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San Mateo County Vulnerability Assessment

Appendix A: Methodology Report

September 14, 2015

ARCADIS

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Tables

1. Introduction

ARCADIS was selected by San Mateo County (the County) and the State Coastal Conservancy (the Conservancy) to perform a sea level rise (SLR) vulnerability assessment for San Mateo County and advise the County on assets of concern. This document describes the method that will be used to assess vulnerability of San Mateo County to current and future flooding, and identifies the deliverables that will be produced.

1.1 Project Background

Recent reports by the Pacific Institute[1], the US Army Corps of Engineers (USACE) and the California Department of Water Resources (DWR)[2], and a Grand Jury report[3] have pointed out that San Mateo County is extremely vulnerable to the impacts of flooding. San Mateo County is working in partnership with the Conservancy to assess the County's vulnerability to current and future flooding due to SLR. Concurrent local efforts within the County have begun to address similar issues, but focus on smaller geographic areas, such as San Francisco International Airport, Foster City, Redwood City, and Half Moon Bay. This will be the first comprehensive County-wide vulnerability assessment. The project boundary includes the area in San Mateo County that would be inundated inland of the Pacific coastline from Half Moon Bay northward (and including Half Moon Bay) to the San Francisco County line and the San Francisco Bay shore.

1.2 Project Vision/Goals

ARCADIS will assess the overall vulnerability of San Mateo County to current and future floods due to SLR, and will provide decision makers with useful information that can lead to actionable outcomes. The team will produce maps and inventories of built and natural assets in the County exposed to current and future inundation (for which data are available). Organized by city, these inventories will also estimate the number of individuals that may be exposed to flooding, as well as the total monetary value of exposed built assets, and impacts to natural and coastal resources that could result from inundation of the assets. ARCADIS will also develop detailed asset vulnerability profiles (AVPs) for 30 key assets in the County to

[1] The Pacific Institute. (2012). The Impacts of Sea Level Rise on the San Francisco Bay. Accessible from: http://www.energy.ca.gov/2012publications/CEC-500-2012-014/CEC-500-2012-014.pdf

[2] California Department of Water Resources (DWR) and USACE. (2013). Floodsafe California: California's Flood Future: Recommendations for Management the State's Flood Risk.

[3] San Mateo County Civil Grand Jury. (2014-2015). Accessible from: http://www.sanmateocourt.org/documents/grand_jury/2014/sea_level_rise.pdf

provide more insight into the scale and magnitude of the economic, societal, environmental, and other consequences of inundation.

The project team includes Lisa Wise Consulting, Inc. to assist with the stakeholder engagement efforts; specifically, the assessment will engage local experts through public meetings, workshops, mapping exercises, guided discussions, personal interviews, and site visits. In particular, the team will work with businesses, asset managers, civic leaders, elected officials, and representatives from agencies and special interest groups. This will augment scientific and archival information to provide a more comprehensive perspective on sea level rise vulnerability in San Mateo County.

Lastly, ARCADIS will provide a framework for next-steps in a risk analysis, and will recommend high-level adaptation measures to reduce vulnerabilities to selected assets.

Because assets will be categorized according to risk-based criteria that are informed by nationally-accepted guidance (as described later), this vulnerability assessment will identify *what* the risks to the community are, *where* the risks are, and *how large* the potential flooding impacts could be. The results of the vulnerability assessment will:

- Lay the foundation for future, more detailed analyses to be conducted by San Mateo County or its cities;
- Help the County formulate an efficient, strategic approach to reducing risk that increases the community's "preparedness and resilience to sea level rise and storm events while protecting critical ecosystem and community services[4]";
- Quantify the value of built assets exposed to flooding, and where possible, quantify direct damages, thereby establishing a baseline against which to compare the effectiveness of future sea level rise adaptation and flood risk-reduction measures;
- Provide a baseline inventory of natural assets and potential ecosystem services, against which to compare future sea level rise adaptation and flood risk reduction measures;
- Employ a risk-based methodology, thereby helping the County be more competitive in its future funding requests (because State and Federal Agencies are moving toward a risk-based approach in allocating funds for infrastructure and hazard mitigation.).

[4] San Francisco Bay Conservation Development Commission (BCDC). (2012). Adapting to Rising Tides: Chapter 1

1.3 Methodology Development

This methodology is adopted from common best practices in both sea level rise (SLR) vulnerability assessments (VA) and flood risk management. Concerning the former, it is complimentary to and informed by regional SLR planning efforts, and is consistent with the California Coastal Commission's May 2015 Sea Level Rise Guidance document *Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs and Coastal Development Permits*.

At its core, the methodology incorporates strategies from other national and regional SLR VA studies[5] [6] [7] [8] [9] [10]; including the San Francisco Bay Conservation Development Commissions' *Adapting to Rising Tides (ART)* project[11]. It varies from the ART methodology in that it also integrates a flood risk management component. This risk component (described in step 3

[5] Delaware Department of Natural Resources and Environmental Control (2012). Preparing for Tomorrow's High Tide: Sea Level Rise Vulnerability Assessment for the State of Delaware

[6] San Francisco Bay Conservation Development Commission (BCDC). (2012). *Adapting to Rising Tides* project. Accessible: http://www.adaptingtorisingtides.org/

[7] US Federal Highway Administration. (2012). Climate Change and Extreme Weather Vulnerability Assessment Framework. Accessible: http://trid.trb.org/view.aspx?id=1302417

[8] National Oceanic and Atmospheric Administration (NOAA). 2010. Adapting to Climate Change: A Planning Guide for State Coastal Managers. NOAA Office of Ocean and Coastal Resource Management.

[9] Hutto, S.V., K.D. Higgason, J.M. Kershner, W.A. Reynier, D.S. Gregg. (2015). Climate Change Vulnerability Assessment for the North-central California Coast and Ocean. Marine Sanctuaries Conservation Series ONMS-15-02. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 473 pp.

[10] Grifman, P.M., J.F.Hart,, J. Ladwig, A.G. Newton Mann, M. Schulhof. (2013). Sea Level Rise Vulnerability Study for the City of Los Angeles. USCSG-TR-05-2013

[11] San Francisco Bay Conservation Development Commission (BCDC). (2012). *Adapting to Rising Tides* project. Accessible: http://www.adaptingtorisingtides.org/

below) is adapted from flood risk and public facilities mitigation assessments[12]. It is intended to provide decision makers and asset owners/managers with a clear understanding of flood risk, and to set San Mateo County up for developing a long term flood risk management strategy. The approach described below ensures that San Mateo County's vulnerability assessment utilizes best available science and captures the population at risk, as well as built assets like infrastructure and buildings as well as and natural assets like habitat types.

A review of many regional efforts to-date suggests that this SLR vulnerability assessment is an appropriate next step in the future of San Mateo County's climate change adaptation. Further, San Mateo County's 2013 climate action plan and 2013 general plan both recommend a SLR vulnerability assessment. While not all of San Mateo County's cities have performed SLR vulnerability assessments, detailed studies or planning efforts in the County are beginning to incorporate SLR. The outcomes and relevant data sources identified in these studies may be utilized in this vulnerability assessment. Where appropriate, potential adaptation measures will be considered in San Mateo County's adaptation planning phase of this project. Looking at many local SLR planning efforts can encourage coordination and cooperation between San Mateo County's work and other ongoing activities. Detailed studies within San Mateo County that incorporate SLR in some manner include Half Moon Bay, San Francisco International Airport, San Bruno and Colma Creeks, San Francisquito Creek, Redwood City, and Foster City. Most studies reviewed to-date utilize sea level rise range projections identified in the 2012 National Research Council Report[13] and many follow the most recent guidance used by the City and County of San Francisco.

Summaries of the local efforts used to inform San Mateo County's SLR vulnerability assessment are found in Attachments A and B. Additional reports may be reviewed to support the vulnerability assessment, as appropriate, and corresponding references will be provided in the final report.

[12] Florida Division of Emergency Management (2015). Public Facilities Flood Hazard Mitigation Assessment Manual. Accessible: http://www.floridadisaster.org/Mitigation/SMF/Index.htm

[13] National Research Council (NRC). (2012): Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future Accessible from: http://www.nap.edu/catalog/13389/sea-level-rise-for-the-coasts-of-california-oregon-and-washington

2. Methodology

This section describes the step-by-step process that will guide San Mateo County's SLR vulnerability assessment.

2.1 Step 1: Identify the Data/Data Types Needed for the Vulnerability Assessment

Two types of data will be incorporated into the vulnerability assessment; flood hazard data and asset data.

The flood hazard data will be the results from prior modeling effort (described in step 5 below) and will include the geographical extent of the flood hazard on the landscape for a given inundation scenario, the depth of flooding for that scenario, and will include a temporal component that addresses whether the flood is temporary or permanent (in the case of SLR). Flood hazard data includes all of the components of total water level: sea level rise, in addition to mean higher high water or a king tide, elevated water levels due to a 1% annual chance storm (surge), and wind waves. Existing data on shoreline change and erosion will be incorporated into the analysis on the open coast to evaluate erosion hot spots and areas where increased erosion due to sea level rise would cause problems.

Examples of asset types considered in this analysis include (but are not limited to) infrastructure, buildings, natural resources, cultural resources, recreational assets, and human assets. The availability of data varies across the County or across asset types. In general, however, the types of data collected on these assets include the location, elevation, and foundation information of built assets; the level and type of service; asset function; economic replacement values; environmental benefits and impacts; the effects of loss of use of an asset; and additional local or regional consequences resulting from temporary or permanent inundation of the asset. Discussed in detail in section 5, this information informs the exposure of an asset to flooding, the sensitivity of that asset to flooding, as well as the adaptive capacity of that asset.

The flood hazard and asset data that will be considered in this vulnerability assessment are consistent with and align with other asset exposure and vulnerability assessments as previously mentioned. Data will be made available for local use following completion of this vulnerability assessment.

2.2 Step 2: Collect Data from Various Sources

The vulnerability analysis will rely on existing data. These data may be obtained through multiple sources. The primary format for these data will be a Geographic Information Systems

(GIS)-compatible format. Flood inundation data will primarily be derived from the Our Coast Our Future (OCOF) tool, and data on shoreline change and erosion may come from the Pacific Institute or a Coastal Sediment Management Study Group. To the extent that inundation data are available from other sources identified below, these data will be collected to compare to the OCOF results.

Data are expected to come from San Mateo County, online GIS databases like the State of California's GIS Portal, and additional stakeholders, cities, or agencies such as the San Francisco Estuary Institute (SFEI), the San Francisco Bay Conservation Development Commission (BCDC), USACE, Federal Emergency Management Agency (FEMA), United States Geological Survey (USGS), and the California Department of Water Resources.

Supplemental detailed information on assets chosen for the AVPs (see Step 7) may be collected from interviews or discussions with local agencies and asset owners or managers. A survey will be developed to elicit this information on assets from stakeholders and asset managers, as appropriate. Data to support the assessment of potential economic consequences (such as the cost of replacing damaged infrastructure or buildings), environmental consequences, and societal consequences may come from prior asset or habitat exposure analyses in California, from interviews with experts or asset managers, and from supplemental studies provided by the County and Conservancy. Input will also be gathered from key stakeholders in the community through participation in a Technical Working Group and a Policy Advisory Committee. Together, these data will provide an insiders' perspective on assets and risk.

A final list of all data sources used in the study, as well as a discussion on data gaps and uncertainties in the study, will be provided in the final project report.

2.3 Step 3: Categorize and Classify Assets

The purpose of categorizing and classifying assets is to provide a high-level understanding (and inventory) of what is at risk in the County and where that risk is. Rather than treating all assets equally, this type of categorization and classification can focus future risk analyses and prioritize flood risk management investments or adaptation strategies. The approach taken in this SLR VA varies slightly from and is complimentary to regional SLR VA methodology,[14] in that in addition to categorizing all assets by their similar function or sector, this method integrates a risk component for built assets whereby prior to any assessment or evaluation of an asset, and following nationally accepted guidance concerning design requirements for built assets in

[14] BCDC. (2012). *Adapting to Rising Tides*. Accessible: http://www.adaptingtorisingtides.org/

flood hazard areas[15], the asset will be assigned to a risk class (1, 2, 3, or 4) according the severity or magnitude of the consequences if it were to flood. Natural and human assets will be addressed differently as described below.

It should be clear that asset *classification* is different from asset *prioritization*. Asset classification is an objective way to organize assets that could be exposed to inundation, and the process is briefly described below. Asset *prioritization* would be the part of an overall flood risk reduction and sea level rise adaptation strategy that is informed by the results of a risk analysis and incorporates stakeholder values and preferences. A report on asset categorization and classification explains the following process in greater detail.

First, all assets will be categorized according to the 12 categories developed in the ART project and listed below.

- Airport
- Community land use, services, and facilities
- Contaminated lands
- Energy infrastructure and pipelines
- Ground transportation
- Hazardous materials
- Natural areas
- Parks and recreation areas
- Seaport
- Structural Shorelines
- Storm water
- Wastewater

All built asset types will also be organized into four classes considering guidance and criteria established by the American Society of Civil Engineers (ASCE) in *ASCE 24-14 Flood Resistant Design and Construction* and *ASCE 7-10 Minimum Design Loads for Buildings and Other Structures* (see Table 1 below). Therefore, in the end, each asset will be assigned both a category and a class. The type of criteria considered in identifying classifications in these documents or legislation generally include function, type of occupancy, and level of use of an asset as it relates to public safety, health, and welfare. As such, the categories align well with best practices in flood risk management, including FEMA's hazard mitigation and public

[15] American Society of Civil Engineers (ASCE). (2015). 24-14 Flood Resistant Design and Construction

assistance programs. It is also consistent with the State of Florida Department of Emergency Managements' Public Facilities Flood Mitigation Initiative.[16]

To date, no guidance exists to assign *natural assets* to a risk class (low to high) as in the built asset method, and the best available science does not agree on which ecosystem types are more critical or more valuable than others. However, natural assets such as wetlands, marshes, beaches, and endangered species are of great importance to San Mateo County, the State of California, and the federal government (see executive order 11990 on the protection wetlands, Executive Order 11988 on the wise use of floodplains, and the Federal Endangered Species Act). Not only are they recognized for their intrinsic value, but natural assets are also recognized for the services they may provide, including biodiversity, flood and erosion control, water quality improvement, and carbon sequestration.[17] Therefore natural assets will be included in this vulnerability assessment, and will be classified as simply N, 'Natural,' with a descriptor such as *N-beach*, or *N-wetlands*, or *N-species of concern* (Table 2). This provides an inventory of natural assets to support future flood risk analyses, and provides a baseline against which future adaptation strategies can be compared, in terms of how strategies may positively or negatively affect the county's natural assets.

Human assets, including people exposed to sea level rise and socially vulnerable communities will not be assigned to a risk-class or a natural-class. However, inventories will count the number of people exposed to inundation, and both inventories and maps will identify the number and location of socially vulnerable populations, (disadvantaged communities).

Classifying assets will consider input from the project management team (PMT) and additional stakeholders, as appropriate.

