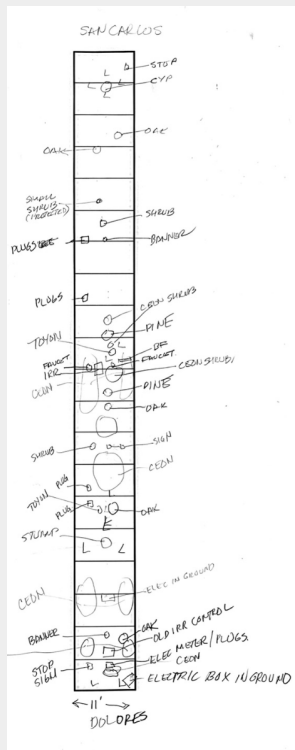
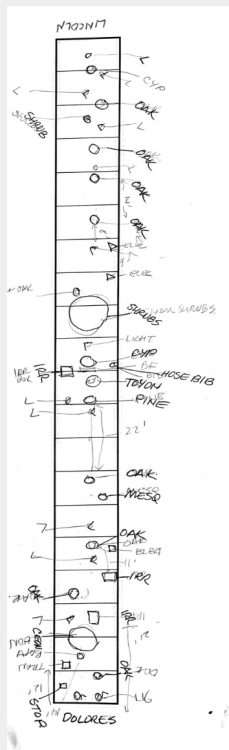
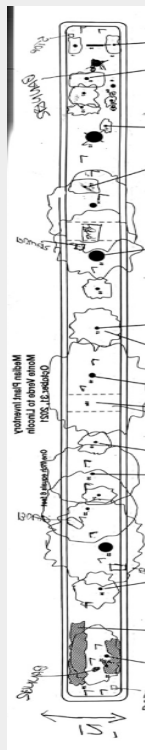
Labor Requirement

Labor Costs	
Boulder Placement	\$2,000
Design/Planting Supervision	\$4,000
Planting - Volunteer & Professional	\$1,500
Irrigation - Materials & Labor City Provided	\$0
Total Labor	\$7,500

Materials Requirement

Budget Summary	
Boulders	\$5,750
Plants	\$3,900
Labor	\$7,500
Fertilizer Tea Bags	\$200
Total	\$17,350

Median Inventory



Issues

- Tree removals are done. Stumps remain.
- Electrical wiring and other infrastructure is challenging
- Need to remove existing soil and plants as much as possible and practical
- Boulder delivery charge is high - consolidate orders?
- Boulders cannot be staged on roadway
- Tractor for installation?
- Budget from City and other funding sources

Next Steps

- Would like to start with Dolores->Lincoln
- Submitted Rotary Club grant - Mid-February decision
- Future routine tree maintenance by City
- Approve planting mix and landscape plan while checking with actual detailed conditions on medians
- An encroachment permit will be applied for/issued
- Develop plant and boulder orders
- Order all required plants and materials
- Execute plan for boulders, plants, and irrigation

Overview

- Project Purpose
- Site Analysis/Priorities
- Incorporating Sustainable Practices
- Fostering Biodiversity with Native Plant Selection
- Bridging Art and Nature in the Landscaping Design
- The Role of Landscaping in Enhancing Civic Pride and Identity
- Designing for Year-round Appeal and Seasonal Variations
- Implementing and Maintaining for Long-term Success
- Thank You and Q&A



CITY OF CARMEL-BY-THE-SEA FOREST AND BEACH COMMISSION Staff Report

March 14, 2024
ORDERS OF BUSINESS

TO: Forest and Beach Commissioners

SUBMITTED BY: Thomas C. Ford, Administrative Analyst

SUBJECT: Receive a presentation regarding a component of the Urban Forest Master Plan: the Preliminary Tree Species List

RECOMMENDATION:

Receive a presentation regarding a component of the Urban Forest Master Plan (UFMP): the Proposed Tree Species List. The Forest and Beach Commission and Steering Committee are asked for guidance of the preliminary list before inclusion into the upcoming UFMP.

BACKGROUND/SUMMARY:

Attachment 1 is the preliminary Recommended Tree Species list, prepared by City Forester Justin Ono alongside recommendations from Davey Resource Group, as part of the UFMP project. For comparison, **Attachment 2** is the Recommended Tree Species list from the current (2001) Forest Management Plan.

The Proposed Tree Species List is notably much more comprehensive in species diversity than the existing list, was developed with Climate Change impacts in mind, and is displayed in a tabular format, for easier, side-by-side comparisons, as compared to the more narrative format of the existing list. The new list also includes more information including canopy spread, being utility friendly, native or adaptive, sun exposure, pest and disease concerns, and more.

The purpose of having a greater variety of recommended trees for residents (and the City) to choose from is also to avoid catastrophic loss of trees if there is a pest affecting any one tree species.

Following the presentation by the City Forester, the Forest and Beach Commission and Steering Committee are encouraged to provide feedback on the overall format for the new list, suggest modifications/additions/deletions to the list of trees, and other guidance.

Additional reports will continue to be presented to the Forest and Beach Commission over the next few months leading up to the draft UFMP which will contain Tree Species List, previously-presented technical reports, and other upcoming reports and survey results.

Environmental Evaluation

This action does not constitute a project within the meaning of the California Environmental Quality Act under Public Resources Code Section 21065. It has no potential to cause either a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment and, therefore, does not require environmental review.

FISCAL IMPACT:

Preparation of the Tree Species List was included in UFMP project account.

ATTACHMENTS:

Attachment 1 - Updated Tree Species List

Attachment 2 - Tree Species List from 2001 CBTS Forest Management Plan

Upper Canopy Trees

	Species	Common Names	Climate Ready	From Recommended Species List	Upper (U)/Ler (L) Canopy Tree	Native (N), Near Native (NN), Adapted (A)	Deciduous (D), Evergreen (E), Semi-deciduous (SD)	Max Height	Max Canopy Spread	Hardscape Damage Potential High (H), Moderate (M), Low (L)	Utility Friendly	Salt Spray Tolerance High (H), Moderate (M), Low (L)	Sun Exposure	Pests and Disease Concerns	Disease Resistance	Notes
1	<i>Abies bracteata</i>	Santa Lucia fir			U	N	E	80	20	M	No	M	Partial to Full			Tree is deer resistant and attracts birds, squirrels
2	<i>Aesculus x carnea 'Briotii'</i>	red horsechestnut			U	A	D	50	50	L	No	M	Full Sun	Chlorosis		Tree is deer resistant and attracts bees, squirrels, Poisonous fruit
3	<i>Arbutus menziesii</i>	Pacific madrone			U	NN	E	70	50	L	No	M	Full Shade/Full Sun	Needle Cast, Sudden Oak Death, Anthracnose, Phytophthora and Caterpillars, Scales, Thrip		
4	<i>Arbutus unedo</i>	strawberry tree			U	A	E	80	60	H	No	M	Partial to Full	Armillaria, Root Rot, Verticillium and Invasive Shot Hole Borer, Aphids, Scales, Spider Mites		
5	<i>Betula jacquemontii</i>	white-barked Himalayan birch			U	A	D	60	30	M	No	M	Full Shade to Full Sun	Armillaria and Aphids, Beetle Borers	Verticillium	
6	<i>Brachychiton acerifolius</i>	Illawarra flame tree			U	A	SD	60	40	M	No	L	Full Sun			Tree is deer resistant
7	<i>Callistemon citrinus</i>	lemon bottlebrush			U	A	E	60	30	M	No	M	Partial to Full	Armillaria, Phytophthora, Root Rot, Sooty Mold and Beetle Borers	Verticillium	
8	<i>Calocedrus decurrens</i>	incense cedar		x	U	NN	E	90	15	M	No	M	Partial to Full	Mistletoe, Phytophthora, Root Rot, Red Ring Rot and Beetle Borers, Juniper Scale, Western Cedar Bark Beetle		
9	<i>Carpinus betulus 'Fastigiata'</i>	European hornbeam			U	A	D	50	40	L	No	M	Partial to Full	Armillaria, Root Rot and Scales	Verticillium	Tree is deer resistant and attracts birds, Needs little pruning
10	<i>Castanospermum australe</i>	Moreton Bay chestnut			U	A	E	100	40	M	No	L	Partial to Full			Tree is deer resistant, Fruits are supposedly edible but the seeds are poisonous. Wood is valued for lumber
11	<i>Catalpa speciosa</i>	Northern catalpa			U	A	E	50	30	M	No	M	Partial to Full	Armillaria, Phytophthora, Root Rot, Sooty Mold and Aphids, Leaf Miner		
12	<i>Cedrus atlantica</i>	atlas cedar		x	U	A	E	60	30	M	No	M	Partial to Full	Armillaria, Phytophthora, Root Rot, Sooty Mold and Beetle Borers	Verticillium	
13	<i>Cedrus deodara</i>	Deodar cedar			U	A	E	60	40	M	No	M	Partial to Full	Phytophthora, Root Rot, Sooty Mold	Verticillium	
14	<i>Cedrus libani</i>	cedar of Lebanon			U	A	E	100	100	L	No	M	Partial to Full		Verticillium	SL growing, Tree is deer resistant and attracts squirrels
15	<i>Cupressus sempervirens</i>	Italian cypress			U	A	E	70	70	M	No	M	Partial to Full	Armillaria, Phytophthora, Root Rot and Invasive Shot Hole Borer	Verticillium	
16	<i>Fraxinus americana 'Autumn Purple'</i>	Autumn Purple ash			U	A	D	80	50	H	No	M	Partial to Full	Anthracnose, Sooty Mold and Scales, White Fly		Tree is deer resistant
17	<i>Ginkgo biloba</i>	maidenhair tree			U	A	E	50	20	H	Yes	M	Partial to Full	Phytophthora, Root Rot and Invasive Shot Hole Borer, Beetle Borers, Thrip		
18	<i>Gleditsia triacanthos 'Inermis'</i>	thornless honeylocust			U	A	D	60	40	M	No	L	Partial to Full	Mistletoe, Phytophthora, Root Rot and Invasive Shot Hole Borer, Caterpillars, Insect Galls, Pod Gall Midge	Verticillium	Tree is deer resistant and attracts bees, birds
19	<i>Harpephyllum coffrum</i>	Kaffir plum			U	A	E	50	40	H	No	M	Partial to Full			Tree is deer resistant
20	<i>Cupressus macrocarpa</i>	Monterey cypress		x	U	NN	E	70	40	M	No	H	Partial to Full	Armillaria, Phytophthora, Root Rot and Beetle Borers		
21	<i>Hymenosporum flavum</i>	sweetshade			U	A	E	50	20	L	No	M	Partial to Full			Tree is deer resistant and attracts bees, birds
22	<i>Juniperus chinensis 'Torulosa'</i>	Hollywood juniper			U	A	D	70	40	M	No	M	Partial to Full	Armillaria, Phytophthora, Root Rot, Verticillium and Aphids, Beetle Borers, Scales		
23	<i>Leptospermum scoparium</i>	Tea tree			U	A	D	60	40	M	No	M	Full Shade to Full Sun	Anthracnose, Powdery Mildew, Root Rot, Verticillium and Caterpillars		
24	<i>Liriodendron tulipifera</i>	Tulip tree			U	A	D	80	40	M	No	M	Partial to Full	Anthracnose, Chlorosis, Fusarium, Armillaria and Aphids, Scales		Tree is deer resistant and attracts birds
25	<i>Lophostemon confertus</i>	Brisbane box			U	A	E	50	30	M	No	M	Partial to Full	Phytophthora, Root Rot and Scales		Tree is deer resistant
26	<i>Magnolia x soulangeana</i>	saucer magnolia			U	A	E	70	20	M	No	M	Partial to Full	Gummosis, Phytophthora, Root Rot and Spider Mites		
27	<i>Metasequoia glyptostroboides</i>	dawn redwood			U	A	E	90	20	M	No	M	Partial to Full		Armillaria	Tree is deer resistant
28	<i>Nyssa sylvatica</i>	black gum			U	A	D	50	30	L	No	M	Partial to Full	Fusarium, Phytophthora, Root Rot, Rust		Attracts birds
29	<i>Pinus canariensis</i>	Canary Island pine		x	U	A	E	80	35	M	No	H	Partial to Full	Armillaria, Phytophthora, Root Rot, Sooty Mold and Aphids, Beetle Borers, Spider Mites	Verticillium	
30	<i>Pinus muricata</i>	Bishop pine		x	U	NN	E	70	40	M	No	H	Partial to Full	Armillaria, Phytophthora, Root Rot, Rust and Aphids, Beetle Borers	Verticillium	

