February 2016

Local Hazard Mitigation Plan

San Francisco Bay Area Rapid Transit District

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1 Introduction

Hazard mitigation is a sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards. A local hazard mitigation plan (LHMP) identifies the hazards a community or region faces, assesses their vulnerability to the hazards and identifies specific actions that can be taken to reduce the risk from the hazards. The Federal Disaster Mitigation Act of 2000 (DMA 2000) outlines a process which cities, counties, and special districts can follow to develop a Local Hazard Mitigation Plan (LHMP). Development of this plan is a requirement for certain mitigation benefits from CalEMA and FEMA. Updates to the LHMP are required every five years.

This LHMP (Plan herein) represents an update to the previous 2011 plan lead by Association of Bay Area Governments (ABAG). Beginning 2016 and forward, the San Francisco Bay Area Rapid Transit District (the District) will prepare its own LHMP as opposed to the partaking in a multi-jurisdictional plan. The rationale for this change is due primarily to the discontinuation of the ABAG in leading and implementing a multi-jurisdictional planning process for the region. In addition, given the uniqueness of the District's jurisdiction across multiple counties in the region and as a transit agency, it is advantageous to have a District-specific plan that can be more responsive to the hazards and issues that BART faces.

The District has been part of the multijurisdictional hazard mitigation planning prepared by Association of Bay Area Governments (ABAG) for the greater San Francisco Bay Area including the 2005 and 2011 plans. These plans included hazard mitigation planning and strategies for people, cities, utility providers, organizations, and private entities living and operating in the region.

The Plan follows the guidelines outlined in the Local Mitigation Planning Handbook published by FEMA published in March of 2013. The five key elements of the Plan aim to produce a roadmap for identifying and mitigating hazard exposure.

A. Planning Process

B. Hazard Identification and Risk Assessment

C. Mitigation Strategy

D. Plan Review, Evaluation, and Implementation

E. Plan Adoption

The scope of this Plan covers the District's jurisdiction, namely, property within BART's Right-of-Way. This Plan acknowledges that coordination with other local jurisdictions as well as members of the community can strengthen and enhance mitigation response.

1.1 BART System

BART is one of the San Francisco Bay Area's most vital transportation links, providing an average of 441,000 passenger trips every weekday as of October 2014. During peak commute hours, BART carries as many passengers as there are drivers travelling over the Bay Bridge.

BART is an electrically powered rapid transit commuter rail system currently comprised of 104 miles of double track (including some areas of multiple tracks) and 45 stations throughout the San Francisco, Alameda, San Mateo, and Contra Costa counties with the inclusion of Warm Springs.

1.2 BART Asset Profile

The Plan conducts the hazard risk assessment and hazard mitigation strategy prioritization on high priority assets consistent with those identified by the District's Asset Management Team. High priority assets in the plan assessment include the following facilities and systems:

- **Passenger stations** - There are currently 44 stations in the existing system. There are three basic types of station construction – aerial, at-grade, and subway. The stations are further classified between center platforms (located between tracks), and external platforms (located on the outside of the two tracks). The addition of Warm Springs station will make a total of 45 in the system.
- **Substations** – substations provide traction power used for vehicle propulsion. Traction power is stepped down from 34.5 kV AC to 1 kV DC and sent to the electrified third rail system mounted outside of and in parallel with the running rails.
- **Switching stations** – These stations are the receiving points for high voltage power from the electric utility. The switching stations convert the power to 34.5 kV AC and distributed to substations.
- **Train control rooms** – These rooms house the automatic train control system equipment. The system provides vital train functions including train detection, speed control and switch machine operations. The system also provides non vital train functions including platform functions, automatic route requests, and communication with operations control center.
- **Shops/yards** – BART has four yards: Daly City, Hayward, Concord, and Richmond. The yards provide dispatching of trains for revenue service; train storage during non-revenue and off-peaks periods; and train washing and cleaning. BART has four shops co-located with the yards for repair and maintenance of train cars. A fifth shop in Oakland provides maintenance of non-revenue vehicles.
- **Ventilation structures** – These structures provide ventilation for underground assets.
- **Emergency exits** – These exits/entrances provide for safe evacuation in emergencies

Through the asset management program, BART prioritizes its assets (e.g. criticality) based on the impact of an asset failure on reliable and safe service capabilities. BART has defined the following asset priority ratings:

<u>High (3) Priority</u> – Failure results in immediate impact to service capabilities, or shutdown of, any single or multiple operations or systems. This failure will prevent service to the public due to operational, safety, or environmental issues. Asset(s) assigned this priority typically will have no

redundancy and identified issues must be addressed immediately to meet District goals. All protective devices without back-up systems are included in this priority.

Medium (2) Priority – Failure results in a limited impact to service capabilities, or shutdown of, any single or multiple operations or systems. Assets(s) assigned this priority may have redundancy or established by-pass equipment or systems but may limit the service schedule. Although this asset(s) could become highly critical if the redundancy or by-pass fails, identified issues should be planned and scheduled with a higher work order priority. All protective devices with back-up systems are included in this priority.

Low (1) Priority- Failure has no impact to service capabilities. Some of these assets may have the maintenance strategy of run-to-fail associated with them, while others may require issues be addressed in a timely manner through the normal Planned Work flow process.

2 Planning Process

2.1 Overview

The Plan will be integrated with BART's existing emergency response plans and planning mechanisms. The plan will be used to guide emergency preparedness operations and can support asset management on project prioritization during the 5-year plan period. Additionally, the plan will inform capital improvement programs and project planning.

2.2 Core Team

In early 2015, the District formed a Core Team tasked with updating the Plan. The team is jointly represented by the Office of District Architect, Emergency Management, and Civil Engineering. The team is responsible for updating and addressing all section of the Plan. Key efforts by the core team include:

- Participation in ABAG LHMP workshops
- Review of progress since the last Plan update
- Review of existing District plans
- Identification of critical assets
- Hazards identification and risks assessment
- Mitigation strategies development
- Engagement with the Emergency Preparedness Task Force Committee
- Engagement with community in the planning process
- Solicitation and incorporation of feedback from external stakeholders and the public

2.3 Stakeholders

Stakeholders have been invited to participate in the LHMP development process through meetings with the Emergency Preparedness Task Force Committee (Internal) and the Title VI Environmental Justice Advisory Committee (External)

2.4 Internal Engagement

2.4.1 Emergency Preparedness Task Force Committee

The Emergency Preparedness Task Force Committee (EPTFC) serves as a steering committee to the District's Emergency Preparedness Program and for the LHMP update process. They assist the Core Team in plan evaluation and decision making. Personnel involved in these evaluation meetings included senior management and staff from the System Safety, Office of Civil Rights, Maintenance and Engineering, Transportation Operations, BART Police, Rolling Stock and Shops, Planning Development & Construction, and the Earthquake Safety Program.

The Core Team held two engagements with the EPTFC.

Engagement 1 (April 30, 2015)

The core team introduced the need for the Plan and update. The core team provided plan overview identifying core team members, deliverables, deadline, and role of the EPTFC. The goal of the engagement was to gain work approval and identify resource needs for the Plan update.

Engagement 2 (December 2, 2015)

Representatives from several BART departments met to identify and prioritize appropriate mitigation strategies for the Plan. Representatives from each department were responsible for communicating existing efforts and thoughts on appropriate future risk mitigation actions in the hazard area of their expertise. In addition, the draft mitigation strategies prepared by the Core Team following regional plans were forwarded to other responsible departments for comment.

The goal of the meeting was to review and prioritize the draft mitigation strategies for the five year plan period. The EPTFC provided valuable input in relation to existing programs to continue, critical issues to be addressed, urgent facility upgrade priorities and existing capital improvement programs.

2.5 External Engagement

2.5.1 ABAG/BCDC LHMP Coordination

BART engaged in three workshops supported by ABAG and BCDC in providing assistance to communities in updating or developing hazard mitigation plans. The workshops provided key resources and guidance in the Plan update.

2.5.2 Title VI/Environmental Justice Advisory Committee

The Advisory Committee members are active participants of local community-based organizations that serve minority and low-income populations within the BART service area. As many as many as 13 community-based organizations are represented in in the Advisory Committee. The Advisory Committee encourages the full and fair participation of minority and low-income populations in the District's transportation decision-making process. The advisory committee was selected as an ideal and primary means for community engagement because minority and low-income populations are disproportionately more sensitive to natural disasters than other populations.

Hosted by the Office of Civil Rights, BART engaged in two advisory meetings with the public through the Title VI/Environmental Justice Advisory Committee. These meetings were held on:

Engagement 1 (August 11, 2015)

The core team introduced the purpose and goals of the Plan. The core team provided an overview identifying hazards and exposure to the BART system. The goal of the engagement was to gain feedback on plan process and hazard identification.

Engagement 2 (December 2, 2015)

The core team introduced the mitigation strategies, purpose and goals of the Plan. The core team provided an overview identifying hazards and exposure to the BART system. The goal of the engagement was to gain feedback on plan process and hazard identification. Public comment on the BART mitigation strategy selection process. Participants were able to identify potential new strategies and areas of concern.

In addition, the proposed mitigation strategies were distributed to the community through the Title VI mailing list for feedback.

2.5.3 Public Comment

The Core Team solicited public comment on the Plan through posting of the draft Plan on the BART.gov public website. A dedicated webpage was made for the Plan update. The webpage can be found with the following URL.

http://www.bart.gov/content/local-hazard-mitigation-plan-update

The draft LHMP was posted on the BART website in February 2016 for three weeks for public comment. Announcements were made to the public through email and newsfeed articles.

The Core Team has also solicited comment from Alameda, Contra Costa, San Francisco, and San Mateo Counties and various local cities.

As BART is committed to continually providing public oversight of its planning process, BART will consider additional outreach methods, such as local newspapers, direct mail, and flyers at stations in its service area to promote wider public participation.

2.6 Plan Maintenance

The Core Team will be responsible for annual evaluation and determination if the Plan should be updated. The Core Team will recommend update to the Plan to the EPTFC for approval. The EPTFC will ensure that monitoring of this plan will occur such that status of each Mitigation Action is recorded. This monitoring will be on an on-going basis undertaken by the Core Team responsible for development of the Plan.

Necessary public participation in the plan maintenance process will be held at public board meetings or using existing community groups such as the Advisory Committee with the Office of Civil Rights.

3 Hazard Identification and Risk Assessment

3.1 Hazard Exposure

Hazard exposure mapping was performed by the District's EGIS department using geographical information system (GIS) tools and a local understanding of the environment surrounding the San Francisco Bay Area. GIS exposure mapping was performed for seven hazards having potential to threaten the BART system. These included Earthquakes, Tsunamis, Landslides, Flood, Sea Level Rise, Wildfire and Drought. Hazard exposure evaluation assessed exposure levels of the hazard to BART high priority assets. Under each hazard scenario, high priority assets were identified for high exposure areas. Refinements in the assessment can be made in future plan updates to incorporate site-specific information with regard to existing protections, hazard sensitivity, and adaptive capacity.

Generally, the main hazard of concern to BART facilities are related to earthquakes, followed by flooding. This is based on both the asset exposure mapping information and institutional understanding and past performance of the high priority assets to the hazards examined.

The BART service area has experienced a number of disasters over the past decades, including earthquakes, floods, droughts, wildfires, energy shortages, landslides, and severe storms. The most significant disasters impacting the District were the Loma Prieta earthquake and the East Bay Hills Firestorm.

3.2 Earthquake

Major faults cross through all nine Bay Area counties. Every point within the Bay Area is within 30 miles of an active fault, and 97 of the 101 cities in the Bay Area are within ten miles of an active fault. Most of BART facilities are located in areas with potential for high shaking potential. This is the major reason earthquakes pose the largest threat to much of BART's system and require the bulk of existing and planned hazard mitigation efforts. In terms of ground failure, associated with earthquakes, 32 assets are identified in very high liquefaction susceptibility zones.

