OAKLAND
PRELIMINARY

SEA LEVEL RISE ROAD MAP

Fall 2017

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ACRONYMS AND ABBREVIATIONS

ABAG	Association of Bay Area Governments
ACFCD	Alameda County Flood Control District
ART	Adapting to Rising Tides Program
BARC	Bay Area Regional Collaborative
BART	Bay Area Rapid Transit
BCDC	San Francisco Bay Conservation and Development Commission
Caltrans	California Department of Transportation
CCC	California Coastal Commission
CDFW	California Department of Fish and Wildlife
CHARG	San Francisco Bay Regional Coastal Hazards Adaptation Resiliency Group
CRI	Climate Resilience Institute
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
LUTE	Land Use and Transportation Element
MHHW	Mean Higher High Water
MTC	Metropolitan Transportation Commission
OCAC	Oakland Climate Action Coalition
RCI	Bay Area Resilient Communities Initiative
SDMP	Storm Drainage Master Plan
SLR	Sea level rise
WOEIP	West Oakland Environmental Indicators Project

1. INTRODUCTION

The Preliminary Sea Level Rise Road Map was developed as part of Resilient Oakland, a coordinated effort to align resources, plans, and actions in support of a thriving and resilient community. Oakland was competitively selected in December 2013 to join 100 Resilient Cities, an initiative Pioneered by the Rockefeller Foundation that aims to help cities around the world build resilience to the social, economic, and physical challenges of the 21st century. Through this initiative, an Oakland Resilience Strategy was developed through a two-phase process. Phase 1 involved an initial resilience baseline assessment, culminating in the selection of discovery areas to be prioritized for further investigation and a Preliminary Resilience Assessment[1] that describes the resilience challenges facing Oakland. In Phase 1, "resilience" was defined as the "capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience."[1] Phase 2 involves strategic planning and technical analysis to better understand the underlying issues and identify solutions to some of Oakland's most critical resilience challenges. One of the discovery areas identified was "Recovering Quickly from Adversity," and work under this discovery areas seeks to better understand:

- What key actions are needed to prepare for, mitigate, and recover from the potential impacts of natural disasters and climate change?
- Which services and critical assets should be prioritized for seismic safety and resilience to sea level rise (SLR) and flood risk, particularly for the most vulnerable neighborhoods and in those neighborhoods furthest from opportunity?
- Which policies, regulations, and data analysis systems can support decision-making around how land use, building, and zoning can advance Oakland's long-term sustainability, climate resilience, housing, and job growth?

Oakland Inner Harbor

Oakland has 19 miles of Bay shoreline that are lined with regionally significant infrastructure, diverse neighborhoods, and open space. Therefore, SLR was selected as an impact that warranted further diagnostic investigation under this discovery area.

Several groundbreaking SLR studies have already been conducted for parts of the Oakland shoreline, such as the Bay Conservation and Development Commission (BCDC) Adapting to Rising Tides (ART) Sub-regional Pilot Project,[2] Climate Change and Extreme Weather Adaptation Options for Transportation Assets in the Bay Area Pilot Project,[3] and the ART Oakland/Alameda Resilience Study.[4] Based on these studies, critical assets such as highways, transit stations, schools, wastewater infrastructure, and landfills are anticipated to be impacted by SLR.

In addition, the Association of Bay Area Government (ABAG) and BCDC Safer Housing, Safer Communities Report identified that many Bay Area residents who live in areas at higher risk from natural disasters are resource-constrained.[5] This includes households that are low- and very low-income, households of all income levels that are housing and transportation cost-burdened, and transit-dependent households that do not own a car. Resource-limited households are less able to prepare for natural disasters, and if displaced from damaged homes, will likely struggle to find housing that is affordable and near to the jobs, schools, medical facilities, and other services on which they rely.

This Road Map builds on the findings from those studies, as well as other work carried out by the City and community organizations, to document existing conditions, set forth potential actions to address these conditions, and continue focus on this critical area of the City's resilience.

ROAD MAP PURPOSE

The Road Map helps identify SLR adaptation actions to best address the conditions, needs, and issues in Oakland. This document:

- Summarizes the most up-to-date climate science, relevant policies and regulations, and vulnerability and risk assessments conducted to date;
- Identifies information gaps and establish needs for further assessment;
- Provides the foundation and guidance to develop a citywide SLR adaptation plan; and
- Identifies opportunities for engagement, collaboration, and coordination.

The City of Oakland is committed to planning for and adapting to the impacts of climate change and has a number of initiatives and policies already in place. For example, Oakland's Energy and Climate Action Plan[6] calls for "Identifying and Acting on Opportunities to Improve Resilience in City Plans and Policies." The Coliseum Specific Plan[7] includes forward-thinking policies requiring new development to consider SLR and adaptive management. The 2016 Local Hazard Mitigation Plan[8] also includes several SLR adaptation strategies.

In addition to the City-adopted policy documents listed above, a variety of neighborhood-based and issue-based community groups have actively been working to address SLR impacts in Oakland. These groups have led community workshops, initiated dialogue with government at all levels, and advocated for resources to protect vulnerable populations from future impacts. Bringing the work of the City and these groups together is critical to ensuring Oakland's resilience. The partnership and collaboration among government and local and regional stakeholders, including community-based organizations, neighboring cities, regional agencies, and infrastructure owners along the Bay is essential. In addition, SLR adaptation planning will need to engage residents of the neighborhoods most vulnerable to the impacts of SLR; share information about the risks; better understand local conditions and impacts; and co-create adaptation strategies. This Road Map documents the City's near-term approach to build upon ongoing efforts to enhance the resiliency of Oakland's most vulnerable physical and social assets.

