

# The New Normal for Shoreline Flooding - from Headwaters to High Tides

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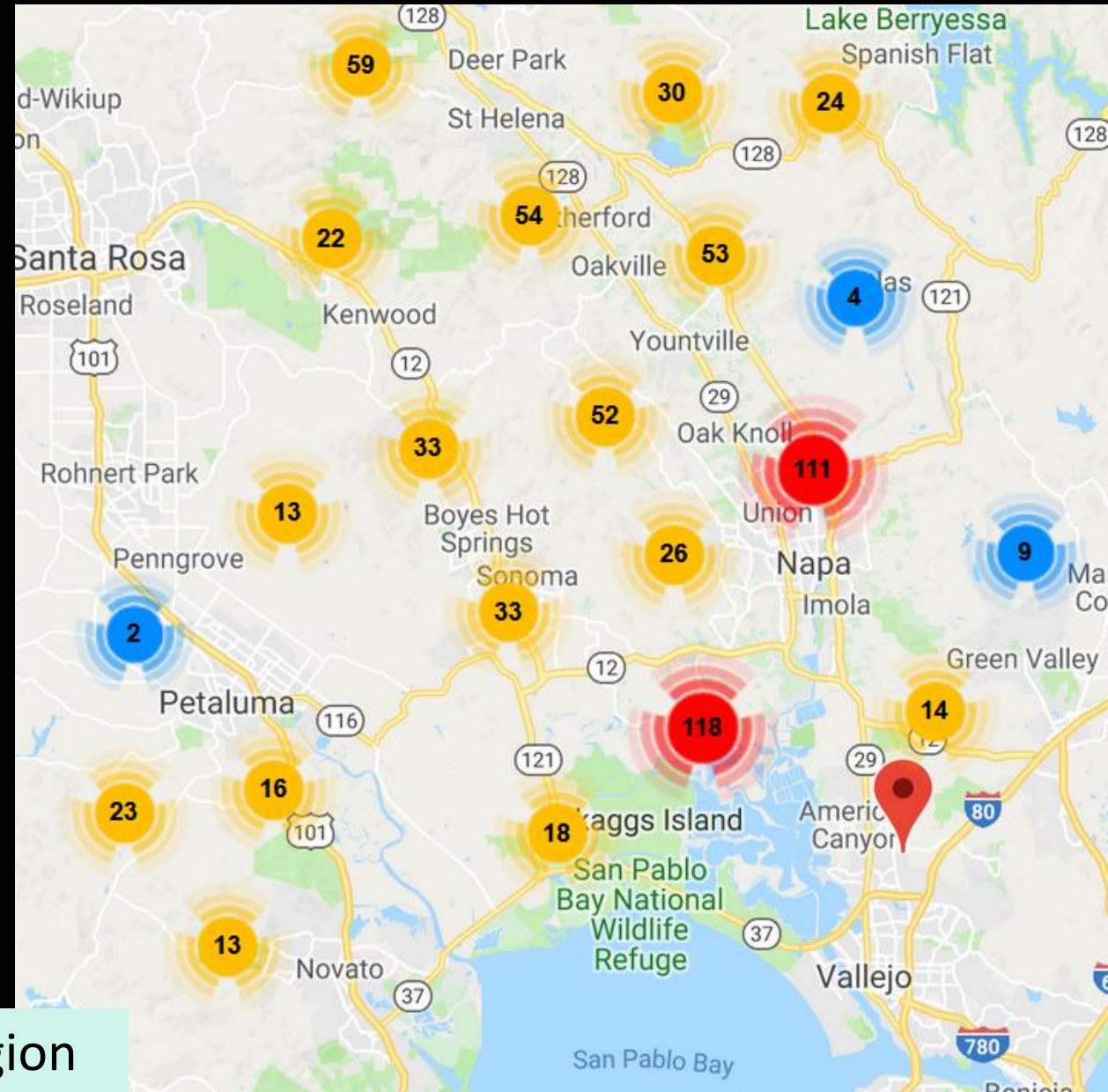