3.2.1 Potential Impacts

In 2000, the District hired a team of consultants led by Bechtel Infrastructure and HNTB to evaluate all of the facilities and components in the BART system. Completed in 2002, the Seismic Vulnerability Study was the most comprehensive evaluation of BART facilities since original construction of the system. It involved one and one-half years of engineering and statistical analyses, which included developing scenario earthquakes, computer models, damage predictions, upgrade options, and cost-benefit analyses. The study also incorporated new information from the 1994 Northridge, California and 1995 Kobe, Japan earthquakes.

The original system, consisting of 34 stations and 74 miles of track, was designed to criteria that were considered conservative at the time. However, lessons learned from subsequent earthquakes, including more knowledge about seismicity and behavior of structures, led BART to believe that the system had vulnerabilities that needed to be mitigated. The evaluation

contained in the BART Seismic Risk Analysis Report and BART System wide Seismic Vulnerability Study Report confirmed that the system and specific facilities/components in the original system were vulnerable to damage that would leave the system with significant life safety and operability impacts. The original BART system, completed between 1972 and 1976, has a service area spanning three counties-Alameda, Contra Costa and San Francisco. System extensions, built mostly during the 1990s, employed more stringent and up-to-date seismic criteria than the original system, and thus do not require upgrades.

Since the formation of the Earthquake Safety Program (ESP), the District has made extensive progress in reducing the potential seismic impacts. See Section 4.3 under existing programs.

3.2.2 Financial Impacts

Earthquake scenario studies, including but not limited to the San Andreas magnitude 8.0 and the Hayward magnitude 7.0, were used to assess the impact of likely earthquakes on the life safety and operability performance of the system, and to develop cost/benefit information of various retrofit packages as part of the Seismic Vulnerability Study Report. It was determined that it is not practical or economically feasible to retrofit to a "damage-proof" level. Thus, focused emergency response, inspection and repair plans/procedures are being developed to help expedite restoration of service, and a comprehensive seismic retrofit program for the original BART system was put underway.

Results of the Seismic Vulnerability Study indicated that if the BART system is not strengthened, it would take years to restore service after a major earthquake. The study found that portions of the system most susceptible to earthquake damage include the Transbay Tube, aerial structures, stations and equipment. The study recommended that priority be given to the Transbay Tube, where soil backfill is prone to liquefaction.

BART generated estimates of potential dollar losses due to four earthquake scenarios. Estimates of direct capital losses to overhead and at-grade trackways, the Transbay Tube, the Berkeley Hills tunnel, stations, buildings, systems and equipment due to faulting, shaking, liquefaction, and landslides are provided below. Damage to specific components, and loss by type of component was also determined.

- Hayward – Magnitude 7 - $1.1B
- San Andreas – Magnitude 8 - $860M
- Calaveras – Magnitude 6.8 - $260M
- Concord – Magnitude 6.8 - $250M

The financial impact estimates have not been updated since Earthquake Safety Program began.

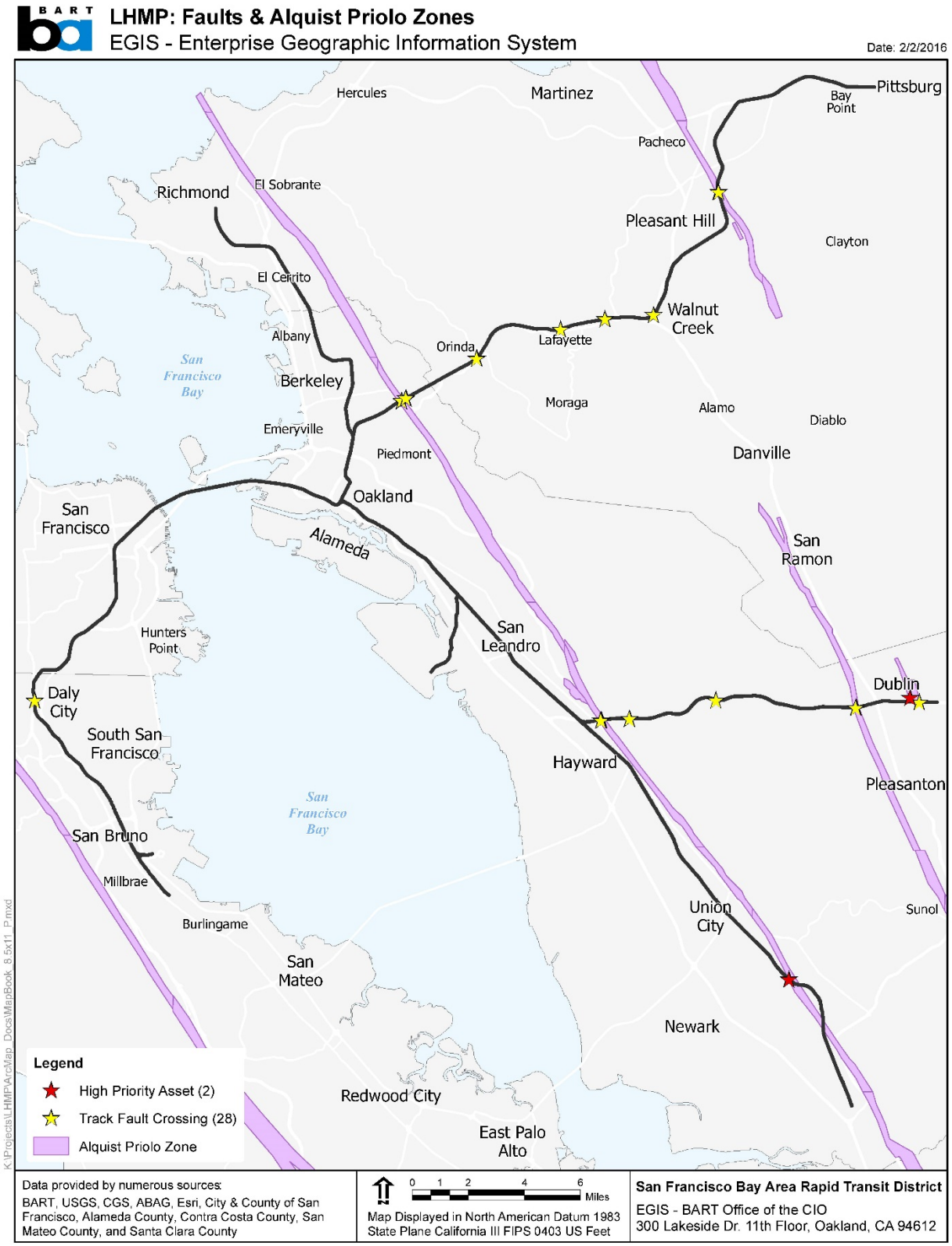
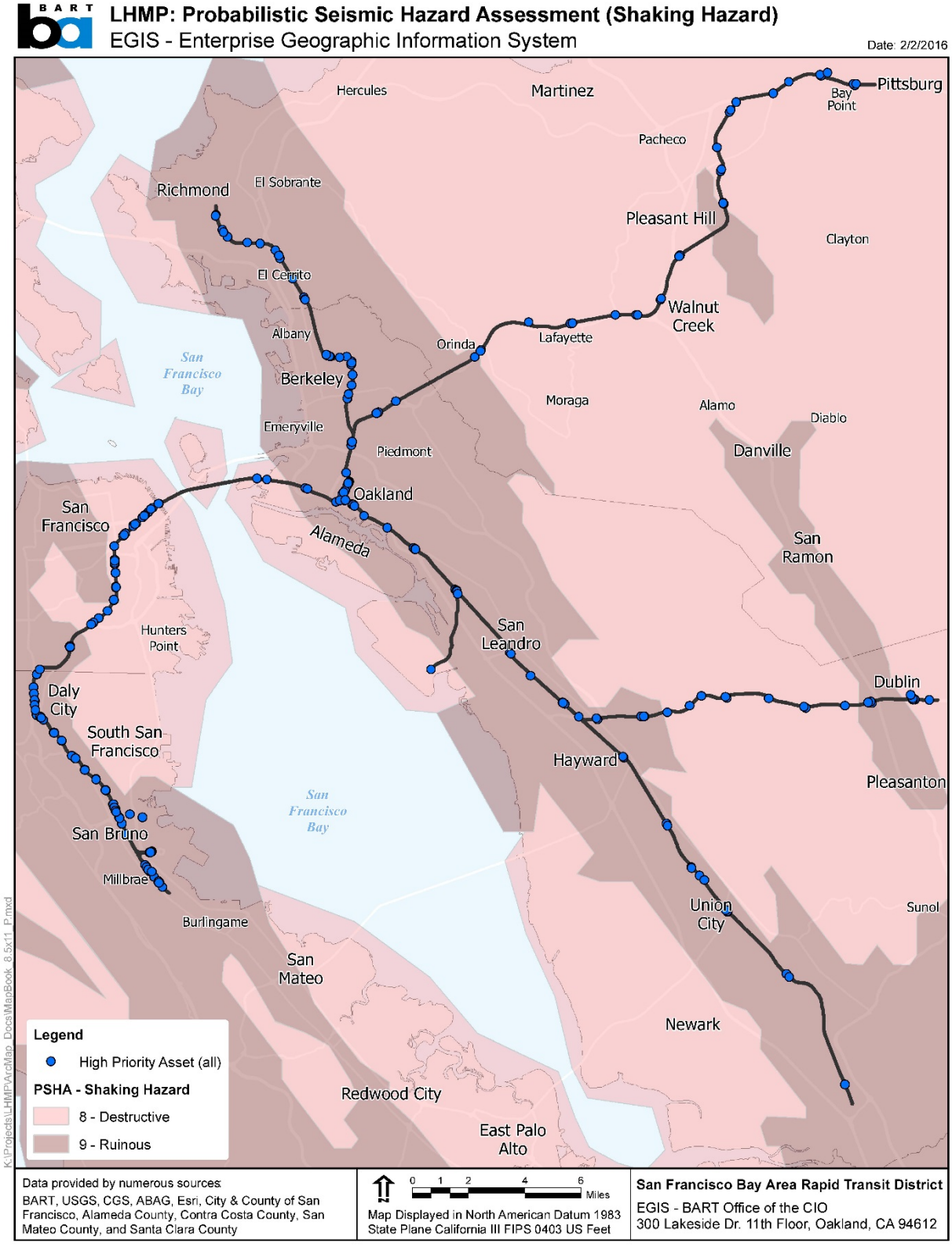


