Minutes: Thursday, January 29, 2015
10:00am – 12:00pm
State Route 37 Integrated Traffic, Infrastructure and Sea Level Rise Analysis
Norman C. King South Vallejo Community Center
545 Magazine Street, Vallejo, CA 94590

Purpose: 1) Learn about potential inundation in the North Bay due to sea level rise.
2) Discuss specific planning steps and requirements to flexibly adapt to future changes.

Welcome and Introductions – Fraser Shilling, UC Davis

- Fraser Shilling welcomed everyone and then all attendees gave their name and affiliation.

Brief Description of Previous Stewardship Study (1011/12) and Stakeholder Meeting, September 3rd, 2014 – Ina Gerhard, Caltrans and Fraser Shilling, UC Davis

Phase 1 was conducted in 2011-2012 with the lead being the Road Ecology Center, UC Davis.

There was an extensive stakeholder process and we are now moving into a more concrete facility planning phase. From a Caltrans perspective we have three objectives:

- 1st – Get a much better understanding of the highway's vulnerability to flooding and inundation and when it is going to happen.
- 2nd – Objective was to get a better idea of the alternatives, of what would maximize the benefits to transportation and to the adjacent lands and communities.
- 3rd – Get a high level cost estimate of some of the improvement options.

At the meeting last week with the resource agencies some people questioned why we are doing all this work when we already know it will flood, but this study will help to communicate the urgency.

Current Study Overview (2014/15) – Fraser Shilling, UC Davis

Some of the maps seen in the media depict Sea-level Rise (SLR) as a bathtub effect; the sea rise and flood everything near the coastline. This is not an accurate depiction as it does not consider berms and levees. The idea is to think about the phasing of what is possible in the North Bay, especially around SR 37 and the associated marshlands so that any type of adaptive response is thought through and everyone is part of the conversation. It is an inclusive planning process, the solution will likely be expensive and affect a lot of people.

The first phase of this project was a federally funded with a lot of people participating (**Slide 4**). It went for about 20 months in 2011 and 2012. It was about introducing stakeholders to each other, share concerns and the idea that SLR would potentially be an issue for SR 37. From the transportation point of view there were congestion and maintenance issues, so there was a need to develop some type of new structure. And there were a lot of other needs and values that needed to be considered as well. A lot has to do with the marshes that surround the highway as either a constraint, because permits are required, or the highway has impact on the marshes so. In order to have an integrated approach, we had to think of the highway and the marshes together and treat the whole renewal of 37 and the continuing renewal of the marshes as a stewardship process – this was the key to the first phase (**Slides 5 & 6**).

One issue that came up phase 1 and is being explored in the second phase is that parts of the landscape near the highway are actually below mean high high waters (MHHW) or below high tide, therefore below sea level when you are at high tide. See **Slide #7** areas in red.

Accounting for Impacts (**Slide 8**): The road impacts are expressed in the Road Effect Zone Model. The environment potentially affects the highway and the flooding and the highway affects the environment around it.

In the first phase we came up with five options (**Slide 9**).

1. No expanded capacity
2. Expanded Footprint Levee, increased capacity
3. Causeway, Increased capacity
4. Strategic co-alignment
5. Tunnel

These have been narrowed down considerably and there has been a bridge proposal since then where the causeway would basically become a bridge when there is flooding. They were looked at from different points of view including the regulatory point of view (**Slide 10**). The expanded footprint option was not likely to be permitted without legislative action. The causeway would be self-mitigating as it doesn't interfere with the marshes, but cost were not factored in.

Phase II began with the stakeholder meeting on September 3rd, 2014 in Vallejo with attendance up by 25% compared to Phase I (**Slide 12**). The discussion revolved around moving fast – how can we get something done fast in a reasonable timeframe because of congestions and risk of flooding and failure of the highway (**Slide 13**). What kind of information do we need to make good decisions, why are we not considering transit, what about the private toll road possibility and why do we have a constrained list? A highway on a levee or a highway on a causeway – why aren't we looking at other possibilities.

Goals for Phase II (**Slide 15**) include:

- Maintain and improve transportation corridor benefits and develop long-term solutions for the corridor; and

- Determine how to support large-scale restoration of tidal and other marshes to benefit native species, ecological processes, and decrease the severity of storm and tidal action on coastal infrastructure.

The distribution of Tasks (**Slide 16**) are:

- Task 1: Inundation assessment of infrastructure and associated lands (18%)
- Task 2: Vulnerability assessment for existing transportation system (9%)
- Design and cost estimates for resilient and sustainable transportation (26%)
- Environmental and community benefits for different future scenarios (9%)
- Stakeholder involvement to improve sustainability (19%)
- Project management, presentations and reporting (19%)

AECOM is doing the modeling for this Phase (**Slide 17**). Anywhere is say inundation, it is really potential inundation or modelled inundation.

- Task 1 Inundation Mapping
- Task 2: Vulnerability and Risk Assessment
- Task 3: Engineering Concept Design
- Task 4: Engineering Cost Estimation
- Task 5: 3D Visualization

The Stakeholder Participation (**Slide18**) has been through meetings like this one, and two focal meetings: The Congestive Management Agencies and the marsh restoration agencies and groups. Questions were about when and where breaches would occur and how is that going to affect our thinking about the highway as they change the marshland. Other meetings and presentations will be around involving boards and commission meetings, including the California Transportation Commission. Any highway right now that needs some type of modifications/improvement is competing with other highways for funding, so this a good time to speak up for Highway 37.

The first task on the Timeline (**Slide 19**) is the inundation modeling which informs Task 2, the Risk Assessment. The timeline shows we are about 1/3 of the way into the technical part. We will finish up at the end of the year.

The Inundation Modeling and Mapping (**Slide 20**) includes a draft model of potential inundation under different future sea level conditions, and will inform the risk/vulnerability assessment. We will need your input on the draft and get your local knowledge to finalize it.

Slides 21 and 22 address focus meetings with local and regional transportation agencies, marsh restoration groups and the private toll-road consortium. **Slide 23** addresses the local transportation agencies and the January 2014 meeting with the marsh restoration group (**Slide 24**). (Separate minutes are available for those meetings.)

Next Steps of the study include the next stakeholder meeting in April with a presentation from AECOM on risk/vulnerability assessment, figuring out how to deal with data gaps and inaccuracies, and funding the next planning steps.

For more information go to: http://hwy37.ucdavis.edu and or email Fraser Shilling at: fmshilling@ucdavis.edu

Questions and Comments

Are the options already being considered in stone are you still looking for input from stakeholders?
There is never an end to feedback until there is some of commitment on a project to be build. There is a point of no return in our scope, so right now we are looking at raising the road on the levee and the causeway as the primary two. However, we have been asked about bridge options, like a floating bridge for example.

Is the levee model nixed or is that only from a regulatory point of view?
From a regulatory perspective the levee model is a bad idea and from a practical point of view a bad idea gets sometimes picked anyway. It's possible that parts of the highway could be on a levee so we want to understand what that could look like rather than ignoring it and have the causeway be the only option.

Will the levee alternative have bigger culverts?
You then would have to deal with the levee being hit by the bay on one side. The marshland renovation is already changing the flows so if there were culverts or bridges it would be very complicated hydrologically so there would have to be a lot of study. We will not be doing that as part of this study. We are going to consider the main two options.

What are you going to study?
The levee footprint is one of the main alternatives and the causeway is the other. By looking at those we are looking at a mixed model levee and causeway – that's a possibility. And then a floating bridge or a bridge on stilts.

What about the option to move the corridor outside the marsh altogether – any discussion on that?
Any process like this has its political, scientific and planning and engineering parts. Politically to move the corridor elsewhere is unlikely. For Napa County it would push traffic to Hwy 12 and there is concern that most of the traffic would go to 80 and the Richmond Bridge. Where would the traffic go and who would be impacted and that was the trade off to benefits to the marsh to moving the highway altogether.

At the last meeting, you discussed a survey that was done. That said we wanted a 4-lane causeway with a bike trail. Is that correct?

You could read into it that it was the favorite option but people were asked whether those different models met their needs and the one that was most popular was the causeway because it would relieve the most congestion. Also discussed was if the adjacent bike/ped is attached to the highway or would use the old bed as long as it lasts as a trail and whether or not you could support transit on that causeway.
Can you speak to timing on the climate models and the planning and engineering process - I'm curious as to how they intersect.
Basically there is an inevitability of the water getting higher and sloshing over the berms. Avoiding that means there is a certain timeframe of when action is needed. In the next decade we'll keep having those events. By 2030 with a storm you are looking at overtopping some of these lower lying berms and levees and having to close the highway. There are increased expenses associated with closure and flooding. There is a backend when it is over but it is currently outside the typical window for how long it takes to build a new structure. If we were on a ten year timeframe we would probably have it done in time.

Is the toll-road still on the table? Is there a possibility of using the old roadbed for a trail?
We are keeping the toll road on the table, could be private. Putting the bike/ped trail associated with the causeway puts people directly next to traffic for 10 miles. You could have the bike/ped trail, but maybe people who do not want to be near traffic could be on the old roadbed until it goes away.

Is the idea of an interchange at Sears Point instead of a stop sign being considered? Because you could go over the train tracks and not have to go back to square one in the future. Because of the hazmat limitations, every tanker truck has to use Hwy 37. That is the only road that brings gasoline to Sonoma and Napa counties.
There was a discussion regarding the Railroad and the private toll road being sold to a Texan company, but due to time constraints, the meeting continued to AECOMs presentation.

Sea Level Rise Modeling – Justin Vandever and Kris May, AECOM

Justin gave a brief outline of his presentation to the stakeholder group (**Slide 2**). The Purpose of the Study was HWY 37 Integrated Traffic, Infrastructure, and Sea Level Rise Analysis (**Slide 3**). Goal: Determine possible future planning solutions for the highway and its human and natural environment.
AECOM's study deliverables:

- SLR inundation mapping
- Vulnerability assessment
- Conceptual engineering drawings and cost estimates for highway alternatives

The Hwy 37 Study Area (**Slide 4**)

- Study area spans four counties: Marin, Sonoma, Solano, and Napa
- HWY 37 corridor vulnerable to inundation and flooding now and in future
- Major flooding sources:
    - San Francisco Bay

- Novato Creek
- Petaluma River
- Tolay Creek
- Sonoma Creek
- Napa River

SLR Inundation Mapping (**Slide 5**)
Purpose and role of mapping in study:

- Informs the exposure component of the SLR vulnerability study (multiple SLR scenarios)
- Depth and extent of inundation
- Depth of roadway overtopping and freeboard
- Timing of inundation and adaptation options

Justin added that each segment of the highway is at a different elevation and the flooding is controlled by different sources.

Data Requirements (**Slide 6**) see *graphs on slide*

- Sea level rise scenarios - NRC (2012)
- Topography – 5-ft (1.5m) grid Digital Elevation Model (DEM) using 2010 CA Coastal LIDAR (NOAA). Vert. rms error ~9 cm.
- Water levels – daily and extreme tides from FEMA hydrodynamic model

SLR Scenarios (**Slide 7**)

- Sea Level Rise Projections (NRC 2012)
  See table and graph on slide 7
- Selected Inundation Mapping Scenarios:
  - NRC "most likely": 12 inch (2050) and 36 inch (2100)
  - NRC "high-end": 24 inch (2050) and 66 inch (2100)

Water Level Analysis – Key Terms (**Slide 8**)

- Mean Higher High Water (MHHW). Typical daily high tide. Frequent inundation (permanent).
- 100-yr Stillwater Elevation (SWEL) – Extreme high tide + storm surge. Very rare flooding (temporary) event. No wave or local meteorological effects.
- 100-yr SWEL + wind and wave effects. (Not evaluated)
  See diagram on slide 8

Water Level Analysis (**Slide 9**) *22 locations in yellow on slide*

- FEMA hydrodynamic modeling for existing conditions
- 32-year continuous simulation
- Analyzed data at 22 locations
- Daily and Extreme (storm surge) tides
- MHHW: 6.0-6.3 ft
- 100-yr SWEL: 9.3-9.9 ft

- Add SLR for mapping

Inundation Mapping Process (**Slide10**) *Example of overtopping map on slide*

- Followed NOAA Coastal Service Center's methodology
- Create topographic DEM (5-ft grid)
- Create water surface DEM
    - MHHW + SLR
    - 100-yr SWEL + SLR
- Project water surface overland
- Determine depth and extent of inundation
- Determine hydraulic connectivity
- Assess overtopping
- Caveat: not a hydraulic model; only a mapping tool

Preliminary Mapping Results (**Slide 11**)

- MHHW + 12" (2050 most-likely)
- MHHW + 24" (2050 high-end)
- MHHW + 36" (2100 most-likely)
- MHHW + 66" (2100 high-end)
- 100-yr SWEL + 12" (2050 most-likely)
- 100-yr SWEL + 36" (2100 most-likely)

MHHW + 12", 24", 36" and 66" (**Slides 12-15**) *are DRAFT Mean High High Water maps.*
Green areas are below water level, quite low lying with some barrier, Blue are wet areas.

100 year SWEL + 12" and 36" (**Slides 16-17**) are DRAFT 100 yr storm surge + 12" and 36" SLR maps.

Comments *were made by several stakeholders that these draft maps (Slides 12-17) are out of date already due to the recent breach at Cullinan Ranch. Also, the elevation built into the 2010 DEM is biased due to the LIDAR measuring the top of vegetation, not the ground. It was noted that this would be easy to resolve by measuring the elevation of the berms and levees in the field.*

Preliminary Vulnerability Assessment (**Slide 18**)
HWY 37 is protected by a complex system of interconnected levees

- Divide study area into five reaches (west to east). Each reach is a system of flood protection:
    - Reach 1: HWY 101 to Petaluma River
    - Reach 2: Petaluma River to HWY 121
    - Reach 3: HWY 121 to Sonoma Creek
    - Reach 4: Sonoma Creek to Napa River
    - Reach 5: Napa River to I-80

- What are the sources of inundation/flooding within each reach (e.g., levee overtopping, direct inundation)?
- What is timing of inundation/flooding within each reach?

For each reach shown, it is a 1st scenario where we see inundation of the highway. Also, the red circles are low spots for the pathways of flooding that produce the inundation – not comprehensive. The whitetish blue arrow show the pathway of flooding from the bay to the highway. Will look at these as we move through the vulnerability assessment in more detail.

Preliminary Vulnerability Assessment Reaches (**Slide 19**) *slide shows 5 reaches on a map with MHHW+36". Reaches 1 & 2 are the lowest and to the east is higher.*

Preliminary Vulnerability Assessment (**Slides 20-24**) *these depict Reaches 1 - 5 with a map.*
Reach 1, Slide 20 with MHHW+36"
Reach 2, Slide 21 with MHHW+24"
Reach 3, Slide 22 with MHHW+36"
Reach 4, Slide 23 with 100-yr SWEL + 12""
Reach 5, Slide 24 with MHHW+66"

Preliminary Vulnerability Assessment Reaches (**Slide 25**) *slide shows 5 reaches on a map with first scenario to inundate Hwy.*

Overtopping Assessment Example: MHHW+36" (**Slide 26**) *map of extract depth of inundation along Hwy (eastbound and westbound) with 5ft inundation depth*

Next Steps

- Revise inundation maps based on stakeholder feedback. Finalize inundation maps.
    - Recently restored areas?
    - Water control structure operations?
- Complete overtopping and freeboard assessment of HWY 37 roadway
- Complete vulnerability assessment of HWY 37

Overtopping and Freeboard (**slide 29**)
Definitions of Overtopping and Freeboard with diagram

Questions and Comments

Novato Creek is under study for a re-design of the flood control channel and Hwy 37 at that point could become vulnerable, so I encourage you to do some planning with Novato and Marin County so the designs can work in tandem.

Marin County has a Watershed program and their technical workgroup is ramping up in 2015. We are getting into what the alternatives are and there is talk about laying back some levees north of 37, but it is all very conceptual at this point.

Your map shows in the scenario projection that the water level is 9.3ft but the levees are 10-13ft. Are the low spots shown lower than 10ft?
Yes. The red circles are lower than an elevation of about 9.3ft. It is approximate at this point; some may be a little bit higher or lower.

For the inundation mapping, did you look at the scenario of the highway as a causeway with the water flowing underneath it?
No, we haven't looked at that. All the mapping we are doing now is based on the existing configuration.

A number of the San Francisco Bay Joint Venture's partners have been doing studies for their restoration projects, but also USGS and others have done SLR projection maps that are showing data differently. I could put you in touch and get the information to you.

The Sears Point new levee and the Cullinan Ranch breach have changed these projections.
Yes, and the Port of Sonoma too.

What happens to the old route if there is causeway, floating bridge, and tunnel – is that known? That is important for corrective action that would be analyzed ultimately in the environmental document and needs to be part of the understanding for all of us. Has that been decided yet by Caltrans? It would be important for the modeling of the causeway if it remains or goes away. Will you be analyzing both of those?
At this point we are not planning on revisiting the mapping in consideration of different alternatives. The mapping is to develop the alternatives for the highway, so at this point we are not going to incorporate future changes to the highway into the inundation mapping.

But you will do it in the next phase? Are you keeping the highway, how are you going to model it with the existing highway as it is or removing it? How will that be incorporated in the next phase?
No, it won't result in new inundation mapping in response to possible alternative highway modifications.

