

Central Coast Highway 1 Climate Resiliency Study

February 9, 2021

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The Nature
Conservancy

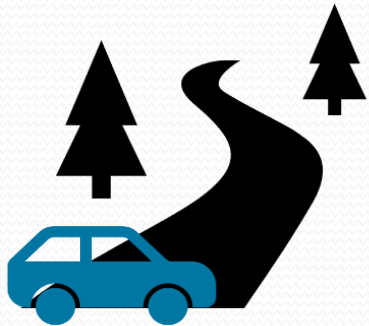


Middlebury Institute of
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Study Overview & Goals

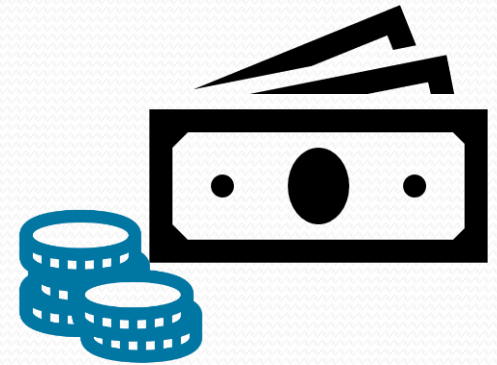
- Develop transportation corridor concepts & sea level rise adaptation approaches that:



Improve
transportation
safety & efficiency



Promote healthy
coastal habitats



Provide economic
security & benefits to
the community

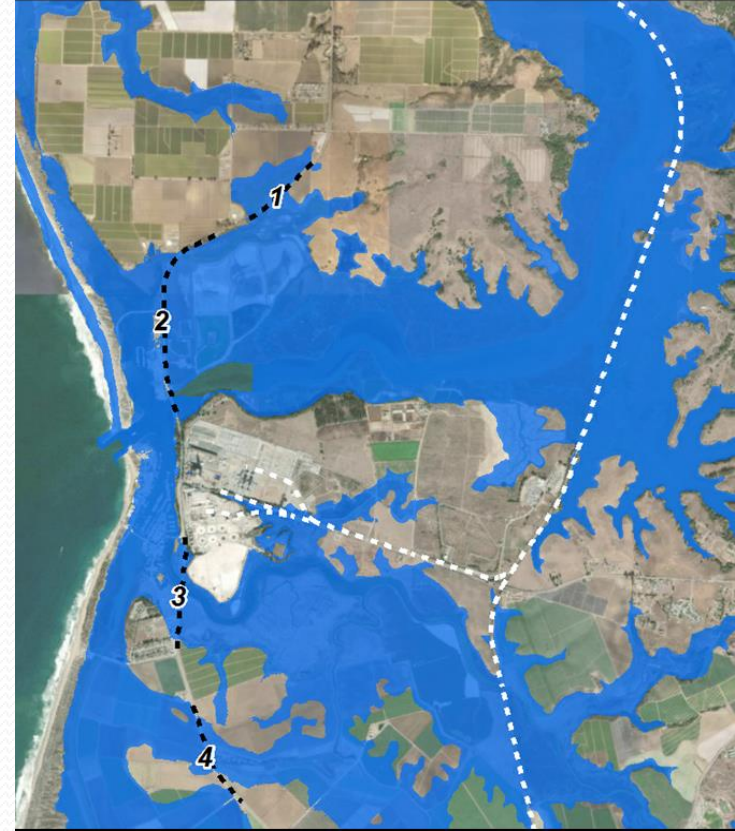
Steering Committee

- AMBAG
- Caltrans
- The Nature Conservancy
- Environmental Science Associates
- TAMC
- Center for the Blue Economy
- County of Monterey
- Ocean Protection Council
- California Coastal Commission
- Elkhorn Slough Foundation
- Elkhorn Slough National Estuarine Research Reserve
- U.S. Fish & Wildlife
- Central Coast Wetlands Group
- Coastal Conservancy
- Moss Landing Harbor District

Risk in Elkhorn Slough



- Four low-lying reaches of Highway 1 are at risk of flooding
- Lack of space for habitat to migrate into due to topography
- Sea level rise could result in loss of 85% of marsh habitat



