

# 19. STATE ROUTE 84 - HIGHWAY 101 INTERCHANGE

California Department of Transportation (Caltrans)

## VULNERABILITY SUMMARY

The State Route (SR) 84 / Highway (Hwy) 101 interchange is **highly vulnerable** to sea level rise. It is already exposed to flooding from the Bayfront Canal (Canal) and Atherton Channel (Channel) when high rainfall coincides with high tides and the canals cannot discharge. Although not as common, overtopping of the San Francisquito Creek has also flooded the area. The interchange must close if inundated, making it highly sensitive. Closure would affect thousands of travelers, creating regional impacts. It is already at, or above capacity during peak hours, and detours lack the capacity to support the usual level of service, giving the interchange no redundancy and low adaptive capacity.

<b>SENSITIVITY</b> High	<b>EXPOSURE</b> High	<b>ADAPTIVE CAPACITY</b> Low	<b>CONSEQUENCES</b> High
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## ASSET CHARACTERISTICS

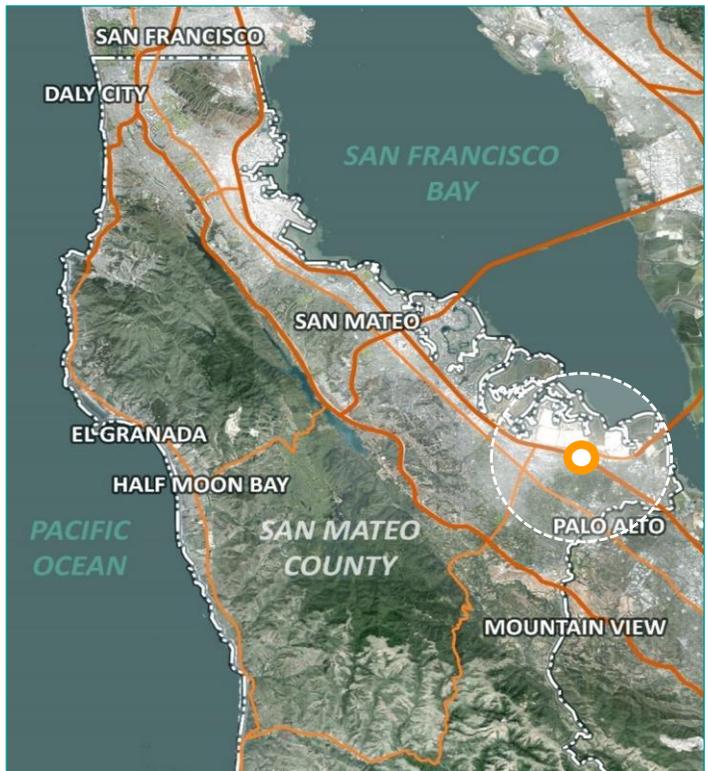
State Route-84 / Highway 101 | Menlo Park

### Asset Description and Function:

The interchange at SR 84 (Marsh Road) and Hwy 101 is a regional transportation node for local, regional, and interregional travel. The interchange is in the City of Menlo Park and consists of a freeway interchange with on/off ramps, ramp meters, and vehicle loop detectors. SR 84 connects to Alameda County and carries 45,500 vehicles daily; Hwy 101 connects peninsula communities, linking San Francisco, San Mateo County, and Silicon Valley, and carries 217,000 vehicles daily.



<b>Asset Type</b>	Transportation Infrastructure
<b>Asset Risk Class</b>	4
<b>Size</b>	23 acres
<b>Year of Construction</b>	1964, 1984
<b>Elevation</b>	Ramps 13.32 feet, NAVD88
<b>Level of Use</b>	260K vehicles per day
<b>Annual O&amp;M Cost</b>	\$1,150,000
<b>Special Flood Hazard Area</b>	Asset is in SFHA
<b>Physical Condition</b>	Good
<b>Landowner</b>	State of California
<b>Underground Facilities</b>	Sanitary sewers, water mains, storm drains, electrical conduits, lighting, transponders, ramp meters, gas lines, and fiber optics are underground.
<b>Environmental Considerations</b>	Special status plants, animals, and natural communities may be present in the project area; a more detailed analysis will be needed before implementing adaptation strategies.