Does your causeway alternative includes maintaining the existing route 37 which functions somewhere as a levee?
No, it doesn't assume that. It is like a one way street – once the causeway design is out there it doesn't mean we will come back look at what would be the result of inundation mapping. The inundation map is based on the existence of the current roadway and its elevation.

You aren't going to do inundation modeling without the roadbed.
The next phase this month is basically where are the breaches occurring, get that kind of feedback. It's not a new model, it's like the roadbed is still there.

We have envisioned more tidal action, there are questions about how quickly the elevation of the wetlands can keep up with SLR, so it seems there would be some strategic levees but that is a whole other study.
If there is a mixed levee-causeway model or causeway with culverts, then when the tidal action starts coming across and hitting the foot of the highway, that water is going to be rocketing back and forth so you'll get erosive action on the highway itself and the strand of marsh.

Austin Creek also has a connection under 37 and 29 into to White Slough.

To clarify, the vulnerability is Tolay Creek and Sonoma Creek from tidal water moving up the creek.
We are primarily looking at bay sources of flooding from very high tides, overtopping. This mapping exercise is completely independent of riverine or fluvial flooding, which may or not be higher than what we are looking at.

We have seen serious flooding from upstream/downstream in Sonoma Valley. Take this into account with this exercise what level the new highway should be.

How are you going to deal with subsidence?
As you measure berm and levee elevation, that data gets out of date as they sink, which is also true for the highway. Maintenance in Caltrans said that there are stretches of the highway where they are adding a foot of new highway every year because the highway is sinking. We need frequent data collection because the elevations are so low compared to what the new sea levels are going to be. It is not just the bathtub model that sea level is rising, but you always have wave action in extreme events sitting on top of that.

How much change is there right now? The structure has to be functional under a wide range of conditions; how long will the structure last? There is a lot of uncertainty.
50 years is planned obsolescence for Caltrans. The least amount of uncertainty would be a floating bridge. Ducks Unlimited has done some surveys on the sediments associated with Cullinan Ranch – there is ~70ft of unconsolidated sediment under there. That starts to put a bit of a price tag on the footing/causeway. The tunnel would be the safest because a floating bridge would be exposed and higher maintenance cost.

Wouldn't the tunnel be a huge environmental impact?
It depends on how you build it. Once it's built, the impacts are reduced.

From a Regional Water Quality Control Board perspective, the need to treat any impervious surface triggers the permitting process.

Given the geologic condition why is the causeway a good idea? Washington is having issues with their floating bridge.
Levees are prone to liquefaction in an earthquake, floating bridges always have maintenance costs.

North Mare Island has earthquake protection. Victor Zias makes earthquake protective services for causeways.

RWQCB mentioned structural skimmer structures and other treatments at other locations. It will be very expensive to keep the existing roadway - that would bring about mitigation issues. We would say take it out.
If you take the existing roadbed out, then you have tidal action that wasn't there before.

You should be as efficient as possible by engaging with regulatory agencies now. Know if it is staying, temporary or removed.

There is a Transportation Concept Report 2014. That, plus this study, lays out the concepts. It is on the Highway 37 website.

Does the Caltrans study address rail at all? SMART was not a part of the focus group.
We had a Congestions Management Agencies focus meeting. We want SMART and the Railroad to be involved. There will be a Transit Agency meeting in February or March.

The highway is underperforming and the problem is not going to go away. Government has ignored us for a long time – it needs programmed funds.
Within this region, it is not a high priority – Hwy 101 and the Bay Bridge are. In 2017 the Regional Transportation Plan (RTP) will have SLR as a focus area and hopefully the money will come with it. We are doing this study to go into the RTP. We need to identify funding to move forward and get everyone involved and understand the urgency.

We need political pressure on the politicians. There could be billboards on Highway 37 for www.fix37. 43 thousand people could see them driving by Sears Point. Only 471 have signed the petition to fix it on moveon.org.
This venue isn't for advocacy, this is the technical part of urgency.

Meetings with Focal Groups – Fraser Shilling, UC Davis

Meeting with Private Toll-road Consortium (**Slide 22**)

- Group is a mix of a bridge-building company, attorneys, a consulting firm, and Jerry Meral
- Focus was primarily on what it might take to build a toll-road on a mixture of levees and causeway across the marshes

Meeting with Local Transportation Agencies (**Slide 23**)

- Group included all county transportation agencies, the Metropolitan Transportation Commission, and Caltrans

- Focus was primarily on the practical steps necessary to plan for modification of 37 and the data needed to make a good decision

Meeting with Marsh Restoration Organizations (**Slide 24**)

- Group was a mix of private and public organizations restoring the Napa Sonoma Marshes
- Focus was primarily on the relationship between marsh restoration activities and 37 modification, including timing, data needs, and modeling

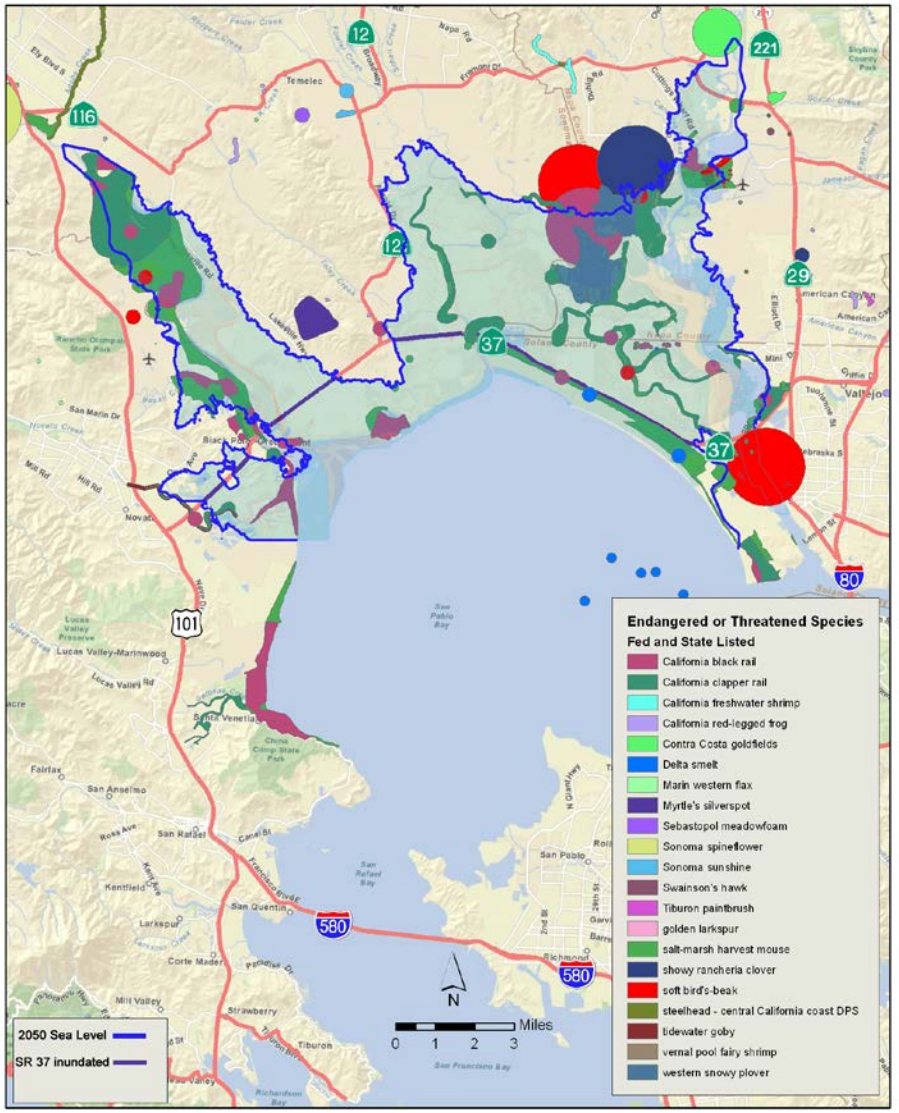
Next Steps and Next Meeting – Fraser Shilling, UC Davis and Ina Gerhard, Caltrans

- Stakeholder Meeting in April 2015 - Presentation of risk/vulnerability assessment from AECOM
- Incorporate feedback from today's meeting
- Comments on draft maps
- Figuring out how to deal with data gaps and inaccuracies
    - Actual marsh, berm and levee elevations
    - Actual rate of landscape change from sea level rise
    - Likely rate of threat to infrastructure/landscape
- Funding next planning steps

State Route 37 Integrated Traffic, Infrastructure and Sea Level Rise Analysis

Ina Gerhard, Branch Chief
System Planning North/Peninsula
District 4, Caltrans

Fraser Shilling, Co-Director
Road Ecology Center
University of California, Davis

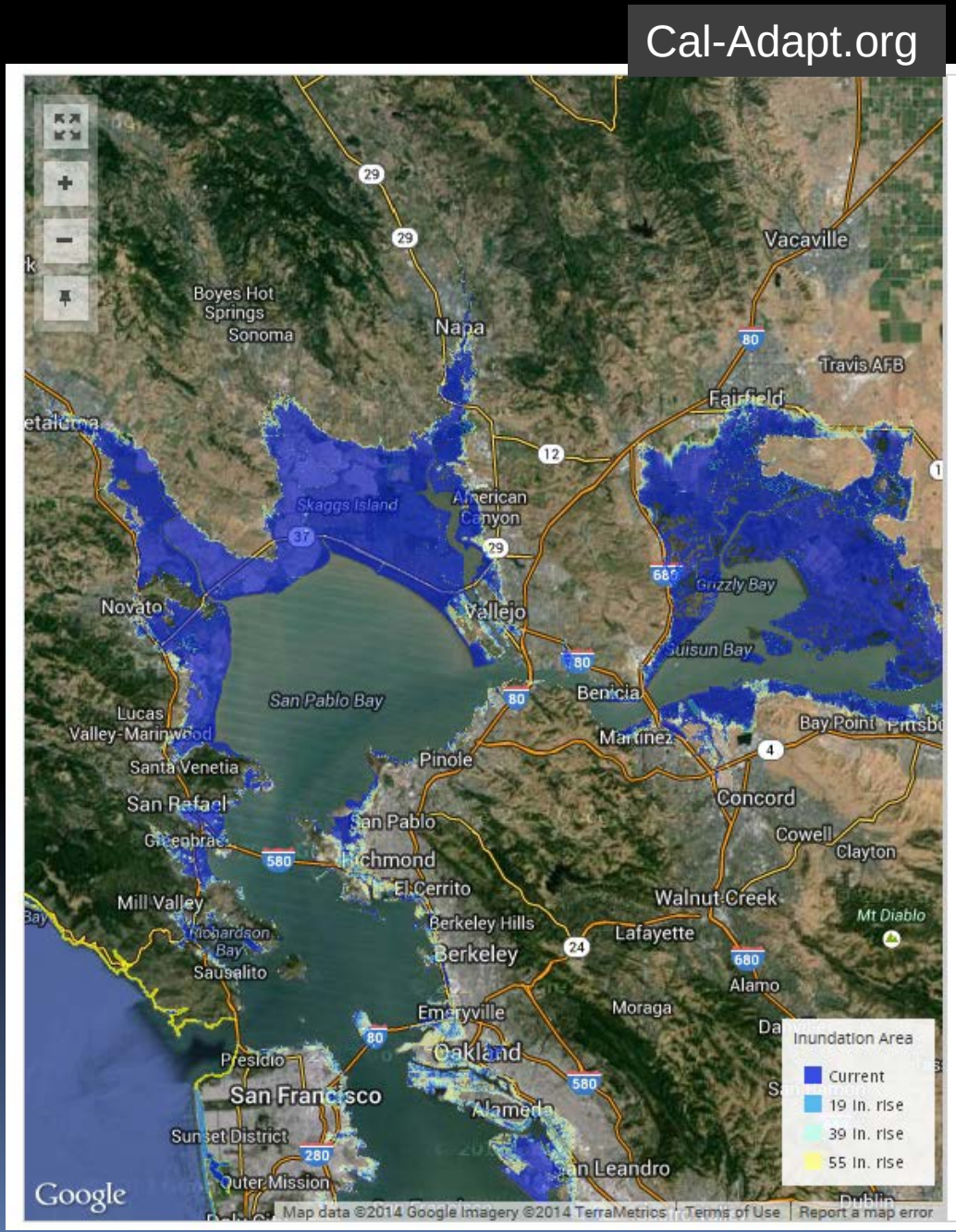


Listed Species Map

Imperative

Inter-generational, Adaptation, Demonstration

State route 37 is possibly the most vulnerable of infrastructure in Bay Area. Show how integrated, inclusive planning and implementation can help adaptation



Phase I: State Route 37 Stewardship Study: Integrating Environment and Community in Transportation Planning

C21 (California): Product-Testing the TCAPP and Ecological Framework Approaches in Corridor Planning

Stakeholder List

Army Corps of Engineers ,Association of Bay Area Governments, Bay Planning Coalition, Bay Conservation and Development Commission, Black Point Improvement Club Buck Institute, California Department of Fish and Game, Caltrans HQ, Caltrans District 4, California Highway Patrol, City of Vallejo, City of Vallejo Sanitation District, Coastal Conservancy, Congressman George Miller, Ducks Unlimited, East Bay Regional Park District, ESA PWA (consultant), Felidae Conservation Fund, Federated Indians of Graton Rancheria, Friends of the Esteros, Friends of the Napa River, GAIA (consulting), Hanson Bridgett LLP, Hungry Owl Project, Infineon Raceway, Landowner (5), Marin Audubon, Marin County Bicycle Coalition, Marin County Public Works, Michael Allen Assembly-member 7th District, Moffatt and Nichol, Metropolitan Transportation Commission, Napa County Transportation and Planning Agency, Napa County, Napa County Resource Conservation District, Napa Valley Bike Coalition, Napa-Solano Audubon, NBAA / Canalways, National Oceanic and Atmospheric Administration, North Bay Agricultural Alliance, North Bay Leadership Council, Natural Resource Conservation Service, Nute Engineering, Point Reyes Bird Observatory, San Francisco Bay Regional Water Board, San Francisco Estuary Project, Save the Bay, Schellville Fire Department, Senator Noreen Evan's Office, San Francisco Bay Joint Venture, Sonoma County Agricultural Preservation & Open Space District, Solano County, Solano Transportation Authority, Sonoma County Bike Coalition, Sonoma County Permit and Resource Management Department, Sonoma County Regional Parks, Sonoma County Transportation Authority, Sonoma County Water Agency, Sonoma Ecology Center, Sonoma Land Trust, Sonoma Marin Area Rail Transit, Sonoma Valley Heritage Coalition, Southern Sonoma County Resource Conservation District, Transportation Authority of Marin, The Bay Institute, Trout Unlimited Redwood Chapter, US Environmental Protection Agency, US Fish & Wildlife Service (regulatory), USFWS - San Francisco Bay National Wildlife Refuge, Vallejo Sanitation and Flood Control, Weston Solutions, Inc.