# Acknowledgements

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# Water Supply

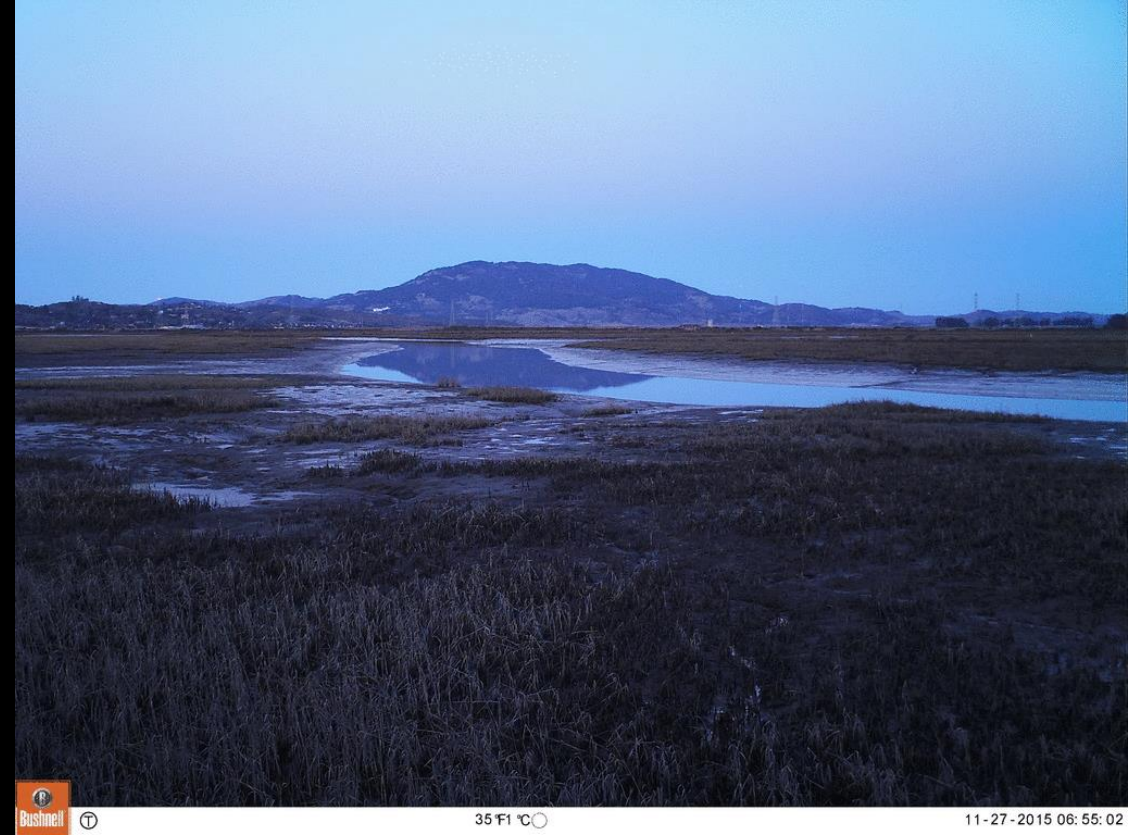
Watersheds provide us with water



Water diversions, North Bay region

# Ecosystems

Tides, flows, and sediment  
give us marshes





# Ecosystems

Tides, flows, and sediment  
give us marshes & fish



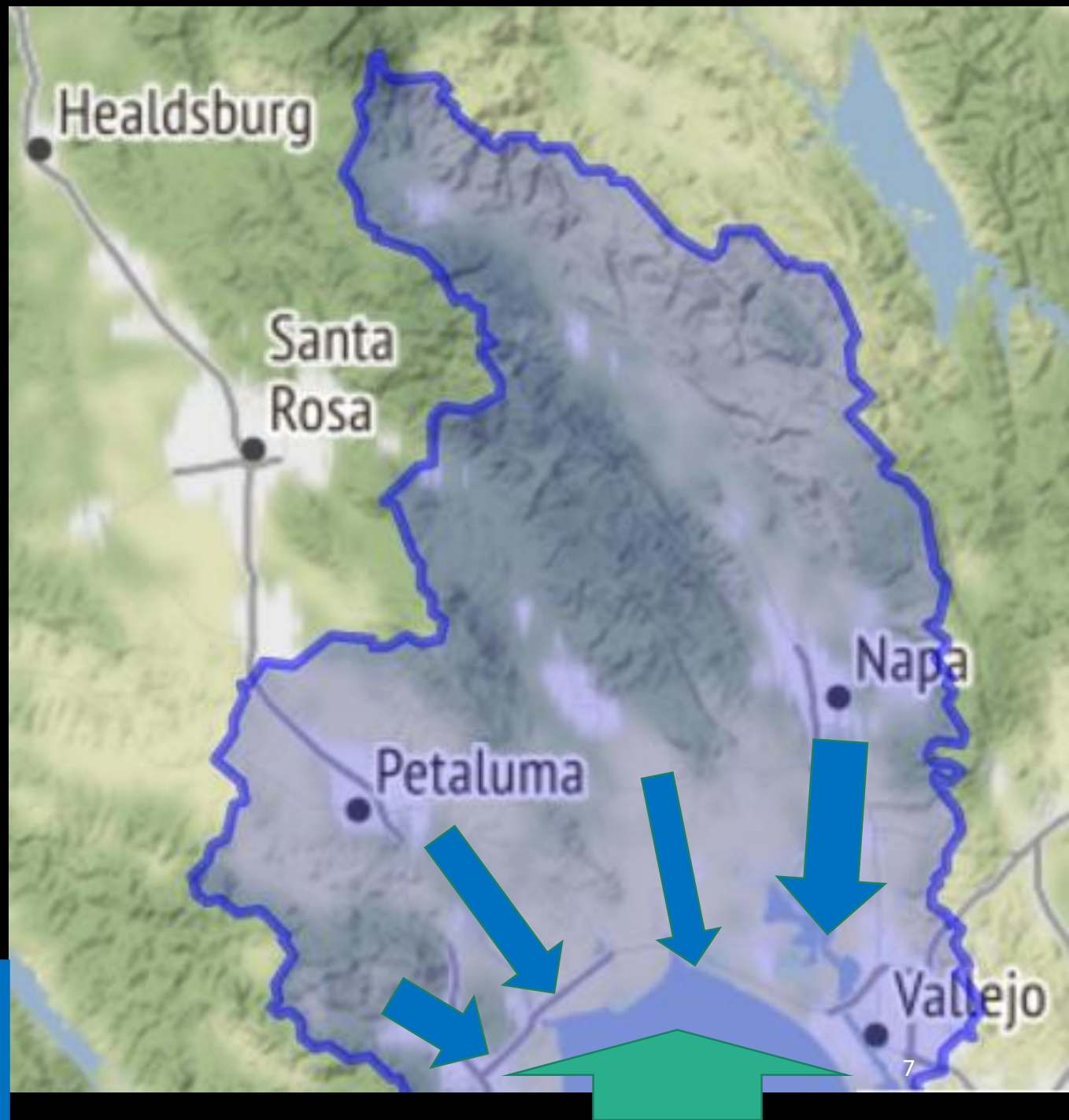