Table 1 Classifications for built assets identified in ASCE in 24-14 (summarized)

Risk Category	Description
I	Buildings and other structures that represent a low risk to human health in the event of failure (flood)
II	All buildings and other structures except those listed in categories I, III, IV

[16] Florida Division of Emergency Management (2015). Public Facilities Flood Hazard Mitigation Assessment Manual. Accessible: http://www.floridadisaster.org/Mitigation/SMF/Index.htm

[17] BCDC (2012). *Adapting to Rising Tides: Chapter 4*

III	Buildings and other structures, • The failure of which could pose a substantial risk to human health • Not included in category IV, with potential to cause a substantial economic impact and/or mass disruption of day to day civilian life in the event of a flood • Not included in category IV (including, but not limited to facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, or hazardous waste) containing toxic or explosive substances where their quantity exceeds a threshold quantity established by the authority having jurisdiction and is sufficient to pose a threat to the public if released.
IV	Buildings and other structures, • Designated as essential facilities • The failure of which could pose substantial hazard to the community • (including but not limited to, facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, or hazardous waste) containing sufficient quantities of highly toxic substances where the quantity exceeds a threshold quantity established by the authority having jurisdiction to be dangerous to the public if released and is sufficient to pose a threat to the public if released • Required to maintain function of other category IV structures

Table 2 Draft Classification for natural assets in San Mateo County

Class	Natural Asset Descriptor	Natural asset type and examples
N-W	Natural Assets – Wetlands	Wetlands, marshes, etc.
N-B	Natural Assets – Beaches	Beaches
N-S	Natural Assets – Species identified in CNNDB	Federally or State-listed, threatened, or endangered species; or other species of concern
N-G	Natural Assets – Groundwater	Groundwater basin or source
N-O	Natural Assets – Other	Natural assets not listed in any other category

The organization of human assets is shown in table 3 below.

Table 3 Draft Classification for human assets in San Mateo County

Class	Asset Description	Example or description
H-P	Human – Person	Number of individuals exposed to current or future inundation will be counted
H-DC	Human–Disadvantaged Community	Disadvantaged communities identified in existing social vulnerability indices

2.4 Step 4: Select Inundation Scenarios

Three inundation scenarios will be selected that are based on the guidance in the California Coastal Commission's May 2015 Sea Level Rise Guidance document *Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs and Coastal Development Permits*. This is consistent with many of the local SLR planning efforts (Attachments A and B). It is the intent to select scenarios that provide an overview of today's flood risk as well as realistic future scenarios that account for sea level rise.

While scenarios are still to be selected, the baseline scenario will likely be the flood resulting from a 1% chance flood (also known as "100 year flood") using today's mean higher high water

level (MHHW). The second scenario could then be the flood resulting from a 1% chance flood using today's MHHW + a realistic SLR scenario for 2050. The third scenario used could be the flooding resulting from a 1% chance flood using MHHW + the most likely SLR scenario for 2100. The three scenarios may change pending guidance from the County and Conservancy during project execution as well as input from the Technical Working Group.

Each scenario will include quantitative projections of the geographic extent and depth of inundation. There are some portions of the OCOF tool in San Mateo County that may not accurately reflect the shoreline elevation and could over or underestimate the risk from sea level rise. The United States Geological Survey (USGS) will identify key areas where discrepancies might exist, and ARCADIS will work with USGS, County staff, and city engineers to correct the errors in the mapping.

The final project report will provide an explanation of the selected scenario.

2.5 Step 5: Inundation Mapping and Asset Exposure Analysis

The asset exposure analysis will use GIS to identify those assets that will be exposed to flood waters during each of the three selected inundation scenarios. Inundation pathways may be identified by BCDC's overtopping analysis for the 30 assets selected for Asset Vulnerability Profiles described below in step 7.

Three GIS layers will be created from the corrected OCOF tool to show the extent of flooding in San Mateo County. As currently planned, the first layer will be the baseline scenario flood extent, the second layer will be the mid-century scenario flood extent, and the third layer will be the 2100 flood extent. These flood extent layers will be overlain on a map of San Mateo County that includes the identified assets. Those assets that fall within the flood extent will be considered exposed to flooding and may be selected for further analysis.

2.6 Step 6: Prepare Asset Exposure Maps

To illustrate the assets exposed to flooding in San Mateo County, maps will be prepared for each coastal city that experiences inundation under one or more of the selected scenarios. Both regional and local maps will be prepared, and the coverage will be sufficient to display adjacent inundated areas in the unincorporated area of the County. Assets will be visually represented in the maps according to the four classes detailed in Step 3.

2.7 Step 7: Prepare Asset Exposure Inventories

An asset inventory provides an outline of resources in San Mateo County that will be affected by current or future flooding. Asset inventories will be prepared for each of San Mateo County's

cities that will experience inundation under one or more of the three SLR scenarios. Each inventory will include a brief summary that describes the at-risk assets within the city boundaries, including the location of socially vulnerable populations. The inventory will also list all assets exposed to flooding in that city according to both category and class. Each asset inventory will correspond with the asset exposure map prepared for that city described in step 6 above.

A prototype/example asset inventory is provided in Attachment C.

2.8 Step 8: Prepare Asset Vulnerability Profiles

The PMT, with input and feedback from the Technical Working Group and asset managers where appropriate, will establish asset selection criteria and select 30 representative assets from the exposed asset inventories. Detailed AVPs will be prepared for each selected asset. A least one exposed asset will be chosen from each city, and at least one asset will be chosen from each of the following asset types: hospitals; other critical facilities types; waste water treatment plants; a groundwater extraction well; transportation infrastructure; beaches; and wetlands areas. Criteria used to select assets will be detailed in the final report.

Detailed information on the assets collected in Step 2 and from the surveys will inform the AVPs (working with the Technical Working Group and asset managers, where appropriate). Prior studies such as those that address the impacts of SLR on ecosystems[18] may also inform the AVPs. Each AVP will present the exposure of an asset to the water surface elevation associated with each inundation scenario, including flood depth and duration (i.e., permanent or temporary inundation). The AVP will describe an asset's function or service, along with the sensitivity of the asset and its function to the flood depth and duration. The AVP will also characterize the adaptive capacity of that asset or function, and will discuss the potential consequences (economic, social/equity, environmental, or otherwise) that could result from the loss of the asset or function. The asset managers or other stakeholders will also be included to provide a sense of potential management or adaptation challenges.

[18] Hutto, S.V., K.D. Higgason, J.M. Kershner, W.A. Reynier, D.S. Gregg. (2015). Climate Change Vulnerability Assessment for the North-central California Coast and Ocean. Marine Sanctuaries Conservation Series ONMS-15-02. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 473 pp.

Exposure is defined as whether and to what degree a particular area will be inundated,[19] and will discuss the degree to which the physical structure, or natural/human asset is subject to high water under each of the three inundation scenarios. This will be based on the water surface elevation, the elevation of the asset itself, and the potential duration of the inundation (temporary or permanent).

Sensitivity is the degree to which an asset is impaired by inundation,[20] and will explain whether and how the assets' function or service will be impaired. Characteristics that affect sensitivity include things like age of the asset, elevation of the asset, the level of use, condition of the asset, etc. For natural assets, sensitivity may include the type of vegetation or other species present. If an asset's function is compromised by inundation, it would be considered highly sensitive. This will be a qualitative description and will address built, natural, and human assets.

Adaptive Capacity will describe the assets' ability to accommodate or adjust to an impact to maintain its primary function while inundated.[21] It also addresses how quickly an asset can be restored. If an asset that it exposed to flooding can still maintain function or can offer an alternate means to providing a function, it would have a high adaptive capacity. If an asset cannot function while inundated, it would have a low adaptive capacity. This will be a qualitative discussion and will address built, natural, and human assets.

Following the guiding risk questions in BCDC's *Adapting to Rising Tides* project (2012), assessing the *consequences* provides an understanding of the scale of the impacts from inundating an asset, or the consequences from inaction. Where information is available, consequences will include the direct damages from asset repair and asset replacement costs (as is standard in most flood risk analyses), asset contents losses, and asset inventory losses. Where available, this section may also include *in*direct damages from inundation – for example, a substation that floods may cut off power for 100,000 customers, including businesses, which could in turn have additional local and regional economic consequences. Identifying indirect or secondary consequences helps target those "cross cutting" vulnerabilities, or those assets whose inundation may cause broader impacts. The consequences discussion will be both qualitative and quantitative in describing the impacts to individuals and the community, to the local and regional economy, and to the environment.

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[19] BCDC. (2012). *Adapting to Rising Tides: Chapter 1*

[20] ibid

[21] ibid

To identify issues of equity, the VA will consider information, including social vulnerability indices such as those from the University of South Carolina's Hazards and Vulnerability Research Institute, to assess how SLR may affect socially vulnerable populations in the County. As mentioned, these socially vulnerable communities will be identified in the inventories in Step 7 and can be evaluated in more detail in an AVP.

The project will evaluate the potential impacts to municipal and industrial groundwater extraction wells from salinity intrusion that may result from SLR. The locations and completion details of municipal and industrial groundwater extraction wells will be provided by local officials or other stakeholders. These data may be supplemented with discussions with local groundwater managers to identify potential vulnerability concerns associated with SLR.

Attachment D shows an AVP from the City of Los Angeles identifying one format that may be used.

2.9 Step 9: Adaptation Planning

The project will identify *conceptual* adaptation measures to reduce risk to San Mateo County and its assets. Both structural and non-structural adaptation measures will be explored, as well as both conventional "gray" infrastructure solutions and "green" infrastructure solutions – those that are often referred to as natural or nature-based features, where appropriate. Each AVP will identify one or two conceptual adaptation strategies. In addition, two to three artist renderings of regional adaptation measures (developed to reduce risk to more than one asset at a time) will be prepared to provide a vision for how adaptation measures may look when implemented in San Mateo County.

Results from current local sea level rise adaptation efforts, from the inundation mapping, and the outcomes of the AVPs will inform where both regional and asset-specific adaptation strategies may be appropriate. Where many assets are spatially concentrated, for example, it may make sense to take a regional approach and select a strategy that protects a larger number of assets at once. On the other hand, where a critical facility is isolated from other facilities, an asset-specific approach may be more prudent.

3. Deliverable Summary

As mentioned, the ARCADIS team will develop a final report detailing the vulnerability assessment methodology and findings, a discussion of the data that were used, including the OCOF tool, as well as an overview of the conceptual adaptation strategy for San Mateo County. The report will provide brief discussions of gaps in available information, limitations of this effort and the associated uncertainties, and recommendations for next steps. It will also include the following interim deliverables as described above: a report on asset categorization,

regional and city-specific asset exposure maps with sufficient coverage; asset exposure inventories for each city that will experience inundation under at least one of the three SLR inundation scenarios, AVPs for 30 assets, and a GIS geodatabase with all of the information used in this analysis.

4. Change Management

The methodology is subject to change as new data become available or with input and guidance from the PMT during project execution. Mutual agreement will be reached regarding any technical changes to the methodology and any corresponding changes to the project schedule and/or budget. Certain tasks in this methodology may be modified based on future support that could be provided by USACE.

5. Attachments

5.1 Attachment A. Summary of Local Sea Level Rise Planning Efforts

5.1.1 Half Moon Bay SLR Planning Efforts

The City of Half Moon Bay is currently updating their general plan and local coastal program (LCP) in order to account for sea level rise. Further, a sea level rise vulnerability assessment to inform the General Plan update and support adaptation is ongoing and expected for completion by February 2016. At the time of this document, Half Moon Bay is still in the process of selecting three scenario to use for the SLR VA and general plan. To date, areas of concern include Surfer's Beach due to its low elevation, as well as multiple bluff areas that are prone to erosion.

5.1.2 City of Foster City Levee Protection Planning Study

Many of the Foster City levees are no longer accredited under the National Flood Insurance Program administered by the Federal Emergency Management Agency (FEMA), resulting in 17,000 properties being placed in the Special Flood Hazard Area (SFHA) and subject to the mandatory flood insurance requirement. As a result, Foster City initiated the Foster City Levee Protection Planning Study to review and better assess the current state of its levee system, and to propose alternatives to improve the levees to meet FEMA accreditation standards. The study was recently completed and the city is moving to the design process. After the design process (2015) the permitting process should take two years (2016-2018) followed by two years of construction (2018-2020).

The study compared current survey data (elevations) of the levee system to surge levels from the California Coastal Analysis and Mapping Program (CCAMP) that were prepared in July 2014. The study found 85% of the city's levees do not meet the required freeboard elevation to retain FEMA accreditation by an average of approximately two feet and a maximum of four feet. These numbers do not consider sea level rise (SLR) or land settlement, which could add another 1.5 feet to the freeboard requirement. Approximately 17,000 properties are at risk in Foster City and the City of San Mateo if levees are insufficient to protect against flooding. Widening of levees would be on the landward side due to the sensitive habitats and endangered species on the bay side of the levee.

Concerning SLR, the report references the 2012 National Research Council Report "Sea-Level Rise for the Coasts of CA, OR, and WA: Past Present Future" (NRC Report) as the best available science and is supported by both the City and County of San Francisco (CCSF) and the California Coastal Commission (CCC). The NRC Report provides a range of SLR estimates for years 2030, 2050, and 2100. CCSF and Foster City recommend using the mean of each range:

0.5 foot for 2030, 1 foot for 2050, and 3 foot for 2100. Levee improvements should be built to last until at least 2050, meaning they should have an extra foot of freeboard to accommodate for SLR.

Data used in this work that may be relevant to San Mateo County include LIDAR surveys and levee profiles for the region. Foster City's work is confirmation that the San Mateo County Vulnerability Assessment is relevant and necessary. The SLR component provides a good baseline of an approach and assumptions that can be built upon, and levee designs may be useful in the Adaptation Planning phase of the San Mateo Vulnerability Assessment. Coordination of efforts between the San Mateo County study and the Foster City assessment is encouraged.

5.1.3 San Francisco International Airport Shoreline Protection Feasibility Study Evaluation and Recommendations

CCSF recently entered into the NFIP in 2010, and preliminary flood insurance rate map (FIRM) data suggests the entire airport property is in the 1% flood zone (requiring flood insurance) with flood elevations ranging from 10-14ft NAVD along the shoreline. San Francisco International Airport (SFO) has undertaken a shoreline protection study aimed at removing the Special Flood Hazard Area (SFHA) designation for the airport property. Moffatt and Nichol with AGS Inc. performed the shoreline protection study with the following objectives: identify deficiencies in the current flood defense/protection system (levees), provide recommendations to correct deficiencies along with preliminary cost estimates, and address SLR by providing solutions for the increase in water level.

Regarding SLR scenarios for design, SFO defers to CCSF's recommendation of using the NRC Report. Because the NRC Report indicates a maximum of 2 feet of SLR by 2050, two scenarios were examined: 2ft of SLR and greater than 2ft of SLR. Moving forward, SFO plans to apply for A99 certification through planned improvements to their flood protection system.

Potential data from this study that may be useful in San Mateo County's work include results from modeling of storm surge along San Francisco Bay. This work is confirmation that the San Mateo County study is relevant and necessary. It provides a good baseline of approach and assumptions that can be built upon. Coordination of efforts between the San Mateo County study and the SFO assessment is encouraged.

5.1.4 San Bruno Creek and Colma Creek Resiliency Study

The purpose of the study was to assess the vulnerability of SFO and its neighbors to flooding from sea level rise and storms along the Bay shoreline directly northwest of the airport where San Bruno Creek and Colma Creek meet the Bay. The scope of the study includes establishing

an interagency working group, data collection, surveying, hydrologic and hydraulic modeling, and identifying vulnerable reaches and potential adaptation measures for the project area.

The study considers three scenarios for sea level rise: one foot (expected to occur between 2030 and 2080), two feet (expected to occur between 2050 and 2125), and three feet (expected to occur between 2065 and 2155). These estimates are taken from the NRC Report.

This study is an example of a smaller scale assessment and provides a good baseline of approach and valuable insight into that region of the County. Potential data from this study that may be useful in San Mateo County's work include LIDAR data for the project area, locations of flood control and other drainage infrastructure, and hydrologic and hydraulic modeling results from HEC-HMS and HEC-RAS models. Adaptation measures recommended may also be considered in the adaptation planning phase of the San Mateo County vulnerability assessment.