INTEGRATING ENVIRONMENT AND COMMUNITY IN TRANSPORTATION PLANNING

Corridor Planning Need:

-- to balance access and economic demands with environmental processes and attributes

-- acknowledge and integrate community/stakeholder needs and concerns in planning and decision-making

-- develop a crediting and valuation approach to aid decisions

INTEGRATING ENVIRONMENT AND COMMUNITY IN TRANSPORTATION PLANNING

Environmental Need:

-- to provide room for the San Francisco Bay to move as sea level rises

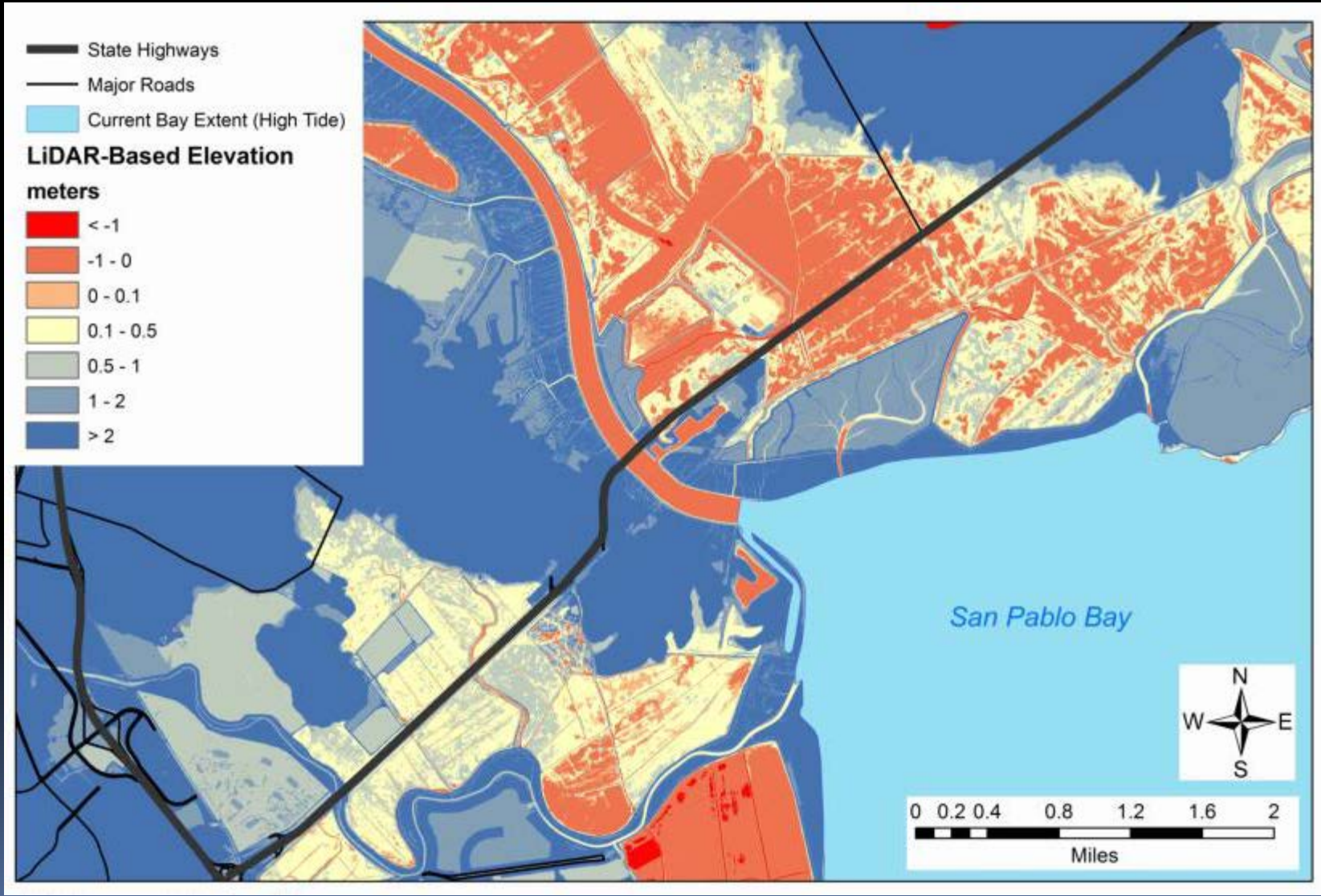
-- to allow marshes to connect with rising Bay waters and adapt

-- to reduce traffic noise and air quality impacts to marsh habitats

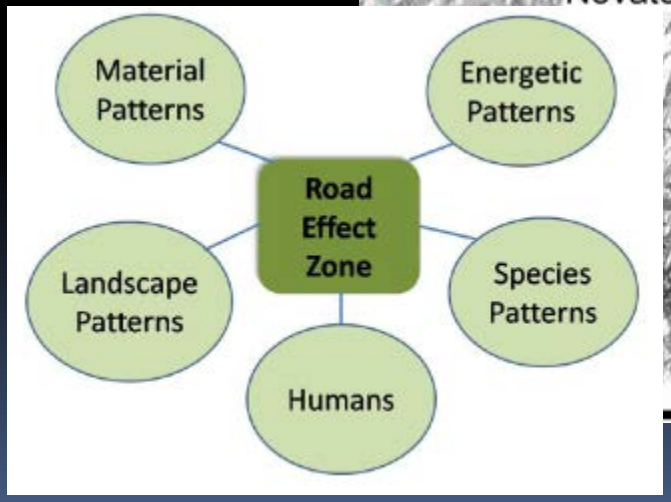
-- to reduce direct mortality effects on listed and non-listed wildlife

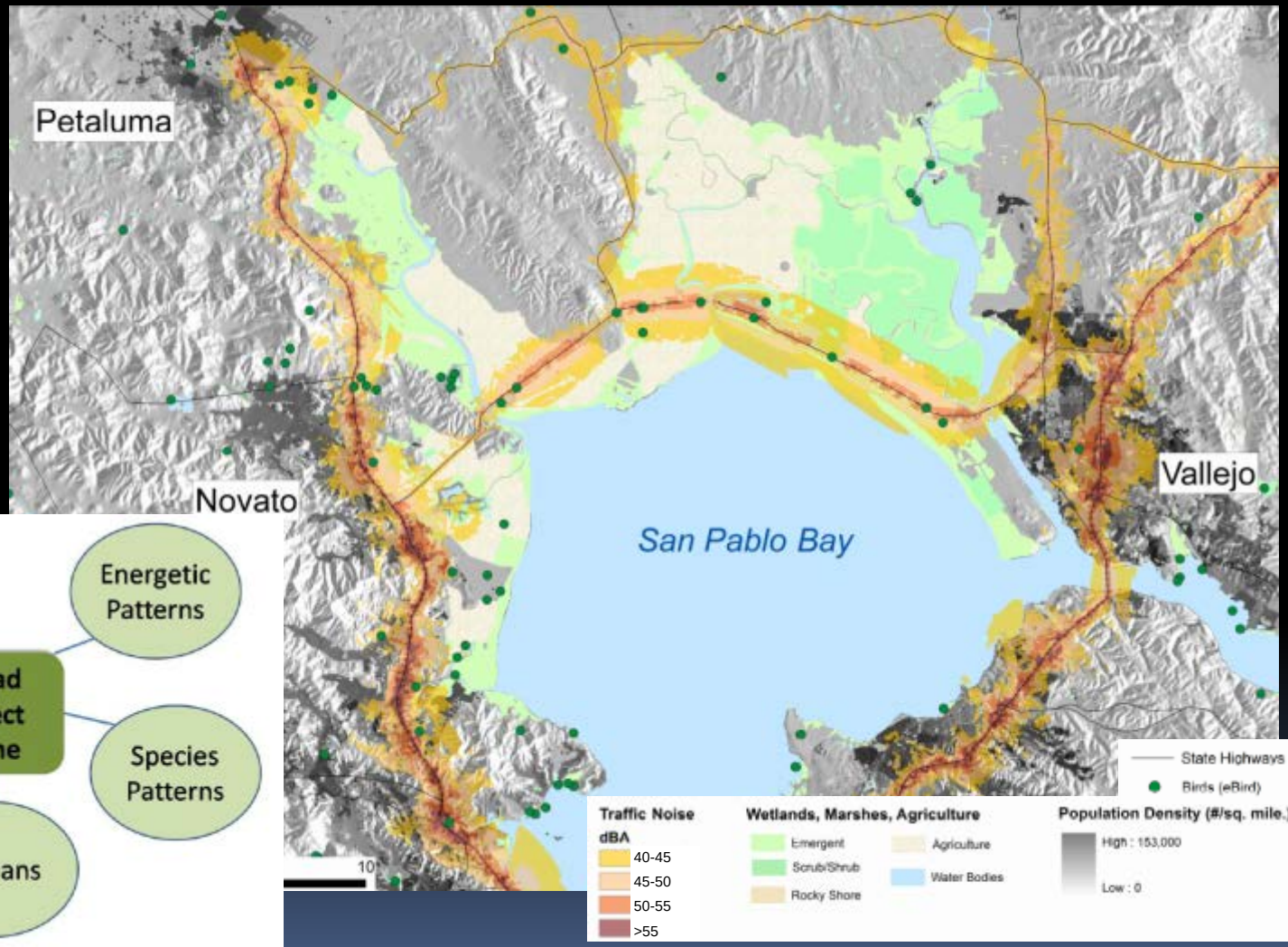
-- to go beyond typical mitigation approaches and treat this as a stewardship process

Sea Level Rise – Highway



Accounting for Impacts





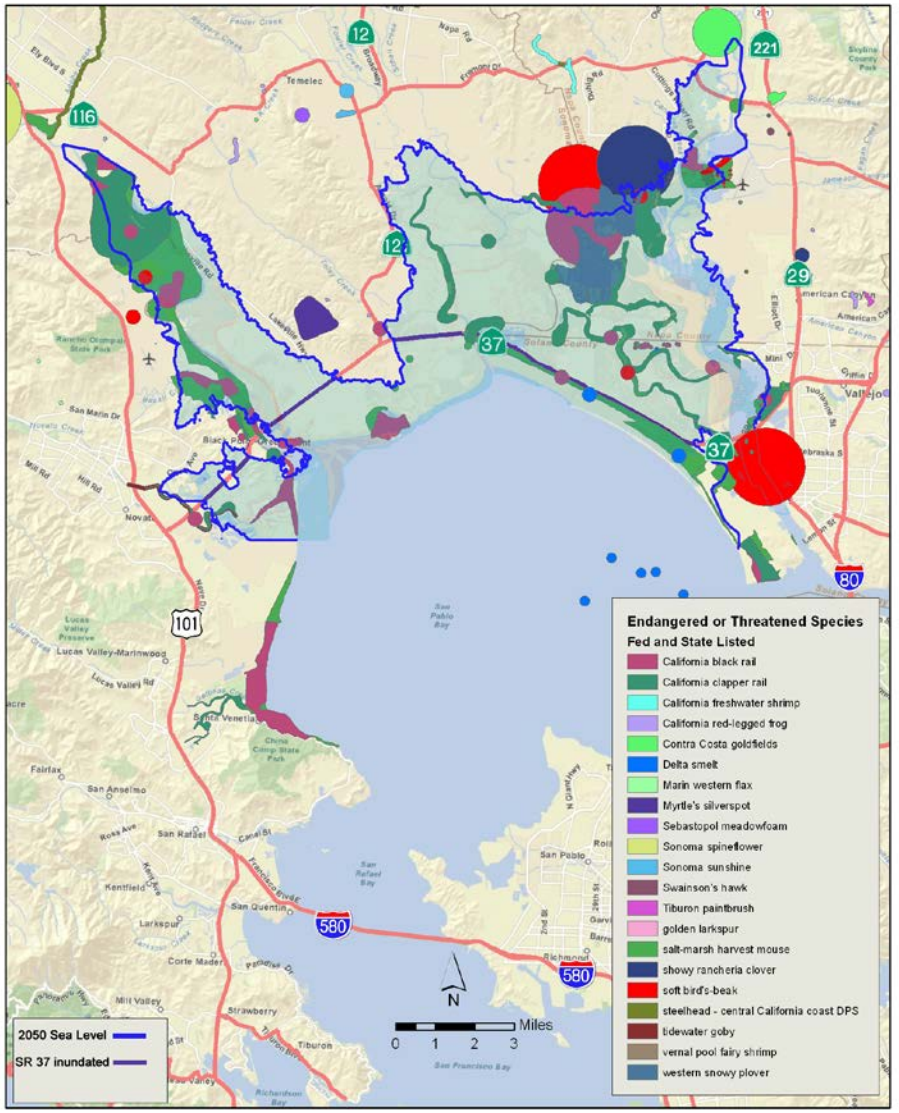
Corridor Options

- No expanded capacity (business-as-usual)
  - Cost-effective (short-term), supports rural character, future risk increases with sea level rise
- Expanded footprint levee, increased capacity
  - Costly, provides capacity, harms rural character and environment, unknown adaptation to sea level rise
- Causeway, increased capacity
  - Costly, good for rural character and environment, provides capacity, adaptive to sea level rise
- Strategic co-alignment
  - Cost-effective, good for environment, does not provide capacity, adaptive to sea level rise
- Tunnel
  - Costly, good for environment, provides capacity, adaptive to sea level rise

Early Regulatory Consultation

- No expanded capacity (business-as-usual)
  - Permits for emergency repair and small-scale "improvements"
- Expanded footprint levee, increased capacity
  - Permits not likely to be awarded without legislative action
- Causeway, increased capacity
  - "Self-mitigating", permits for construction
- Strategic co-alignment
  - Permits for removal of roadway
- Tunnel
  - Permits for construction, removal of roadway

Phase II: State Route 37 Integrated Traffic, Infrastructure and Sea Level Rise Analysis: Goals and Milestones



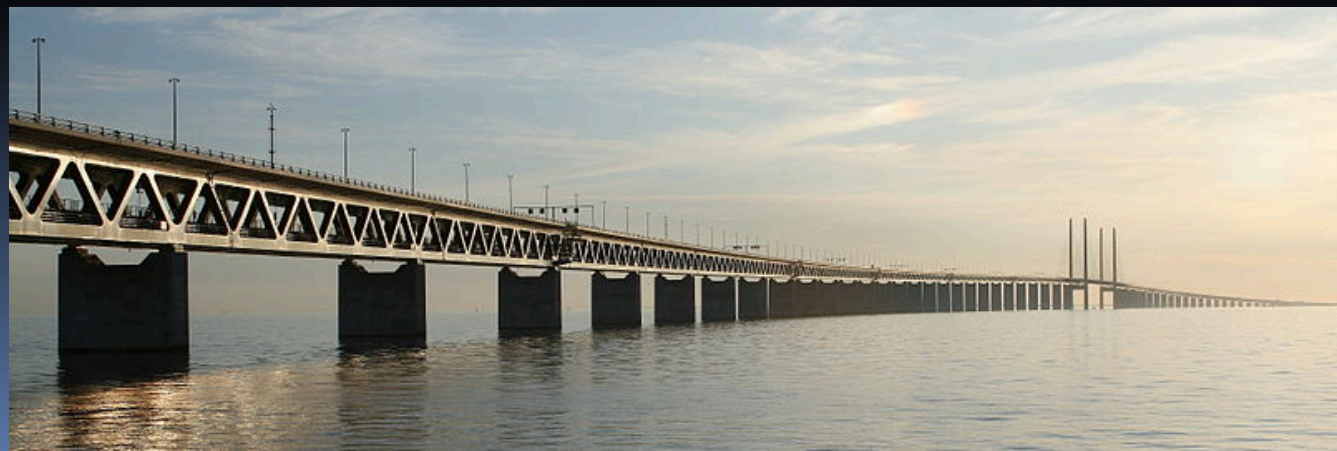
Listed Species Map

Stakeholder Meeting #1

- September 3rd in Vallejo
- >170 people on stakeholder list so far, up by 25% compared to Phase 1
- Goals for meeting were to remind people about project Phase 1 and set them thinking about Phase 2

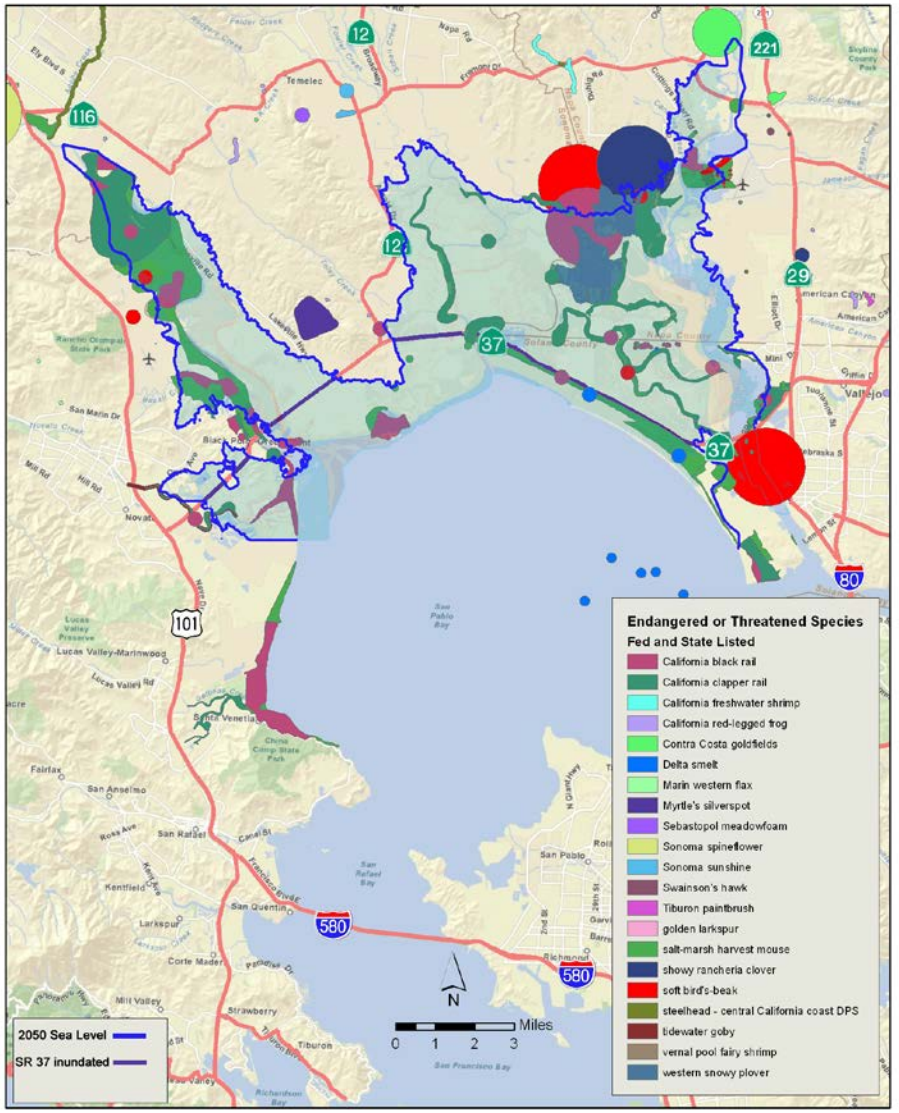
Stakeholder Meeting #1

- Discussion revolved around speed of responding to needs along SR37, information needs to make good decisions, why not transit, private toll road, why constrained list of highway responses …



Phase II: State Route 37 Integrated Traffic, Infrastructure and Sea Level Rise Analysis: Goals and Milestones