# Ecosystems

Tides, flows, and sediment  
give us marshes, fish, &  
birds



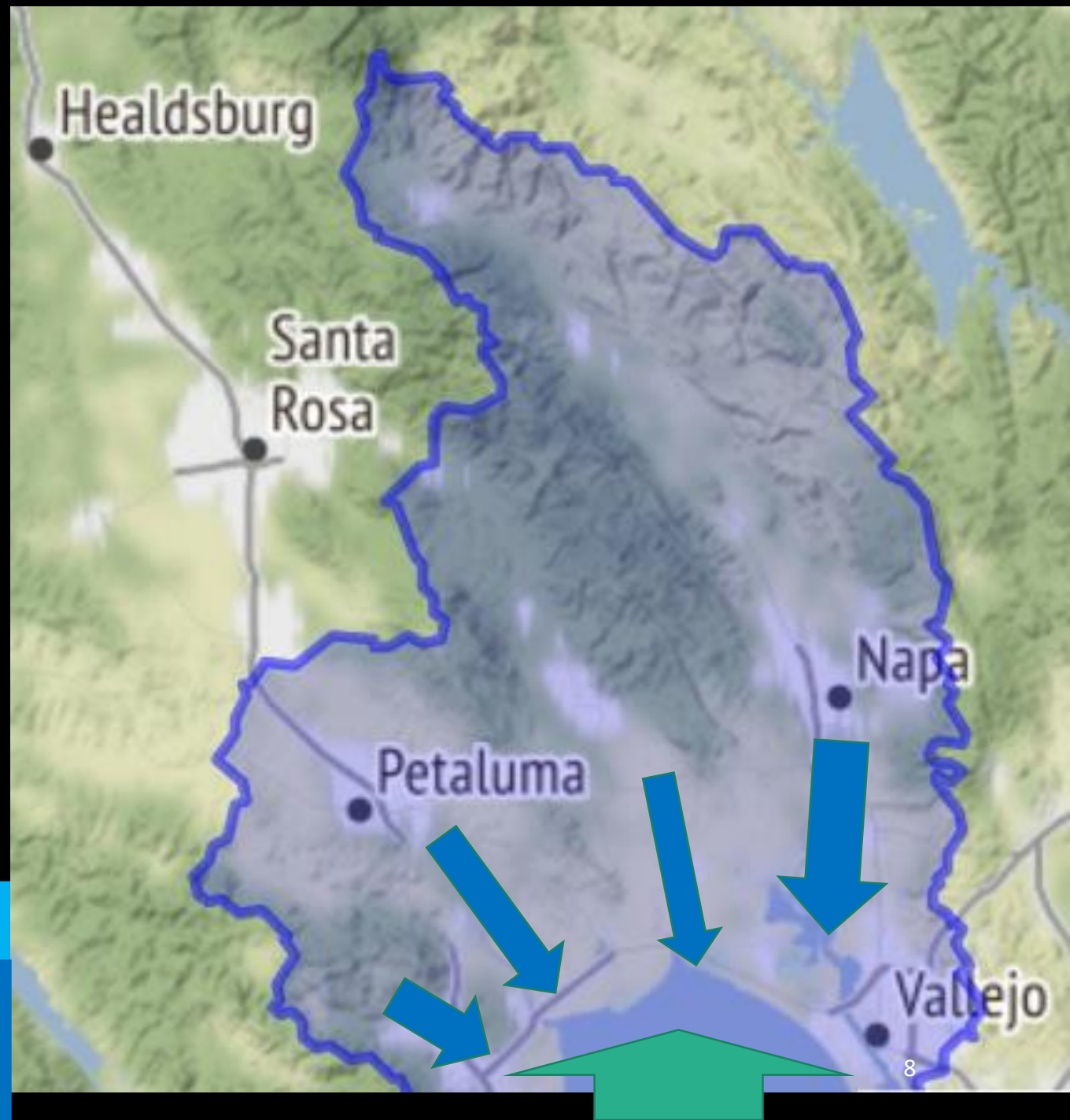
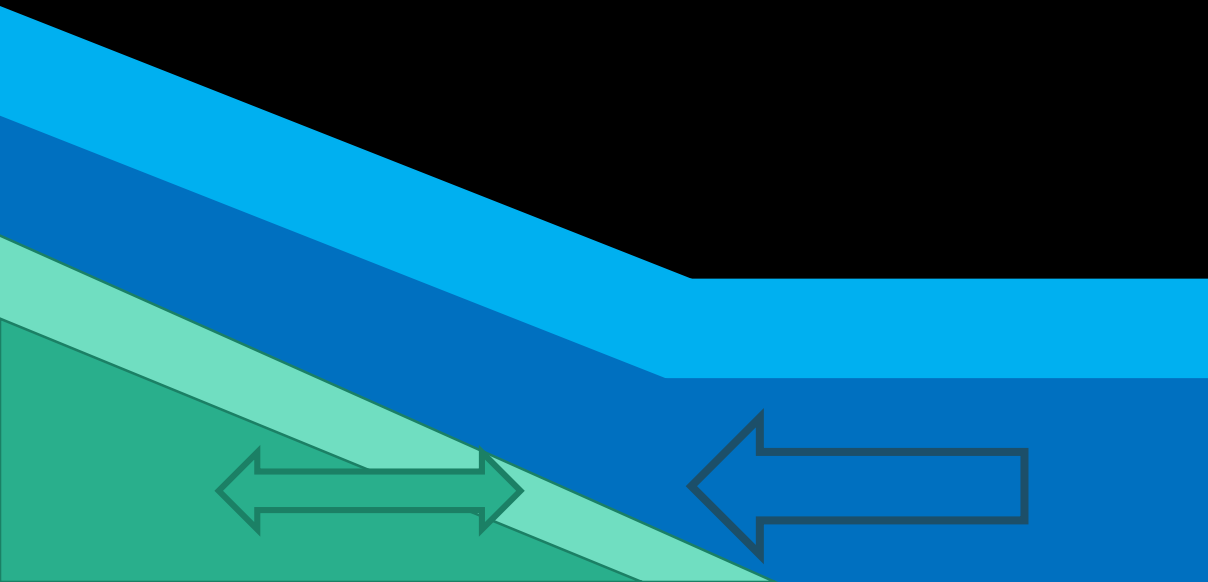
Watershed discharge  
interacts with tides





# Watershed discharge interacts with tides

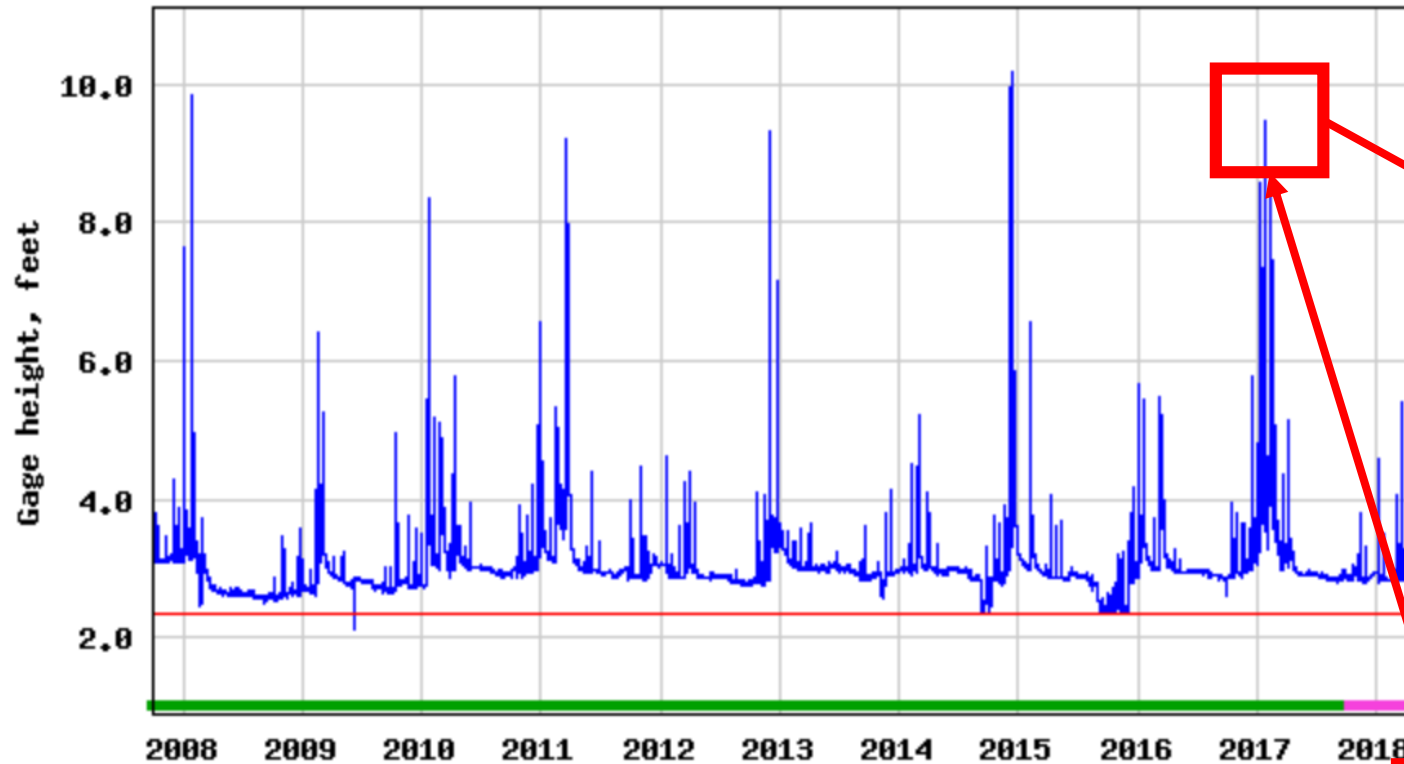
Climate change will cause increased stormwater runoff and sea levels