31	<i>Pinus pinaster</i>	<i>maritime pine</i>			U	A	E	90	35	M	No	H	Partial to Full	Armilaria, Phytophthora, Root Rot and Aphids	Verticillium	Tree is deer resistant and attracts birds, squirrels. A vigorous growing pine for coastal areas.
32	<i>Pinus radiata</i>	<i>Monterey pine</i>		x	U	N	E	100	35	M	No	H	Partial to Full	Armilaria, Leaf Blight, Phytophthora, Root Rot and Aphids, Beetle Borers, California Five Spined Engraver Beetle, IPS	Verticillium	
33	<i>Pinus sylvestris</i>	<i>Scots pine</i>			U	A	E	70	30	M	No	M	Partial to Full	Fusarium, Armilaria, Phytophthora, Root Rot and Aphids	Verticillium	Tree is deer resistant and attracts birds, squirrels
34	<i>Platanus acerifolia</i> 'Columbia' or 'Yarwood'	<i>London planetree</i>			U	A	D	80	40	M	No	M	Partial to Full		Verticillium, Mildew, Anthracnose	Tree is deer resistant and attracts birds
35	<i>Pyrus communis</i>	<i>European pear</i>			U	A	D	90	60	M	No	M	Full Shade to Full Sun	Armilaria, Anthracnose and Aphids, Beetle Borers	Verticillium and Bronze Birch Borer	
36	<i>Quercus agrifolia</i>	<i>coast live oak</i>		x	U	N	E	85	40	M	No	L	Partial to Full	Armilaria, Anthracnose and Aphids, Beetle Borers		
37	<i>Quercus coccinea</i>	<i>scarlet oak</i>			U	A	D	70	50	M	No	M	Partial to Full	Armilaria and Caterpillars, Scales	Verticillium	Tree is deer resistant and attracts birds, squirrels
38	<i>Quercus douglasii</i>	<i>blue oak</i>			U	N	E	70	50	L	No	M	Partial to Full	Crown Rot, Mistletoe, Armilaria, Brown Rot and Caterpillars, Insect Galls, California Oak Moth, Gall Wasp	Verticillium	Tree is deer resistant and attracts birds, squirrels
39	<i>Quercus frainetto</i> 'Forest Green'	<i>Hungarian oak 'Forest Green'</i>			U	A	D	100	70	M	No	L	Partial to Full	Armilaria, Crown Rot, Mistletoe, Root Rot and Beetle Borers, Caterpillars, Insect Galls, Scales	Verticillium	Attacts birds, squirrels
40	<i>Quercus garryana</i>	<i>Oregon white oak</i>			U	N	D	90	60	L	No	M	Partial to Full	Crown Rot, Mistletoe, Armilaria, Root Rot and Beetle Borers, Caterpillars, Insect Galls, Scales	Verticillium	Attacts birds, squirrels
41	<i>Quercus kelloggii</i>	<i>California black oak</i>			U	N	D	70	50	M	No	L	Partial to Full	Sudden Oak Death, Anthracnose, Armilaria, Brown Rot and Goldspotted Oak Borer, Insect Galls, Carpenterworm, California Oak Moth	Verticillium	Tree is deer resistant and attracts birds, squirrels
42	<i>Quercus lobata</i>	<i>valley oak</i>			U	N	D	70	50	M	No	L	Partial to Full	Armilaria, Crown Rot, Mistletoe, Root Rot and Invasive Shot Hole Borer, Beetle Borers, Caterpillars, Insect Galls	Verticillium	Tree is deer resistant and attracts birds, squirrels
43	<i>Quercus macrocarpa</i>	<i>Bur oak</i>			U	A	D	80	30	M	No	M	Partial to Full	Armilaria and Aphids, Spider Mites	Verticillium	Tree is deer resistant and attracts birds, squirrels
44	<i>Quercus palustris</i>	<i>pin oak</i>			U	A	D	70	40	L	No	M	Partial to Full	Armilaria and Scales	Verticillium	Armilaria and Scales
45	<i>Quercus robur</i>	<i>English oak</i>			U	A	D	100	80	M	No	M	Partial to Full	Armilaria, Powdery Mildew and Invasive Shot Hole Borer, Insect Galls	Verticillium	Tree is deer resistant and attracts birds, squirrels
46	<i>Quercus rubra</i>	<i>Northern red oak</i>			U	A	D	80	70	M	No	M	Partial to Full	Armilaria, Anthracnose, Phytophthora, Root Rot and Aphids, Caterpillars, Insect Galls	Verticillium	Tree is deer resistant and attracts birds, squirrels
47	<i>Quercus shumardii</i>	<i>Shumard oak</i>			U	A	D	70	40	M	No	M	Partial to Full	Armilaria and Beetle Borers, Beetle Leaves, Caterpillars, Insect Galls	Verticillium	Tree is deer resistant and attracts birds, squirrels
48	<i>Quercus tomentella</i>	<i>Channel Island oak</i>			U	NN	E	50	40	M	No	M	Partial to Full	Armilaria	Verticillium	Tree is deer resistant and attracts birds, squirrels
49	<i>Quercus virginiana</i> "Skyclimber"	<i>Southern live oak "Skyclimber"</i>			U	A	E	80	100	M	No	M	Partial to Full	Armilaria, Phytophthora, Root Rot and Insect Galls		Attacts birds, squirrels
50	<i>Rhus lancea</i>	<i>African sumac</i>			U	A	D	50	30	L	No	M	Full Sun	Armilaria, Brown Rot, Canker, Crown Rot and Aphids, Coddling Moths, Mealy Bugs, Psyllid	Verticillium	
51	<i>Sequoia sempervirens</i>	<i>coast redwood</i>		x	U	N	E	200	100	L	No	H	Partial to Full	Armilaria, Phytophthora, Cypress Canker, Root Rot and Beetle Borers, Redwood Bark Beetle		
52	<i>Sophora japonica</i> 'Regent'	<i>Japanese pagoda tree</i>			U	A	D	50	40	L	No	M	Full Sun	Canker, Twig Blight, Powdery Mildew and Potato Leafhopper		Tree is deer resistant
53	<i>Tilia americana</i> 'Redmond'	<i>American linden 'Redmond'</i>			U	A	D	70	45	L	No	M	Partial to Full	Anthracnose, Leaf Blight, Canker, Leaf Spot and Aphids, Borer, Leaf Miner, Scales	Verticillium	Tree is deer resistant
54	<i>Tipuana tipu</i>	<i>Tipu tree</i>			U	A	SD	50	50	M	No	H	Partial to Full			Tree is deer resistant, drought tolerant
55	<i>Ulmus parvifolia</i> 'Brea'	<i>Chinese elm 'Brea'</i>			U	A	D	25	50	M	No	M	Partial to Full	Armilaria, Dutch Elm Disease, Canker, Twig Blight and Beetle Leaves, Borer		Branches droop but resist breakage
56	<i>Ulmus parvifolia</i> 'Drake'	<i>Drake Chinese elm</i>			U	A	D	25	50	M	No	M	Partial to Full	Dutch Elm Disease, Armilaria, Phytophthora, Root Rot and Aphids, Beetle Borers, Beetle Leaves, Caterpillars		Tree is deer resistant
57	<i>Zelkova serrata</i>	<i>Japanese zelkova</i>			U	A	D	70	65	M	No	M	Partial to Full	Dutch Elm Disease and Beetle Leaves, Spider Mites		Somewhat more resistant to Dutch Elm Disease