Current Project Overview



Listed Species Map

Goals

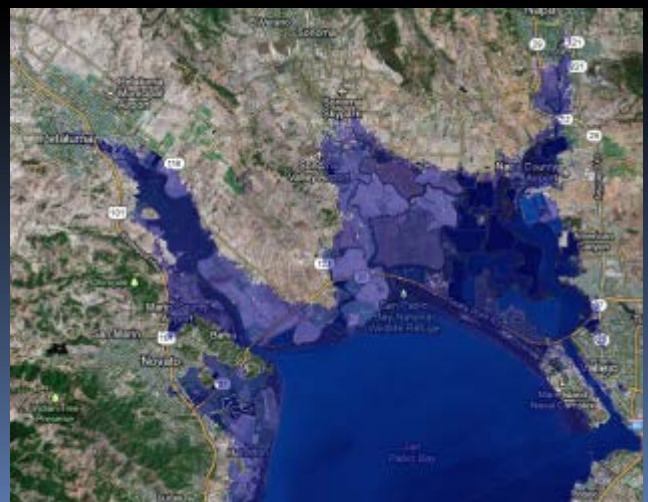
- Maintain and improve transportation corridor benefits and develop long-term solutions for the corridor
- Determine how to support large-scale restoration of tidal and other marshes to benefit native species, ecological processes, and decrease the severity of storm and tidal action on coastal infrastructure

Tasks

- Task 1: Inundation assessment of infrastructure and associated lands (18%)
- Task 2: Vulnerability assessment for existing transportation system (9%)
- Design and cost estimates for resilient and sustainable transportation (26%)
- Environmental and community benefits for different future scenarios (9%)
- Stakeholder involvement to improve sustainability (19%)
- Project management, presentations and reporting (19%)

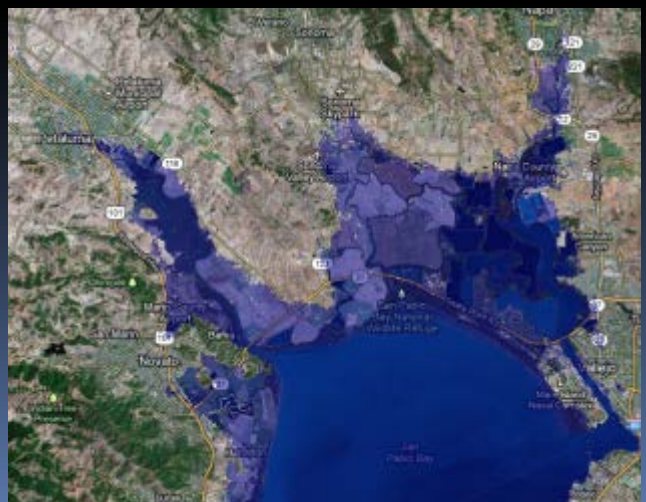
Subcontractor (AECOM): Risk Assessment & Response

- Task 1 Inundation Mapping
- Task 2: Vulnerability and Risk Assessment
- Task 3: Engineering Concept Design
- Task 4: Engineering Cost Estimation
- Task 5: 3D Visualization



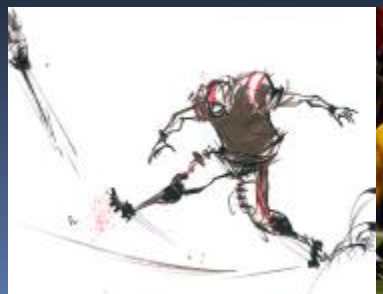
Stakeholder Participation

- Primarily through meetings like this
- Focal meetings to drill down into critical issues
- Other venues include county and regional boards and commissions and the California Transportation Commission



Timeline

Tasks/Sub-tasks	FY 2014/15															FY 2015/16							
	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Execute Contract																							
1. Inundation Assessment of Transportation System and Associated Lands																							
1a. Assessment of SLR Maps, incl. overtopping potential maps																							
1b. Memo with methods and results																							
2. Vulnerability Assessment for Existing Transportation System																							
2a. Risk assessment memo for 3 SLR scenarios + vulnerability assessment																							
3. Design and Cost Estimates																							
3a. Designs: plans, profiles, cross-sections																							
3b. Cost estimates																							
3c. 3D simuations of 3 engineered scenarios																							
4. Environmental and Community Benefits for Future Scenarios																							
4a. Report of community and environmental benefits																							
5. Stakeholder Involvement																							
5a. Quarterly stakeholder meetings																							
5b. Bimonthly small group meetings																							
5c. Three presentations to CT upper management and critical stakeholders at the same time or in place of the bimonthly/quarterly meetings (5a)																							
6. Project Management and Technical Reporting																							
6a. Task reporting and presentation to sponsor																							
6b. Project website to support stakeholders and future project development																							
6c. Technical paper submitted and presented at TRB 2015																							

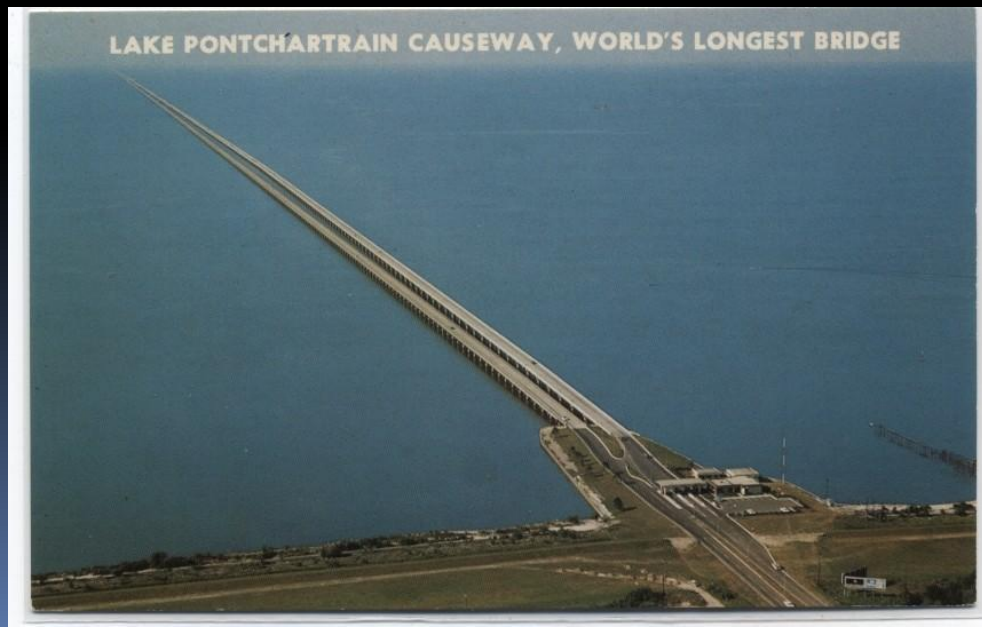


Inundation Modeling/Mapping

- DRAFT model of potential inundation under different future sea level conditions
- Will inform risk/vulnerability assessment
- Needs your input and local knowledge to finalize

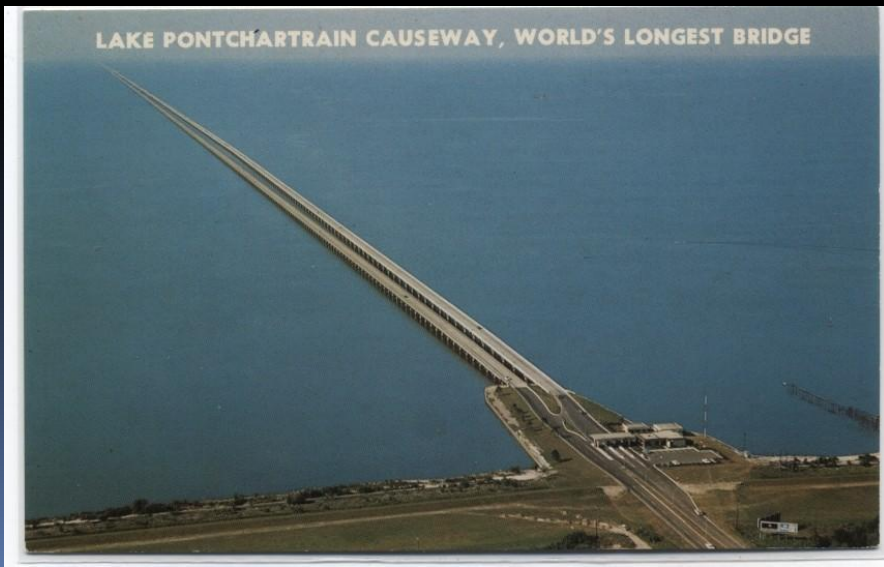
Meetings with Focal Groups

- Focus meetings with private toll-road consortium, local/regional transportation agencies, marsh restoration groups



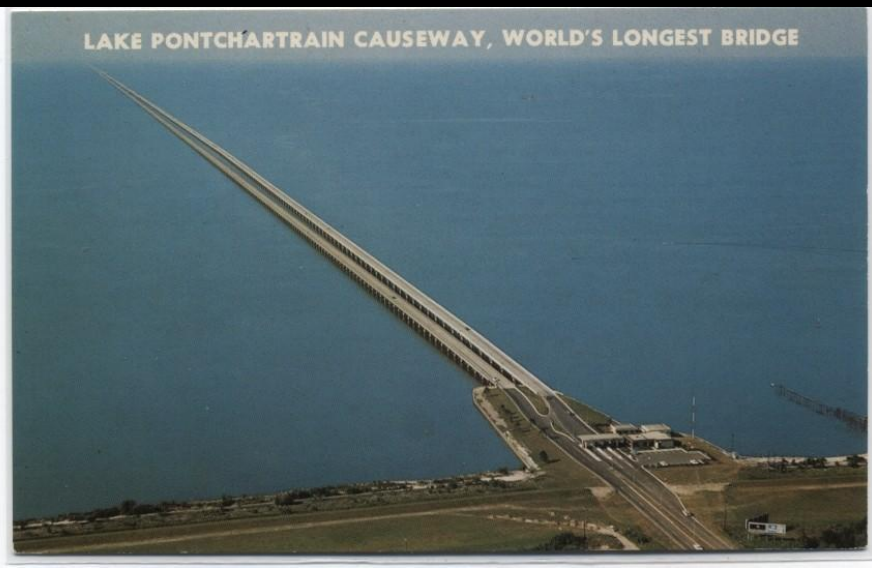
Meeting with Private Toll-Road Consortium

- Group is a mix of a bridge-building company, attorneys, a consulting firm, and Jerry Meral
- Focus was primarily on what it might take to build a toll-road on a mixture of levees and causeway across the marshes



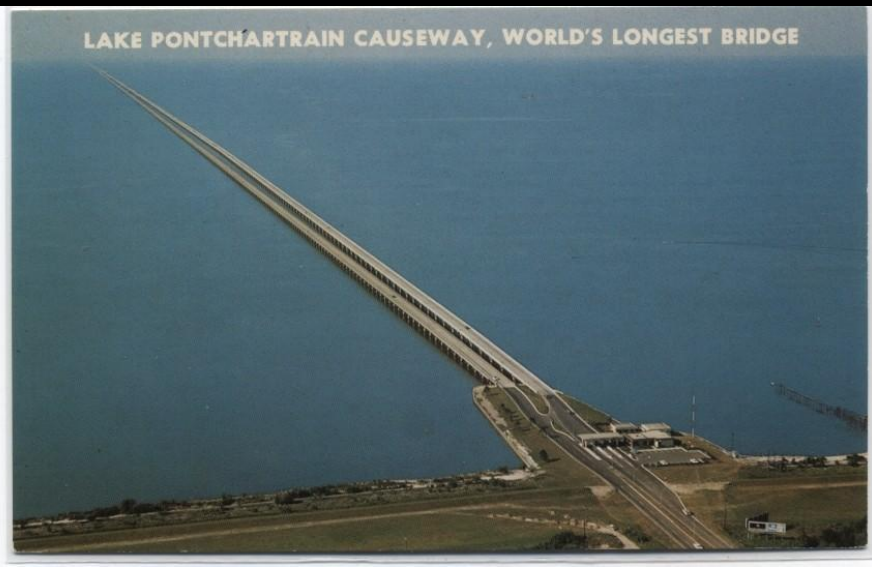
Meeting with Local Transportation Agencies

- Group included all county transportation agencies, the Metropolitan Transportation Commission, and Caltrans
- Focus was primarily on the practical steps necessary to plan for modification of 37 and the data needed to make a good decision



Meeting with Marsh Restoration Organizations

- Group was a mix of private and public organizations restoring the Napa Sonoma Marshes
- Focus was primarily on the relationship between marsh restoration activities and 37 modification, including timing, data needs, and modeling



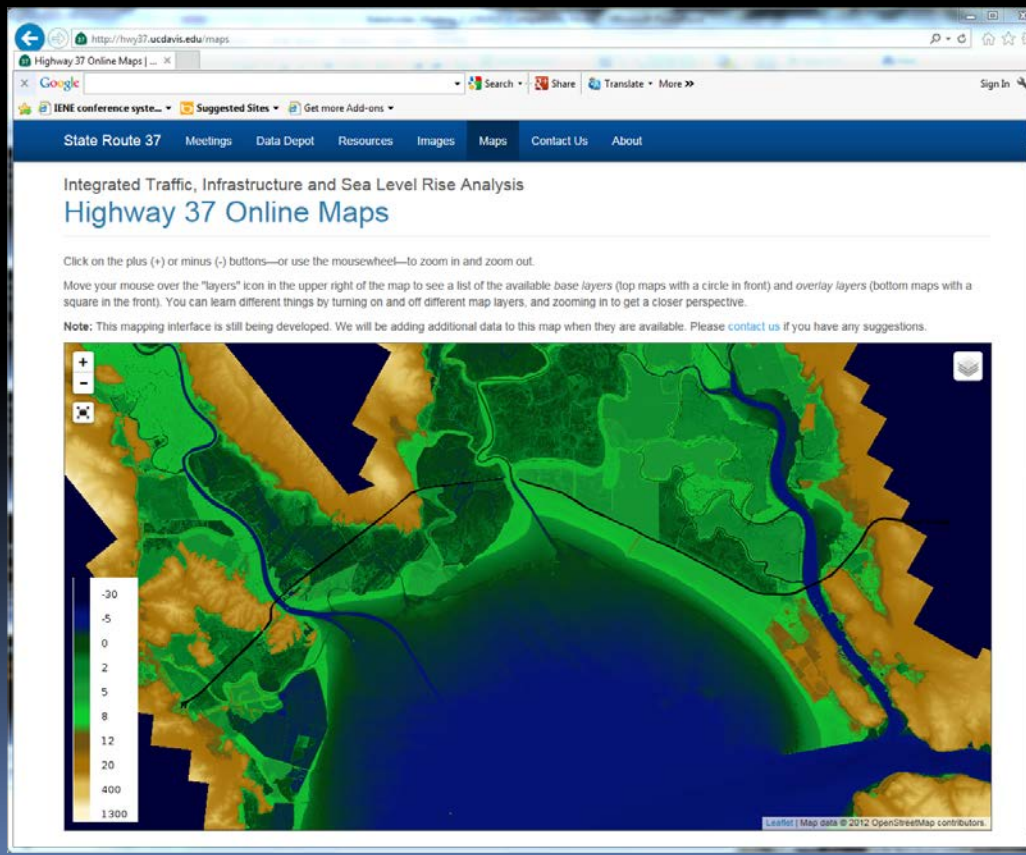
Next Steps

- Next stakeholder meeting in April
  - Presentation of risk/vulnerability assessment from AECOM
- Figuring out how to deal with data gaps and inaccuracies
  - Actual marsh, berm and levee elevations
  - Actual rate of landscape change from sea level rise
  - Likely rate of threat to infrastructure/landscape
- Funding next planning steps

More Information

http://hwy37.ucdavis.edu

fmshilling@ucdavis.edu



HWY 37 SLR Inundation Mapping

Justin Vandever, PE and Kris May, PhD, PE
AECOM – Oakland, CA
Justin.Vandever@aecom.com
Kris.May@aecom.com

Highway 37 Stewardship Study

Stakeholder Meeting – Vallejo, CA

January 29, 2015

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Presentation Outline

- Study Purpose
- HWY 37 Study Area
- Mapping Methods
  - Data Sources
  - Analysis and Mapping

- Preliminary Inundation Mapping Results
- Preliminary Vulnerability Assessment
- Next Steps and Stakeholder Feedback

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Purpose of Study:

HWY 37 Integrated Traffic, Infrastructure, and Sea Level Rise Analysis

- Goal: Determine possible future planning solutions for the highway and its human and natural environment
- Study components for HWY 37:
  - SLR inundation mapping
  - Vulnerability assessment
  - Conceptual engineering drawings and cost estimates for highway alternatives

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HWY 37 Study Area

- Study area spans four counties: Marin, Sonoma, Solano, and Napa
- HWY 37 corridor vulnerable to inundation and flooding now and in future
- Major flooding sources:
  - San Francisco Bay
  - Novato Creek
  - Petaluma River
  - Tolay Creek
  - Sonoma Creek
  - Napa River

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SLR Inundation Mapping

Purpose and role of mapping in study:

- Informs the exposure component of the SLR vulnerability study (multiple SLR scenarios)
- Depth and extent of inundation
- Depth of roadway overtopping and freeboard
- Timing of inundation and adaptation options