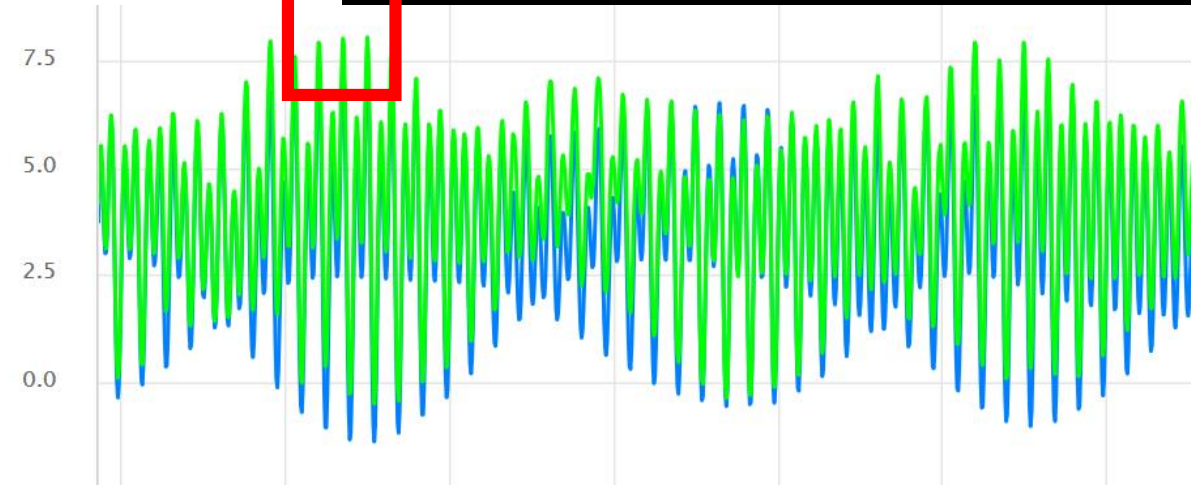




## USGS 11459500 NOVATO C A NOVATO CA

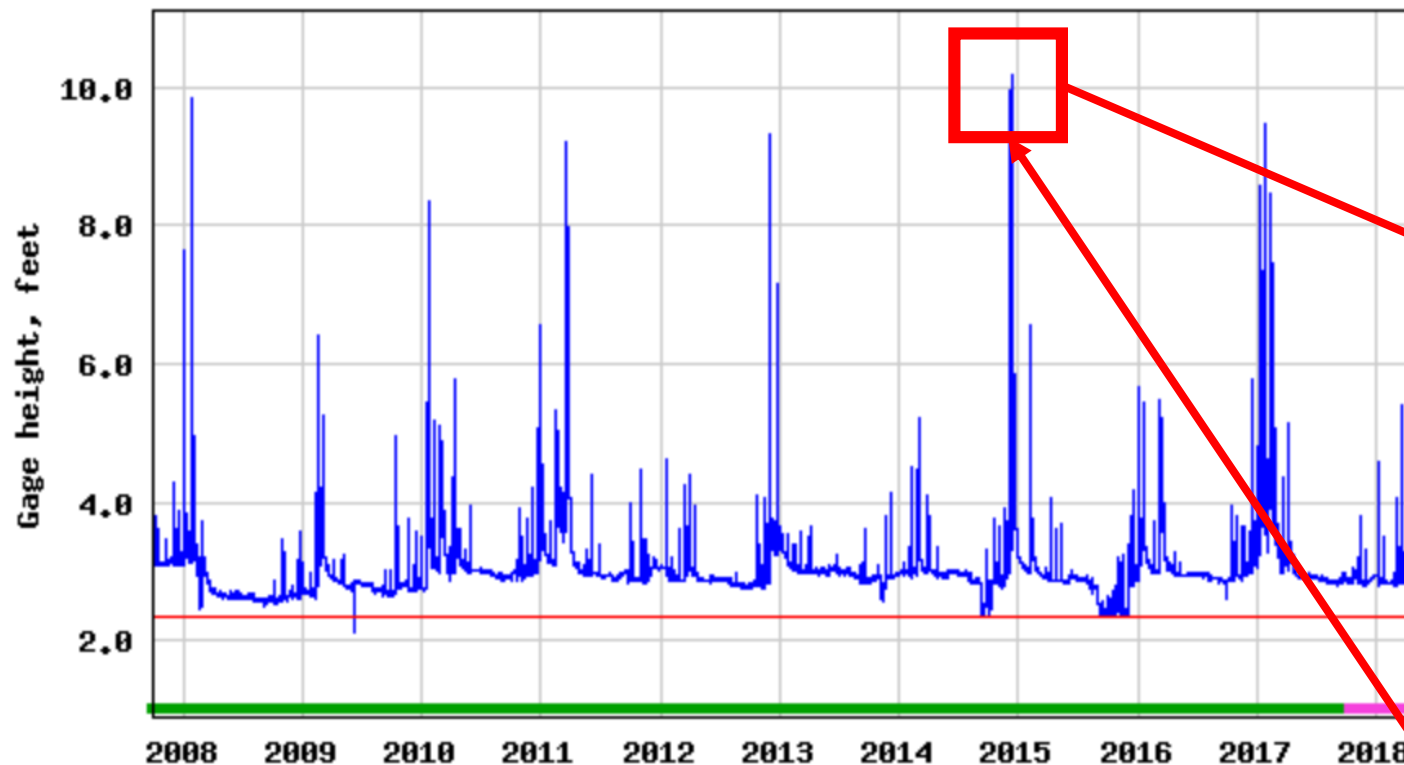


Watershed discharge and high tides can combine to cause flooding

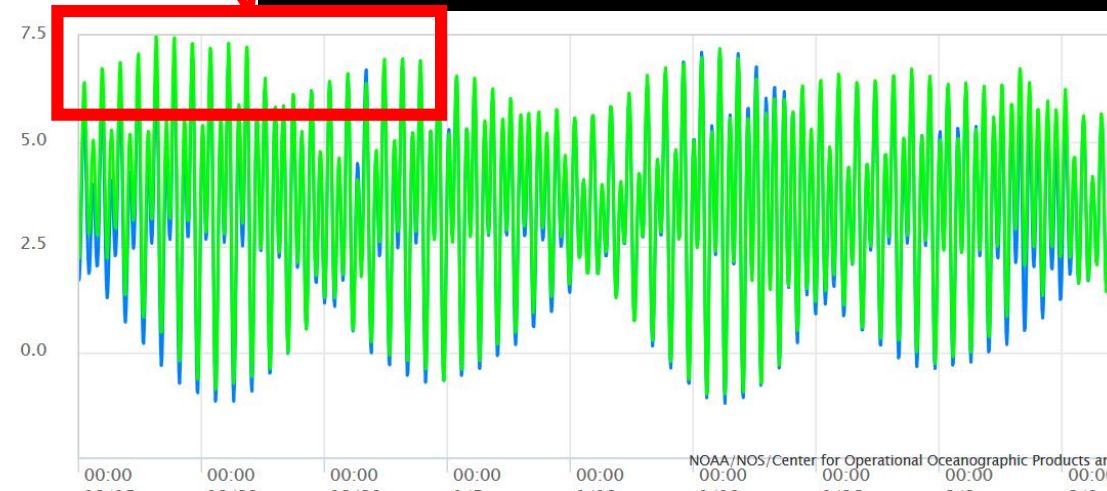




# USGS 11459500 NOVATO C A NOVATO CA



Watershed discharge and high tides often don't combine to cause flooding



# State Route 37 – First shoreline highway adaptation?

UC Davis study (<http://hwy37.ucdavis.edu>)

