

Airport and Infrastructure Resilience Project Overview

Danielle Mieler, Earthquake and Hazards Program Coordinator

Lifeline Committee Meeting

April 25, 2013



earthquake and hazards program

Association of Bay Area Governments

Objectives for Our Study

Objective

- Gain a comprehensive understanding of the role Bay Area airports can play in long-term social, economic, and physical recovery from a disaster, given their vulnerabilities, interdependencies on regional infrastructure, and capacity for functioning following a disaster.

Project Overview

Four Interrelated Projects

- Airport Liquefaction Susceptibility Analysis
- Role of Airports in Regional Disaster Response and Recovery
- Sub-Regional Infrastructure Vulnerabilities and Interdependencies
- Oakland Airport Focus Area Shoreline Resilience Planning (in partnership with BCDC)
- http://quake.abag.ca.gov/airport_resilience/

Project Outcomes

- A liquefaction susceptibility assessment of SFO, OAK, Buchanan, Livermore and Moffett.
- Better understand the role of airports during regional disaster response and recovery.
- Understanding at the sub-regional level of the current state of infrastructure systems, including airports.
- A replicable, focused process for deeper understanding the vulnerabilities and interdependencies of an airport.

Project Timeline

Airport Liquefaction Susceptibility Analysis
June 2012 – May 2013

Role of Airports in Regional Disaster Response and
Recovery
June 2012 – May 2013

Sub-Regional Infrastructure Vulnerabilities and
Interdependencies *and* Oakland Airport Focus Area
Shoreline Resilience Planning (in partnership with BCDC)
January 2013 – June 2014

Advisory Committee

- Help guide development of the project
- Meetings held quarterly on the 4th Thursday of the month
- Provide guidance and clarification on project direction, review materials, and discuss major findings

Project Scope

Determine susceptibility to liquefaction at five Bay Area Airports: SFO, OAK, CCR, LVK, and NUQ.

TASKS:

- Acquire existing geotechnical and geologic reports
- Develop surface and sub-surface geologic model
- Perform liquefaction susceptibility analysis using previously acquired geotechnical data
- Determine amount of settlement that could be anticipated
- Develop liquefaction susceptibility maps in GIS
- Summarize the analysis and results in a technical report, and make recommendations for additional investigations

Airport and Fault Location Map

Explanation

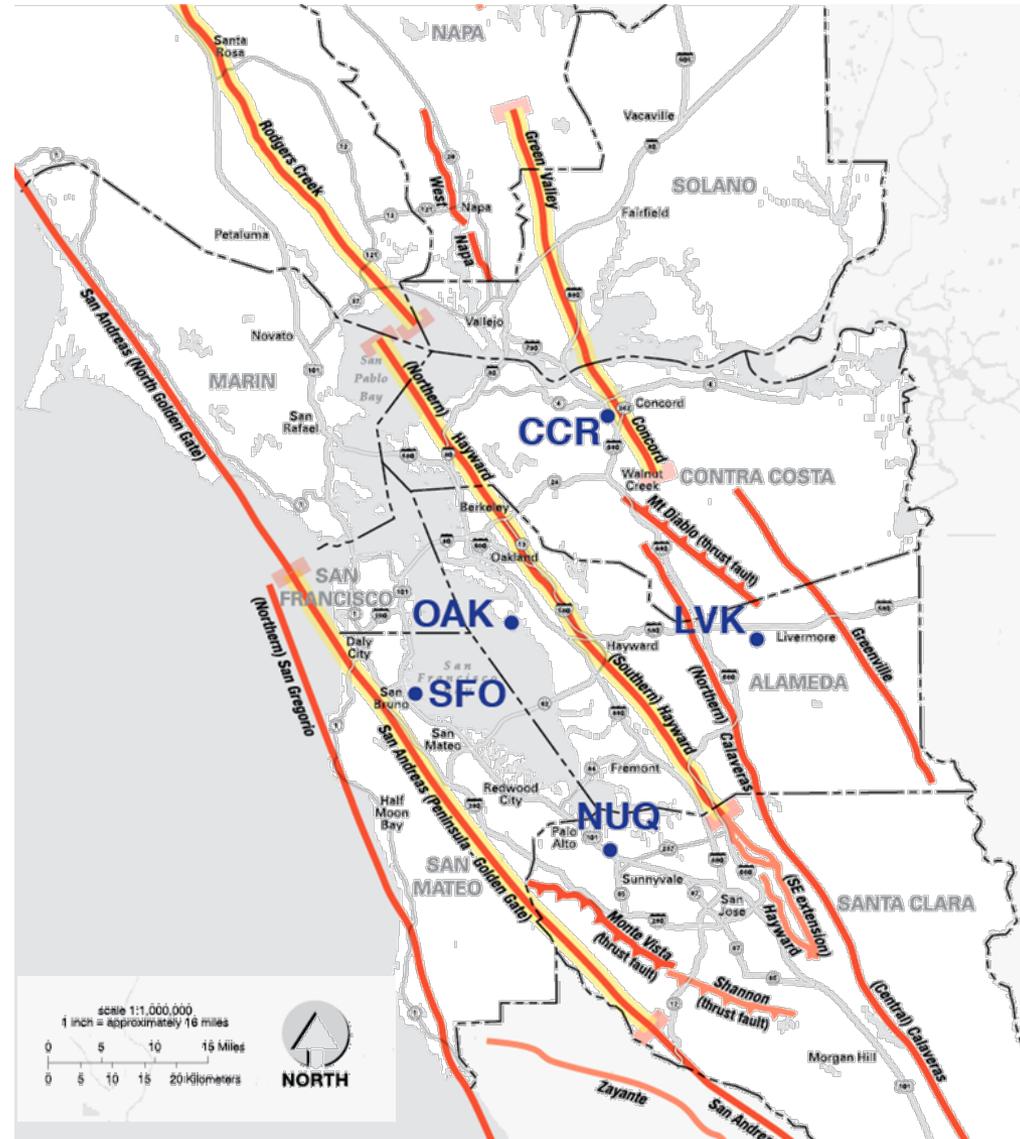
-  Faults used in ABAG earthquake scenarios
-  Other significant Bay Area faults
-  Fault segment boundaries used in ABAG scenario
-  **SFO** San Francisco International Airport
-  **OAK** Oakland International Airport
-  **NUQ** Moffett Federal Airfield
-  **LVK** Livermore Municipal Airport
-  **CCR** Buchanan Field Airport

3 Deterministic EQ Scenarios:

- 1906 SAF
- Hayward-Rodgers Creek Faults
- Concord-Green Valley Faults

2 Probabilistic EQ Scenarios

- 10% chance in 50 years
- 2% chance in 50 years



Examples of Liquefaction



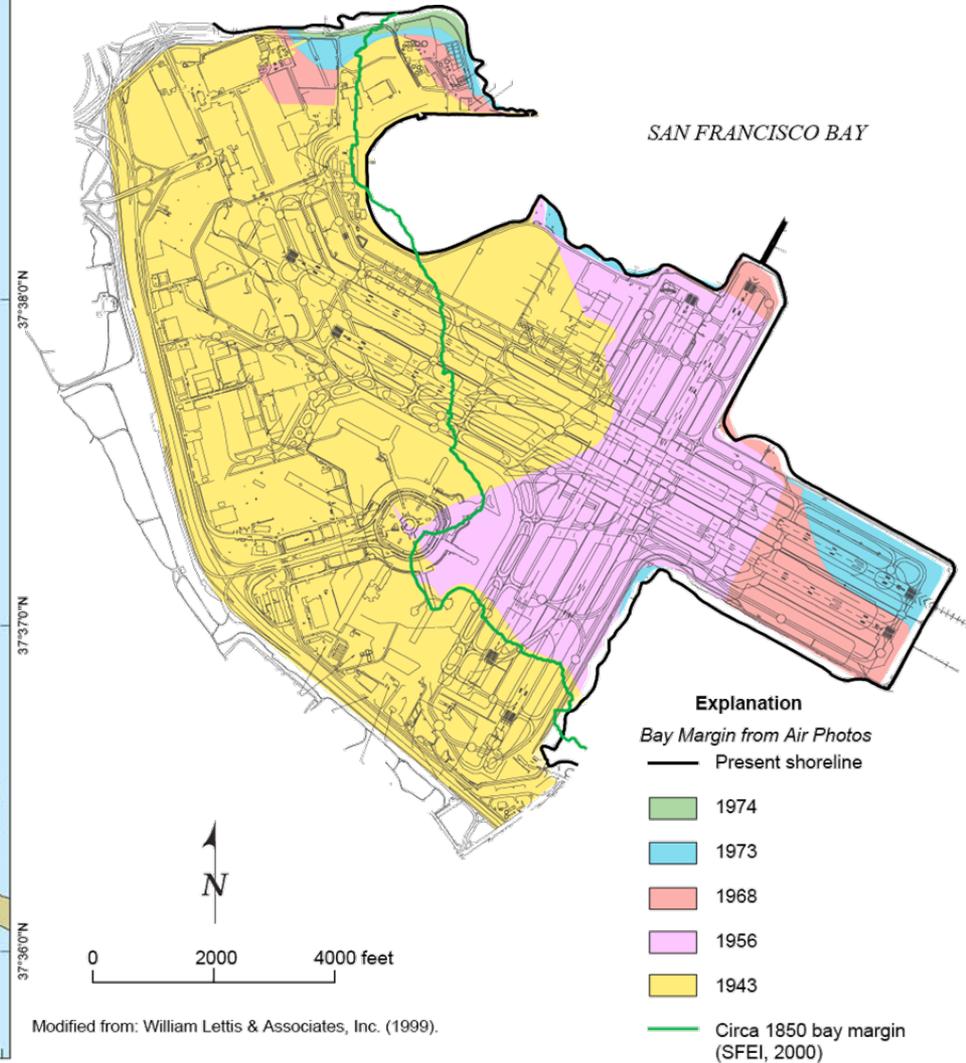
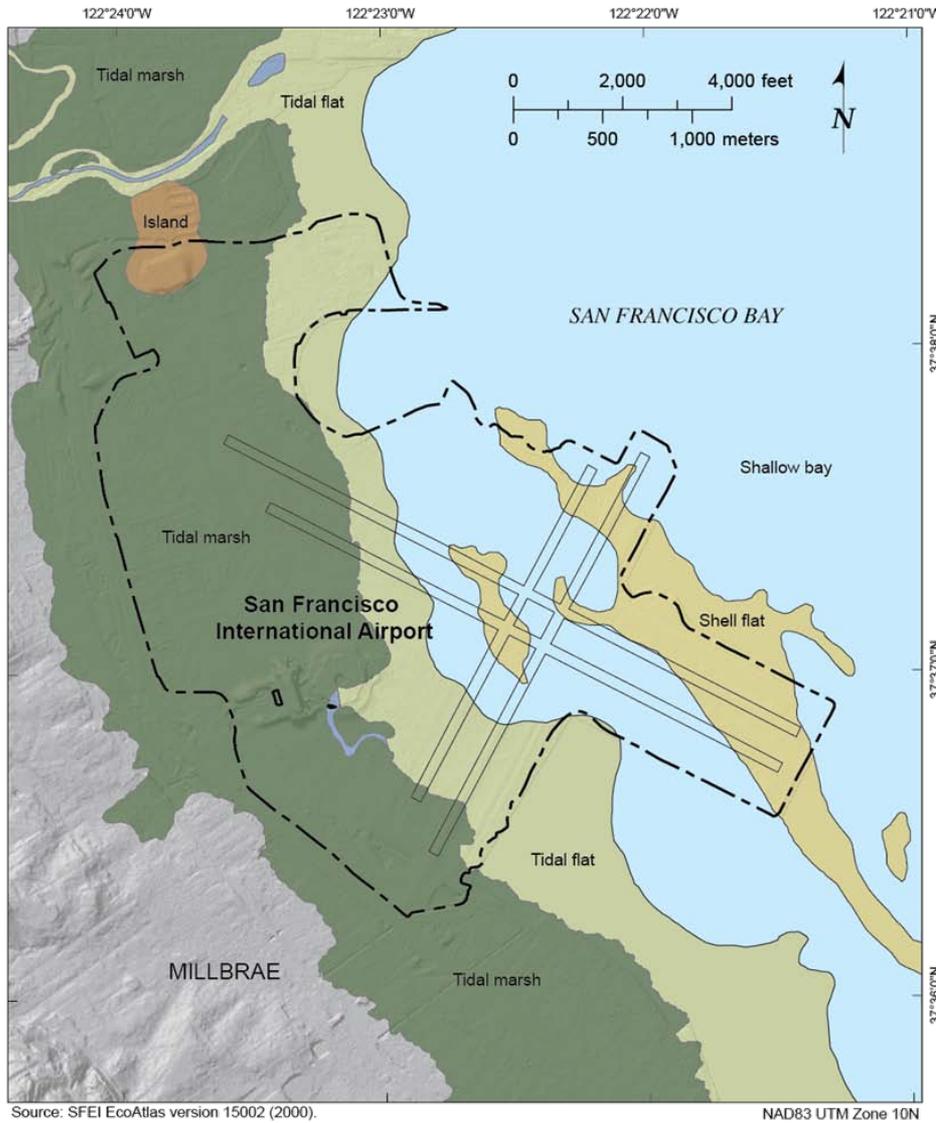
A) Northwest end of main runway (bottom) and adjacent taxiway (top) at Oakland International Airport. Photo source: Holzer (1998).