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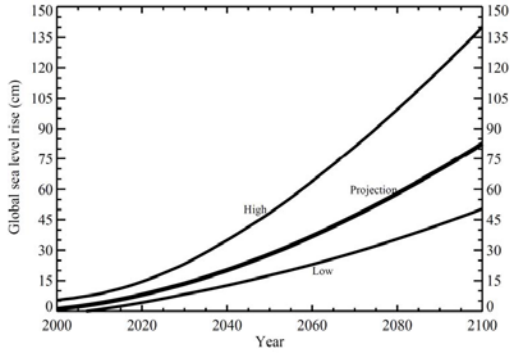
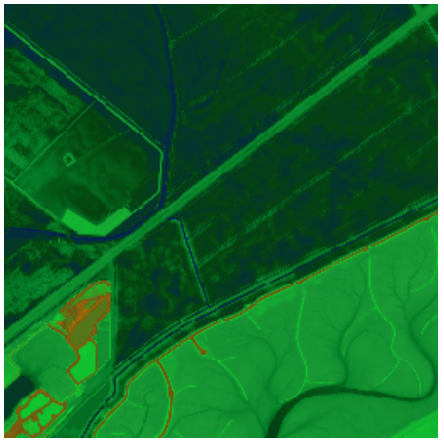
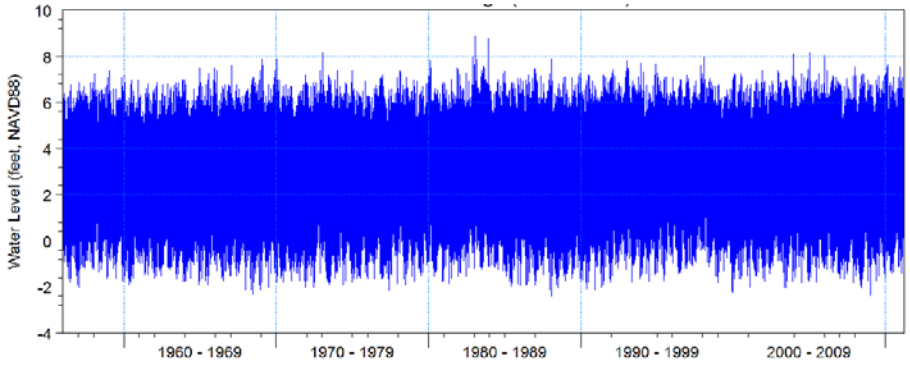
Data Requirements

- Sea level rise scenarios - NRC (2012)
- Topography – 5-ft (1.5m) grid Digital Elevation Model (DEM) using 2010 CA Coastal LIDAR (NOAA). Vert. rms error ~9 cm.
- Water levels – daily and extreme tides from FEMA hydrodynamic model







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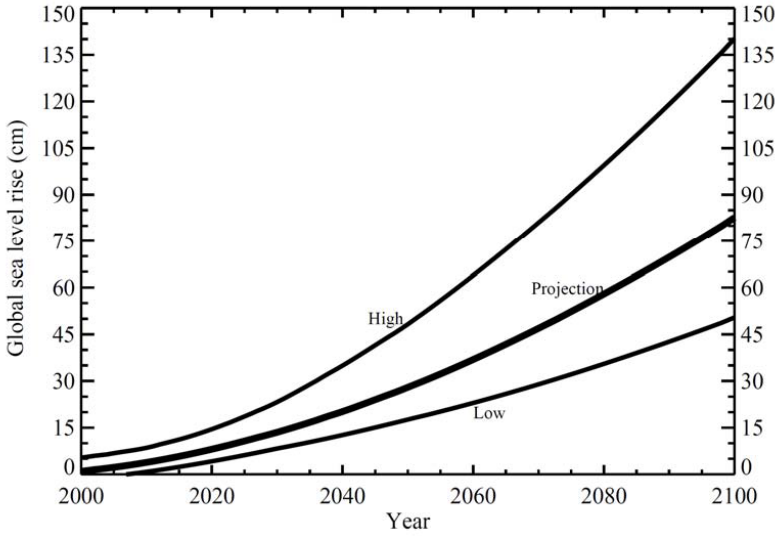
Sea Level Rise Scenarios

- Sea Level Rise Projections (NRC 2012)

Year	Projections	Ranges
2030	6 ± 2 in	2 to 12 in
2050	11 ± 4 in	5 to 24 in
2100	36 ± 10 in	17 to 66 in



- Selected Inundation Mapping Scenarios:
  - NRC “most likely”: 12 inch (2050) and 36 inch (2100)
  - NRC “high-end”: 24 inch (2050) and 66 inch (2100)

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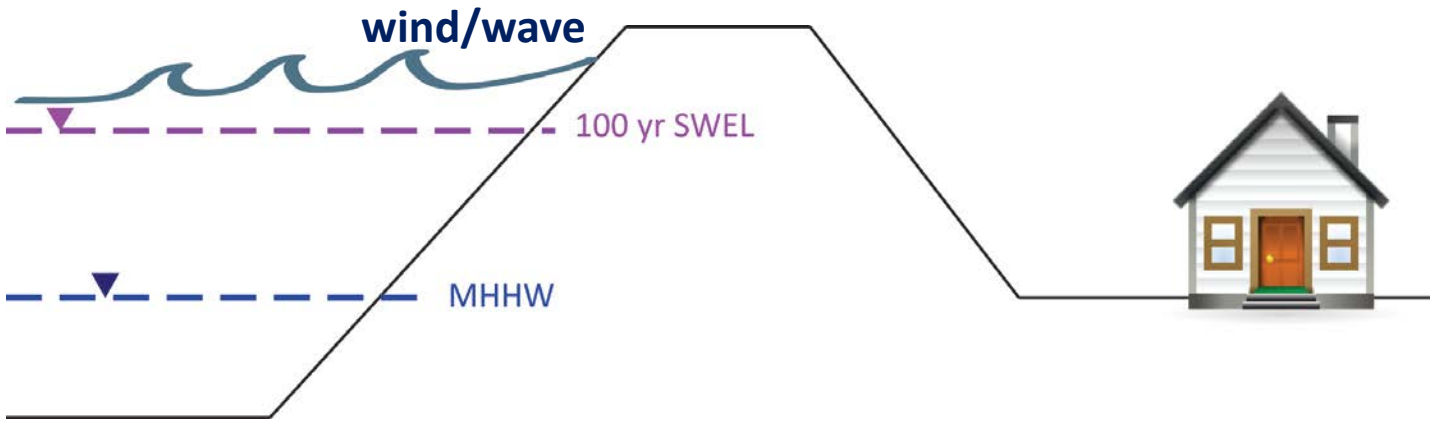
Water Level Analysis – Key Terms

- Mean Higher High Water (MHHW). Typical daily high tide. Frequent *inundation* (permanent).
- 100-yr Stillwater Elevation (SWEL) – Extreme high tide + storm surge. Very rare *flooding* (temporary) event. No wave or local meteorological effects.
- 100-yr SWEL + wind and wave effects. (Not evaluated)



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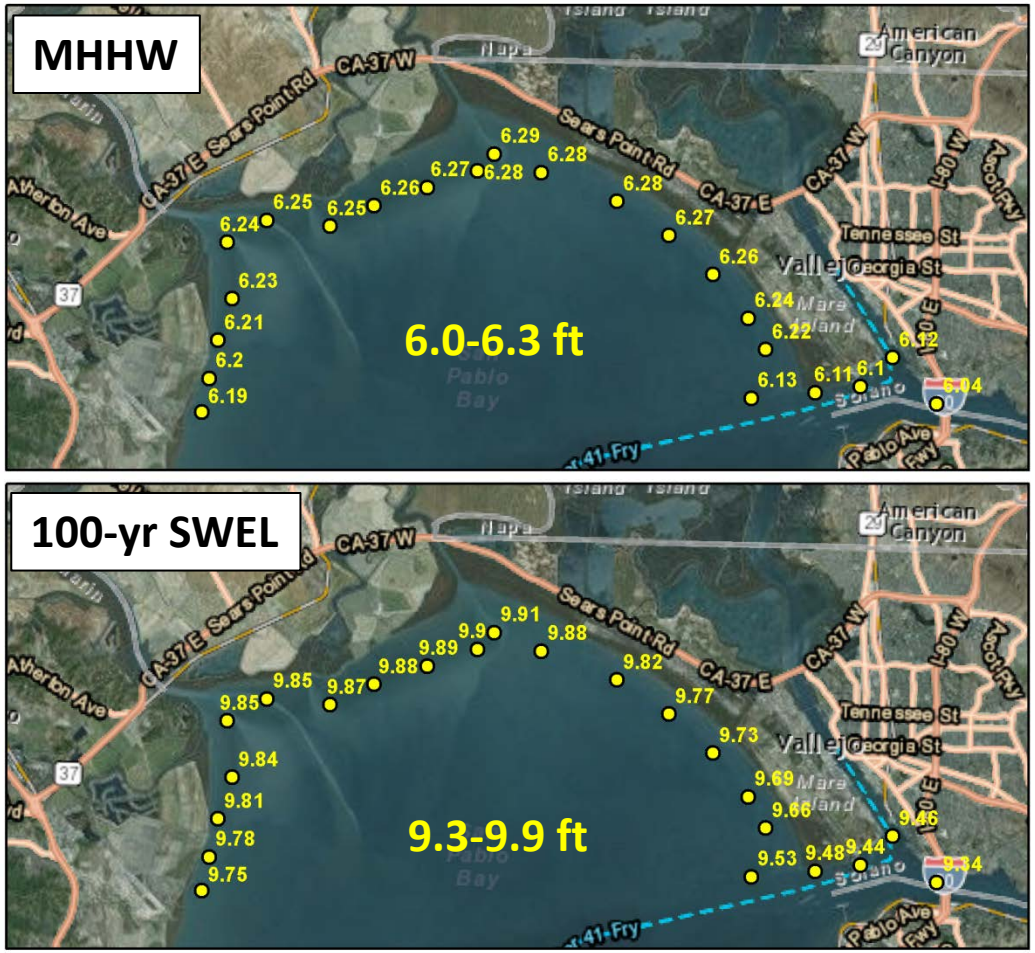
Water Level Analysis



- FEMA hydrodynamic modeling for existing conditions
- 32-year continuous simulation
- Analyzed data at 22 locations
- Daily and Extreme (storm surge) tides
- MHHW: 6.0-6.3 ft
- 100-yr SWEL: 9.3-9.9 ft
- Add SLR for mapping

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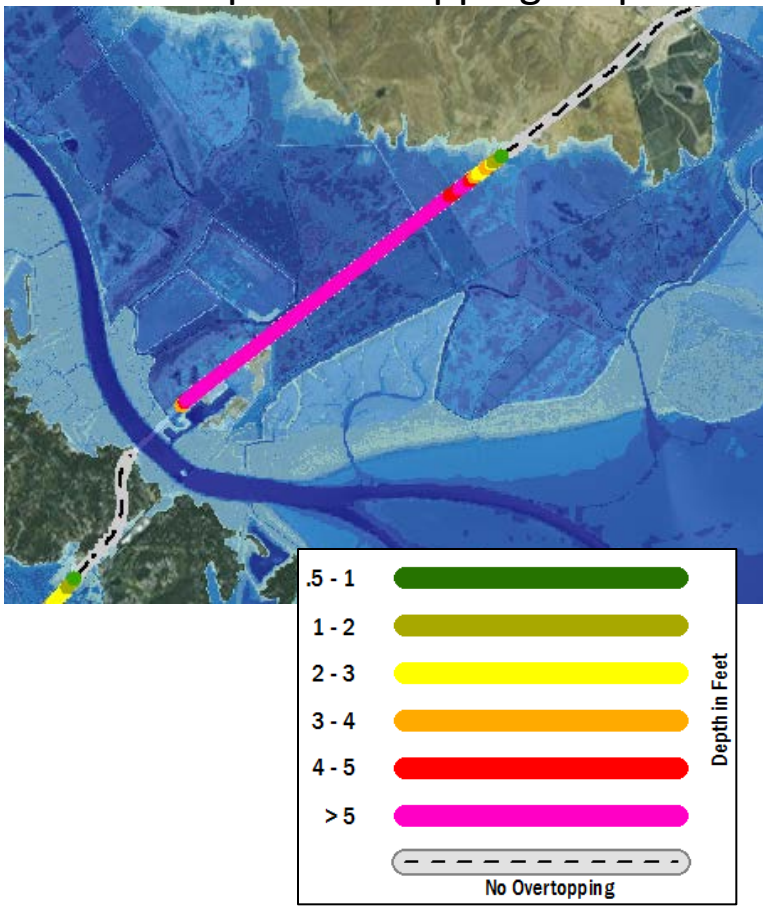
Inundation Mapping Process

- Followed NOAA Coastal Service Center's methodology
- Create topographic DEM (5-ft grid)
- Create water surface DEM
  - MHHW + SLR
  - 100-yr SWEL + SLR
- Project water surface overland
- Determine depth and extent of inundation
- Determine hydraulic connectivity
- Assess overtopping
- Caveat: not a hydraulic model; only a mapping tool

Example Overtopping Map



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Preliminary Mapping Results

- MHHW + 12” (2050 most-likely)
- MHHW + 24” (2050 high-end)
- MHHW + 36” (2100 most-likely)
- MHHW + 66” (2100 high-end)
- 100-yr SWEL + 12” (2050 most-likely)
- 100-yr SWEL + 36” (2100 most-likely)

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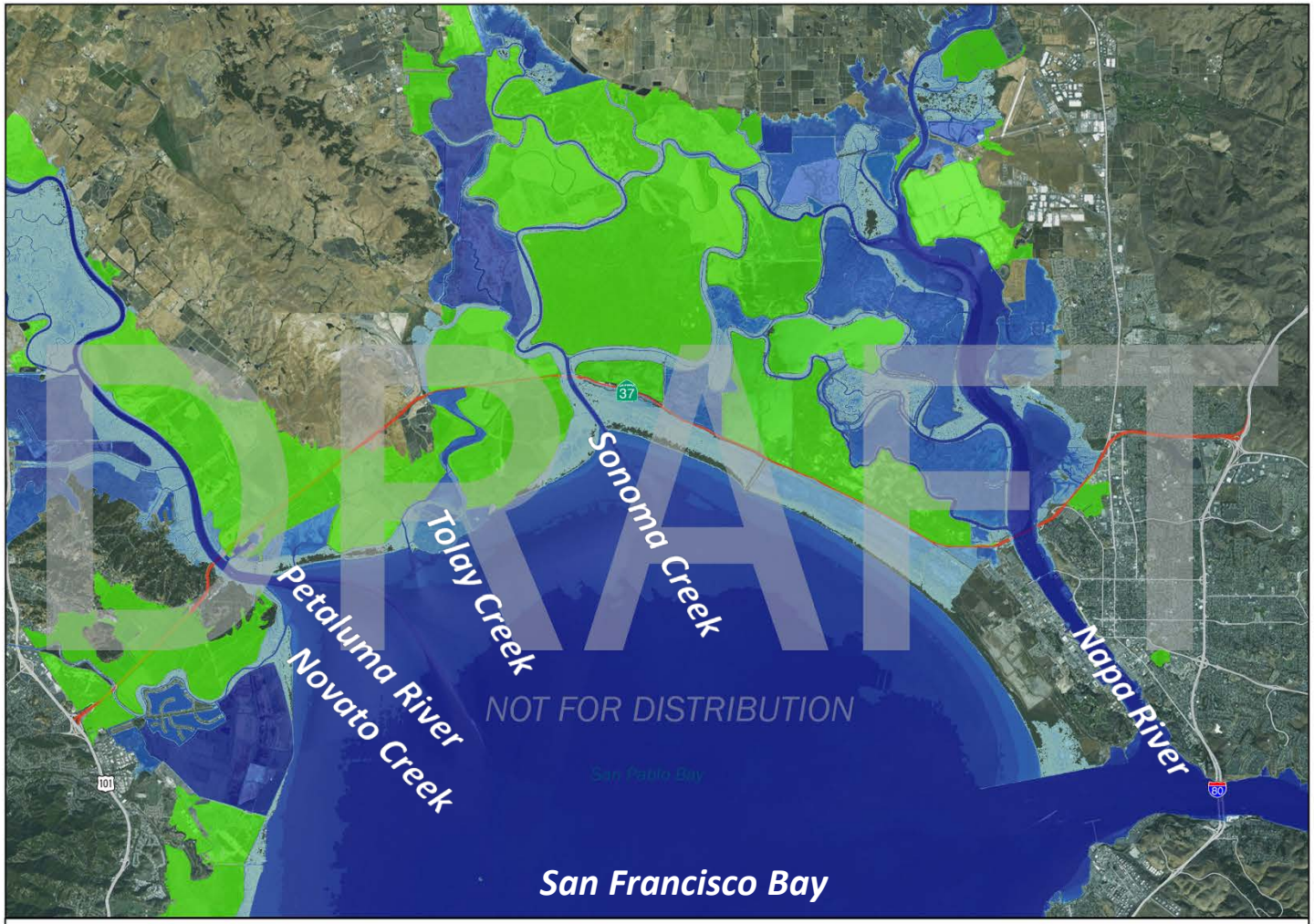
MHHW + 12”



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. 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 context about the maps and analyses, including a description of the data and methods used, please see the Sea Level Rise Inundation Mapping for HWY 37 Region Memorandum. January 2015.