The Road Map was prepared from collaboration in two working group meetings (June and August, 2016). The working group was made up of City and Port of Oakland staff, county and

regional agencies and districts, educational organizations, and community stakeholders, such as the San Francisco Estuary Institute, and the Pacific Institute.

HOW SEA LEVEL RISE WILL AFFECT OAKLAND

Climate change is already affecting California and the Bay Area communities. In the last century, the San Francisco Bay water levels have risen 8 inches.[9] By 2100, they are likely to rise an additional 36 to 66 inches.[10] The science of SLR is being continuously revised as climate models are improved and updated with new data and observations. These revisions improve our understanding of both natural climate variability and the global oceanic response to atmospheric greenhouse gases. Keeping up-to-date with such scientific advances is vital for developing appropriate adaptation strategies that prove implementable over time.

Existing Impacts

As a Bayfront city with an active commercial shipping seaport, international airport, and many communities at low elevations, the City of Oakland has long been vulnerable to flooding. Rising Bay waters already affect Oakland with periodic coastal flooding of low-lying shorelines, loss of valuable saltwater marshes, and saltwater impacts to wastewater treatment systems serving Oakland.[11, 12,13] When heavy rains are coupled with higher-than-normal tides, tide levels can slow the drainage of runoff into San Francisco Bay, increasing the potential for urban stormwater flooding. Evidence of this coincidental precipitation and high-tide flooding can be seen at the low-lying Jack London Square, Oakland Coliseum Complex, and Lake Merritt on Grand and Lakeshore Avenues. The Coliseum and Lake Merritt areas are located near channel restrictions and experience rainwater flooding that is unable to properly drain when the downstream channels reach capacity during high tides.[8,14] For the Lake Merritt area, several capital projects have been implemented to alleviate upstream flooding and the City is continuing to further manage lake water levels.[8]

King Tide flooding at Jack London Square

Photo by: knmoor - Flickr

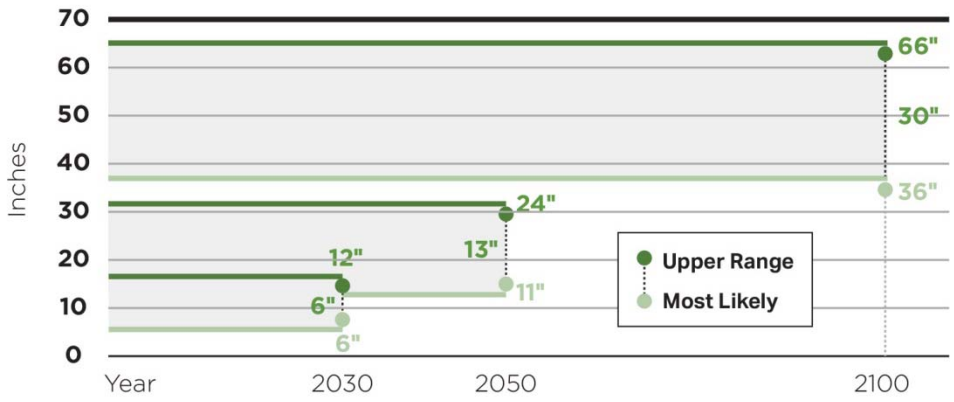
Future Impacts

Rising sea levels represent new challenges to Oakland's future. As Bay water levels rise, the extent and frequency of flooding will increase. Areas once considered to be outside of the floodplain will begin to experience periodic coastal and/or urban flooding. Sections of Oakland's shoreline built on Bay fill, such as the Port of Oakland and the Oakland International Airport, are increasingly vulnerable, because they are chronically subsiding and are at a higher risk of liquefaction during seismic events.[15]

Because rising ocean levels are dependent on a number of factors, projections are provided in ranges of likely amounts. Sea levels offshore of Oakland are expected to rise between 11 and 24

inches by mid-century, and 36 to 66 inches by 2100 (Figure 1).The most likely SLR projections are based on a moderate level of global greenhouse gas emissions and continued accelerating land ice melt patterns. The upper-range estimates represent unlikely—but possible—levels of SLR using very high greenhouse gas emissions scenarios with significant land ice melt contributions. It is important to note that greenhouse gases remain in the atmosphere for tens or thousands of years, depending on the type of gas and atmospheric conditions. Even if the nations of the world are successful in significantly reducing emissions levels during the next century, the lower levels of sea level rise remain likely to occur.

Figure 1 Sea Level Rise Projections for Oakland Relative to the Year 2000



Source: NRC (2012) Lower range projections are excluded as they are not recommended for planning purposes.

Without action, SLR poses a threat to Oakland's neighborhoods and ecological systems. Specific impacts include:

- **Temporary coastal flooding from extreme tides**. Extreme tides are temporary occurrences when measured tides are above the predicted (astronomical) levels. These tides are caused by a variety of factors, including storm surge and El Niño conditions. Oakland's existing coastal flood issues, including damaged infrastructure, impacted sewage systems, and road closures, will increase in frequency and extent, because rising seas will further elevate extreme tides. Several key assets such as the Oakland International Airport, rail lines connecting to the seaport of Oakland, and three wastewater treatment plants are vulnerable to future extreme tides.[16]

- **Urban or watershed flooding.** Unlike coastal flooding, urban flooding is caused by rainfall runoff. As the sewage and stormwater system storage capacity is maximized, Bay discharges occur. When the Bay is high enough to slow discharges, drainage of stormwater runoff from Oakland to the Bay can be impeded, resulting in inland urban flooding during storms. Similarly, the ability of creeks and channels to release excess precipitation will be reduced due to rising Bay levels, and will overwhelm their banks, flooding adjacent areas. Due to their low-lying elevations and proximity to water, areas such as the Oakland Coliseum Complex and the certain streets in West Oakland are some of the most vulnerable to this impact.[13]