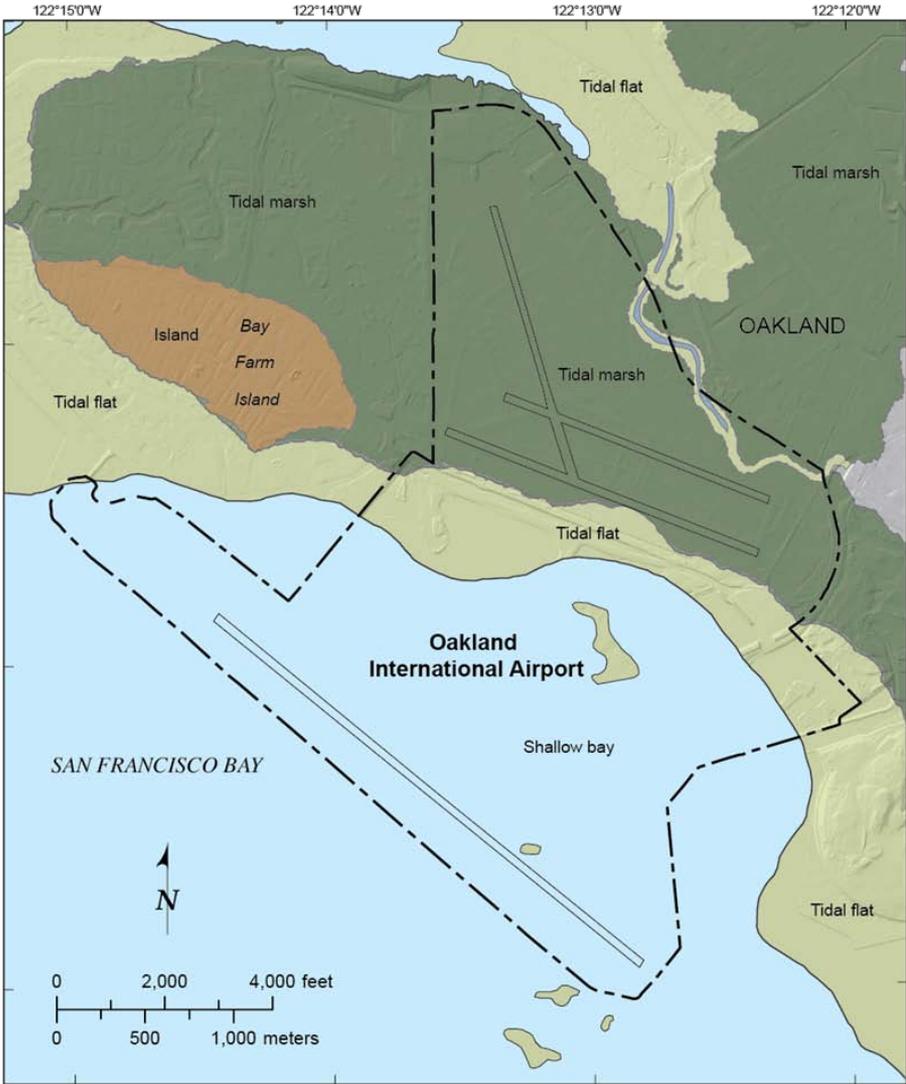
B) Large sand boil near north end of main runway at Oakland International Airport. Photo source: Holzer (1998).

Potential to disrupt Airport operations

San Francisco International Airport Geologic Setting

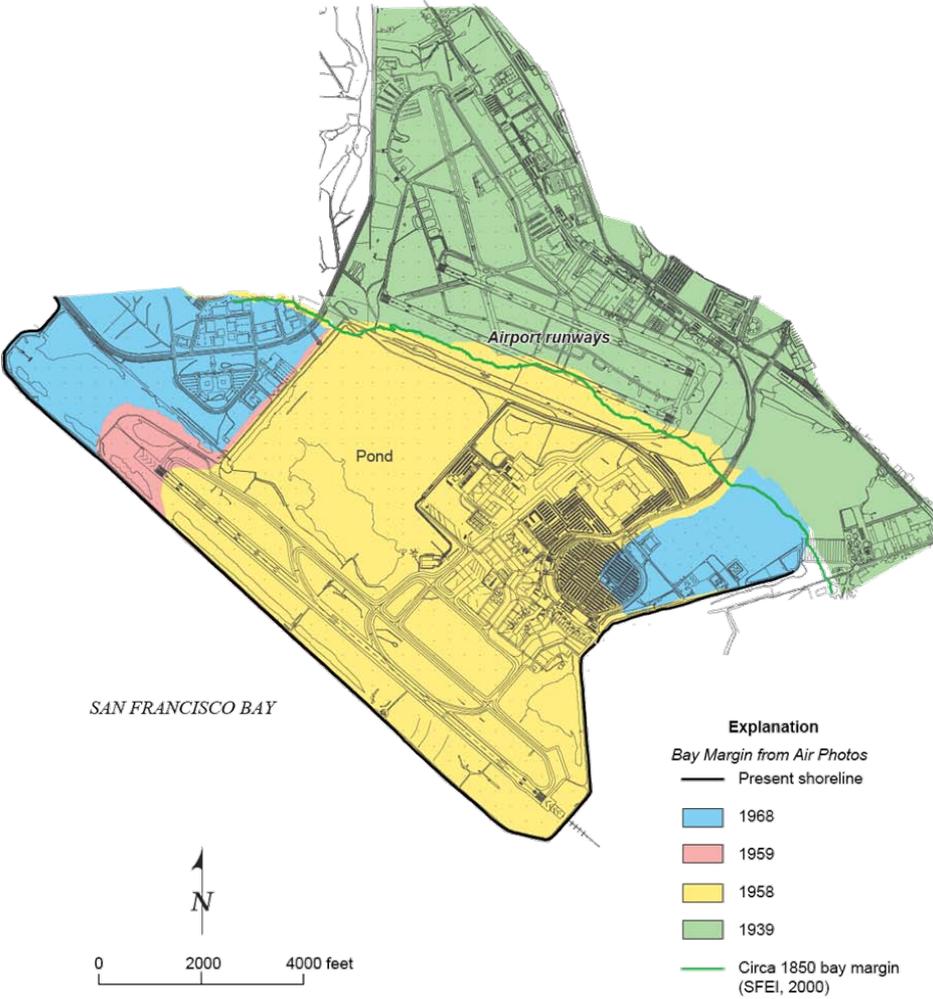


Oakland International Airport Geologic Setting



Source: SFEI EcoAtlas version 15002 (2000).

