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## **Coastal adaptation in California: experiences, successes, challenges and the way forward for effective, equitable implementation**

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# The rising costs of coastal climate change

- California's coast is being impacted by not only increased flooding, but also eroding beaches and cliffs, and raising coastal groundwater levels.
- **Two-thirds of California's residents** live in coastal counties where over 675,000 people and \$250 billion in property are at risk of flooding from sea level rise and a 100-yr storm during the 21st century (Barnard et al., 2019).
- This represents **6% of the state's GDP** of the 4th largest global economy
- **85% of the shoreline is rapidly eroding**, threatening 390 km of major highways, 16 km of railways, 14,000 residents, and 6,000 coastal workers



President Biden granted a Major Disaster Declaration for the State of California twice so far this year, triggering the release of Federal funds to help individuals and communities recover from severe winter storms, flooding, landslides, and mudslides.

<https://www.nytimes.com/2023/01/09/us/california-central-coast-santa-cruz-storm.html>

# But rapidly becoming a leader in climate solutions



1. Strengthen **Protections for Climate Vulnerable Communities**
2. **Bolster Public Health and Safety** to Protect Against Increasing Climate Risks
3. Build a **Climate Resilient Economy**
4. Accelerate **Nature-Based Climate Solutions** and Strengthen Climate Resilience of Natural Systems
5. Make Decisions Based on the **Best Available Climate Science**
6. **Partner and Collaborate** to Leverage Resources



# UC Multicampus initiative on Coastal Adaptation

## MULTICAMPUS RESEARCH PROGRAMS AND INITIATIVES

*Systemwide research to strengthen the UC research enterprise*

**Goal:** understand the use and integration of science with coastal adaptation planning, policy, and action in order to build UC's research capacity to support effective climate change adaptation

1. Review understanding of coastal hazards, climate impacts, adaptation science needs
2. Convene experts, target science for ground policy development
3. Coordinate with communities... to identify gaps that UC could help address in the next ~5 years to support adaptation.