5.1.5 Climate Change Vulnerability Assessment for the North-central California Coast and Ocean (Farallones)

This vulnerability assessment aims to identify how habitats, species, and ecosystem services are likely to be affected by future climate conditions. The goal is to provide an assessment for marine resource managers to use to plan, manage, and respond to impacts of climate change. The study area included coast and ocean ranging from the southern edge of San Mateo County up to Alder Creek in Mendocino County. The study reviewed adaptive capacity, degree of exposure, and sensitivity for eight habitat types, 31 species, and 5 ecosystem services. Vulnerability was equated with decreased adaptive capacity, and increased exposure and sensitivity of the resource. In addition, 32 stressors were listed and scored according to the degree of sensitivity the resources exhibited to that stressor. The number of resources impacted by each stressor was also recorded. The most vulnerable habitats, species, and ecosystems were those existing at the land-sea interface. Climate information referenced in the study was from Climate Change Impacts Report from the Cordell Bank and Gulf of the Farallones National Marine Sanctuary Advisory Councils. The study also included the NRC Report's estimates of 5-24 inches of SLR by 2050 and 17-66 inches of SLR by 2100.

We are currently waiting to hear what data sources may be available from this study. This work may be useful to San Mateo's vulnerability assessment by providing insight into relevant ecosystem vulnerabilities and impacts from SLR inundation. This will be useful in developing the Asset Vulnerability.

5.1.6 SMC Climate Action Plan

The report describes a vulnerability assessment that focused on six distinct types of county assets: agriculture, built infrastructure in coastal zone, coastal ecosystems, property and safety threats due to wildfire, public health threats from increased temperatures, and impacts on water supply. The four major hazards analyzed were increased temperature, increased variability in precipitation, sea level rise, and increased chance of wildfire. Key findings and recommendations include a variety of 'warnings' regarding erosion risk along the coastline. Specifically, bluffs, low-lying beaches and trails, major roads including Highway 1, and coastal wetlands all are at risk of being eroded or destroyed. More irregular precipitation cycles will affect the water table, which will affect flooding patterns.

The SLR portion references the NRC report and establishes sea level rise averages for 2030 (7"), 2050 (14"), 2100 Low greenhouse gas (GHG) (40"), and 2100 High GHG (55"). Next steps include transitioning from the key vulnerability areas identified in the report to developing adaptation actions to address these areas.

The report lays out the various changes that will increase vulnerability across the region and lays out the need for a more focused sea level rise vulnerability assessment for the County.

5.1.7 Energy Efficient Climate Action Plan (EECAP)

EECAP intends to illustrate the County's continued commitment to reducing GHG emissions. The purpose of the report is to inventory GHG emissions, provide reduction strategies, discuss adaptation measures to future climate change impacts, and provide implementation strategies for reducing GHG emissions. The adaptation section summarizes the analysis provided in the SMC Climate Action Plan. The section recognized special vulnerabilities to increased temperature, increased variability in precipitation, increased wildfire risk, decreased supply of fresh water, and increased sea level rise. It also identifies adaptation measures such as updating the Local Hazard Mitigation Plan, updating the resource management plans, updating emergency operations plan, and developing programs to educate residents and businesses of anticipated changes.

This report lays out the expected changes that will increase vulnerability across the region and emphasizes the need for further vulnerability assessment for the County.

5.1.8 San Mateo County General Plan: Energy and Climate Change Element

The purpose of the Energy and Climate Change Element of the General Plan is to demonstrate the County's commitment to energy efficiency and mitigate impact on climate change by reducing GHG consistent with state legislation (Assembly Bill AB32 – The Global Warming

Solutions Act of 2006). The section on Potential Impacts of Climate Change references the NRC Report, which estimates 5-24 inches of SLR by 2050 and 17-66 inches of SLR by 2100. A series of adaptation goals were detailed as well, the first of which is to identify and prepare for climate change impacts by tracking and funding climate change assessments, integrate the assessments into the planning process, and develop a county-wide adaptation strategy. The second goal is to enhance the adaptive capacity of natural and man-made systems by encouraging future construction to consider climate change risks, as well as implementing generic monitoring and adaptation strategies and programs.

This report is relevant as it makes clear the need for further vulnerability assessment for the County. The report lays out the various changes that will increase vulnerability across the region.

5.1.9 Climate Snapshot San Mateo County

The Snapshot lists programs across the County that are addressing climate impacts and building community resiliency. It identifies Bay Area cities that have Climate Action Plans. Finally, a summary is provided of input from San Mateo stakeholders regarding forms of resources and assistance that would be useful for the community and these programs. Common themes from stakeholders include praise for the Regionally Integrated Climate Action Planning Suite (RICAPS), requests for planning guidelines or mandates from the state, desire to build political support for adaptation and resilience initiatives, requests for accessible and sustainable funding streams for local agencies, getting insurance industry more involved in adaptation, need for assistance with energy projects, and a push to focus outreach to the most vulnerable communities.

This report does not contain specific data relevant to use in the vulnerability assessment, but it is useful and relevant for the public outreach section of the County's vulnerability assessment and to identify vulnerable communities. The Snapshot can be used as a summary or glimpse into the local stakeholders' interests and viewpoints.

5.1.10 SAFER Bay Project

Motivated by preliminary NFIP maps which put a large number of properties in the SFHA adjacent San Francisco Bay shoreline and San Francisquito Creek, and following high projections for SLR (released 2010), San Francisquito Creek Joint Powers of Authority initiated the Strategy to Advance Flood protection Ecosystems and Recreation (SAFER Bay). The SAFER Bay project was initiated in order to reduce the risks from flooding and "remove" 5,000 properties from the SFHA while accounting for future sea level rise. The project also plans to restore historical marshes and improve trail access along the shoreline. The study area includes East Palo Alto and Menlo Park, and covers roughly nine miles of bay shoreline. The SAFER Bay

project proposes alternatives for shoreline protection irrespective of individual vulnerabilities in East Palo Alto or Menlo Park. Specifically, the shoreline protection approach aims to protect everyone. Design criteria for the shoreline project include water surface elevations for the 1% annual chance flood (base flood) with two feet of additional freeboard and three more feet to account for SLR over the project lifespan (50 years, consistent with US Army Corps of Engineers design processes).

LIDAR and parcel data for the project area may be available. The results from this study may be used in the adaptation planning phase of the San Mateo vulnerability assessment to ensure regional coordination. Completion of the feasibility analysis of alignment alternatives and features, and selection of preferred alternative is planned to be done January 2016.

5.1.11 Silicon Valley 2.0

The Silicon Valley 2.0 project was developed to address regional climate adaptation planning for Santa Clara County. The purpose of the project was to identify the region's climate vulnerabilities (including flood but also other hazards), catalogue assets, map climate impacts, analyze the gaps in climate preparedness, and create a decision-support tool that maps assets with impact zones to assess the potential risk and cost of losing those assets. The Project does not provide any coverage outside of Santa Clara County.

The Project involved nine sectors from across the county: transportation, water, energy, telecom, shoreline assets, waste and waste treatment, super fund sites, state fund sites, and public health. Rather than using discrete SLR scenarios, the tool provides a sliding scale for storm surge and SLR. The tool aimed to address a number of uncertainties associated with SLR estimates such as: the estimates are too speculative, the existing data are too uncertain, the impacts are too far in the future to address now, resiliency projects cost too much, and we can rely on federal organizations to step in and protect the region. The online tool is expected to go live within the next few months.

5.2 Attachment B. Draft Summary Table of Local Sea Level Rise Planning Studies or Efforts

Study or Project	Year	Sponsor	Geographic Area	Participants	Goals	Major Findings	Recommendations (Where applicable)	SLR Projections	Data source	Data date	How will the study be used?
City of Half Moon Bay Local Coastal Program Update (ONGOING)	2015/2016 (ONGOING)	California Coastal Conservancy	City of Half Moon Bay	City of HMB, Coastal Conservancy, Consulting team	Not yet developed	Not Applicable	Not applicable	Preliminary/NA	NA	NA	It will be used to update the General Plan, Local Coastal Program, and to inform SLR adaptation.
City of Foster City Levee Protection Planning Study	2015	Foster City	Foster City	Schaaf and Wheeler	Review levee system to regain FEMA accreditation	85% of levees do not meet required elevation by average of 2ft.	Large improvement of levee system is required to regain FEMA accreditation	2030: 0.5ft 2050: 1ft 2100: 2ft	CCAMP NRC Report	July 2014 2012	Design phase for updating levee system is beginning now.
San Francisco International Airport Shoreline Protection Feasibility Study Evaluation and Recommendations Report	2015	SFO	SFO	Moffatt and Nichol + AGS Inc.	Removing the Special Flood Hazard Area (SFHA) FEMA designation for the airport property	The current flood protection system was assessed for deficiencies and corrections to those deficiencies were proposed.	Address deficiencies in flood protection system so that SFO can apply for A99 certification.	Based on max SLR of 2ft by 2050, 2 scenarios were proposed: 2ft SLR and >2ft SLR	NRC Report	2012	The study will be used to update SFO's flood protection system to remove the SFHA designation from the project area.
Climate Change Vulnerability Assessment for the North-central California Coast and Ocean	2015	Gulf of the Farallones National Marine Sanctuary California Landscape Conservation Cooperative	North-central California coast and ocean	NPS, Point Reyes National Seashore, EcoAdapt, California Landscape Conservation Cooperative, Bay Area Ecosystems Climate Change Consortium, Golden Gate National Recreation Area, Point Blue Conservation Science	The goal is to provide an assessment for marine resource managers to use to plan, manage, and respond to impacts of climate change.	The most vulnerable habitats, species, and ecosystems were those existing at the land-sea interface.	Managers should focus on addressing stressors that impact high vulnerability areas at the land-sea interface	References range of estimates from NRC Report	Climate Change Impact Report NRC Report	2010 2012	Marine resource managers will use the report as a guide for addressing impacts of climate change.

Study or Project	Year	Sponsor	Geographic Area	Participants	Goals	Major Findings	Recommendations (Where applicable)	SLR Projections	Data source	Data date	How will the study be used?
San Mateo County Climate Action Plan	2011	San Mateo County	San Mateo County	ICLEI	Identify key areas that the County can focus on to increase resilience to climate change.	Erosion along the coastline is not well understood and can lead to major losses for multiple different areas	Nothing specific	again references NRC Report	NRC Report	2012	Adaptation actions need to be developed to address key areas of vulnerability identified in the report
Energy Efficient Climate Action Plan	2013	San Mateo County	San Mateo County	DOE PMC DNV KEMA Fehr and Peers ICLEI	The purpose of the report is to inventory GHG emissions, provide reduction strategies, discuss adaptation measures to future climate change, and provide implementation strategies for reducing GHG emissions	Relevant sections repeat the analysis provided in the SMC Climate Action Plan.	Action items proposed as response to SMC Climate Action Plan include updating the County's hazard mitigation plans as well as public outreach to educate residents and businesses on anticipated changes.	again references NRC Report	NRC Report	2012	Primarily the study will be used to continue to reduce GHG emissions across the County.
SMC General Plan. Energy and Climate Change Element	2013	San Mateo County	San Mateo County	PMC	Demonstrate commitment to energy efficiency and mitigate impact on climate change by reducing GHG consistent with state legislation.	Same list of potential impacts of climate change as the other reports.	First, ID and prepare for climate change impacts. Second, enhance adaptive capacity of natural and man-made systems	again references NRC Report	NRC Report	2012	Primarily the study will be used to continue to reduce GHG emissions across the County.
SAFER Bay Project	2014-ongoing	San Francisquito Creek JPA	Shoreline, San Francisquito Creek Watershed, including East Palo Alto and Menlo Park	City of Palo Alto, City of East Palo Alto, Menlo Park	Remove properties from SFHA, reduce flood risk, restore marshes, enhance restoration	List of alternatives for shoreline protection to protect entire area	Alternatives (report not yet available, but proposed alignment is)	3 feet of sea level rise	Lidar data, parcel data, FEMA preliminary FIRM data		After feasibility analysis complete, project will begin construction.

Study or Project	Year	Sponsor	Geographic Area	Participants	Goals	Major Findings	Recommendations (Where applicable)	SLR Projections	Data source	Data date	How will the study be used?
San Bruno and Colma Creek Resilience Study	2015	SFO	San Bruno and Colma Creeks	SFO and interagency groups	Assess vulnerability of SFO and its neighbors to flooding from sea level rise and storms along the Bay shoreline directly northwest of the airport where San Bruno Creek and Colma Creek meet the Bay	Shoreline vulnerabilities and deficiencies	List of alternatives, including regional tide gate	1 foot 2 feet 3 feet	Lidar, modeling data results, flood and drainage infrastructure		May use relevant data, and will consider adaptation strategies from study in the adaptation planning phase of our vulnerability assessment

5.3 Attachment C. Sample Asset Exposure Inventory

	[CITY NAME]: INVENTORY OF EXPOSED ASSETS	
	Total Area	34.62 mi^2
	Area exposed to inundation	00.00 mi^2
	Total population	XX,XXX
	Population exposed to inundation	X,XXX
	Minimum and Maximum depth of inundation with SLR	XX feet
	Summary: This section will summarize the key vulnerabilities in each city, including identification of any socially vulnerable communities and other important issues.	

CLASS	CATEGORY	ASSET TYPE	QUANTITY	DESCRIPTION/NOTES
(1, 2, 3, 4)		Residential parcels/ buildings		
		Commercial parcels/buildings		
		Buildings with large # occupants		
		Waste Water Treatment Plants		
		Sewage Treatment Plants		
		Hazardous Materials/Sites		
		Hospitals		
		Elder Care Facilities		
		Police Department		
		Fire Department		
		Schools		
		Listed Species (threatened/endangered)		i.e., red legged frog
		Natural Areas		i.e., wetlands,
		Parks		
		Flood Control/Coastal Infrastructure		
		Community Centers		i.e., church, community buildings
		Recreational Access points		
		Recreational Areas (other)		
		Federal or State Highways (Length)		
		Roads (in length)		
		Railroads (in length)		
		Public transit (in length)		
		Public transit hubs (Samtrans/bart/caltrain station)		
		Transit maintenance yard		

		Industrial facilities		
		Emergency shelters		
		Evacuation Routes		
		Marinas		
		Ports		
		Cell phone towers		
		Gas fields		
		Power plants		
		Substations		
		Transmission lines		
		Transmission towers		
		Air strips/airports		
		Oil pipelines		
		Historic Places/Landmarks		
		Cultural resources/landmarks		
		Agricultural area (acres)		
		Storm water Infrastructure		

	TOTAL CLASS 1 ASSETS	XX
	TOTAL CLASS 2 ASSETS	XX
	TOTAL CLASS 3 ASSETS	XX
	TOTAL CLASS 4 ASSETS	XX

5.4 Attachment D. Prototype of Potential Asset Vulnerability Profile (Taken from City of Los Angeles)

Bureau of Sanitation

Venice Storm Water / Urban Runoff Pumping Plant (VSPP)
1600 Main Street
Venice, CA 90291

Asset Overview
Owner: City of Los Angeles
City Department and Point of Contact: Department of Public Works, Bureau of Sanitation
Regulatory Oversight: Regional Water Quality Control Board State Water Resources Control Board Environmental Protection Agency
Summary of Asset: The Venice Storm Water / Urban Runoff Pumping plant is a low flow diversion pump designed to move urban runoff and, in the wet season, stormwater flows from a lower elevation up to a higher one, so that it can be transported through pipelines by gravity for eventual processing at a treatment plant during low flows and discharge into the ocean during storm flows.