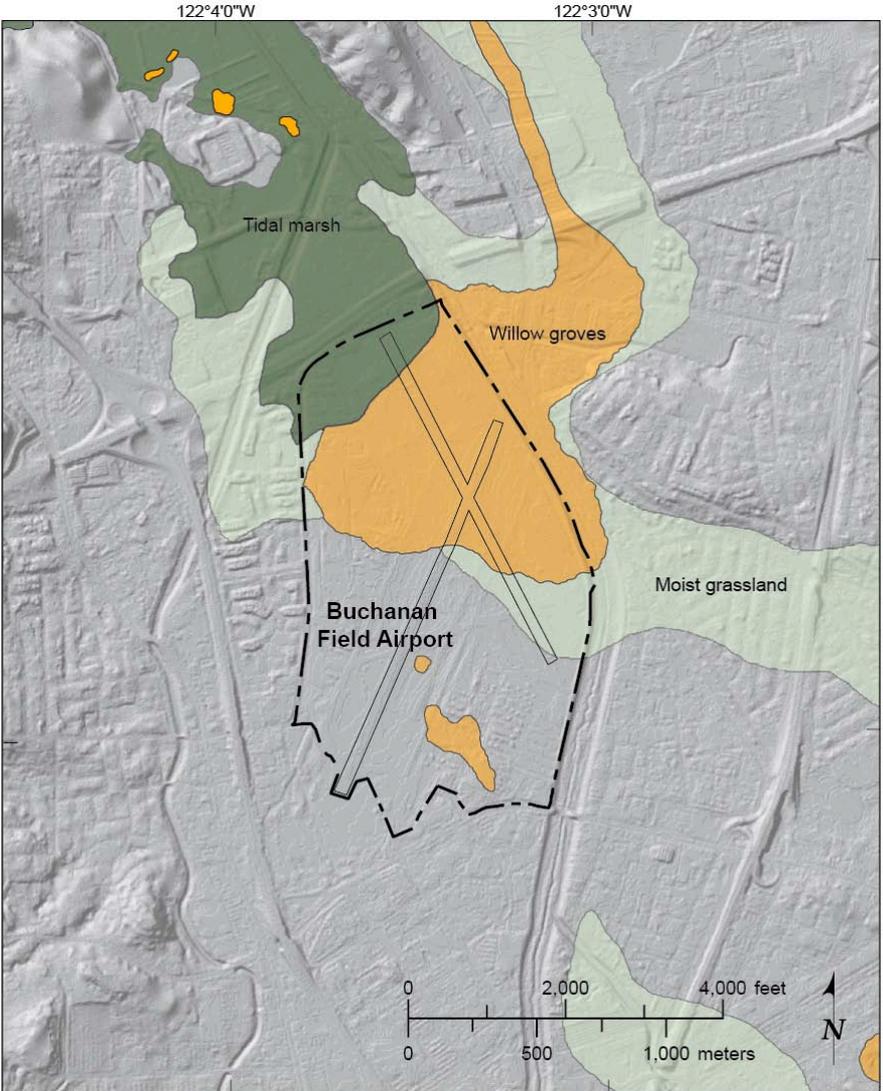
NAD83 UTM Zone 10N



Modified from: William Lettis & Associates, Inc. (1999).

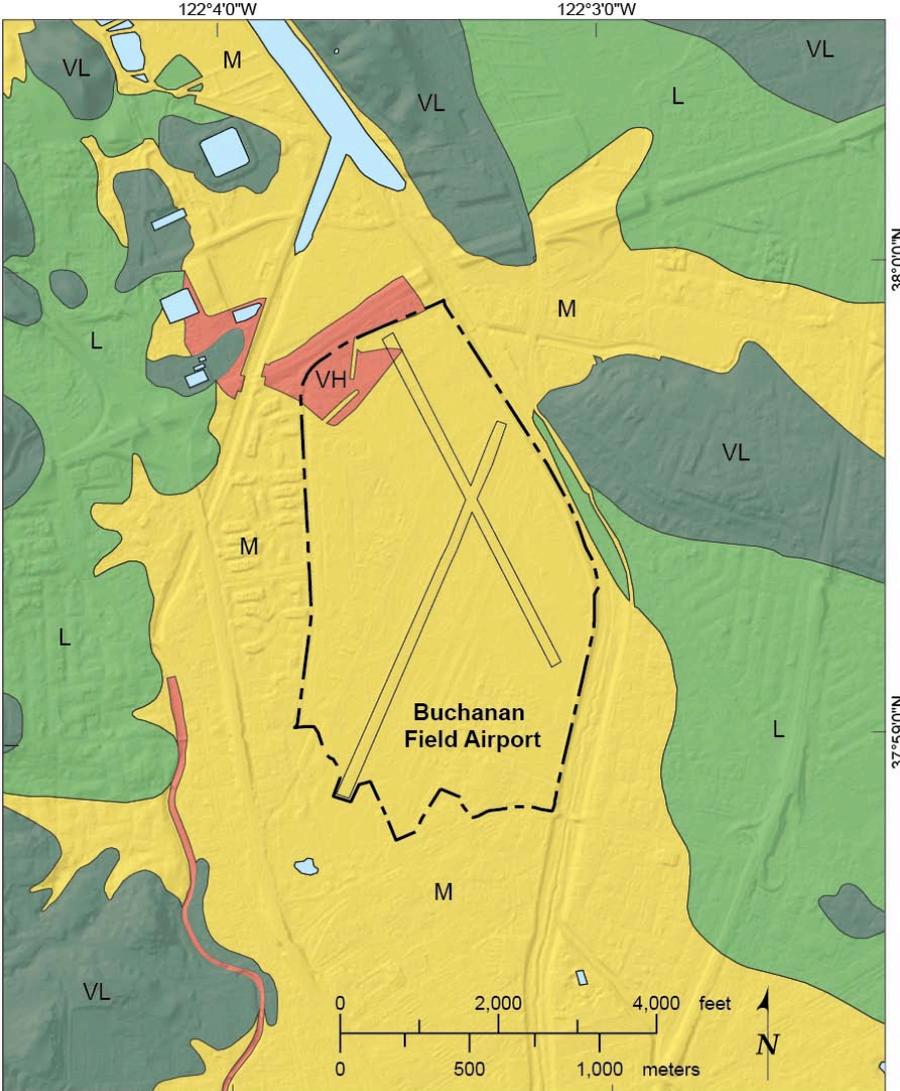
- Explanation**
- Bay Margin from Air Photos
 - Present shoreline
 - 1968
 - 1959
 - 1958
 - 1939
 - Circa 1850 bay margin (SFEI, 2000)

Buchanan Field Airport Geologic Setting



Source: SFEI EcoAtlas version 15002 (2000).

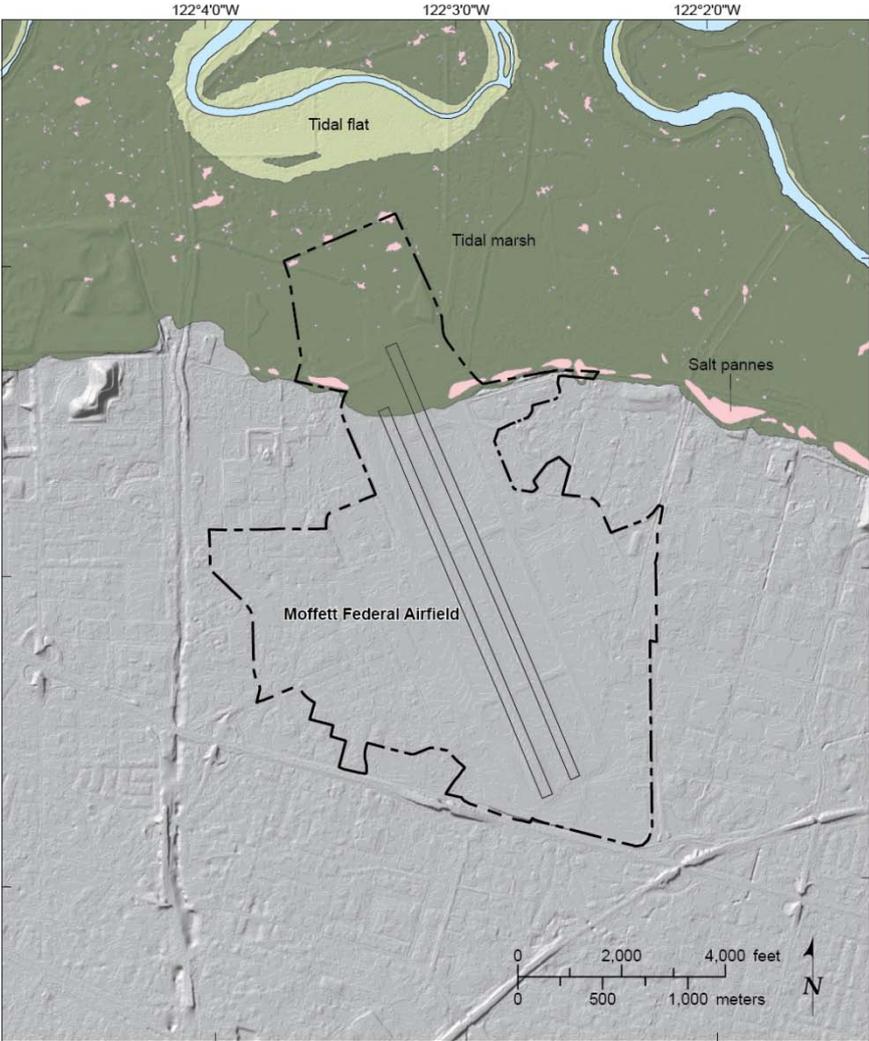
NAD83 UTM Zone 10N



Source: Witter et al., 2006; USGS OFR 06-1037.