- **Accelerated loss of marshlands.** Tidal marshes, which dissipate wave energy, improve water quality, and provide ecological habitat, are highly sensitive to sea levels. Many marshes will be lost under accelerated SLR, facing permanent inundation. Tidal marsh areas along the Martin Luther King Jr. Regional Shoreline are vulnerable to this impact.[11]

Arrowhead Marsh, part of the Martin Luther King Jr. Regional Shoreline

Photo by: Ingrid Taylor - Flickr

- **Daily tidal inundation.** As sea level rises, the elevation of average daily high tides will also continue to increase. This will result in permanent inundation of many areas that were once intertidal, and temporary daily flooding of landward areas that were previously not reached by tides.

- **Enhanced King Tide flooding.** King Tides are those which are higher than typical due to the location of the Earth, Moon, and Sun in close proximity to one another. The banks of Damon Slough are at capacity during existing King Tide conditions, even in the absence of storms. Without protective action, this regular, predictable event will cause flooding at the Oakland Coliseum Complex, as well as other areas around the City, such as Channel Park and portions of Bay Farm Island. Because King Tides occur during the rainy winter season, the intensity and impacts from King Tide flooding are expected to worsen over time.

Damon Slough

Photo by: sfbaywalk - Flickr

- **Rising groundwater levels.** As sea levels rise, so will groundwater levels. SLR causes saltwater to intrude into underground reservoirs, raising the historical groundwater elevation ranges beyond levels that Oakland utilities were planned and built to accommodate. With rising groundwater levels, the likelihood and extent of liquefaction will increase, magnifying the potential for damage to buried assets in a seismic event. Many of the ground transportation assets in Oakland, such as I-880, BART and railroad rights of way are vulnerable to elevated groundwater levels, because exposure can corrode the reinforcing materials in concrete structures, damage pavement, or interfere with sensitive electrical components.

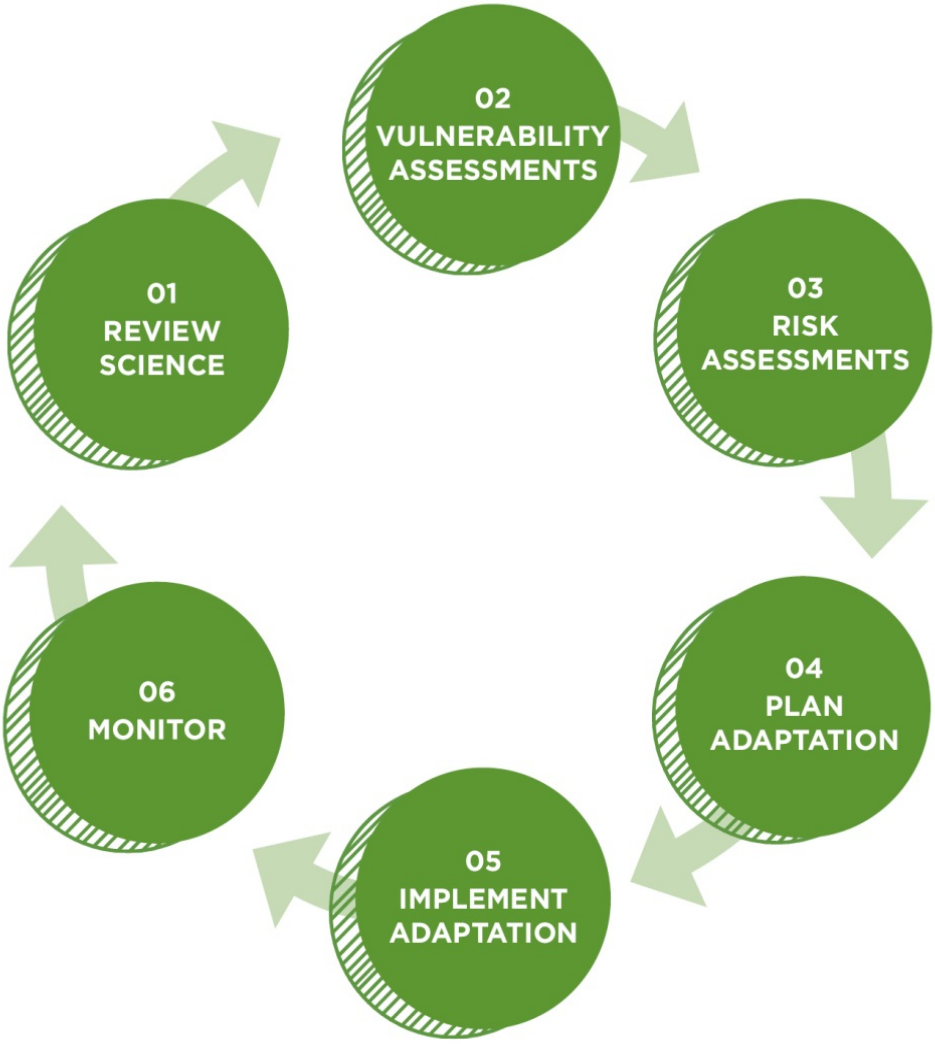
SLR will not impact all Oakland residents in the same way, as some are more vulnerable than others. Some communities are in areas prone to temporary flooding, or in areas predicted for

inundation due to SLR, and lack access to preparedness information, transportation options, healthcare, and insurance, which increase their vulnerability to the adverse impacts of a flood event. Communities of color and low-income communities are overly represented in the most vulnerable segments of the population. Other vulnerable subgroups include renters, children, the elderly and non-English speakers.[17]

THE ADAPTATION PROCESS

There is an emerging standardization of the methodology for describing adaptation planning and implementation,[18] which follows a cyclical, six-step process, summarized by Figure 2. To date, various efforts and projects in Oakland have touched on all stages of this cycle, which are described below. Actions recommended in this Road Map align to every stage of this recognized sequence of procedural steps and actions. The six steps are further described below.