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## ASSET SENSITIVITY

The sensitivity of the interchange directly depends on the severity and extent of inundation, but in general it is highly sensitive to severe flooding. If severely flooded, the highway cannot function. The highway is already at capacity, and with a loss of any lanes of Hwy 101 or the lanes of SR 84, levels of service would be severely decreased. If any of the underground infrastructure (metering and detection equipment) were exposed to salt water, their functions would likely be affected.

To date, ponding under the interchange has not caused a disruption, but future sea level rise could cause deeper or more frequent ponding, disrupting ramp access. While the interchange itself would remain dry because it is elevated, a water level increase of 36 inches is expected to cause flooding on the north side of the interchange, rendering it inaccessible.

Street view of Marsh Road overpass heading south on Highway 101.



Image is 'Streetview' from Google Maps

## SHORELINE VULNERABILITY

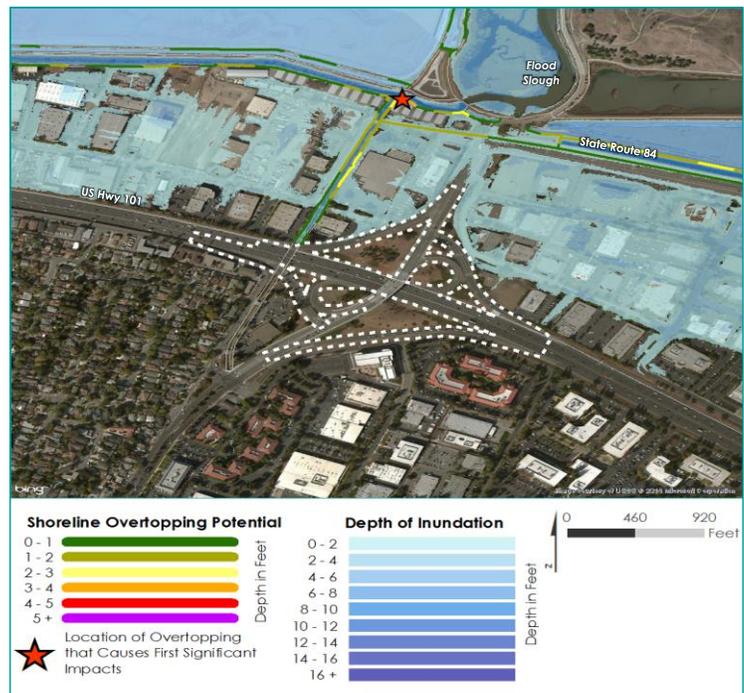
### Shoreline Overtopping Analysis

The primary source of flooding is from the Canal and Channel. When the tides are high and the Flood Slough tide gates are closed, the Canal cannot drain, causing flooding of the Haven Avenue area. When water surface elevations reach between 12 and 24 inches above the current mean higher high water (MHHW) level, the slough overtops the embankment roughly 720 feet north of the interchange, indicated by a red star on the map to the right, creating a potential flow path. The first damaging inundation to the site, however, does not occur until water elevations reach between 24 and 36 inches above MHHW.

### Cross-Cutting Vulnerabilities

This section could create significant geographical cross-cutting issues, as it joins the North, South, and East Bay to San Mateo County and to each other.

First Significant Impacts: 36 inches above MHHW.



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## SEA LEVEL RISE EXPOSURE ANALYSIS

### Exposure Discussion

Exposure of the asset to surface water flooding and sea level rise is high. Other than nearby standing water, most flooding near the interchange to date has been caused by overflow of the Canal and Channel. Both the Canal and Channel have caused flooding during high tides and rain events. Less frequently, flooding also occurs from San Francisquito Creek. With high tide and heavy rainstorms, the creek overflows the banks and runs along the southbound lanes of Hwy 101 toward the SR 84 Interchange. This does not appear in the Baseline Scenario figure (right) because it is driven by the creek, not sea level rise. The Bay side of the interchange sits at 17 feet (NAVD, 1988), 4 feet above the Federal Emergency Management Agency projected 1% base flood elevation at 13 feet (NAVD, 1988), so it is unlikely to flood under current conditions. With no action, sea level rise will likely result in more frequent canal and creek overflows and could also cause inundation of the interchange from the Bay side. Modeling suggests that 3 feet of sea level rise would begin to affect the interchange. There are drainage pipes and electrical conduits that run parallel to Hwy 101 underneath the pavement. They were not built for waterlogged environments and there is no underground system to pump flood waters away from the infrastructure. Water entry at any point in either utility system (even outside this asset boundary) could affect the infrastructure.

