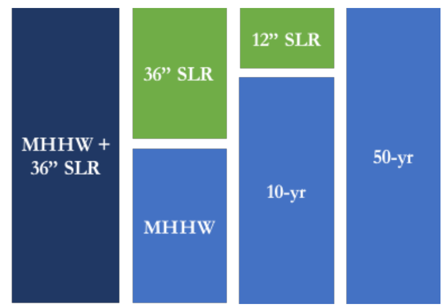
Adapting to Rising Tides

Eastern Contra Costa and Solano Counties Adapting to Rising Tides

Modeling and Mapping

The Eastern Contra Costa ART project will evaluate current and future flooding that is likely to occur on the shoreline from Pittsburg to Clifton Court. As part of the project new modeling will be completed for the eastern portions of Contra Costa and Solano Counties to illustrate where water will go as sea levels rise and storm flooding occurs. The ART approach requires modeling and mapping that is flexible and can accommodate uncertainty and changing climate change projections over time, while still allowing consideration of current best available science and projections. In order to consider current and future flooding, mapping and modeling must show both temporary and permanent flood risk at current and future water levels.

In the Bay - The ART maps of the Bay (developed in partnership with AECOM) accomplish this by evaluating inundation and vulnerability of shoreline areas at 10 different water levels, from 12” to 108” above current average high tide (also known as mean higher high water), rather than pre-determined sea level rise scenarios tied to a specific time horizon. This “One Map, Many Futures” approach enables exploration of dozens of possible sea level rise and extreme tide (storm surge) combinations. This approach can be used to approximate impacts from either 1) anticipated daily high tide levels in the future or 2) temporary flooding from the combination of sea level rise and extreme tides.



This building blocks diagram demonstrates that three scenarios of sea level rise and storm surge can produce the +36” water level

In the Delta – The Delta is fundamentally different than the Bay because it is influenced not only by daily tides, but also the freshwater inputs from the Sacramento and San Joaquin Rivers. Previous hydrodynamic modeling studies of sea level rise in the Bay-Delta have indicated that increased water levels at the Golden Gate may not produce a 1:1 increase in water levels everywhere within the Bay-Delta estuary. This may be particularly true in the area upstream of the Benicia Bridge where complex interactions between Bay tidal processes and Delta freshwater inflow processes occur.

Therefore, the complex dynamics of the Delta region require different modeling to understand how fresh water flows and Bay water levels at different locations in the Delta will interact and change with rising sea levels. The ART Program is working with AECOM and Anchor QEA on new modeling of sea level rise and flood scenarios for eastern Contra Costa and eastern Solano Counties—specifically, the modeling will be conducted for the shoreline eastward of the Benicia-Martinez Bridge southward to the Contra Costa-Alameda County line at Clifton Court Forebay and eastward to the Solano-Yolo County line at Liberty Island. This new modeling will inform the Eastern Contra Costa ART Project and is expected to produce mapping products that can be used in parallel with the ART maps of the Bay.

The sea level rise modeling will be conducted using the existing UnTRIM Bay-Delta three dimensional model developed by Michael MacWilliams of Anchor QEA. This model has been used and tested extensively in the Bay and Delta, including for the California Department of Water Resources (CDWR), the U.S. Bureau of Reclamation (USBR), the U.S. Geological Survey (USGS), and the U.S. Army Corps of Engineers (USACE) (MacWilliams, et. al. 2015). The model has successfully simulated water levels over broad time scales

Sea Level Rise Scenarios

In March 2018 the Ocean Protection Council adopted updated guidance for state and local governments to adapt to rising sea levels. The report updates the 2013 sea level rise guidance based on new science for ice sheet melt in Antarctica and Greenland, and probabilistic, projections for of amounts of sea level rise.

For the San Francisco Bay Area the new guidance recommends water levels for planning ranging from low risk aversion project (i.e. low consequences if the site is flooded) in 2030 to an extreme risk aversion project in 2150. The water levels range from 6 inches for low risk aversion in 2030 to 21.9 feet for extreme risk aversion in 2150. This very broad range of potential water levels is difficult to model and also challenging to use in guiding a planning process. Low increases in sea level are difficult to accurately model due to the margin of error inherent in the models and in the elevation data for the shoreline, and the reliability of models at very high rises in sea level begins to fall due to the changes in landscapes and hydrologic systems that would likely occur (but are hard to predict) with very large changes in sea level.

The Eastern Contra Costa ART Project will analyze water levels ranging from 12 inches to 83 inches, which covers many of the potential scenarios in the state guidance: ranging approximately from the low risk aversion recommendation at 2050 (1.1 feet) to the medium-high risk aversion at 2100 (6.9 inches). Specifically, this range will inform broad vulnerability analyses and adaptation planning that can help inform more detailed site/project specific planning.

throughout the entire Bay-Delta Estuary, including the impacts from tidal and non-tidal influences (i.e. freshwater inflow and storm surge) (MacWilliams, et. al. 2015).

The UnTRIM model will be applied to compute daily tidal datums and extreme water level along the eastern Contra Costa and Solano county shorelines—this will provide a baseline from which to understand how water levels will change with sea level rise. Specifically, the UnTRIM modelling process will begin by simulating a 1980-2014 time period under present day sea level conditions. Simulated water levels will be compared with the modeling used for the Bay ART maps to develop results and at similar spacing in the Delta which will allow the calculation of daily and extreme water levels along the Delta shoreline.

Next, the model will also be used to simulate several sea level rise scenarios, capturing the complex interactions between the Bay and freshwater inflows, and providing the inputs needed to map sea level rise inundation in the eastern portions of the counties. Simulations using SLR amounts of 12”, 36”, and 83” will be conducted and water level time series will be used to evaluate the sea level rise response for daily and extreme water level events throughout eastern Contra Costa and Solano counties.

Based on the results, additional water levels will be calculated in between these three values (i.e. at 24”, 48”, 60” etc.). Using the “One Map, Many Futures” approach (discussed above), maps illustrating the multiple water levels will be created.

Shoreline overtopping can occur when water levels rise higher than the shoreline, allowing water to flow inland. The ART maps for the Delta will depict the elevation of the shoreline and illustrate not only where overtopping may occur, but how deep the water may be. Additionally, the Delta maps will include low-lying disconnected areas – locations that are lower in elevation than the nearby water surface, but currently protected by a higher shoreline. Given the ability of water to make its way to low areas, we know that there is existing or future flood risk in these areas due to potential connectivity via culverts, storm drains, or other features, or from rising groundwater levels. In the Delta many of these areas are protected by levees that may be at greater risk due to potential levee failure.

- Historical inflows and diversions are included in the model through the long-time series analysis and simulation. However, projected changes in hydrology due to increased or decreased rainfall or snowpack caused by climate change, and changes caused by changes in water diversions will not be modeled.
- Merging of the eastern Counties’ datasets with the existing ART maps for the Bay Area is contingent upon the results of the modeling in the Delta. Due to different flooding processes in the Delta and because the GIS layers will be developed using a different modeling approach, it may not be possible to combine all the data layers in a manner that is entirely consistent with the existing mapping products.