Lower Canopy Trees

	Species	Common Name	Climate Ready	From Recommended Species List	Native (N), Near Native (NN), Adapted (A)	Deciduous (D), Evergreen (E), Semi-deciduous (SD)	Max Height	Max Canopy Spread	Hardscape Damage Potential High (H), Moderate (M), Low (L)	Utility Friendly	Salt Spray Tolerance High (H), Moderate (M), Low (L)	Sun Exposure	Pests and Disease Concerns	Disease Resistance	Notes
1	<i>Acer macrophyllum</i>	bigleaf maple		x	N	D	80	50	H	No	M	Full Shade/Full Sun	Sudden Oak Death, Root Rot, Armillaria, Annosus Root Disease and Invasive Shot Hole Borer, Beetle Borers, California Flathead Borer, Caterpillars		
2	<i>Acer palmatum</i>	Japanese maple			A	D	40	35	L	No	L	Partial Sun to Full Sun	Verticillium, Root Rot	Verticillium, Root Rot	
3	<i>Acer rubrum</i>	red maple			A	E	35	35	L	No	H	Partial to Full	Anthrachnose, Phytophthora, Root Rot, Rust and Scales, Thrip	Armillaria	
4	<i>Agonis flexuosa</i>	willow myrtle			A	E	35	30	M	No	M	Partial Sun to Full Sun	Phytophthora, Root Rot		
5	<i>Arbutus 'Marina'</i>	marina strawberry tree		x	A	E	40	30	L	No	H	Full Sun	Anthrachnose, Phytophthora, Root Rot, Rust and Scales, Thrips		
6	<i>Arbutus unedo</i>	strawberry tree			A	E	35	35	L	No	H	Full Shade/Full Sun	Armillaria		
7	<i>Bauhinia variegata</i>	orchid tree			NN	SD	35	35	L	No	L	Partial Sun to Full Sun			Tree is deer resistant and attracts birds
8	<i>Calodendrum capense</i>	Cape chestnut			A	SD	40	40	L	No	H	Full Sun			Tree is deer resistant
9	<i>Carpinus betulus</i>	European hornbeam			A	D	40	30	L	No	M	Partial Sun to Full Sun	Armillaria, Root Rot and Scales		Tree is deer resistant and attracts birds
10	<i>Ceratonia siliqua</i>	carob tree	Y	x	A	E	40	40	H	No	M	Partial Sun to Full Sun	Armillaria, Root Rot		Drought tolerant
11	<i>Cercis canadensis</i>	Eastern redbud			A	D	40	35	L	No	M	Partial Sun to Full Sun	Anthrachnose, Crown Rot, Armillaria, Phytophthora and Caterpillars, Scales		
12	<i>Chionanthus retusus</i>	Chinese fringetree			A	D	30	12	L	No	M	Partial Sun to Full Sun			Tree is deer resistant and attracts birds
13	<i>Crataegus phaenopyrum</i>	Washington hawthorn			A	D	40	25	L	No	M	Full Sun	Armillaria, Powdery Mildew, Root Rot and Aphids, Beetle Borers, Scales, Spider Mites	Fair Resistance to Fire Blight, Verticillium	Tree is deer resistant and attracts bees, birds
14	<i>Eriobotrya deflexa</i>	bronze loquat		x	A	E	30	30	L	No	M	Partial Sun to Full Sun	Fire Blight, Armillaria, Root Rot		Requires more frequent pruning
15	<i>Eriobotrya japonica</i>	loquat		x	A	E	45	60	M	No	H	Partial Sun to Full Sun	Armillaria, Phytophthora, Root Rot and Invasive Shot Hole Borer, Beetle Borers, Thrips	Texas Root Rot, Verticillium	Drought and smog tolerant
16	<i>Eucalyptus polyanthemos</i>	silver dollar gum			A	E	25	10	L	Yes	M	Full Sun	Brown Rot, Chlorosis, Crown Rot, Armillaria and Aphids, Mealy Bugs, Scales, Spider Mites	Verticillium	
17	<i>Fagus sylvatica</i>	European beech			A	D	80	50	M	No	M	Full Sun	Canker, Armillaria, Phytophthora, Root Rot and Aphids, Spider Mites	Verticillium	Tree is deer resistant and attracts birds, squirrels
18	<i>Fraxinus dipetala</i>	California ash			NN	D	25	20	L	Yes	M	Partial Sun to Full Sun	Root Rot, Sooty Mold, Verticillium and Scales		Tree is deer resistant and attracts birds
19	<i>Geijera parviflora</i>	Australian willow myrtle			A	E	45	20	L	No	M	Partial Sun to Full Sun		Armillaria	water-filled leaves that are fire resistant, Tree is deer resistant and attracts bees
20	<i>Koelreuteria bipinnata</i>	Chinese flame tree			A	D	40	30	L	No	M	Partial Sun to Full Sun			Tree is deer resistant
21	<i>Lagerstroemia indica</i>	crape myrtle			A	E	40	40	L	No	M	Partial Sun to Full Sun	Sooty Mold and Aphids, Scales		
22	<i>Magnolia grandiflora</i>	Southern magnolia			A	E	40	30	L	No	H	Partial Sun to Full Sun			
23	<i>Magnolia grandiflora 'Little Gem'</i>	little gem southern magnolia			A	D	20	10	L	Yes	M	Partial Sun to Full Sun	Armillaria, Root Rot, Verticillium and Invasive Shot Hole Borer, Aphids, Scales, Spider Mites		Tree is deer resistant and attracts birds
24	<i>Melaleuca linariifolia</i>	flax-leaved paperbark			A	SD	35	20	M	No	M	Partial Sun to Full Sun	Armillaria, Fusarium, Root Rot and Invasive Shot Hole Borer, Caterpillars		
25	<i>Olea europaea</i>	olive tree	Y	x	A	E	30	30	M	No	M	Partial Sun to Full Sun	Anthrachnose, Armillaria, Phytophthora, Root Rot and Scales, Psyllid	Texas Root Rot	
26	<i>Pinus pinea</i>	Italian stone pine		x	A	E	80	60	M	No	H	Partial Sun to Full Sun	Armillaria, Phytophthora, Root Rot, Pitch Canker and Aphids	Verticillium	
27	<i>Pistacia chinensis</i>	Chinese pistache	Y		A	E	25	25	L	No	M	Partial Sun to Full Sun	Chlorosis		
28	<i>Platanus racemosa</i>	California sycamore		x	N	D	80	50	M	No	M	Partial Sun to Full Sun	Anthrachnose, Armillaria, Phytophthora, Mistletoe and Invasive Shot Hole Borer, Leaf Miner, Scales, Spider Mites	Verticillium	
29	<i>Platanus x hybrida</i>	London planetree		x	A	D	80	70	H	No	M	Partial Sun to Full Sun	Anthrachnose, Powdery Mildew and Invasive Shot Hole Borer, Scales, Spider Mites	Verticillium	
30	<i>Podocarpus gracilior</i>	fern pine		x	A	E	70	40	L	No	M	Partial Sun to Full Sun			
31	<i>Quercus suber</i>	cork oak			A	E	30	25	L	No	M	Partial Sun to Full Sun	Chlorosis, Phytophthora, Root Rot		

32	<i>Robinia pseudoacacia</i>	black locust		x	NN	D	70	35	H	No	M	Partial Sun to Full Sun	Fusarium, Armillaria, Phytophthora, Root Rot and Aphids, Beetle Borers		
33	<i>Stenocarpus sinuatus</i>	firewheel tree			A	E	30	15	L	No	M	Partial Sun to Full Sun			Tree is deer resistant
34	<i>Tristania laurina</i> 'Elegant	Elegant water gum			A	E	35	25	L	No	H	Partial Sun to Full Sun			Tree is deer resistant
35	<i>Tristaniopsis laurina</i>	water gum			A	D	25	25	L	Yes	M	Partial Sun to Full Sun	Armillaria and Aphids, Scales, Spider Mites		

CITY OF CARMEL BY THE SEA RECOMMENDED TREE SPECIES LIST

An urban forest is an ecosystem that operates as a result of multiple interactions among vegetation, soils, water, insects, wildlife, climate, anthropogenic surfaces, and people. The goal of the Forest and Beach Commission is to manage that operation for the improvement of the urban forest and the quality of life of the City's residents.

Our forest is based on the concept of a two-story canopy consisting of native and indigenous trees and is one that the Commission feels is essential for the continuation of Carmel's forest.

Monterey pines (*Pinus radiata*) and cypresses (*Cupressus macrocarpa*) are the primary upper canopy trees of the forest and the planting of these species shall receive the greatest priority in appropriate situations. Coast live oak (*Quercus agrifolia*) is the preferred lower canopy tree. In general, the native indigenous trees (pine, cypress, and oaks) will do well planted at any location throughout the City.

Pinus radita – “Monterey Pine”

An attractive pine that creates the forested character of our village. A fast growing native species, which naturally occurs along the coast of central California, and can rapidly attain 70-100 feet. It is best suited to coastal landscapes where it becomes drought tolerant. Monterey pine has the form of a pyramid, but at maturity develops a rounded or flatish crown. Accepts lots of water, but can get overgrown and die at early ages, therefore, watering should be limited to the first few years after planting. (**Native, evergreen, upper canopy tree**).

Cupressus macrocarpa – “Monterey Cypress”

Stately and conical when young. At maturity attains heights of 40 feet and more, and as wide. With supplemental water, it produces amazing growth. Planted away from the coast, it is susceptible to canker fungus. Fog and wind conditions will allow proper development and freedom from canker. (**Native, evergreen, upper canopy tree**).

Quercus agrifolia – “Coast Live Oak”

Evergreen tree, developing a broad round dome from 30-60 feet high, 35-80 feet wide. Fast growing when young, especially with ample water. Supplemental watering of mature trees is not recommended. Native to coast ranges from Mendocino to San Diego counties. Has greedy roots and drops almost all of its old leaves in early spring. It is a magnificent year-round cover for small gardens. (**Native, evergreen, lower canopy tree**).