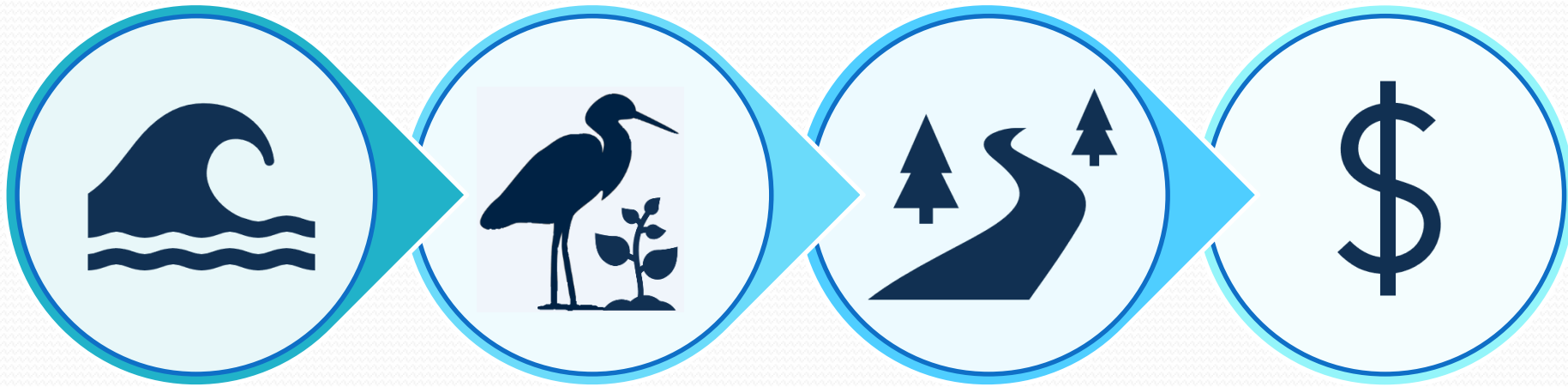
Importance of Elkhorn Slough



- 3rd largest saltwater marsh in California
- Critical habitat for 20,000 migratory shore birds
- Crucial for threatened species
 - Over 100 southern sea otters
 - Largest nesting populations of snowy plovers
- Popular tourist destination



Evaluation of Adaptation Scenarios



Climate Modeling

Model future potential flooding conditions

Ecological Conditions

Examine the changes in habitat extents over time

Transportation Modeling

Model future highway traffic conditions

Cost Benefit Analysis

Weigh potential gains and losses, including ecosystem services

Adaptation Scenarios

2-Lane Elevated Highway 1



Highway maintained at 2 lanes, elevated in place, and marsh ecotones established

4-Lane Elevated Highway 1



Highway expanded to 4 lanes, elevated in place, and marsh ecotones established

Improved G12 Inland Corridor as Main Route



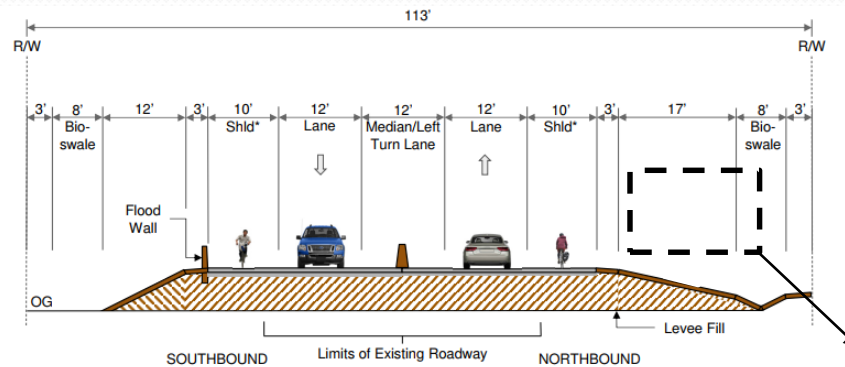
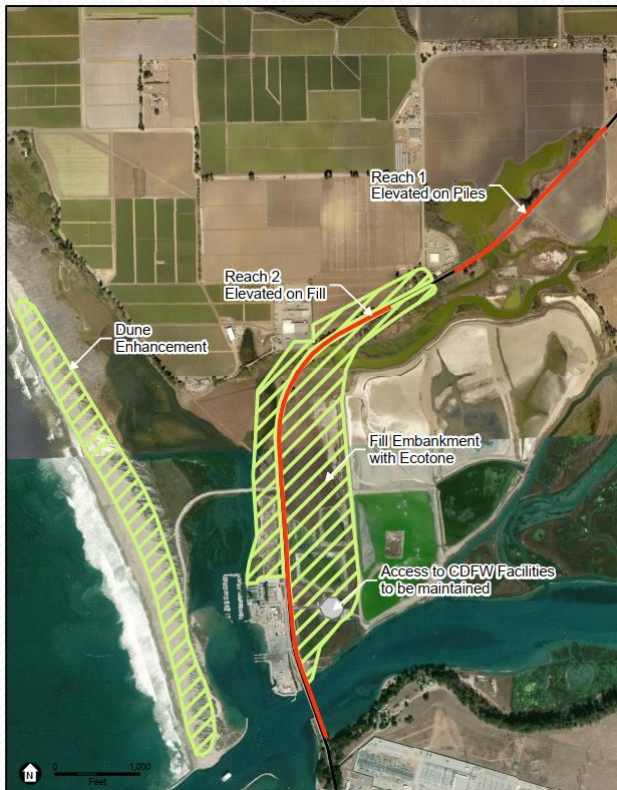
Traffic rerouted further inland and current highway changed to local access only