UC SANTA CRUZ

UC San Diego

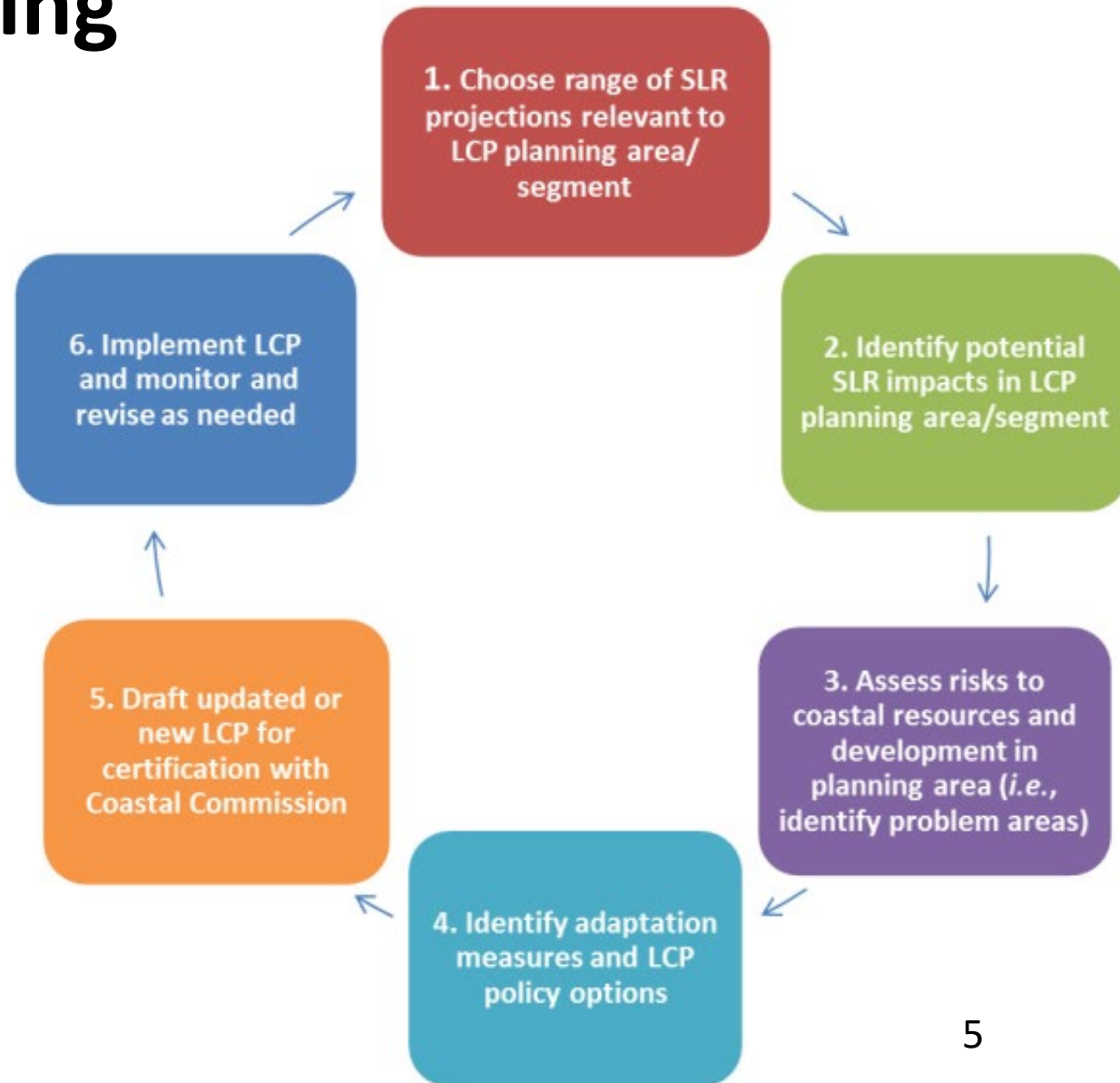
UC SANTA BARBARA

# (Coastal) Adaptation Planning Process

CA Coastal Commission SLR Guidance, 2018

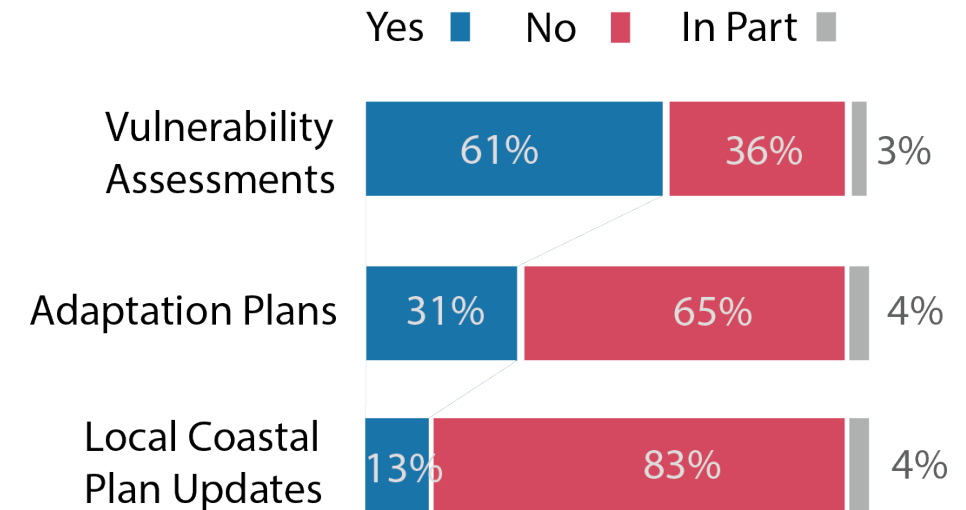
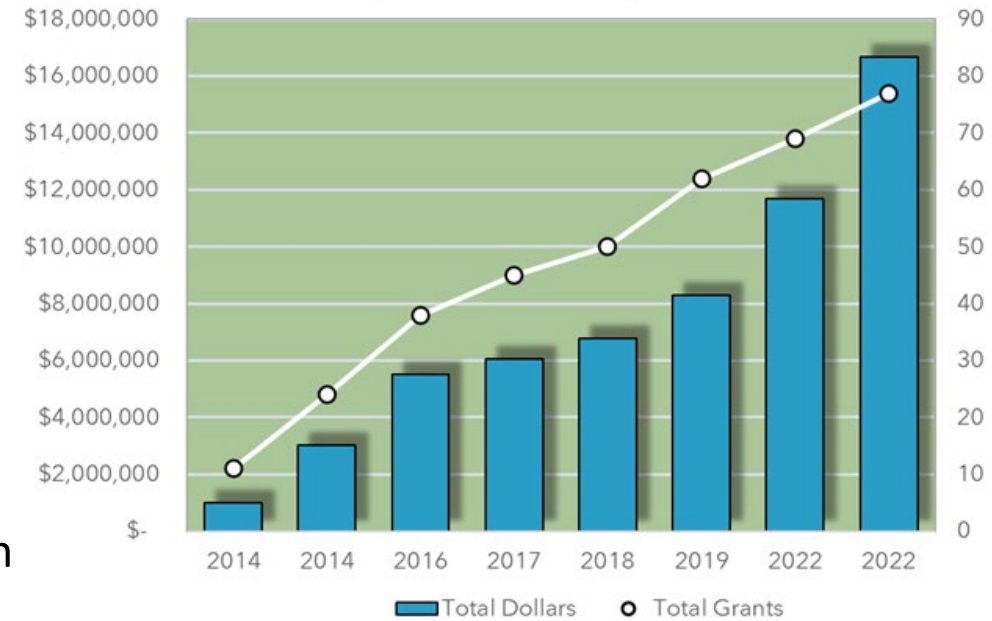
**Local Coastal Programs (LCPs)** are basic planning tools used by local governments to guide development in the coastal zone.

