

Sea Level Rise (SLR) Overview in Zone 4

December 7, 2017

FLOOD CONTROL ZONE 4

Photo Credit: Jeff Wong

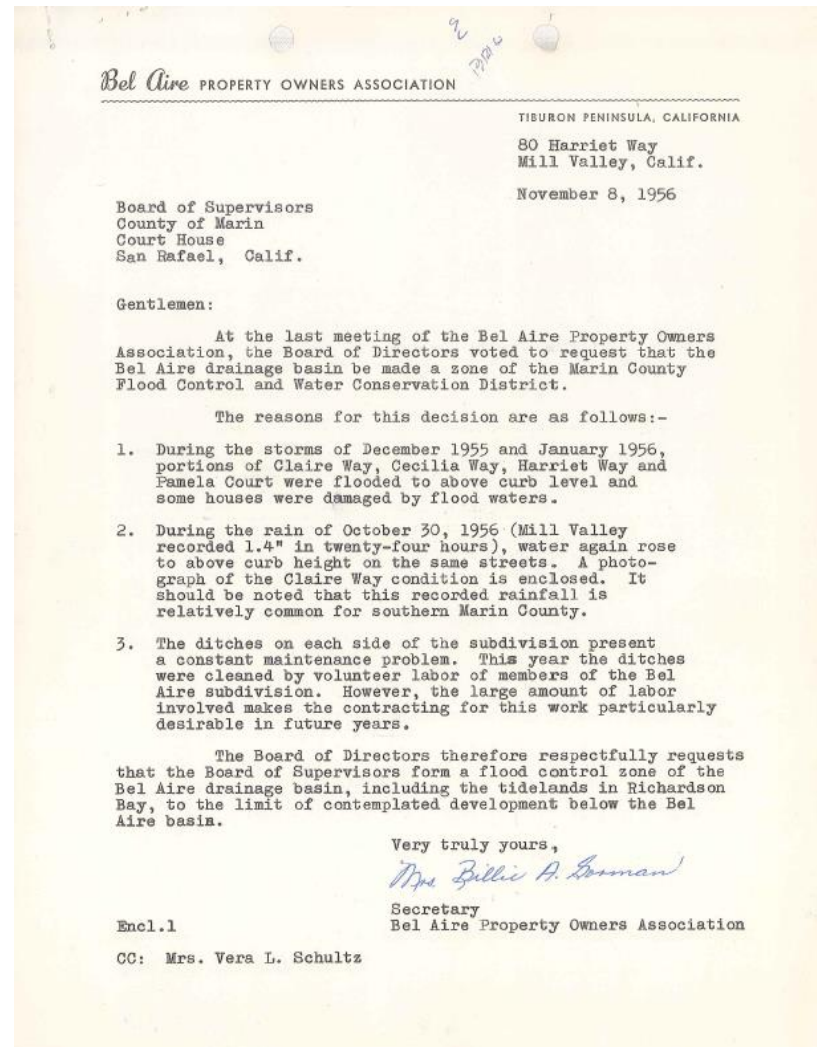


Flood Zone 4 Background

1953: Marin County Flood Control & Water Conservation District Established under Chapter 666 of the Statutes of 1953

1956: Bel Aire Property Owners Association Requests Creation of Zone 4.

1957: Zone 4 Established by Marin County Flood Control & Water Conservation District BOS



Bel Aire PROPERTY OWNERS ASSOCIATION

TIBURON PENINSULA, CALIFORNIA
80 Harriet Way
Mill Valley, Calif.

November 8, 1956

Board of Supervisors
County of Marin
Court House
San Rafael, Calif.

Gentlemen:

At the last meeting of the Bel Aire Property Owners Association, the Board of Directors voted to request that the Bel Aire drainage basin be made a zone of the Marin County Flood Control and Water Conservation District.

The reasons for this decision are as follows:-

1. During the storms of December 1955 and January 1956, portions of Claire Way, Cecilia Way, Harriet Way and Pamela Court were flooded to above curb level and some houses were damaged by flood waters.
2. During the rain of October 30, 1956 (Mill Valley recorded 1.4" in twenty-four hours), water again rose to above curb height on the same streets. A photograph of the Claire Way condition is enclosed. It should be noted that this recorded rainfall is relatively common for southern Marin County.
3. The ditches on each side of the subdivision present a constant maintenance problem. This year the ditches were cleaned by volunteer labor of members of the Bel Aire subdivision. However, the large amount of labor involved makes the contracting for this work particularly desirable in future years.

The Board of Directors therefore respectfully requests that the Board of Supervisors form a flood control zone of the Bel Aire drainage basin, including the tidelands in Richardson Bay, to the limit of contemplated development below the Bel Aire basin.