2011-2016

>200 stakeholders/organizations

Bringing ecosystem and community concerns into early stages of transportation planning

Inundation models

“Adaptive designs”

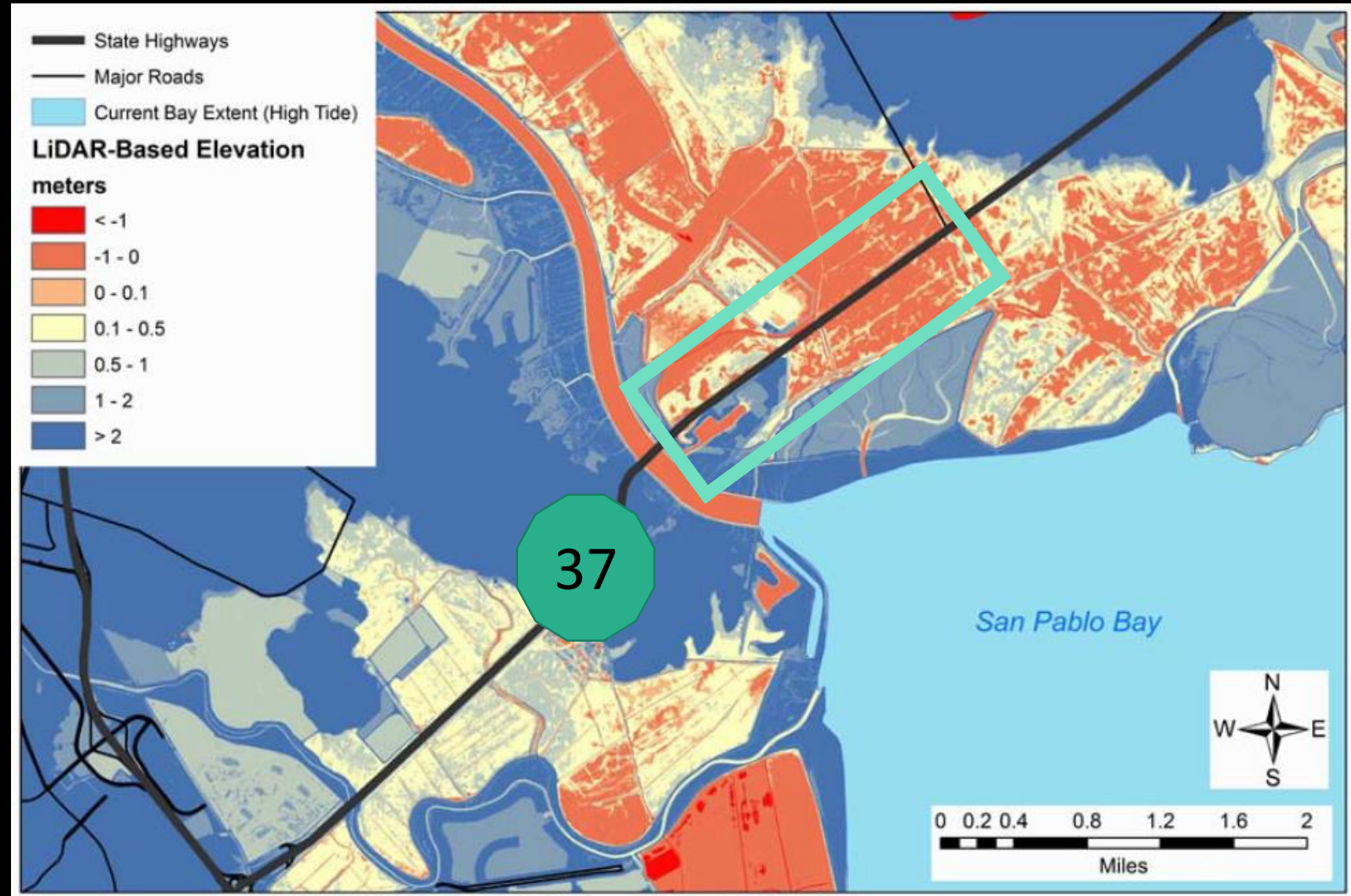
Cost estimates and priorities



# Priorities and Trade-offs

The segment of highway between Petaluma River and Lakeville is the lowest part of the highway