Figure 1 Fault Zones


LHMP: Probabilistic Seismic Hazard Assessment (Shaking Hazard)
EGIS - Enterprise Geographic Information System
Date: 2/2/2016
Hercules
Martinez
Pittsburg
Bay Point
Pacheco
Richmond
El Sobrante
Pleasant Hill
Clayton
El Cerrito
Walnut Creek
Albany
Orinda
Lafayette
San Francisco Bay
Berkeley
Moraga
Alamo
Diablo
Emeryville
Piedmont
Danville
Oakland
San Francisco
Alameda
San Ramon
Hunters Point
San Leandro
Dublin
Daly City
South San Francisco
Hayward
Pleasanton
San Bruno
Millbrae
Burlingame
Union City
Sunol
San Mateo
Newark
Redwood City
East Palo Alto
Legend
High Priority Asset (all)
PSHA - Shaking Hazard
8 - Destructive
9 - Ruinous
Data provided by numerous sources:
BART, USGS, CGS, ABAG, Esri, City & County of San Francisco, Alameda County, Contra Costa County, San Mateo County, and Santa Clara County
0 1 2 4 6 Miles
Map Displayed in North American Datum 1983 State Plane California III FIPS 0403 US Feet
San Francisco Bay Area Rapid Transit District
EGIS - BART Office of the CIO
300 Lakeside Dr. 11th Floor, Oakland, CA 94612
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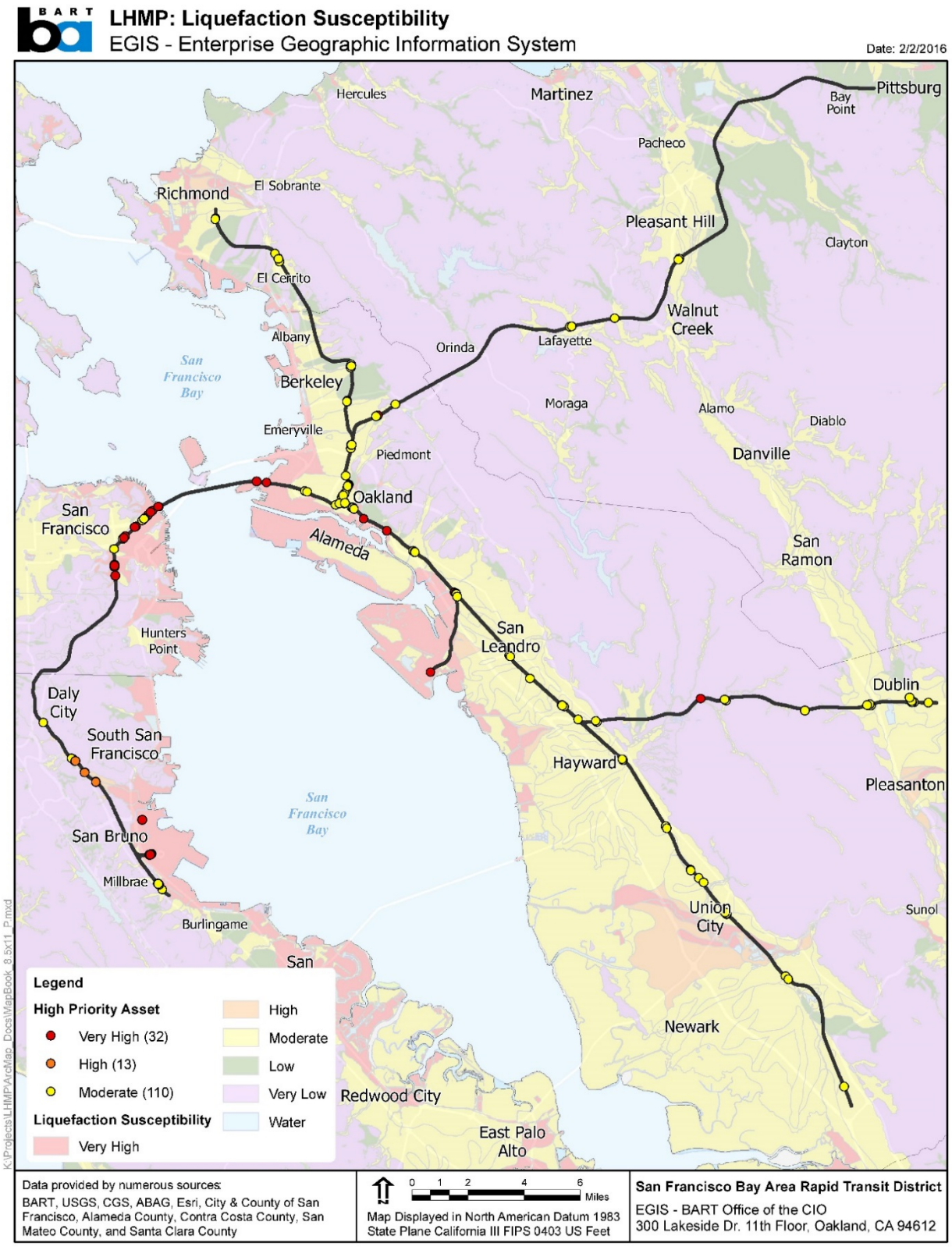
LHMP: Liquefaction Susceptibility
EGIS - Enterprise Geographic Information System
Date: 2/2/2016
Hercules
Martinez
Pittsburg
Bay Point
Pacheco
El Sobrante
Richmond
Pleasant Hill
Clayton
El Cerrito
Walnut Creek
Albany
Orinda
Lafayette
San Francisco Bay
Berkeley
Moraga
Alamo
Diablo
Emeryville
Piedmont
Danville
Oakland
San Francisco
Alameda
San Ramon
Hunters Point
San Leandro
Dublin
Daly City
South San Francisco
Hayward
Pleasanton
San Bruno
Millbrae
Union City
Sunol
Burlingame
Newark
Redwood City
East Palo Alto
Legend
High Priority Asset
Very High (32)
High (13)
Moderate (110)
Liquefaction Susceptibility
Very High
High
Moderate
Low
Very Low
Water
K:\Projects\LHMP\ArcMap_Docs\MapBook_8.5x11_P.mxd
Data provided by numerous sources:
BART, USGS, CGS, ABAG, Esri, City & County of San Francisco, Alameda County, Contra Costa County, San Mateo County, and Santa Clara County
0 1 2 4 6 Miles
Map Displayed in North American Datum 1983 State Plane California III FIPS 0403 US Feet
San Francisco Bay Area Rapid Transit District
EGIS - BART Office of the CIO
300 Lakeside Dr. 11th Floor, Oakland, CA 94612

3.2.3 Historical events

3.2.3.1 Napa Earthquake (August 2014)

A 6.0 magnitude earthquake struck the Bay Area on August 24, 2014. The event, localized approximately six miles southwest of Napa Valley, caused an estimated $360 million in damages and resulted in over 200 casualties, including one fatality. Napa Division Fire Chief John Callanan stated that he event triggered six major fires.

Figure 4 illustrates the extent of shaking felt in and around the Bay Area. The United States Geological Service estimated that some 15,000 people experienced severe shaking, 106,000 persons felt very strong shaking and another 176,000 felt strong shaking.

BART's earthquake early warning system provided up to 10 seconds of notice prior to the event, which would have allowed any moving trains enough time to stop and/or slow down, preventing derailments, injuries and deaths. Given the time of the earthquake (3:20 AM) no trains were in operation and no action was necessary by BART. No earthquake-related disruptions were identified, demonstrating progress by BART's extensive seismic retrofit program.[1]

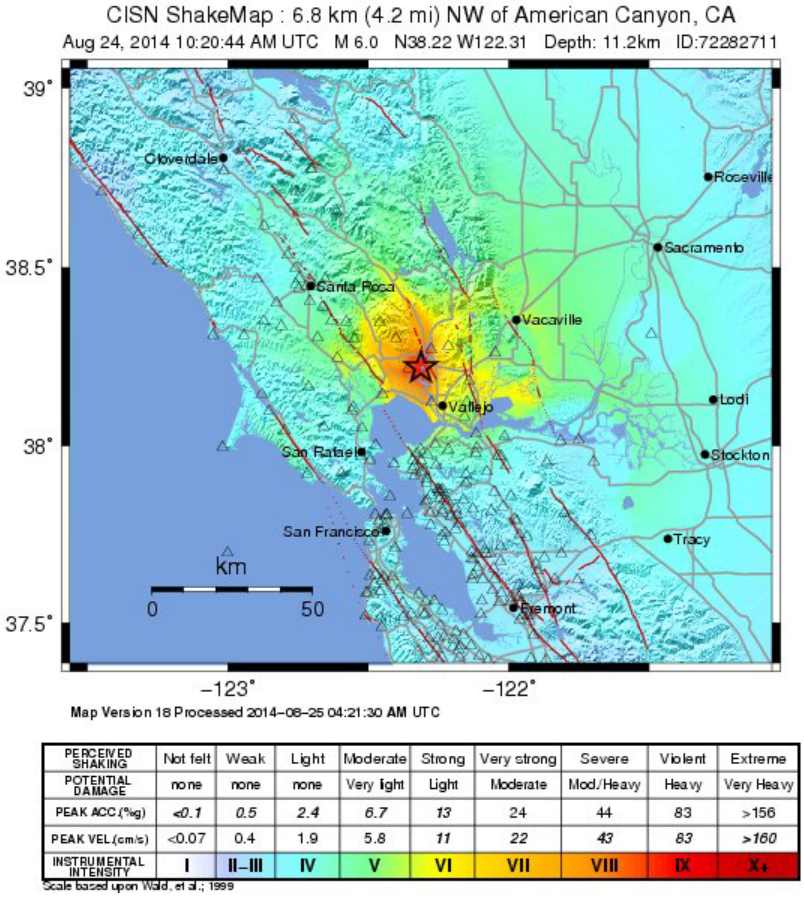

Figure 4 August 2014 earthquake shake map illustrates reach of shaking

[1] http://sfappeal.com/2014/08/barts-earthquake-early-warning-system-could-have-broader-applications/

3.2.3.2 Loma Prieta Earthquake of 1989

The Loma Prieta Earthquake of 1989 is an example of the kind of large-scale disaster which could strike the Bay Area. The event killed 63 persons, injured 3,757, and displaced over 12,000 persons. With over 20,000 homes and businesses damaged and over 1,100 destroyed, this quake caused approximately $6 Billion of damage.

BART's success in maintaining continuous service directly after the 1989 Loma Prieta earthquake reconfirmed the system's importance as a transportation "lifeline." While the earthquake caused transient movements in the Tube there was no significant permanent movement and BART service was uninterrupted except for a short inspection period immediately following the quake. With the closure of the Bay Bridge and the Cypress Street Viaduct along the Nimitz Freeway, BART became the primary passenger transportation link between San Francisco and East Bay communities. Its average daily transport of 218,000 passengers before the earthquake increased to an average of 308,000 passengers per day during the first full business week following the earthquake.

3.3 Tsunamis

Tsunamis can result from off-shore earthquakes within the Bay Area or from distant events. It is most common for tsunamis to be generated by offshore subduction faults such as those in Washington, Alaska, Japan, and South America. Tsunami waves generated at those far-off sites can travel across the ocean and can reach the California coast with several hours of warning time.

Local tsunamis can also be generated from offshore strike-slip faults. Because of their close proximity, we would have little warning time. However, the Bay Area faults that pass through portions of the Pacific coastline or under portions of the Bay are not likely to produce significant tsunamis because they move side to side, rather than up and down, which is the displacement needed to create significant tsunamis. They may have slight vertical displacements, or could cause small underwater landslides, but overall there is a minimal risk of any significant tsunami occurring in the Bay Area from a local fault. The greatest risk to the Bay Area is from tsunamis generated by earthquakes elsewhere in the Pacific.

3.3.1 Potential Impacts

The CalEMA tsunami evacuation planning maps indicated that several facilities are in the evacuation zone – including vent structures, passenger stations, and the Oakland shops. Since the intent of the maps is limited to evacuation planning, not infrastructure vulnerability assessments, the maps indicate that there is a need to incorporate tsunami evacuation planning into the BART Emergency Operations Plan. Historical Events

The San Francisco bay has not yet experienced a tsunami with capacity to flood the BART system.

