



THE TOWN OF  
Corte Madera  
*California*

# Climate Adaptation Plan



June 18, 2020


# Zoom Orientation

- Please mute yourself
- Under "Participant" select "Raise Hand" to ask a question or comment during discussion sections
- Use the "Chat" function to add comments and ask questions during other parts of the conversation
- Breakout rooms will also be used today



# Agenda

- |      |  |               |
|------|--|---------------|
| I.   | <b>Introductions and Meeting Objectives</b>      | 10 min        |
| II.  | <b>Climate Adaptation Plan Process and Scope</b> | 15 min        |
| III. | <b>Hillside and Wildfire Strategies</b>          | 15 min        |
|      | - <i>Q&amp;A</i>                                 | <i>5 min</i>  |
| IV.  | <b>Shoreline and Sea Level Rise Strategies</b>   | 30 min        |
|      | - <i>Q&amp;A</i>                                 | <i>10 min</i> |
| V.   | <b>Wrap Up and Next Steps</b>                    | 5 min         |
|      | - <i>Detailed Q&amp;A and Discussion</i>         |               |



Tell us what you think!

***Comments via Storymap and Online for next four weeks - July 17***

# About You!

Tell us what part of the Town you are from and your greatest concern...



# Adaptation Plan Process and Scope

2019



Laying the  
Foundation

2020



Engaging on  
Adaptation



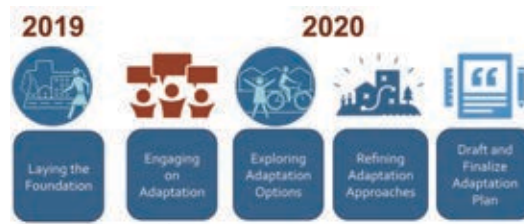
Exploring  
Adaptation  
Options



Refining  
Adaptation  
Approaches



Draft and Finalize  
Adaptation Plan



## Community Engagement



Two Workshops  
 Community Survey  
 Flood Control Meetings  
 City Council Meetings  
 Compilation of Existing Conditions

## Resilience Advisory Committee & Analysis



Four Advisory Committee Meetings  
 10 Partner Meetings  
 GIS & Other Technical Analysis

## Community Workshop 2

Agenda	
I. Introductions and Meeting Objectives	10 min
II. Climate Adaptation Plan Vision and Goals	15 min
III. Hillside and Watershed	20 min
IV. Shoreline and Sea Level Rise	40 min
V. Wrap Up and Next Steps	5 min
<ul style="list-style-type: none"> <li>Provide Feedback on Adaptation Strategies Survey</li> <li>Spread the Word!</li> </ul>	

Tell us what you think!

**Happening Now**

Virtual Workshop (Now)  
 Storymap and Survey (Forthcoming)

# Study Areas for Detailed Concept Development

## Lucky Drive

- First place to overtop
- Intervention here may prevent more extensive flooding
- Access to bike/ped path over creek
- Critical connection to central Marin

## Madera Gardens

- Susceptible to heavy rainfall.
- Will be covered in Stormwater Master Plan

## Christmas Tree Hill (NN)

- Narrow streets
- Steep Hillside
- Single way in/out
- High Fire Risk

## Chapman Hill (NN)

- Narrow streets
- Single way in/out
- Alt. evacuation routes on paths

## Railroad Right of Way and Central Marsh

- Buffer to commercial area
- Access to commercial & recreational areas
- Important bike route
- Closest major street to water

## Marina Village & Mariner Cove

- Current flood risk
- Low-lying Residential
- Subsiding Bay Fill
- Coastal Habitat
- Existing Levee System

## Paradise Drive

- Critical access to parts of east Corte Madera and Tiburon
- Important regional bike route
- Closest major street to water

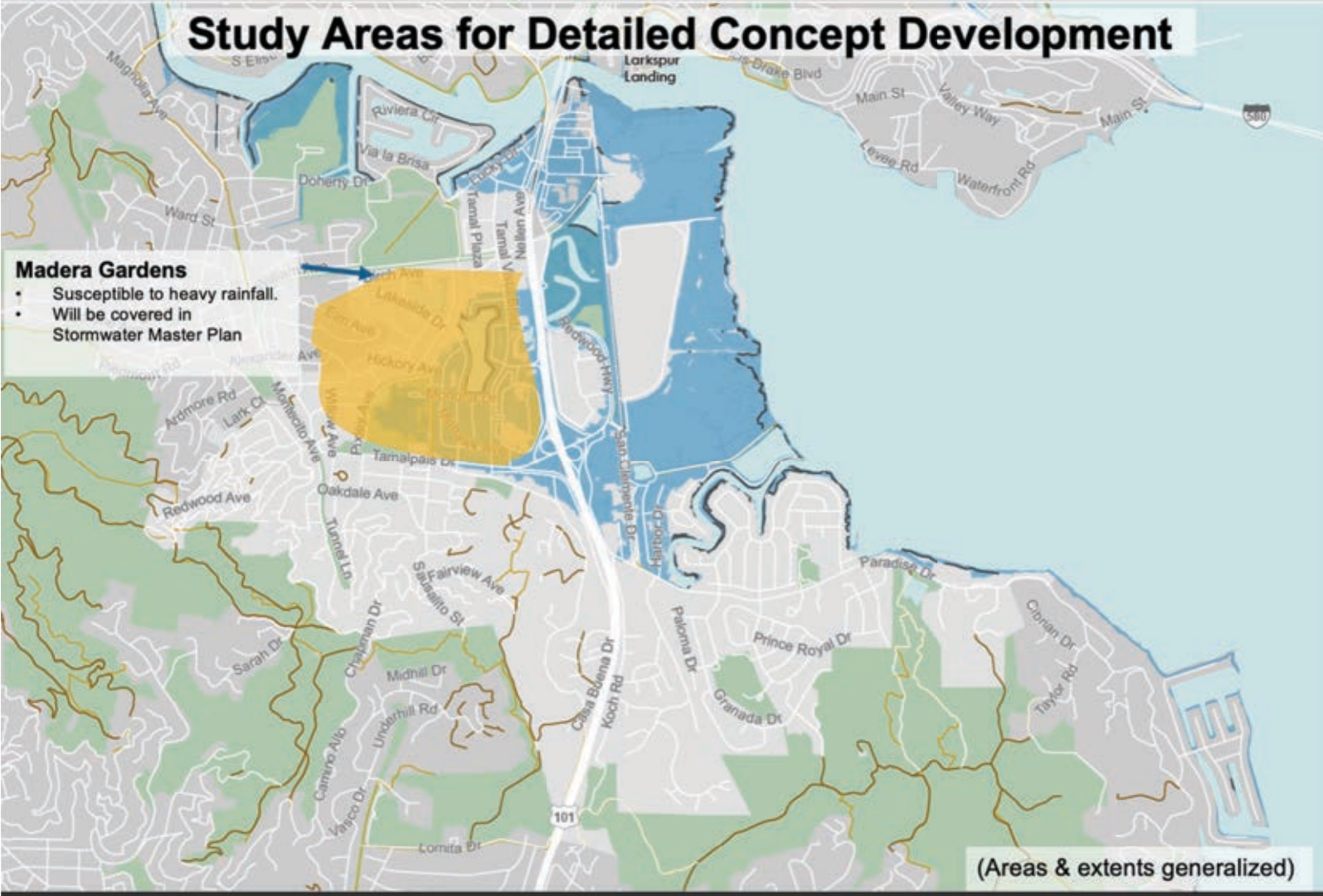
## Granada/Madera del Presidio

- Narrow streets
- Single way in/out

(Areas & extents generalized)



# Study Areas for Detailed Concept Development



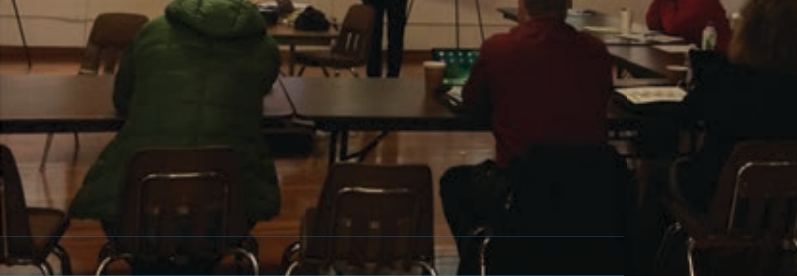
## Madera Gardens

- Susceptible to heavy rainfall.
- Will be covered in Stormwater Master Plan

(Areas & extents generalized)



# Values Driven and Science Based





### DROUGHT

Continued variability in rainfall & hotter temperatures will mean more drying and result in longer & more intense drought events.