A healthy forest requires a variety of tree species to preclude a single disease from causing irreversible damage. Therefore, the following list of tree species, including growth characteristics, is provided for those circumstances where one of the preferred tree species is not appropriate. Native species are favored. The following trees have proved successful in our community given the proper growing conditions.

UPPER CANOPY TREES**Evergreen**

Pinus radita – “Monterey Pine” - see description above.

Cupressus macrocarpa – “Monterey Cypress” - see description above.

Pinus muricata – “Bishop Pine”

Native to the northern coast. Rapid growth to 40 – 50 feet. Tolerates wind and salt air. Disease resistant, can grow in pure sand. (Native upper canopy tree).

Pinus canariensis – “Canary Island Pine”

Native to the Canary Islands. Is a handsome tree that grows to 60-80 feet tall. Long (9-12inch) blue-green needles. Somewhat gawky appearance as a very young tree changing to a slender pyramid shape, finally developing a round canopy with tiered limbs at maturity. Drought tolerant and resistant to oak root fungus. (Upper canopy tree).

Cedrus deodara – “Deodar Cedar”

Moderate growth to 50-60 feet with 30 foot spread at ground level. Very graceful tree with a light texture. Needs infrequent but deep watering and regular fertilization. Prefers sunny warm locations. (Upper canopy tree).

Sequoia sempervirens - “Coast Redwood”

Fast growing with ample water and good drainage. One of the best upper canopy trees planted next to a lawn. Will grow to 50-60 feet in our area, tops usually die as a result of coastal wind. Relatively pest-free. (Native upper canopy tree).

Eucalyptus nicholii – “Peppermint Gum”

Graceful, weeping, vertical evergreen tree that is fast growing to 40 feet. A garden tree with fine textured foliage. Crushed leaves smell like peppermint. (Upper canopy tree).

Deciduous**Platanus racemosa – “California Sycamore”**

Native to stream banks. Fast growing to 60 feet. Attractive patchy, buff colored bark. Deciduous with leaves remaining on until new growth starts. Generally used in informal gardens (Native lower canopy tree in coastal environments).

Forest Management Plan
Appendix G

LOWER CANOPY TREES

Evergreen

Quercus agrifolia – “Coast Live Oak” – see description above.

Pinus pinea – “Italian Stone Pine”

Native to northern Mediterranean region. Moderate growth to 40 feet. Grey-green needles. Round umbrella shaped canopy in youth developing into a flat broad canopy with age. Hardy, drought tolerant tree. (Lower canopy tree).

Lyonothamnus floribunda asplenifolius – “Catalina Ironwood”

Moderate growth rate, 30-40 feet in height. Considered drought tolerant, however, will look much better if watered occasionally during the summer. Notable feature is its redwood colored bark that peels off in long thin strips. Grows near the coast and is very handsome when planted in groves. Needs excellent drainage. (Native lower canopy tree).

Arbutus menziesii – “Madrone”

Slow growing evergreen. Mature height varies with growing conditions and site. Rarely exceeds 25 feet in our area. Main feature is smooth reddish-brown bark that peels in thin flakes. Needs well-drained soil and ample water to become established. (Native, evergreen, lower canopy tree).

Arbutus ‘Marina’

Multi- or single stem tree growing to 20-30 feet tall. Noted for clusters of rosy pink flowers and cinnamon red bark. Good looking specimen tree that prefers acidic soils an occasional deep watering. (Evergreen lower canopy tree)

Quercus ilex – “Holly Oak”

Native to the Mediterranean region. Medium size tree grows to 30 feet with a round canopy. Leaves glossy green on top grey-green underneath with prickly (hence the common name) or smooth edges. Tolerates salt air and coastal conditions. Grows best in well-drained soils but can tolerate poor conditions, although growth will be slower. (Lower canopy tree)

Schinus molle – “California Pepper Tree”

Fast growing to 25-40 feet. Distinctive light brown, scaly bark on gnarled trunks. Evergreen tree with pale foliage. Will tolerate poor soil and drainage, wind, dust and limited water. It has a voracious root system and generates large amounts of litter. Avoid summer water. (Lower canopy tree).

Schinus terebinthifolius - “Brazilian Pepper Tree”

Evergreen shrub to small dome-shaped tree that grows at a moderate rate to 15-30 feet. Darker green and coarser leaf than California Pepper. It does not develop the same problems with roots and litter as the Schinus molle. Frequently used for lawn and courtyard accents. It responds well to pruning and can become a clipped screen. (Lower canopy tree).

Forest Management Plan
Appendix G

Umbellularia californica – “California Bay”

Needs deep moist soil to attain a height of 25-40 feet. Dry or windswept sites cause a more shrub like appearance, which make it a good screen. Aromatic leaves used in cooking (Native lower canopy tree).

Calocedrus decurrens – “Incense Cedar”

Slow growing pyramidal conifer. Can grow to 80 feet, but in our coastal environment 20 feet is the norm. Tolerates poor soil, full sun and high winds. (Native lower canopy in this area).

Olea europaea – “Olive”

A medium sized evergreen tree (25-30 feet). Willow like foliage is a soft gray-green that combines well with most colors. With time, these trees develop into a round dome shape and have interesting gnarled trunks. Needs full sun and are tolerant of most soils. Plant fruitless variety to avoid messy litter. (Lower canopy tree).

Eucalyptus ficifolia - “Red Flowering Eucalyptus”

Round headed evergreen tree that grows to about 30 feet. Spectacular 1-foot clusters, can have variable colored flowers (cream, light pink, orange and red). Flowers during summer months. Good coastal tree but should not be used in lawns. (Lower canopy tree).

Eriobotrya japonica – “Loquat”

Grows to 15-30 feet tall and equally broad. Large, leathery and heavily veined leaves. Needs well-drained soil and is drought tolerant once established. May produce edible fruit, but is mainly used as an ornamental. (Lower canopy tree).

Podocarpus gracilior – “Fern Pine”

Not a true pine. Native to eastern Africa. Glossy fine-textured green leaves 2-4 inches long and ½ inch wide. Grows to 30 feet with a billowy neat rounded vase or oval canopy. Tolerates drought, poor drainage, and compacted or restricted soils. Very few pests or diseases. (Lower canopy tree)

Tristania conferta – “Brisbane Box” (Lophostemon confertus)

Australian native that resembles some eucalyptus species. Upright growth to 30 feet tall. Reddish brown bark peels off the trunk and limbs similar to a madrone. Large dark green oval leaves 4-6 inches long and clusters of 3-7 white colored flowers in summer. Tolerates a wide range of soils but best growth is achieved in well drained soils. (Lower canopy tree)

Ceratonia siliqua – “Carob”

Evergreen shrub or tree. If pruned to grow as a tree can attain a height of 30 feet and as wide. Male trees have flowers; females produce abundant one-foot leathery pods that create litter beneath the tree. Water deeply and infrequently as this tree is subject to root crown rot. (Lower canopy tree)

Forest Management Plan
Appendix G

Deciduous

Aesculus californica – “California Buckeye”

Small single or multi-trunked tree that will grow to 15 to 20 feet. Native to dry slopes but will grow in a variety of cultural situations. Usually drop their leaves in early summer exposing its silver-gray bark and artistic structure. (Native lower canopy tree).

Liquidambar styraciflua – “Sweet Gum”

Moderate growth rate with cone shape form at maturity. Deciduous trees with brilliant fall foliage. Grows to 40-feet in coastal climate, needs well-drained soil (Lower canopy tree).

Robinia pseudoacacia – “Black Locust”

Deciduous tree. Fast growth to 40-70 feet with rather open, sparse-branching habit. Thorny branchlets and showy flowers form grape-like clusters. A very aggressive tree which tolerates the most adverse conditions. (Lower canopy tree).

Platanus acerifolia - “London Plane”

Fast growing to 40-50 feet. Tolerant of most soils, smog, dust, and reflective heat. Deciduous tree that is fairly insect free, but subject to anthracnose, which causes early, continued leaf fall. Interesting bark texture and color. (Lower canopy tree).

'Yarwood' – Preferred variety due to its tolerance of poor environmental conditions and disease resistance. In addition, it exhibits fine ornamental attributes such as uniform pyramidal habit, dark green leaves and early development of attractive exfoliating bark. (Lower canopy tree).

Acer macrophyllum – “Big Leaf Maple”

Deciduous tree, native to stream banks and moist canyons. Broad topped, dense shade tree that grows to 30 feet tall in our coastal area. Golden fall color. Tree produces fruit with twin wings that persist for a long time providing the tree with an interesting decorative feature. (Native lower canopy tree).

Ulmus parvifolia – “Chinese Elm ”

Evergreen or deciduous according to the trees individual heredity. Very fast growth to 40 feet. Older trees have bark that sheds similar to sycamores. Makes a good patio tree, but has an aggressive root system. (Lower canopy tree).

'Drake' This Chinese elm variety forms a graceful, spreading, rounded canopy of long, arching, and somewhat weeping branches with two to three-inch-long, shiny, dark green, leathery leaves. The showy, exfoliating bark reveals random, mottled patterns of grey, green, orange, and brown, adding great textural and visual interest. It makes a good shade, specimen, or street tree, provided it is trained and pruned to develop a strong branch structure. (Lower canopy tree).



CITY OF CARMEL-BY-THE-SEA FOREST AND BEACH COMMISSION Staff Report

**March 14, 2024
ORDERS OF BUSINESS**

TO: Forest and Beach Commissioners

SUBMITTED BY: Justin Ono, City Forester

SUBJECT: City Forester's Report for February 2024

RECOMMENDATION:

Receive the City Forester's Report for February 2024

BACKGROUND/SUMMARY:

Environmental Evaluation

This action does not constitute a project within the meaning of the California Environmental Quality Act under Public Resources Code Section 21065. It has no potential to cause either a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment and, therefore, does not require environmental review.