Current Observed Vulnerabilities
Pumping plant may be damaged if an extreme wet weather event floods electrical components. It is in the Tsunami Warning Area. Severe tidal condition could flood the plant.

Physical Vulnerability to Sea Level Rise Based on USGS Exposure Analysis		
Sensitivity (LOW)	Adaptive Capacity (HIGH)	Consequences (LOW)
The VSPP is not sensitive to storm-related flooding, tidal flooding, and erosion. Discharge during each storm season continues as designed and does not impact pumping capacity. The pump does not operate during rain events and the flow is conveyed to the discharge locations by gravity. The plant is located between the beach and a channel, so the plant could potentially be inundated by sea level rise from both sides.	The plant has been identified as an asset that is functioning as intended. Any flooding would not be related to function of the low flow pump. The BOS is evaluating the need to make the plant more resilient to storm-related flooding through functional and reliability improvements. The BOS has emergency plans in place to restore function. A study to better understand the impacts of groundwater and seawater intrusion into the VSPP is underway.	Any localized flooding would not be related to function of the low flow urban runoff diversion pump. Flooding would have high social consequences including displacement and public health concerns. The replacement value of the plant itself is ten million dollars however impacts to individual pieces of equipment would cost significantly less than the loss of the entire facility.

Replacement value (e.g., cost of inaction):	$10 million

APPENDIX B

Built Asset Exposure

Zone 1:
Brisbane, South San Francisco

Appendix B: Asset Exposure Maps

Essential Facilities

- Airport
- Fire Station
- Hospital
- Police Station
- School

Transportation Systems

- Highway
- Port
- Railroad
- Railroad Station

Lifeline Utilities & Hazardous Materials

- Energy Asset (Power Plant)
- Hazardous Material Site
- Pump Station
- Wastewater Treatment Facility

Other Built Assets

- Class 4
- Class 3
- Class 2
- Class 1

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

N

This map is intended to improve sea level rise awareness and preparedness by providing a regional-scale illustration of inundation and coastal flooding due to specific sea level rise and storm surge scenarios. This map is not detailed to the parcel-scale and should not be used for navigation, permitting, regulatory, or other legal uses. Flooding due to sea level rise and storm surge is possible in areas outside of those predicted, and even the best predictions cannot guarantee the safety of an individual or structure. Nor does this map model flooding from riverine, surface water flooding from rainfall-runoff events, or other sources. The contributors and sponsors of this product do not assume liability for any injury, death, property damage, or other effects of flooding. All underlying data for the inundation layers is from the Our Coast Our Future tool and the erosion layers are from the Pacific Institute. The erosion scenario does not account for shoreline protection. For the inundation scenarios, although care was taken to capture relevant topographic features and coastal structures that may impact coastal inundation, it is possible that structures may not be fully represented.

COUNTY OF SAN MATEO
Coastal Conservancy
ARCADIS Design & Consultancy for natural and built assets

Built Asset Exposure

Zone 2:
San Bruno, San Francisco International Airport

Appendix B: Asset Exposure Maps

Essential Facilities

- Airport
- Fire Station
- Hospital
- Police Station
- School

Transportation Systems

- Highway
- Port
- Railroad
- Railroad Station

Lifeline Utilities & Hazardous Materials

- Energy Asset (Power Plant)
- Hazardous Material Site
- Pump Station
- Wastewater Treatment Facility

Other Built Assets

- Class 4
- Class 3
- Class 2
- Class 1

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
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- City and Town Boundaries

0 0.8 1.6
Miles

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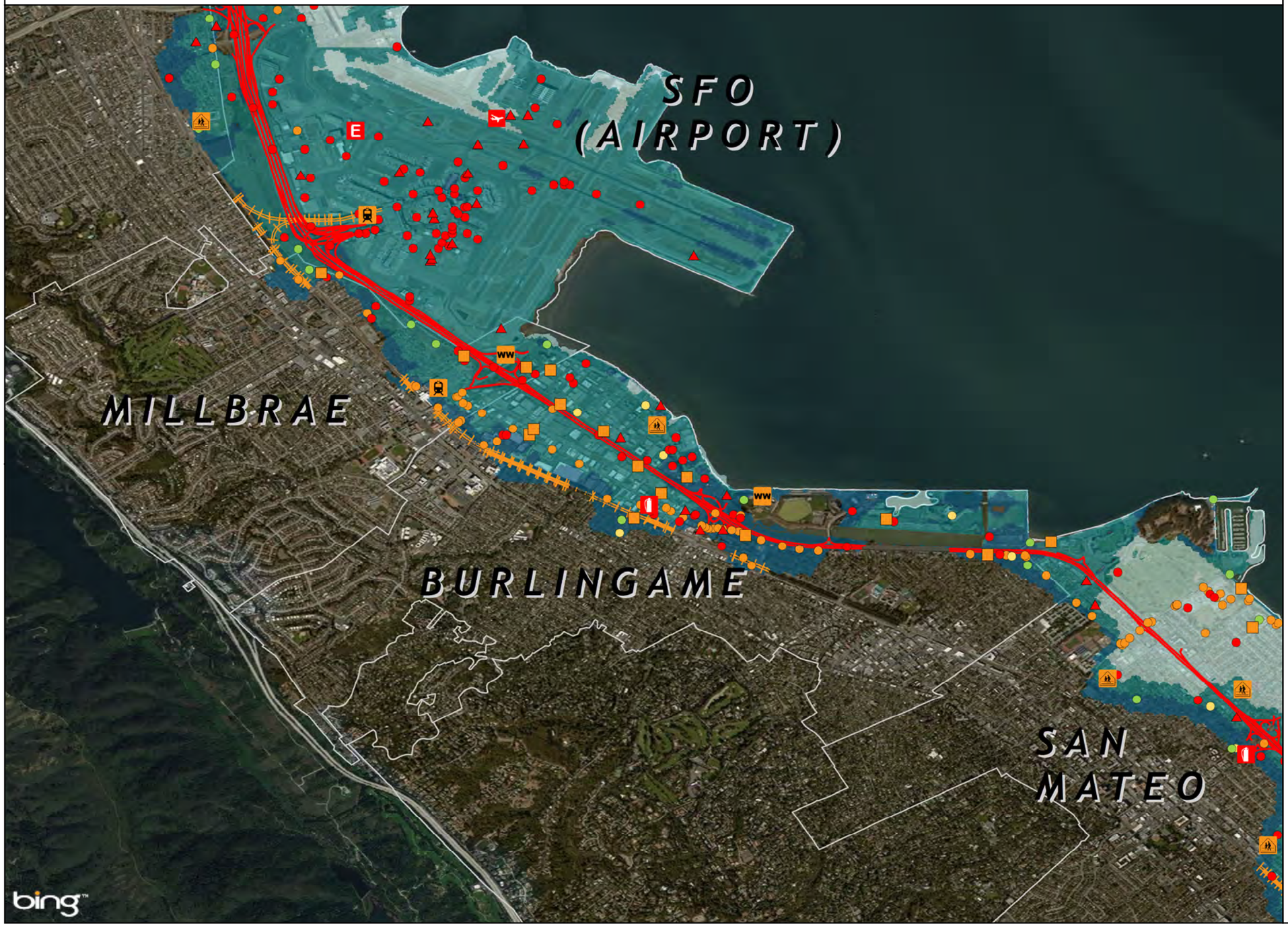
COUNTY OF SAN MATEO | Coastal Conservancy | ARCADIS Design & Consultancy for natural and built assets

Built Asset Exposure

Zone 3:
Burlingame, Milbrae



Essential Facilities

- Airport
- Fire Station
- Hospital
- Police Station
- School

Transportation Systems

- Highway
- Port
- Railroad
- Railroad Station

Lifeline Utilities & Hazardous Materials

- Energy Asset (Power Plant)
- Hazardous Material Site
- Pump Station
- Wastewater Treatment Facility

Other Built Assets

- Class 4
- Class 3
- Class 2
- Class 1

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

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Miles

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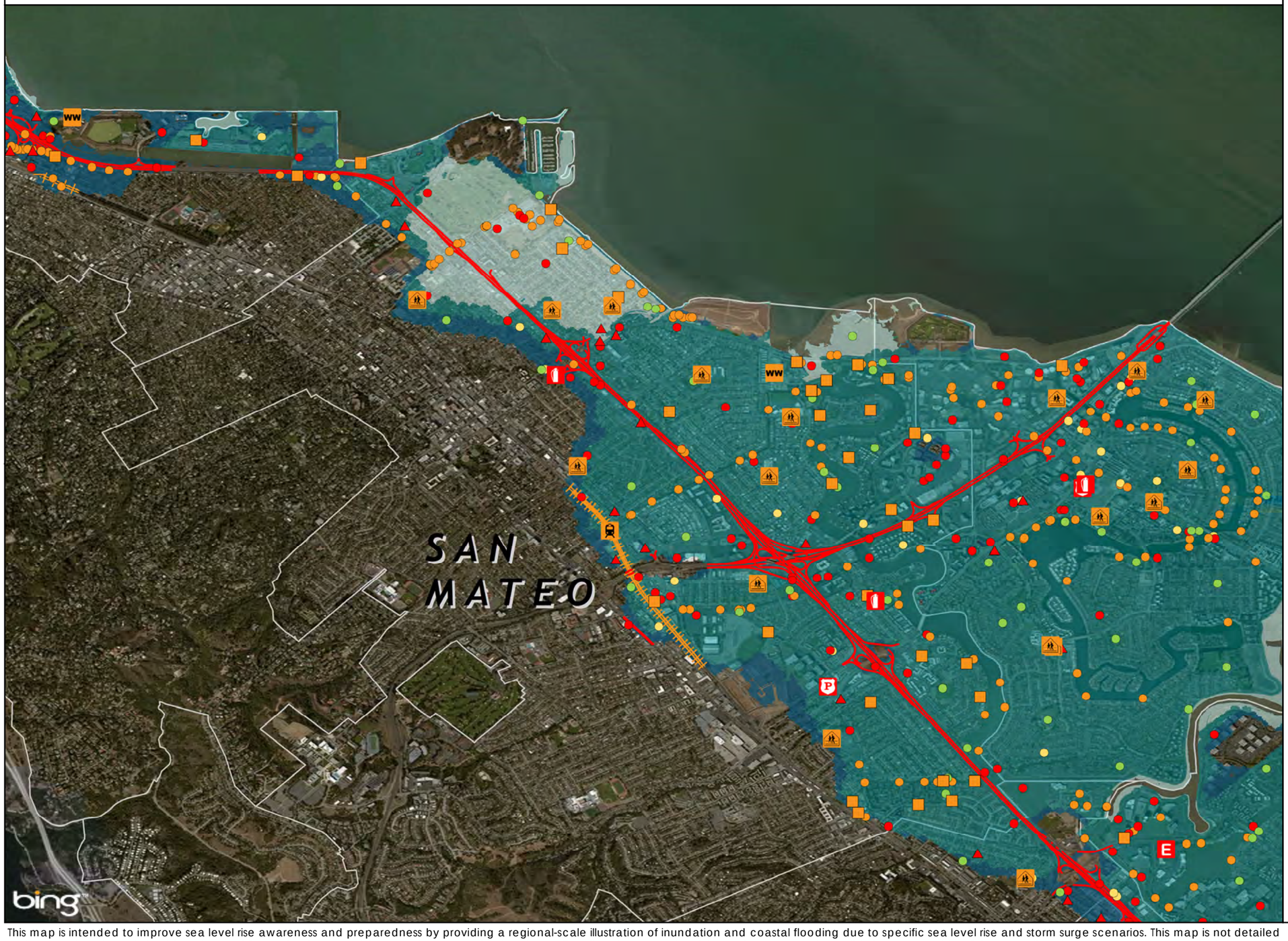
COUNTY OF SAN MATEO · Coastal Conservancy · ARCADIS Design & Consultancy for natural and built assets

Built Asset Exposure

Zone 4:
San Mateo

Appendix B: Asset Exposure Maps



Essential Facilities

- Airport
- Fire Station
- Hospital
- Police Station
- School

Transportation Systems

- Highway
- Port
- Railroad
- Railroad Station

Lifeline Utilities & Hazardous Materials

- Energy Asset (Power Plant)
- Hazardous Material Site
- Pump Station
- Wastewater Treatment Facility

Other Built Assets

- Class 4
- Class 3
- Class 2
- Class 1

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

N

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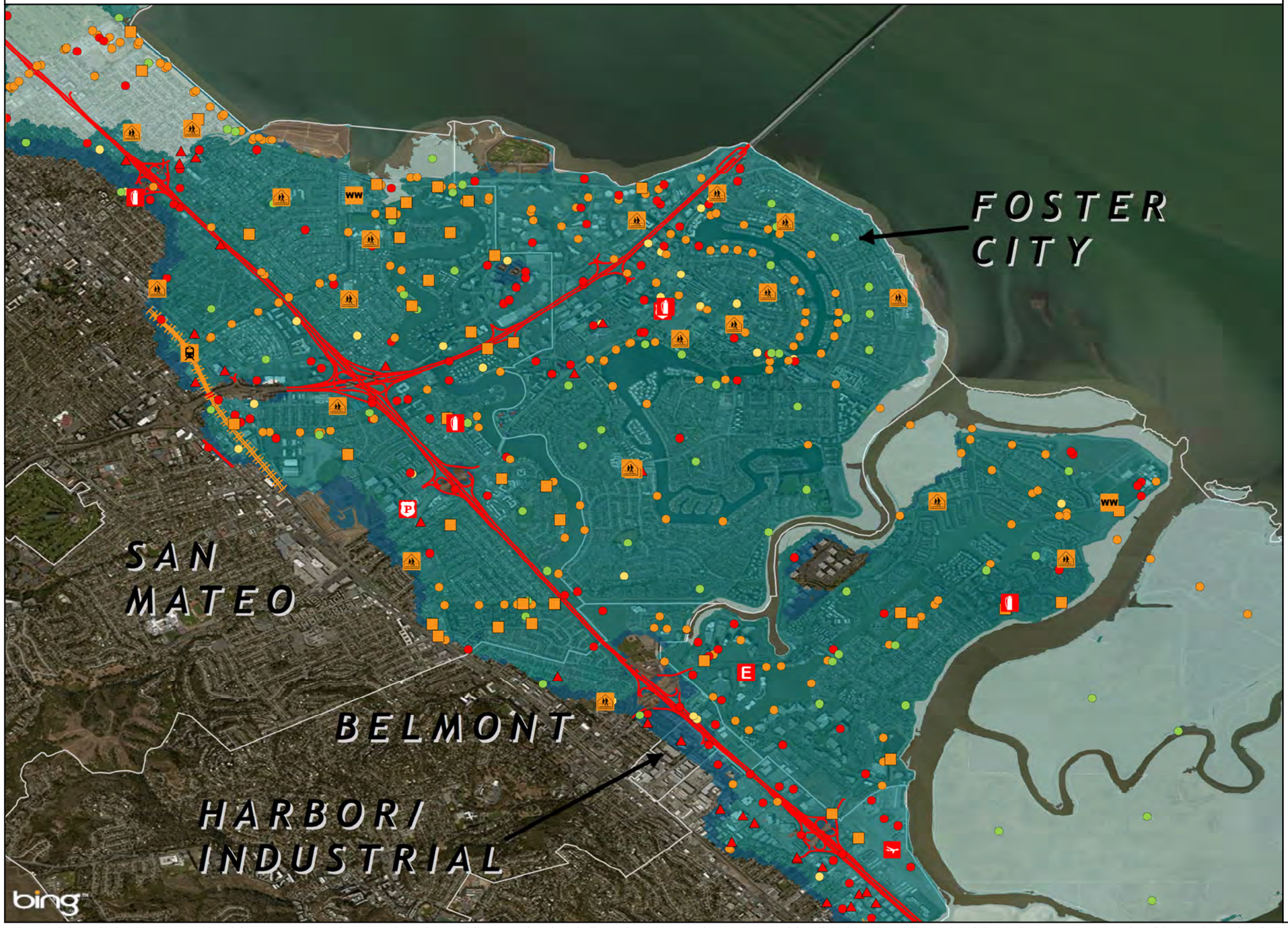
COUNTY OF SAN MATEO
Coastal Conservancy
ARCADIS Design & Consultancy for natural and built assets