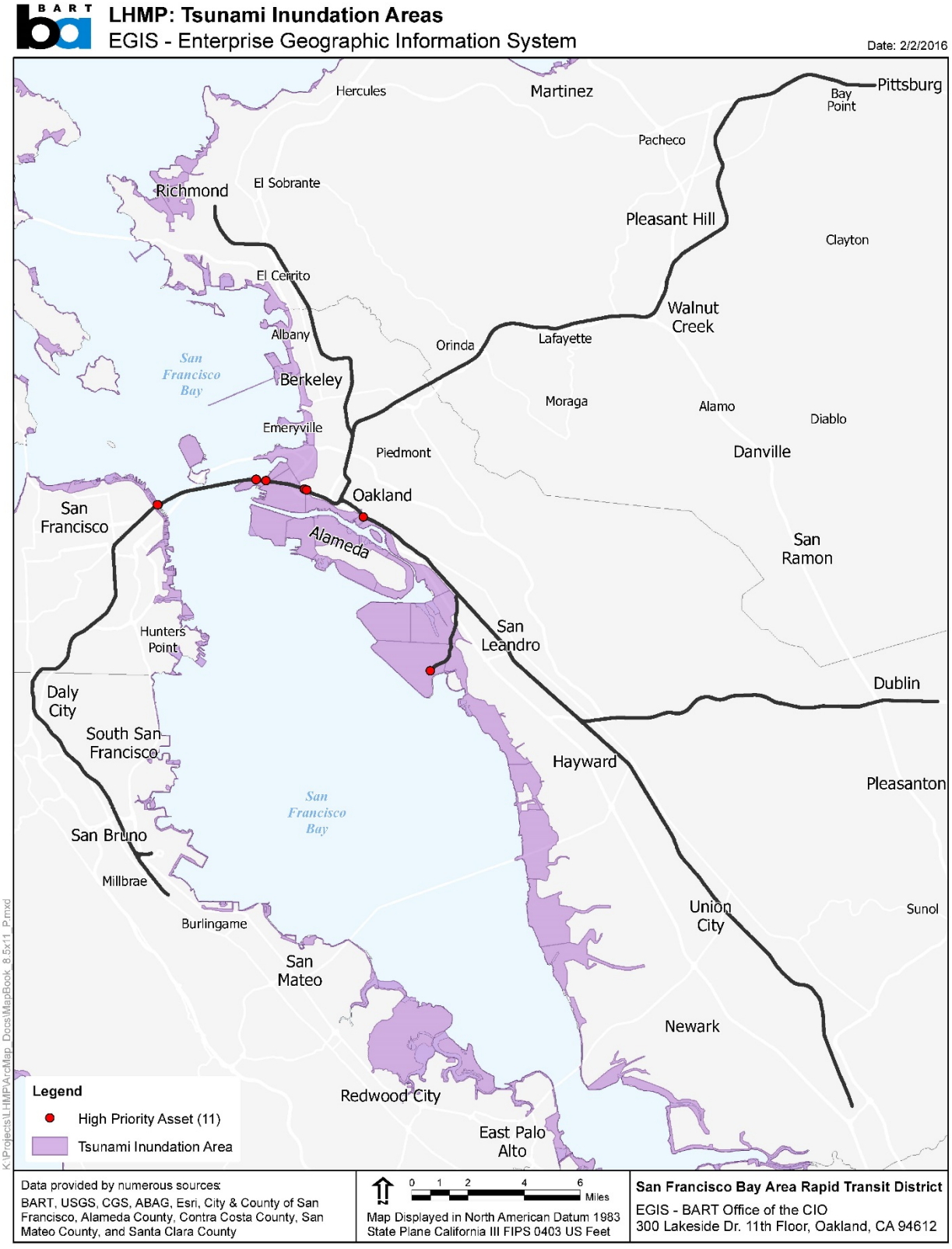

Figure 5 Tsunami Zones

3.4 Landslides

In the Bay Area, landslides typically occur as a result of either earthquakes (earthquake-induced landslides), or during heavy and sustained rainfall events (weather induced landslides). A given area can be at risk for both earthquake-induced landslides as well as landslides caused by rain-saturated soils but the variables that contribute to each landslide risk are different. Typically an earthquake-induced landslide occurs when seismic energy at the top of a slope gets concentrated and breaks off shallow portions of rock. In rainfall-induced landslides, the slide can begin much deeper in the slope, in very-saturated layers of soil.

For both types of landslides, there are not currently methods available to estimate the probabilities of future landslides at a local, or jurisdictional, scale. Steep slopes and varied types of underlying soils can influence the likelihood of landslides. Additionally, surface and subsurface drainage patterns also affect landslide hazard, and vegetation removal can increase landslide likelihood. Future landslides are most likely to occur within and around the places where they have previously occurred.

3.4.1 Potential Impacts

The greatest risk of landslide occurring is in the mountainous regions of the Bay Area including the C-line and L-Line crossing the East Bay hills. In these areas, the BART system is sited along major freeways and is less likely to be directly impacted by landslide. However, landslides in the mountain areas could potentially impact roads needed to travel to BART.

The GIS mapping shown below shows areas with potential for land sliding and not explicit threat to BART systems. Previous assessments have identified that four miles of trackways and two facilities (LSR Substation and radio tower in Dublin) are in areas of existing susceptible landslide zones. Some assets in Berkeley area are shown to be exposed under weather-related landslide. For additional detail on landslide threats in Berkeley see the City of Berkeley LHMP.

http://www.ci.berkeley.ca.us/Mitigation/

3.4.2 Historical Events

No past known landslide events have been known to impact BART services.


LHMP: Landslide Potential (Earthquake Induced)
EGIS - Enterprise Geographic Information System
Date: 2/2/2016
Hercules
Martinez
Pittsburg
Bay Point
Pacheco
Richmond
El Sobrante
Pleasant Hill
Clayton
El Cerrito
Walnut Creek
Albany
Orinda
Lafayette
San Francisco Bay
Berkeley
Moraga
Alamo
Diablo
Emeryville
Piedmont
Danville
Oakland
San Francisco
Alameda
San Ramon
Hunters Point
San Leandro
Dublin
Daly City
South San Francisco
Hayward
Pleasanton
San Francisco Bay
San Bruno
Millbrae
Union City
Sunol
Burlingame
San Mateo
Newark
Redwood City
East Palo Alto
Legend
High Priority Asset (2)
Earthquake-Induced Landslide Hazard Zone
K:\Projects\LHMP\ArcMap_Docs\MapBook_8.5x11_P.mxd
Data provided by numerous sources:
BART, USGS, CGS, ABAG, Esri, City & County of San Francisco, Alameda County, Contra Costa County, San Mateo County, and Santa Clara County
0 1 2 4 6 Miles
Map Displayed in North American Datum 1983
State Plane California III FIPS 0403 US Feet
San Francisco Bay Area Rapid Transit District
EGIS - BART Office of the CIO
300 Lakeside Dr. 11th Floor, Oakland, CA 94612


LHMP: Landslide Potential (Weather Related)
EGIS - Enterprise Geographic Information System
Date: 2/2/2016
Hercules
Martinez
Pittsburg
Bay Point
Pacheco
Richmond
El Sobrante
Pleasant Hill
Clayton
El Cerrito
Walnut Creek
Albany
Orinda
Lafayette
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Diablo
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Danville
Oakland
San Francisco
Alameda
San Ramon
Hunters Point
San Leandro
Dublin
Daly City
South San Francisco
Hayward
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San Bruno
Millbrae
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San Mateo
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Few Landslides
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Data provided by numerous sources
BART, USGS, CGS, ABAG, Esri, City & County of San Francisco, Alameda County, Contra Costa County, San Mateo County, and Santa Clara County
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Miles
Map Displayed in North American Datum 1983 State Plane California III FIPS 0403 US Feet
San Francisco Bay Area Rapid Transit District
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3.5 Flooding

Flooding can occur from a number of sources. Near the shoreline, flooding can occur from a combination of high tide, storm surges, or tsunami (see Tsunami in Section 3.4). In low lying areas near streams or creeks, flooding can occur from riverine overflow during extreme storm events. BART is especially exposed to the threat of flooding due to the fact that many assets are at or below grade. During severe storm events, water intrusion to BART assets can occur from exposed entrances/exits and in the form of leaks from aged assets.

FEMA mapped flood plains and expected USGS predicted rainfall intensities are planned for during BART's standard design and construction process. However, elevated flood plain levels and increased rainfall during more intense storms are becoming more frequent and concentrated.

3.5.1 Potential Impacts

The hazard exposure mapping shows overlaps of the BART system to FEMA flood zones. The flood map shows a number of assets are in areas subject to flooding either in the 100- or 500 year FEMA flood plain zones.

Potential impacts are challenging to estimate without incorporating knowledge of existing protections, asset-specific elevations, and drainage capacity. However, wet weather is known to cause delays in the BART system and is expected to be an ongoing challenge.

A past study for the four-station extension to San Francisco International Airport identified that water levels from a 100-year storm in Colma Creek running through South San Francisco could potentially flood the South San Francisco station.

3.5.2 Historical Events

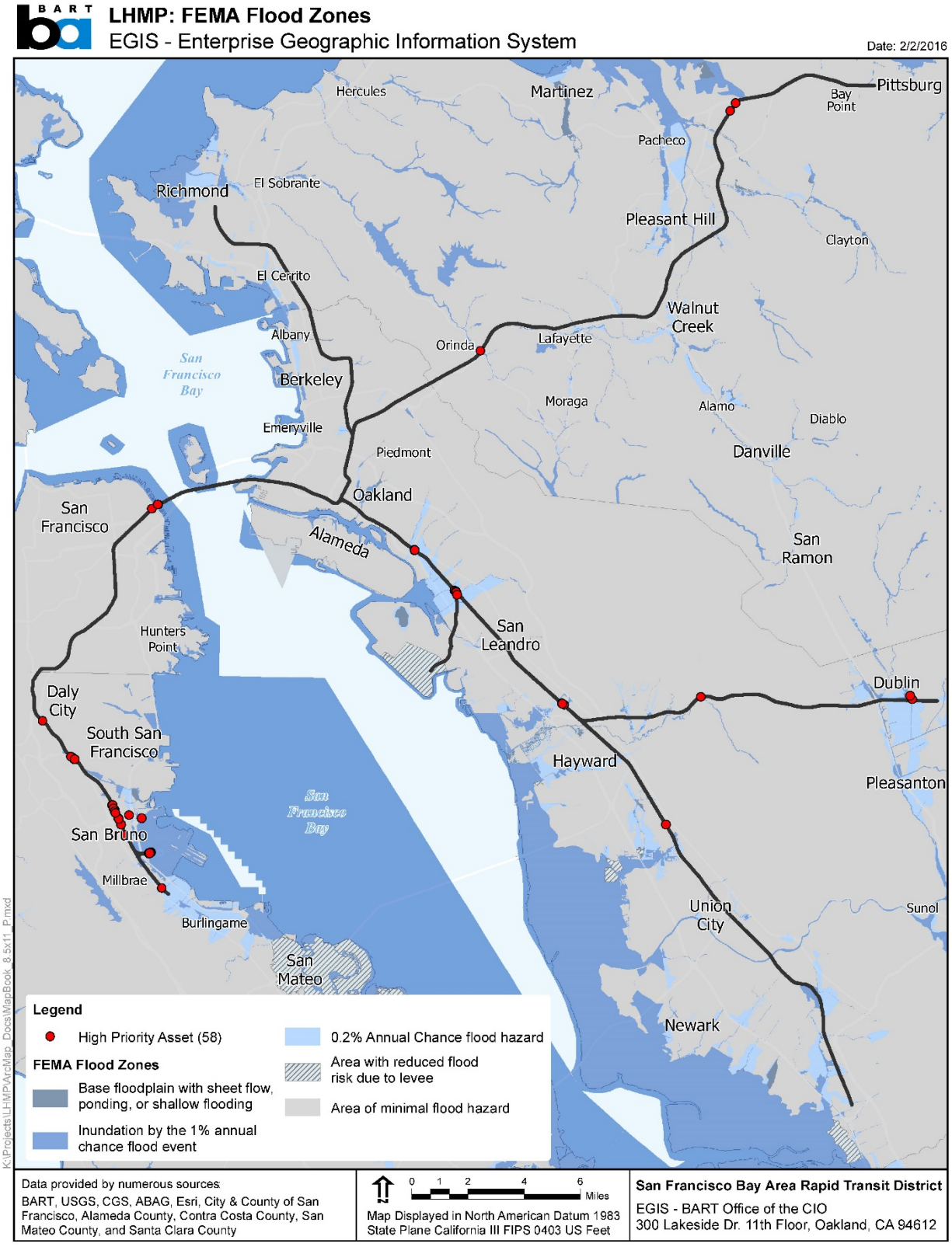
There are no major historical events related flooding that are noteworthy to report. But smaller episodes of rain events causing BART delays do occur in the winter months. The following is a sample of water-related weather events that have cause delays in November/December of 2014.

October 25, 2014 – Water intrusion in San Leandro impaired train control equipment. 53 trains were delayed up to 5-20 minutes.

October 30, 2014 – Water intrusion in San Leandro caused loss of routing control & indications. 64 trains were delayed up to 5-38 minutes.

December 11, 2014 – San Bruno Station flooded due to drain problem. 20 trains were delayed up to 15 minutes.

December 11, 2014 – Reduced train speeds due to wet tracks. 78 trains were delayed up to 5-20 minutes.