### WILDFIRE

Wildfire risk is increasing in intensity, duration, and severity with a potential 50% increase in area burned annually by the end of the century.

### EXTREME HEAT

Temperatures are rising and may rise up to 7° F by the end of the century with 2.5 times more extreme heat days.

### INLAND FLOODING


The largest storms are becoming more intense. By 2100, current 20-year rainfall events may occur every seven years.

### SEA-LEVEL RISE

Sea levels are rising and will continue to rise, up to 2 feet by the 2050s and potentially as much as 7 feet by the end of the century.

# Vision: One Town, One Region, Resilient Together

- **Goal 1:** Protect the health, safety, and wellbeing of all Town residents, visitors, and workers by focusing on preparedness and prevention.
- **Goal 2:** Incorporate resilience and equity into all of the Town's plans, policies, and projects.
- **Goal 3:** Prioritize feasible, cost-effective, and nature-based actions that provide multiple benefits to the community.
- **Goal 4:** Increase community awareness about the urgent need to take action and prepare for climate change.
- **Goal 5:** Bring the community, neighboring towns, and the region together to plan and fund actions to build resilience.



Tell us what  
you think!

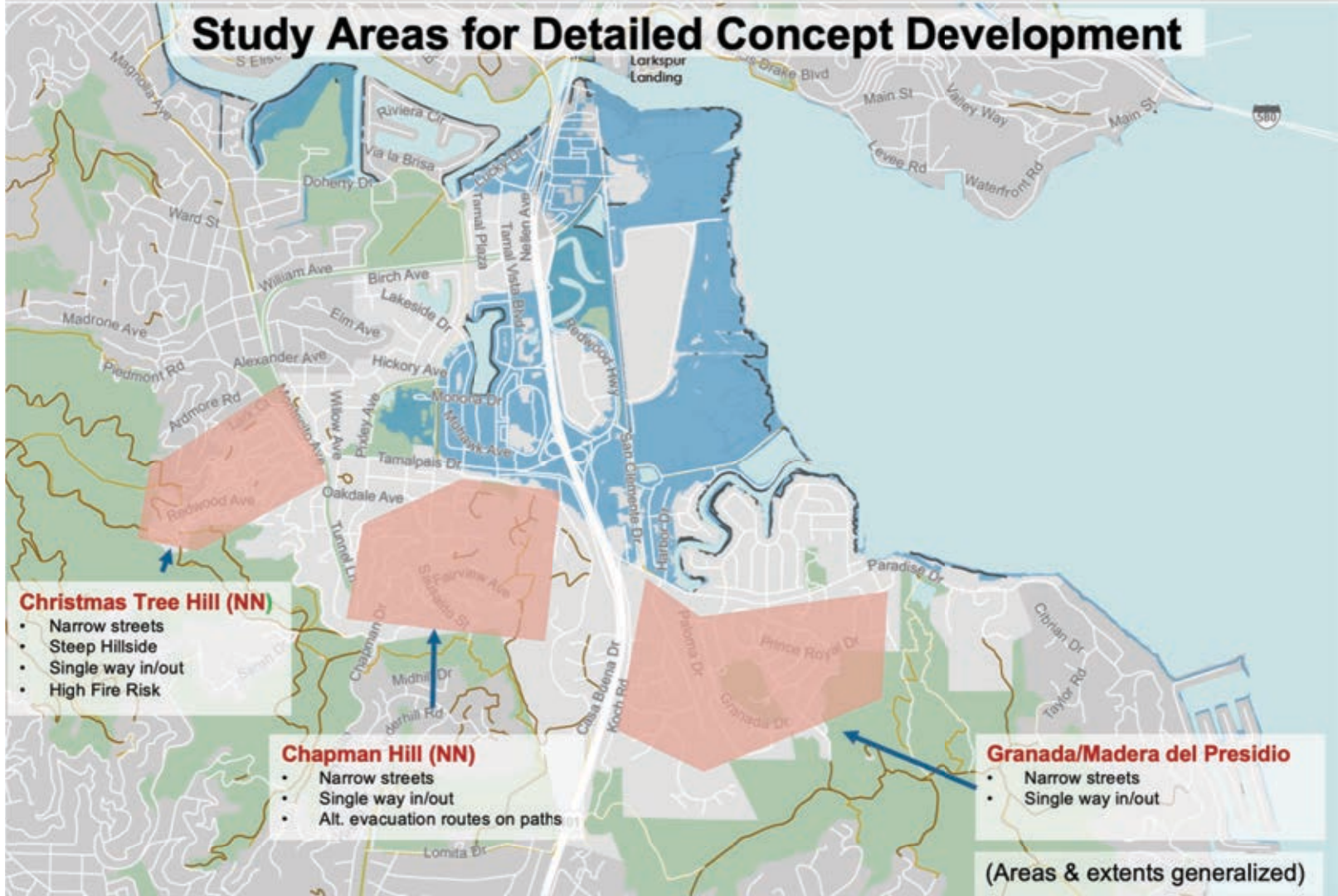


# Hillside Challenges and Strategies





# Study Areas for Detailed Concept Development





# Christmas Tree Hill CAL FIRE Wildfire Hazard Designations



Map Credit: Traver Earth Adaptation International (2020)  
Data Source: USFS, Department of Marine and Coastal Services, USFS  
National Map, 401 Fire Building Project, Oregon  
Source Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNR/StereoImage, USDA, USGS, AeroGRID, IGN, and the GIS User Community