Very truly yours,

Mrs. Billie A. Gosman

Secretary
Bel Aire Property Owners Association

Encl.1

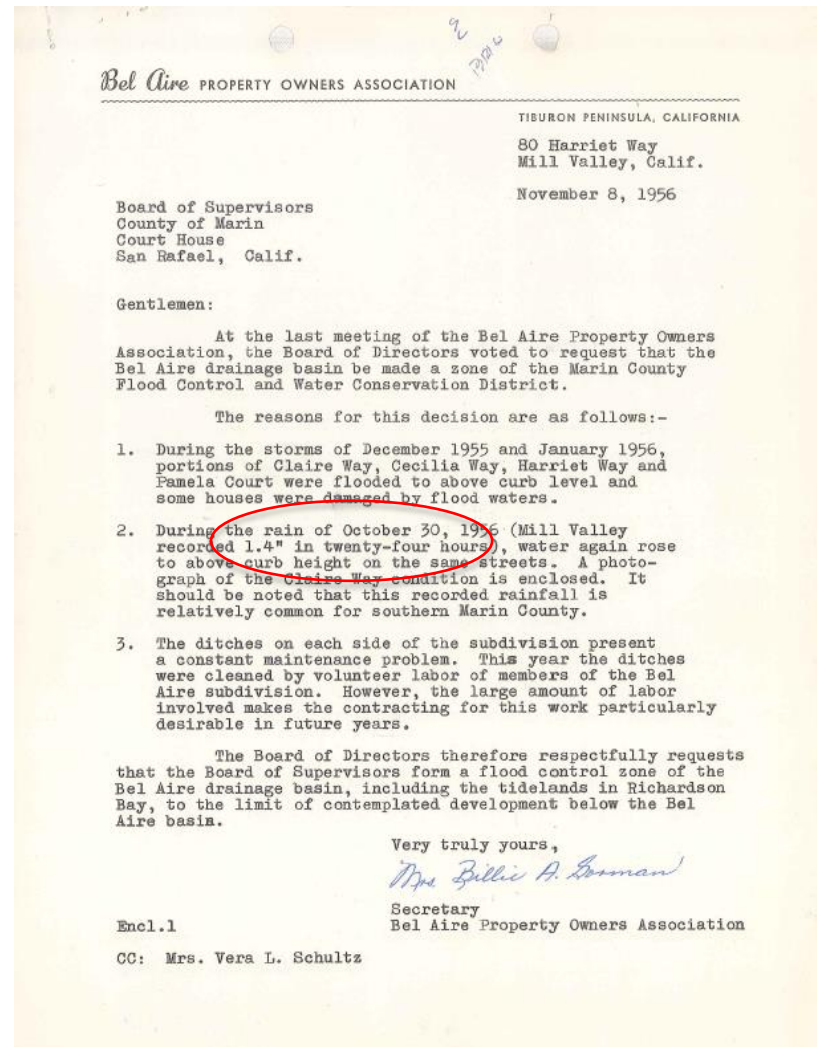
CC: Mrs. Vera L. Schultz

Flood Zone 4 Background

1953: Marin County Flood Control & Water Conservation District Established under Chapter 666 of the Statutes of 1953

1956: Bel Aire Property Owners Association Requests Creation of Zone 4.

1957: Zone 4 Established by Marin County Flood Control & Water Conservation District BOS



Flood Zone 4 Major Construction History

1976: East Ditch Pumping Station and Improvements (Cove Pump Station)

1976: Karen Way Drainage Project

1977: Culvert Replacement Between Cecilia Way and Cove Shopping Center

1993: West Ditch Pumping Station (Pamela Court PS)

2005: Strawberry Circle Pump Station

2005: Saltworks Canal Floodwall and Ditch

2016: Cove PS Culvert Replacement

2017: East Creek Cattail root mass removal



CosMoS SLR Mapping

DETAILS & DISCLAIMERS

[Our Coast Our Future](http://ourcoastourfuture.org)

<http://ourcoastourfuture.org>

Collaborative Studies

The results are being directly used in climate change vulnerability studies for Marin County and San Mateo County. Projections from CoSMoS 2.1 are being used in follow-on collaborative USGS studies investigating socio-economic climate impacts and vulnerability throughout the Bay.