Figure 2: Adaptation Process



Step 1: Review Science

Selecting the most reliable climate information to plan around requires drawing on local, regional, and national scientific expertise. Over time, adaptation efforts will need to accommodate new science, information, and conditions.

Step 2 Assess Vulnerability

SLR **vulnerability assessments** describe the **impacts** that would be felt by a physical asset (e.g., infrastructure) or community asset (e.g., populations) by temporary flooding or permanent inundation from coastal waters. Impacts may include physical damage, disruption to systems or services, and displacement. Screening for vulnerability lays the groundwork for adaptation planning.

Based on recommendations from the California Coastal Commission Sea Level Rise Policy Guidance[19] and the California Adaptation Planning Guide[18] the vulnerability assessment approach follows a standardized step–by-step approach.

1. **Community/Asset Inventory**: Provides information on the types, location, and condition of assets or the demographic characteristic of populations.
2. **Exposure:** Provides information on flood timing and pathways.
3. **Sensitivity**: Provides information on the effects to an asset or population if flooded.
4. **Adaptive Capacity**: Provides information on existing resiliency to flood waters or rising sea levels.

Assets are considered vulnerable if they are exposed to flooding, have high sensitivity, and low adaptive capacity. Assets found to be vulnerable are prioritized in the risk assessment and adaptation planning phases.

Step 3: Assess Risk

Vulnerability assessments are often followed by **risk assessments**, which describe (quantitatively or qualitatively) the potential **consequences** that could occur due to an SLR impact. Types of consequences considered in a risk assessment may include:

- Critical service consequences: Temporary or permanent inundation to power, communications, water and wastewater services, medical facilities, and/or lifeline transportation services.
- Social consequences: Impacts to public health and safety, general displacement and homelessness, and to the provision of social services.
- Economic and financial consequences: Workforce disruption, loss of real estate, or impacts to tourism or to significant industries.

Findings from risk assessments help inform the prioritization of assets and services for adaptation planning.

Step 4: Develop Adaptation Plan

Once assets have been prioritized for adaptation, comprehensive planning evaluates the best strategies to reduce climate impacts. Adaptation planning is a result of a participatory community

engagement sequence, to include those residents who are being affected by the impacts of SLR, and should, ideally, integrate interdisciplinary problem solving and solution generation. Ensuring that the adaptation plans and projects reflect community needs and priorities is also considered to be essential in creating a successful process and outcome.

Step 5: Implement Adaptation

Implementation of several strategies can start immediately, such as governmental interventions, in the form of adopting planning policies or building code changes, to address SLR. Longer term and larger-scale interventions which are identified, prioritized, and designed as part of a comprehensive SLR Adaptation Plan can be phased in over time, as better information, funding, and/or partnerships are developed or identified.

Step 6: Monitor Adaptation

Monitoring is a critical and ongoing component of any successful adaptation effort. Monitoring provides an understanding of which actions are most effective; highlights unintended consequences; and identifies new data, which may indicate a need to change direction or implement additional strategies. Effective adaptation plans will include the types and timeframe of monitoring to be conducted, and any thresholds that would trigger new actions, reporting requirements, and responsible parties.

KEY THEMES AND ROAD MAP ORGANIZATION

This Road Map is organized around four key themes:

- **Engagement and Collaboration**
- **Regional Coordination**
- **Understanding Neighborhood Vulnerabilities**
- **Climate-Smart Development**

Sections 2 through 5 of the Road Map provide summaries of existing efforts for each theme. The summaries are not intended to comprehensively cover every existing activity; but rather, to highlight those activities that are most relevant for near-term actions moving forward in Oakland. Section 6 provides a snapshot of some of the key contextual factors that shape the SLR Road Map actions, including regulatory agencies, major public land owners, critical assets, and vulnerable communities. Section 7 discusses recommended near-term actions for Oakland, which are organized around the four themes. These themes are further explained below.

Engagement and Collaboration

For this Road Map, engagement and collaboration refers to partnerships and the exchange of information and ideas among City departments, stakeholder organizations, residents, and businesses. The City places a high priority on robust engagement and collaboration efforts as they strengthen the capacity of all those involved to fully participate in decision-making related to SLR adaptation, leading to more equitable and effective solutions. Engagement and collaboration may—and should—happen during every step of the adaptation process.

City staff and community members at a community engagement workshop

Photo by: Ayushi Roy, City of Oakland

Regional Coordination

For this Road Map, regional coordination refers to efforts to enhance information sharing, planning, and advocacy between cities in Alameda County, adjacent counties, regional agencies, and other stakeholders. Critical SLR adaptation decisions made in one jurisdiction—such as flood protection infrastructure—can have far-reaching impacts. Coordinating flood protection efforts can also lead to larger, regional-scale resiliency options that may not be possible when led by an isolated agency or jurisdiction. In addition, the Bay Area region can be a more powerful and effective advocacy voice than individual cities regarding Federal and State policies, and more effectively advocate and apply for funding for projects and activities to reduce impacts and vulnerabilities. Regional coordination will remain a high priority throughout the adaptation planning and implementation process.

