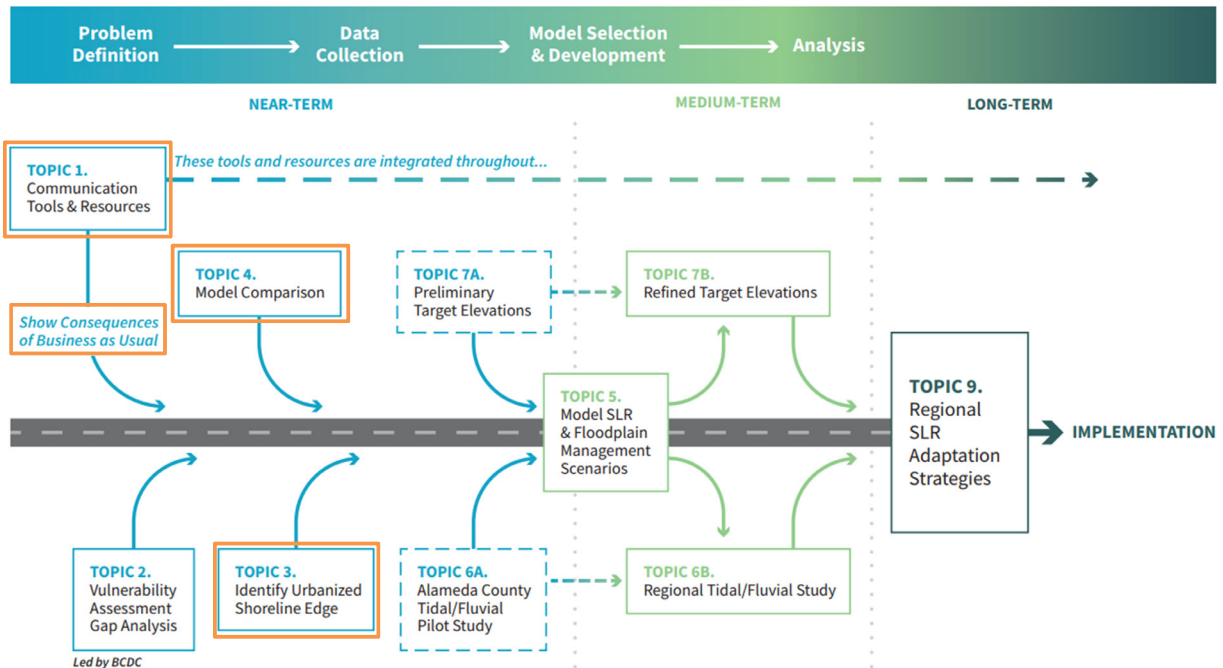# Technical Priorities to Support Regional Sea-Level Rise Adaptation and Resilience

Presenter: Matt Brennan, PhD, PE
Environmental Science Associate (ESA)

10/3/19

This is a representation of the "road map" of the tasks outlined in CHARG's Technical Priorities Plan (TPP). The TTP is CHARG's workplan for the next 1-2 years to create the technical basis and modeling building blocks to provide input into regional SLR adaptation strategies.

The items outlined in orange are the topics of today's presentation.

Presentation Outline
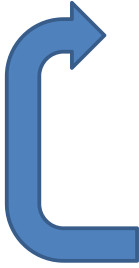
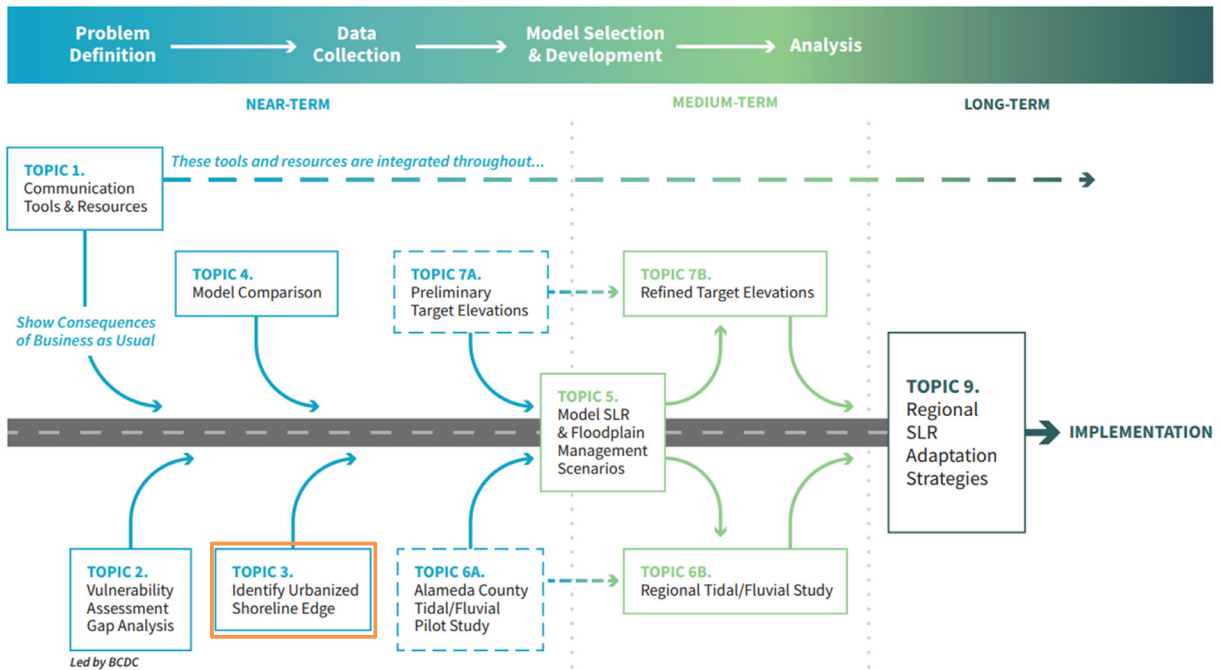**Topic 1: Communication Tools & Resources**