# Transportation Actions

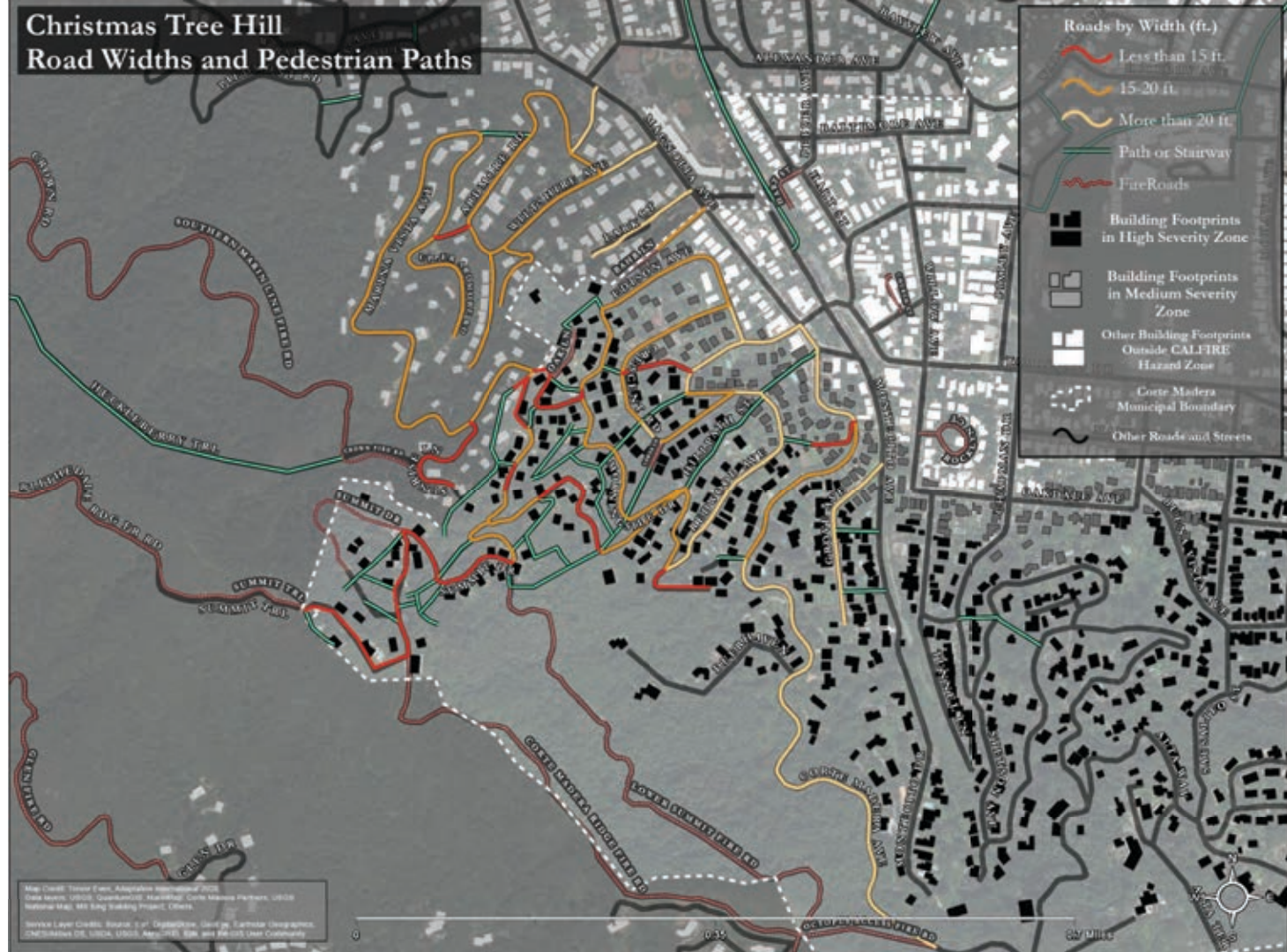
- Policy changes such as improved parking management and incentives for other modes
- Enhance steps, lanes, and paths including wayfinding
- Enhance streets
- Improved networks with new connections



- Support other modes of transportation
- Manage on-street parking
- Create pull-outs
- Widen narrow street sections
- Create new connections



# Christmas Tree Hill Road Widths and Pedestrian Paths



**Roads by Width (ft.)**

- Less than 15 ft.
- 15-20 ft.
- More than 20 ft.
- Path or Stairway
- Fire Roads

**Building Footprints in High Severity Zone**

**Building Footprints in Medium Severity Zone**

**Other Building Footprints Outside CALFIRE Hazard Zone**

**Cotuit Madera Municipal Boundary**

**Other Roads and Streets**

Map Credits: Tomer Eran, Adaptation International 2023  
 Data Sources: USGS, Government, Mapping, Cotuit Madera Partners, USGS  
 National Map, MS King Trading Project, Others  
 Source Layer Credits: Source: 3rd, DigitalGlobe, GeoEye, Earthstar Geographics,  
 CNR/Airvana DS, USDA, USDA, AeroGRID, IGN, and the FAA. User Contributed  
 Data



# Chapman Hill CAL FIRE Wildfire Hazard Designations



- Very High Fire Severity Risk Zone
- High Fire Severity Risk Zone
- Medium Fire Severity Risk Zone
- Building Footprints in Medium Severity Zone
- Building Footprints in High Severity Zone
- Building Footprints (2015)
- + Cortez Madera Municipal Boundary
- Roads and Streets
- Highway

Map Credit: Trevor Clark, August 2016  
 Data Source: CAL FIRE, Geographic Information Systems, Cortez Madera Planning, 2015  
 Technical Staff: 300 Map Making Project, 2015  
 Source: Layer Credits: Source: Fire Designations, 2015; Building Footprints, 2015; Building Footprints (2015), 2015; Cortez Madera Municipal Boundary, 2015; Roads and Streets, 2015; Highway, 2015

# Chapman Hill Road Widths and Pedestrian Pathways



Map Credit: Topographic, Aerial, and Satellite Imagery © 2020  
 Data Source: National Geographic, 2020; Mapbox; Cortes Madera Partners, 2020  
 Source Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics,  
 CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

# Chapman Hill


## Road Widths and Pedestrian Pathways






Approach/Metric	Status Quo	Policy Changes	Enhanced Network	Expanded Network
Multimodal access	Vehicle Pedestrian (limited)	Vehicle Pedestrian Bike/e-bike	Vehicle Pedestrian Bike/e-bike	Vehicle Pedestrian + ADA Bike/e-bike
Streets permitting simultaneous access & egress	Very limited	Very limited	More	Most
Emergency exits from neighborhood	1-2	Same (less blockage)	Same (less blockage)	2-3
Flexibility	-	Can easily be adapted to changes	Once the network meets width minimums enhancements are not necessary	Future expansions can be considered to respond to future needs
Cost	-	Low	Medium (lower for existing fire trails)	High

# Consider a Phased Approach



Tell us what  
you think!

- **Near-Term** - Outreach and education about wildfire risk. Property assessment, building hardening, defensible space. Enhancements to paths and stairs.
- **Medium-Term** - Parking management, E-bikes, widen streets.
- **Long-Term** - Plan to be adaptive, create new street connections, improve fire roads, develop post wildfire policies.



Tell us what  
you think!