- LCPs contain the ground rules for future development and protection of coastal resources in the 76 coastal cities and counties.
- 126 coastal zone jurisdictions separated into geographic segments

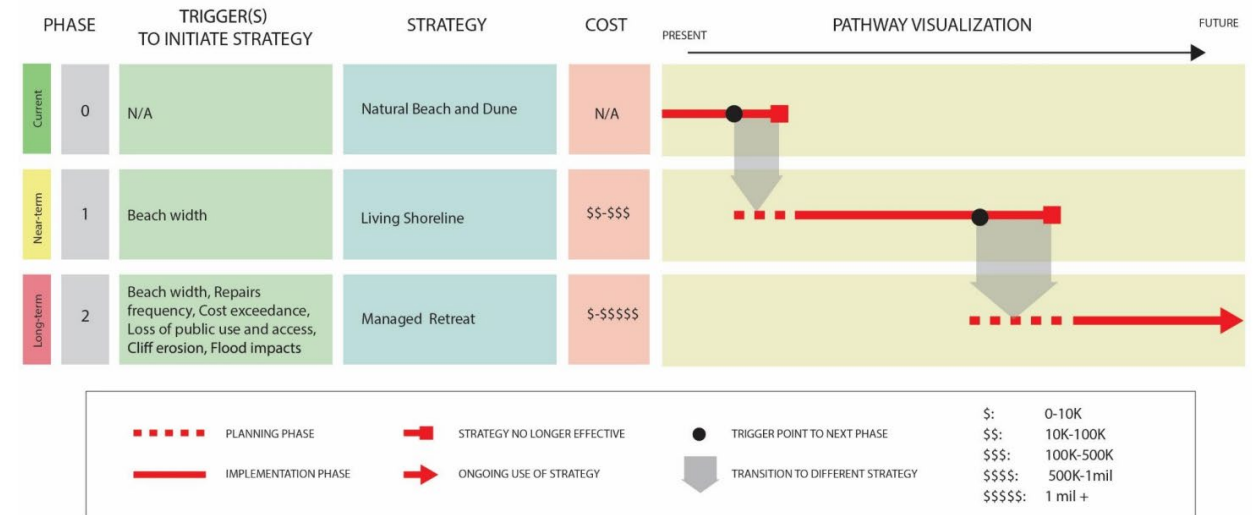
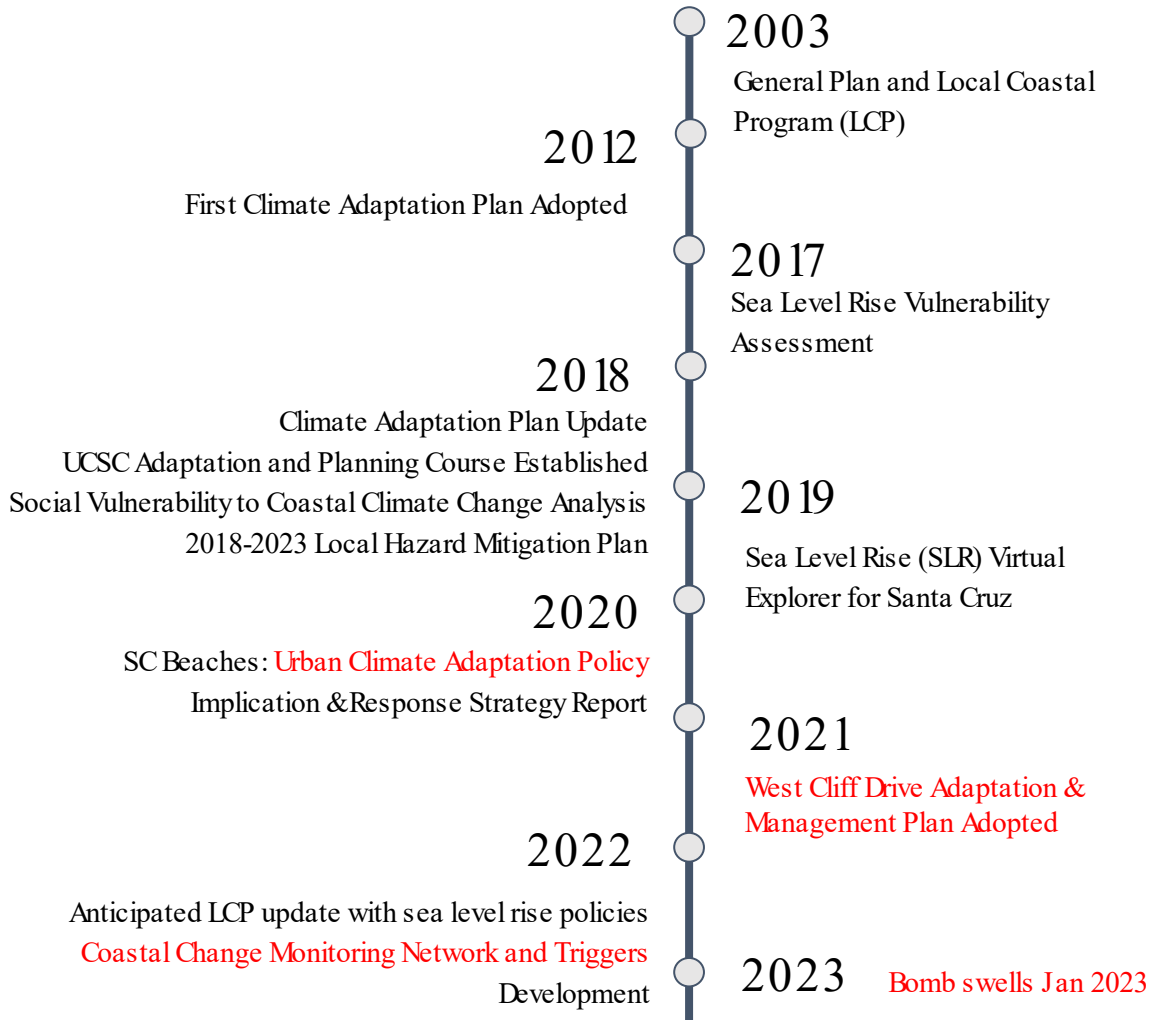