Understanding Neighborhood Vulnerabilities

Life in Oakland revolves around its neighborhoods and their schools, parks, shops, homes, transit, and other community assets. Continuing to gather information to better understand how SLR could impact life in Oakland's neighborhoods is critical for developing proactive plans and strategies. The information needed to understand vulnerability could come from many sources, including SLR projections, crowd-sourced mapping of flooding hotspots, and conversations with residents and neighborhood groups that help identify important community assets. Both SLR science and neighborhood conditions continue to evolve, so this work requires regular updates and iterations. Understanding neighborhood vulnerabilities most closely relates to Steps 1 through 3 of the adaptation process.

Climate-Smart Development

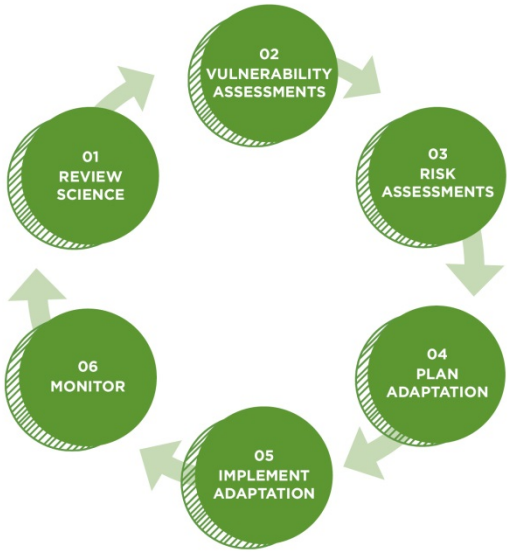
Preliminary rendering of East Bay Gateway Park, which will incorporate adaptive management strategies

Source: Gateway Park Working Group, 2014

Existing and future development is shaped by a variety of factors, including policies, plans, codes, financing, real estate markets and regional changes. The City seeks to ensure that policies, plans, and programs are in place so that developers and property owners are appropriately incorporating adaptive management strategies. “Climate-smart development” is the term for future building and renovation plans that emphasize in a reduction of greenhouse gas emissions and improving climate resilience. Proactive management of risks from SLR is typically more effective and less costly than repairing or recovering once major damage has already occurred. Climate-smart development most closely relates to Steps 4 and 5 of the adaptation process.

2. CURRENT ENGAGEMENT AND COLLABORATION ACTIVITIES

The following initiatives and projects related to engagement and collaboration are relevant to the SLR Road Map. Engagement and collaboration will occur during all six steps of the adaptation process.



Adapting to Rising Tides

Adapting to Rise Tides (ART) is a program coordinated by the San Francisco Bay Conservation and Development Commission (BCDC) that seeks to help San Francisco Bay communities and natural ecosystems adapt to SLR and storm-event flooding. Initiated in 2010, the ART project has convened multiple adaptation planning efforts in the East Bay area. Working collaboratively with local agencies and organizations, the ART program released a pilot project that assessed vulnerability and risk of shoreline and community resources to SLR and storm surge events in Alameda County and developed adaptation responses.[2] This effort prompted several other more detailed adaptation planning efforts, including the Oakland/Alameda Resilience Study, which convened a Working Group to collaboratively assess vulnerabilities and risks and mitigation opportunities for earthquakes, SLR, and flooding.[3]

Bay Area Resilient Communities Initiative

The aim of the Bay Area Resilient Communities Initiative (RCI) is to create a model of resilience planning led by the communities most impacted by climate change and natural disasters, for the benefit of all residents. RCI is a coalition of community organizations throughout the nine-county Bay Area with experience in improving the quality of life in the region. Funded by the Kresge Foundation, RCI is conducting a series of six policy workshops on resilience and equity issues in the Bay Area in 2016-2017.

Oakland Climate Action Coalition

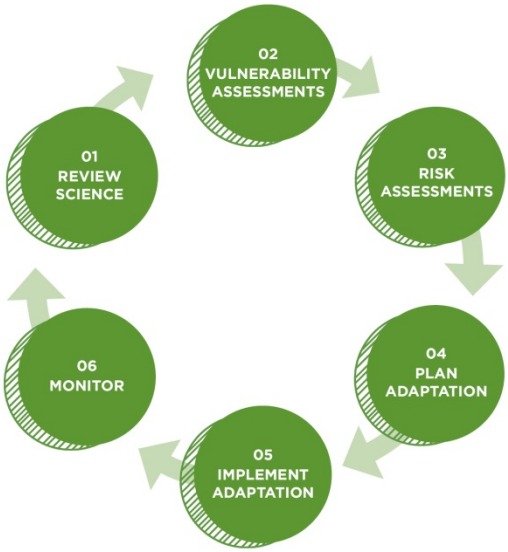
The Oakland Climate Action Coalition (OCAC) is a collaborative effort to lead Oakland's response to climate change through community-based development.[20] Including more than 60 member organizations across the city, OCAC has worked with the City of Oakland to engage residents and ensure effective implementation of the City's Energy and Climate Action Plan. OCAC has a Resilience and Adaptation Committee, which is co-chaired by the Pacific Institute and the West Oakland Environmental Indicators Project (WOEIP).

West Oakland Environmental Indicators Project

WOEIP is a resident-led, community-based, environmental justice organization assisting West Oakland residents in understanding the political, social, and natural forces that impact their lives.[21] Their mission is to increase awareness of issues surrounding public health, air quality, and smarter land use, while providing neighborhood advocacy tools. WOEIP helps at-risk West Oakland residents to set priorities, foster political education, and make research and data available. Recent efforts of WOEIP include the creation of the Oakland Academy of Science and Sustainability, an outdoor classroom that teaches students about the issues of climate adaptation, green infrastructure, and changing landscapes due to climate change.