LHMP: FEMA Flood Zones
EGIS - Enterprise Geographic Information System
Date: 2/2/2016
Hercules
Martinez
Pittsburg
Bay Point
Pacheco
Richmond
El Sobrante
Pleasant Hill
Clayton
El Cerrito
Walnut Creek
Albany
Orinda
Lafayette
San Francisco Bay
Berkeley
Moraga
Alamo
Diablo
Emeryville
Piedmont
Danville
Oakland
San Francisco
Alameda
San Ramon
Hunters Point
San Leandro
Dublin
Daly City
South San Francisco
Hayward
Pleasanton
San Bruno
Millbrae
Burlingame
Union City
Sunol
San Mateo
Newark
Legend
High Priority Asset (58)
FEMA Flood Zones
Base floodplain with sheet flow, ponding, or shallow flooding
Inundation by the 1% annual chance flood event
0.2% Annual Chance flood hazard
Area with reduced flood risk due to levee
Area of minimal flood hazard
Data provided by numerous sources:
BART, USGS, CGS, ABAG, Esri, City & County of San Francisco, Alameda County, Contra Costa County, San Mateo County, and Santa Clara County
0 1 2 4 6 Miles
Map Displayed in North American Datum 1983 State Plane California III FIPS 0403 US Feet
San Francisco Bay Area Rapid Transit District
EGIS - BART Office of the CIO
300 Lakeside Dr. 11th Floor, Oakland, CA 94612
K:\Projects\LHMP\ArcMap_Docs\MapBook_8.5x11_P.mxd

3.6 Sea Level Rise

Sea level rise (SLR) has the potential to increase the frequency and severity of coastal, riverine and localized nuisance flooding. In particular, without intervention rising sea levels may cause more frequent and longer flooding of existing flood-prone areas, shoreline erosion, elevate groundwater, and permanent inundation in the coastal zones. Sea level is projected to rise 16 inches by mid-century (Year 2050), and 55 inches by end of century (Year 2100).

As sea levels rise, groundwater and salinity levels are also predicted to rise. This will increase the risk of salt water intrusion into below grade assets including sensitive electrical/mechanical equipment. In addition, increasing groundwater levels may increase liquefaction susceptibility, and may increase the need for routine flood management activities.

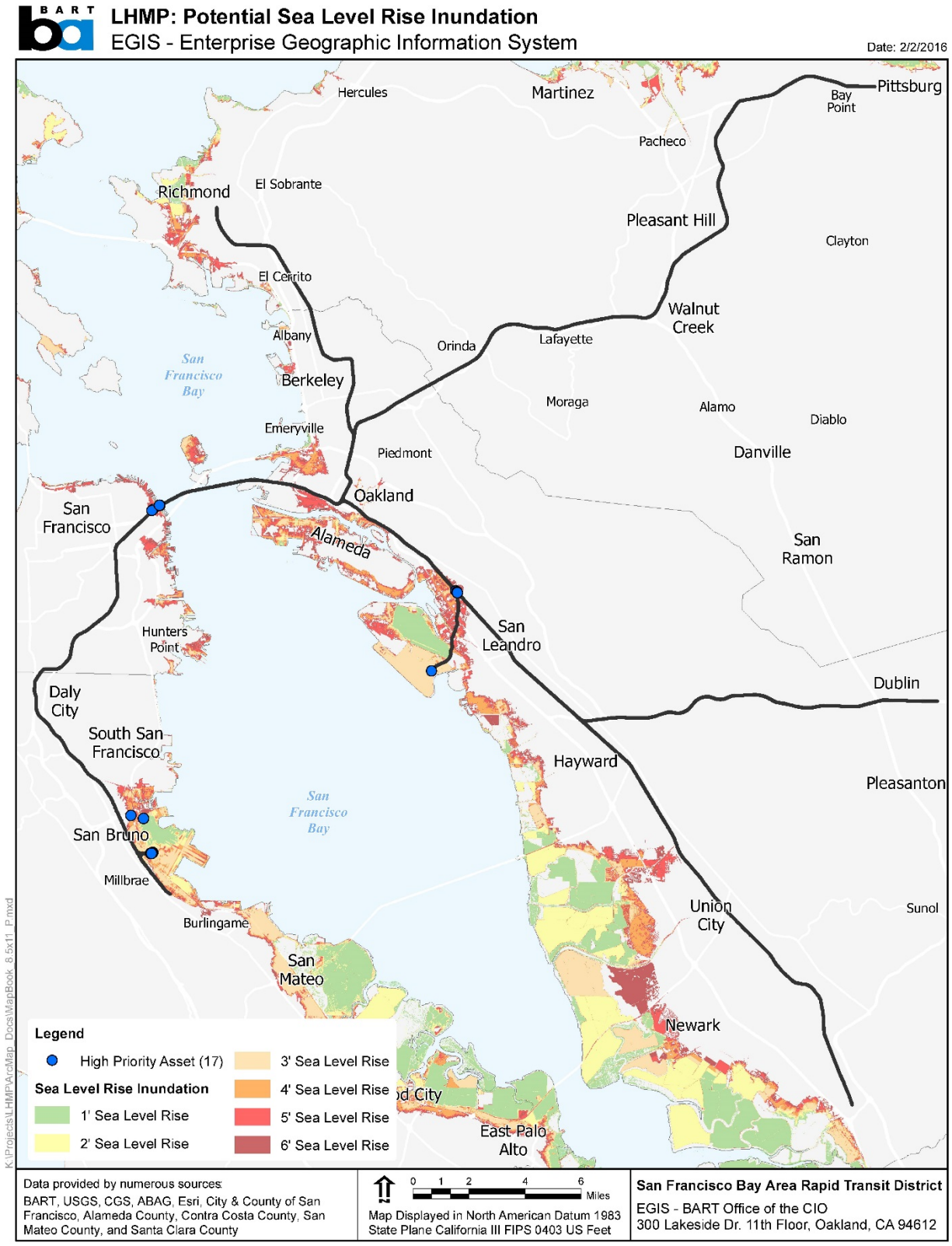
3.6.1 Potential Impacts

There are numerous exposed areas identified by the hazard exposure mapping as affected by 36 inches of SLR and higher. The greatest exposures include the W-line and Y-line around the San Francisco International Airport and the Oakland Airport Connector at the Oakland International Airport. Both the San Francisco Airport and Port of Oakland are aware of the low-lying conditions of these areas and are doing extensive work to address these risks and enhance existing shoreline protections.

The hazard exposure map illustrating projected sea-level rise in the Bay Area is provided below.

3.6.2 Historical Events

SLR has not caused major events in the BART system at this time. Increases to storm intensities have caused drainage issues however, which is expected to continue and be accelerated.


LHMP: Potential Sea Level Rise Inundation
EGIS - Enterprise Geographic Information System
Date: 2/2/2016
Hercules
Martinez
Pittsburg
Bay Point
Pacheco
Richmond
El Sobrante
Pleasant Hill
Clayton
El Cerrito
Walnut Creek
Albany
Orinda
Lafayette
San Francisco Bay
Berkeley
Moraga
Alamo
Diablo
Emeryville
Piedmont
Danville
Oakland
San Francisco
Alameda
San Ramon
Hunters Point
San Leandro
Dublin
Daly City
South San Francisco
Hayward
Pleasanton
San Bruno
Millbrae
Union City
Sunol
Burlingame
San Mateo
Newark
East Palo Alto
Legend
High Priority Asset (17)
Sea Level Rise Inundation
1' Sea Level Rise
2' Sea Level Rise
3' Sea Level Rise
4' Sea Level Rise
5' Sea Level Rise
6' Sea Level Rise
K:\Projects\LHMP\ArcMap_Docs\MapBook_8.5x11_P.mxd
Data provided by numerous sources:
BART, USGS, CGS, ABAG, Esri, City & County of San Francisco, Alameda County, Contra Costa County, San Mateo County, and Santa Clara County
0 1 2 4 6 Miles
Map Displayed in North American Datum 1983 State Plane California III FIPS 0403 US Feet
San Francisco Bay Area Rapid Transit District
EGIS - BART Office of the CIO
300 Lakeside Dr. 11th Floor, Oakland, CA 94612

3.7 Wildfire

Wildfires are fires that rage out of control and are common to wildland settings, such as forests and regions with little rainfall, where there is combustible vegetation. Wildfires occur when a 'fire triangle' is met; that is, when there is heat, fuel and an oxidizing agent such as oxygen. Such events, while typically small at its inception, spread rapidly, igniting nearby vegetation and buildings. Their danger lies in its speed, ability to change directions unexpectedly and jump gaps (e.g. rivers, roads). They can be naturally-occurring or human-caused.

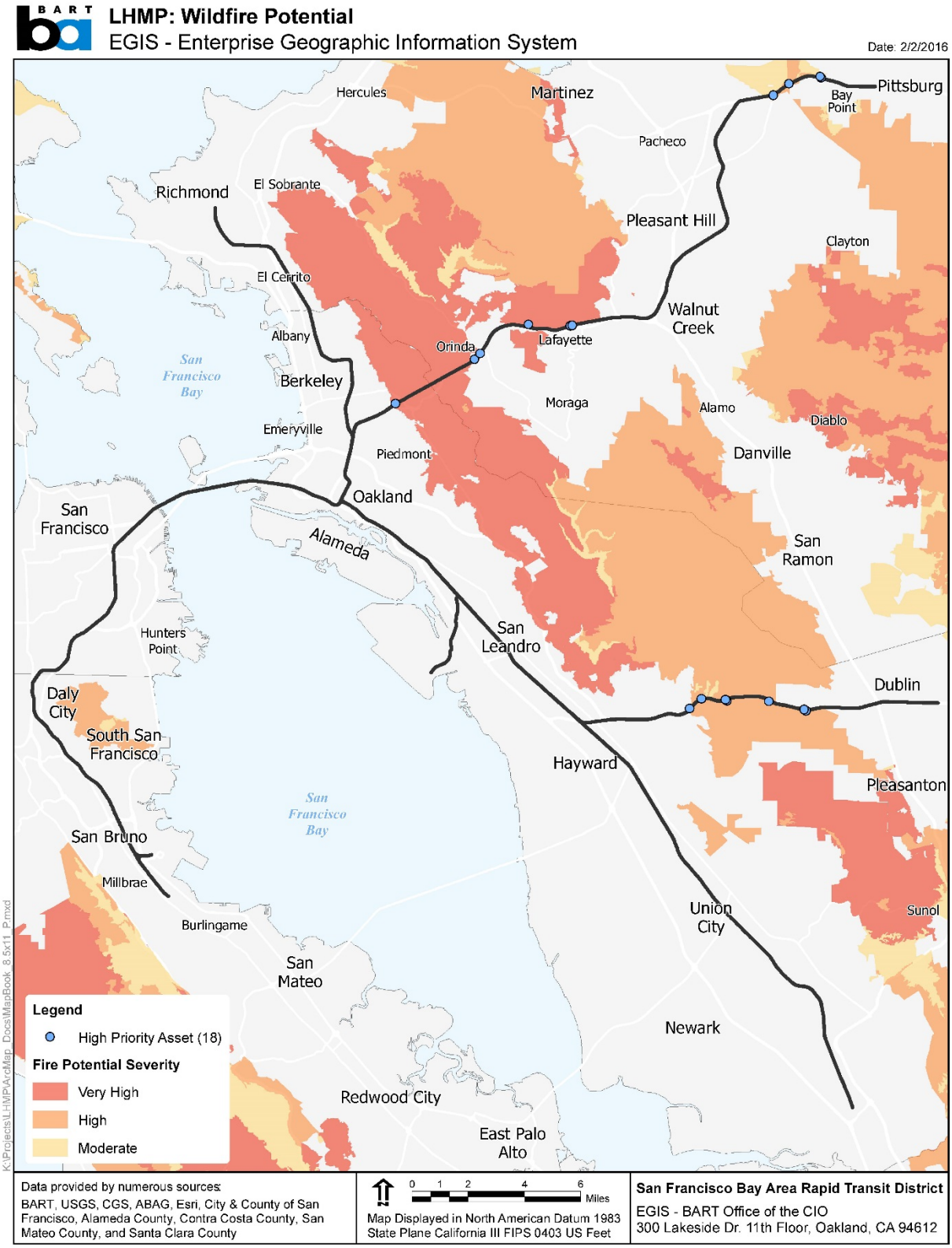
3.7.1 Potential Impacts

Wildfire does not present a major threat impacting BART services. The greatest risk to wildfire is in the mountainous regions along the Pittsburg/Bay Point and Dublin/Pleasanton lines. However, on these lines, BART is sited alongside the freeway providing buffer to wildfire exposure. In addition, there is limited amounts of vegetation adjacent to BART's Right-of-Way and the vegetation that do exists are in small isolated patches. Drought conditions such as those currently experienced in 2014, 2015, and 2016 can heighten the risk of urban wildland interface fires.