# Tell Us Your Thoughts on Hillside Adaptation

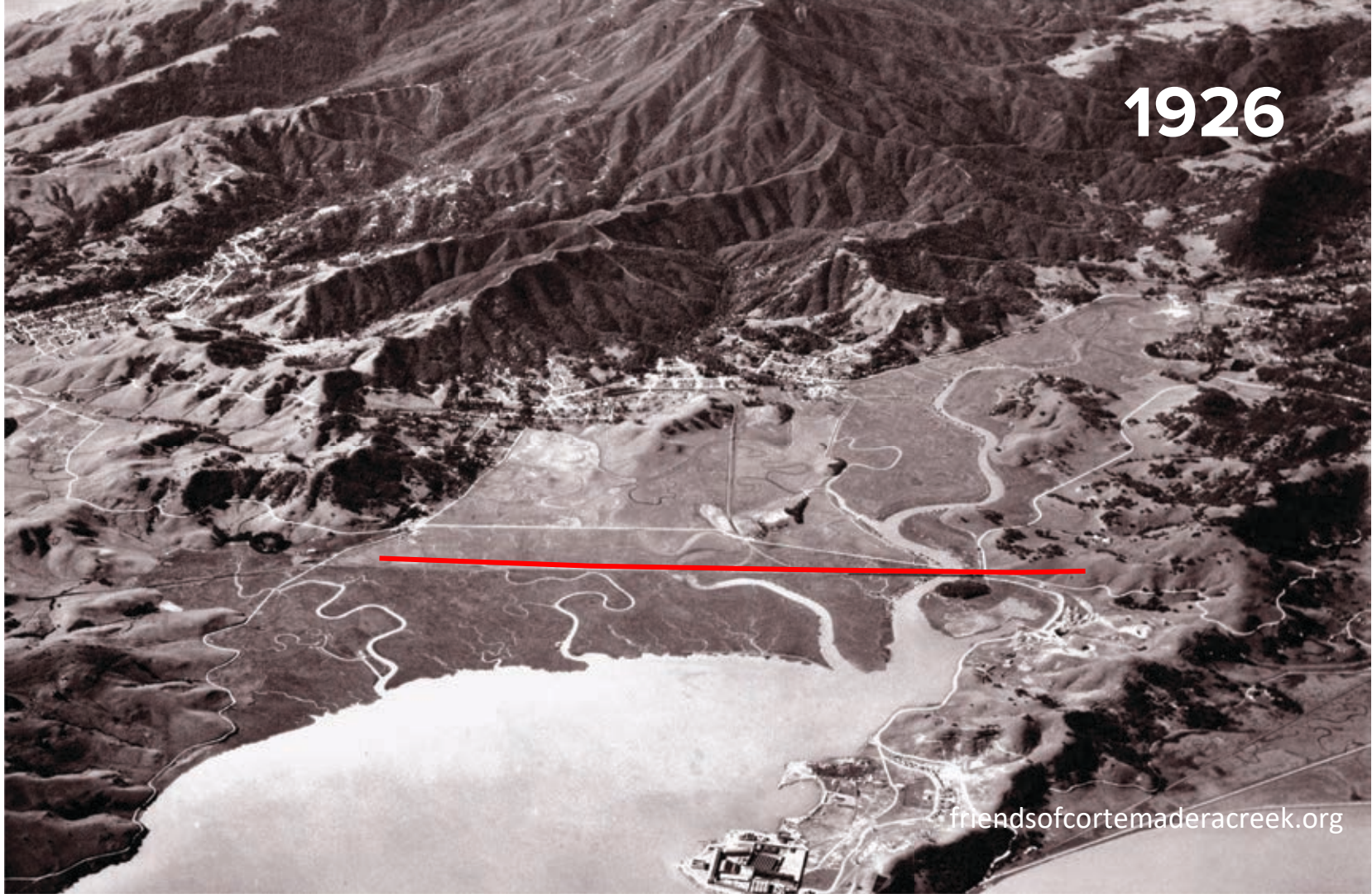
How prepared are we and what should we do to better adapt....





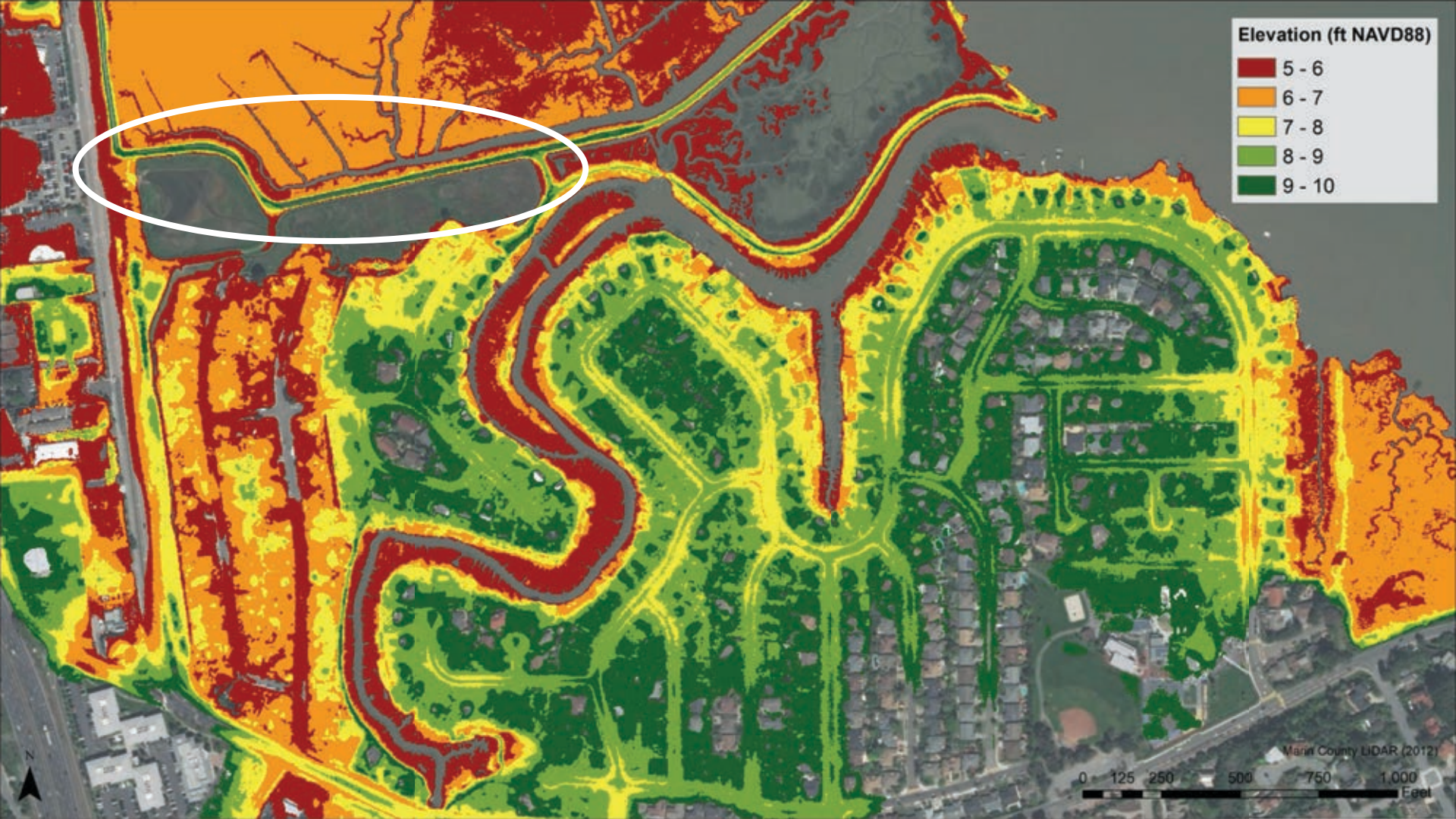
# Coastal Challenges and Strategies

1926



2019





Elevation (ft NAVD88)

- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- 9 - 10

Main County LIDAR (2012)

0 125 250 500 750 1,000 Feet



**King Tide  
2015**

7.4ft NAVD, 1.5 ft above normal  
high tides  
New normal in 2040

Source: Adam Wolff



# Mariners Cove and Marina Village MHHW + 1 foot scenario Elevation of king tides today



Hydrologically Discrete Areas below MHHW+ 1 ft.