Collaborators

- Bay Area Ecosystems Climate Change Consortium
- Coravai
- NOAA Coastal Services Center
- Gulf of the Farallones National Marine Sanctuary
- National Park Service
- Point Blue Conservation Science
- San Francisco Bay National Estuarine Research Reserve (NERR)
- USGS Earth Resources Observation and Science (EROS) Data Center



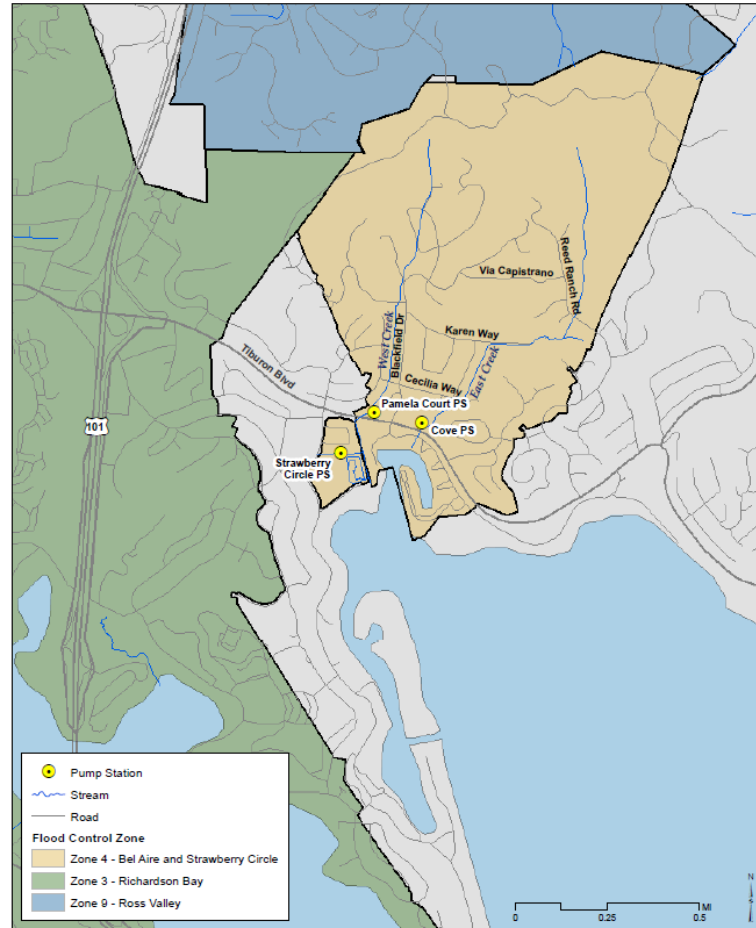
Disclaimer: This interactive mapping tool, including its data and other information ("tool and data") are provided for informational purposes. The tool and data are not for the purpose of providing advice or guidance on issues or activities related to its content including, but not limited to, navigation, investment, development or permitting. The tool and data are based on model simulations, which are subject to revision and do not take into account many variables that could have substantial effects on flood extent and depth. Real world results will differ from results of the tool and data. Commercial use of this tool and data are prohibited.

The tool and data are provided "as is" without any representations or warranties as to their accuracy, completeness, performance, merchantability, or fitness for a particular purpose. The entire risk associated with the results and performance of the tool and data is assumed by the user. OCOF, Point Blue and all their partners ("OCOF") shall not be responsible or liable to you for any loss or damage of any sort incurred in connection with your use of the tool and data.

The Marin County Flood Control & Water Conservation District (District) makes no representation or warranty, express or implied, with respect to data accuracy, completeness, timeliness, reliability, quality, or usefulness. Data are provided "as-is" and should not be relied upon for making critical decisions. The District assumes no liability for any damage to or loss of property, or personal injury or loss of life, which may arise out of use of data.



Map of Zone 4



Flood Control Zone 4 - Bel Aire and Strawberry Circle



BayWAVE Sea Level Rise Vulnerability Assessment Update

The vulnerability assessment is an informational document that catalogs impacts with six different sea level rise scenarios across the entire bay shoreline. The best available science was used to complete the report with a range of projections including those that we already face with high tides and storms. Certain areas of Marin already deal with flooding on a regular basis and this report demonstrates the impacts across jurisdictional boundaries and along our shared resources, utilities, and infrastructure. The full report can be accessed on this website:

<https://www.marincounty.org/main/baywave/vulnerability-assessment>.