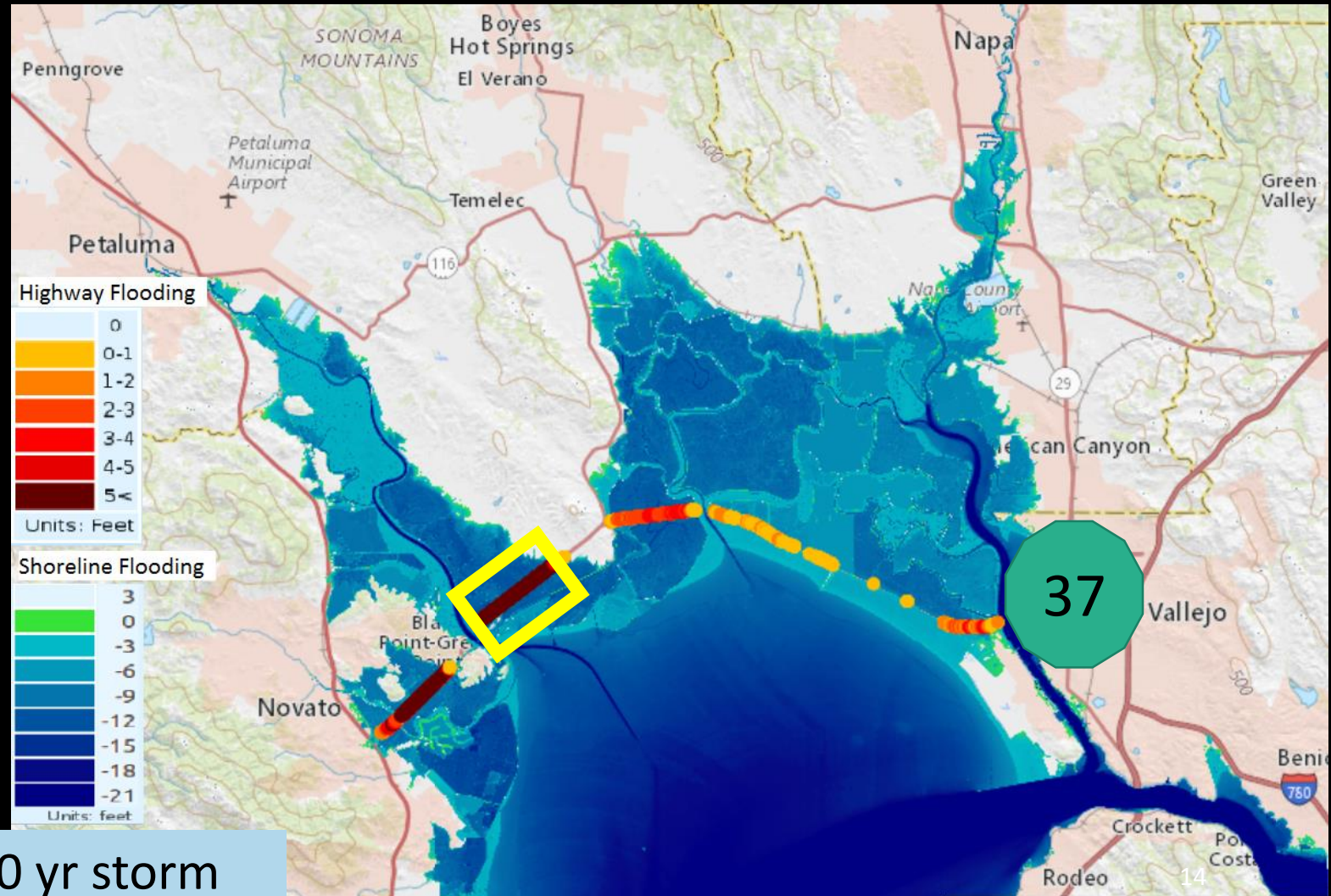
(Shilling et al, 2012)



# Priorities and Trade-offs

The segment of highway between Petaluma River and Lakeville is the lowest part of the highway and most of the highway is vulnerable

(Shilling et al, 2016)



12" sea level rise + 100 yr storm



# Priorities and Trade-offs

most of the highway is vulnerable

-- so what do we do and when?

(SR37 Policy Committee, 2018; Moore and Shilling 2017; Shilling et al., 2016)

12" sea level rise + 100 yr storm





# When to act?

The segment of highway between Petaluma River and Lakeville is the lowest part of the highway, but is not the part that flooded last year – this is!

(Swedberg; Shilling et al, 2016)

12" sea level rise + 100 yr storm





# When to act?

From a risk point of view --

(Shilling et al, 2016)