    Hydraulically Connected Jurisdictions

    Business-As-Usual ROM Cost Estimate

Topic 3: Identify Urbanized Shoreline Edge

Topic 4: Model Comparison

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Topic 3. Identify and document the current and planned urbanized shoreline edge of San Francisco Bay

Results will provide accurate shoreline boundaries for use in modeling and in adaptation planning.

Value: Increased transparency on modeling inputs and assumptions, avoiding future disruptions when modeling results are questioned, and ensuring more accuracy and uniformity across the region.

Urbanized Shoreline Edge

- Landward alignment
  - Assumes existing buildings and infrastructure to be protected

  OR
  - High ground at 100-yr water level + 5 ft SLR

- Bayward alignment
  - Landward alignment

  AND
  - Assumes wetlands used for industrial processes, proposed shoreline development, and agricultural lands to be protected

- Difference in area
  - 35% of San Pablo Bay
  - 26% of South Bay

Note: These alignments are based on readily available information, and only intended for high-level regional planning. Actual land use decision-making authority remains with local agencies and land owners.

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Legend:
— Urban Edge - Bayward Alignment
— Urban Edge - Landward Alignment
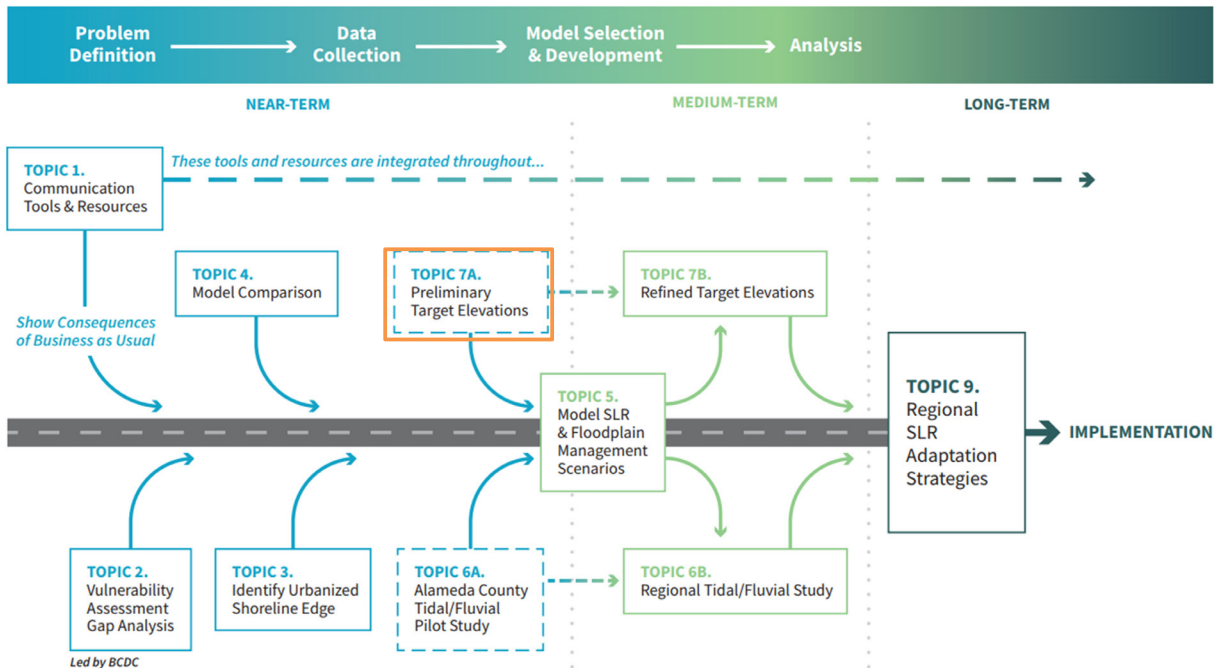▨ Difference
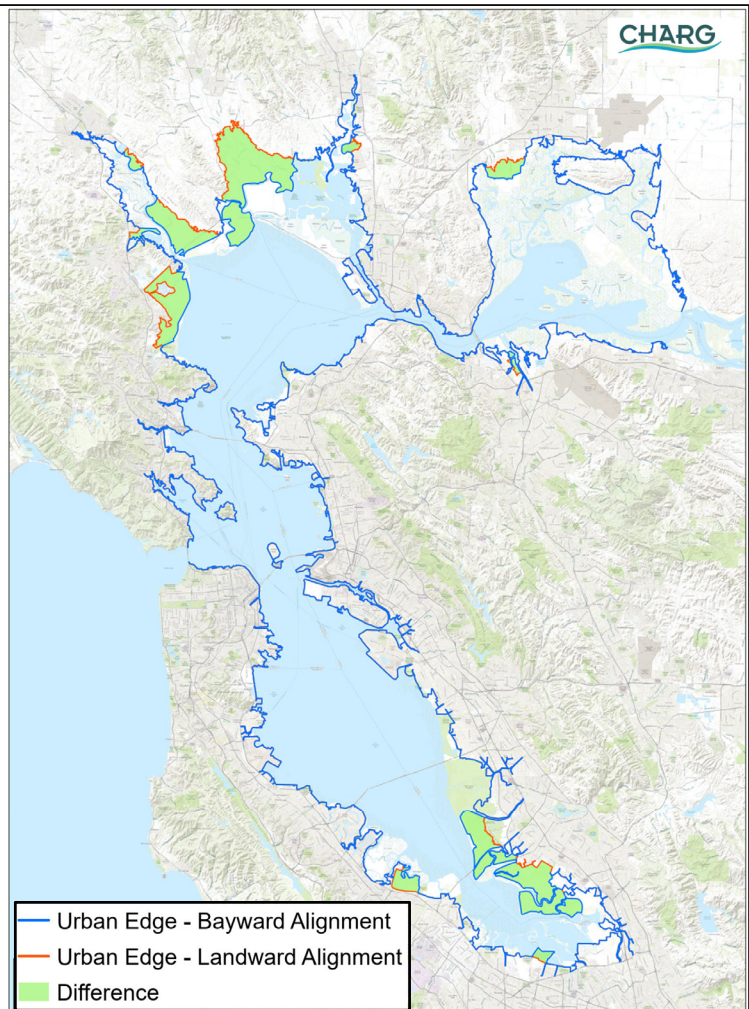
Where are we protecting? Two alignments are shown (landward and bayward emphasis).

Areas in green indicate large regions identified with potential optional futures.

Managed retreat not yet addressed, requires more input from local land owners and municipalities.

Topic 7. Identify threshold water levels along the San Francisco Bay shoreline where flood protection requires subregional and regional coordination.

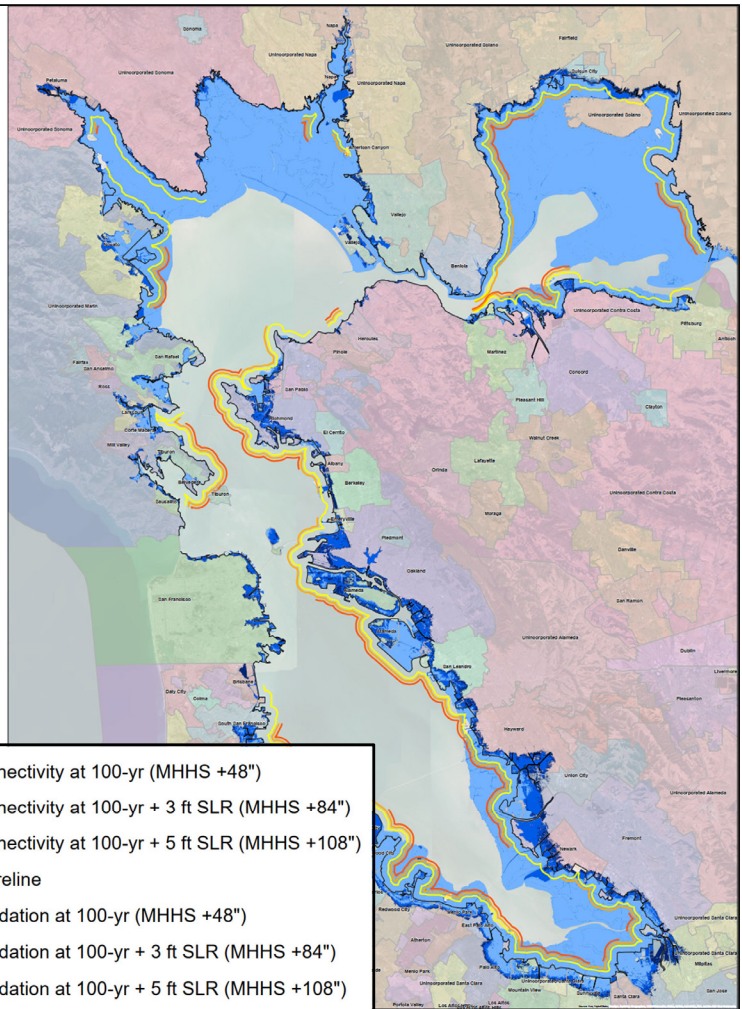**Results** will raise awareness of the need for multi-jurisdiction coordination for effective flood protection with SLR.