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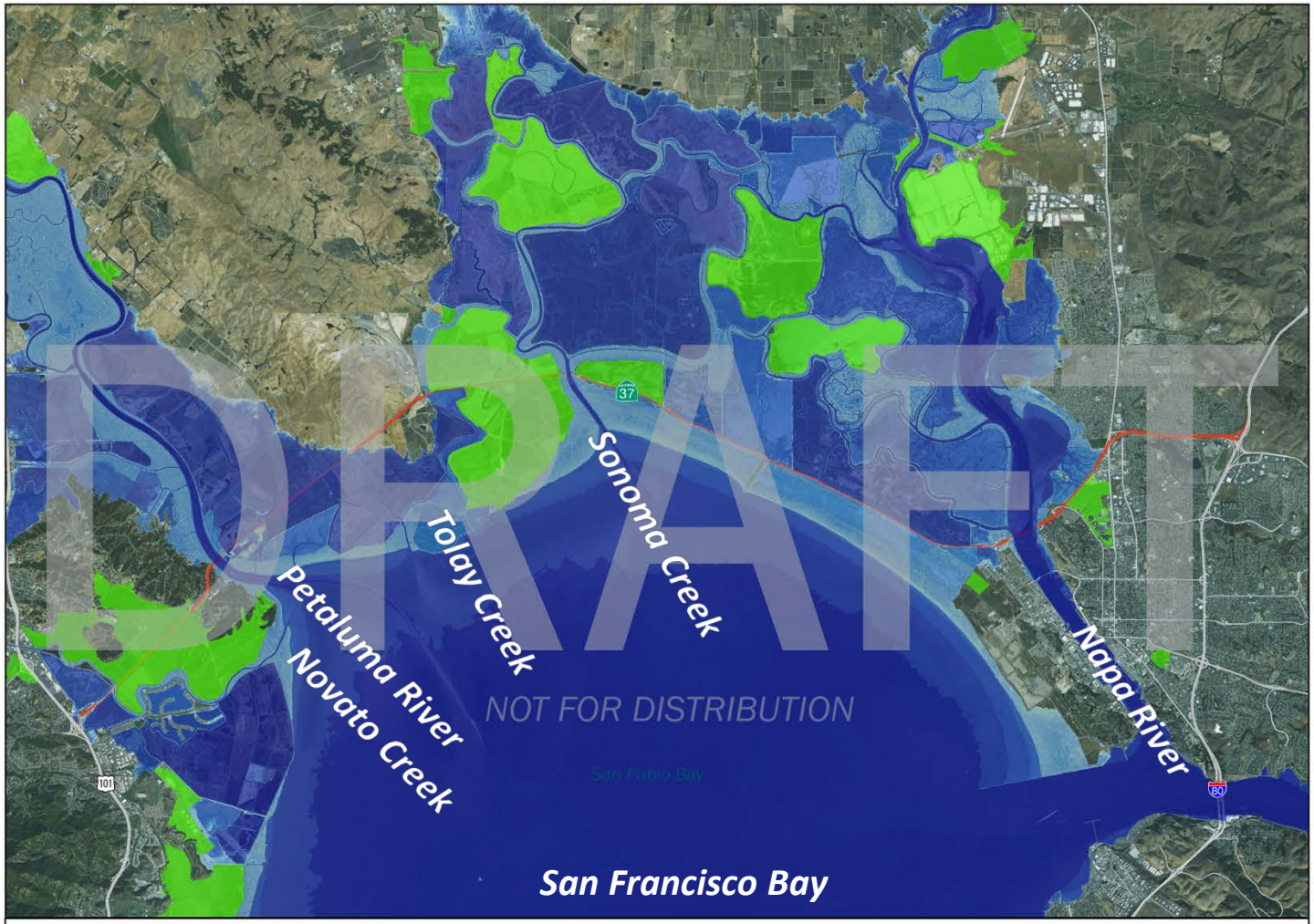
MHHW + 24”



HIGHWAY 37
DRAFT - Inundation Mapping

MHHW + 24" SEA LEVEL RISE

6" SLR + 2-yr Storm Surge
0" SLR + 5-yr Storm Surge

Depth in Feet
- 0 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- 2.5 - 3
- 3 - 5
- 5 - 7
- 7 - 10
- 10 +
- Lowlying Areas > 1 Acre

0 1 2 Miles
0 5,000 10,000 Feet

AECOM

CALIFORNIA 37

Projection: NAD 1983 California (1) North American Datum 1983 Date: 1/20/2015

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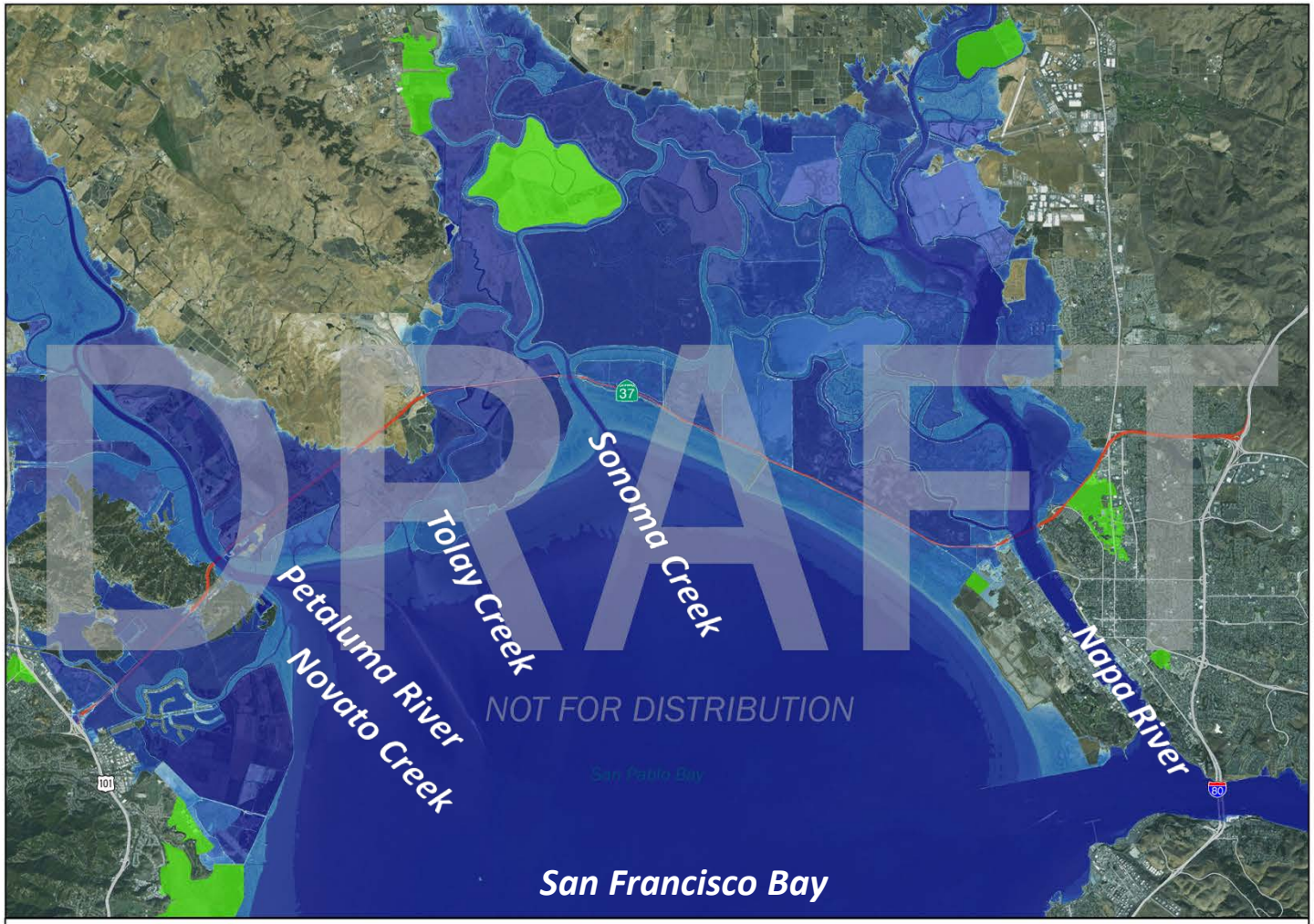
Caltrans UCDAVIS UNIVERSITY OF CALIFORNIA AECOM

MHHW + 36”



HIGHWAY 37
DRAFT - Inundation Mapping

MHHW + 36" SEA LEVEL RISE

12" SLR + 5-yr Storm Surge
6" SLR + 10-yr Storm Surge
6" SLR + 25-yr Storm Surge
0" SLR + 25-yr Storm Surge
0" SLR + 50-yr Storm Surge

Depth in Feet
0 - 0.5
0.5 - 1
1 - 1.5
1.5 - 2
2 - 2.5
2.5 - 3
3 - 5
5 - 7
7 - 10
10 +
Lowlying Areas > 1 Acre

0 1 2 Miles
0 5,000 10,000 Feet

AECOM

CALIFORNIA 37

Projection: NAD 1983 California (2) North American Datum 1983 Date: 1/20/2015

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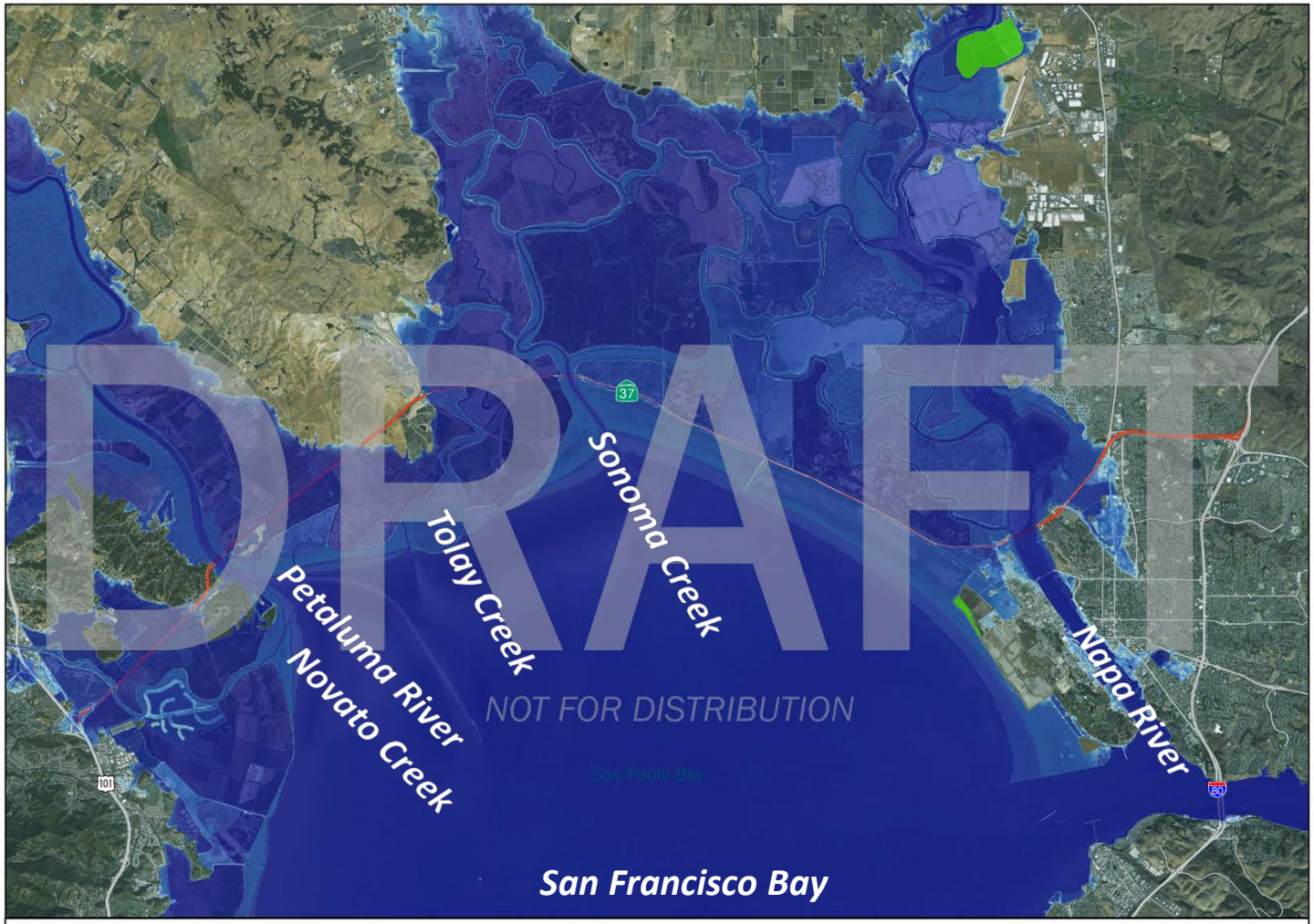
MHHW + 66”



HIGHWAY 37
DRAFT - Inundation Mapping

MHHW + 66" SEA LEVEL RISE

48” SLR + 2-yr Storm Surge
42” SLR + 5-yr Storm Surge
36” SLR + 10-yr Storm Surge
36” SLR + 25-yr Storm Surge
24” SLR + 100-yr Storm Surge
12” SLR + 500-yr Storm Surge
0” SLR + 50-yr Storm Surge

Depth in Feet
0 - 0.5
0.5 - 1
1 - 1.5
1.5 - 2
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2.5 - 3
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0 1 2 Miles
0 5,000 10,000 Feet

AECOM

CALIFORNIA 37

Projection: NAD 1983 California (1) North American Datum 1983
Date: 1/20/2015

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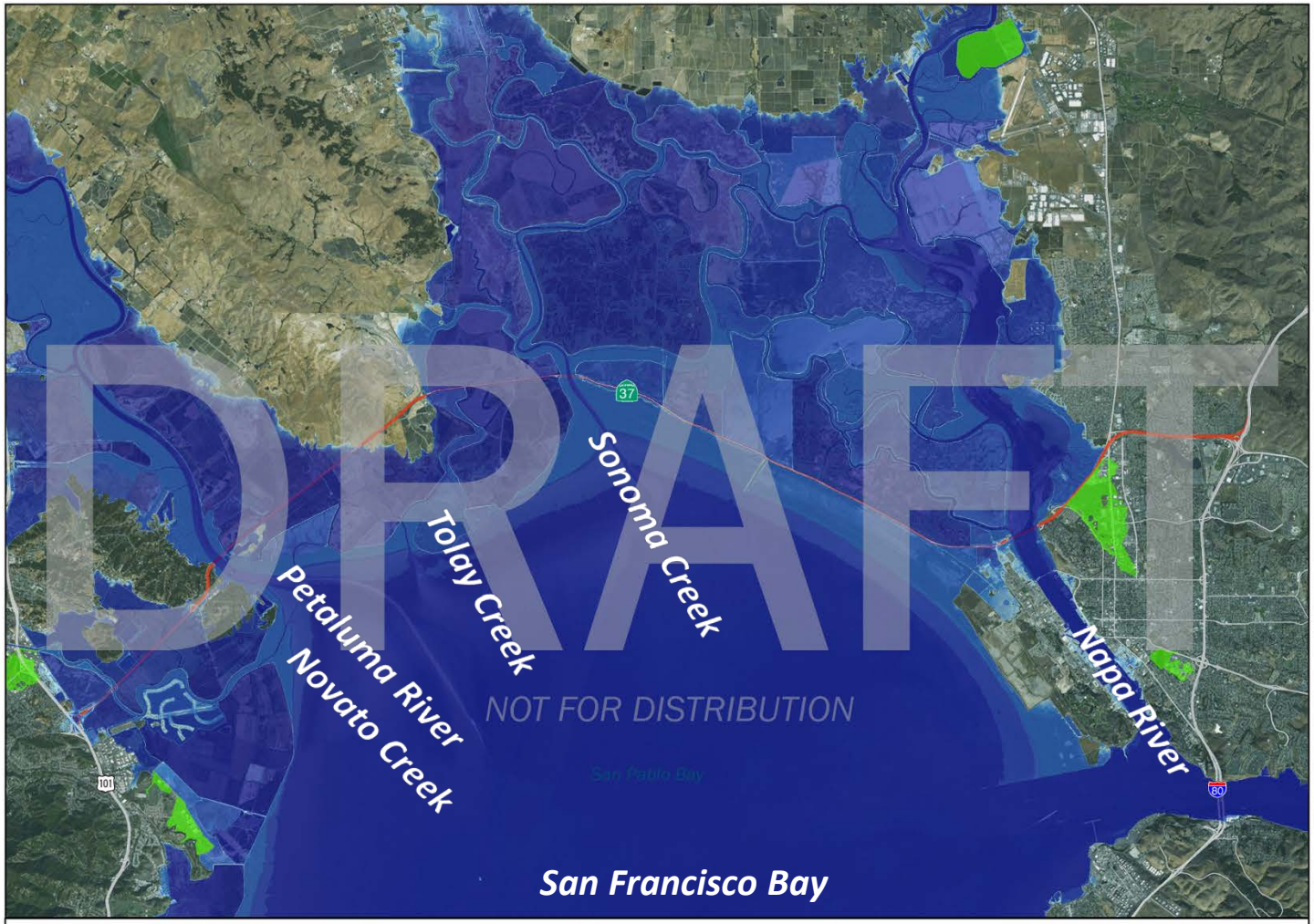
100-yr SWEL + 12”