Built Asset Exposure

Zone 5:
Belmont, Foster City, Harbor/Industrial

Appendix B: Asset Exposure Maps



Essential Facilities
- Airport
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- Police Station
- School

Transportation Systems
- Highway
- Port
- Railroad
- Railroad Station

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Other Built Assets
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Hazard Extent
- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6 Miles

N

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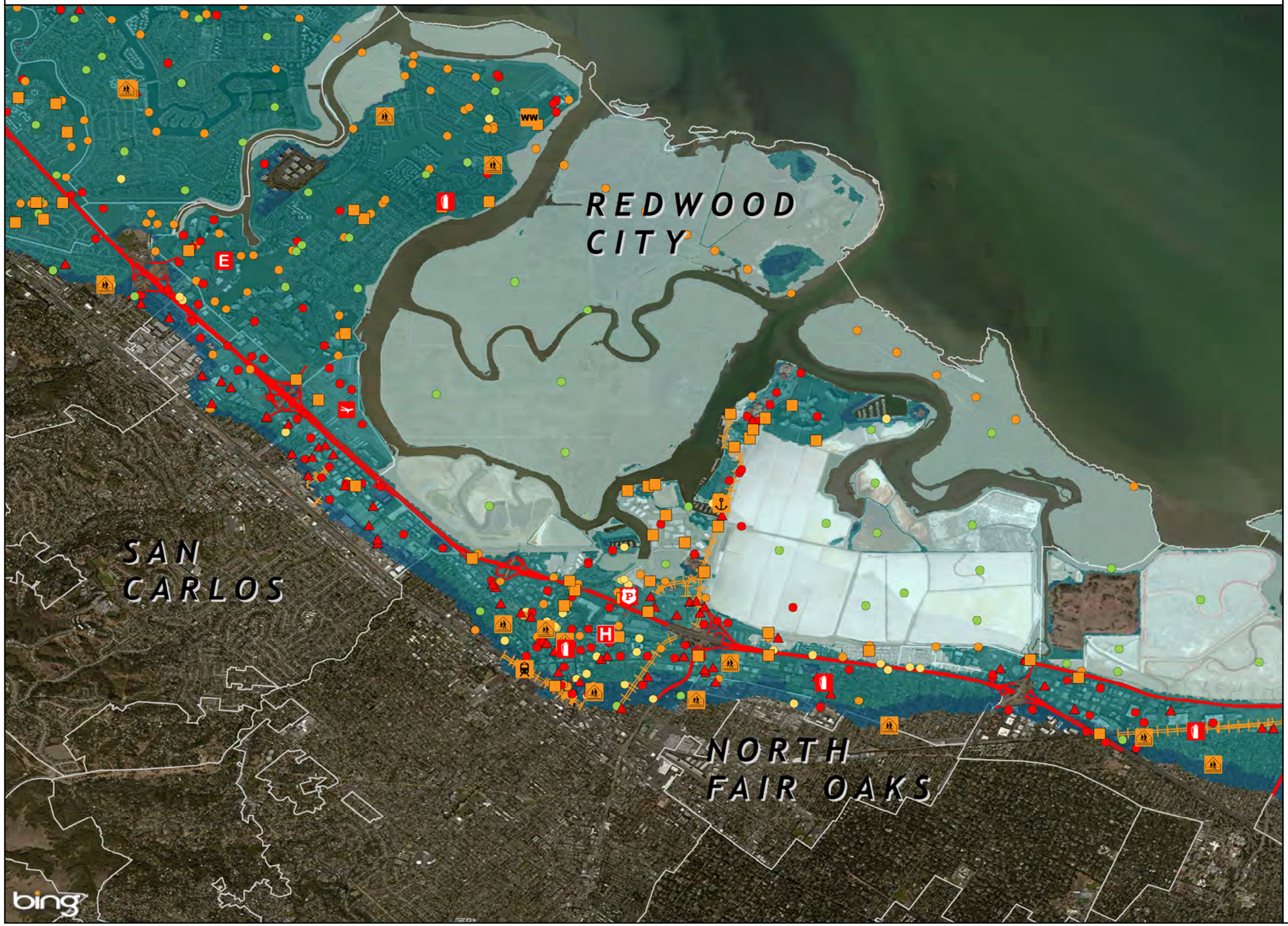
COUNTY OF SAN MATEO · Coastal Conservancy · ARCADIS Design & Consultancy for natural and built assets

Built Asset Exposure

Zone 6:
North Fair Oaks, Redwood City, San Carlos

Appendix B: Asset Exposure Maps



Essential Facilities
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Transportation Systems
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- Port
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- Railroad Station

Lifeline Utilities & Hazardous Materials
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- Pump Station
- Wastewater Treatment Facility

Other Built Assets
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- Class 3
- Class 2
- Class 1

Hazard Extent
- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 1 2 Miles

N

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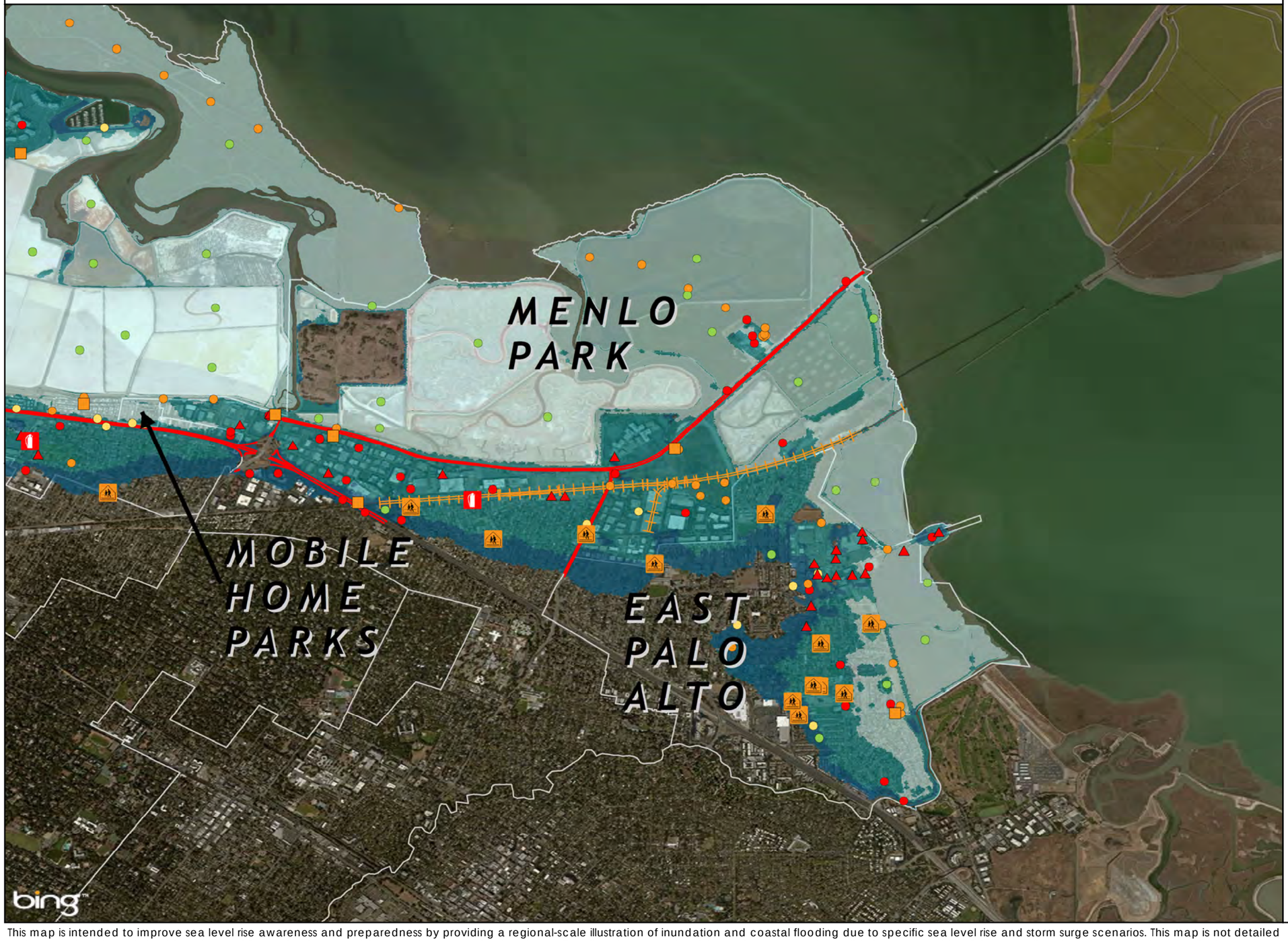
COUNTY OF SAN MATEO | Coastal Conservancy | ARCADIS Design & Consultancy for natural and built assets

Built Asset Exposure

Zone 7:
East Palo Alto, Menlo Park, Mobile Homes Parks

Appendix B: Asset Exposure Maps



Essential Facilities
- Airport
- Fire Station
- Hospital
- Police Station
- School

Transportation Systems
- Highway
- Port
- Railroad
- Railroad Station

Lifeline Utilities & Hazardous Materials
- Energy Asset (Power Plant)
- Hazardous Material Site
- Pump Station
- Wastewater Treatment Facility

Other Built Assets
- Class 4
- Class 3
- Class 2
- Class 1

Hazard Extent
- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

N

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COUNTY OF SAN MATEO
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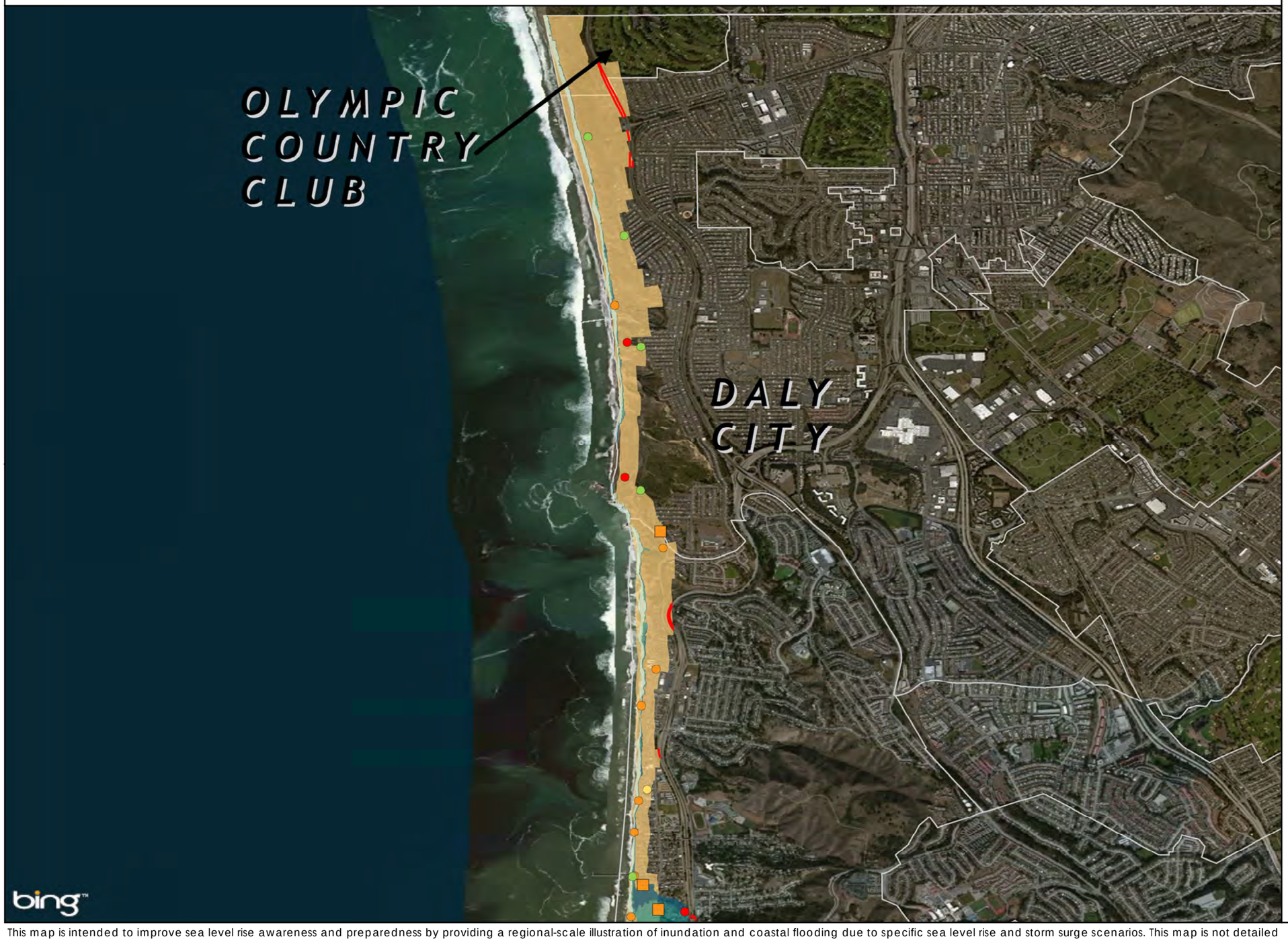
Built Asset Exposure

Zone 8:
Daly City, Olympic Country Club

Appendix B: Asset Exposure Maps



Essential Facilities

- Airport
- Fire Station
- Hospital
- Police Station
- School

Transportation Systems

- Highway
- Port
- Railroad
- Railroad Station

Lifeline Utilities & Hazardous Materials

- Energy Asset (Power Plant)
- Hazardous Material Site
- Pump Station
- Wastewater Treatment Facility

Other Built Assets

- Class 4
- Class 3
- Class 2
- Class 1

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

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COUNTY OF SAN MATEO | Coastal Conservancy | ARCADIS Design & Consultancy for natural and built assets

Built Asset Exposure

Zone 9:
Pacifica

Appendix B: Asset Exposure Maps

Essential Facilities

- Airport
- Fire Station
- Hospital
- Police Station
- School

Transportation Systems

- Highway
- Port
- Railroad
- Railroad Station

Lifeline Utilities & Hazardous Materials

- Energy Asset (Power Plant)
- Hazardous Material Site
- Pump Station
- Wastewater Treatment Facility

Other Built Assets

- Class 4
- Class 3
- Class 2
- Class 1

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

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COUNTY OF SAN MATEO
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Built Asset Exposure

Zone 10:
Montara, Moss Beach, Unincorporated Area - North

Appendix B: Asset Exposure Maps

Essential Facilities
- Airport
- Fire Station
- Hospital
- Police Station
- School

Transportation Systems
- Highway
- Port
- Railroad
- Railroad Station

Lifeline Utilities & Hazardous Materials
- Energy Asset (Power Plant)
- Hazardous Material Site
- Pump Station
- Wastewater Treatment Facility

Other Built Assets
- Class 4
- Class 3
- Class 2
- Class 1

Hazard Extent
- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6 Miles

N

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COUNTY OF SAN MATEO | Coastal Conservancy | ARCADIS Design & Consultancy for natural and built assets