**Baseline Scenario:** Asset not yet inundated.



**Mid-Level Scenario:** Inundation up to 5 feet deep.



**High-End Scenario:** Inundation up to 8 feet deep.



### Exposure Analysis Results

Potential Inundation Depth (feet)		
Scenario	Minimum	Maximum
First Significant Impacts (36 inches)	0	3
Baseline 1% Flood	0	0
Mid-Level 1% + 3.3 feet	0	5
High-End 1% + 6.6 feet	0	8

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## ADAPTIVE CAPACITY, CONSEQUENCES, AND POTENTIAL ADAPTATION

### Adaptive Capacity

Adaptive capacity at the interchange is low, as there is limited ability to remove water in near-term floods, and the Canal and Channel have limited additional capacity in high tide and rain events. Caltrans generally allows the road to drain naturally after a heavy rain event, utilizing the sound wall and barrier to direct water across the highway and into the Bay. If the road flooded, Caltrans pump stations could be used to pump water out. This would happen only after the rain event, as they are not sized to address anything more than storm flows up to a 50-year event. Temporary flooding would require detours, such as using Willow Road and University Avenue, neither of which can accommodate the volume of traffic from the interchange. If the facility became permanently inundated and closed, use of these streets would not be a viable permanent solution to maintain the level of service provided by Hwy 101 and SR 84.

### Consequences

Impacts from the loss or disruption of this asset are high and far-reaching. Floodwater would not likely cause direct damage to roadways; however, continual exposure to salt water could reduce the service life. Salt water would more immediately affect infrastructure near/under the interchange (e.g., electrical cabinets, loop detectors). Damaging the utility network here could disable the system more broadly. With enough structural or foundation damage, ramps could need replacing, costing up to \$63 million. Likely, the impacts of temporary or permanent closure due to flooding would be more significant. Prior to complete closure of this section of highway, hazardous conditions could lead to accidents (e.g., hydroplaning). Closure would create delays for more than 260,000 travelers who use these routes daily (especially commuter traffic to job centers) and increased traffic volumes would impact the level of service and service life of detours. Loss of service at this interchange would make it particularly difficult to travel to or from the east bay, since bridge access could be blocked, and travel north to the San Mateo Bridge would require detours.

### Additional Important Information

The SAFER Bay project led by the San Francisquito Creek Joint Powers of Authority (SFCJPA), is ongoing and plans to reduce flood exposure to the highway (and by default, SR 84-Hwy 101 interchange and adjacent communities) by building levees along the Bay shoreline. The San Francisco Bay-Hwy 101 project also led by the SFCJPA is also working to reduce highway and residential flooding exposure in East Palo Alto from the San Francisquito Creek. Plans consider sea level rise and aim to provide ecological and recreational benefits as well.

### Asset-Specific Adaptation

The underground infrastructure could be protected by barriers to prevent saltwater intrusion; however, salt water could still enter at other vulnerable spots and disable the network, so system-wide (not local) adaptation is recommended. In the near-term, pump stations could be built or relocated nearby to alleviate flooding and maintain service. Long-term region-wide adaptation will be required and is already underway, including the two projects listed above and possible restoration of the Ravenswood Ponds complex.

### Vulnerable Highways

There are Asset Vulnerability Profiles on the following vulnerable highways: SR 1 (AVP #3) and HWY 101 (AVP #9). The vulnerability assessment analysis shows that there are 99.6 miles of vulnerable highways in the project area, including SR 54, 92, and 114.

Aerial view of the interchange at State Route 84 and Highway 101.