FISCAL IMPACT:

ATTACHMENTS:

Attachment 1` - Foresters Report



CITY OF CARMEL-BY-THE-SEA

Monthly Report

City Forester's Report

TO:	Forest and Beach Commissioners
FROM:	Justin Ono, City Forester
SUBJECT:	February 2024 Forester's Report

Forestry, Parks, and Beach Highlights:

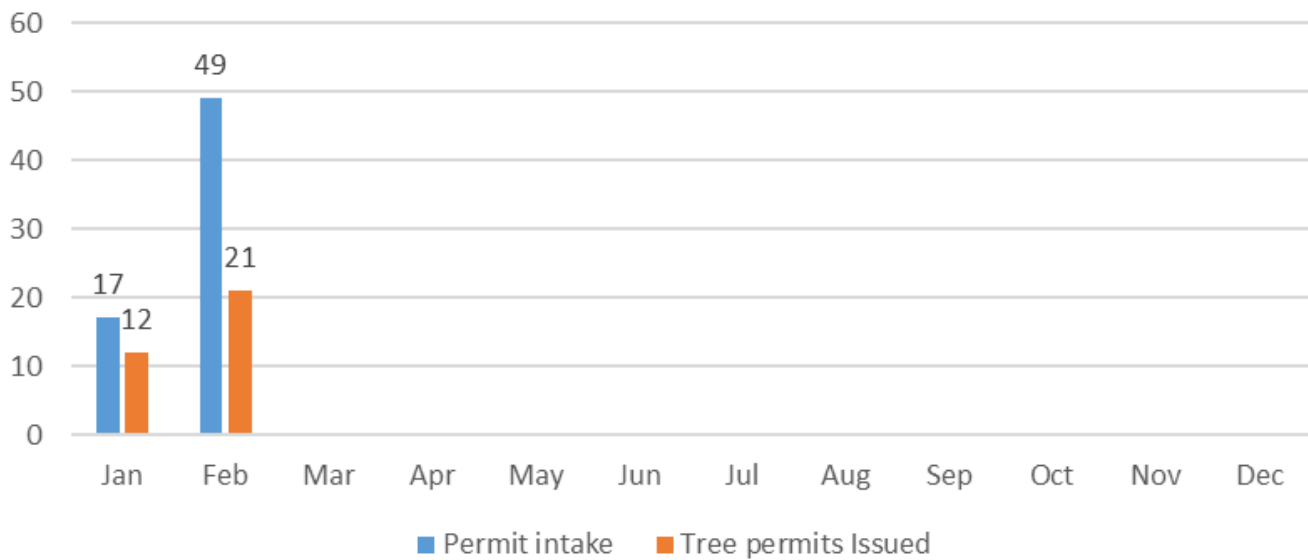
- Status of Davey Resource Group (DRG) development of the Urban Forest Master Plan (UFMP):
 - The first draft of the UFMP was expected in December, but has been delayed and is expected in the next month.
 - The UFMP technical report regarding the Tree Planting Palette will be presented to the Forest and Beach Commission and Steering Committee on March 14th.
 - Coordinated with Commissioner Brezoczky regarding coding of information submitted under the UFMP Community Survey to better distinguish input from Carmel residents versus input from respondents from adjacent geographic areas.
- In February, Forestry crews picked up 19 piles of storm damaged trees and branches, removed 20 fallen, dead or hazardous trees, and pruned 7 trees. Storm cleanup is still ongoing. No new city trees were planted due to the urgency of storm recovery.
- The intense storm in early February brought on a mass of communication from residents seeing over 300 calls and/or emails come in. 224 "tickets" were resolved but do to staffing challenges 863 tickets remain outstanding including correspondences prior to the storm.
- At the February 14 Forest and Beach Commission meeting, the City Forester presented the preliminary statistics of impacts of the significant February 4th storm. Impacts included 106 tree incidents, 43 trees fell, 8 trees in active failure removed, 50 large limbs, power lines down in 4 locations, and 12 homes impacted.
- Predominantly as a result of the February 4th storm, our 3 tree contractors removed 18 falling trees and pruned 15 trees with broken hanging branches determined by the Forester to be of imminent risk, under contract Task Orders.
- Landscape maintenance work across the City continues to be fully engaged by Town & Country.
- Purchased electric chainsaw in first step to electrifying tools for tree crew.
- Began to transition tree permit intake processing from the Community Planning and Building counter at City Hall over to the Public Works/Forestry office. Cross training underway with an official transfer date scheduled in March.

Permit Information

2024 Permitted removals, pruning, and required planting

	Tree permits received	Tree permits Issued	Site Inspections Performed	Total Prunings	Total Removals	Removal of Upper	Removal of Lower	Required to Plant Upper	Required to Plant Lower	No room for new tree	Meets Density Rec.	Total Number of Trees Required
January	17	12	1	4	8	6	2	5	1	0	2	6
February	49	21	4	6	21	11	10	3	3	0	0	6
March												
April												
May												
June												
July												
August												
September												
October												
November												
December												
2024 Totals	66	33	5	10	29	17	12	8	4	0	2	12

2024 Permits Intake vs. Issued



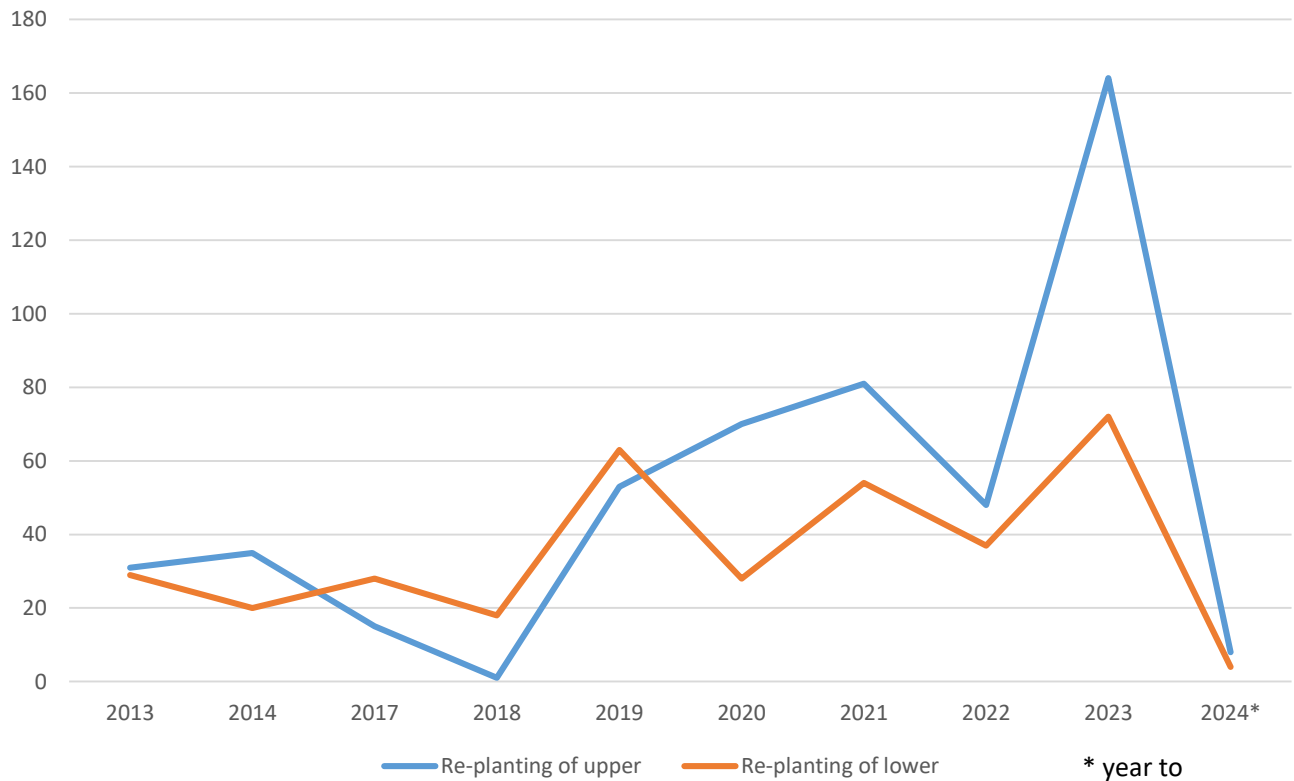
Historic permitted removals and required planting

	Re-planting of upper	Re-planting of lower
2013	31	29
2014	35	20
2017	15	28
2018	1	18
2019	53	63
2020	70	28
2021	81	54
2022	48	37
2023	164	72
2024*	8	4

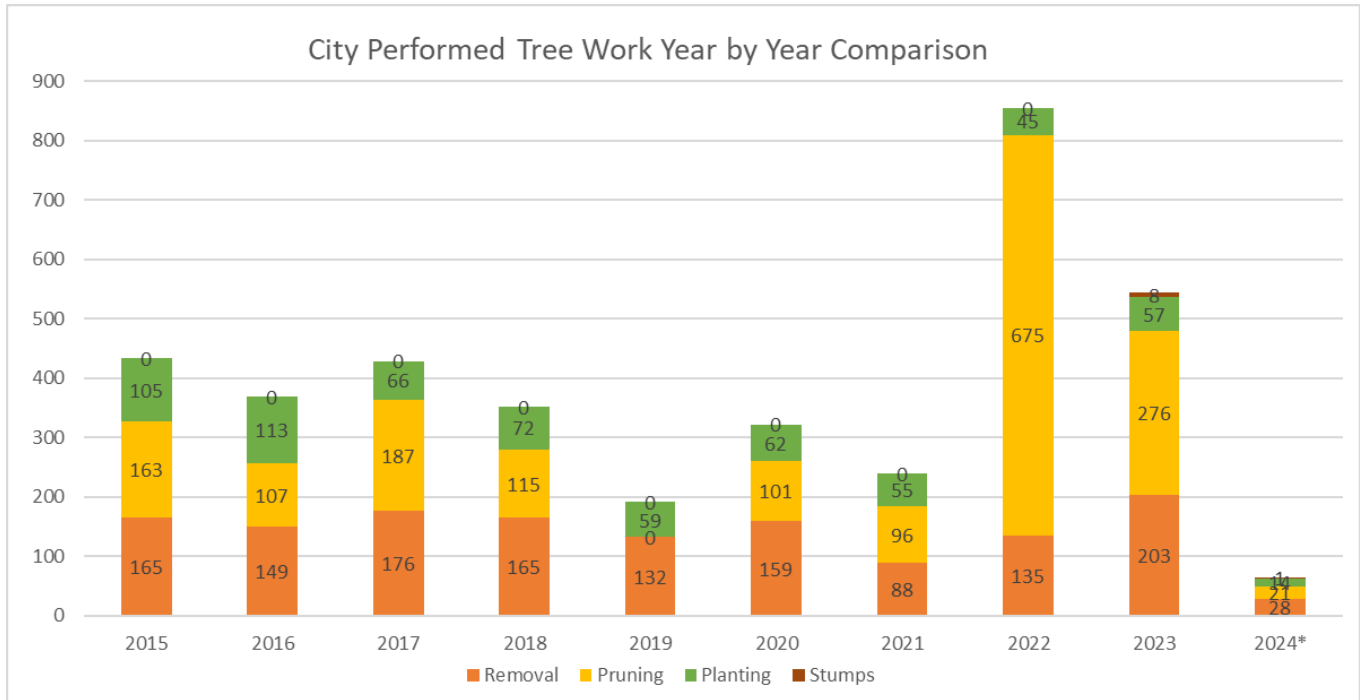
Historic permitted removals and required planting