TIBURON

Map 71. Tiburon Vulnerable Buildings

Vulnerable Assets

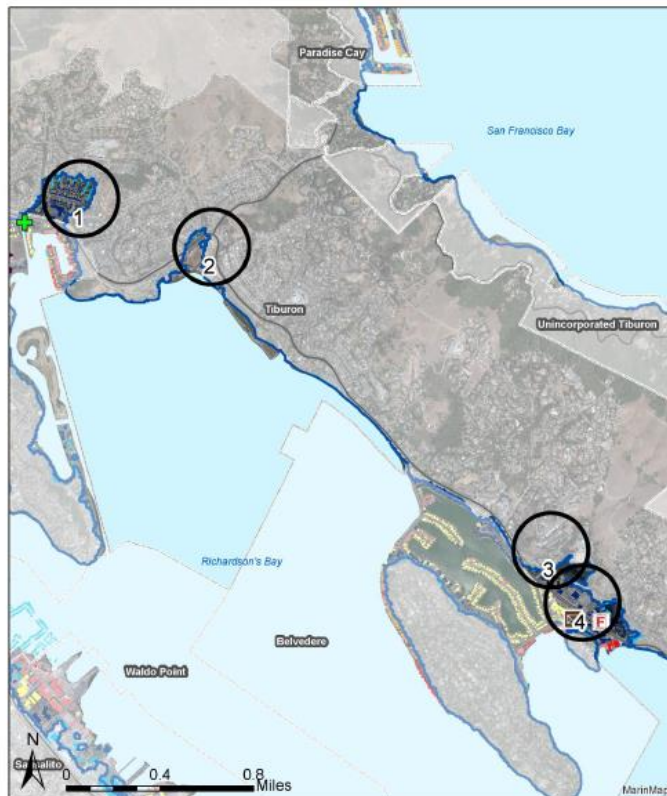
-  Post Office
-  City Hall
-  Emergency Shelter
-  Fire Station

Vulnerable Buildings

-  Scen. 1: 10" Sea Level Rise (SLR)
-  Scen. 2: 10" SLR+Storm Surge
-  Scen. 3: 20" Sea Level Rise
-  Scen. 4: 20"SLR+Storm Surge
-  Scen 5: 60" Sea Level Rise
-  Scen. 6: 60"SLR+Storm Surge

Location Indicators

-  Unincorporated
-  Municipality
-  Road
-  Bay
-  Inland Extent: Sea Level @ 60"+100-year Storm



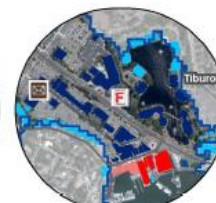
1: The Cove



2: Blackie's Pasture



3: Entry to Downtown



4: Downtown

Disclaimer: Vulnerability Assessment maps, tables, etc. can be used as a resource to help identify potential hazardous areas and vulnerable assets. Marin County, and data providers here in, make no warranties of the accuracy or completeness of maps and data. Maps are representational and subject to future revision. Local site conditions must be examined. Commercial use is prohibited.



Date: 1/15/2017



TIBURON

Map 72. Tiburon Vulnerable Transportation Assets

Vulnerable Assets

- Bike path
- Bay Trail
- Trail
- GGT Bus Stop
- Marina
- Ferry
- Public Boat Launch

Vulnerable Roads

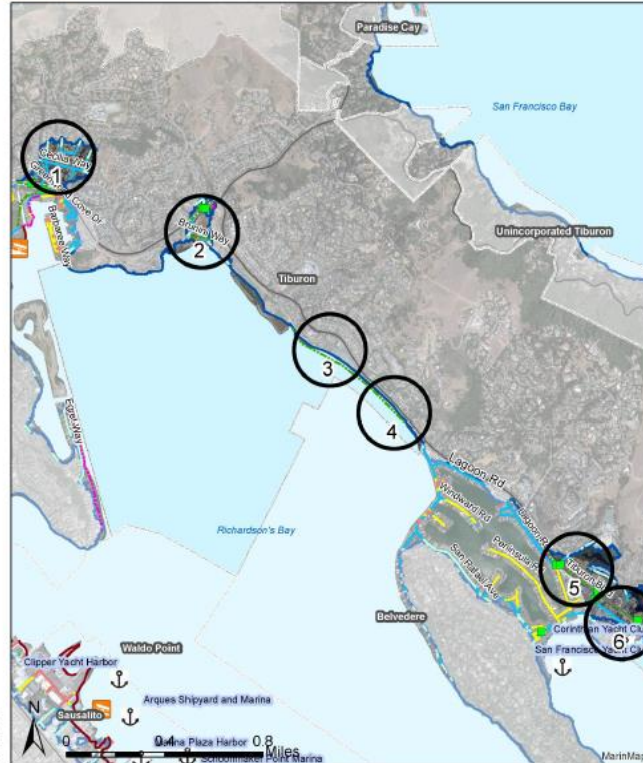
- @10" Sea Level Rise (SLR)
- @10"SLR+ 100-year Storm Surge
- @20" Sea Level Rise
- @20"SLR+ 100-year Storm Surge
- @60" Sea Level Rise
- @60"SLR+ 100-year Storm Surge

Location Indicators

- Unincorporated
- Municipality
- Road
- Bay
- Inland Extent: Sea Level @ 60"+100-year Storm



Date:
1/15/2017



1: Northern Marinship



2: Southern Marinship



3: Bridgeway



4: Golden Gate Ferry

Disclaimer: Vulnerability Assessment maps, tables, etc. can be used as a resource to help identify potential hazardous areas and vulnerable assets. Marin County, and data providers here in, make no warranties of the accuracy or completeness of maps and data. Maps are representational and subject to future revision. Local site conditions must be examined. Commercial use is prohibited.