3.7.2 Historic Events

BART service was interrupted for only a short period (less than 24 hours) for replacement of a short stretch of kinked rails during the worst urban wildfire in the Bay Area history, the Oakland Hills fire of 1991.

The hazard exposure map illustrating wildfire exposure to BART assets is provided below.


LHMP: Wildfire Potential
EGIS - Enterprise Geographic Information System
Date: 2/2/2016
Hercules
Martinez
Pittsburg
Bay Point
Pacheco
Richmond
El Sobrante
Pleasant Hill
Clayton
El Cerrito
Walnut Creek
Albany
Orinda
Lafayette
San Francisco Bay
Berkeley
Moraga
Alamo
Diablo
Emeryville
Piedmont
Danville
Oakland
San Francisco
Alameda
San Ramon
Hunters Point
San Leandro
Dublin
Daly City
South San Francisco
Hayward
Pleasanton
San Bruno
Millbrae
Union City
Sunol
Burlingame
San Mateo
Newark
Redwood City
East Palo Alto
Legend
High Priority Asset (18)
Fire Potential Severity
Very High
High
Moderate
K:\Projects\LHMP\ArcMap_Docs\MapBook_8.5x11_P.mxd
Data provided by numerous sources:
BART, USGS, CGS, ABAG, Esri, City & County of San Francisco, Alameda County, Contra Costa County, San Mateo County, and Santa Clara County
0 1 2 4 6 Miles
Map Displayed in North American Datum 1983 State Plane California III FIPS 0403 US Feet
San Francisco Bay Area Rapid Transit District
EGIS - BART Office of the CIO
300 Lakeside Dr. 11th Floor, Oakland, CA 94612

3.8 Drought

A drought is characterized as a period of below-average precipitation in a particular region which culminates in water supply shortages. Such storages may be surface or ground level. Duration of droughts can very significantly, from as little as two weeks to several years.

3.8.1 Potential Impacts

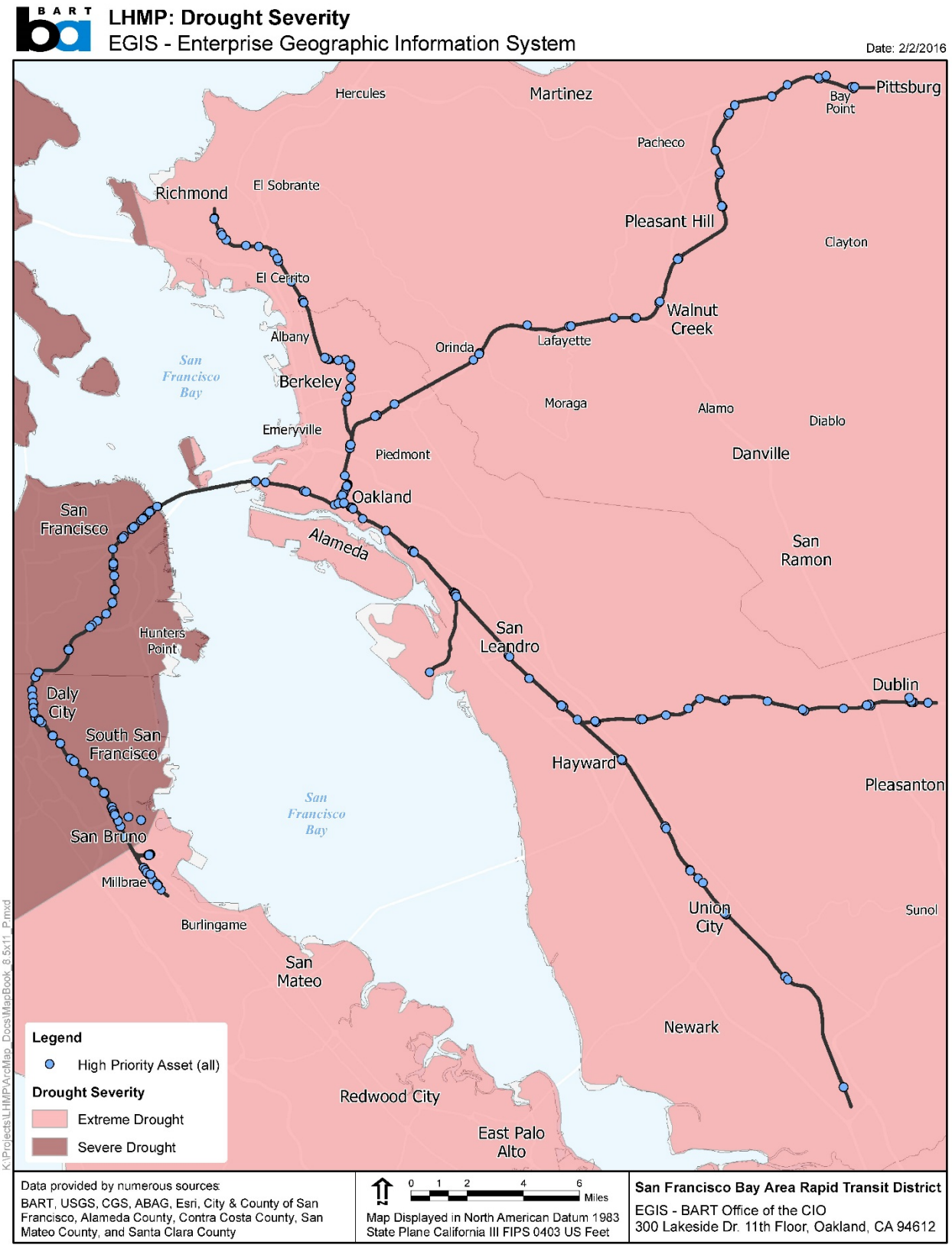
Drought has a lower impact on BART operation. When drought conditions do occur, BART can curtail use of water for such purposes as station cleaning, washing trains, and landscape irrigation. However, severe drought in the Bay Area can increase risk of other hazards such as wildfires. At minimum, the District requires a water supply in order to support fire protection of the system.

3.8.2 Historic Events

The State of California has suffered the driest drought in the history of the state, with the governor calling for a State of Emergency on January 17, 2014. At present, the State continues to operate under a declared drought State of Emergency.

The District has been responsive to the call to action for water conservation. BART operations have reduced water use in maintenance and irrigation. The District has reduced the train washing schedule and some cleaning processes have been transitioned to use dry ice instead of water.

The hazard exposure map provided below illustrates areas impacted by drought.


LHMP: Drought Severity
EGIS - Enterprise Geographic Information System
Date: 2/2/2016
Hercules
Martinez
Pittsburg
Bay Point
Pacheco
El Sobrante
Richmond
Pleasant Hill
Clayton
El Cerrito
Walnut Creek
Albany
Orinda
Lafayette
San Francisco Bay
Berkeley
Moraga
Alamo
Diablo
Emeryville
Piedmont
Danville
Oakland
San Francisco
Alameda
San Ramon
Hunters Point
San Leandro
Dublin
Daly City
South San Francisco
Hayward
Pleasanton
San Bruno
Millbrae
Union City
Sunol
Burlingame
San Mateo
Newark
Redwood City
East Palo Alto
Legend
High Priority Asset (all)
Drought Severity
Extreme Drought
Severe Drought
K:\Projects\LHMP\ArcMap_Docs\MapBook_8.5x11_P.mxd
Data provided by numerous sources:
BART, USGS, CGS, ABAG, Esri, City & County of San Francisco, Alameda County, Contra Costa County, San Mateo County, and Santa Clara County
0 1 2 4 6 Miles
Map Displayed in North American Datum 1983 State Plane California III FIPS 0403 US Feet
San Francisco Bay Area Rapid Transit District
EGIS - BART Office of the CIO
300 Lakeside Dr. 11th Floor, Oakland, CA 94612

3.9 Extreme Heat

The Bay Area, especially the parts further away from the coast and bay, can experience extreme heat days, where the Heat Index, a function of heat and relative humidity, is high. Extreme heat days pose a public health threat, causing symptoms such as exhaustion, heat cramps, and sunstroke if the Heat Index is over 90° F. The National Weather Service has developed a Heat Index Program Alert which gets triggered when high temperatures are expected to exceed 105° to 110° for at least two consecutive days. Heat emergencies occur when residents are subject to heat exhaustion and heatstroke, and are more likely to occur in areas not adapted to heat and without air conditioning, cooling centers, or vegetation to mediate heat impacts in exposed areas. Certain populations are typically the most at risk during extreme heat emergencies, including people with disabilities, chronic diseases, the elderly, and children.

Climate change is expected to generate an increase in ambient average air temperature, particularly in the summer. The outer Bay Area will likely experience greater temperature increases than coastal or bayside jurisdictions, though likely not as great as in the eastern-most inland communities. The frequency, intensity, and duration of extreme heat events and heat waves are also expected as regional climate impacts. According to California Climate Change Center, by mid-century, extreme heat in urban centers could cause two to three times more heat-related deaths than occur today. Statewide, temperatures could increase anywhere from 3 to 10.5° depending on CO2 emission levels, leading to more frequent, hotter days throughout the year.

3.9.1 Potential Impacts

Extreme heat events have the potential to severely impact BART service. Increases in overall temperatures strain the regional power network and could lead to more frequent PG&E brown-outs resulting in service delays within the system. In addition, extreme heat can cause BART's own electrical systems to overheat which would impact delivery to the third rail and stations. Air conditioning systems can become strained and lead to failure.

Heat waves could impact patron and employee health and safety particularly among vulnerable populations.

In other transit agencies, extreme heat has caused rail buckling. Rail buckling is not a known issue at BART.

3.10 Terrorism

Terrorism is the calculated use of unlawful violence or threat of unlawful violence to inculcate fear; intended to coerce or to intimidate governments or societies. Terrorism is a criminal act that draws attention of the local populace, the government and the world to their cause.

BART is a transit industry leader in security. As of FY16, BART has a police department with over 300 employees. BART police maintain police presence patrolling inside stations and on trains and responding to emergencies quickly. Protection measures such as alarm systems, video surveillance, and intrusion prevention, support a secure BART infrastructure. In addition, the District maintains an "eyes and ears" public awareness campaign to encourage patrons to report unattended packages or suspicious behavior.

4 Mitigation Strategy

4.1 Mitigation Goal

The mitigation goal of the Plan is to maintain and enhance a disaster-resilient District by reducing the potential for loss of life, property damage, and environmental degradation from natural disasters, while supporting economic recovery from such disasters. This goal is unchanged from the previous plan and continues to be the goal of BART in designing its mitigation program.

4.2 Mitigation Actions

The Core Team reviewed existing mitigation measures identified in the previous plan and supplemented these with mitigation measures based on identified needs and current emergency preparation practices.

Prioritization of mitigation actions was established using a voting method and commentary support from the EPTFC and the Title VI committee. Support of each proposed mitigation strategy was determined based on the alignment of each strategy with the following priorities:

1. Mitigation goal
2. Hazard exposure reduction
3. Public and political support
4. Environmental benefit
5. Cost to benefit value
6. Funding availability
7. Timeline for completion

Thirty two actions were identified and prioritized through this process. “High” (6-9 votes), “Medium” (4 or 5 votes), and “Low” (1-3 votes) rankings reflect the District priorities and current needs. All actions identified are important; “Low” does not necessarily mean that the action is not important but that it is holds a lower rank relative to other actions identified. “Ongoing” actions emphasize activities that are currently being implemented and continue to be implemented in the five-year Plan period. Actions that did not receive votes in this process were excluded from the Plan.