Value: identify the water level at which neighboring or regional jurisdictions must coordinate on flood protection and adaptation.

Hydraulically Connected Jurisdictions

- Methodology
  - ART inundation mapping for:
    - 100-yr storm surge
    - 100-yr + 3 ft SLR
    - 100-yr + 5 ft SLR
  - Assign urbanized shoreline edge to city boundaries
  - Identify connected boundaries where inundation depths exceed one foot for more than 200 linear feet of city-to-city boundary

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Legend:
- Connectivity at 100-yr (MHHS +48")
- Connectivity at 100-yr + 3 ft SLR (MHHS +84")
- Connectivity at 100-yr + 5 ft SLR (MHHS +108")
- Shoreline
- Inundation at 100-yr (MHHS +48")
- Inundation at 100-yr + 3 ft SLR (MHHS +84")
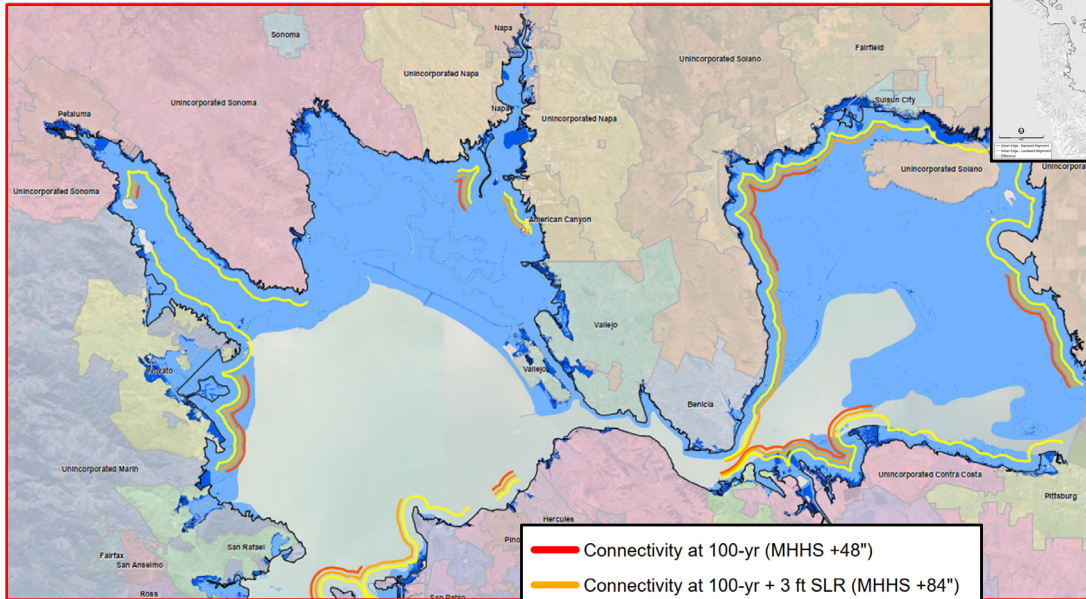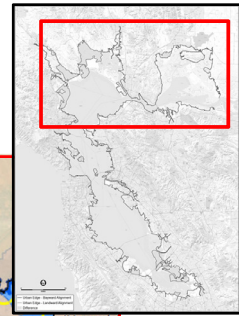- Inundation at 100-yr + 5 ft SLR (MHHS +108")

CHARG and ESA are working on a tool to visually represent where and under which scenarios flooding crosses municipal boundaries. For example, City A may have coastal flood protection measures in place, but if adjacent City B does not, City A will still be at risk under certain situations.