1.6 Feet SLR; No Storm Scenario

OCOFOUR COAST OUR FUTURE
Interactive Map

map help
clear
navigate

1) Choose a topic.

Flooding shows the inundation due to SLR, waves, and storm surge.

Flooding	Waves
Current	Duration
Flood Potential	

[What do the Topics represent?](#)

Compare Flooding Scenarios

2) Choose an Amount of Sea Level Rise

0	0.8	1.6	2.5	3.3	4.1
4.9	5.7	6.6	16.4	[Use cm]	

[What Sea Level Rise scenario should I use?](#)

3) Choose an Event

Choose Storm Scenario Frequency

None	Annual	20 year	100 year
------	--------	---------	----------

Or Choose SF Bay King Tide Scenario

King Tide

100 m
500 ft

Enter an address or placename
16 -122.5083 37.9024

Pan Zoom
Draw Report
GIS File Report
Known Issues
King Tides
Get Data
Print Map

Strawberry Cove
Cove Shopping Center
Strawberry
Strawberry Point Elementary School - Mill Valley
Audubon Wildlife Sanctuary

OCOFOUR COAST OUR FUTURE
CoSMoS

2.5 Feet SLR; No Storm

The screenshot displays the OCOF Interactive Map interface. The main map area shows an aerial view of a coastal area with a blue overlay indicating the flooded region. The flooded area includes Strawberry Cove and extends inland along the coastline. Key locations labeled on the map include Strawberry Rec Strawberry Park, Strawberry Point Elementary School - Mill Valley, Strawberry Cove Shopping Center, and Audubon Wildlife Sanctuary. The address 16-122.5001 37.8981 is visible at the top of the map.

1) Choose a topic.
Flooding shows the inundation due to SLR, waves, and storm surge.

Flooding	Waves
Current	Duration
Flood Potential	

[What do the Topics represent?](#)

Compare Flooding Scenarios

2) Choose an Amount of Sea Level

0	0.8	1.6	2.5	3.3	4.1
4.9	5.7	6.6	16.4	[Use cm]	

[What Sea Level Rise scenario should I use?](#)

3) Choose an Event

Choose **Storm Scenario Frequency**

None	Annual	20 year	100 year
------	--------	---------	----------

Or Choose **SF Bay King Tide Scenario**


King Tide

100 m / 500 ft scale bar

OCOFR
OUR COAST OUR FUTURE
CoSMoS



3.3 Feet SLR; No Storm



Interactive Map

map help
clear
navigate

1) Choose a topic.

Flooding shows the inundation due to SLR, waves, and storm surge.

Flooding	Waves
Current	Duration
Flood Potential	

[What do the Topics represent?](#)

Compare Flooding Scenarios

2) Choose an Amount of Sea Level Rise

0	0.8	1.6	2.5	3.3	4.1
4.9	5.7	6.6	16.4	[Use cm]	

[What Sea Level Rise scenario should I use?](#)