Year	Permitted removals	Removal of upper	Removal of lower	Replanting Required	Replanting of upper	Replanting of lower	Replanting %	Applications processed
2021	204	81	123	135	81	54	66.18%	213
2022	149	82	67	85	48	37	57.05%	155
2023	324	211	113	223	164	72	68.83%	336
2024	29	17	12	12	8	4	41.38%	39

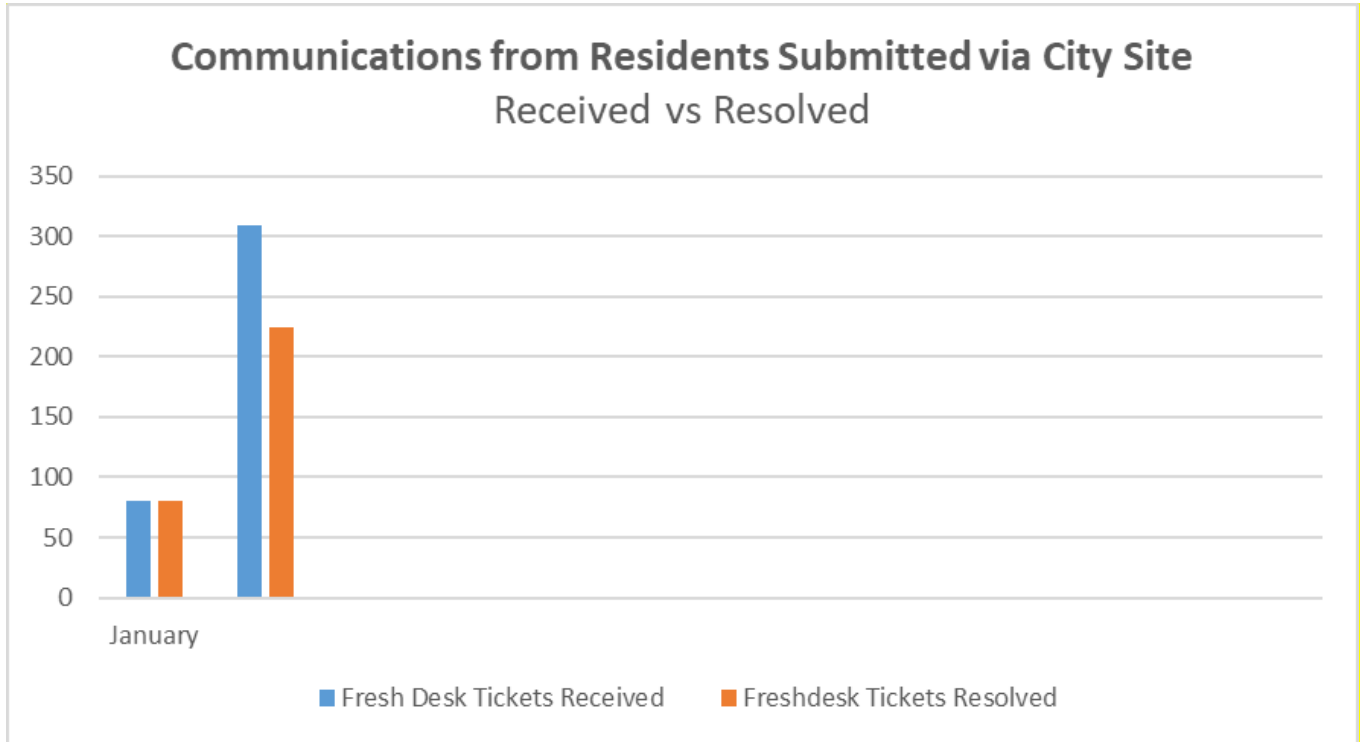
Historic Required Replanting



City Forestry, Parks, and Beach Activities



*Year to date



*Numbers only represent correspondences received via the City's website and do not include live calls, voicemails, drop-in visitors, and emails sent directly to employees from residents, nor return calls and emails from staff.



CITY OF CARMEL-BY-THE-SEA FOREST AND BEACH COMMISSION Staff Report

March 14, 2024
ORDERS OF BUSINESS

TO: Forest and Beach Commissioners

SUBMITTED BY: Robert M. Harary, P.E., Director of Public Works

SUBJECT: Public Works Director's Report for February 2024, including an Update on Repairs of the Beach Access Stairs

RECOMMENDATION:

Receive the Public Works Director's Report for February 2024.

BACKGROUND/SUMMARY:

The Public Works Director's Report for February 2024 will include:

- A. City Council actions related to Forestry, Parks, and Beach issues
- B. Forestry, Parks, and Beach-related Capital Improvement Projects
- C. Climate Committee meetings and Climate Action and Climate Adaptation Plan implementation
- D. Update on Volunteer Organizations
- E. Miscellaneous Forestry, Parks, and Beach-related Public Works items
- F. Update on repairs to Beach Access Stairs

Environmental Evaluation

This action does not constitute a project within the meaning of the California Environmental Quality Act under Public Resources Code Section 21065. It has no potential to cause either a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment and, therefore, does not require environmental review.

FISCAL IMPACT:

None.

ATTACHMENTS:

- Attachment #1 - Public Works Director's Report for February 2024
- Attachment #2 - Beach Access Stairs Inspection and Repairs



CITY OF CARMEL-BY-THE-SEA

Public Works Department

February 2024 Monthly Report

TO:	Honorable Mayor and City Council Members
SUBMITTED BY:	Robert M. Harary, P.E., Director of Public Works
SUBMITTED ON:	March 3, 2024
APPROVED BY:	Chip Rerig, City Administrator

City Council Meeting of February 6, 2024

- Meeting cancelled due to the storms. Items deferred to the March 4th and 5th meetings.

Forest and Beach Commission Meeting of February 8, 2024

- Announcements included:
 - The City Forester will summarize the impacts from the significant February 4th storms under the City Forester's Report.
 - Police Chief Tomasi will attend the meeting next month to review the criteria of when we need to close the beach, coordinating emergency services with the County, and FEMA funding.
 - At the February 15th Climate Committee meeting, the consultants preparing the Coastal Engineering Study, Phase 1 will be presenting the results of sea level rise impacts to the shoreline and vulnerable infrastructure. Same presentation will be made at the March meeting.
- Commission approved the proposed project by the Leadership Carmel Class of 2024 for enhancements to the overlook along the Scenic Pathway south of Eighth Avenue, subject to issuance of an encroachment permit by staff.
- City Forester presented the results of one of the technical studies that comprises the Urban Forest Master Plan (UFMP), regarding the Tree Canopy and Land Cover Assessment. This included a summary of the 9,875 City-owned trees that were inventoried and geo-located.
- City Forester gave a live demonstration of the TreeKeeper computer program in which all City trees are mapped. Each tree is linked to their attribute data, current health, and ties to any permits.
- The City Forester presented the Forester's Report for January 2024 which included the preliminary impacts of the February 4th storm. Impacts included 106 tree incidents, 43 trees fell, 8 trees in active failure removed, 50 large limbs, powerlines down in 4 locations, and 12 homes impacted.
- The Public Works Director presented the Public Works Department Report for January 2024.

Climate Committee Meeting of February 15, 2024

- Consultants with Integral, Corp., who are completing the Coastal Engineering Study, Phase 1, presented their technical findings of Task 3, Shoreline and Beach Erosion Exposure Modeling, which included an overview of sea level rise impacts to the shoreline over the next 75+ years, and Task 4, Coastal Hazard and Sea Level Rise Vulnerabilities. Presentation is available on the City website under <https://ci.carmel.ca.us/public-works>.
- Staff presented updated project tracking spreadsheets for Climate Adaptation Plan and Climate Action Plan projects.

Traffic Safety Committee Meeting of February 28, 2024

- Based on recent pruning to improve sight visibility at Santa Rita Street at Fourth Avenue since the last TSC meeting, denied a request for a 4-way stop controlled intersection.
- As a follow up to the last meeting's review of trucks using Junipero Street to bypass the designation San Carlos Street truck route, between Eighth and Thirteenth Avenue, the Police noted that 0 to only 6

trucks per day were counted over the course of nearly a week, and most of those trucks were local delivery trucks. Public Works noted that there is adequate signage for trucks to use the designated truck route although a couple of signs need to be replaced. While no further action required at this time, the TSC will review this item following paving along San Carlos, scheduled for April, to ensure no change in truck routing behaviors once San Carlos is a shared truck/bus/bicycle route.