# Challenges so far

1. **The identification and implementation of “actionable” strategies**
2. **Interventions often occur independently of an adaptation plan (e.g. NBS)**
3. **Transboundary effects: geographic scale and sectoral coverage**
  1. Regional vs local strategies (e.g. SF Bay Shoreline Adaptation Atlas)
  2. legislation for the establishment of special districts to address flooding hazards and financing across legal jurisdictions
4. **Equity, inclusion and engagement** – climate equity and environmental justice implications of adaptation responses
5. **Embracing adaptation pathways** - integrating the monitoring of changes in environmental and social conditions with community vision and values



# Example: Santa Cruz, CA



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# Key information, knowledge and technological gaps

## Roadmap for targeted adaptation science (UC system)



1 What is projected to happen?

2 How can we better communicate this change?

3 How can we center environmental justice, equity, and communities in adaptation investments?

4 What works?

5 How can we effectively implement adaptation pathways and avoid maladaptation?

6 Monitoring and Technology for implementation: when intervention should be implemented and how to measure their performance?

7 How can we better integrate researcher and practitioner objectives to better support actionable adaptation?



# Key information, knowledge and technological gaps Roadmap



What is  
projected to  
happen?

## A. COASTAL CLIMATE CHANGE

- Total water level components
- Updated (local) projections
- Short to long-term variability
- Local wave action

## B. COASTAL IMPACTS

- Advances in flood mapping
- Historic information on impacts
- Erosion rates and shoreline change
- Coastal access and recreation
- Coastal squeeze and ecosystem change
- Coastal ecosystems structures
- Coastal Infrastructure at risk
- Regional connectivity
- Groundwater
- Economic effects

# Key information, knowledge and technological gaps Roadmap

2

How can we better  
communicate this  
change?

- Advances in decision support tools
- Improving coastal change communication

*(Abundance of information available to guide adaptation planning process is both a strength and a weakness of the current state of coastal planning)*

3

How can we center  
environmental justice,  
equity, and communities  
in adaptation  
investments?

- Quantification of Climate vulnerability
- Equitable distribution of adaptation benefits

# Key information, knowledge and technological gaps Roadmap

4

**What works?**

- Evaluation of available solutions and their cost-effectiveness
- Quantitative adaptation pathways
- Nature-based Adaptation
- Wetland restoration
- Spatial distribution of benefits and regional interconnection between strategies
- Costs and Benefits
- Climate co-benefits

5

**How can we effectively implement adaptation pathways and avoid maladaptation?**

- Effects across time horizons
- Framing long-term needs in shorter term programs
- Making decisions based on available science
- Addressing the adaptation finance gap

# Key information, knowledge and technological gaps Roadmap

6

Monitoring and Technology for implementation: when interventions should be implemented and how to measure performance?