Hydraulically Connected Jurisdictions:
Central & South Bay
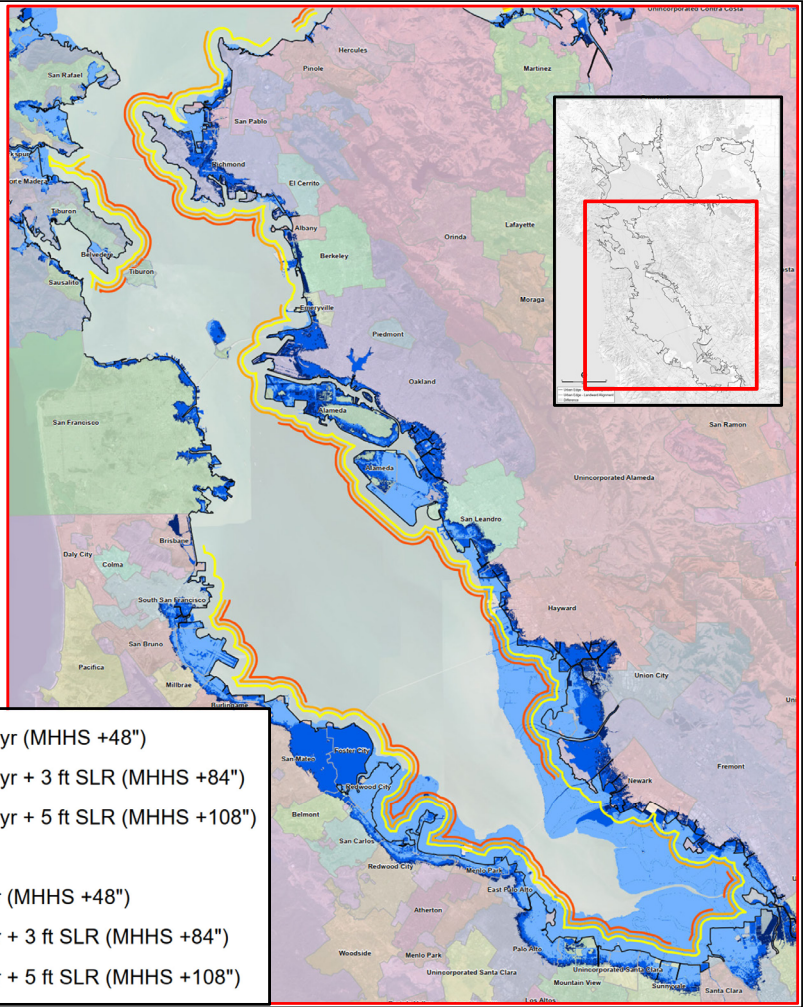
Legend:
- Connectivity at 100-yr (MHHS +48")
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- Shoreline
- Inundation at 100-yr (MHHS +48")
- Inundation at 100-yr + 3 ft SLR (MHHS +84")
- Inundation at 100-yr + 5 ft SLR (MHHS +108")

Hydraulically Connected Jurisdictions: North Bay
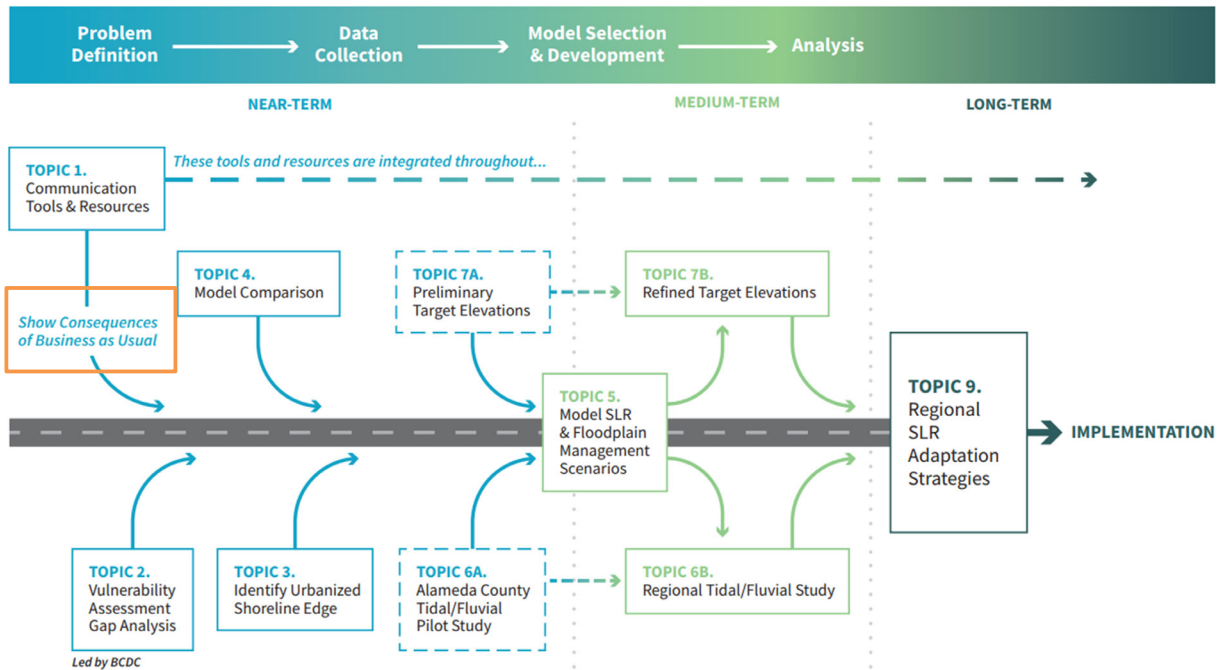