4.2.1 General Hazard Mitigations

Code	Strategy	Description	Priority
GN-1	BART Emergency Plan Update	Integrate climate change considerations into BART's Emergency Plan	Low
GN-3	Asset Management Integration	Include Climate Risk Management into Asset Management Plan	Low
GN-4	Climate Risk of Projects	Incorporate best available climate risk data in projects	Ongoing
GN-5	Assess Critical BART Facilities	Improve the assessment vulnerability of critical facilities to damage in natural disasters or security threats, including systems, utilities, and facilities that can impact service delivery.	Low
GN-7	Emergency Power	Increase emergency power generation capacity (or have rental/lease agreements for these generators) in critical locations to maintain continuity of BART services.	Low
GN-8	Power Resilience	Minimize the likelihood that power interruptions will adversely impact lifeline utility systems or critical facilities by ensuring they have adequate back-up power.	Medium
GN-9	Public Planning Materials	Improve communication to the public related to family and personal planning for delays due to transit system disruption, due to disasters.	Medium
GN-10	Portable Backup	Maintain portable equipment (such as hoses, pumps, emergency generators, or other equipment) to allow for continuity and recovery of service in locations and/or assets prone to failure.	High
GN-11	Retrofit critical infrastructure	Retrofit or replace critical lifeline infrastructure facilities and/or their backup facilities that are shown to be vulnerable to damage in natural disasters.	Medium
GN-14	Emergency Operations Center	Designate and establish a back-up Emergency Operations Center with redundant communications systems.	High
GN-16	Emergency Response Training	Incorporate ICS & NIMS emergency response training for employees.	Ongoing

4.2.2 Earthquake Mitigations

Code	Strategy	Description	Priority
EQ-1	Seismic Retrofit	Continue ongoing seismic infrastructure retrofit of the BART system.	Ongoing
EQ-5	Prepare Safe Evacuation	Improve training to workers in critical facilities and emergency personnel, as well as communication to the public with regard to safe evacuation protocols or safety procedures in the event of a natural disaster.	High
EQ-6	Waterproof Transbay Tube	Upgrade the Transbay Tube with waterproof lining to preserve the structure from flooding in the event of an earthquake. Waterproof tunnel with a combination of steel plating, rubber, and concrete. (09AU-120)	High

4.2.3 Tsunami Mitigations

Code	Strategy	Description	Priority
TS-5	Identify/Protect Critical Facilities	Identify critical assets prone to flood with most recent FEMA data and elevate/protect those to lower the risk of service disruption.	Low
TS-6	Flood Safe Utilities	Ensure that utility systems in new developments are constructed in ways that reduce or eliminate flood damage.	Ongoing

4.2.4 Landslide Mitigations

Code	Strategy	Description	Priority
LS-3	Advocate for minimum Fire-related erosion	For adjacent cities and counties, advocate that fire-preventive vegetation-management techniques and practices for creek sides and high-slope areas do not contribute to the landslide and erosion hazard.	Low
LS-8	Erosion-related Building Code	Comply with all applicable facility standards with respect to landslides and erosion prevention in existing and future developments, such as those appearing in the BART Facilities Standards and California Building Code. Examples of those standards include excavation, fill placement, cut-fill transitions, slope stability, drainage and erosion control, slope setbacks, expansive soils, collapsible soils, environmental issues, geological and geotechnical investigations, grading plans and specifications, protection of adjacent properties, and review and permit issuance.	Ongoing

4.2.5 Flooding Mitigations

Code	Strategy	Description	Priority
FL-1	Watershed Analysis	Conduct (or partner with the local watershed jurisdiction to conduct) a watershed analysis of runoff and drainage systems to predict areas of insufficient capacity in the storm drain and natural creek system.	Low
FL-2	Storm Drainage Repair	Continue to repair and make structural improvements to storm drains, pipelines, and/or channels to enable them to perform to their design capacity in handling water flows as part of regular maintenance activities. (This strategy has the secondary benefit of addressing fuel, chemical, and cleaning product issues.)	Ongoing
FL-3	Construct Resilient Utility Systems	Ensure that utility systems in BART developments are constructed in ways that reduce or eliminate flood damage.	Ongoing
FL-4	Work with Local Agencies	Recognize that a multi-agency approach is needed to mitigate flooding by having flood control districts, cities, counties, and utilities meet at least annually to jointly discuss their capital improvement programs for most effectively reducing the threat of flooding. Work toward making this process more formal to insure that flooding is considered at existing joint-agency meetings.	Low
FL-9	Sandbags and Sheeting	Maintain on-hand sandbags and plastic sheeting in anticipation of rainstorms, and deliver those materials to key BART sites.	Ongoing

4.2.6 Sea Level Rise Mitigations

Code	Strategy	Description	Priority
SL-1	Best Available Science	Stay informed of scientific information compiled by regional and state sources on the subject of rising sea levels and global warming, especially on actions that local governments can take to mitigate this hazard including special design and engineering of facilities in low-lying areas.	Ongoing
SL-2	Buffer Zones	Encourage new development near floodways to incorporate a buffer zone or setback from that floodway to allow for changes in storm water flows in the watershed over time.	Medium
SL-5	Promote Low-Carbon Travel	Promote transit and active modes of transportation to transit such as biking and walking to reduce the region's carbon footprint.	Ongoing

4.2.7 Wildfire Mitigations

Code	Strategy	Description	Priority
WF-1	Fire Suppression Water	Ensure a reliable source of water for fire suppression (meeting acceptable standards for minimum volume and duration of flow) for existing and new development.	Ongoing
WF-2	Fire Code Compliance	Continue to comply with state and local fire codes and standards for all facilities including providing adequate access roads, onsite fire protection systems, evacuation signage, and fire breaks.	Ongoing
WF-6	Water Distribution System	Ensure water distribution systems on BART facilities are functional and make repairs as necessary. Work with fire jurisdictions and water supply agencies to identify improvements to the water distribution system and advocate for improvements to ensure resiliency in the water system.	Ongoing
WF-8	Fire Safety Inspections	Continue conducting periodic fire-safety inspections of all BART owned buildings.	Ongoing

4.2.8 Drought Mitigations

Code	Strategy	Description	Priority
DR-1	Increase Water Efficiency	Evaluate and implement opportunities to increase water efficiency in water fixtures, wash facilities, and irrigation.	Ongoing
DR-3	Investigate High Usage Facilities	Track the water use of each facility and investigate facilities that have high water usage.	Ongoing
DR-4	Irrigation and Landscape Improvements	Prioritize irrigation and landscape improvements that will help the district to reduce maintenance hours and conserve water.	Low

4.3 Existing Mitigation Programs and Resources

The following are the District's authorities, policies, programs and activities that support efforts to mitigate hazards.

4.3.1 National Flood Insurance Program

As a transit agency BART is not eligible to participate in the National Flood Insurance Program (NFIP). BART is however engaged in numerous other efforts to reduce flood exposure of the critical system assets.

4.3.2 Emergency Preparedness Program

The District operates an Emergency Preparedness Program that provides employees with training, tools, and resources to prepare the District in restoration of critical infrastructure and essential service in a safe and timely manner in emergency situations.

4.3.3 Earthquake Safety Program

The Earthquake Safety Program is tasked with upgrading vulnerable portions of the original BART system to ensure safety for the public and BART employees. Portions of the original system with the highest traffic are being upgraded not only for life safety but also to ensure that they can return to operation shortly after a major earthquake. The upgrades will be accomplished by using the latest seismic standards to improve the structural integrity of BART facilities. Completion of all earthquake upgrades is expected by 2022.

The Earthquake Safety Program addresses the original BART system completed between 1972 and 1976, with a service area spanning three counties-Alameda, Contra Costa and San Francisco. System extensions, built mostly during the 1990s, employed more stringent and up-to-date seismic criteria than the original system, and thus do not require upgrades. The original BART system includes the following elements:

- 74 miles of track
- 34 stations (11 elevated, 14 subway and 9 at-grade)
- The Transbay Tube
- The Berkeley Hills Tunnel
- Train maintenance yards
- Terminal, operations and administration facilities
- Power, mechanical, train control and communications equipment

The original Earthquake Safety Program budget is $1.307 billion. The current funding sources include:

- $125 million from California Department of Transportation Local Seismic Safety Retrofit Program
- $143 million from Regional Measure 2 (RM2), State Transportation Improvement Program (STIP), Prop 1B
- $11.5 million from Transportation Congestion Relief Program (TCRP)
- $3 million from FEMA Pre-Disaster Mitigation Program
- $980 million from General Obligation Bonds (Regional Measure AA)
- $60 million from other Funds

4.3.4 Water Intrusion Program

The Water Intrusion Program is a rehabilitation program to address water leaks. Water leaks are caused by infrastructure degradation from structural fatigue, environmental impacts, materials performance, and high rates of usage in actual operating conditions. The following are the Program efforts:

- Water intrusion mitigation for the Pleasant Hill station was completed in 2012.
- BART addressed water intrusion at the concourse level of the Powell St station.
- BART is working to address station train control rooms in its next phase.

In 1997, BART converted most of the M line sumps from column type to submersible pumps and standardized the controllers to Warrick controllers. There were/are specific cases that remained as column, split case, etc type of pumps. Most of these pumps were designed for 20 year life and thus we are currently going through a round of purchases so that BART maintenance staff can replace the existing pumps that are approaching the 20 year mark. As for the actual sumps, most of them are concrete structures buried in the ground and would not normally need replacing.

There have been a variety of designs put forward to expand the pumping system to attempt to address large scale flooding. The current system is designed to address standard rain water intrusion, minor structure leakage and water removal in the event of a fire in the tunnel. These systems are fully redundant and based on two 250 gpm fire hose streams for a total of 500 gpm. Being a fully redundant system, the system as designed should be able to handle 1000 gpm at any time.

Recent proposals look to provide a pumping system piggybacked on the existing system that could move around 5000 gpm. This system will add sumps and various pumps and piping to the M line to move flood water from the low points of tube 24 and 38 to the vent structures at Oakland and San Francisco where the water would be discharged. Since this proposed emergency flooding pumping system is 10 times the size of the current pumping system it will not likely be useful during normal operations.

4.3.5 Annual Winterization

On an annual basis, the BART Operating Departments engage in preparatory efforts to ready the system for the rainy season. These activities include:

1. Cleaning and flushing right of way, station and shop culverts and drains.
2. Cleaning Station and Shop Facility Gutters
3. Patching and repairing roofs at Stations, Traction Power Substations, Train Control Hut, Shops and Yard facilities
4. Testing and make necessary repairs to elevator, escalator and station sump pumps
5. Trimming trees and bushes that could create a potential hazards
6. Securing backup generators and staging them at vital locations

7. Reviewing procedures for deployment of staff to critical areas for 'Storm Watch' during periods of heavy rain and high wind
8. Reviewing protocols with for response to mutual problems with MUNI.
9. Reviewing System Service protocols for response to flooding and wet conditions at stations
10. Inventorying and ordering materials to ensure necessary maintenance materials will be readily available.
11. Ensuring that maintenance vehicles are properly stocked to respond to weather related issues
12. Designating vehicles that will always have a generator hitched to it for quicker response
13. Reconfirming protocol, providing training and performing increased inspections for debris management and flood avoidance.
14. Identifying flood risks and per staging sand bags
15. Ensuring adequate inventory of emergency supplies in stations and facilities
16. Ordering large floor mats to be installed as necessary to mitigate slip and fall risk
17. Leak inspections of all rooms during first rains.

4.3.6 Sustainability Program

The District has had long history in advancing sustainability. In 2003, the District adopted its first sustainability policy that directs the District to integrate best practices in sustainability in the organization. In 2016, the District is formalizing its sustainability program and defining more clearly its program objectives. Three aspects of the program which that relate directly to the Plan are water conservation, GHG mitigation, and extreme weather adaptation.