- Targeted monitoring of the coastal system across scales
- Technology advances to support implementation

7

How can we better integrate researcher and practitioner objectives to more effectively support actionable adaptation?

- Regional collaboration and partnerships in coastal resilience
- Alignment of academic incentives and adaptation progress



# Conclusions

- **7 adaptation-centered research questions**
- **33 specific research gaps** to address through actional science
- To be resolved by working together with practitioners and planners. It requires **local, regional, and state partnerships** with stakeholders and agencies, and intercampus collaboration
- Collectively, UC campuses can bring the expertise, technology, capacity, and relationships to holistically address these 7 questions
- A **UC-wide disaster resilience hub** can serve as an advisory body to local adaptation could critically support the integration of science with on-going coastal adaptation practice





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## UC Multicampus Climate Resilience Initiative

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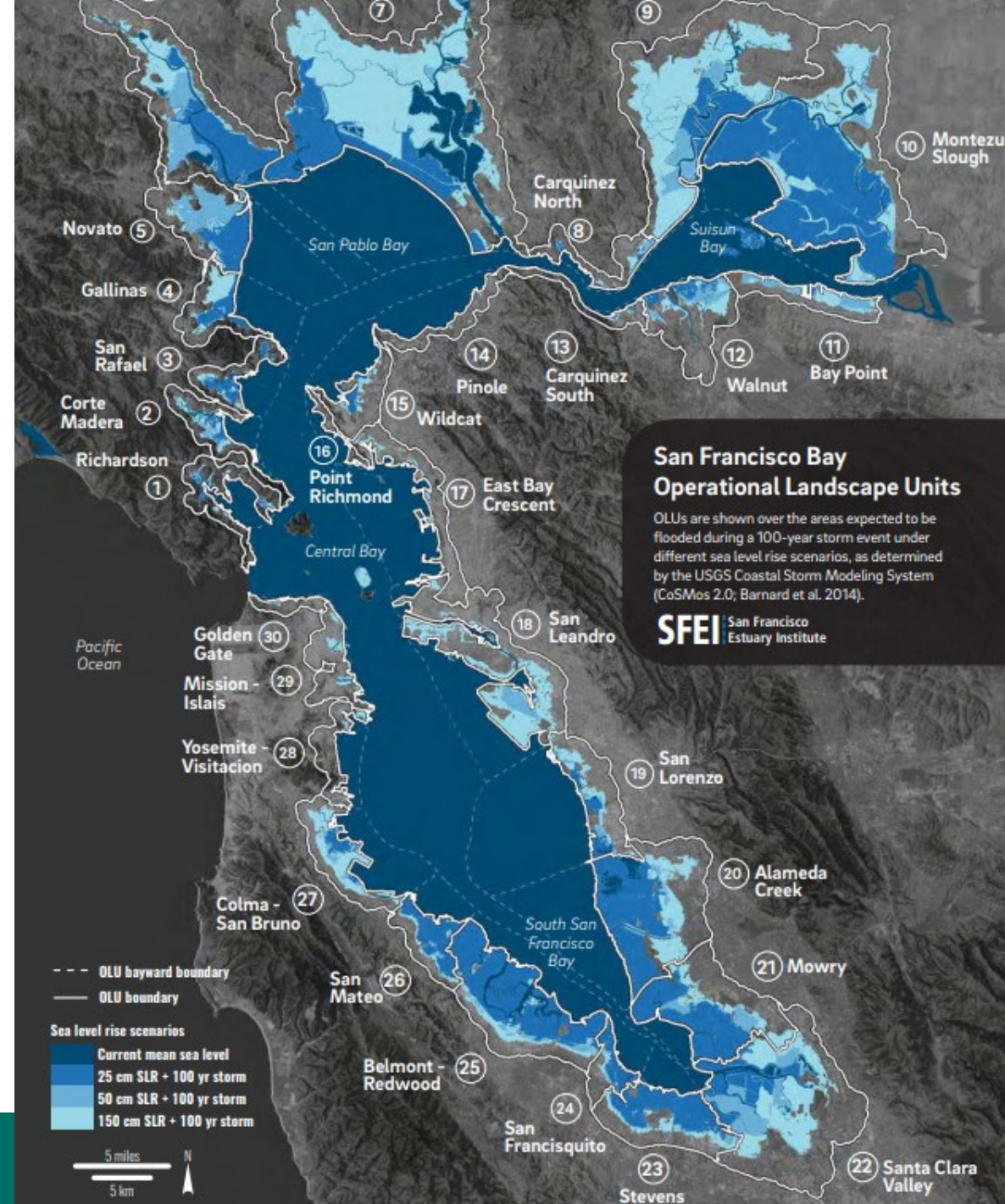