Legend:
- Connectivity at 100-yr (MHHS +48")
- Connectivity at 100-yr + 3 ft SLR (MHHS +84")
- Connectivity at 100-yr + 5 ft SLR (MHHS +108")
- Shoreline
- Inundation at 100-yr (MHHS +48")
- Inundation at 100-yr + 3 ft SLR (MHHS +84")
- Inundation at 100-yr + 5 ft SLR (MHHS +108")

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Technical Priorities Road Map

To make a case for action, we need to understand the consequences and costs of doing "Business as Usual" in the Bay.
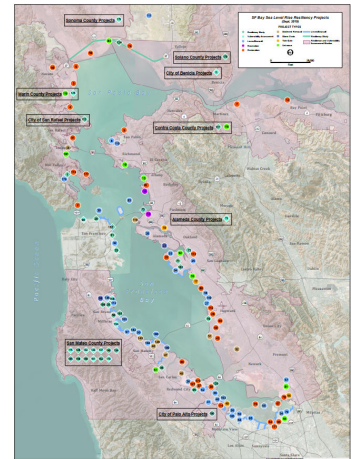
Business-As-Usual: Defined

- Protect along urbanized edge – landward alignment
- Design elevation:
    FEMA freeboard + 3 ft SLR
- Raise bay shoreline levees & floodwalls
- Creeks with 100-yr discharge greater than 1,000 cfs: Raise levees & floodwalls
- Creeks & interior drainage with 100-yr discharge less than 1,000 cfs
    - Manage interior drainage with pump stations and tide gates
- Erosion protection for high ground constrained by development
- Allow high ground unconstrained by development to retreat

—— Urban Edge - Bayward Alignment
—— Urban Edge - Landward Alignment
▇ Difference

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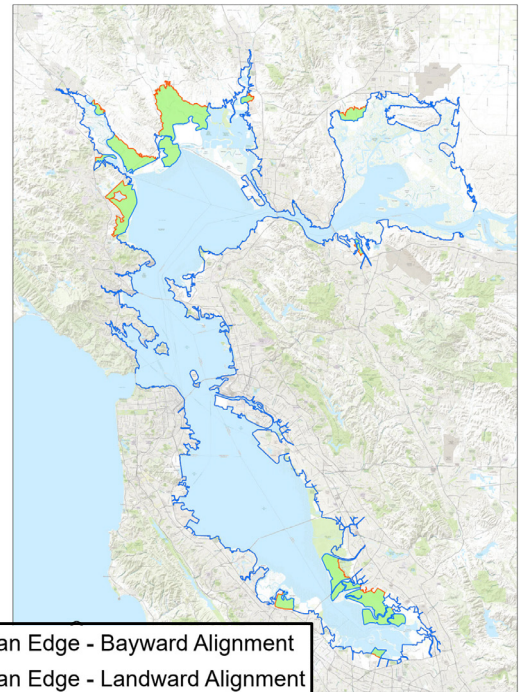
Cost Estimating Sources

- Existing projects with at least rough-order-of-magnitude (ROM) cost estimates
  - E.g. South SF Bay Shoreline Project – Alviso, San Francisco Seawall, Treasure Island, SAFER Bay
  - Approximately 9% of shoreline

- Unit Costs

Shoreline Type	Unit Cost, $ / linear foot
Seismically stabilized seawall	$300,000
Raise shoreline elevation	$4,000
Landfill cap stabilization & erosion protection	$3,000
High ground w/development - erosion protection	$1,000

