Making the case for landscape-scale flood management along California’s coastal transportation corridors

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Transportation corridors as barriers

Physical | Geomorphic | Ecological | Hydrological | Access
Avoiding or mitigating the hazard

Devil’s Slide, San Mateo County

An artist’s rendering of the tunnels’ south portal and public access parking.

Source: Caltrans
Avoiding or mitigating the hazard

Gleason Beach, Sonoma County

PROPOSED CONDITION, PREFERRED ALTERNATIVE (Alternative 19A):
Project shown immediately after bridge and roadway completion. Renderings are conceptual and are currently being refined.
and rehabilitating natural processes...

Ocean Beach Master Plan, San Francisco
Nature-based solutions (my definition)

A nature-based solution performs the same physical function as a corresponding grey infrastructure solution, while:

• rehabilitating and allowing natural processes to occur
• enhancing or restoring natural habitat and aesthetics
• providing greater adaptability and resilience to SLR

A solution that does more than just make a site-specific enhancement, but also integrates with the surrounding landscape and allows it to function
SR 37 Case Study: San Francisco Bay

Key Issues:
- Congestion
- Flooding
- Subsidence
- Connectivity
- SLR Resilience
Making the case... for a new approach

How would these issues be solved using traditional approaches?

Widen the highway

Flood barriers and levees

Mitigation

Shoreline enhancement
SR 37 Flood Vulnerabilities

• SR 37 is protected by complex system of interconnected levees
• Highway acts as a “levee” between Sonoma Creek and Mare Island
• Highway and levees are settling over time
• SLR will cause overtopping of existing levee system and highway
SR 37 Sea Level Rise Vulnerabilities

Disclaimer: The inundation maps and the associated analyses are intended as planning level tools to illustrate the potential for inundation and coastal flooding under a variety of future sea level rise and storm surge scenarios. The maps depict possible future inundation that could occur if nothing is done to adapt or prepare for sea level rise over the next century. The maps do not represent the exact location or depth of flooding. The maps relied on a 5 ft. digital elevation model created from LiDAR data collected in 2010. Although care was taken to capture all relevant topographic features and coastal structures that may impact coastal inundation, it is possible that structures narrower than the 5 ft. horizontal map scale may not be fully represented. In addition, inundation and flooding of bridges along the SR 37 alignment was not evaluated. The maps are based on model outputs and do not account for all of the complex and dynamic San Francisco Bay processes or future conditions such as erosion, subsidence, future construction or shoreline protection upgrades, or other changes to San Francisco Bay or the region that may occur in response to sea level rise. For more content about the maps and analyses, including a description of the data and methods used, please see project documentation for the State Route 37 Integrated Traffic, Infrastructure and Sea Level Rise Analysis Study (UC Davis Reed Ecology Center and California Department of Transportation).
Potential Shoreline Deficiencies

- **Freeboard** – Is the shoreline, levee, or roadway high enough to prevent overtopping by floodwaters?
- **Erosion** – Have waves or high flows eroded the shoreline or levee?
- **Seepage** – Is the shoreline or levee an effective barrier to flow through or underneath?
- **Stability** – Is the shoreline or levee stable from a geotechnical standpoint?
Traditional Flood Protection Strategies

**Levee Improvements**
- Raise elevation of existing levee
- Stability berm on landside slope
- Seepage berm on landside slope
- Erosion protection on waterside slope

**Shoreline Improvements**
- Concrete wall along edge of roadway
- Sheet pile wall along edge of roadway
- Install drainage

**Roadway Improvements**
- Raise elevation of roadway surface
### What is the cost to address freeboard alone?

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Existing Conditions</th>
<th>2050 (1 ft SLR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High tide</td>
<td>$ -</td>
<td>$1 – 2M</td>
</tr>
<tr>
<td>1-yr</td>
<td>$2 – 3M</td>
<td>$10 – 20M</td>
</tr>
<tr>
<td>10-yr</td>
<td>$10 – 20M</td>
<td>$70 – 80M</td>
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<tr>
<td>50-yr</td>
<td>$50 – 60M</td>
<td>$120 – 140M</td>
</tr>
<tr>
<td>100-yr</td>
<td>$90 – 100M</td>
<td>$140 – 180M</td>
</tr>
</tbody>
</table>

*Estimated costs do not include addressing levee geotechnical issues, environmental mitigation, or land acquisition costs.*
Substantial investment required...

• Substantial investment required to maintain adequate level of flood protection along existing shoreline

• Small-scale fixes can only address localized flooding issues for a small amount of SLR

• Traditional approach inadequate to meet complex needs of today’s standards

• Long-term corridor-wide solution needed to address higher amounts of SLR and integrate highway project into surrounding landscape
SR 37 Environmental Stakeholder Process

Metropolitan Transportation Commission is working with environmental stakeholders to develop a project that address all of the needs

Embankment + Causeway = Hybrid Options
SR 37: an opportunity for a new approach

Integrate transportation, ecosystem, and sea level rise adaptation into one design

Improve mobility across all modes and maintain public access

Increase corridor resilience to storm surges and sea level rise