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# General trends

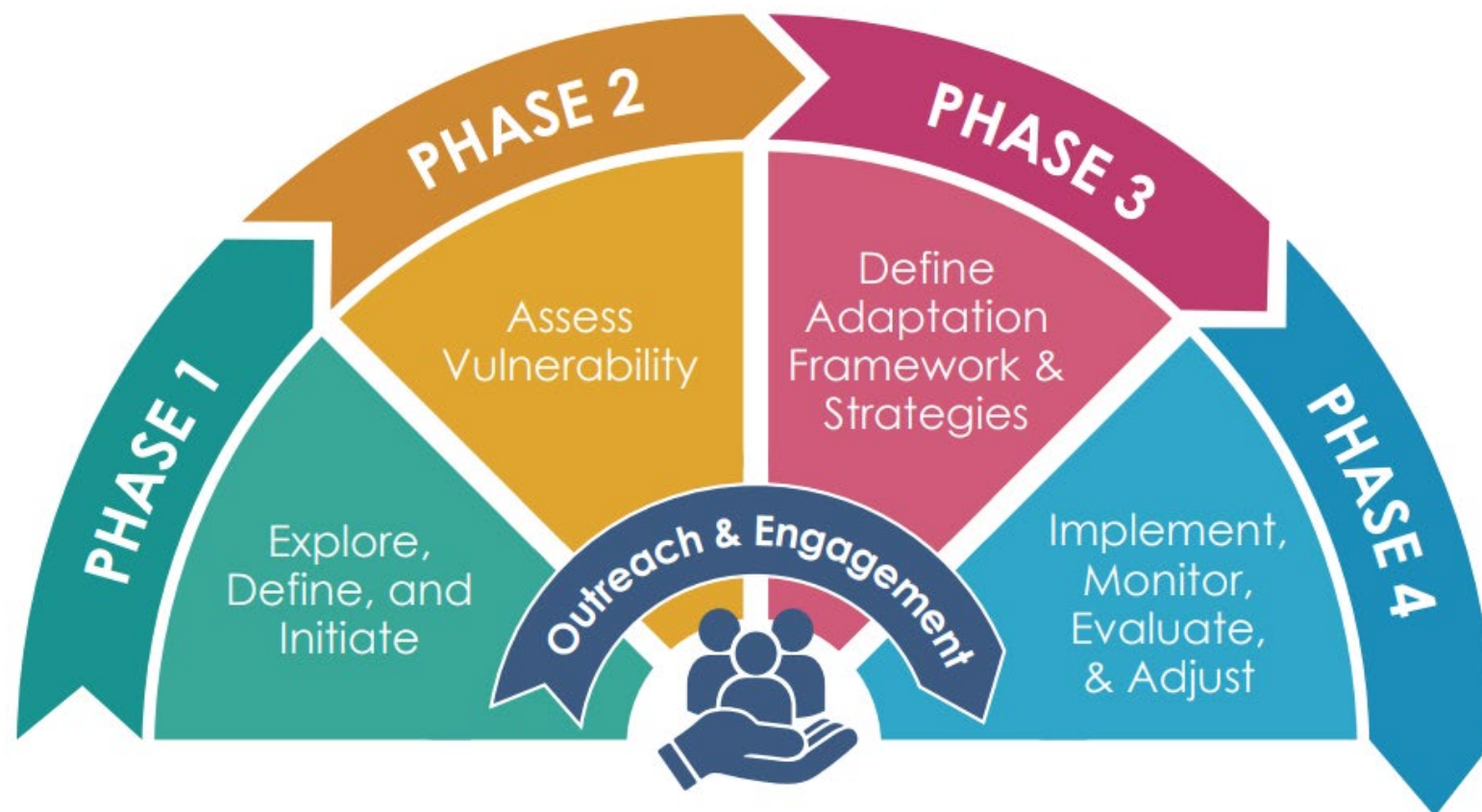
- 1) **The need for regional strategies.** Ex. San Francisco Bay area, through hydrological connection between communities.
- 2) **Use of special ‘coastal adaptation’ districts to address hazards and financing challenges.** Ex. “neighborhood scale” planning
- 3) **Increasing focus on social equity, inclusion and community engagement,** which are featured in multiple state guidance documents
- 4) **Dynamic re-visioning of the adaptation planning process and the use of “adaptation pathways”,** by linking future actions to potential changes in environmental and social conditions.