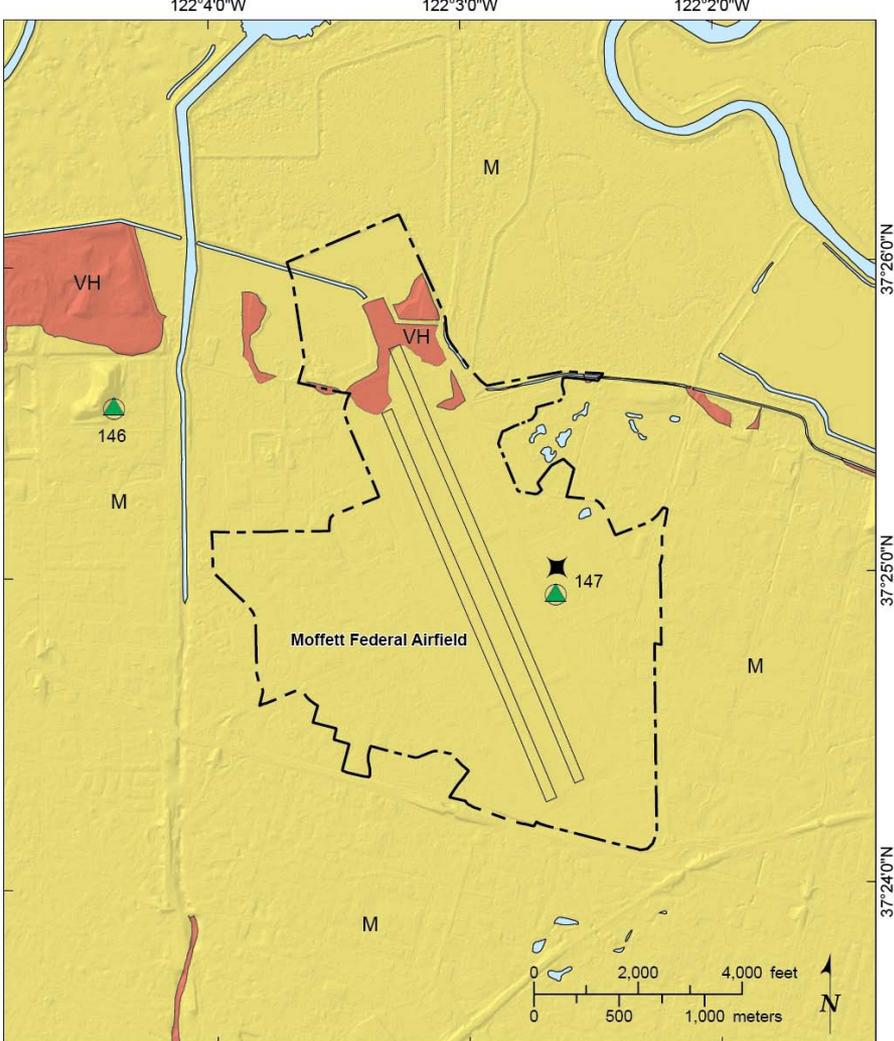
NAD83 UTM Zone 10N

Moffett Federal Airfield Geologic Setting



Source: SFEI EcoAtlas version 15002 (2000).

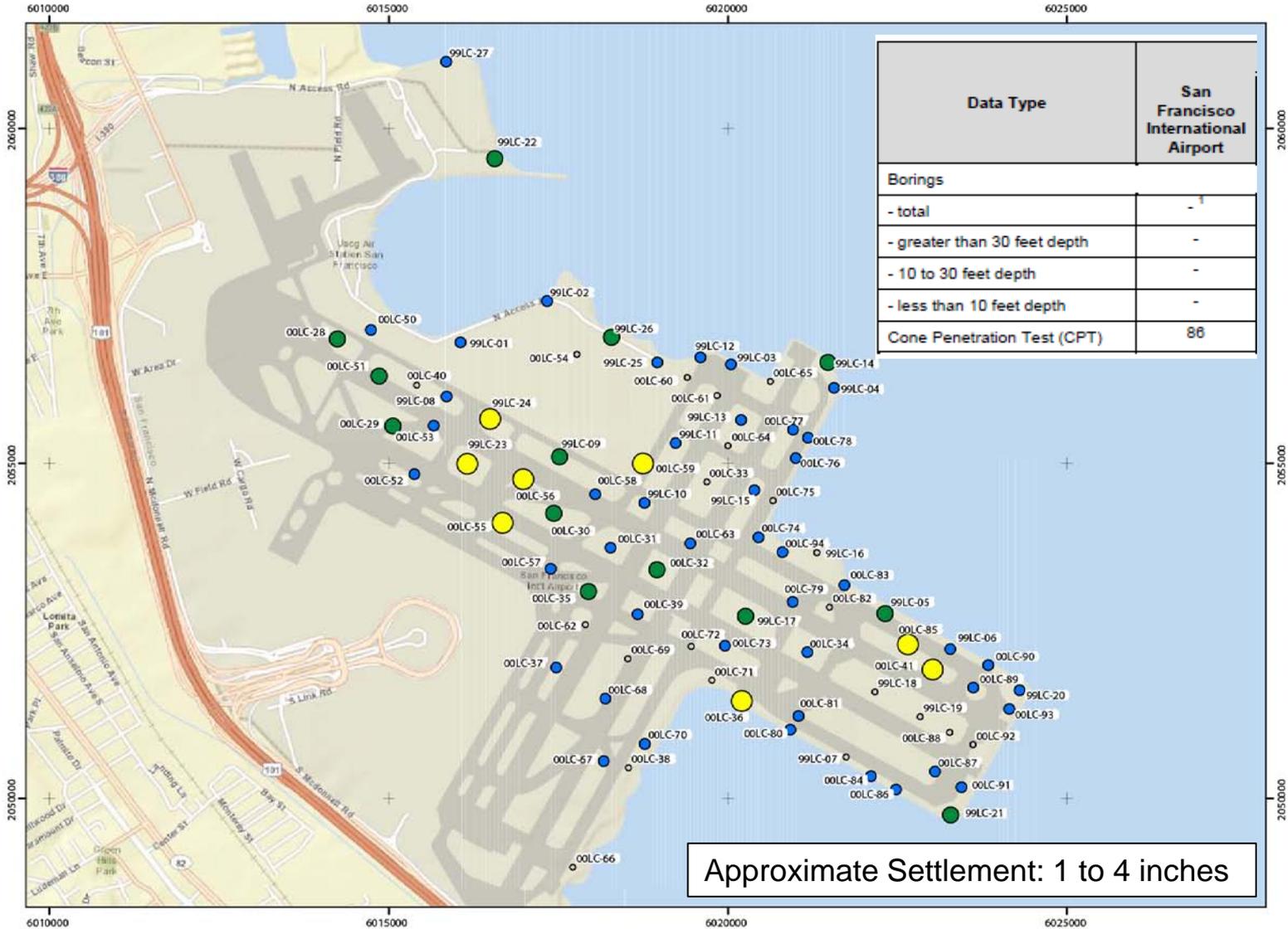
NAD83 UTM Zone 10N



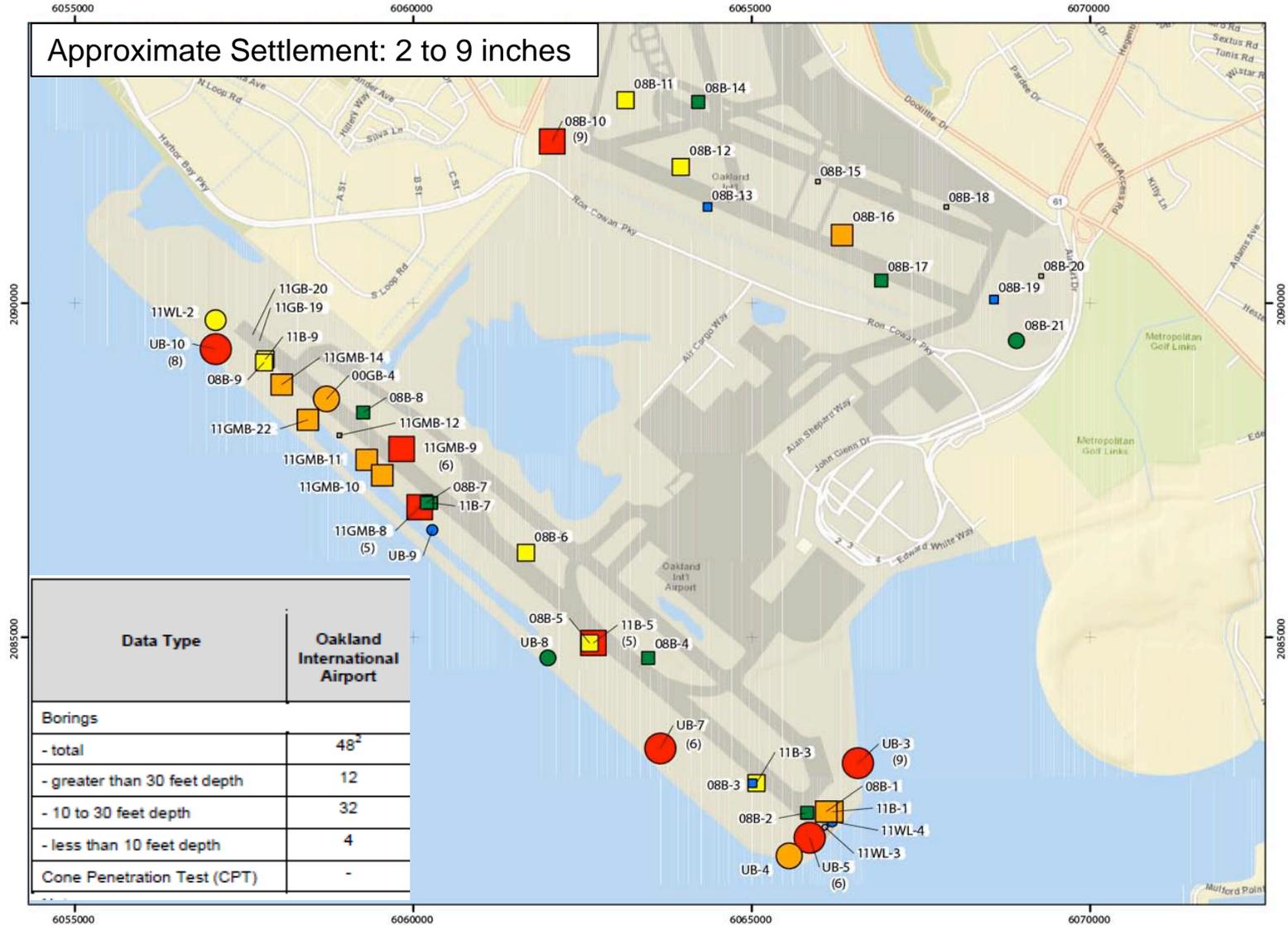
Source: Witter et al. 2006; USGS OFR 06-1037.