HIGHWAY 37
DRAFT - Inundation Mapping

100-YR STORM SURGE + 12" SEA LEVEL RISE

36” SLR + 2-yr Storm Surge
24” SLR + 10-yr Storm Surge
24” SLR + 25-yr Storm Surge
12” SLR + 100-yr Storm Surge
0” SLR + 500-yr Storm Surge

Depth in Feet
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Lowlying Areas > 1 Acre

0 1 2 Miles
0 5,000 10,000 Feet

AECOM

CALIFORNIA 37

Projection: NAD 1983 California (1) North American Datum 1983 Date: 1/20/2015

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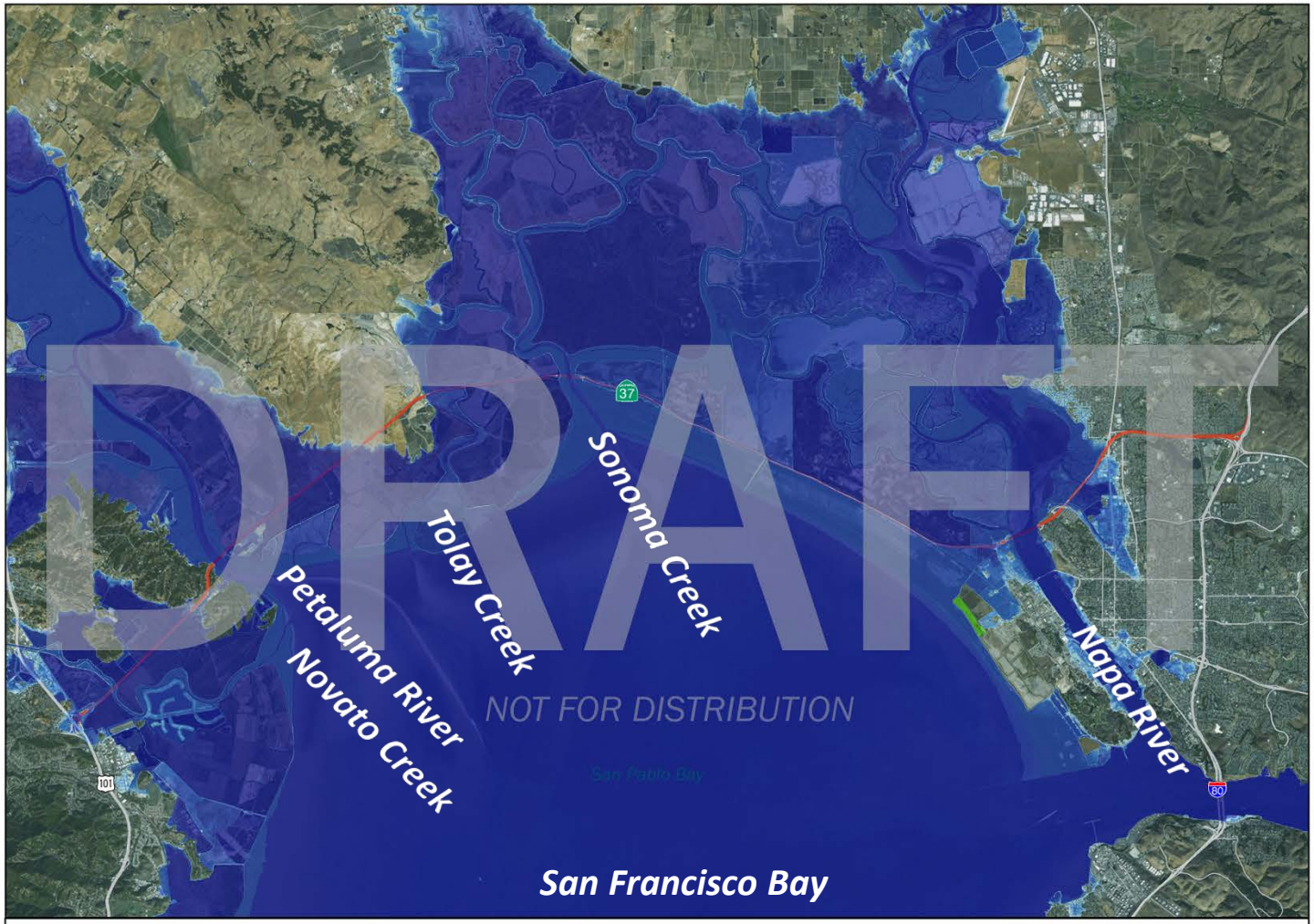
100-yr SWEL + 36”



HIGHWAY 37
DRAFT - Inundation Mapping

100-YR STORM SURGE + 36" SEA LEVEL RISE

60” SLR + 2-yr Storm Surge
54” SLR + 5-yr Storm Surge
48” SLR + 10-yr Storm Surge
48” SLR + 25-yr Storm Surge
42” SLR + 25-yr Storm Surge
42” SLR + 50-yr Storm Surge
36” SLR + 100-yr Storm Surge
24” SLR + 500-yr Storm Surge

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0 1 2 Miles
0 5,000 10,000 Feet

AECOM

CALIFORNIA 37

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. 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 context about the maps and analyses, including a description of the data and methods used, please see the Sea Level Rise Inundation Mapping for HWY 37 Region Memorandum. January 2015.

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Preliminary Vulnerability Assessment

- HWY 37 is protected by a complex system of interconnected levees
- Divide study area into five reaches (west to east). Each reach is a system of flood protection:
  - Reach 1: HWY 101 to Petaluma River
  - Reach 2: Petaluma River to HWY 121
  - Reach 3: HWY 121 to Sonoma Creek
  - Reach 4: Sonoma Creek to Napa River
  - Reach 5: Napa River to I-80
- What are the sources of inundation/flooding within each reach (e.g., levee overtopping, direct inundation)?
- What is timing of inundation/flooding within each reach?

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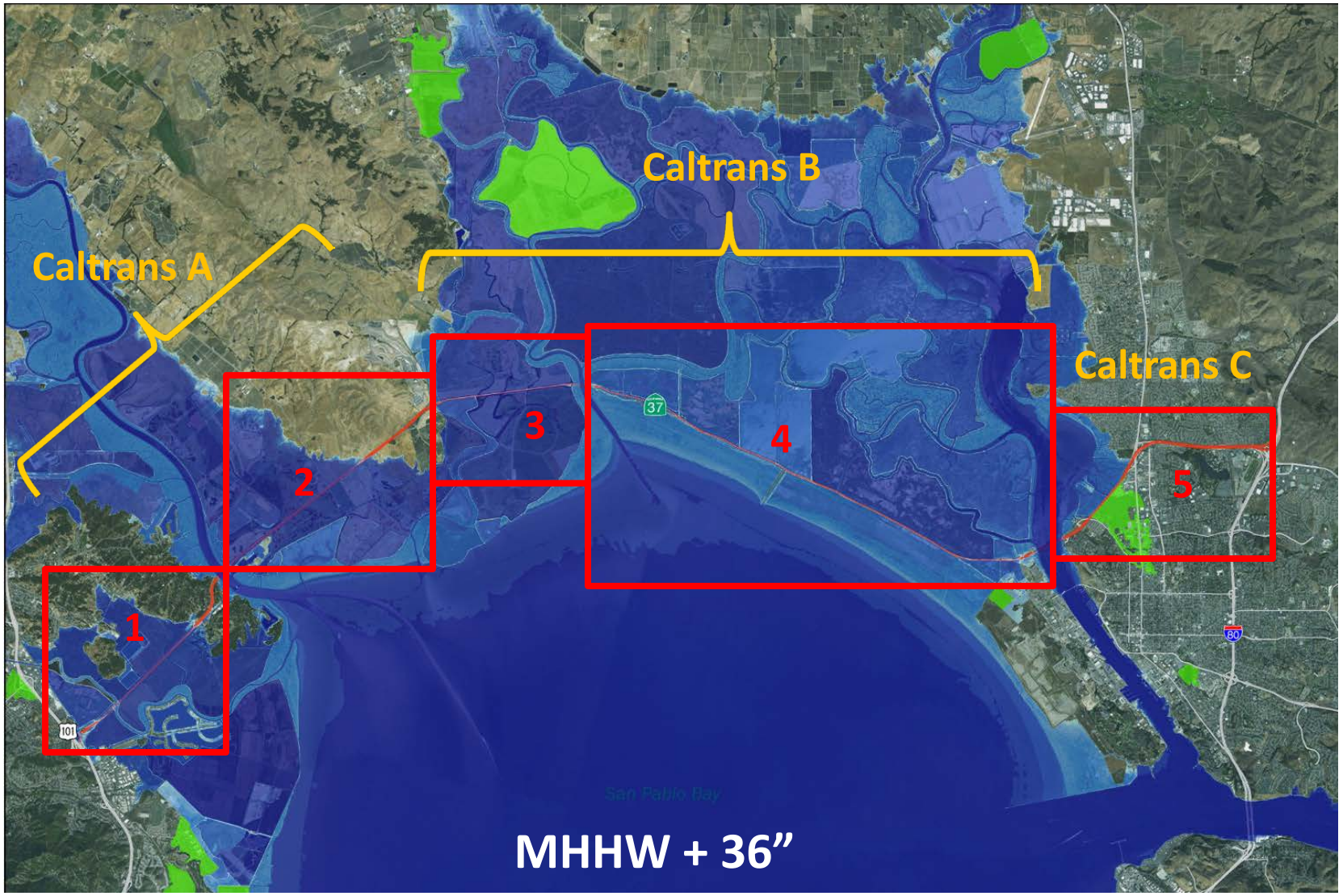
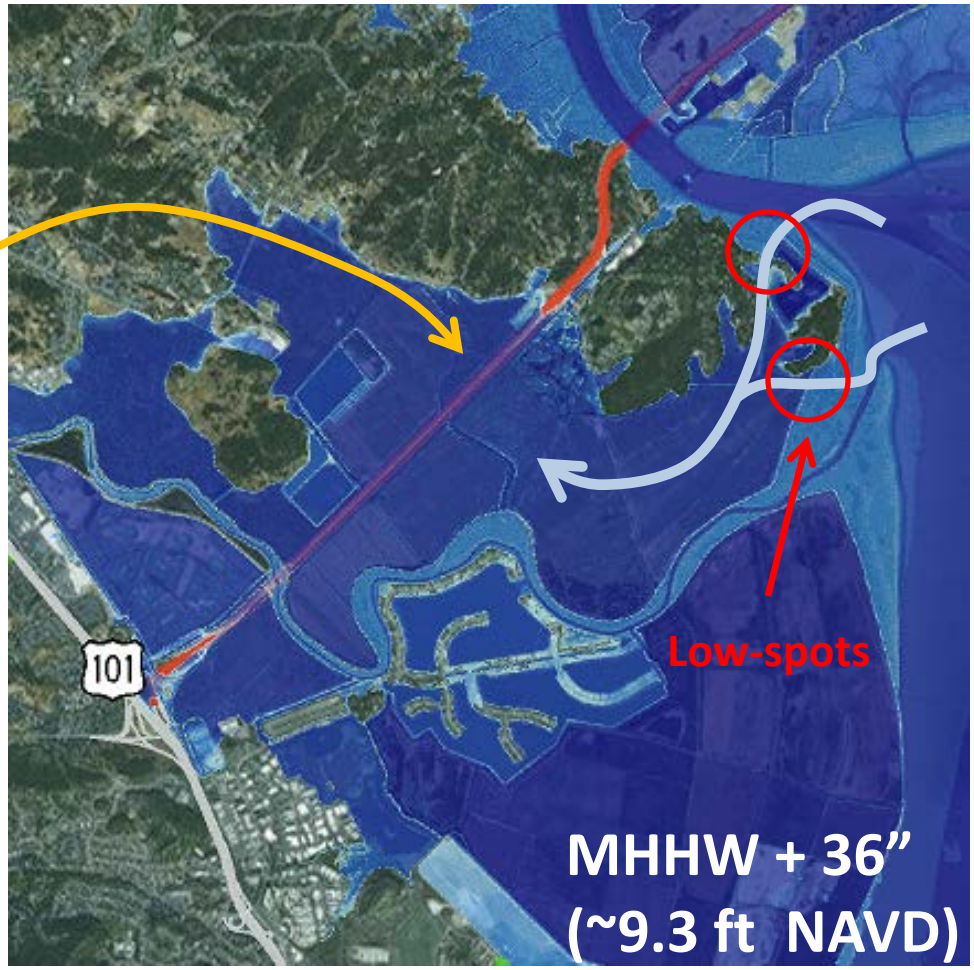
Preliminary Vulnerability Assessment: Reaches



Preliminary Vulnerability Assessment:

Reach 1 – HWY 101 to Petaluma River

- East of Novato, north of Bel Marin Keys, west of Petaluma River
- Middle segment of HWY low-lying (4-6 ft NAVD)
- Protected by Novato Creek levees (10-13 ft NAVD)
- Sources of flooding: overland flooding at Black Point-Green Point and levee overtopping at Novato Creek Mouth



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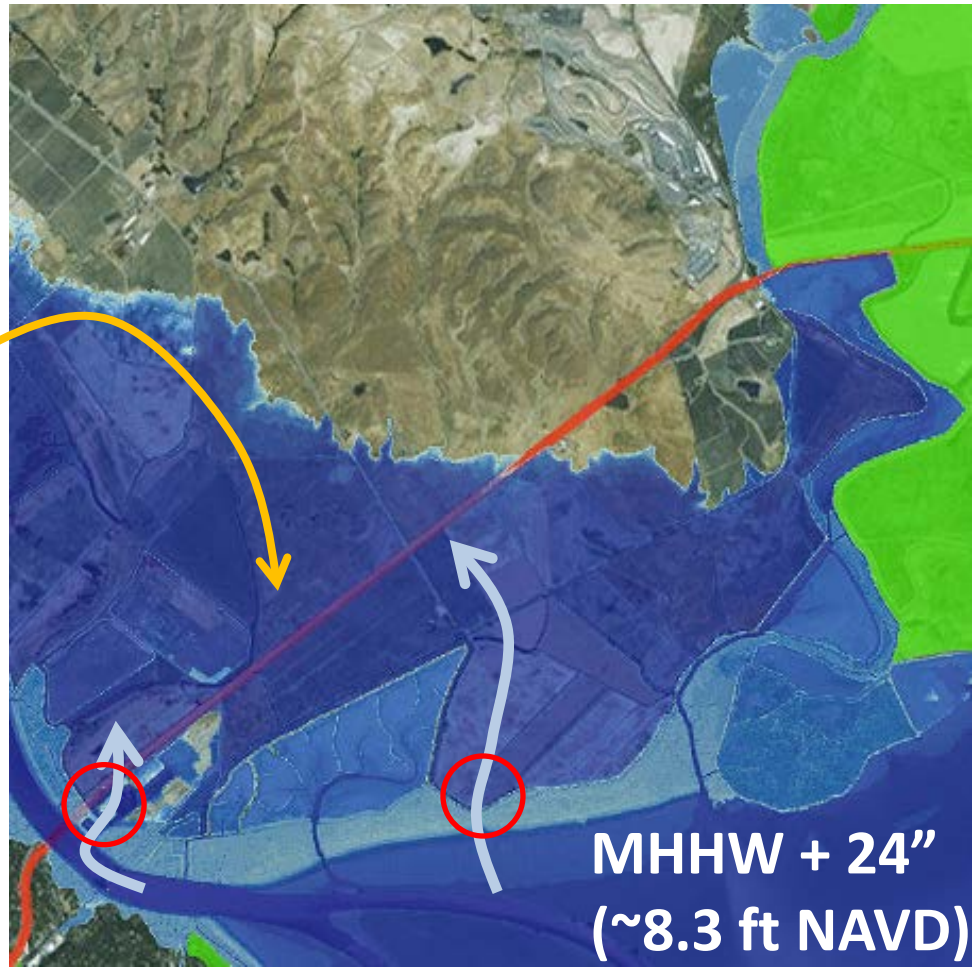
Preliminary Vulnerability Assessment:
Reach 2 – Petaluma River to HWY 121

- East of Petaluma River and west of HWY 121 near Sears Point
- Western segment of HWY low-lying (2-4 ft NAVD)
- Protected by Petaluma River levees, Sonoma Baylands restoration site, Tolay Creek levees
- Sources of flooding: Port Sonoma marina and Bayfront levees