Built Asset Exposure

Zone 11:
Miramar, Princeton, Unincorporated Area - South

Appendix B: Asset Exposure Maps

Essential Facilities

- Airport
- Fire Station
- Hospital
- Police Station
- School

Transportation Systems

- Highway
- Port
- Railroad
- Railroad Station

Lifeline Utilities & Hazardous Materials

- Energy Asset (Power Plant)
- Hazardous Material Site
- Pump Station
- Wastewater Treatment Facility

Other Built Assets

- Class 4
- Class 3
- Class 2
- Class 1

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

N

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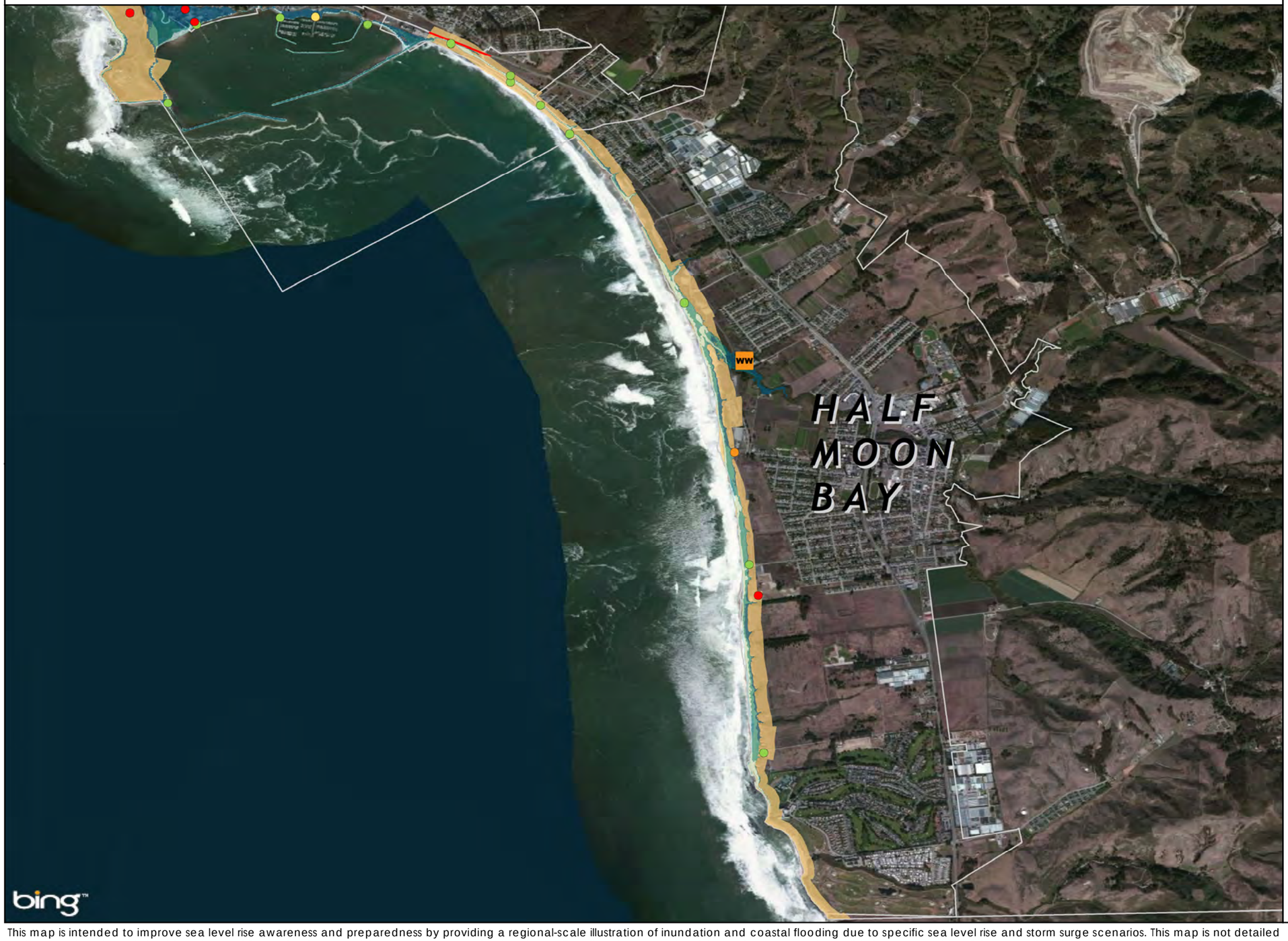
Built Asset Exposure

Zone 12:
Half Moon Bay

Appendix B: Asset Exposure Maps



Essential Facilities

- Airport
- Fire Station
- Hospital
- Police Station
- School

Transportation Systems

- Highway
- Port
- Railroad
- Railroad Station

Lifeline Utilities & Hazardous Materials

- Energy Asset (Power Plant)
- Hazardous Material Site
- Pump Station
- Wastewater Treatment Facility

Other Built Assets

- Class 4
- Class 3
- Class 2
- Class 1

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

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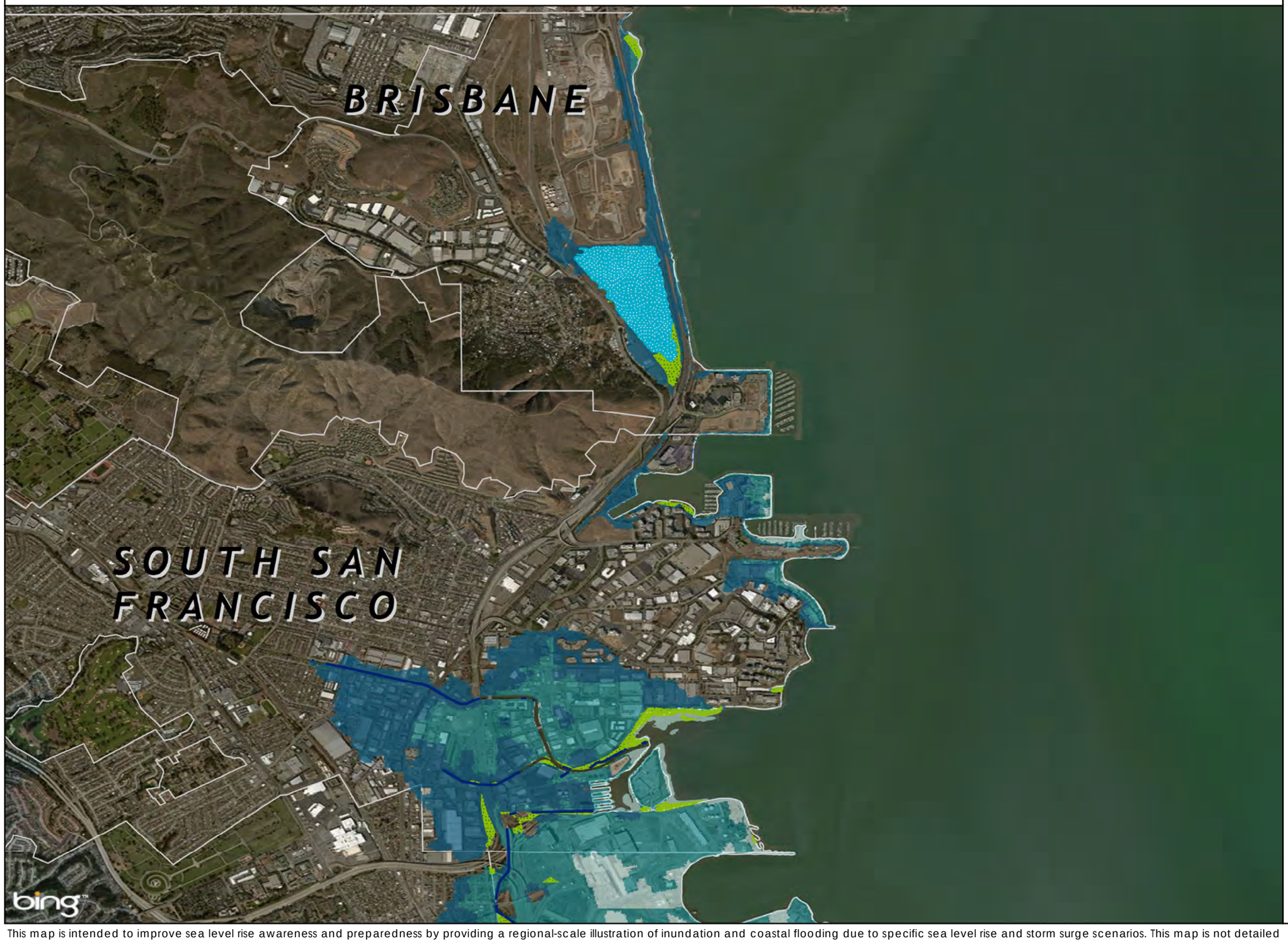
Natural Asset Exposure

Zone 1:
Brisbane, South San Francisco

Appendix B: Asset Exposure Maps



Natural Assets

- Beaches
- Streams
- Surfgrass Habitat
- Eelgrass Habitat
- Inland Water Features
- Kelp Habitat
- Wetlands

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

N

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Natural Asset Exposure

Zone 2:
San Bruno, San Francisco International Airport

Appendix B: Asset Exposure Maps

Natural Assets

- Beaches
- Streams
- Surfgrass Habitat
- Eelgrass Habitat
- Inland Water Features
- Kelp Habitat
- Wetlands

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

N

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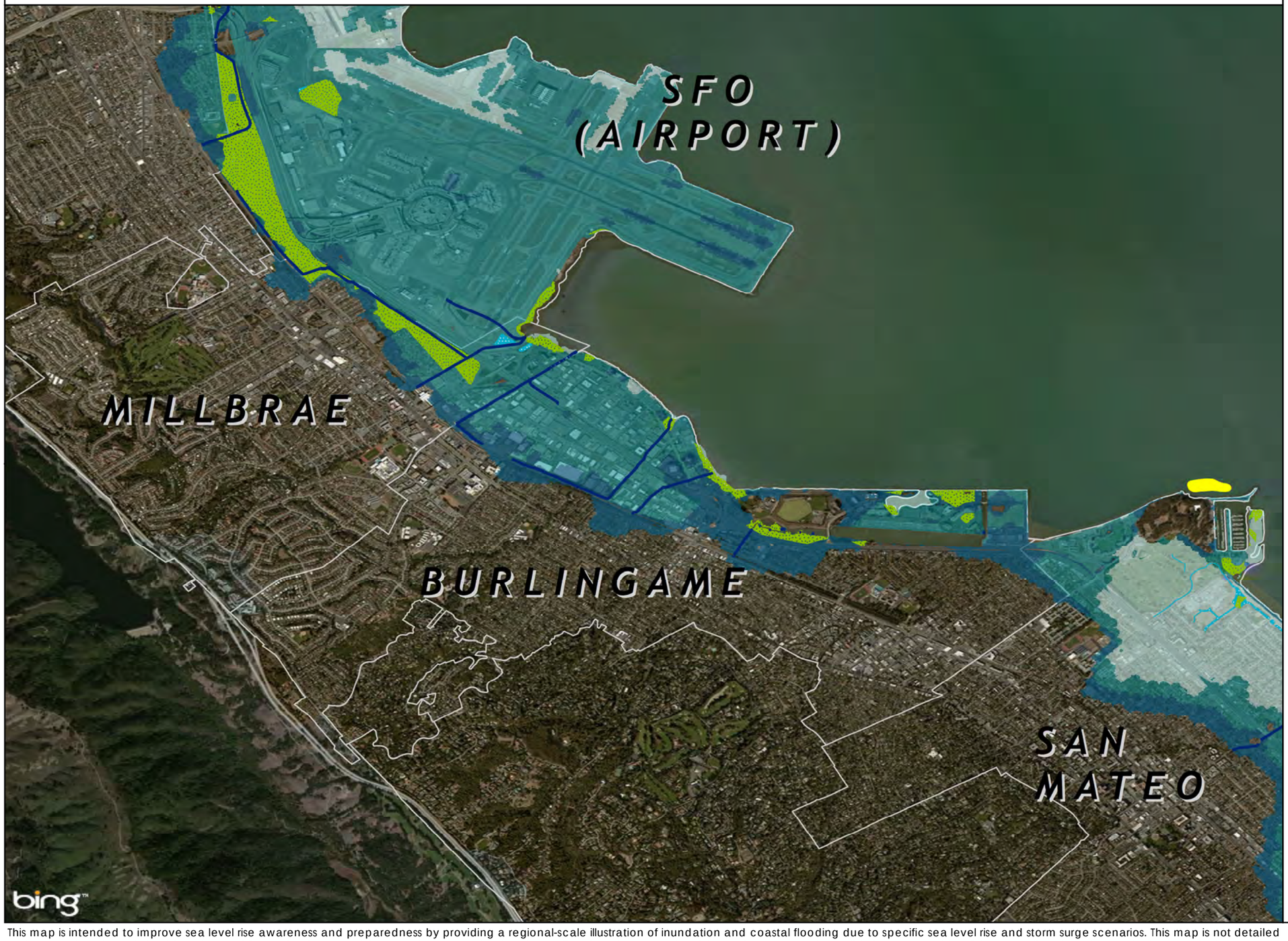
Natural Asset Exposure

Zone 3:
Burlingame, Milbrae

Appendix B: Asset Exposure Maps



Natural Assets

- Beaches
- Streams
- Surfgrass Habitat
- Eelgrass Habitat
- Inland Water Features
- Kelp Habitat
- Wetlands

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

N

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Natural Asset Exposure

Zone 4:
San Mateo

Appendix B: Asset Exposure Maps

Natural Assets

- Beaches
- Streams
- Surfgrass Habitat
- Eelgrass Habitat
- Inland Water Features
- Kelp Habitat
- Wetlands