3) Choose an Event

Choose Storm Scenario Frequency

None	Annual	20 year	100 year
------	--------	---------	----------

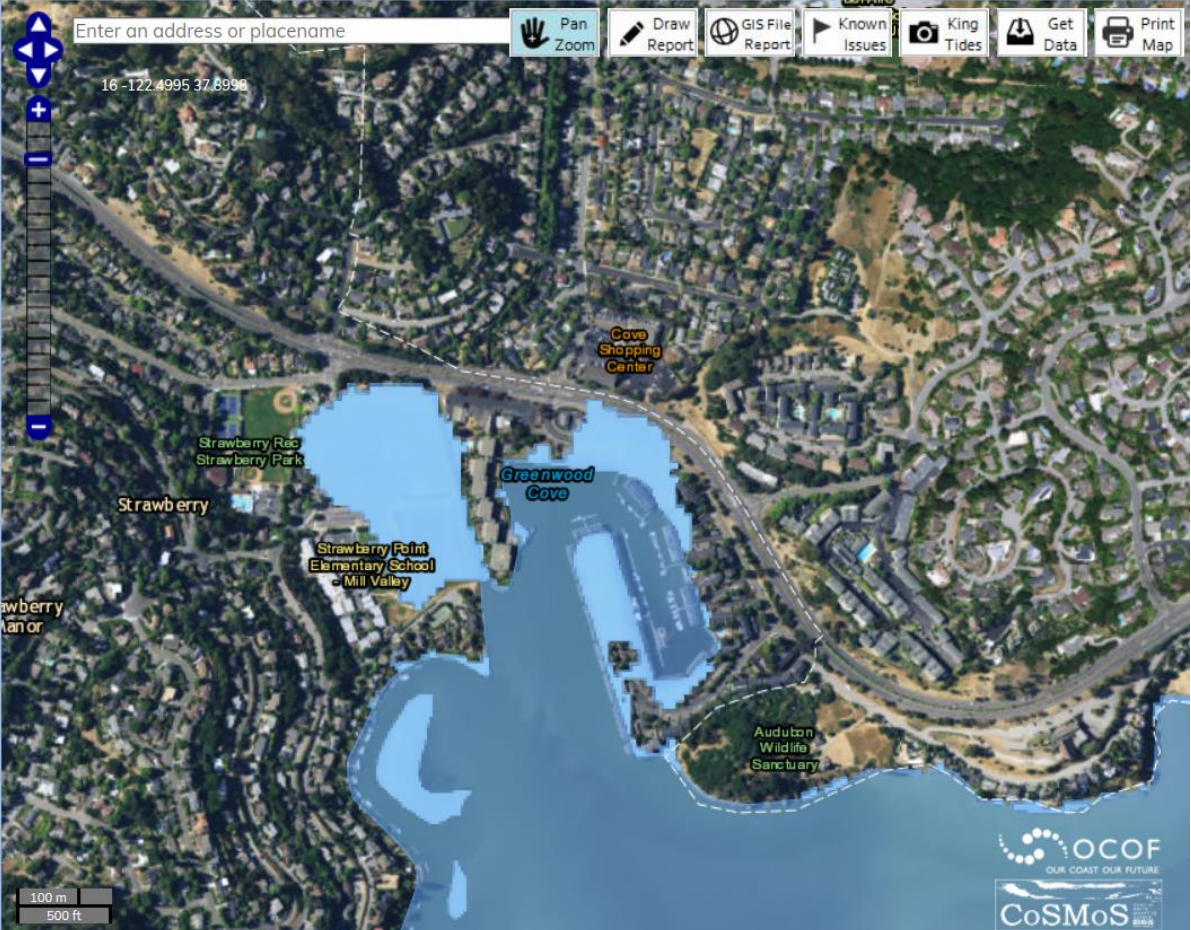
Or Choose SF Bay King Tide Scenario

King Tide



Enter an address or placename

16 -122.4995 37.8998

Pan Zoom
Draw Report
GIS File Report
Known Issues
King Tides
Get Data
Print Map



100 m
500 ft



3.3 Feet SLR; 20 Year Storm

OCOOF
OUR COAST OUR FUTURE
Interactive Map

map help
clear
navigate

1) Choose a topic.

Flooding shows the inundation due to SLR, waves, and storm surge.

Flooding	Waves
Current	Duration

Flood Potential

[What do the Topics represent?](#)

Compare Flooding Scenarios

2) Choose an Amount of Sea Level Rise

0	0.8	1.6	2.5	3.3	4.1
4.9	5.7	6.6	16.4	[Use cm]	

[What Sea Level Rise scenario should I use?](#)

3) Choose an Event

Choose Storm Scenario Frequency

None	Annual	20 year	100 year
------	--------	---------	----------

Or Choose SF Bay King Tide Scenario

King Tide

Detail View

16 -122.5097 37.9033

16 -122.5097 37.9033

100 m
500 ft

OCOOF
OUR COAST OUR FUTURE
CoSMoS

4.1 Feet SLR; No Storm

Interactive Map

map help
clear
navigate

1) Choose a topic.

Flooding shows the inundation due to SLR, waves, and storm surge.

Flooding	Waves
Current	Duration

Flood Potential

[What do the Topics represent?](#)

Compare Flooding Scenarios

2) Choose an Amount of Sea Level

0	0.8	1.6	2.5	3.3	4.1
4.9	5.7	6.6	16.4	[Use cm]	

[What Sea Level Rise scenario should I use?](#)

3) Choose an Event

Choose Storm Scenario Frequency

None	Annual	20 year	100 year
------	--------	---------	----------

Or Choose SF Bay King Tide Scenario

King Tide

Detail View

Enter an address or placename

16 -122.4927 37.9017

100 m
500 ft

4.1 Feet SLR; 20 Year Storm

OCOF
OUR COAST OUR FUTURE
Interactive Map

map help
clear
navigate

1) Choose a topic.

Flooding shows the inundation due to SLR, waves, and storm surge.