- Building Footprints in Inundation Zone
- Building Footprints (2018)
- Corte Madera Municipal Boundary
- Roads and Streets
- Highway
- Low-Lying Area Currently Protected by Stormwater Infrastructure

Map © 2018, Esri, Inc. All rights reserved. 2018  
Map data © 2018, Esri, Inc. All rights reserved. 2018  
Map data © 2018, Esri, Inc. All rights reserved. 2018





# Structure Height Assumptions

Elevations in feet  
NAVD88

With natural  
outboard edge  
(beach or  
ecotone slope)

Traditional  
levee/wall

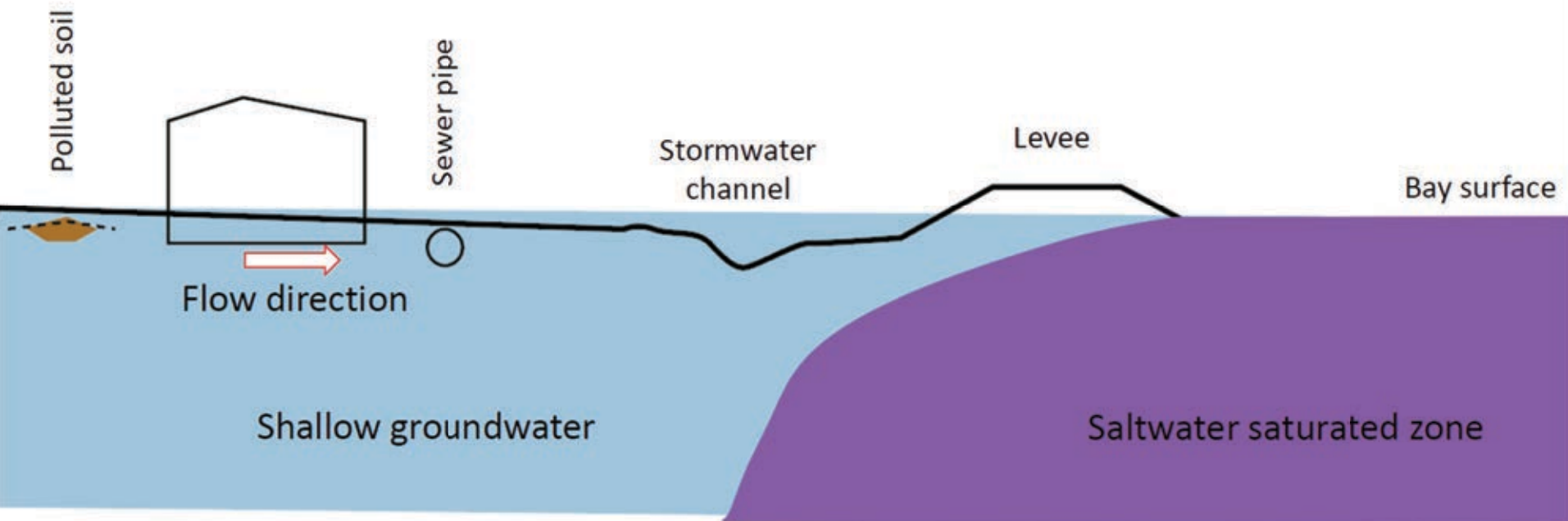
SLR	MHHW + SLR	MHHW + SLR + 100 yr storm	MHHW + SLR + 100 yr storm + 2' freeboard	MHHW + SLR + 100 yr storm + 2' freeboard + wave runup
0'	6.1'	9.5'	11.5'	13.9'
1.9'	8.0'	11.4'	13.4'	15.8'
3.5'	9.6'	13.0'	15.0'	17.4'
6.9'	12.9'	16.4'	18.4'	20.8'

*Unofficial "goal"  
for 2050 by  
California State  
Assembly, Sea  
Level Rise and  
California  
Economy  
Committee*

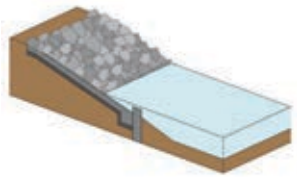
Sea Levels from OPC (2020). *Strategic Plan to Protect California's Coast and Oceans 2020-2025*. California Ocean Protection Council. <http://www.opc.ca.gov/2020/02/the-ocean-protection-council-approves-a-bold-plan-to-protect-californias-coast-and-oceans/>

Tides and extreme water levels from AECOM (2016). *San Francisco Bay Tidal Datums and Extreme Tides Study*. Bay Conservation and Development Commission [http://www.adaptingtorisingtides.org/wp-content/uploads/2016/05/20160429.SFBay\\_Tidal-Datums\\_and\\_Extreme\\_Tides\\_Study.FINAL\\_.pdf](http://www.adaptingtorisingtides.org/wp-content/uploads/2016/05/20160429.SFBay_Tidal-Datums_and_Extreme_Tides_Study.FINAL_.pdf)

If sea level rises 3 feet, then shallow groundwater rises as much as 3 feet, within about a half mile of the Bay - probably farther inland as well.



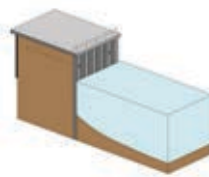
# Structural adaptation toolbox: Green, grey, hybrid measures