- Continued a request for a "Children at Play" sign(s) on Monte Verde Street, between Eighth and Ninth Avenues, pending more information from the Golden Bough Theater regarding anticipated children attending events following its renovation, and the possibility for the Theater to provide a traffic guard.
- Denied a request for a 4-way Stop controlled intersection at Camino Real and Ninth Avenue.
- Denied a request for additional Stop signs along San Antonio Avenue, between Eighth and Thirteenth Avenues, noting that San Antonio is an emergency access route and that the intersecting streets are T-intersections.
- Approved a request for No Parking post(s) on the east side of San Antonio Avenue just north of Eleventh Avenue, due to parked vehicles obstructing the travel lane and reducing visibility.
- Approved a request for No Parking post(s) on Dolores Street 2 southeast of Vista Avenue, across from the Stevenson School driveway.
- Approved a request for a convex mirror to be mounted on a power pole at the southwest corner of Santa Fe Street and Mountain View Avenue.
- Acknowledged Public Works' request to allow for gaps in the split rail fence along the Junipero Street median, between Ocean and Seventh Avenues, rather than continuously repairing fences damaged intentionally by jaywalkers.

Administration

- Prepared staff report for the March 5th Council meeting regarding the first review of the Capital Improvement Program for Fiscal Year 2024/25. The report identified 15 capital plus 14 operating budget-funded project completed in FY 2023/24, collectively valued at \$3.3M, four projects recommended to be canceled or modified, 14 active projects to be carried over into FY 2024/25 with a total value of \$8.1M, 6 carry over, "shovel ready" projects that require supplement funding of approximately \$1.7M for construction, 6 new equipment and IT purchases valued at \$0.5M that could be funded by the Vehicle and Equipment Fund, and 12 new capital projects, valued at \$2.9M from the Capital Fund. The report makes clear that the list of needed projects may exceed funding availability and contribute to the current one-year backlog in completing existing projects.
- Updated the preliminary 5-Year Capital Improvement Plan.
- On February 22nd, a meeting was held with the California Coastal Commission (CCC) regarding repairs that are needed along the shoreline that are urgent and longer-term projects, as well as repairs needed for beach access stairs, rock revetments, and seawalls. The CCC advised the City that certain repairs above the mean high tide line could be completed by City forces under a City-issued Emergency Coastal Development Permit.
- Subsequent to the meeting with the CCC, Public Works managers inspected all concrete and wooden beach access stairs and prepared a "Game Plan" to repair the stairs as noted in the Summary Report in **Attachment 2**.
- On February 21st, the Public Works Director participated in a City Directors on Point event at the Women's Club that was sponsored by the Carmel Residents Association.
- On February 27th and 29th, the City Forester, Public Works Superintendent, Environmental Programs Manager and Project Manager managers participated in public Development Workshops to present information on tree permits, encroachment permits, storm water quality measures, and drainage requirements.
- Coordinated with Leadership Carmel Class of 2024 to guide submittals required for staff to process the encroachment permit associated with the Scenic Pathway Overlook Legacy Project approved by the Forest and Beach Commission.
- For the Maintenance Worker vacancy, 10 candidates were interviewed by an external panel and the top four finalists are scheduled for a final departmental interview in early March.
- PW managers met with colleagues in Community Planning & Building Department to continue to review and develop new process improvement strategies.

- Updated a list of 50 active projects and key task assignments for Public Works for the months of February through June 2024.

Carmel Cares and Other Volunteer Groups

- For the Ocean Avenue Median Islands Landscaping Project, Carmel Cares prepared landscaping plans, cost estimates, and PowerPoint slides to present the landscaping project to the Forest and Beach Commission for final approval at the March 14th meeting.
- Carmel High School Interact Group students worked with Carmel Cares volunteers to do extensive weeding and clean up at the Forest Theater native plant garden.
- “Downtown Detail” volunteers cleaned and improved the downtown area.
- “Median Minds” volunteers continued to improve medians across the Village.
- The Friends of Mission Trail Nature Preserve coordinated with Environmental Programs staff regarding new, donor-funded MTNP entry signs. Sign designs will be submitted to the Forest and Beach Commission and Planning Department for approval in April.

Environmental Programs

- For the Coastal Engineering Study, Phase 1, received and accepted the consultants’ technical report covering Tasks 3, Shoreline and Beach Erosion Exposure Modeling, and Task 4, Coastal Hazard and Sea Level Rise Vulnerabilities.
- Prepared staff reports for the February 15th Climate Committee meeting associated with the Coastal Engineering Study Tasks 3 and 4, and regarding project tracking spreadsheets for projects identified in the Climate Action and Climate Adaptation Plans.
- For the Coastal Engineering Study, Phase 2, Amendment No. 1 to the PSA with EMC Planning/Integral/Haro Kasunich was finalized for a fee of \$450,000. A staff report and resolution were prepared for Council to approve the LCP Grant-funded Amendment, and this item was postponed from the February 6th to March 4th Council meetings.
- CalRecycle representatives visited Carmel and performed a random, “lid flip” audit of trash, recycling, and organics containers in the Village. Happy to report that Carmel is “ahead of the curve” in regards to proper sorting of trash, recyclables, and organics in the waste containers.
- Participated in a tour of organizations awarded Edible Food Recovery Program Grants who are redirecting unconsumed, edible food from the landfill, where it breaks down into Greenhouse Gas, to benefit people in need.
- Confirmed 37 organizations and vendors to participate in the second annual Earth Day, to be held in conjunction with Arbor Day and Community Day, on April 20, 2024. Prepared staff report for the March 14th Forest and Beach Commission regarding this event.
- Friday Letter public announcements included:
 - E-waste disposal information
 - Link to a new television commercial regarding proper Pet Waste Disposal
 - Packaging used batteries in bags for recycling pickup outside of the waste stream
 - Rain barrels information
 - Save the date May 4th for “Snapshot Day” for volunteers to collect water quality samples

Facility Maintenance

- For the Sunset Center Carpenter Hall Heater Replacement Project (CIP), a Purchase Order was issued, a mechanical building permit is being processed, and parts were ordered.
- As part of the ADA Upgrade Project Year 6 (CIP), ADA-compliant railings for the Harrison Memorial Library were fabricated and galvanized by the vendor. Installation scheduled in March.
- Received additional quotes from electrical contractors to rebuild the electrical panel next to the Ocean/Juniper Christmas tree for safety reasons.
- Although the annual fire system inspections were completed last fall, the last of the identified, remedial repairs to sprinkler systems were completed in February.
- Following a storm, a drain was clogged in a flat portion of the Sunset Center roof, causing water to leak into the electrical room below. Thanks to Monterey Fire who helped us access the high roof using their ladder truck so we could clear the drains.

- At the request of the Library, began to evaluate the capability of the Park Branch Library emergency generator to be able to backup additional electrical circuits, and possibly heating, to accommodate storm shelter facilities during power outages.
- In the Sunset Center north parking lot, a rusted light pole failed, and a replacement pole was ordered.
- At the Del Mar restroom, replaced rusted rollup door components housing the beach ATV vehicle.
- At the Norton Court parking garage, repaired a parking exit gate, and assessed options to replace the failing security access system that is reaching the end of its useful life.
- Troubleshooting and repairs were completed to prevent short-circuiting of Police parking lot lighting.
- Attended the National Fire Protection Association Fire Pump class.

Project Management for the Capital Improvement Program

4 Leaf Projects:

- Similar to the Police Building Project public meeting on January 25th, the Council Ad Hoc Committee held a second public meeting on February 1st to seek additional community input on the building condition assessment, Police space programming needs, and preliminary concepts for potentially relocating the Police Station to a new site or renovating the building in the current location.
- Amendment No. 1 to the Professional Services Agreement with 4 Leaf consultants was outlined. Three of 4 Leaf's four previously-assigned projects will officially end, and a Notice to Proceed will be issued to authorize \$10,180 for additional services associated with the Police Building Project using available supplemental services funds.

Ausonio, Inc. Projects:

- Elevator Service Company decommissioned the Park Branch Library Dumbwaiter in record time. The contractor also permanently sealed off the dumbwaiter shaft. Notification was also made to the State Department of Industrial Relations/Elevator Unit to release the City of its maintenance obligations for this unused dumbwaiter. A letter was also drafted to terminate our costly maintenance contract with Otis Elevator.
- For the Sunset Center North Wing and Harrison Memorial Library Exterior/Interior Painting Project, the construction kickoff meeting was held with the contractor, Color New Co., and technical submittals and encroachment permits were processed. An \$85,000 deductive Change Order was executed reflecting significantly reduced interior painting in the library. Painting to begin at Sunset Center in March.
- Staff is reviewing 90% complete contract documents for re-bidding the City Hall Roof Replacement Project. This Project will be "shovel ready" for bidding in July should additional CIP funding be allocated for construction.
- For the Sunset Center Retaining Walls Repair Project and San Antonio Walkway Repair Project, Second to Fourth Avenues, ZFA Structural Engineers performed site visits and are developing the 30% design drawings for both projects for City review in March.
- For the Sunset Center Portico Design Project, Ten Over Studio submitted three portico concept designs and renderings. The project team will discuss these options in early March and prepare a preliminary cost figure for potential FY 2024/25 CIP funding.

Wallace Group Projects:

- For the FY 2022/23 Concrete Streets Repair Project, additional meetings were held with BKF Engineers who are incorporating the final 95% review comments, generated by Wallace Group and staff, into their final construction plans, specifications, and cost estimates. Shovel-ready contract documents will be ready well in advance of forecasted construction funding.
- For the FY 2023/24 City-wide Paving Project, Wallace Group submitted the 30% design package and an associated cost estimate of \$1.7M. 30% plans are under review while the consultant begins to advance the project design to 60% complete.
- For the Shoreline Infrastructure Repair Project, reviewed a second draft Request for Proposal to hire an engineering firm with shoreline expertise. Continuing to resolve issues including environmental services scope, options for beach stair repairs, and availability of prior reports.