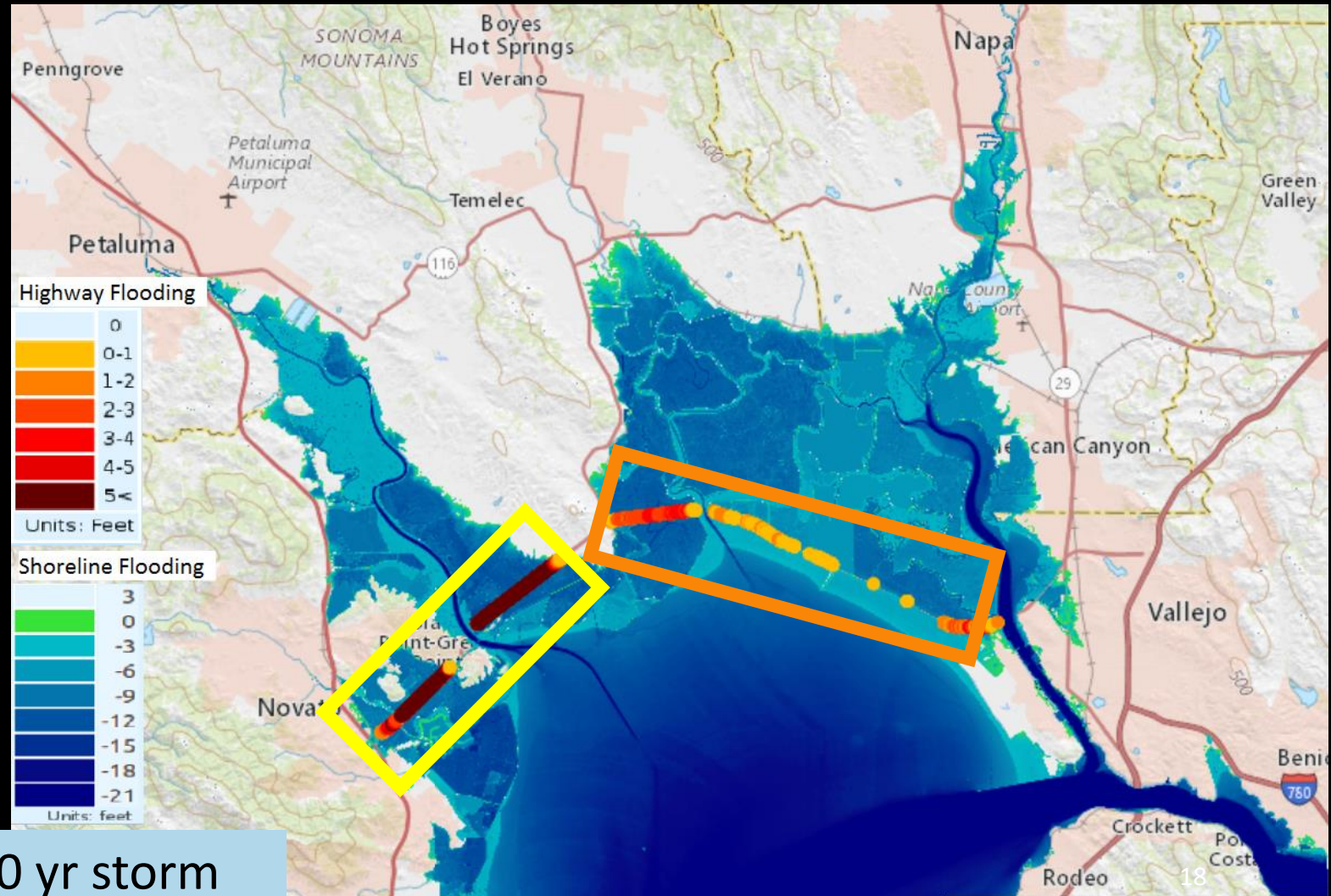
12" sea level rise + 100 yr storm



# When to act?

From a congestion point of view --

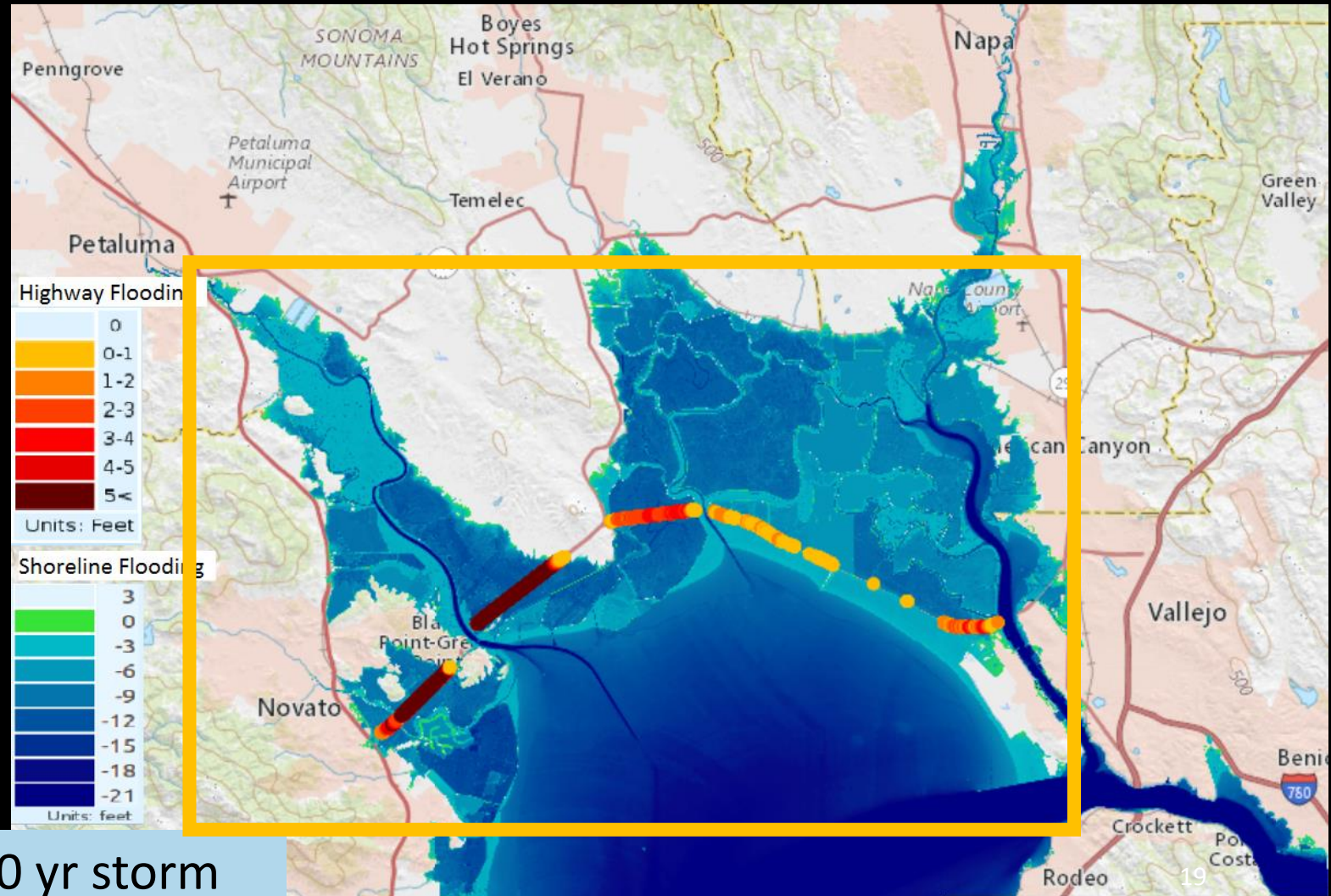
(SR37 Policy Committee, 2018)