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

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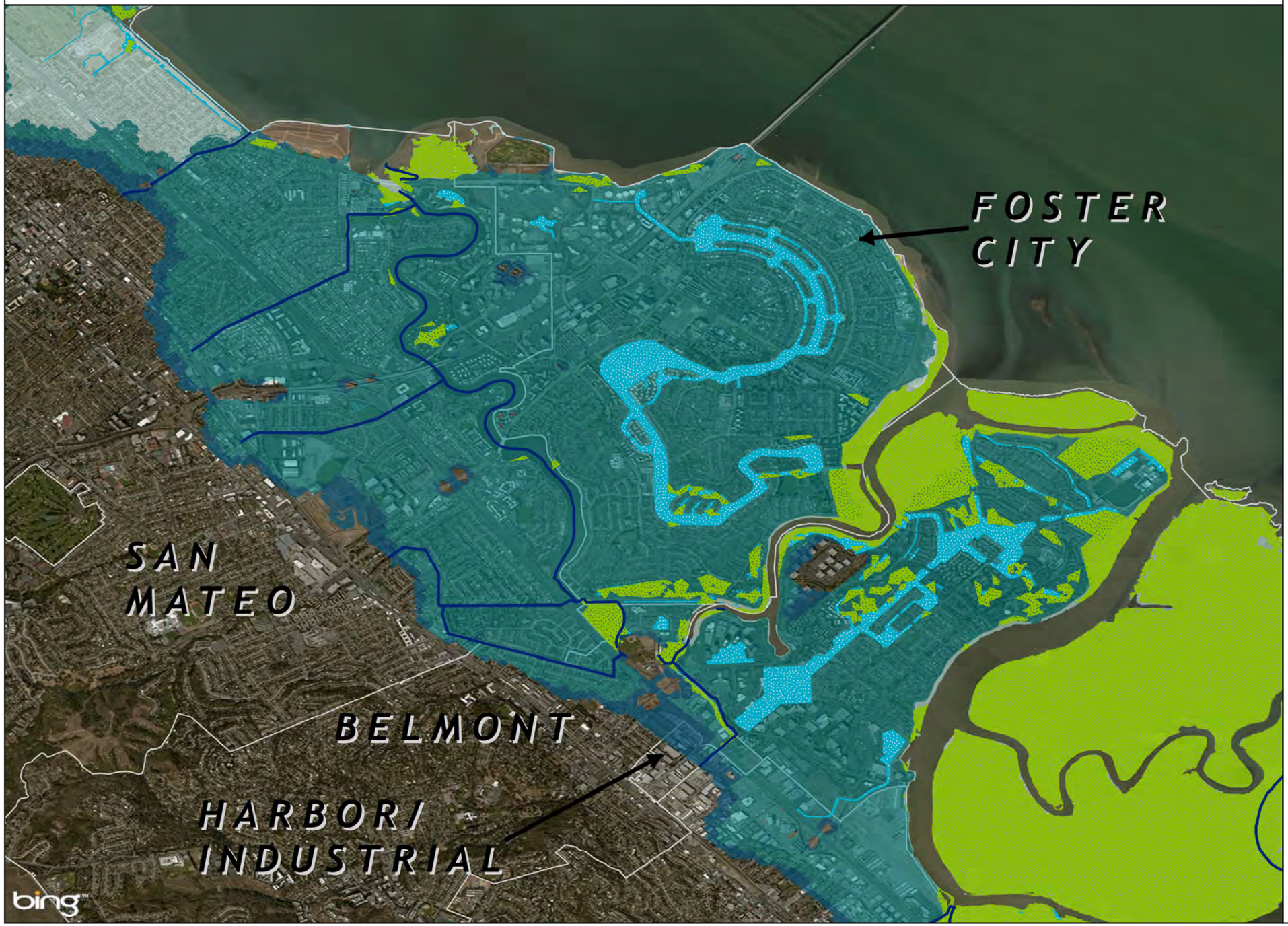
Natural Asset Exposure

Zone 5:
Belmont, Foster City, Harbor/Industrial

Appendix B: Asset Exposure Maps



Natural Assets

- Beaches
- Streams
- Surfgrass Habitat
- Eelgrass Habitat
- Inland Water Features
- Kelp Habitat
- Wetlands

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

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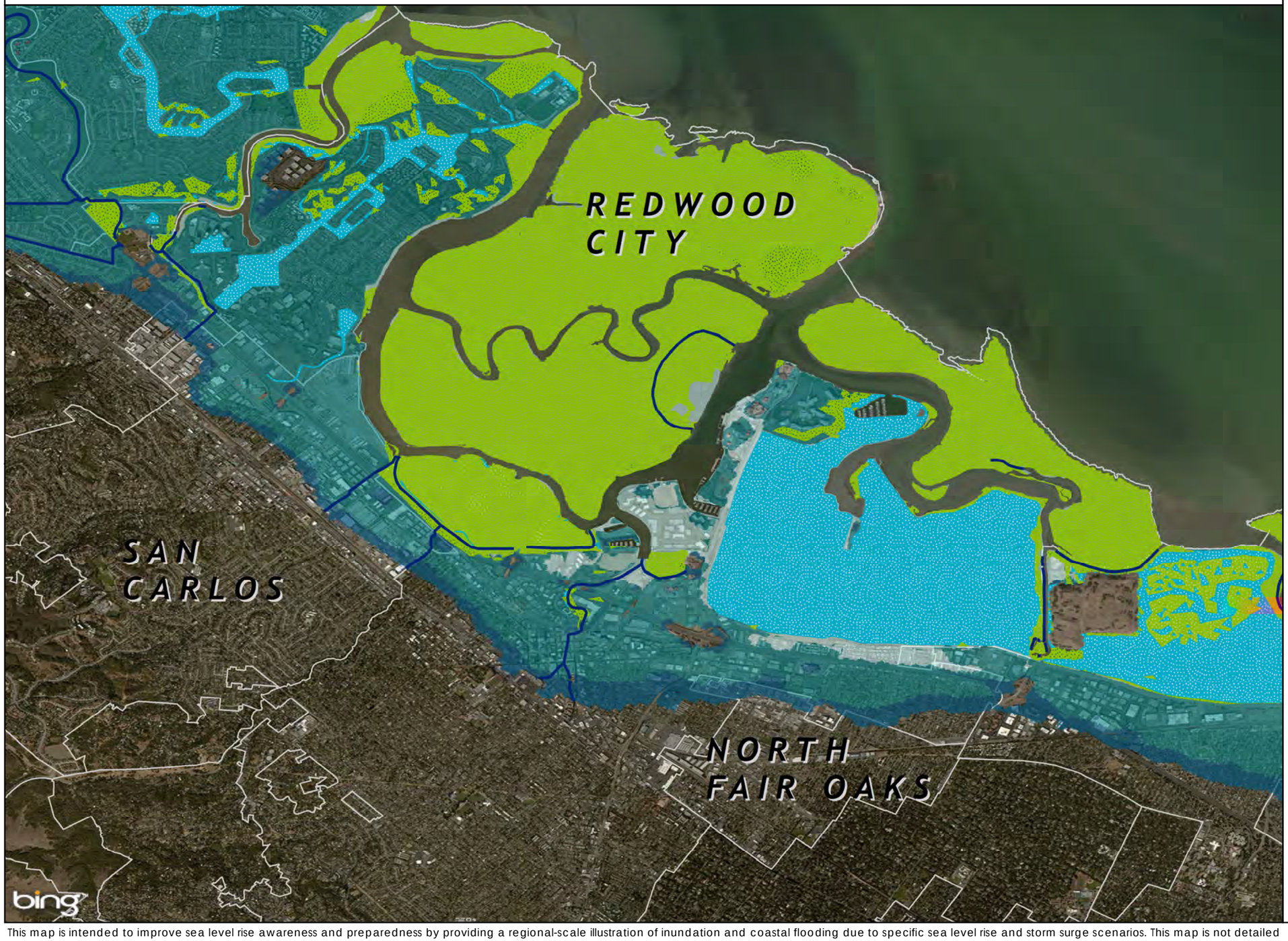
Natural Asset Exposure

Zone 6:
North Fair Oaks, Redwood City, San Carlos

Appendix B: Asset Exposure Maps



Natural Assets

- Beaches
- Streams
- Surfgrass Habitat
- Eelgrass Habitat
- Inland Water Features
- Kelp Habitat
- Wetlands

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 1 2 Miles

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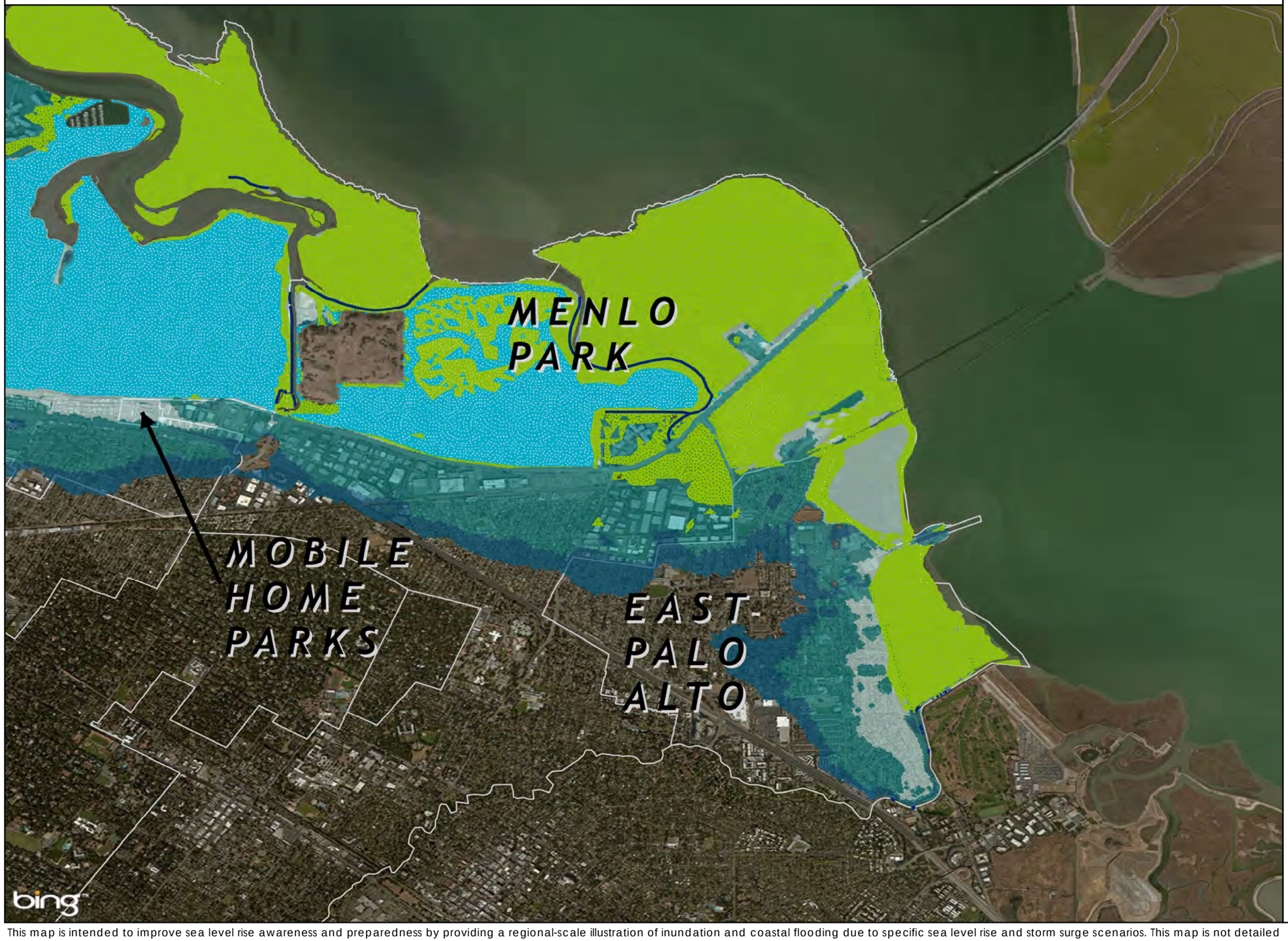
Natural Asset Exposure

Zone 7:
East Palo Alto, Menlo Park, Mobile Homes Parks

Appendix B: Asset Exposure Maps



Natural Assets

- Beaches
- Streams
- Surfgrass Habitat
- Eelgrass Habitat
- Inland Water Features
- Kelp Habitat
- Wetlands

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

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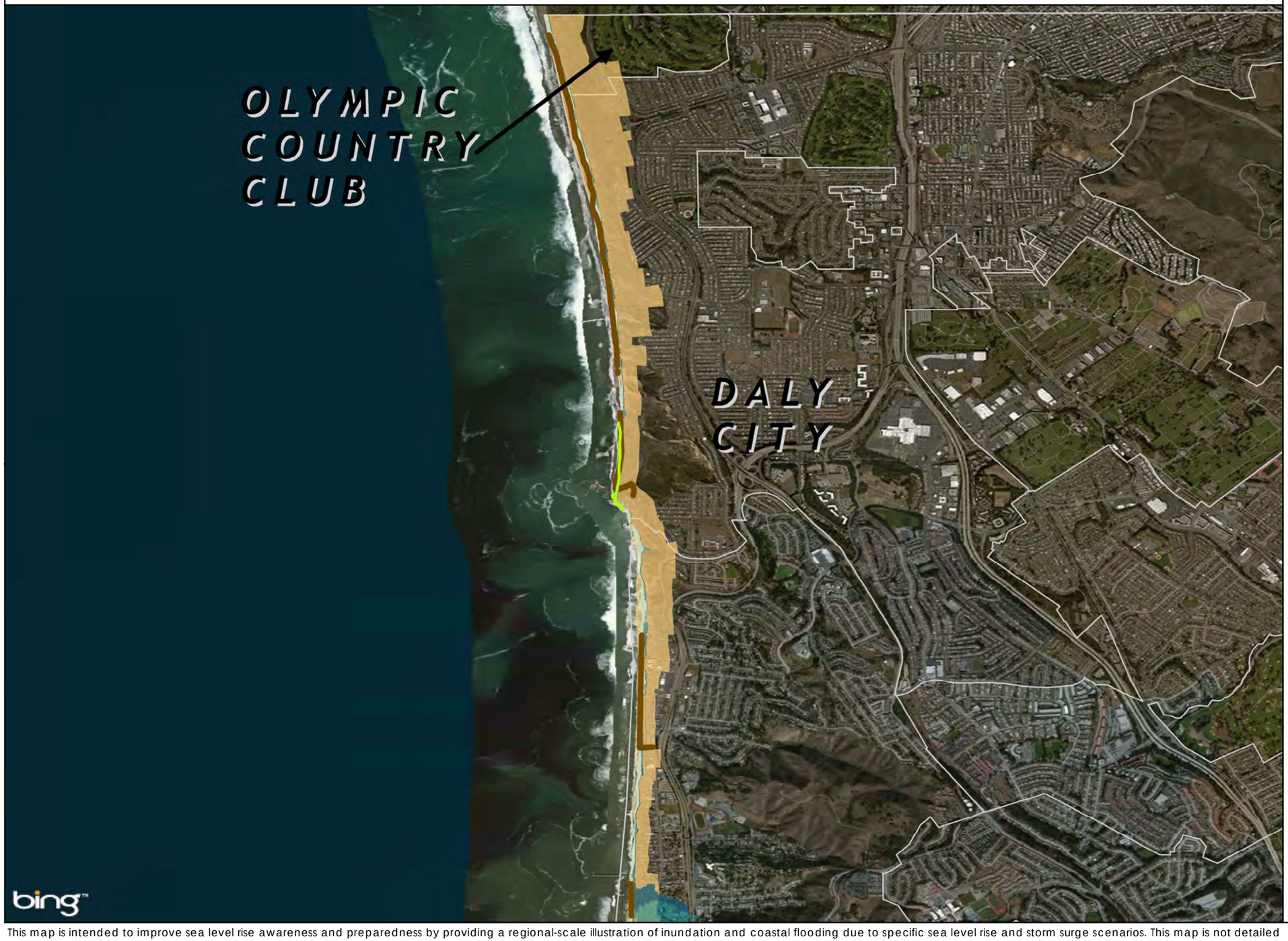
Natural Asset Exposure

Zone 8:
Daly City, Olympic Country Club

Appendix B: Asset Exposure Maps



Natural Assets

- Beaches
- Streams
- Surfgrass Habitat
- Eelgrass Habitat
- Inland Water Features
- Kelp Habitat
- Wetlands

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

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COUNTY OF SAN MATEO
Coastal Conservancy
ARCADIS Design & Consultancy for natural and built assets

Natural Asset Exposure

Zone 9:
Pacifica

Appendix B: Asset Exposure Maps

Natural Assets

- Beaches
- Streams
- Surfgrass Habitat
- Eelgrass Habitat
- Inland Water Features
- Kelp Habitat
- Wetlands

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

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COUNTY OF SAN MATEO
Coastal Conservancy
ARCADIS Design & Consultancy for natural and built assets

Natural Asset Exposure

Zone 10:
Montara, Moss Beach, Unincorporated Area - North

Appendix B: Asset Exposure Maps

Natural Assets

- Beaches
- Streams
- Surfgrass Habitat
- Eelgrass Habitat
- Inland Water Features
- Kelp Habitat
- Wetlands