# (Coastal) Adaptation Planning Process

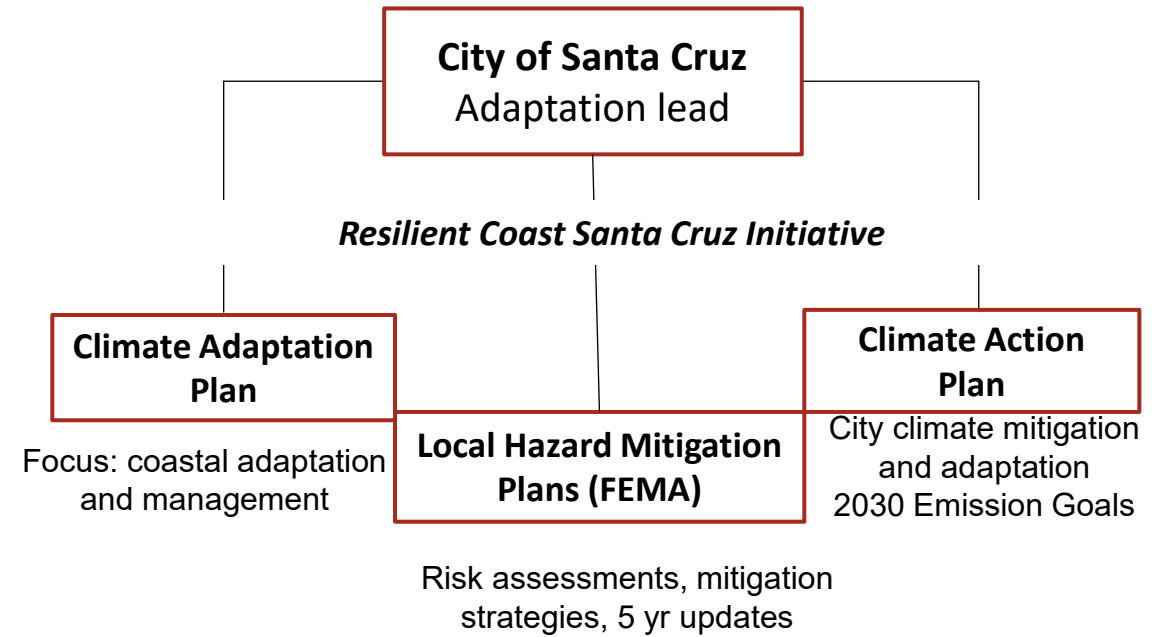
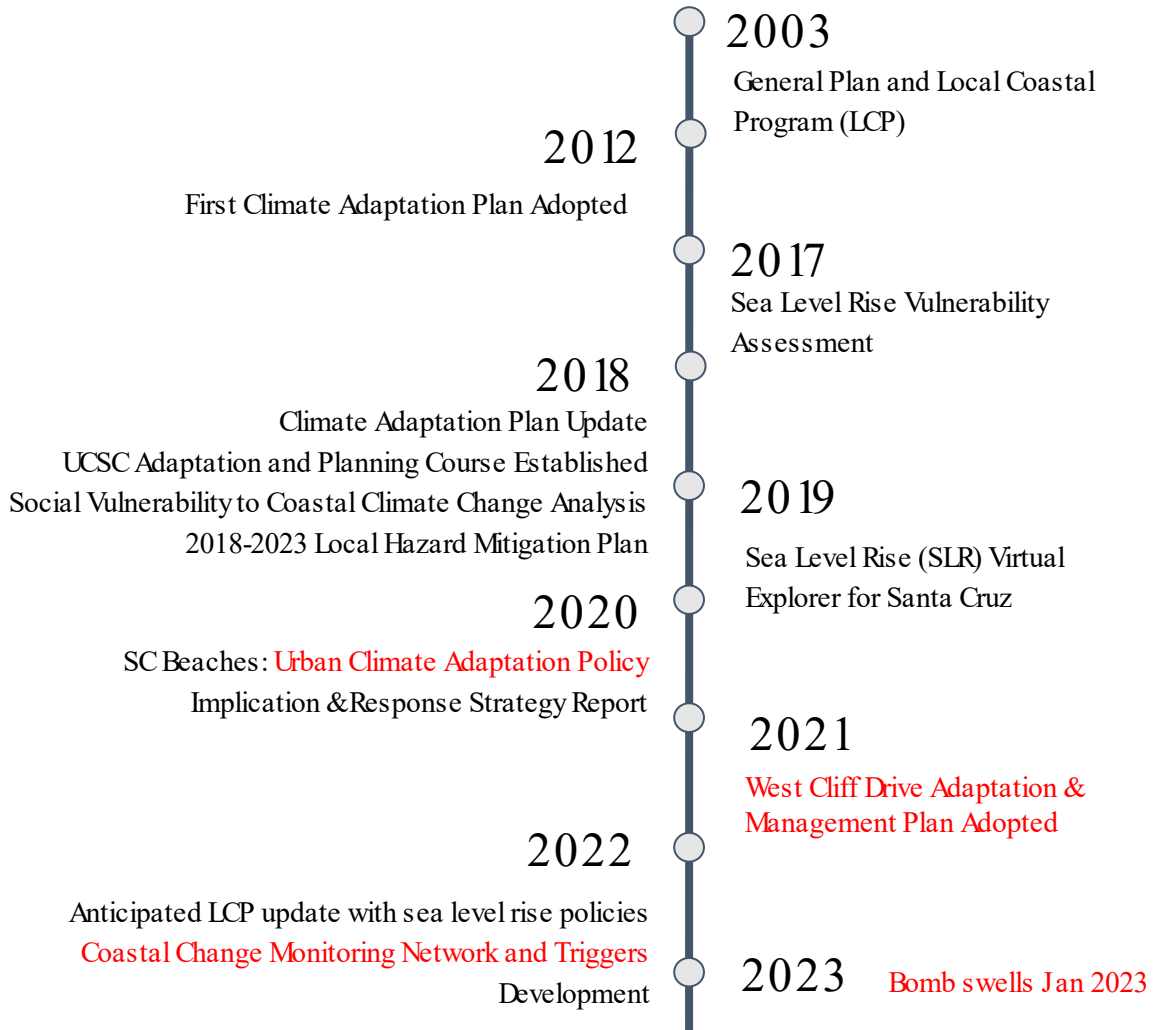
[Adaptation planning guide](#)  
(2020)