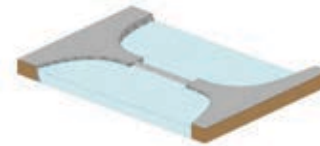
Revetments



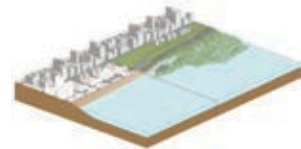
Floodwalls



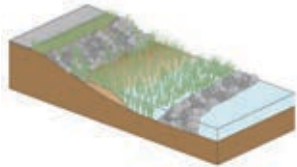
Bulkheads



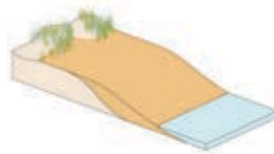
Surge  
barriers



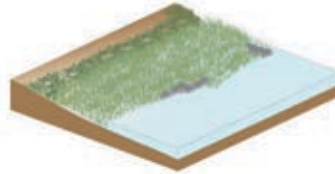
Strategic retreat



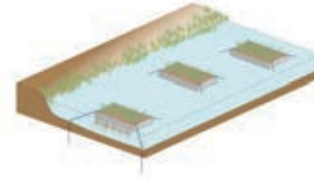
Living shorelines



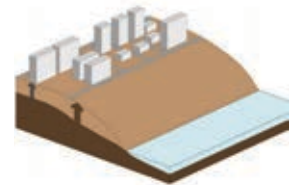
Beaches or  
dunes



Constructed wetlands



Floating islands,  
living breakwaters

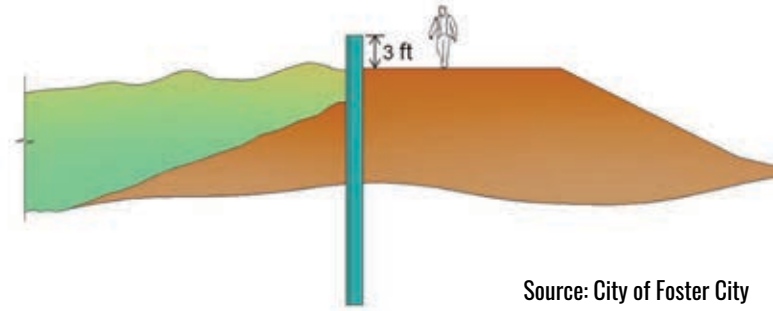


Elevate land

**+ many others...**

*Source: NYC Planning Dept.*

# Levee or sheet-pile seawall



## Pros

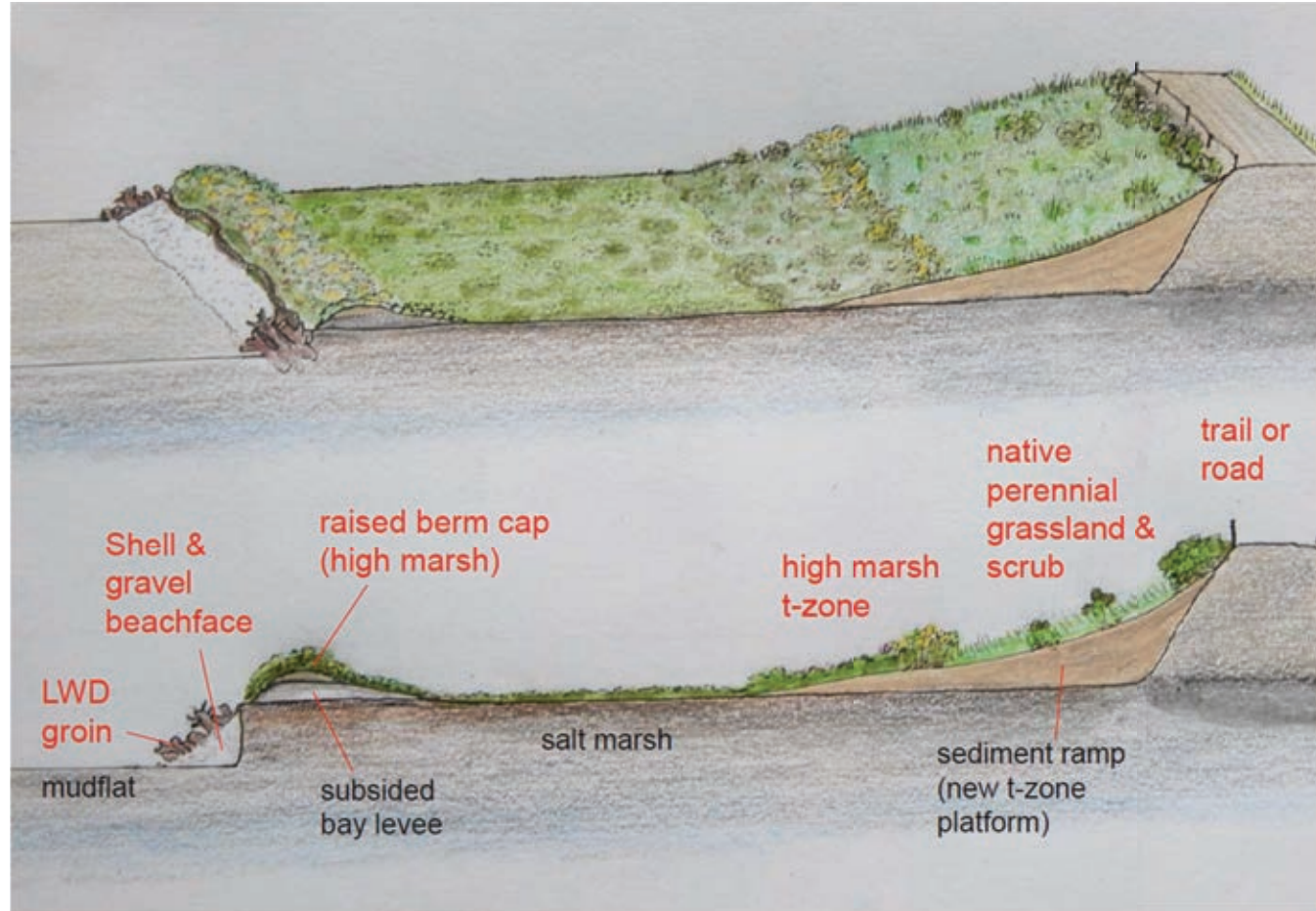
- Reduces near term flooding
- Well-established design guidance and specifications

## Cons

- Reduced views
- Reflection of waves by the wall may increase marsh erosion
- Does not address inland flooding
- Little habitat value

# Ecotone slopes, marshes and beaches

- Reduce wave runup and erosion
- Improve existing marsh habitat





# Tide gate/Storm surge barrier

- Shortens line of defence
- Provides stormwater detention
- Habitat conversion of tidal marsh and tidal flat
- Water quality issues in closed lagoon



**Shorebird Marsh tide gate**

# Study Areas for Detailed Concept Development

## Lucky Drive

- First place to overtop
- Intervention here may prevent more extensive flooding
- Access to bike/ped path over creek
- Critical connection to central Marin

## Railroad Right of Way and Central Marsh

- Buffer to commercial area
- Access to commercial & recreational areas
- Important bike route
- Closest major street to water

## Marina Village & Mariner Cove

- Current flood risk
- Low-lying Residential
- Subsiding Bay Fill
- Coastal Habitat
- Existing Levee System

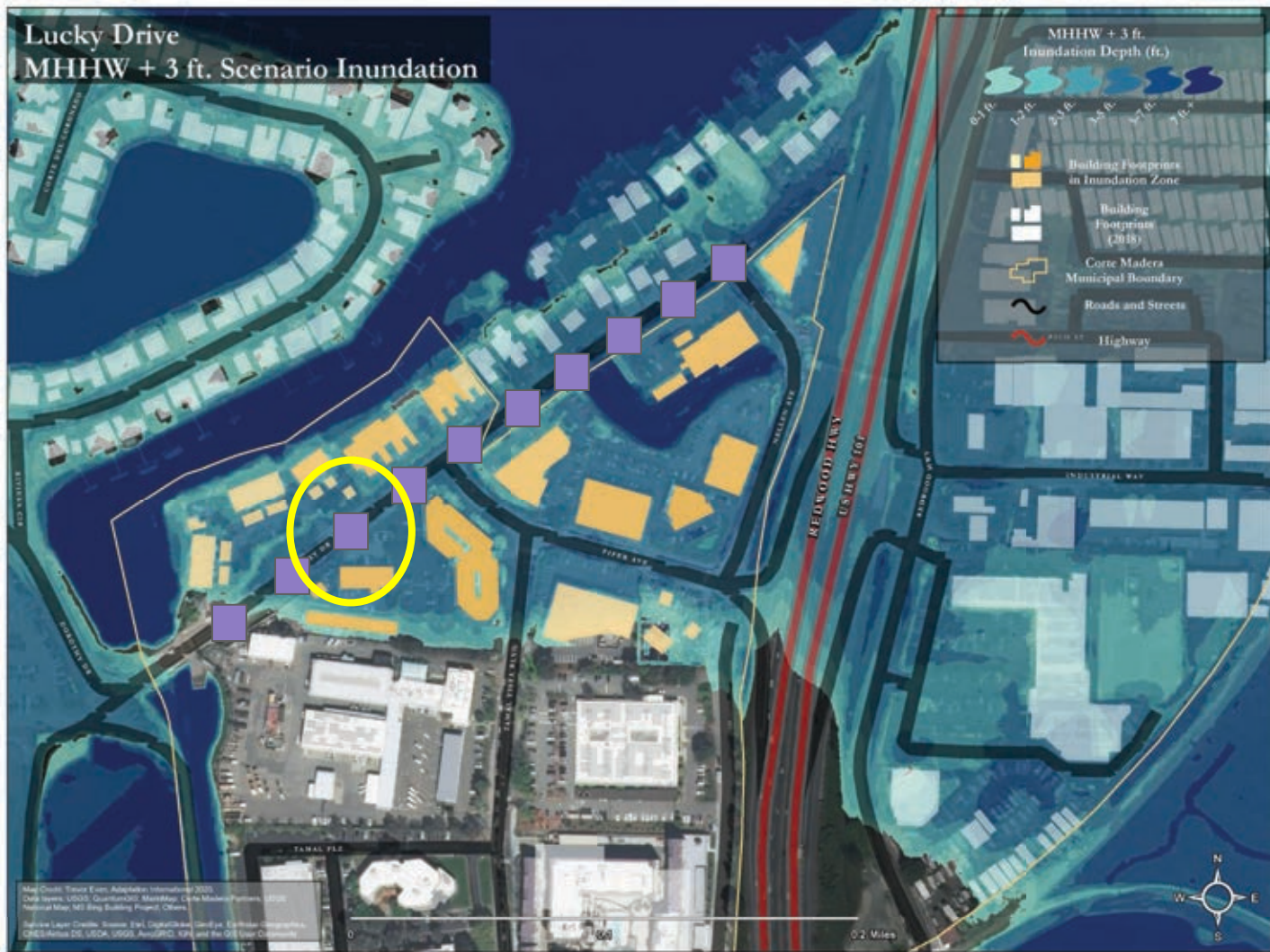
## Paradise Drive

- Critical access to parts of east Corte Madera and Tiburon
- Important regional bike route
- Closest major street to water