NAD83 UTM Zone 10N

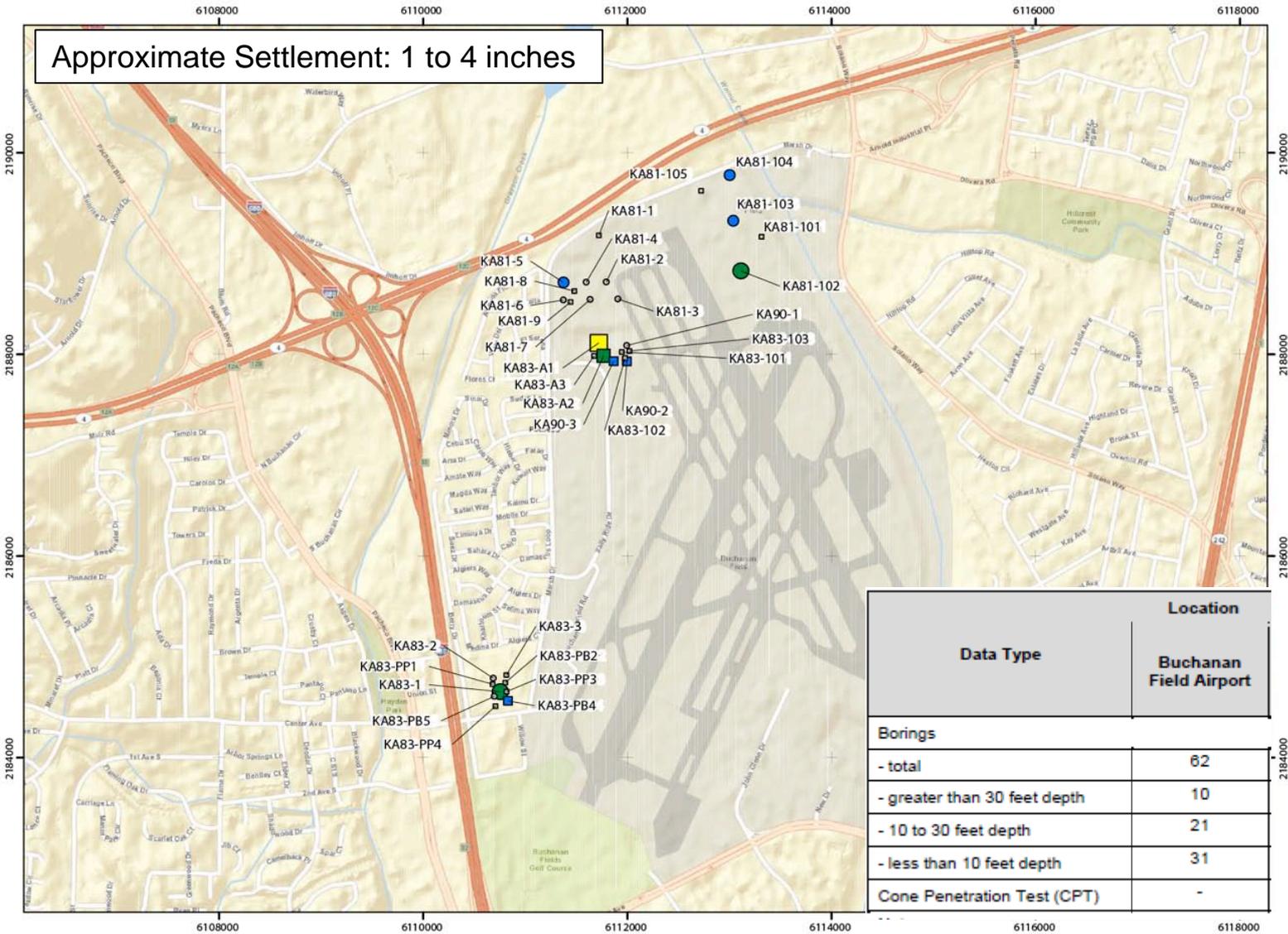
San Francisco International Airport Results



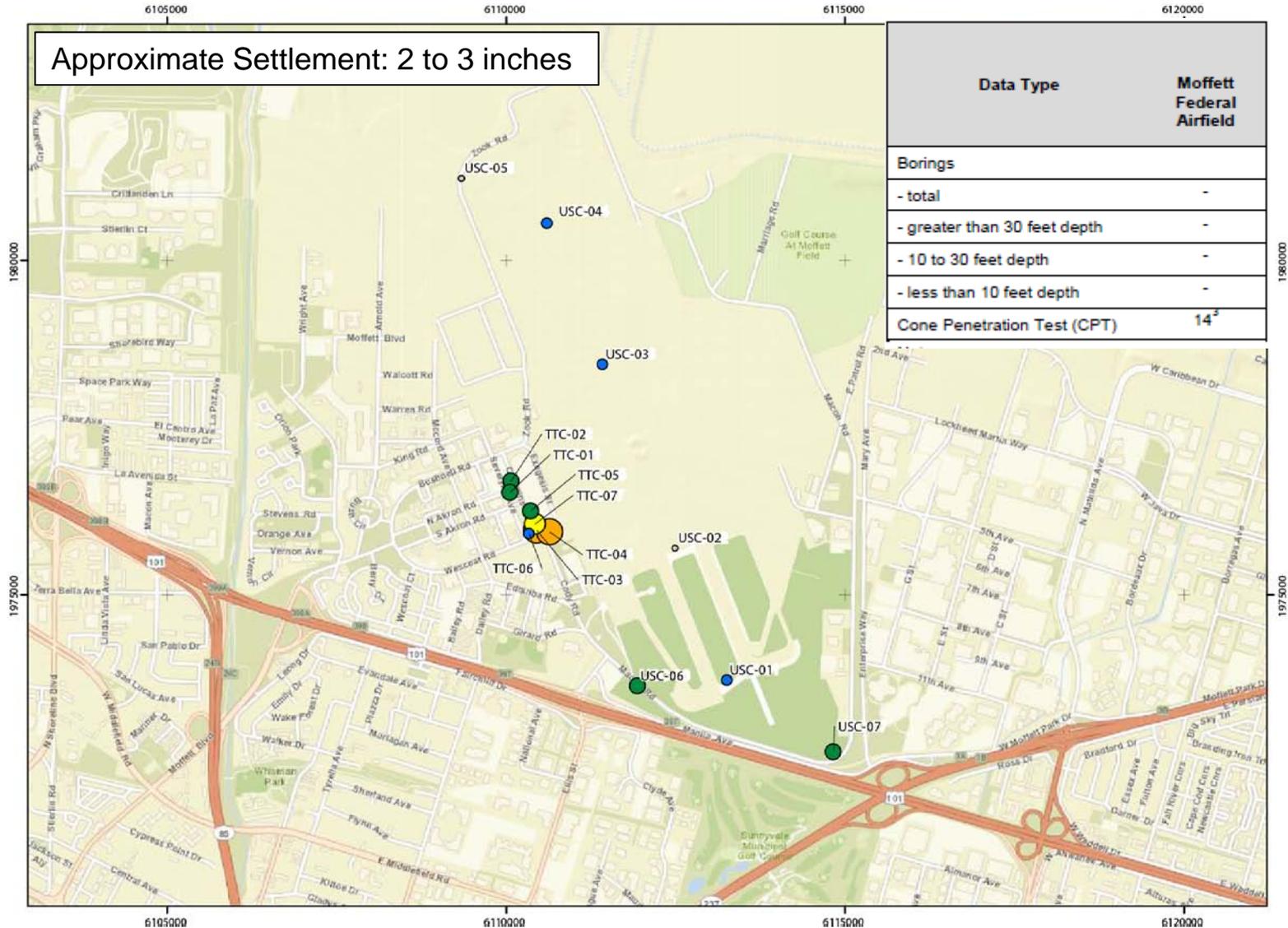
Oakland International Airport Results



Buchanan Airport Results



Moffett Field Airport Results



Conclusions

- All analyzed airports are vulnerable to Liquefaction for each of the 5 analyzed earthquake scenarios (Livermore was not analyzed)
- Our results are limited by available data, and are considered 'Preliminary'. Limitations include: areal extent, spacing, and depth-of-penetration for available data (e.g. Unable to analyze Livermore Airport due to shallow extent of bore holes)
- Additional investigations should be considered at:
 - Buchanan, Livermore, and Moffett (additional borings or CPT's)
 - Characterization of fill placement history should be considered at Oakland and San Francisco Airports
 - Dikes and Levees are a vulnerability at Oakland airport
- It is important to have a plan if one of the major Airports is damaged!

Role of Airports in Disaster Response and Long-Term Disaster Recovery - Gaps, Findings & Recommendations



4/25/2013

Jeanne Perkins
Jeanne Perkins Consulting
April 25, 2013

Part One

Current Planning for and Expectations
of the Role of Commercial and
General Aviation Airports in Disasters

WHAT ARE THE GAPS?