3. CURRENT REGIONAL COORDINATION ACTIVITIES

This section describes ongoing initiatives and projects related to regional coordination that are relevant to the SLR Road Map. Oakland's participation in these regional coordination efforts may—and should—happen during all six step of the adaptation process.



Adapting to Rising Tides

In addition to their role in local engagement and collaboration (described above), ART staff is also actively involved in regional coordination. For example, ART is partnering with the Metropolitan Transportation Commission (MTC) to develop integrated regional shoreline mapping and analysis that will result in robust and accurate SLR and extreme tide mapping products for all nine counties in the Bay Area. ART also partners with other agencies to advance climate resilience in regional projects, such as Plan Bay Area and Stronger Housing, Safer Communities.

Bay Area Regional Collaborative

Previously known as the Bay Area Joint Policy Committee, in 2015, this group changed its name to the Bay Area Regional Collaborative (BARC) and decided to direct a majority of its focus on planning and policy coordination around climate change.[22] All four member agencies (ABAG, Bay Area Air Quality Management District, BCDC, and MTC) are involved in climate change planning, and jurisdictional overlap among the four agencies is best served through collaboration.

Coastal Hazards Adaptation Resiliency Group

In mid-2014, The Alameda County Flood Control District (ACFCD) convened a working group of over 100 engineers, planners, scientists, and policy makers from across all levels of government in the nine Bay Area counties. Named the San Francisco Bay Region Coastal Hazards Adaptation Resiliency Group (CHARG), it has a vision to "collaborate across all levels of government and align resources to implement integrated, multi-benefit coastal hazards solutions to mitigate risk and improve and protect quality of life and property along the San Francisco Bay."[23] CHARG provides a forum for ongoing discussions to develop and implement regional flood protection solutions to SLR and extreme tides. The goal of this group is to enhance alignment and collaboration among various planning efforts around the Bay.

Plan Bay Area Update

Plan Bay Area was adopted by MTC and ABAG in 2013, as the Bay Area's first integrated Regional Transportation Plan/Sustainable Communities Strategy. The Environmental Impact Report for the Plan included an assessment of SLR and documented the communities and transportation assets that would be affected by 12 inches of SLR, as well as making recommendations for mitigation strategies. Updated every 4 years, Plan Bay Area provides a long-range, integrated transportation and land-use/housing strategy for the area. In 2015, MTC and ABAG began a limited and focused update of Plan Bay Area 2013, called Plan Bay Area 2040, which provides regional projections for what the Bay could look like by the year 2040.[24] Forecasted development patterns are made using scenarios, and strategies are developed to accommodate a transportation network and investment plan to support regional land use change projections while simultaneously reducing greenhouse gas emissions. A final version of Plan Bay Area 2040 is due to be finished and adopted in 2017. The 2021 update will provide an opportunity to build SLR into the projection scenarios and will include an assessment of climate resilience.

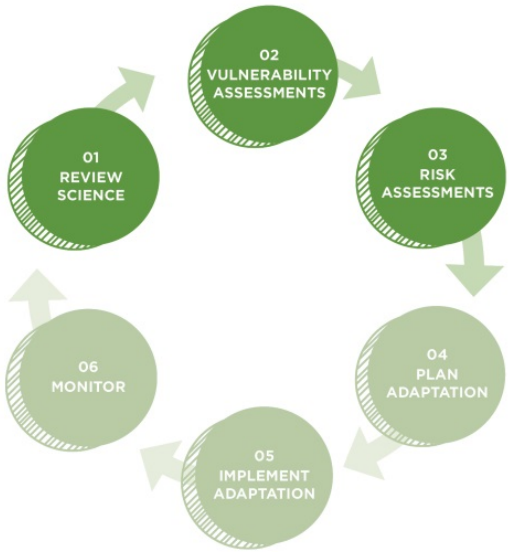
Climate Readiness Institute

The Climate Readiness Institute (CRI), housed at UC Berkeley, develops 21st century climate adaptation solutions to build the Bay Area's capacity for action and disseminates knowledge to inform and inspire cities worldwide.[25] CRI brings together academics and climate practitioners from government, non-profits, and the private sector. This diverse team is developing solutions to the Bay Area's most pressing climate challenges, and creating new information for cities. The CRI conducts work in four areas:

- Climate Adaptation Research – conducting joint academic-stakeholder, inter-disciplinary research projects that inform Bay Area climate decision-making and produce new knowledge.
- Bay Area Climate Adaptation Services – uses workshops, webinars, and various media channels where academics and stakeholders work across disciplines and silos to problem-solve key issues, build the capacity of communities and institutions, and identify topics for in-depth study.
- UC Global Initiative Support - supports university-led global climate initiatives by packaging and presenting Bay Area climate success stories that will inspire and inform metro areas globally, and by bringing Bay Area academics and climate leaders together with their global peers for mutual learning and problem-solving.
- 21st Century Climate Leader Training - providing in-depth climate education experiences for university students, community members, and Bay Area leaders.

4. EXISTING EFFORTS TO UNDERSTAND NEIGHBORHOOD VULNERABILITIES

This section describes ongoing efforts and resources related to understanding neighborhood vulnerabilities that are relevant to the SLR Road Map. Understanding neighborhood vulnerabilities most closely relates to Steps 1 through 3 of the adaptation process.