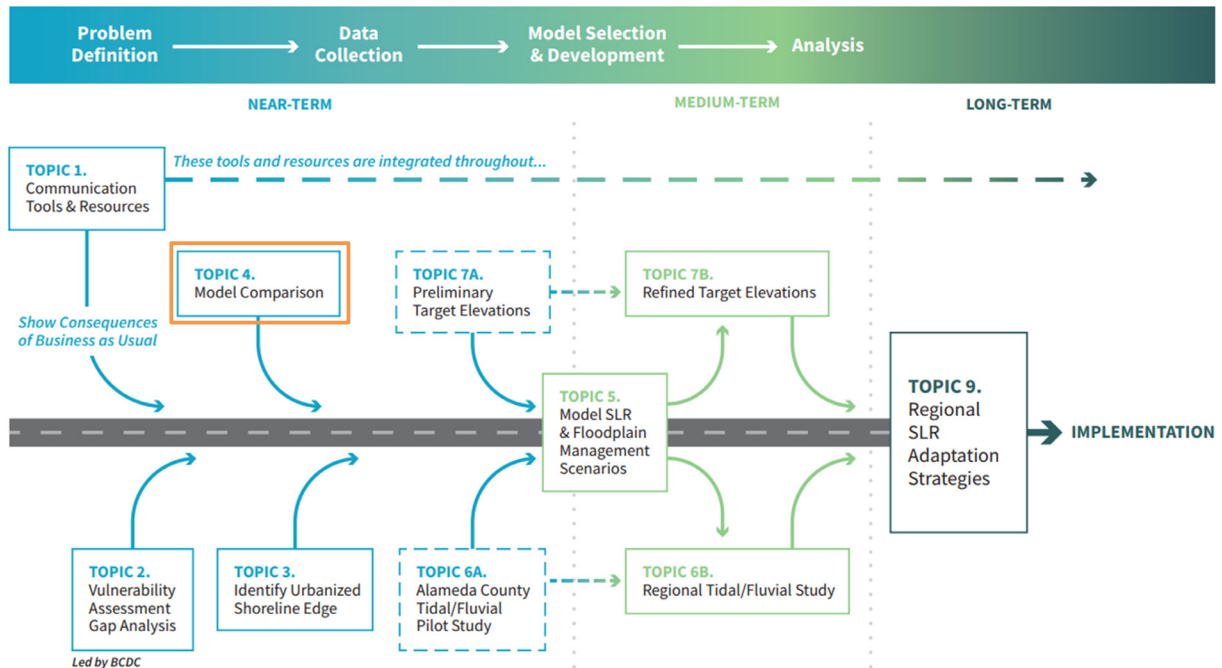**CHARG**

Business-As-Usual ROM Cost Estimate
Bay Area Shoreline Protection, 3 ft SLR

County	ROM Cost Estimate, Billions dollars
Alameda	$14.0
Contra Costa	$1.9
Marin	$3.5
Napa	$0.9
San Francisco	$10.9
Santa Clara	$1.6
San Mateo	$3.5
Solano	$1.3
Sonoma	$0.7
Total	**$38.4**

Including: construction, design, environmental compliance, project management
**Not including:** mitigation, right-of-way

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Topic 4. Compare models suitable for sea level rise analysis in San Francisco Bay.

Results will allow floodplain managers to more quickly select models and compare between models for vulnerability and adaptation planning for more efficient use of resources.

Value: Enables flood managers to provide more value to constituents by being more conversant on various models and results, and making more informed and cost-effective recommendations to decision-makers.
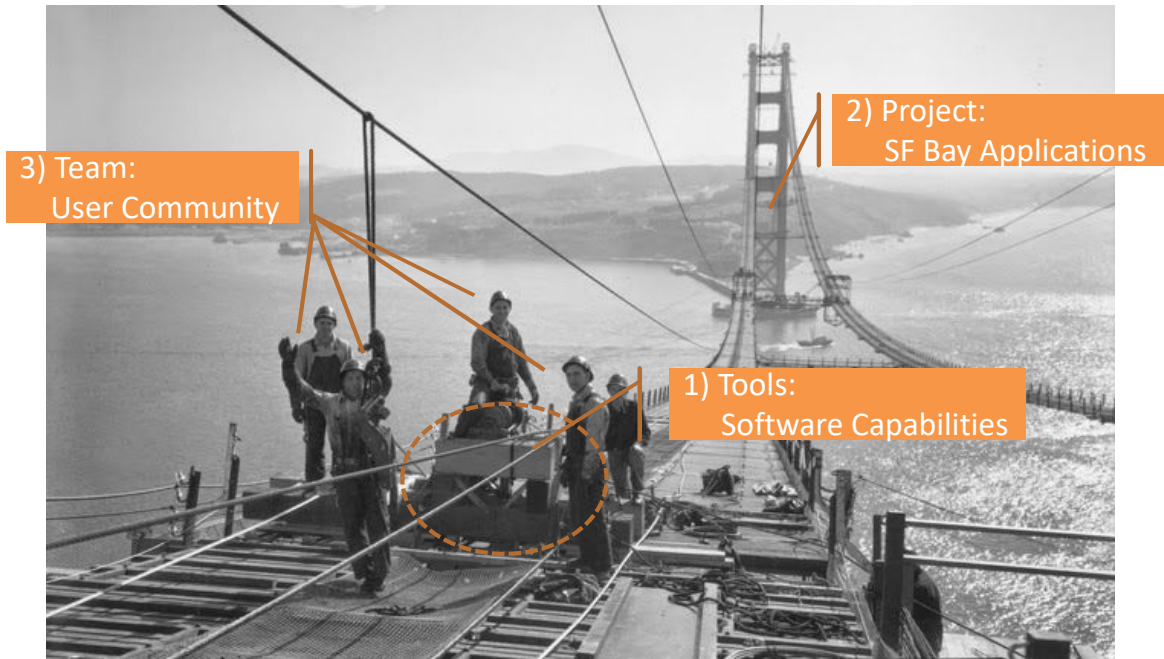
There are three components to any analysis of this type: the Tools, the Project application, and the Users / Team