Each scenario includes elevating the Elkhorn Rail and marsh restoration

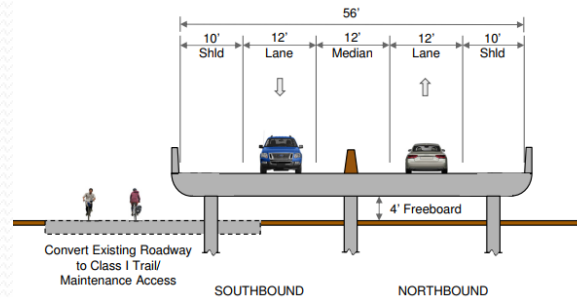
Roadway Improvements & Adaptation Options

- Integrate solutions that enhance the resilience of the roadway and neighboring ecology
 - Reaches 1 and 2 (North of Bridge): Elevate on piles to support increased tidal action and improved water quality or on fill with levee ecotone (gentle slope with vegetation) to facilitate habitat area
 - Reaches 3 and 4 (South of Bridge): Elevate highway on piles to allow for more flexible floodplain management in the future



*Shoulder also serves as class II bicycle lane

Roadway elevated on fill



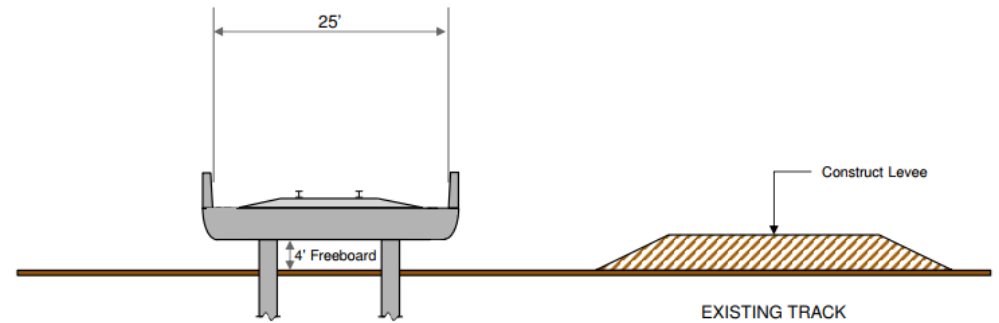
Roadway elevated on piles



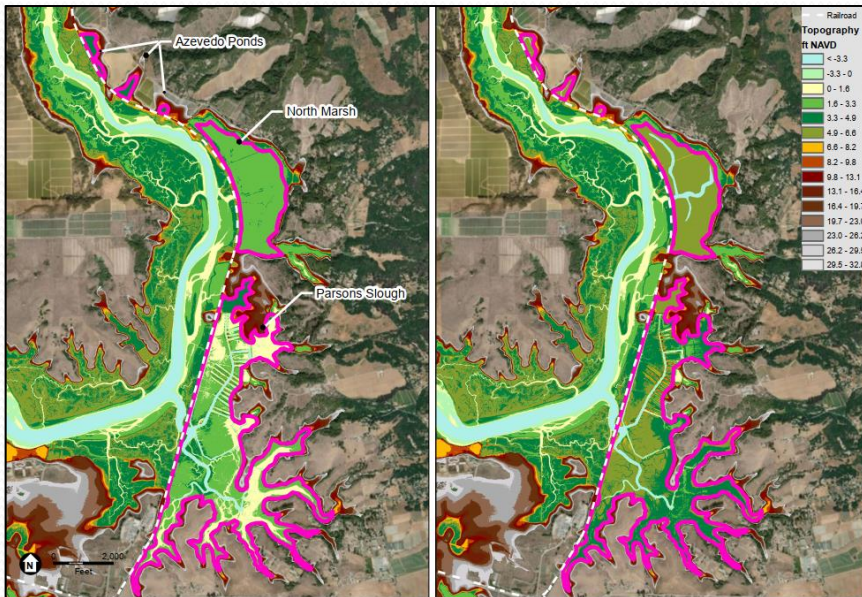
Example of levee ecotone at Hamilton Wetlands

Railway Improvements and Adaptation Actions

- Elevating the rail corridor on trestle
- The railway would be single track through the Slough
- Marsh restoration to support marsh habitat as sea level rises
- Existing railway embankment used to retain sediment for restoration



Profile view of railway elevated on trestle (left) and existing embankment on fill (right). Example of railway elevated on trestle at Lake Pontchartrain in New Orleans, LA (below).