A 4 Step-by-step process that communities can use to plan for Climate Change





## Example: Santa Cruz, CA



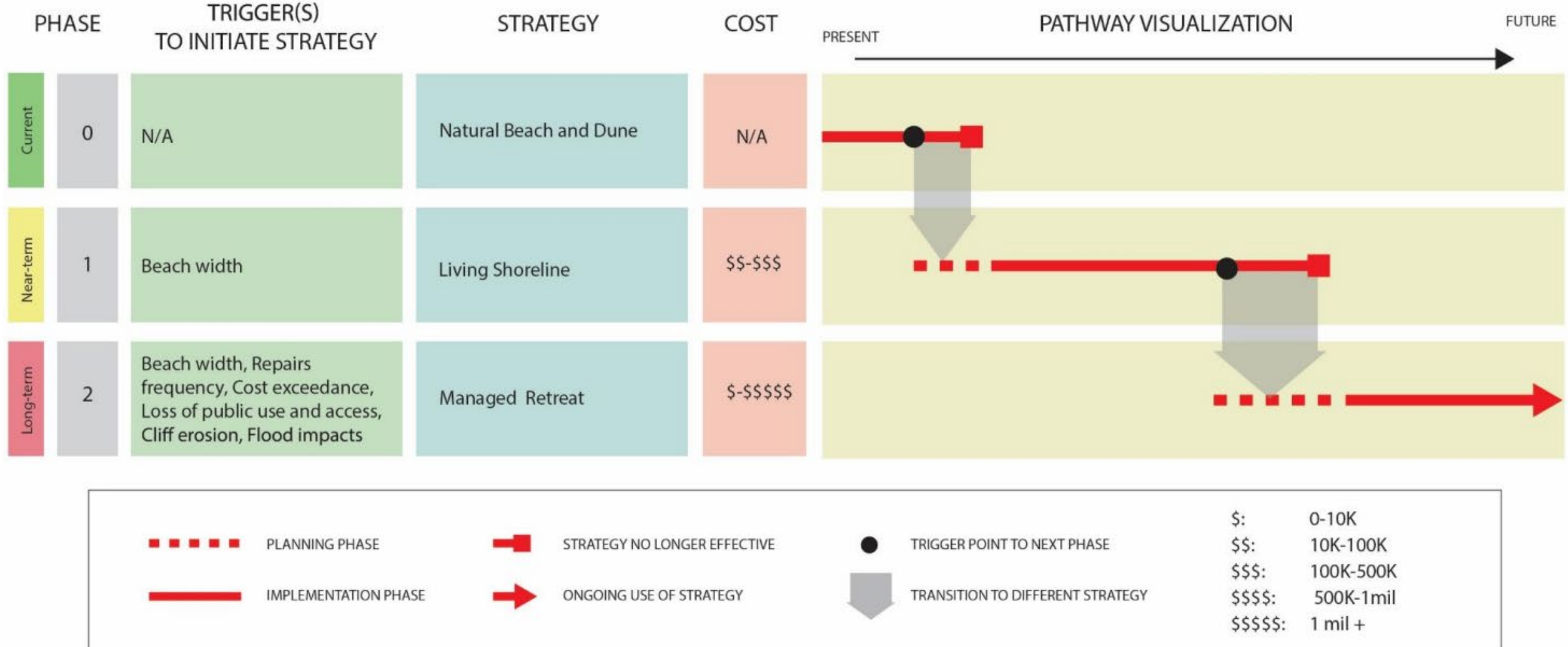


Figure 63. Natural Bridges State Beach adaptation pathway