4/25/2013

Part One – Planning GAPS

1. Lack of Examination of the Role of Airports in Long-Term Regional Economic RECOVERY
2. PRIOR Lack of Examination of the Role of Smaller Commercial and General Aviation Airports
3. Need to Appreciate that Air Cargo Carriers and Passenger Airlines Station Specialized Equipment at the International and Commercial Airports
4. Lack of Continuity in Staffing of Disaster and Recovery Planning

4/25/2013

Part Two

Actual Role of International,
Commercial and General Aviation
Airports in Recent Natural Disasters

**Nine Case Studies – WHAT
WERE OUR FINDINGS?**

4/25/2013

Part Two – Disaster FINDINGS

1. Airport Emergency Plans and Planning Can Comply with FAA Requirements – and Still Have Gaps
2. Cell Phone and Land-Line Communications Are Likely to Be Disrupted as Airports Struggle to Re-Open
3. Airport Staff Will Be Stressed and Additional Equipment May Be Needed
4. Flights Into and Out of Airports Will Increase and Change in Response to the Disaster – and During Long-Term Recovery
5. Priorities of Airport Users and Government Agencies Can Be in Conflict, Particularly If the Disaster Involves Large Numbers of Casualties

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Part Two – FINDINGS (continued)

6. Airport Facility Inspections Can Delay Airport Operations – Even If No Damage Has Occurred
7. Airport Runways, Terminals and Associated Facilities Have All Been Affected by Recent Disasters
8. Airport Control Towers Are Subject to Damage and Controllers Have Had Problems Gaining Access to Airports in Disaster Areas
9. Airport Terminals Can Become De Facto Shelters
10. Airport Revenues Can Decrease Significantly Just as Repairs Are Required

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DRAFT Recommendations

1. Gain Support from Elected Officials and Regional Organizations
2. Commercial Airports - Share FAA-Required AEPs and Open Training to Airport Users
3. GA Airports - Think the Same Way as Required in AEPs
4. Develop Redundant Communications

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DRAFT Recommendations

5. Promote - But Don't Rely on - Mutual Aid Agreements
6. Work with Tenants and Other Users to Develop Equipment Inventories
7. Think through Aviation Fuel Capabilities
8. Coordinate with Caltrans, FAA and CalEMA (soon to be OES again)

4/25/2013

DRAFT Recommendations

9. Speed Up the Post-Disaster Inspection Process
10. Plan for Long-Term Financial Recovery
11. Coordinate with Volunteer Disaster Pilot Groups
12. Add REVIEW to Prepare-Respond-Recovery-Mitigate

4/25/2013

Next Steps

1. BAAMA Meeting
2. Other Forms of Review
3. Implications for Infrastructure Interoperability - Surface Roads Are Key

Questions?

4/25/2013



Adapting to Rising Tides



San Francisco Bay Conservation
and Development Commission

Adapting to Rising Tides

The goal of the ART project is to increase the preparedness and resilience of Bay Area communities to sea level rise and other climate change impacts while protecting ecosystem and community services.



Photo: Ingrid Taylor

Adapting to Rising Tides



- How will sea level rise and storm events affect the future of Bay Area communities, infrastructure, ecosystems and economy?



- What approaches can we pursue, both locally and regionally, to assess these challenges, and reduce or manage these risks?

ART Objectives

- Create an integrative (cross-sector/cross-jurisdiction) adaptation planning framework that can be applied in others in the region
- Develop, test, and refine adaptation tools and processes to help the region address climate change
- Identify how adaptation planning can be scaled to different geographic extents – local, regional, state, federal



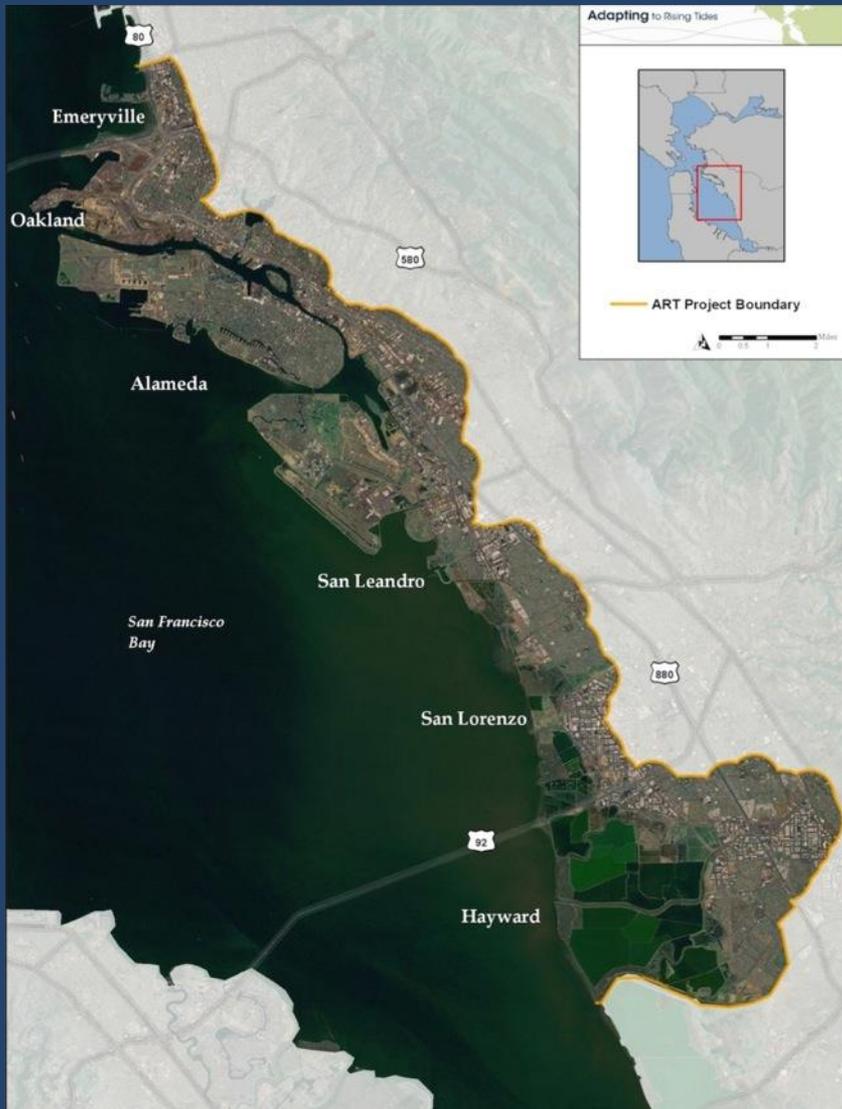
ART Partners

ABAG
Alameda County (AC)
AC Public Works
AC Community Development
AC Public Health Department
AC Transportation Commission
BART
Bay Institute
Bay Trail
CA Coastal Conservancy
Capitol Corridor JPA
City of Alameda
City of Emeryville
City of Hayward
City of Oakland
City of San Leandro
City of Union City

East Bay Dischargers Authority
East Bay Municipal Utility District
East Bay Regional Park District
H.A.R.D.
Pacific Institute
PG&E
Port of Oakland
San Francisco Estuary Institute
San Francisco Estuary Partnership



ART Project Area



- 66.7 square mile area in Alameda county with six cities, one unincorporated community, and numerous special districts
- 126 “shoreline” miles with a diversity of land uses, key regional infrastructure, natural resources and shoreline communities
- Local interest and capacity

ART Climate Impacts



- More frequent floods
- Floods that last longer
- Permanent inundation
- Shoreline erosion and structure overtopping
- Elevated groundwater and salinity intrusion

ART Asset Categories

Airport

Community land use, facilities, services

Contaminated lands

Energy, pipelines and telecom

Hazardous material sites

Ground transportation

Parks and recreation

Natural shorelines

Seaport

Stormwater

Structural shorelines

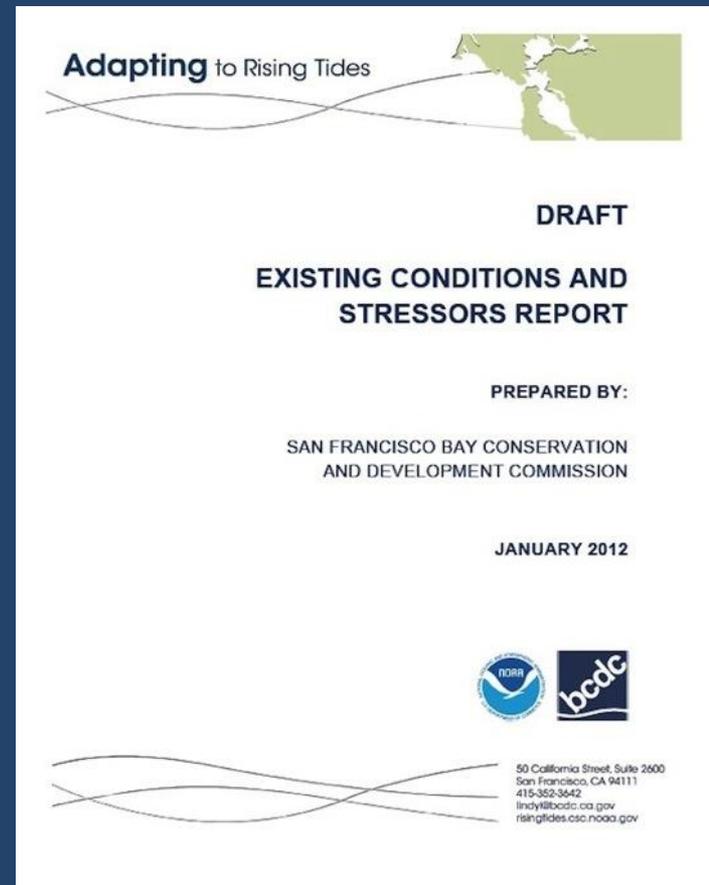
Wastewater



Existing Conditions

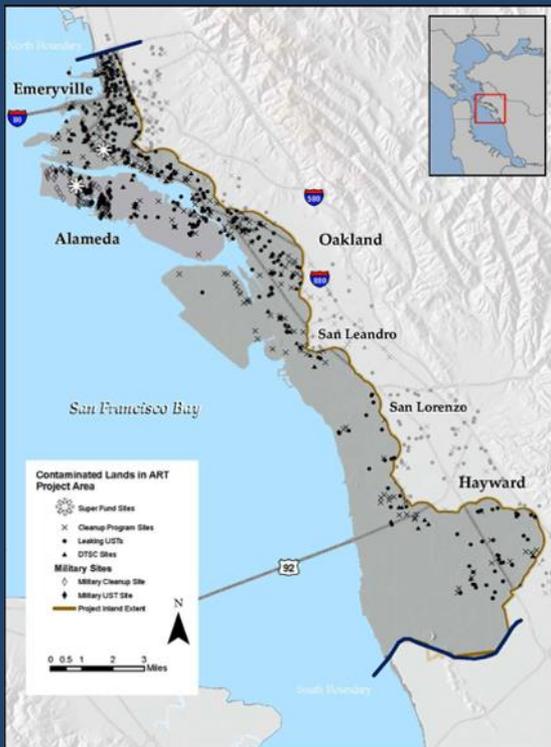
Summarizing the ART Impact Assessment: *The Existing Conditions and Stressors Report*