SLR MAPPING FOR OAKLAND

The most comprehensive and recent SLR mapping for Oakland is *Adapting to Rising Tides Bay Area Sea Level Rise Analysis and Mapping Project*, released in September, 2017.[26] Rather than relying on pre-selected specific SLR projections, this assessment presents ten inundation maps developed to represent a variety of possible scenarios associated with SLR and extreme tide levels, ranging from 12 to 108 inches and the 1-year extreme tide event, to the 100-year extreme tide event, as shown in Figure 3. This robust approach allows for each scenario to approximate to a number of temporary flooding and permanent inundation scenarios associated with various combinations for sea level rise and extreme tide to support an evaluation of potential impacts from a wide range of possible future events. (Please note that at the original time of drafting this document (in 2016), the *Alameda County Shoreline Assessment*[12] provided the most current SLR data, and therefore is the source for all maps created for this document).

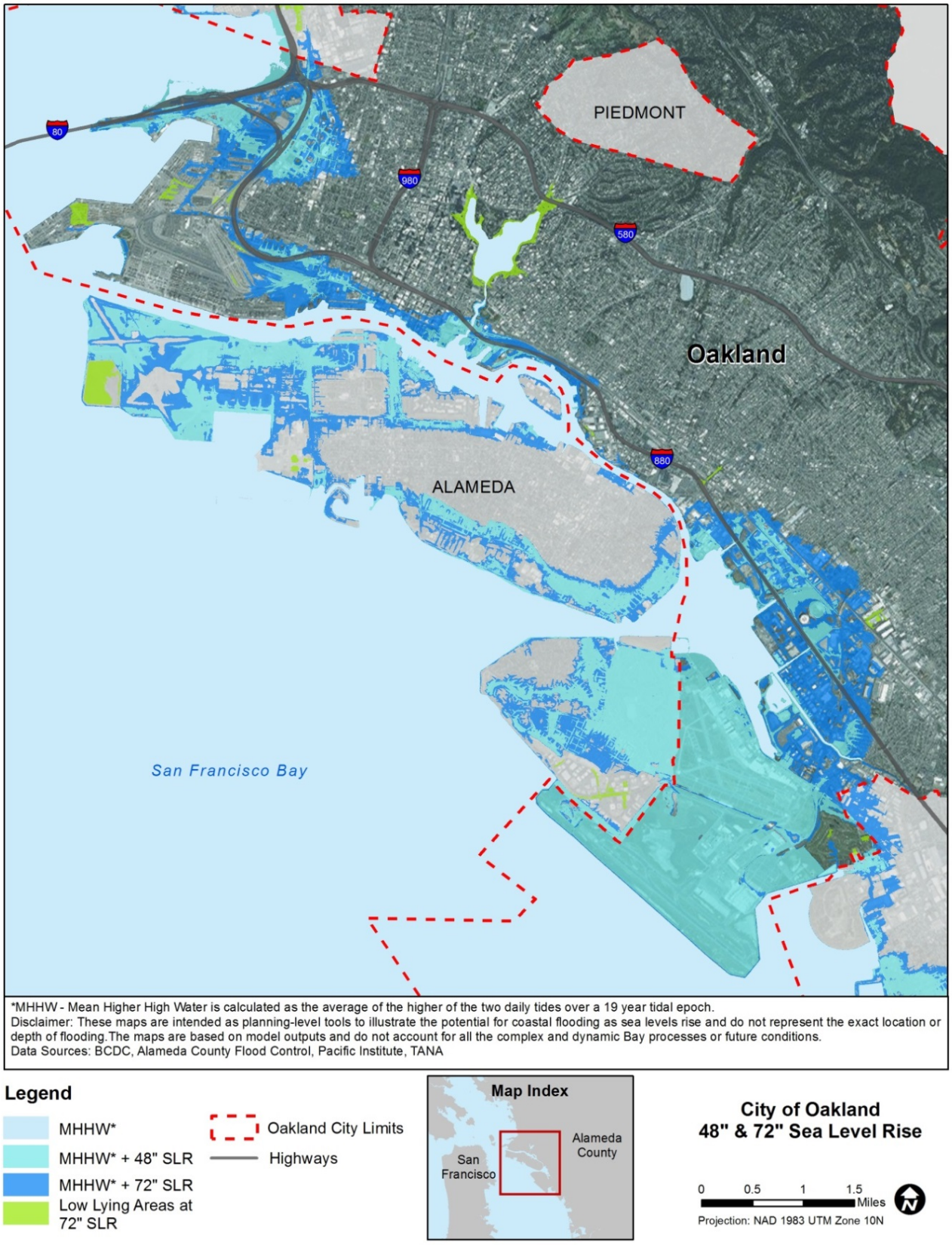
Figure 3: Sea Level Rise and Extreme Tide Scenarios

Sea Level Rise Scenario	Daily Tide	Extreme Tide (Storm Surge)						
	+SLR (in)	1yr	2yr	5yr	10yr	25yr	50yr	100yr
	Water Level above MHHW (in)							
Existing Conditions	0	15	19	24	27	32	37	42
MHHW + 6"	6	21	25	30	33	38	43	48
MHHW + 12"	12	27	31	36	39	44	49	54
MHHW + 18"	18	33	37	42	45	50	55	60
MHHW + 24"	24	39	43	48	51	56	61	66
MHHW + 30"	30	45	49	54	57	62	67	72
MHHW + 36"	36	51	55	60	63	68	73	78
MHHW + 42"	42	57	61	66	69	74	79	84
MHHW + 48"	48	63	67	72	75	80	85	90
MHHW + 52"	52	67	71	76	79	84	89	94
MHHW + 54"	54	69	73	78	81	86	91	96
MHHW + 60"	60	75	79	84	87	92	97	102
MHHW + 66"	66	81	85	90	93	98	103	108

in = inch(es)
MHHW = Mean Higher High Water
SLR = sea level rise
yr = year(s)

Figure 4 maps the 48-inch and 72-inch water levels above mean higher high water (MHHW) for Oakland. The 48-inch water level can be used to approximate areas that would be permanently inundated with 48 inches of SLR, or the area that would be temporarily flooded due to a 100-year storm with only 6 inches of SLR. The 72-inch water level can be used to approximate areas that would be permanently inundated with 72 inches of SLR, or the area that would be temporarily flooded due to a 100-year storm with 30 inches of SLR. By using these maps and the Matrix presented earlier, it is possible to compare the impacts not only of varying sea level rise scenarios, but also their relative impacts during different storm events.