Flooding	Waves
Current	Duration

Flood Potential

[What do the Topics represent?](#)

Compare Flooding Scenarios

2) Choose an Amount of Sea Level Rise

0	0.8	1.6	2.5	3.3	4.1
4.9	5.7	6.6	16.4	[Use cm]	

[What Sea Level Rise scenario should I use?](#)

3) Choose an Event

Choose Storm Scenario Frequency

None	Annual	20 year	100 year
------	--------	---------	----------

Or Choose SF Bay King Tide Scenario

King Tide

Detail View

Enter an address or placename

16 -122.604 37.902

Pan Zoom
Draw Report
GIS File Report
Known Issues
King Tides
Get Data
Print Map

Strawberry Cove
Cove Shopping Center
Greenwood Cove
Strawberry Point Elementary School - Mill Valley
Strawberry Park
Audubon Wildlife Sanctuary

100 m
500 ft

OCOF
OUR COAST OUR FUTURE
CoSMoS



4.9 Feet SLR; No Storm

The screenshot displays an interactive map interface for simulating flooding. The map shows a residential area with a large body of water, Greenwood Cove. The flooding simulation is overlaid on the map, showing the extent of inundation. Key locations labeled on the map include Strawberry Point Elementary School - Mill Valley, Strawberry Rec Strawberry Park, Strawberry Shopping Center, and Audubon Wildlife Sanctuary. The interface includes a search bar at the top with the address 16-122.5031 37.9024. The left sidebar contains navigation and configuration options. The top right has utility icons for Pan Zoom, Draw Report, GIS File Report, Known Issues, King Tides, Get Data, and Print Map. The bottom right has a scale bar for 100 meters and 500 feet, and the OCOF and CoSMoS logos.

OCO
OUR COAST OUR FUTURE

Interactive Map

map help
clear
navigate

1) Choose a topic.

Flooding shows the inundation due to SLR, waves, and storm surge.

Flooding	Waves
Current	Duration
Flood Potential	

[What do the Topics represent?](#)

Compare Flooding Scenarios

2) Choose an Amount of Sea Level Rise

0	0.8	1.6	2.5	3.3	4.1
4.9	5.7	6.6	16.4	[Use cm]	

[What Sea Level Rise scenario should I use?](#)

3) Choose an Event

Choose

Storm Scenario Frequency

None	Annual	20 year	100 year
------	--------	---------	----------

Or Choose

SF Bay King Tide Scenario

King Tide

[Detail View](#)

Enter an address or placename

16-122.5031 37.9024

Pan Zoom
Draw Report
GIS File Report
Known Issues
King Tides
Get Data
Print Map

100 m
500 ft

OCO
OUR COAST OUR FUTURE

CoSMoS

4.9 Feet SLR; 20 Year Storm

Enter an address or placename

16-122.5021.37.5012

OCOF
OUR COAST OUR FUTURE
Interactive Map

map help
clear
navigate

1) Choose a topic.

Flooding shows the inundation due to SLR, waves, and storm surge.

Flooding	Waves
Current	Duration

Flood Potential

[What do the Topics represent?](#)

Compare Flooding Scenarios

2) Choose an Amount of Sea Level

0	0.8	1.6	2.5	3.3	4.1
4.9	5.7	6.6	16.4	[Use cm]	

[What Sea Level Rise scenario should I use?](#)

3) Choose an Event

Choose Storm Scenario Frequency

None	Annual	20 year	100 year
------	--------	---------	----------

Or Choose SF Bay King Tide Scenario

King Tide

Detail View

100 m
500 ft

OCOF
OUR COAST OUR FUTURE
CoSMoS

Map labels: Strawberry Point Elementary School - Mill Valley, Strawberry, Strawberry Park, Strawberry Manor, Greenwood Cove, Cove Shopping Center, Audubon Wildlife Sanctuary.

Map navigation: Pan Zoom, Draw Report, GIS File Report, Known Issues, King Tides, Get Data, Print Map.



Possible SLR Adaptation Tools

3 General Categories

"Hard" Engineering Adaptation

- Floodwalls/seawalls
- Levees/dikes
- Pump stations
- Rock rip rap
- Tidal gates

"Soft" Engineering Adaptation

- Wetlands enhancement/conversion
- Wetlands creation
- Levees with wetlands transition zones
- Shoreline erosion protection

Infrastructure and Lifestyle Adaptation

- Structures elevated above future predicted tides
- Floodable/Floatable development
- Infrastructure relocated
- Planned retreat



SLR Adaptation Goals

- Funding
- Regulatory Approval
(Agencies that may claim jurisdiction)
 - US Army Corps of Engineers
 - SF Regional Water Quality Control Board
 - CA Department of Fish & Wildlife
 - SF Bay Conservation and Development Commission
- Stakeholder Cooperation
 - Regulatory Agencies
 - State and Local Agencies
 - Private Landowners
- Environmental Compliance
 - California Environmental Quality Act (CEQA)
 - National Environmental Policy Act (NEPA)
- Political “Buy In”
- Right of Way