Tools: Software Capabilities

- Hydrodynamics
  - 2D water levels and velocities, forced by tides, discharge, and winds
- Waves
  - Wave generation, propagation, and attenuation
- Additional capabilities
  - 3D hydrodynamics
  - Water quality (e.g. salinity, nutrients)
  - Sediment transport & geomorphic change

- Exemplars:
  - Coupled software suites water quality: SCHISM, Delft3D, MIKE, UnTRIM

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Rules out most 'bathtub' approaches (ART, NOAA SLR Viewer), since they don't have representation for the physics, models cannot predict changes

# Projects: Applications in San Francisco Bay

- **Domain & geometry**
  - Extent – Bay & Delta
  - Resolution – well-resolved levees & floodwalls
- **Model calibration & validation**
  - Bay storm surge
  - Delta flood events
- **Scenarios**
  - Present day flooding
  - Future flooding with sea-level rise, increased rainfall & runoff
  - Operational flood forecasting

- **Exemplars**
  - Calibration & validation for multiple Bay storm surge events
    - FEMA & DHI (MIKE), USACE & Anchor QEA (UnTRIM)
  - Multi-decadal hindcast & extreme value analysis
    - FEMA & DHI (MIKE), USACE & Anchor QEA (UnTRIM)
  - Operational forecasting
    - CoSMoS / USGS (Delft3D)
  - Linked to biological assessment
    - CASCaDE / USGS (Delft3D)

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Team: User Community

- Software costs
- Size of user community
- Institutional custodianship
  - Support ongoing development
  - Integrate updates with systematic version control
- Access to model inputs & outputs

- Exemplars
  - Free or low-cost: HEC-RAS, SCHISM, Delft3D
  - Institutional custodianship: DWR (SCHISM), USGS (Delft3D)
  - Input & methods comparison: Sea The Future
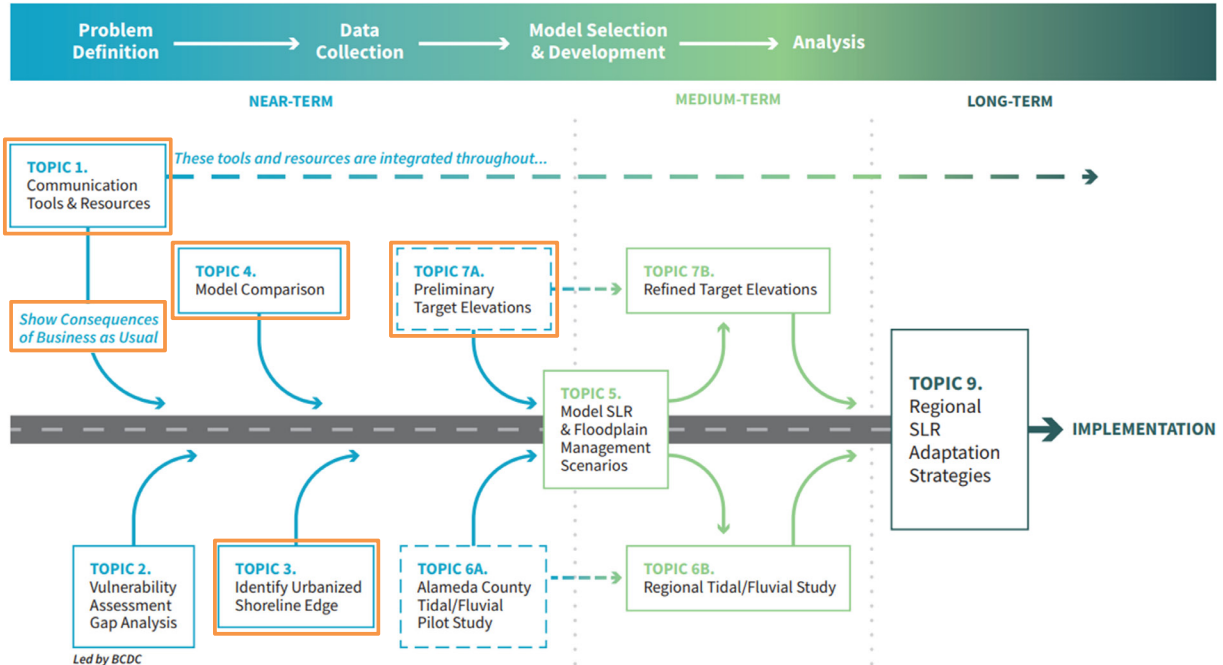
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Many of these CHARG tasks are currently on-going, and we will release them on our website when they are ready. Please contact CHARG with any questions or opportunities for collaboration. We understand that there is a lot of important work happening in the Bay, and we want to provide technical assistance that is useful. Thank you.