- Project introduction and background
- Climate change impacts under consideration
- Description of assets in each category



Assessing Vulnerability & Risk

- Data-driven desktop analyses
- Stakeholder survey and interviews



Adapting to Rising Tides Metrics Evaluation Worksheet

Asset Category: Contaminated Lands	ASSESSMENT FRAMES					VULNERABILITY COMPONENTS					
	Physical/Ecological	Policy/Regulatory	Economic	Governance	Exposure	Sensitivity	Adaptive Capacity	Is metric valuable? (yes/no)	Is data available? (yes/no)	If yes, source?	If yes, type?
Physical/ecological											
High wildlife value/biodiversity	■										
Presence of state or federally listed species	■										
Risk of contaminant(s) of concern to the environment	■										
Topographic elevation of site	■										
Depth to groundwater	■										
Management											
Site ownership, e.g., public or private					■			Yes	Alameda County	Assessor's data	
Number of entities with jurisdiction over the site					■						
Complexity of regulations for site use, reuse or clean up					■						
Potential for mobilization or remobilization of contaminants, e.g. in air/water					■						
Presence of collection, containment or treatment systems					■						
Presence of monitoring systems, ongoing monitoring					■						
Status of existing plans, e.g., master plan, improvement plan, etc.					■						
Public health and safety											
Risk of contaminant(s) of concern to public health	■										
Proximity of the site to critical freshwater aquifers	■										
Proximity of site to sensitive receptors, e.g., schools, elderly housing, hospitals	■										
Site serves as a park, public access or recreation	■										
Site provides food, shelter or serves as an informal trail/corridor	■										
Community and economic value											
Redevelopment potential of the site					■						
Status of site remediation					■						
Exposure to current stressors											
Historic exposure, cost and response to flooding					■						
Seismic susceptibility of site					■			Yes	ABAG and USGS	Earthquake shaking maps	
Site is located within current 100-year floodplain					■			Yes	FEMA	DFIRMs*	

*update in process for coastal zones

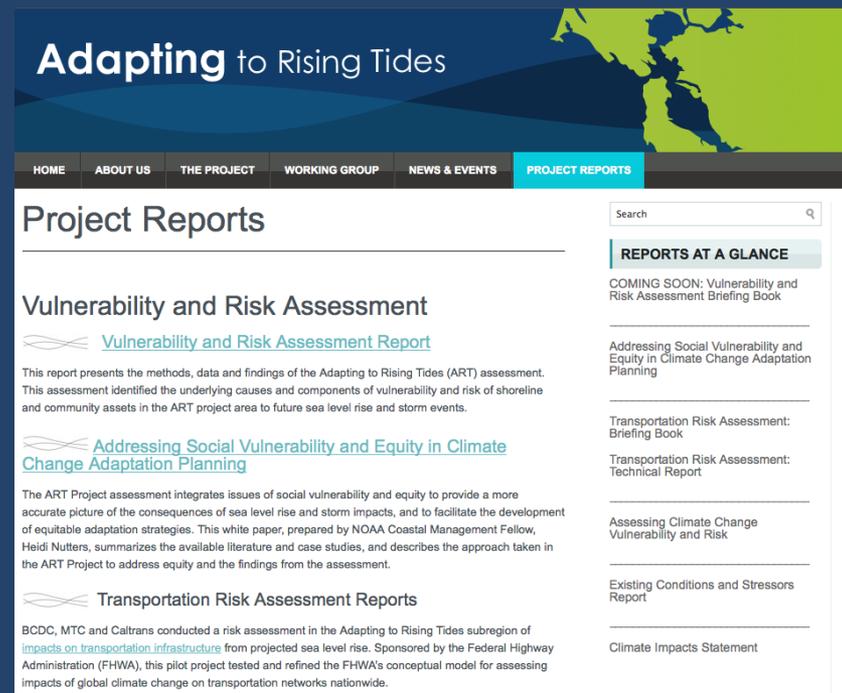
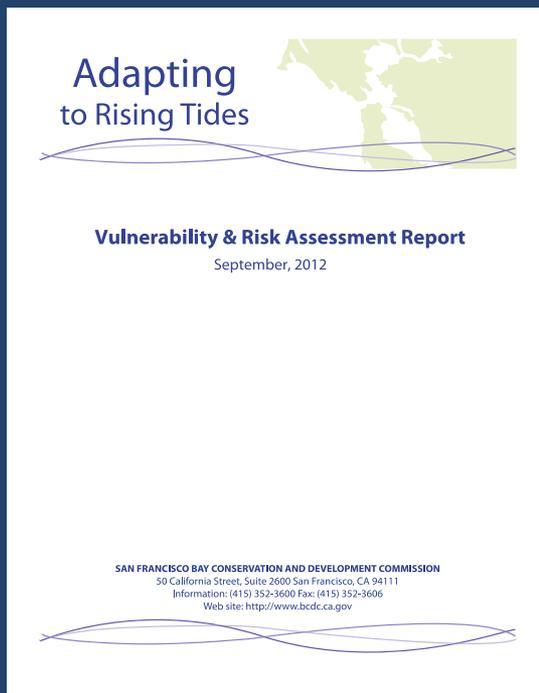
Example Asset Types: Brownfields; Gas Stations (closed); Landfills (open and closed); Superfund sites



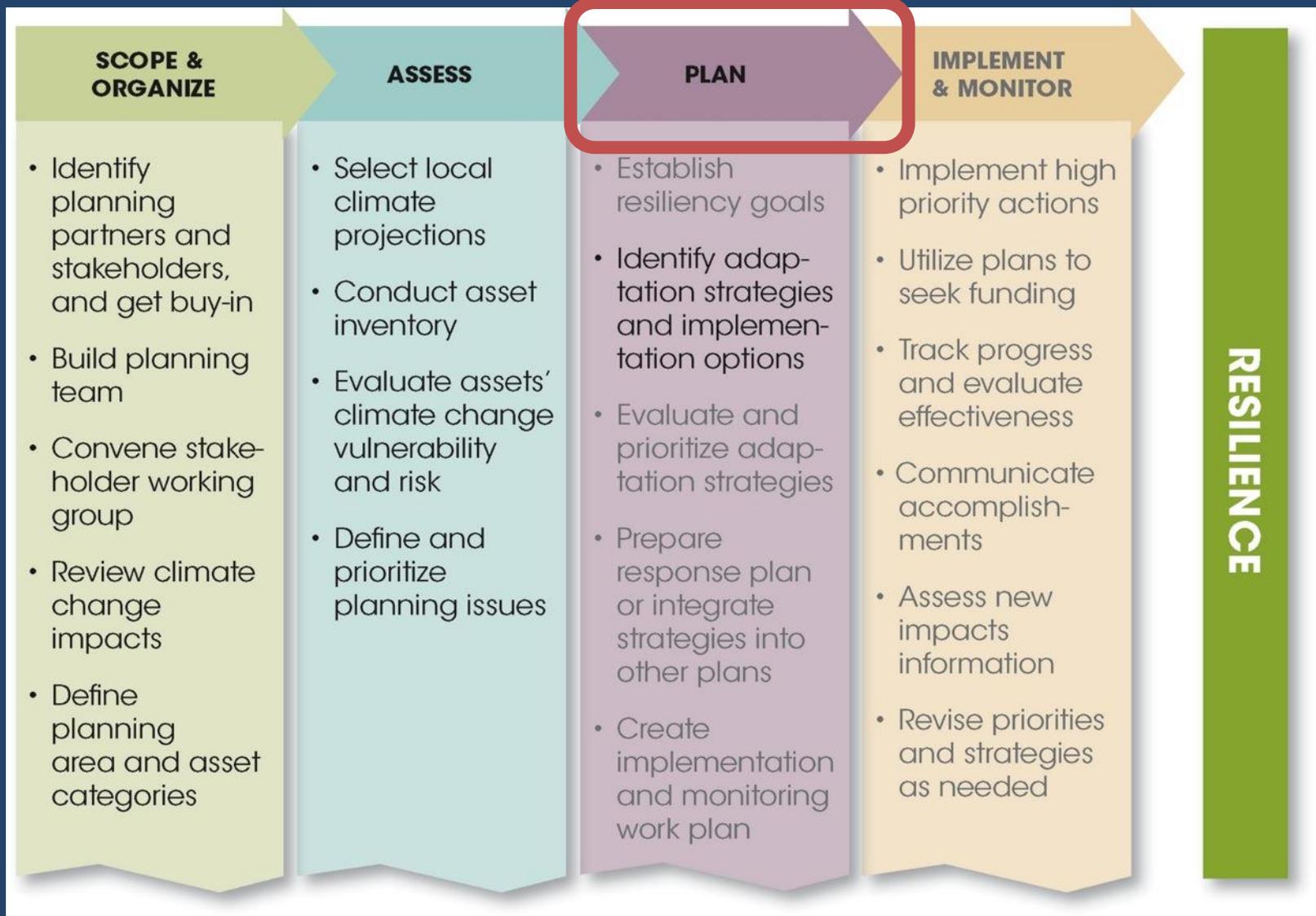
ART V&R Report

Vulnerability & Risk Assessment Report

- Identifies the underlying causes and components of vulnerability and risk
- Presents methods, data and findings of the assessment



ART Adaptation Plan Step



ART Subregional Adaptation Response

Developed for four “roll up categories” incorporating all twelve asset categories.