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

N

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Natural Asset Exposure

Zone 11:
Miramar, Princeton, Unincorporated Area - South

Appendix B: Asset Exposure Maps

Natural Assets

- Beaches
- Streams
- Surfgrass Habitat
- Eelgrass Habitat
- Inland Water Features
- Kelp Habitat
- Wetlands

Hazard Extent

- Baseline Scenario (No SLR)
- Mid-Level Scenario (3.3 feet SLR)
- High Scenario (6.6 feet SLR)
- Future Erosion

- City and Town Boundaries

0 0.8 1.6
Miles

N

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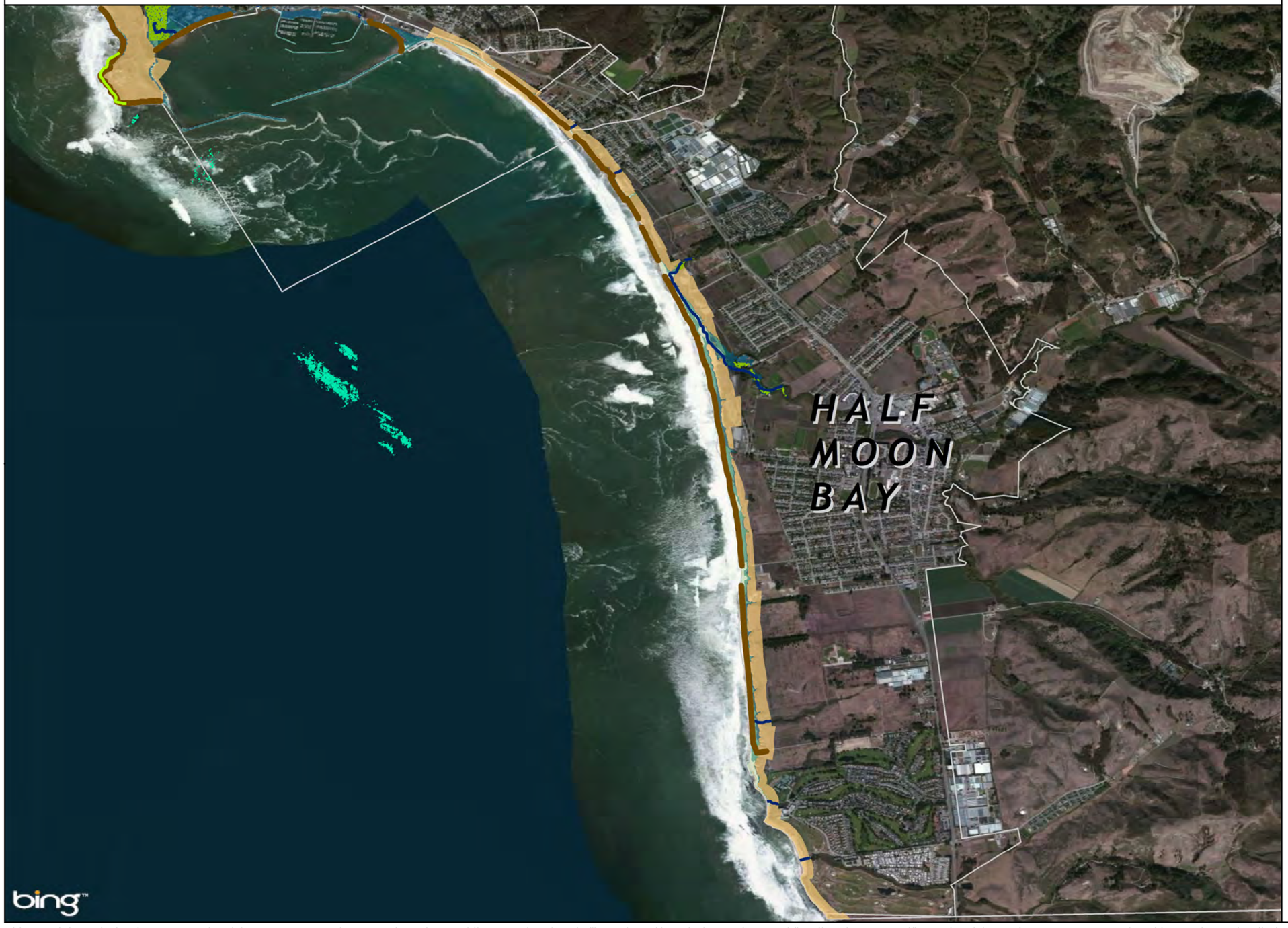
Natural Asset Exposure

Zone 12:
Half Moon Bay

Appendix B: Asset Exposure Maps



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APPENDIX C

ARCADIS Design & Consultancy for natural and built assets

SAN MATEO COUNTY SEA LEVEL RISE VULNERABILITY ASSESSMENT

Asset Questionnaire

Asset Name:

Asset Type: Wastewater Treatment Plant

Thank you for participating in San Mateo County's Sea Level Rise Vulnerability Assessment. As an asset manager, owner, or subject matter expert, your responses to this questionnaire provides the County with critical insight on the specific vulnerabilities to and potential consequences of present day and future hazards (such as flooding or erosion) due to sea level rise. The information you provide will support the development of an Asset Vulnerability Profile that describes the exposure, sensitivity, and adaptive capacity of this facility and others like it.

INSTRUCTIONS

Please fill out the questionnaire below and answer all of the questions to the best of your ability. This should take approximately 1-2 hours. Once completed, please return the survey via email to Hilary Papendick. If you have any questions while filling out the questionnaire please do not hesitate to contact Hilary Papendick by phone or email.

Disclaimer: No information from this questionnaire will be published or released without prior review and approval by the asset owner or operator. However, please indicate if any of the information you share below is sensitive or confidential. For more information, or if you have questions about how information from this questionnaire will be used in the County's Vulnerability Assessment, please contact Hilary Papendick.

FACILITY FUNCTION AND SERVICE

1. **Briefly describe the function of the facility and type of wastewater treated.**
(industrial, residential, commercial)

2. **Please describe the service area, jurisdiction, and population served by the facility**.

Service area:

Jurisdiction(s):

Population served (# of people):

3. a) **What is the level of use or capacity of the facility?** *(i.e., average treatment in MGD)*

b) **Is the facility functioning at capacity, or is there additional capacity to meet future conditions?** *(Yes/no)*

4. a) **How many staff or other individuals are on site during the day?**

b) **At night?**

FACILITY CHARACTERISTICS AND EXISTING CONDITIONS

5. a) What year was this facility built and what is its expected remaining service life?

Year built:

Remaining service life (in years):

b) When and what was the last major repair or improvement?

Year:

Improvement/repair:

6. What is the ground floor elevation (in feet) of the facility? *(provide datum if known)*

7. a) Please identify the major components of this facility (i.e., screen buildings, pump stations, substations, etc.). *Please provide the elevation and building material of each major component if known.*

Component and Description	*Elevation*	*Building Material*

b) Which of the above are *essential components or are interdependent?**
*(*Essential components are those that are required for maintaining the level of service; loss of essential components may impact other parts of the facility and ultimately disrupt the level of service; i.e., conveyance and collection system into plant or treatment bypass; conveyance though the plant or disinfection; primary/secondary treatment; etc.)*

Essential components:

Please explain any interdependencies:

8. **What additional external services, assets, or materials does the facility rely on? (***Such as power/fuel/materials/supply chain issues, and/or any nearby assets or roads etc.) Explain, or write "none."*

9. **Briefly describe the power supply and backup power supply to the facility.**

Power Supply:

Backup Power Supply:

10. **How large is the facility/asset site?** *(Square feet)*

11. **What is the general condition of facility?** *(Check one)*

☐ (1) *Newly Constructed* ☐ (2) *Excellent* ☐ (3) *Good* ☐ (4) *Fair* ☐ (5) *Poor*

12. **Does the facility have any special historical or cultural designation?** *If yes, please explain.*

13. **What is the most recent valuation of the facility** (and its components, if applicable)**?**

Facility:

Other Components:

Source and year of valuation:

COASTAL HAZARD EXPOSURE AND PHYSICAL VULNERABILITIES

Consider the following coastal hazards and exposures that are associated with sea level rise when completing this section. If your facility has previously experienced any coastal flooding or related hazards, please answer the following questions based on what happened. If your facility has not experienced any of the following hazards, please answer to the best of your ability based on what you think could reasonably happen if the following hazards were to occur.

- Rising water table
- Temporary flooding
- Wave impacts
- Beach/cliff erosion
- Saltwater intrusion
- Permanent flooding
- High winds impacts

14. **a) Has this facility or site experienced any flooding or disruption from any other coastal hazard in the past?** *(Yes/no)*

b) If yes, please describe the following.

What happened?

When?

c) How did flood water enter the site? *How might floodwater enter the facility/site?*

d) If known, how deep/high was the floodwater? *(Height of water if possible; otherwise, relative to some landmark, i.e., top of doorway)*

15. **Which components from question 14 were flooded?** *If never flooded, which components might you expect to be flooded/affected by another coastal hazard?*

16. **If flooded, did/would water drain from the site, or did/would it have to be pumped from the facility?** *(Yes/no)*

17. **If known, please identify any additional site vulnerabilities or pathways for floodwaters.** *(not mentioned in Question 14c above)*

18. **a)** **Does the facility have openings at-grade or below-grade that are entry points for coastal flooding or saltwater intrusion?** *(Yes/no)*

b) **Are there other ways might it be possible for this asset or its essential components to be affected by flooding or other coastal hazards?** *(i.e., creek overflow, stormwater backup, sewage back-up etc. Yes/no)*

19. **a)** **Please share any relevant information related to groundwater at your facility; or, write "does not apply."** *(i.e., has groundwater ever been the source of flooding? Are there concerns about contaminants from this facility getting into the groundwater?)*

b) **Are there any systems in place to keep water away from below-grade systems, basements, and foundations?** *(Yes/no)*

c) **If yes, would systems have adequate capacity to remove additional groundwater if levels increase?** *(Yes/no)*

20. **Have there been locally observed changes in land elevation?** *If yes, describe location, degree subsidence or uplift, and timeframe over which it occurred.*

POTENTIAL IMPACTS FROM COASTAL FLOODING AND OTHER HAZARDS RELATED TO SEA LEVEL RISE

Consider the following coastal hazards and exposures that are associated with sea level rise when completing this section. If your facility has previously experienced the effects from any coastal hazards, please answer the questions based on what happened. If your facility has not previously experienced coastal flooding or related hazards, please answer to the best of your ability based on either some prior disruption, or on what could reasonably occur in the future as a result from the hazards below.

- *Rising water table*
- *Temporary flooding*
- *Wave impacts*
- *Beach/cliff erosion*
- *Saltwater intrusion*
- *Permanent flooding*
- *High winds impacts*

21. What is your primary concern related to sea level rise and this facility?

22. a) Has facility been disrupted in the past due to any unplanned event*? (i.e., flood, weather-related closure, emergency repair or improvement, or other event, etc. Yes/no)*

If yes, when did this event occur and what happened? (*If this is the same event described in Question 14 above, please write "same event")*

How long did disruption last?

b) What types of damages or consequences were caused or, what types of damages might be caused? *If possible, please quantify.*

23. a) If the facility experienced or were to experience any of the above hazards, did/could it perform its primary function? *(Yes/no)*

b) Was there (would there be) an impact on the level of service? *(Yes/no)*

c) If yes, for how long? *Please check one and explain if necessary.*

☐ (i) Maintained with minimal disruption

☐ (ii) Use of facility is maintained, but ingress or egress is lost; costs are limited to emergency protective measures only

☐ (iii) Use of facility or service is lost and restored within 24 hours

☐ (iv) Use of facility or service is lost and inoperable for 1-7 day

☐ (v) Use of facility/service is lost and inoperable for 7 days or more *Please provide details as necessary.*

d) If the facility were disrupted for any reason, please describe the previously experienced or potential consequences from partial or complete loss of service.

e) Were (or could there be) other assets or systems at risk due to a loss of service of this facility? *If yes, please list and provide details.*

f) If known, roughly how much revenue (in dollars) was/would be lost per day?

g) How many people were*/(would you expect)* to be affected? (*number of employees, customers, etc.)*

h) Were there (could there be) any injuries? *If yes, how many?*

i) If the facility or its site experienced flooding, would vehicle or foot access to the facility/site be limited/restricted? *(Yes/no)*

j) Is there a potential for impacts to water quality if the facility were damaged, disrupted, or failed? (*e.g., release of pollutants to nearby waters, release of hazardous materials stored on site) Please explain.*

k) Please list/describe any other damages, if any, that could/did occur to the immediate surroundings or to the community due to flooding or a loss of service *(i.e., injuries, fatalities, or other cascading impacts; such as impacts to power supply that may damage electrical components and result in power loss to facility; fuel shortage jeopardizing ability to operate generators over extended period of time, then causing impairment in removing influent wastewater from collection system, etc...)*

l) If known, how were any vulnerable populations affected (could any vulnerable populations be affected) as a result of this facility being flooded, or out of service from a coastal hazard? *(Yes/no/unknown) Please explain.*

m) How much would it cost to repair or replace this facility if it were significantly-damaged? If this facility has been exposed to flooding or other coastal hazard in the past, how much did it cost to repair/replace? *(Please provide a dollar range if you know it; if you do not know, or if your facility has never been damaged, then please state the price per square foot of your facility)*

COASTAL HAZARD MITIGATION AND RISK REDUCTION

24. **a) Is there a backup system or backup facility available to maintain function/level of service if this facility were disrupted for any reason?** *(Yes/no)*

b) If yes, is that asset also vulnerable to flooding?

c) If yes, what percentage of customers does the backup facility serve?

d) What is the cost to operate the back-up system? *(per day, customer, etc.)*

25. Are there any emergency response, or flood mitigation measures in place in order to maintain the asset's function/level of service, or to minimize damage in the event of a flood or other disruption? If your facility experienced flooding in the past, were there measures in place? *(i.e., components flood-proofed, barriers to water entry-points, sand bags, critical equipment stored at higher elevation, etc.) Please explain.*

26. Are there any future improvements, capital investments, mitigation, or proposed developments/modifications to the facility or to the site? *If yes, please explain.*

If yes, do future plans consider sea level rise? How? Are there any related planning documents you could share with us?

27. Does this facility or any of its components on the site carry flood insurance? *(Yes/no)*

FACILITY MANAGEMENT

28. **a)** **Who owns and manages this facility?** *Please note if owner and manager are different.*

b) **If facility owner and manager are different, what is the relationship between them?** *(i.e., a legal agreement: lease, right-of-way, access easement, JPA, MOU, MOA)*

29. **Are there any other organizations or stakeholders that have management, decision-making, funding, or other responsibilities related to this facility**? *If so, what are they?*

30. **What are the total annual operation and maintenance costs of the facility?**

31. **What types of permits (and from which agencies) are necessary to maintain, repair, or improve the facility? Are there special processes for emergency repairs?**

32. **Please describe any management or permitting challenges that might be expected with adaptation**. *(i.e., building codes not up to date, endangered species, angry neighbors, etc.)*

33. **Are there any other stakeholders we should know about who may be concerned with this facility?** *If yes, please list.*

34. **If known, what funding sources currently exist that may be used to assess hazard risk or vulnerability to climate change?**

ANYTHING ELSE

Is there anything else you would like to share about the impacts from coastal flooding and sea level rise to your facility?

DOCUMENTATION

If available, please provide any/all of the following:

- Photos of asset and its critical elements
- Documentation or photos of previous flooding
- Site plans *(structure locations, sizing, interconnections between structures)*

Thank you very much for your participation and involvment in our ongoing vulnerability assessment.