BART has been active in conserving water is continually investigating and evaluating opportunities for water savings. BART has been California is facing a significant drought since 2014. The governor of California has called for a 20 percent voluntary reduction in water use across the State. In response to the drought, The District has modified the train wash schedule from a 4-day to an 8-day cycle cutting wash water usage by as much as 50%. In addition, the District has reduced irrigation schedules by 66% in response to the drought.

BART has been responding to climate change for nearly a decade, instigated by the 2006 passage of California's AB32, which set a reduction target of 1990 emission levels by 2020, and required adoption of reduction measures by 2011. In one of the first steps to understand the impact of AB32 and California's emerging carbon market, BART conducted its first GHG inventory in 2007. BART has made shifts in its energy by evaluating opportunities for procurement of renewable energy sources. In addition, the District has installed solar photovoltaic systems at multiple facilities in effort to curtail GHG emissions.

BART is taking proactive steps to assess climate change impacts. In 2012, BART took its first step by conducting a climate change adaptation assessment looking at water-related climate change impacts including sea level rise, flooding, and heavy downpours.

4.3.7 Plan Integration

This plan is part of an ongoing process to build a disaster-resilient BART. BART will include a review for incorporating the plan considerations into capital improvement plans and budget. BART has, and will continue to use, a variety of project-specific mechanisms to ensure that the projects and mitigation strategies identified as existing or having relatively high priorities in this Plan are implemented.

In addition, the Plan components will assist the Emergency Preparedness Program and related planning activities.

5 Plan Review, Evaluation and Implementation

5.1 Plan Update

This Plan is an update from the 2011 plan. The lead in updating this Plan was taken by the Core Team members represented by the Office of District Architect, Emergency Management, and Civil Engineering.

As required by the Disaster Mitigation Act of 2000, BART will update this plan at least once every five years. In this update, the followings sections have been revised to better reflect actions pertinent to the BART system

- The Planning Process section has been redefined to reflect the departure from participation in a multijurisdictional plan.
- The Hazard and Risk Assessment section has been updated to incorporate the new mapping compiled by ABAG for the region. Specific information on BART has also been updated to reflect additional engineering studies, institutional understanding of assets and progress of mitigation activities that have occurred in the past five years, including seismic retrofitting.
- The Asset Profile Section has been developed to provide more granular understanding of the District's assets and make more concrete the potential impacts from hazards.
- Mitigation Actions have been updated to reflect changes in priorities
- Existing Mitigation Program have been updated to reflect changes in development and progress in local mitigation efforts.

6 Plan Adoption

6.1 Adoption

The BART Board will adopt the plan in a public meeting via an official Resolution upon pre-approval by FEMA. The mitigation strategies will be integrated into the Emergency Operations and Capital Improvement Plans of BART.

7 Plan Point of Contact

Point of Contact

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Telephone:	510.464.6448
Email:	tjohnso@bart.gov

Appendix A

BART System Overview

A1 BART System Overview

A1.1 BART System

Approximately one-third of the BART System is underground, one-third is aerial and one-third is at grade. Service patterns are largely dictated by the topography of the region. Lines run along the east and west sides of the San Francisco Bay, under San Francisco Bay and then traverse the hills and valleys of inland areas.

The BART system radiates from the Oakland Wye, which is located under downtown Oakland. Lines running west from the Wye travel under San Francisco Bay, through downtown San Francisco and terminate at Daly City, Millbrae or the San Francisco International Airport. Other lines radiate out from the Oakland Wye and terminate in Richmond, Pittsburg/Bay Point, Dublin/Pleasanton or Fremont. A second wye is located on the San Francisco Peninsula between the San Bruno station, the Millbrae station and the San Francisco International Airport station. In addition to the two wyes, merges and diverges also occur at two other locations in Alameda County.

For an interactive version of the map below, see http://www.bart.gov/stations/closest.aspx.

Figure 12 BART System Map

A1.2 BART Service

As of June 30, 2012, the District owned 669 rail cars. Trains are from three to ten cars in length and contain one control equipped vehicle (an A-car or C-car) at each end with mid-train vehicles (B-cars or C cars) making up the remainder of each train. Control-equipped C-cars can be used as lead, mid-train, or trail vehicles. All station platforms are constructed to accommodate trains of up to ten cars. Trains are operated from the lead A-car or C-car. Computers located along the right of way automatically control train movements. BART System train supervision is provided by the BART train control computer located at the BART Operations Control Center at the Lake Merritt station. Should the need arise, train operators aboard each train may override the automatic system. The District's 669 car operating fleet currently consists of 59 A-cars, 380 B-cars and 150 C-1 cars, and 80 C-2 cars.

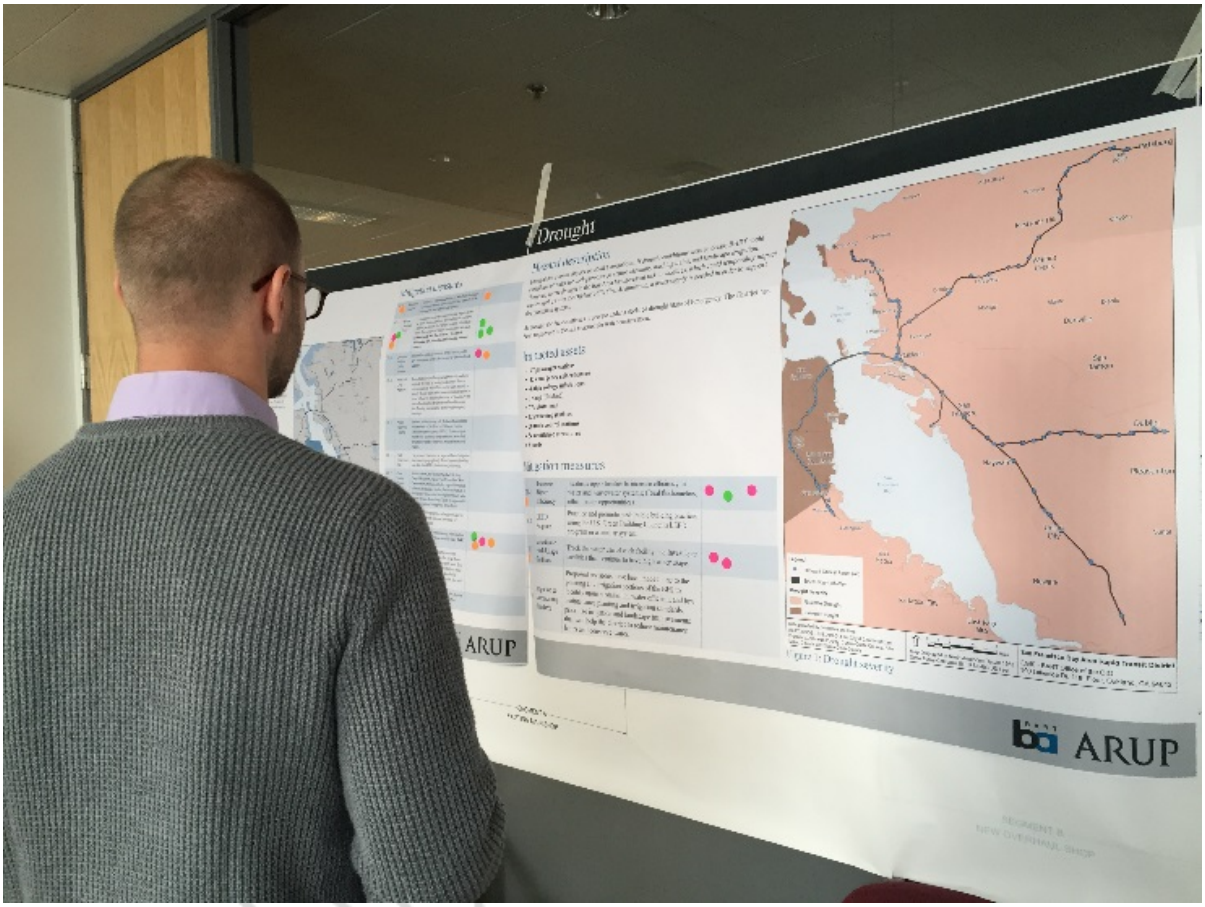
BART revenue hours run from 4:00 a.m. to midnight Monday through Friday, 6:00 a.m. to midnight on Saturdays, and 8:00 a.m. to midnight on Sundays. The last trains depart each end of the line around midnight, so passengers can get anywhere in the BART system if they arrive at any station by midnight. Depending upon demand, holiday rail service is provided on a full or modified weekday schedule, a Saturday schedule or a Sunday schedule.

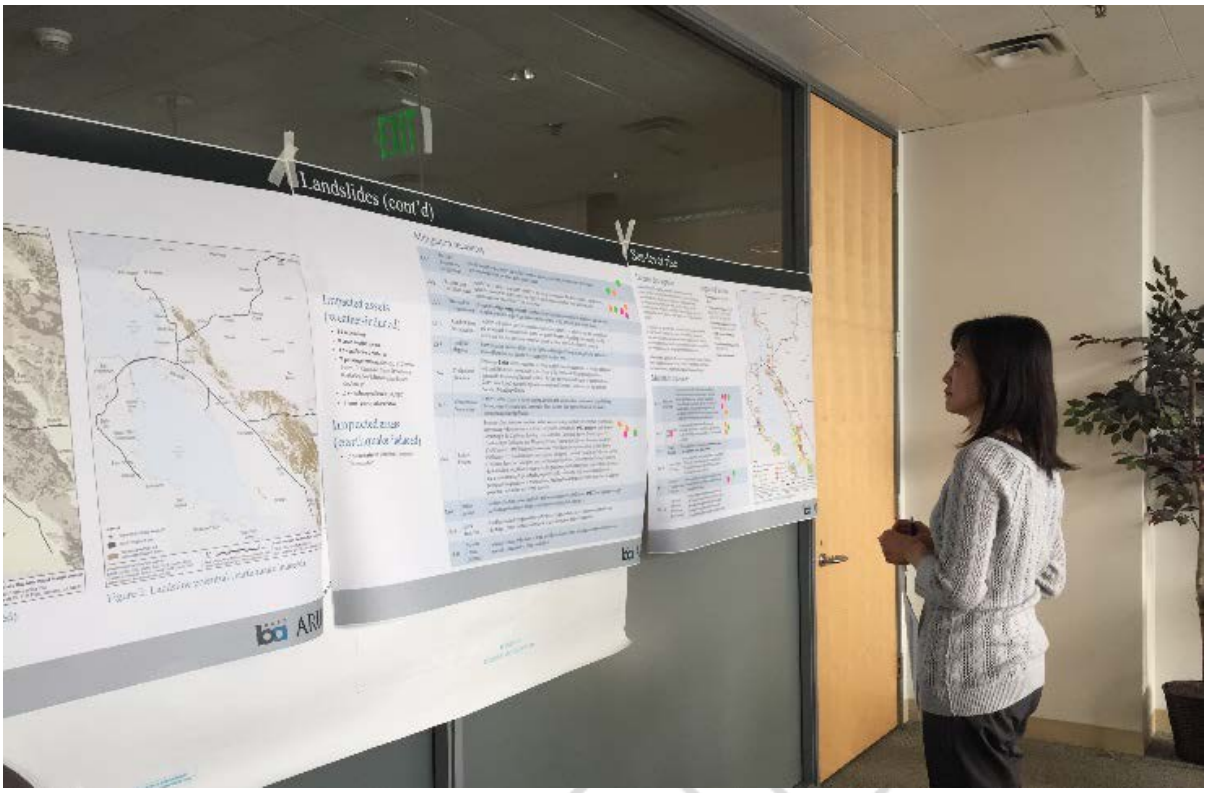
Appendix B

Stakeholder Engagement Photos

B1 Engagement Activities Photos

B1.1 December 2 Emergency Preparedness Program Task Force Committee Meeting




Landslides (cont'd)