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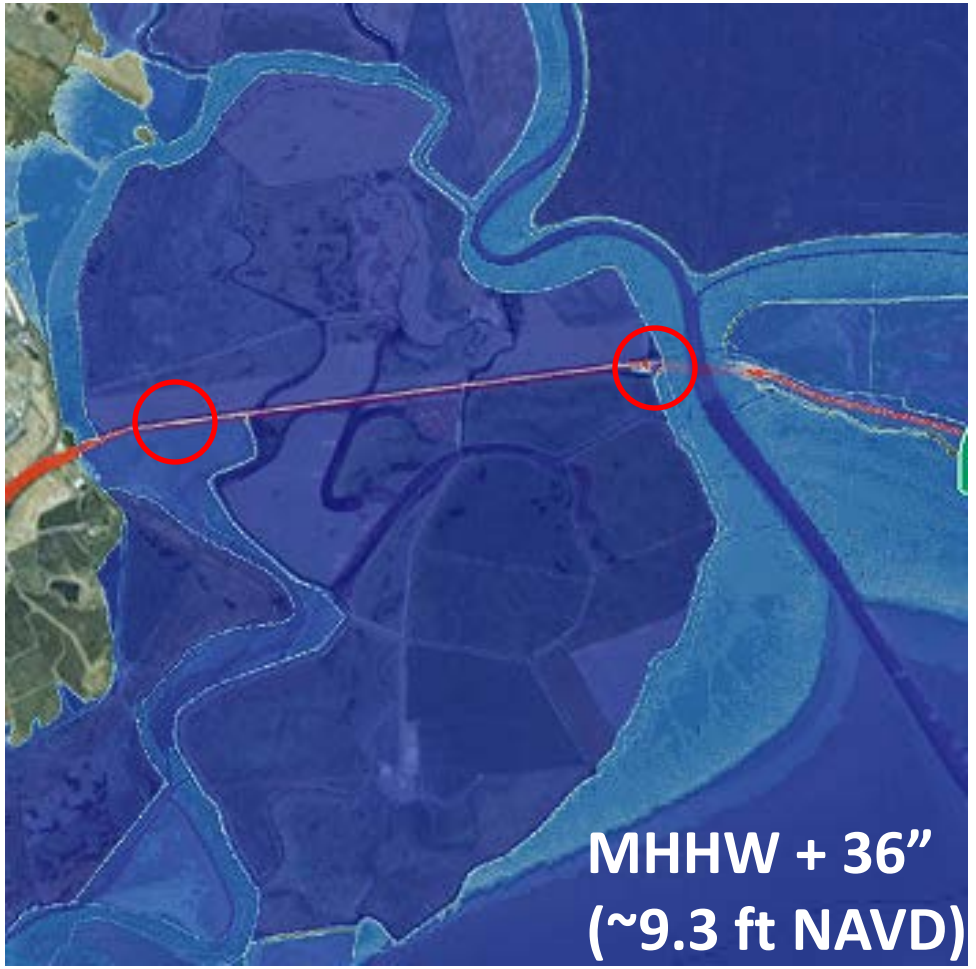
Preliminary Vulnerability Assessment:
Reach 3 – HWY 121 to Sonoma Creek

- East of HWY 121 and west of Sonoma Creek
- Road is 8-9 ft NAVD elevation
- Protected by Tolay Creek and Sonoma Creek levees
- Sources of flooding: Tolay Creek, Sonoma Creek



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Preliminary Vulnerability Assessment:
Reach 4 – Sonoma Creek to Napa River

- East of Sonoma Creek and west of Napa River
- Road is 11 ft NAVD elevation; low spots flood
- No bayfront levee on this reach
- Sources of flooding: Direct flooding from SF Bay

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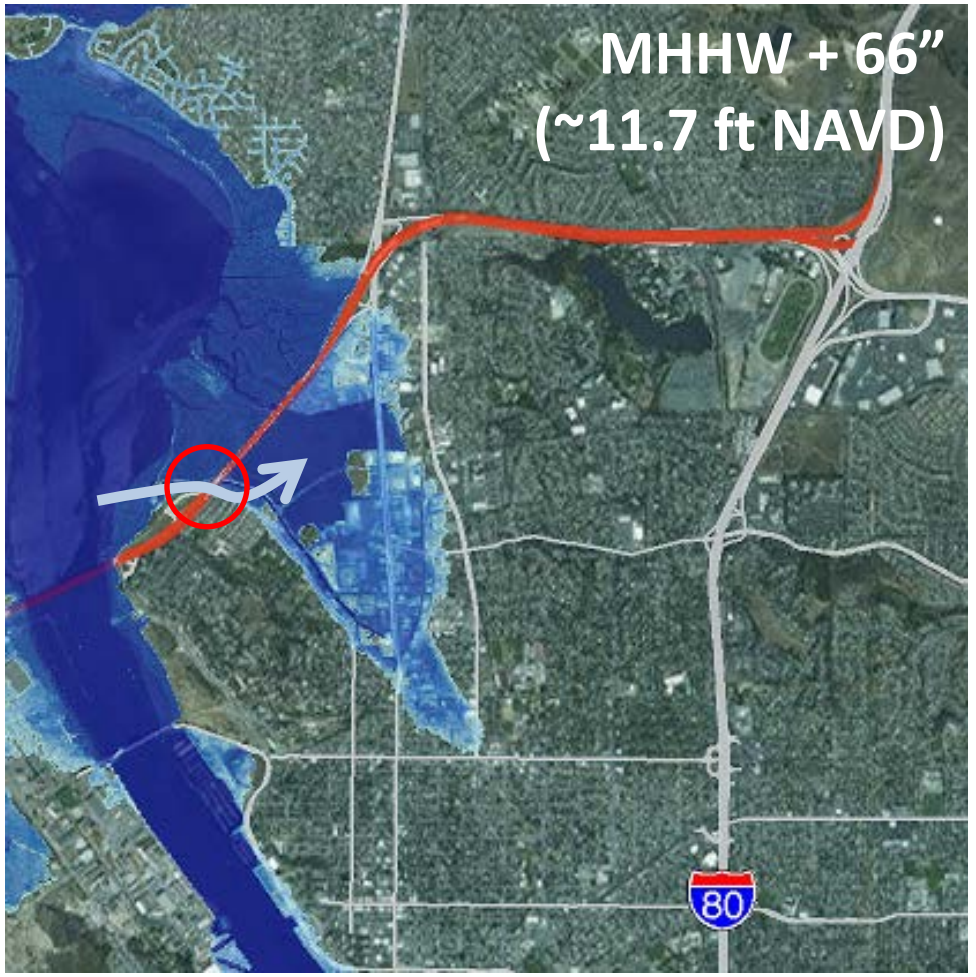
Preliminary Vulnerability Assessment:
Reach 5 –Napa River to I-80

- East of Napa River and west of I-80
- Road is 13-15 ft NAVD elevation
- No bayfront levee on this reach
- Sources of flooding: Direct flooding from SF Bay at Austin Creek



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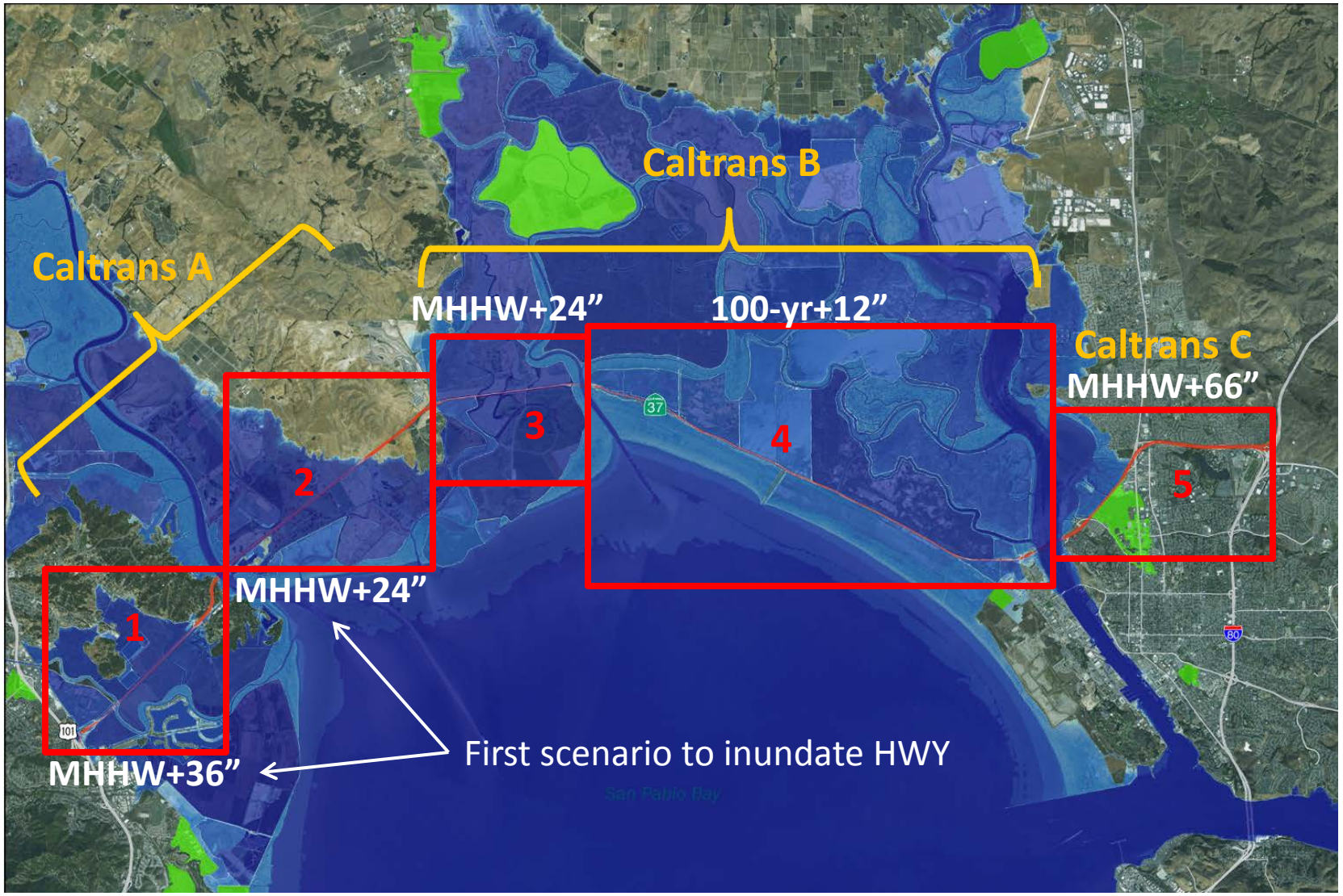
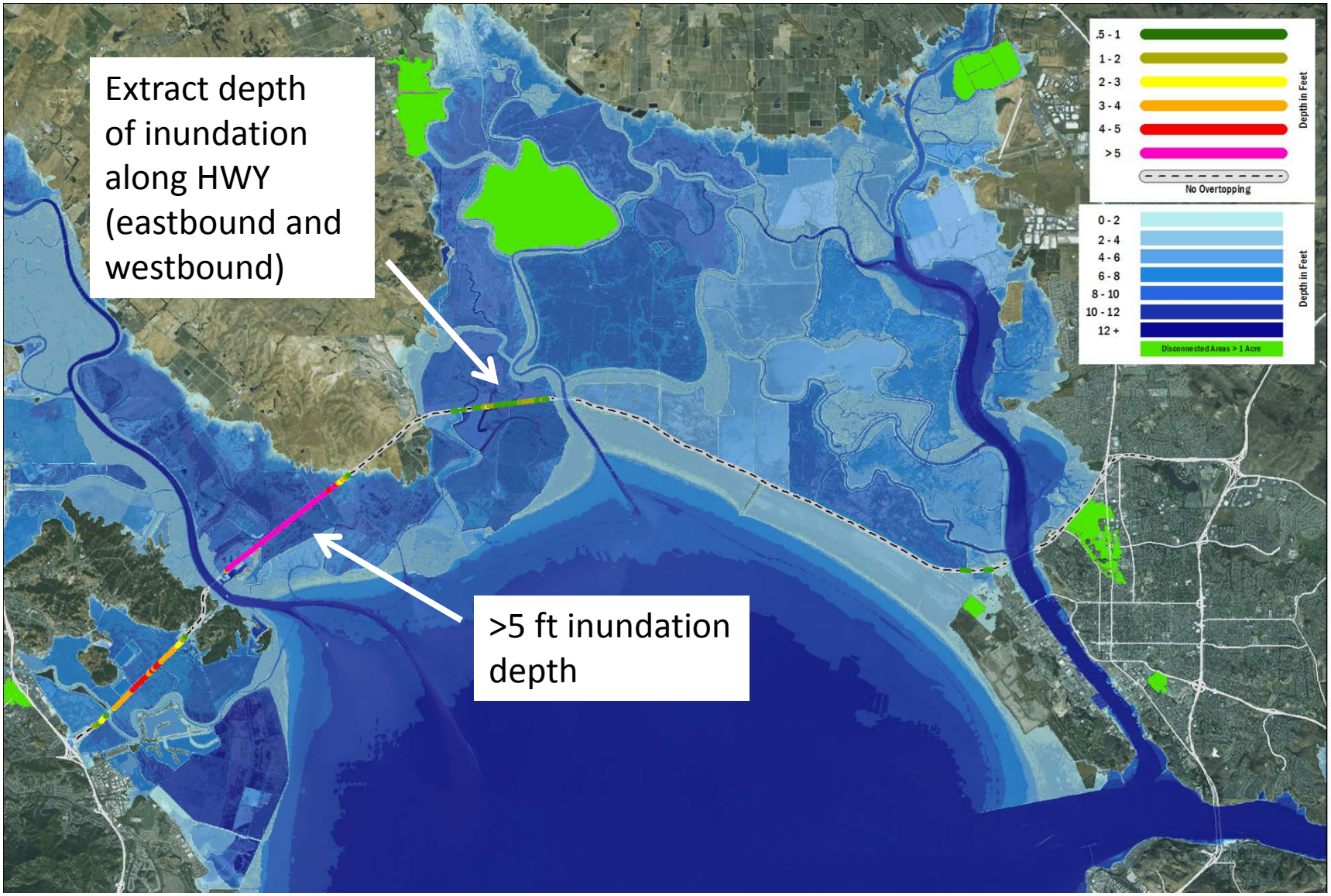
Preliminary Vulnerability Assessment: Reaches



Overtopping Assessment Example: MHHW+36”



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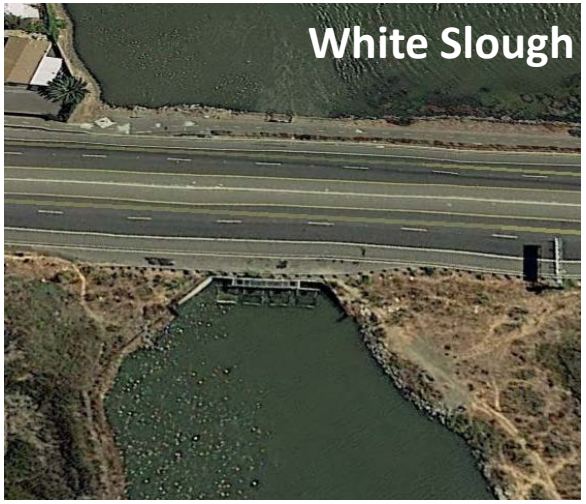
Next Steps

- Revise inundation maps based on stakeholder feedback. Finalize inundation maps.
  - Recently restored areas?
  - Water control structure operations?
- Complete overtopping and freeboard assessment of HWY 37 roadway
- Complete vulnerability assessment of HWY 37



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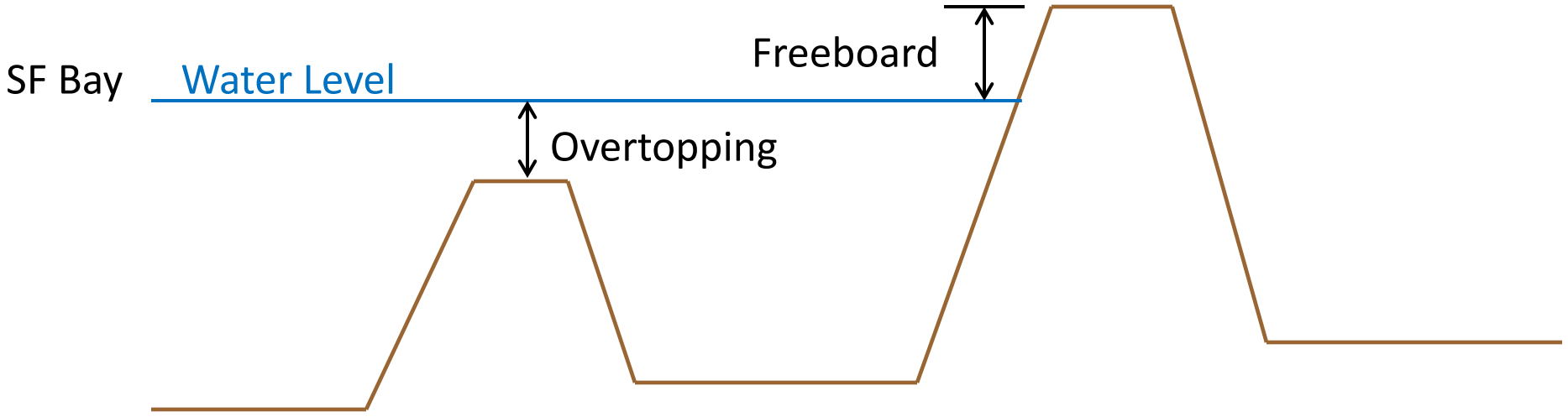
Overtopping and Freeboard

- Overtopping: Water level (MHHW or SWEL) exceeds elevation of roadway. “Depth of overtopping”.
- Freeboard: Elevation of roadway exceeds water level (MHHW or SWEL). Freeboard = the height of the roadway above the adjacent water surface.



Highway 37 Phase II Stakeholder Meeting 2 Attendees

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Highway 37 Phase II Stakeholder Meeting 2 Attendees

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Smith	Belinda	Solano County Board of Supervisors District 2	btsmith@solanocounty.com
Whan	Eric	City of Napa	ewhan@cityofnapa.org