2015 Draft Richardson Bay Shoreline Study

Evaluation of Seal Level Rise Impacts and Adaption Alternatives

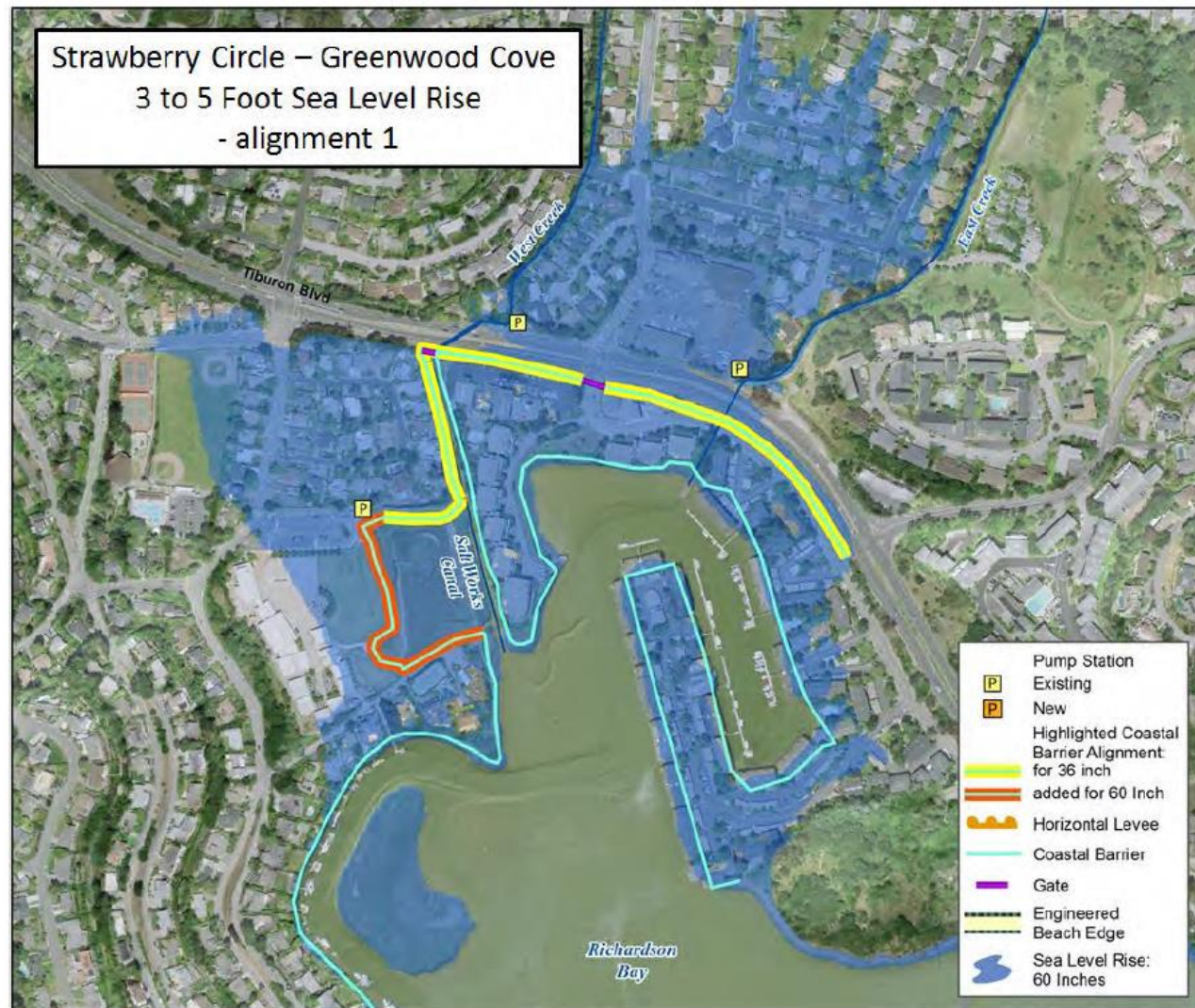
Concept-level evaluation of Strawberry Circle/Greenwood Cove Area included in Study

Several alternatives evaluated. These alternatives are not currently being endorsed by the District, and are provided only as a basis to facilitate discussion on SLR in the area.

Any alternatives used in the area will likely rely on incorporating the existing District infrastructure into the alternatives (i.e. pumps, East and West Creeks)



Strawberry Circle – Greenwood Cove
 3 to 5 Foot Sea Level Rise
 - alignment 1



-  Pump Station Existing
-  Pump Station New
-  Highlighted Coastal Barrier Alignment for 36 inch
-  added for 60 Inch
-  Horizontal Levee
-  Coastal Barrier
-  Gate
-  Engineered Beach Edge
-  Sea Level Rise: 60 Inches

Strawberry Circle – Greenwood Cove
3 to 5 Foot Sea Level Rise
- alignment 2



Strawberry Circle – Greenwood Cove
3 to 5 Foot Sea Level Rise
- alignment 3



Questions and Discussion



Thank You

Scott McMorrow

Zone 4 Engineer

415-473-2918

Smcmorrow@marincounty.Org

Photo Credit: Jeff Wong