Additional Capital Improvement Projects:

- For the \$1.14M, FY 2021/22 City-wide Paving Project, Monterey Peninsula Engineering raised manhole covers to the grade of the new asphalt overlays, constructed asphalt berms, and installed thermoplastic legends and markings along Junipero Street, Third to Fourth Avenues, along Santa Fe Street, Fourth to Fifth Avenue, and at the Junipero/Camino del Monte Intersection. Sidewalk repairs were delayed due to weather and delivery of permeable pavers, but are scheduled for March.
- For the Mission Trail Nature Preserve (MTNP) 3 Drainage Projects, which includes drainage piping near Rio Road, an 85-foot boardwalk over a bog, and reconstruction of a large swale, the contract was advertised for construction bids. Fourteen contractors attended the mandatory pre-bid meeting and site tour. Bid opening is on March 19th. Also, met with Dudek to significantly down scope their environmental monitoring proposals for during and post construction as required by the regulatory agency permits. A revised proposal is forthcoming.
- For the 4 City-wide Drainage Improvement Projects, Denise Duffy & Associates and staff performed site assessments for discharging into the MTNP and Pescadero creeks, and allowing the project to proceed with two Notices of Exemption under CEQA. Contact was also made with a property owner at the south end of Santa Fe Street, south of Eighth Avenue, who supports the City's acquisition of an easement through a landscaped area, to allow for drainage line to discharge into the MTNP creek.
- For the PG&E Rule 20A underground utility district project, the Council Ad Hoc committee and staff toured the two proposed underground district locations: Del Mar parking lot west of San Antonio Avenue, and along the MTNP Willow Trail for power lines servicing homes located along Ridgewood Road.
- Met with Carmel Area Wastewater District staff and their design and environmental consultants, who are working on their upcoming Scenic Road Sewer pipe bursting project, to coordinate environmental documentation processing and minimize construction impacts to the City.

Street Maintenance

- During and following several storm events in February, cleared out storm drains, picked up fallen branches and tree debris piles, and stockpiled additional sand for sand bags.
- Beach access stairs between Eighth Avenue south to Martin Way continue to be temporarily closed. Signs and barricades were replaced as needed.
- Filled a number of street potholes that resulted from rain events, and performed supplemental street sweeping.
- Continued making priority sidewalk repairs based on the recent Annual Sidewalk Survey Update. Began grinding of sidewalk uplifts.
- Installed several more ribbon-style trash and recycling containers. A total of 20 of the 30 recently-purchase containers have now been installed.
- Ordered a new Ford Mustang Mach 3 EV vehicle for Police administration use.
- The two old forestry trucks were sold at public auction for \$6,400.

Forestry, Parks, and Beach (Forester's Report)

- See separate Forester's Report

On Thursday morning, 2/29/2024, Rob Culver, Mary Bilse, Cleve Waters, Javier Hernandez, Leo Hernandez, and Bob Harary visited Carmel Beach to determine the extent of work that could be accomplished in the “immediate” future on the damaged beach stairs. This work will be performed under two separate Emergency Coastal Development Permits (ECDPs) issued by the City, to itself, as recently agreed to by the Coastal Commission Staff.

All of the stairs assessed and explained in this summary fall into one of four categories:

- 1) stairs that will be repaired “immediately” in the short term under ECDP #1,
- 2) stairs that will be opened with more intensive repairs performed by City staff under ECDP #2,
- 3) stairs that require structural engineering and a construction contractor to repair; and
- 4) stairs that need to be reassessed when a significant amount of sand returns to the beach due to a current drop off from the bottom stairs.

General Observations From Site Visit:

1. A remarkable percentage of the beach currently has exposed rock which is normally covered by many feet of sand.
2. People and their pets are ignoring the beach stairs' closed signs and are using the stairs anyway.
3. Overall, the concrete and stone stairs are structurally sound, but some need minor repairs as noted below.
4. Essentially all of the wooden access stairs sustained damage in varying degrees, especially to the lowest 10-20% of the stairways. The bottom of many of the wood stairs are currently well above the level of beach sand or rock, and cannot be opened, at this time, even with repairs, as noted below.
5. At the top of the stairs, existing signs say "Beach Closed" but other signs say "Beach Stairs Closed." The former will be replaced to consistently say "Beach Stairs Closed."
6. The equipment access ramp south of Eighth Avenue currently has a 22-foot drop off. It will likely take much longer than usual for enough sand to return to reestablish this long ramp.

The following, is the current status, recommendation, and timing of repairs for each access point to Carmel Beach, moving from the north to south:

1. **Fourth Avenue – Wooden Stairs** (at end of boardwalk) are currently **Open**.

The bottom portion of these wooden stairs are buried in sand and could not be evaluated today. However, it is known that minor to moderate repairs will be needed when the bottom portion is exposed. It is believed that staff can make these repairs supplemented by a vendor for metal railings.

Recommendations: Remain open, reassess when exposed, and make repairs as needed

Timing: To be determined based on sand movement.

2. **Del Mar Parking Lot** is currently **Open**.

Recommendations: Remain open. Will need to rent a bobcat loader and redistribute sand as per ongoing program to cover exposed rocks.

Timing: Estimate early summer

3. Eighth Avenue - Concrete Stairs are currently **Closed**.

Concrete steps are structurally sound but require a few concrete repairs that can be done by City staff. There is a 6-foot drop-off from the bottom step out to the sand, but it is accessible.

Recommendations: Make repairs under Emergency Coastal Development Permit (ECDP).

Post new signs at top and bottom of stairs that say "Beach Stairs Open - Use Caution" and then reopen.

Timing: Receive ECDP approval by March 8th, target repairs complete approximately 1 month later (barring unforeseen circumstances)

4. Ninth Avenue - Wooden Stairs are currently **Closed**.

Stairs appear to be in acceptable condition; however, there are exposed boulders below and a 7-foot drop off from the bottom step to the boulders/sand level below.

Recommendations: Remain closed until the sand level returns to the bottom step. Reassess these stairs in one year.

Timing: No action to be taken in the next 12 months

5. Tenth Avenue "North" - Wooden Stairs are currently **Closed**.

There is a 5-foot drop off from the bottom step to the sand below. There is some structural damage to support beams, steel brackets, stringers, wobbly and a post. Other damage includes a missing tread, loose handrails, and wood railings.

Recommendations: Remain closed. Retain a structural engineer and construction contract for repairs.

Timing: Begin search for engineer and contractor following completion of more immediate repairs.

6. Tenth Avenue "South" - Concrete Stairs are currently **Closed**.

Concrete steps are structurally sound but require a few concrete repairs that can be done by City staff. Bottom of the stairs land onto a large boulder that is slippery.

Recommendations: Make repairs under Emergency Coastal Development Permit (ECDP). Post new signs at top and bottom of stairs that say "Beach Stairs Open - Use Caution" and then reopen.

Timing: Receive ECDP approval by March 8th, target repairs complete approximately 1 month later (barring unforeseen circumstances)

7. Eleventh Avenue - Concrete Stairs are currently **Closed**.

Similar to Tenth Avenue South, these concrete steps are structurally sound but require a few repairs to concrete and side stonework that can be done by staff.

Recommendations: Make repairs under Emergency Coastal Development Permit (ECDP). Post new signs at top and bottom of stairs that say "Beach Stairs Open - Use Caution" and then reopen.

Timing: Receive ECDP approval by March 8th, target repairs complete approximately 1 month later (barring unforeseen circumstances)

8. Twelfth Avenue - Wooden Stairs are currently **Closed**.

Moderate structural damage to the lower portion of the stairs including support posts. Other damage includes missing treads and handrails, and loose railings, etc.

Recommendations: Remain closed. Retain a structural engineer and construction contract for repairs.

Timing: Begin search for engineer and contractor following completion of more immediate repairs.

9. Thirteenth Avenue - Concrete Stairs are currently **Closed**.

No repairs needed at this time. There is a one foot drop off to a boulder at the base of the stairs, but still accessible to beach sand.

Recommendations: Post new signs at top and bottom of stairs that say "Beach Stairs Open - Use Caution" and then reopen.

Timing: Stairs re-opened approximately 2 weeks (barring unforeseen circumstances)

10. Santa Lucia - Concrete Stairs are currently **Closed**.

Stairs are adequate but a handrail at the bottom needs to be repaired. There is a large pile of driftwood logs at the base of the stairs that should be removed/distributed.

Recommendations: Make railing repairs under Emergency Coastal Development Permit (ECDP). Remove the pile of driftwood logs. Post new signs at top and bottom of stairs that say "Beach Stairs Open - Use Caution" and then reopen.

Timing: Receive ECDP approval by March 8th, target repairs complete approximately 1 month later (barring unforeseen circumstances)

11. Martin Way - Wooden Stairs are currently **Closed**.

Bottom of stairs still land on the sand. However, there is damage to treads, sidings and railing. The amount of damage is extensive, but does not require structural engineer to correct. City crews can make these repairs. This is the largest work effort under the Emergency Permit and will require a full crew for a couple of days.

Recommendations: Make repairs under an ECDP AFTER more immediate stairs are completed and new caution signs are posted on Eighth, Tenth South, Eleventh, Thirteenth, and Santa Lucia.

Timing: Receive ECDP approval by April 8th, target repairs complete approximately 1 month later (barring unforeseen circumstances)

Summary:

- Access currently open, that will stay open = 3
 - Fourth Avenue Stairs
 - Del Mar Parking Access Sand Ramp
 - Thirteenth Avenue Stairs (following new signage)
- Access to be repaired in-house by April 8th under ECDP #1 = 4
 - Eighth Avenue Stairs
 - Tenth Avenue "South Stairs"
 - Eleventh Avenue Stairs
 - Santa Lucia Stairs
- Access to be repaired in-house by May 8th under ECDP #2 = 1
 - Martin Way Stairs
- Access deferred for structural engineering and contractor = 2
 - Tenth Avenue "North" Stairs
 - Twelfth Avenue Stairs
- Access deferred until the sand comes back = 2
 - Ninth Avenue Stairs
 - Eighth Avenue Equipment Access Sand Ramp