Community Land Use

- Community Land Use, Facilities and Services
- Hazardous Materials Sites
- Contaminated Lands

Utilities

- Energy and Pipelines
- Stormwater
- Telecommunication
- Wastewater

Shorelines

- Natural Shorelines
- Parks and Recreation Areas
- Structural Shorelines

Transportation

- Airport
- Ground Transportation
- Seaport

ART Subregional Adaptation Responses

- Highlight key issues in the ART project area
- Adequate for certain vulnerabilities – systemic issues or policy development
- Demonstrates that at the subregional scale some strategies are too general
- Serves as a starting point for specific strategies



ART Next Steps

- Develop a portfolio of planning process tools, materials, and lessons learned
- Initiate Focus Area adaptation planning
- Partner with ABAG on multi-hazard shoreline resilience at the Oakland International Airport and Bay Farm Island Focus Area



ART Focus Area Planning

Bay Bridge Touchdown Focus Area



Hayward Shoreline Focus Area



Oakland Airport / Bay Farm Focus Area



ART Adaptation Scales

Local and Regional Climate Adaptation

ART Subregion vulnerabilities & risks

Asset-specific vulnerabilities & risks

ART Subregion adaptation responses

Asset-specific adaptation responses **FOCUS AREA**



OAK / Bay Farm Island Focus Area

- Focus on the people, facilities, infrastructure and services of the Bay Farm Island community and the Oakland International Airport
- Consider vulnerabilities and risk mitigation strategies for multiple hazards - earthquakes, sea level rise, and future storm flooding
- Examine secondary vulnerabilities and consequences caused by dependencies among asset in the focus area, and dependencies to assets outside of the focus area



Project Goals and Objectives



Conduct a BCDC + AGAG joint project that will:

- Demonstrate the benefits of considering multiple hazards in planning for shoreline resilience
- Identify shared elements of earthquake risk mitigation and sea level rise adaptation planning
- Consider risk mitigation strategies to address hazards *within* a focus area, as well as disruptions occurring *outside of* a focus area
- Actively engage stakeholders in an integrated multiple hazard planning project

Shoreline Resilience Stakeholders

Alameda Municipal Power
Alameda County Public Works
Alameda County Public Health Department
Alameda County Transit
Alameda County Transportation Commission
BART
Bay Trail (ABAG)
CA Coastal Conservancy
CA Department of Transportation
City of Alameda
City of Oakland
East Bay Municipal Utility District
East Bay Regional Park District
MTC
Kinder Morgan Pipeline
PG&E
Port of Oakland (OAK)

Others???



Shoreline Resilience Assets

Community facilities and services

Contaminated lands (closed landfill)

Energy utilities

Gas and fuel pipelines

Ground transportation

Natural shorelines (wetlands/beaches)

Oakland International Airport

Park and recreation areas (trails, golf courses)

Residential land use

Telecommunication infrastructure

Water utilities (wastewater, water supply, stormwater)



Expected Outcomes

- Six stakeholder meetings, a public open house, briefings to Boards and Commissions, two reports over a 12 month period (July 2013 to June 2014)
- Improved understanding of synergies and conflicts between earthquake risk mitigation and sea level rise adaptation planning
- Development and dissemination of communication materials about the project, process, lessons learned, and outcomes

Adapting to Rising Tides

Adapting to Rising Tides

HOME ABOUT US THE PROJECT WORKING GROUP NEWS & EVENTS PROJECT REPORTS

Now Available: **Vulnerability and Risk Assessment Report**
Photo credit: BCDC

Welcome!

Adapting to Rising Tides — the ART Project — is a collaborative planning effort to help San Francisco Bay Area communities adapt to rising sea levels. Led by the San Francisco Bay Conservation and Development Commission and the National Oceanic and Atmospheric Administration Coastal Services Center, the ART Project has engaged local, regional, state and federal agencies and organizations, as well as non-profit and private associations. Together, they are working towards the project goal of increasing the Bay Area's preparedness and resilience to sea level rise and storm events while protecting critical ecosystem and community services.

Click on the image on the right to learn more about specific aspects of the ART Project

ADAPTING TO RISING TIDES

- Goals & Objectives
- SUBREGIONAL Working Group
- Project Management Team
- ADAPTATION PLANNING PROCESS
- ASSESSMENTS
 - IMPACTS
 - VULNERABILITY
 - RISK
- TIMELINE
- FUNDING

Visit the ART project at:
www.adaptingtorisingtides.org

ART Project
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Sub-Regional Infrastructure Interdependencies and Vulnerabilities Research Update

Dana Brechwald, Earthquake and Hazards Specialist
Lifeline Committee Meeting
January 31, 2013



Overview of Our Study

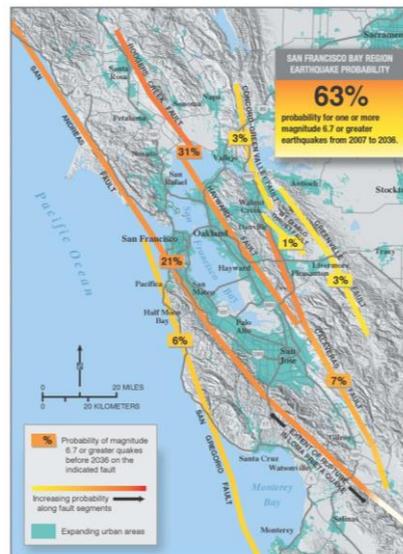
- **Questions to Address**
 - What is the state of the vulnerabilities and interdependencies of our regional and sub-regional infrastructure systems?
- **Goal**
 - Improve the performance and lessen recovery time of infrastructure systems after a major earthquake in the Bay Area
- **Objective**
 - Work collaboratively with partners and stakeholders to identify and qualify infrastructure vulnerabilities, interdependencies, and consequences within the Bay Area.
- **Outcome**
 - Sub-Regional Infrastructure Interdependencies Findings and Recommendations Report

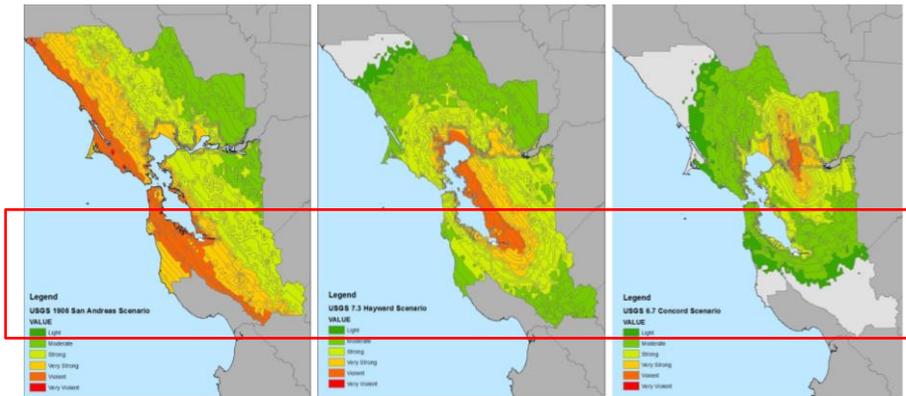
Scope of Our Study

- **Asset Categories**
 - Energy (electricity, natural gas, and fuel)
 - Water and Wastewater
 - Communications
 - Ground Transportation
 - Ports and Airports
- **Asset Components**
 - Key built assets such as pump stations, treatment plants, or substations
 - Distribution and transmission assets such as pipes, wires, or cables
 - Resources necessary for basic operation of the system, such as electricity, gas, or fuel
 - Employees and people who run, make decisions about, and oversee the built systems
 - Information and data on systems and their performance

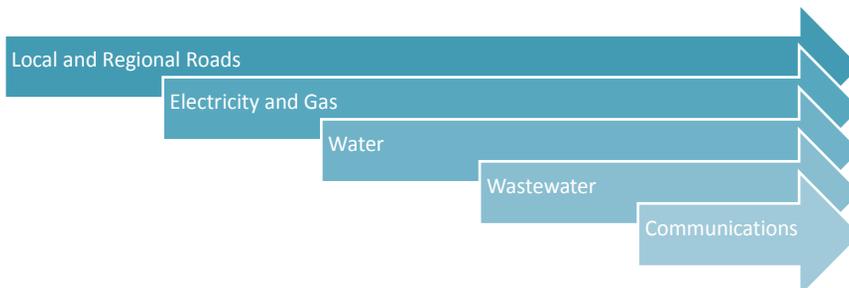
Sub-Regional Analysis

- **Sub-Regions**
 - Alameda
 - Contra Costa
 - Marin, Napa, Solano, Sonoma
 - San Francisco, San Mateo
 - Santa Clara

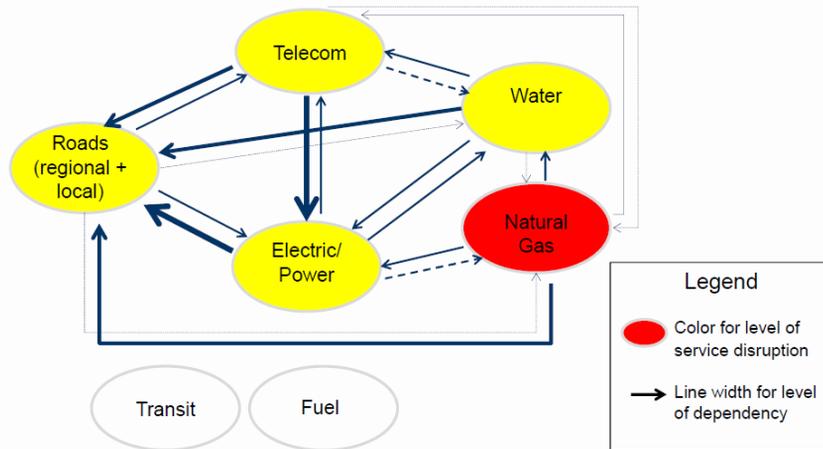




Preliminary Hierarchy – High Level



Lifeline Interdependencies in San Francisco (Progress Report ; September 2012)



Anticipated Products

Service Disruption Level	Sector	Time After Event		
		0 hours	72 hours	2 weeks
No loss	Power	Grey	Grey	Grey
Slight Disruption	Transportation	Grey	Orange	Grey
Moderate Disruption	Water	Green	Green	Grey
Severe Disruption	Wastewater	Orange	Orange	Grey
Uncertain	Natural Gas	Grey	Grey	Grey
	Healthcare	Orange	Orange	Orange
	Solid Waste	Green	Green	Grey

Sub-Regional Analysis

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