(Areas & extents generalized)



# Lucky Drive MHHW + 3 ft. Scenario Inundation



Address Current Flooding

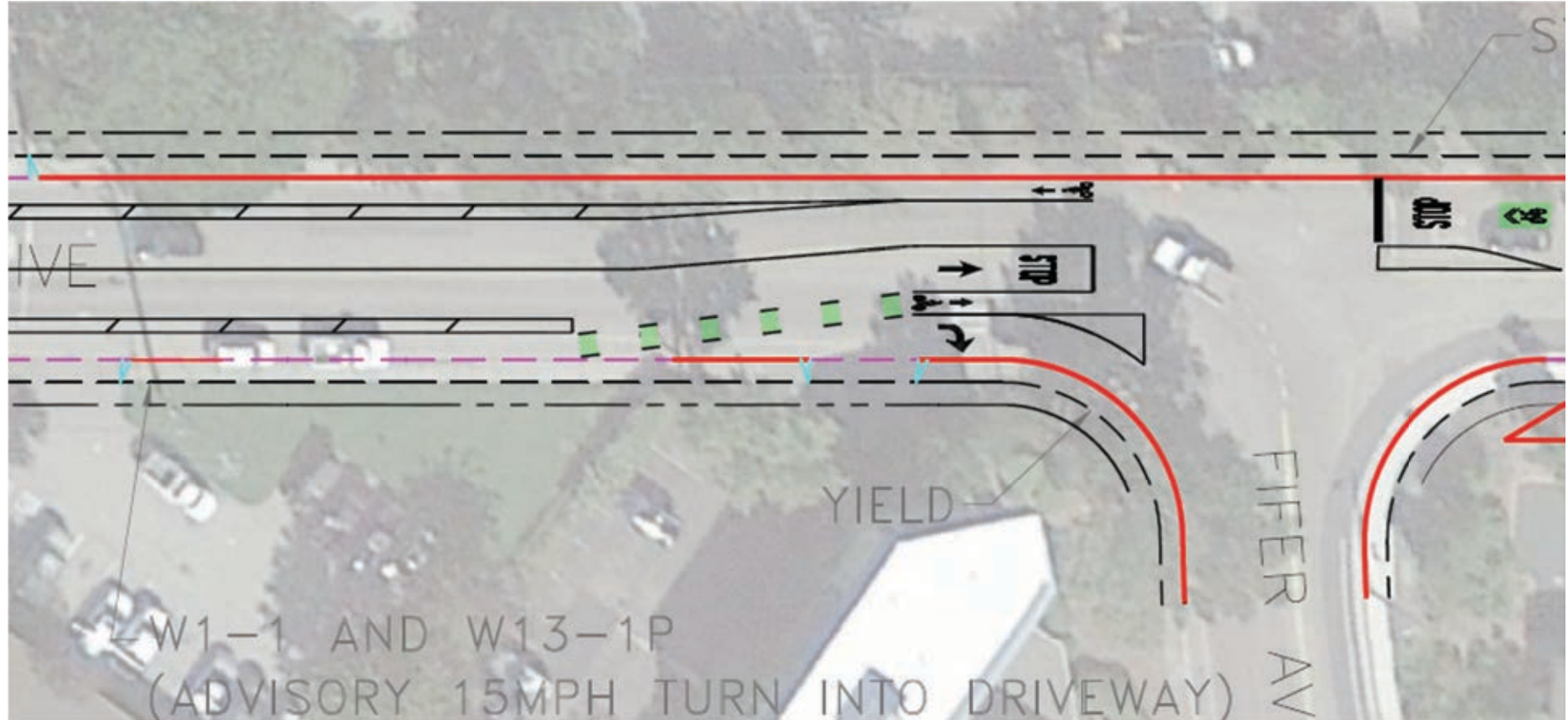
Elevate Roadway to 10 feet

Prepare for 50-yr flood in the 2030s

Ensure transportation connection

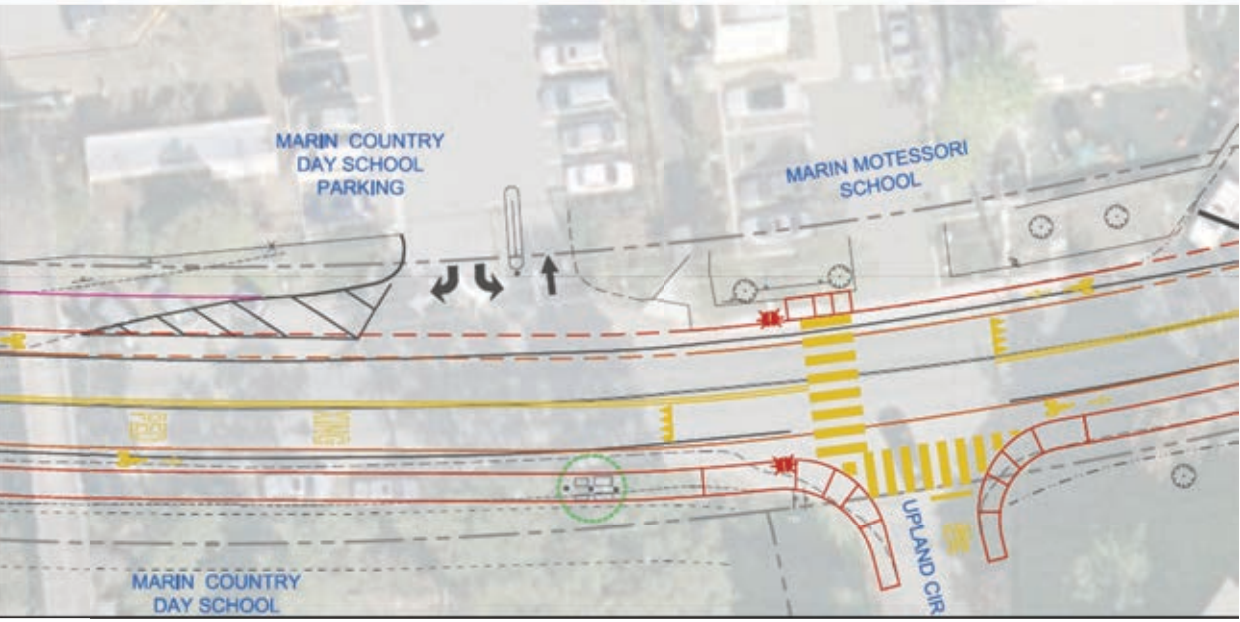
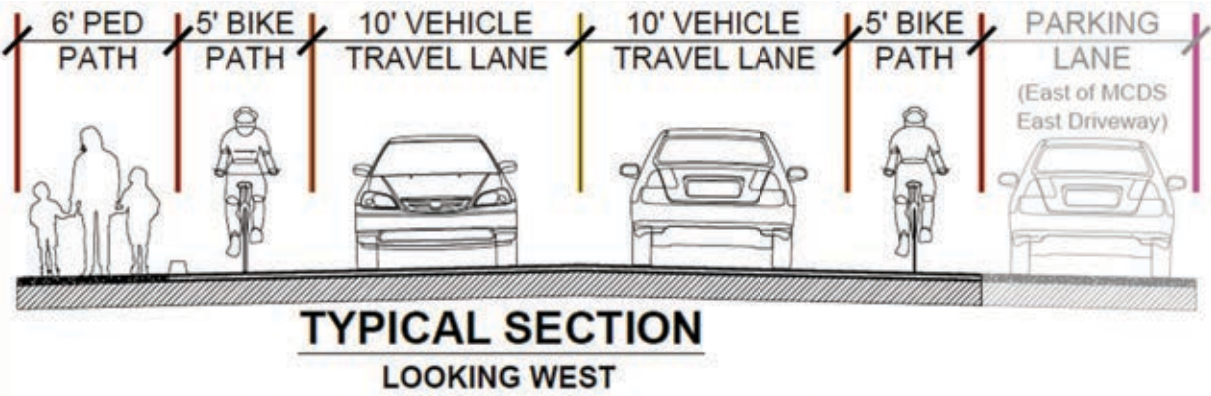
Could be completed in 3-5 years with funding.