Elevation for existing conditions (left) and with proposed marsh restoration and new tidal channel creation (right) at sites outlined in pink



Photo: Edward Branley

Proposed marsh restoration entails raising the marsh plain grade elevations to keep pace with rising water levels.

*Sea Level Rise Affecting Marshes Model

Transportation Utility

- No action is not viable
- Elevating 4-lane highway performed best
- Elevating 2-lane highway not as good as 4 lanes
- Improving G12 – poor performance



Ecological Conditions

- Impacts of sea level rise far outweigh impacts of highway
- Sediment augmentation necessary to maintain salt marsh
- Ecotone levees create habitat area and resilience
- Restoration near rail provides important gains in salt marsh acreage



Benefit Cost Analysis

- No action scenario will result in widespread loss of coastal habitat, significant transportation impacts & economic losses
- Elevating 4-lane Highway 1 – best benefit cost
- Adaptation needs to be in place by the 2050s to ensure benefits to transportation and habitats



Virtual Reality for Project Communication

- Immersive experience to help the public visualize sea level rise risks and adaptation solutions
- Hyper realistic 3D models and 360° views developed using drone imagery
- Emerging research shows that VR can promote prosocial behavior and realistic understanding of the issues
- <https://youtu.be/bRUMYBr0FX0> (video)



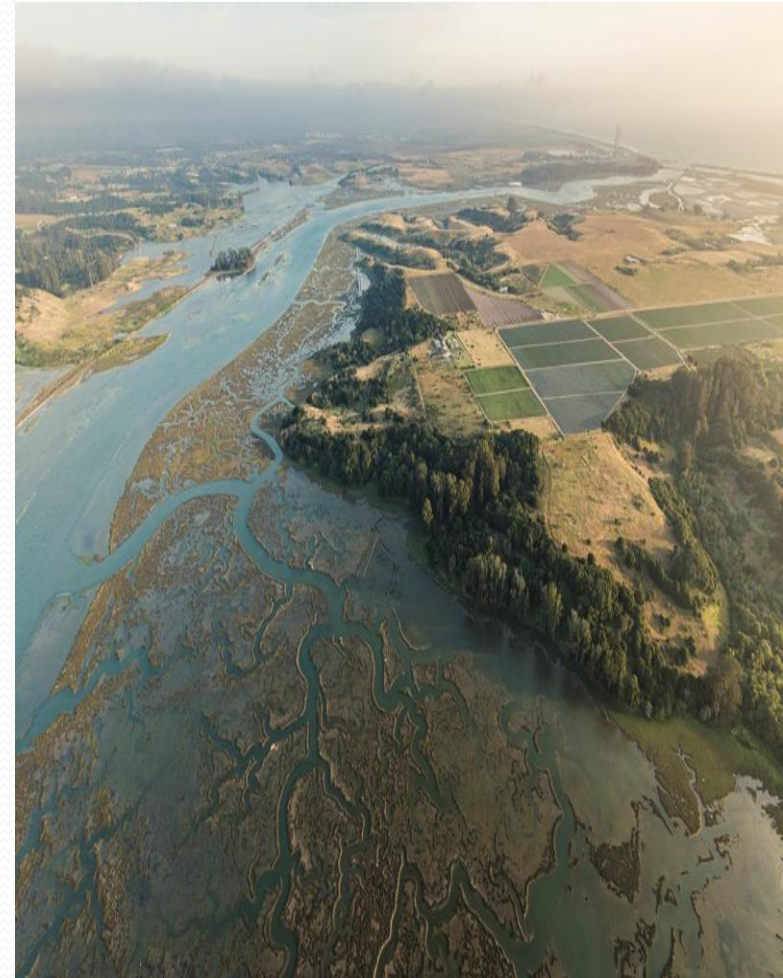
Summary

- Choosing not to adapt to sea level rise is not a viable option
- Adaptation of the highway with nature-based elements help to reduce the loss of habitat
- Adaptation needs to be in place by the 2050s to ensure benefits to transportation and habitats
- Multi-sector cooperation and planning is key



Considerations for Future Planning

- Integrate study results into Regional/State Transportation Plans
- Continue planning processes that combine multi-objective and multi-benefit focus in each stage of adaptation planning
- Integrate best available science and modeling into future analysis
- Pathways, triggers and strong partnerships must be in place now to ensure effective climate change adaptation for the Moss Landing area and Elkhorn Slough



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