12" sea level rise + 100 yr storm

# When to act?

From an integrated point of view --

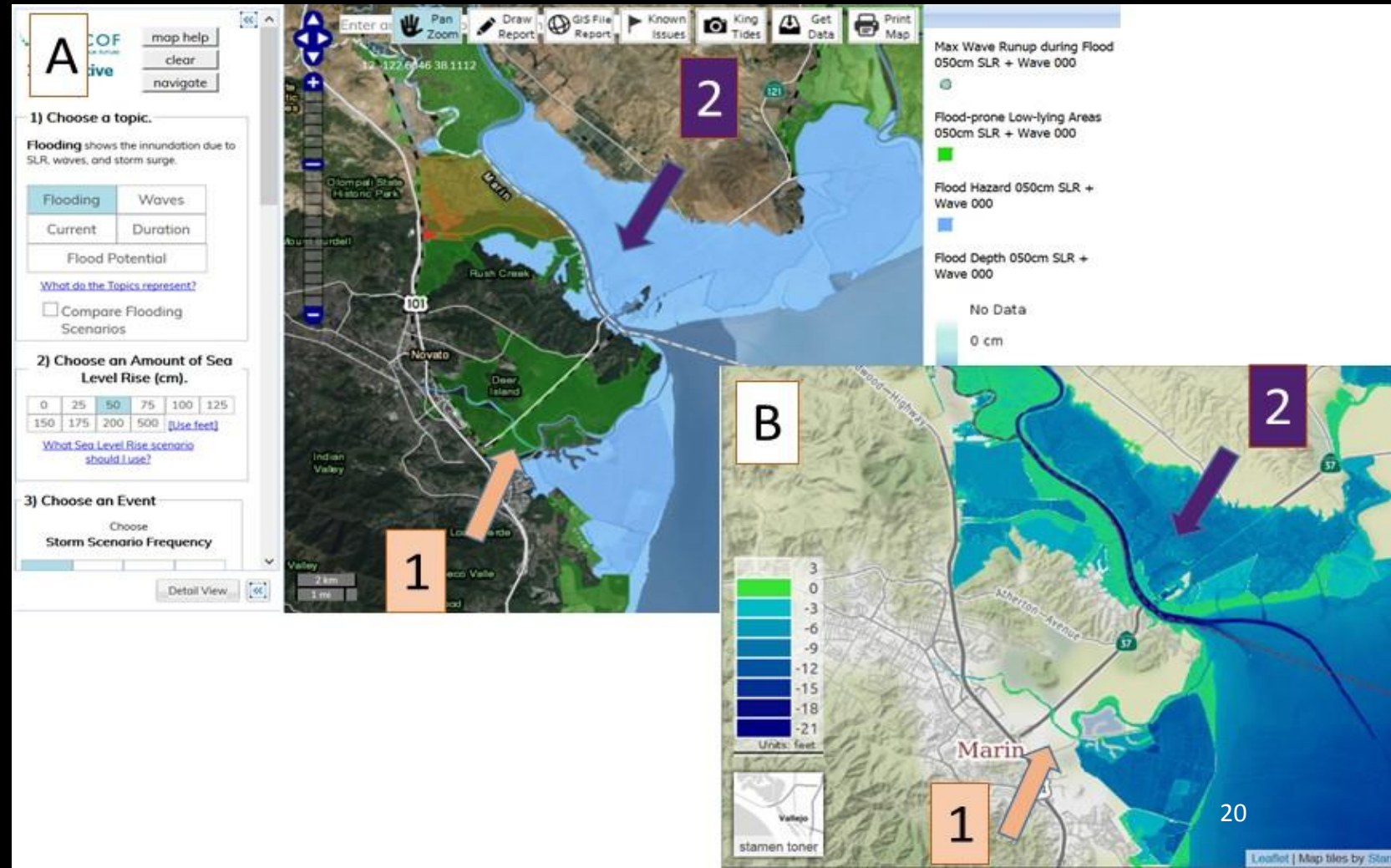


12" sea level rise + 100 yr storm



# Can we predict shoreline flooding?

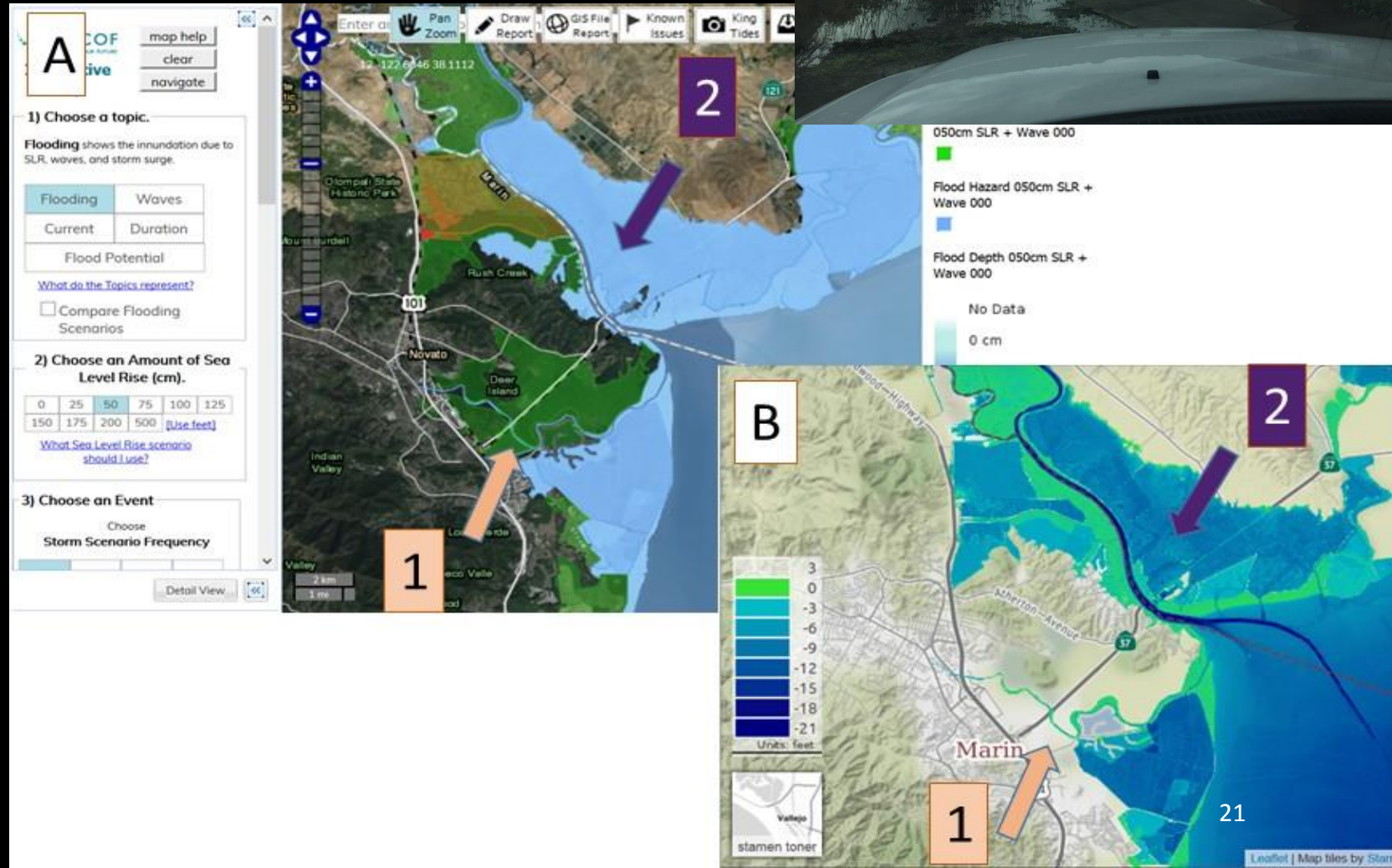
Not yet, two independent models suggested the area east of Petaluma River (2) would flood before the area that flooded and closed 37 (1)



# Can we track shoreline flooding?

Yes, if we invest in real-time and comprehensive data collection, data analysis, and data sharing

This will help with flooding predictions





# What might happen?

# Armoring the shore



(SR37 Policy Committee, 2018; Shilling et al., 2016)



# Vertical retreat



(Shilling et al., 2016)



# Horizontal retreat

Most responsive to  
1) long-term risk and  
inevitabilities, 2)  
needs of marshes, 3)  
managing flood risks





# Next Steps

- Interested in partnering with us?
- Grant Proposals (one going in on Friday)
- Shoreline tracking (drones, cameras, gages, habitat...)
- Resilience and adaptation as economic engine

Thanks, Questions?

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<http://hwy37.ucdavis.edu>

<http://sealevelrise.ucdavis.edu>



# Cost Estimate Comparison



REACH	ALTERNATIVE		
	1 - Berm/ Embankment	2 - Box Girder Causeway	3 - Slab Bridge Causeway
A	\$460	\$1,400	\$1,300
B	\$650	\$2,500	\$2,200
C	\$150	\$400	\$340
TOTAL	\$1,260	\$4,300	\$3,840

(\$ in millions)

# Levee Wars

## -- Section 408 Permits

- Target of lobbying by levee districts in the Midwest and South
- Intention is to remove “in the public interest clause which was designed to stop “levee wars” among municipalities

Source: <https://psmag.com/environment/inside-the-midwest-levee-war>