# Lucky Drive Bike/Ped Improvements





# Paradise Drive Bike/Ped Improvements



# Corte Madera Marsh & Railroad Right-of-Way





# Corte Madera Marsh & Railroad Right-of-Way

- Need to protect the shopping centers and economic core.
- Need to collaborate with landowners (SMART, Golden Gate Bridge District, CA Fish and Wildlife).
- Support long-term survival/enhancement of the marsh.
- Opportunities for multi-benefit, multi-modal transportation.
- Identify timeframe for protection and adaptation pathways.



# Recent and ongoing habitat restorations



Madera Bay Park (Marin Audubon)



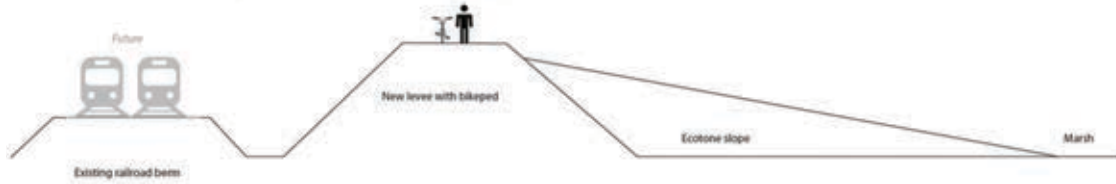
Golden Gate Bridge Highway and Transportation District

# Putting strategies together: some ideas

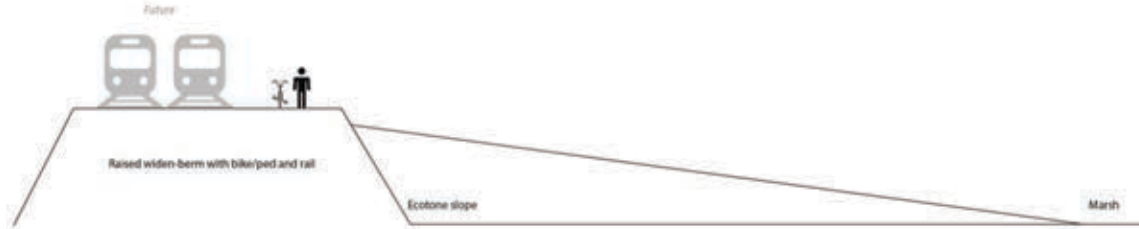


- Alternate tide gate locations
- Alternate levee alignments
- Lower/remove levee
- Channel
- Coarse beach
- Levee
- Ecotone slope
- Restored marsh
- Marsh mounds

**Alternative 2.1 - Full-height levee bayside of existing railroad berm with bike/ped access**



**Alternative 2.2 - Widened and raised berm with bike/ped access and railroad**



**Alternative 2.3 - Full-height levee bayside of existing railroad berm without bike/ped access**



**Alternative 2.4 - Widened and raised berm with bike/ped access only**



# Alternative railroad, levee, trail, habitat cross-sections

## Questions? Comments?

Please add questions or comments into chat  
or “raise” your hand to ask a question

# Marina Village and Mariner Cove



# Marina Village and Mariner Cove

- Evaluate feasible protection options.
- Need to collaborate with landowners (CA Fish and Wildlife).
- Support natural habitat.
- Ensure long-term arterial connection.
- Identify timeframe for protection and adaptation pathways.







# Inner Alignment Option

- Hardened Structure
- Tide Gate Locations (Inner Option)

Marina Village cross-section



DISCLAIMER: This is not a plan, but a conceptual drawing showing potential adaptation options. Additional study, planning, and engineering will be required to further refine these concepts.

# Marina Village



# Marina Village



# Inner Alignment Option

- Hardened Structure
- Tide Gate Locations (Inner Option)
- Alternative Levee Alignment (Inner Option)
- Ecotone Slope
- Coarse Beach
- Marsh Mounds

Mariner Cove cross-section



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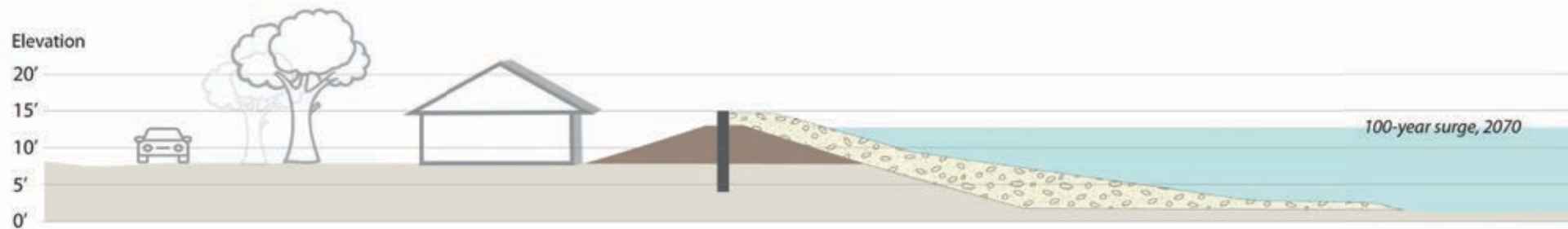


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# Mariner Cove

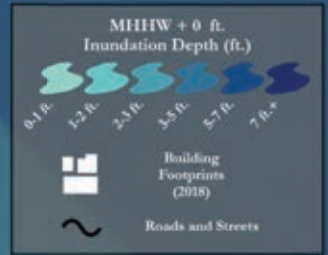


# Mariner Cove



# Outer Alignment Option

- Hardened Structure
- Tide Gate Location (Outer Option)
- Alternative Levee Alignment (Outer Option)
- Ecotone Slope (Outer Option)
- Coarse Beach
- Marsh Mounds



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## Inner Alignment

**Views/space impacted by hardened structure in backyards**

**San Clemente Creek partially disconnected from Bay: fewer ecological impacts**

**Less stormwater detention capacity**

**Less likely to impact Marta's Marsh**

## Outer Alignment

**Preserves neighborhood status quo**

**All San Clemente Creek disconnected from Bay: more ecological impacts**

**More stormwater detention capacity**

**More likely to impact Marta's Marsh**




# What is important?

Please share your thoughts on how we should think about the options.

# Long-term Adaptation

- Sea-level rise will continue into the next century - no structural solution will last forever
- There are many uncertainties in future conditions
- Many long-term solutions are complex to implement and nonstructural options require planning to start now

# Consider a Phased Approach



Tell us what  
you think!

- **Near-Term** - Elevate Lucky Drive and Paradise Drive. Outreach and education about Sea level rise risk zones.
- **Medium-Term** - Evaluate and construct flood protections for the Marina Village and Mariner Cove communities to protect to 2050. Real Estate disclosures and base flood elevation requirements.
- **Medium-Term** (Regional) - Support marsh habitats
- **Long-Term** (Regional) - Plan to be adaptive, can be cost prohibitive to hold the line for ever.



# Wrap up and Next Steps

## Survey links and next steps....

Go to the Corte Madera Adapts website: [www.cortemaderaadapts.org](http://www.cortemaderaadapts.org)

Share your thoughts and inputs via the StoryMap (ideally before July 18<sup>th</sup>)

Share information with your friends, neighbors, and networks.

## Questions? Comments?

Please add questions or comments into chat  
or “raise” your hand to ask a question



# THANK YOU!

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