Figure 4: MHHW* + 48 Inches and 72 Inches of Sea Level Rise



SNAPSHOT OF EXISTING VULNERABILITY AND RISK ASSESSMENTS

Risk and vulnerability assessments are integral components used in the adaptation planning process, as described earlier in the Introduction. They help identify assets and populations that have the potential to be impacted, as well as characteristics that make the assets more or less susceptible to the effects of SLR. Table 1 provides a summary of the vulnerability and risk assessments that are most relevant to understanding Oakland's neighborhood vulnerabilities to SLR and findings from three key studies are described below.

Adapting to Rising Tides (ART) Pilot Project/Alameda County findings (2013)

In 2011-2013, when this study was carried out, it was projected that climate change would cause the Bay to rise 16 inches by mid-century and 55 inches by the end-of-century.[27] As shown in Table 2, the study found that with 16 inches of SLR, very few Oakland residents would be exposed to inundation from daily high tide, while approximately 6,000 would be exposed to wind waves during a storm event. With 55 inches of SLR, nearly 1,400 residents would be exposed to daily high tide inundation, and nearly 9,000 would be exposed to wind waves during a storm event. Approximately 150,000 people work in Oakland. With 16 inches of SLR, nearly 1,000 employees would be exposed to daily high tide inundation; and approximately 4,000 would be exposed to storm event flooding. With 55 inches of SLR rise, over 12,000 employees would be exposed to daily high tide inundation; and over 32,000, or 21 percent, would be exposed to storm event flooding.[28]

The study also assessed the exposure of community facilities and services, including emergency response, facilities serving at-risk populations, and facilities serving less-mobile populations. The study found that found that with 55 inches of SLR, two fire stations, four health care facilities, six childcare centers, and three schools would be exposed to temporary storm event flooding.[27]

Table 1: Existing Sea-Level Rise Vulnerability and Risk Assessments in Oakland

Name of Study, Date, Lead	SLR Scenarios	Assets	Geographic Extent
Adapting to Rising Tides Transportation Vulnerability and Risk Assessment (2011); BCDC, MTC, Caltrans	16, 55 inches	Road network, transit network, transportation facilities, bicycle and pedestrian networks	Alameda County
Adapting to Rising Tides Alameda County Pilot Project (2012); BCDC	16, 55 inches	Airport; land use, services and facilities; contaminated lands, energy infrastructure and pipelines; ground transportation; hazardous materials; natural areas; parks; seaport; shorelines; stormwater; wastewater	Alameda County
Community-Based Adaptation Planning: Case Study of Oakland, CA (2012); Pacific Institute, OCAC	1.0, 1.5 meters (39.4, 59 inches)	Populations (social vulnerability index)	Oakland
BART Climate Change Adaptation Assessment Pilot Study (2013)	16, 55 inches	Station and maintenance facilities, track and aerial structures, train control, traction power	Oakland
Climate Change and Extreme Weather Adaptation Options for Transportation Assets (2014) **BCDC, MTC, BART, Caltrans**	12, 24, 36, 48, 72, 96 inches	Transportation assets, adjacent community assets	Bay Bridge Touchdown, Coliseum, Hayward
Adapting to Rising Tides Alameda County Shoreline Vulnerability Assessment (2015); BCDC, ACFCD	12, 24, 36, 48, 72, 96 inches	Shoreline	Alameda County
Stronger Housing, Safer Communities (2015) **ABAG, BCDC**	24, 36, 48 inches + seismic	Housing, community (socio-economic indicators)	6 case studies (incl. Coliseum)
Bayland Ecosystems Habitat Goals, 2015 Update	20.5, 65 inches	Estuary ecosystem	Baywide
Oakland Local Hazard Mitigation Plan (2016) **City of Oakland**	48 inches	Siren, government buildings, hospitals, libraries, schools, recreation centers, fire stations, police stations	Oakland
Oakland/Alameda Resilience Study (2016) **BCDC**	12, 24, 36, 48, 72, 96 inches + seismic	Oakland International Airport, ground transportation (I-880, surface streets, BART, Amtrak, AC transit, airport connector, ferry), neighborhoods, community facilities, services, emergency response facilities, power, stormwater, wastewater utilities, natural areas, and shoreline recreation	Bay Farm/ Coliseum Focus Area

Table 2: Residents and Employees Exposed to 16 and 55 Inches of Sea Level Rise in the ART Project Area in Oakland

	16-Inch Sea Level Rise			55-Inch Sea Level Rise		
Exposed to:	Daily High Tide	Storm Event	Storm Event wind waves only	Daily High Tide	Storm Event	Storm Event wind waves only
Number/Percent of Residents (out of City total of 399,484)	16 / (0%)	233 / (0%)	5,732/ (1.4%)	1,370/ (0%)	5,840/ (1.5%)	8,991/ (2.2%)
Number/Percent of Employees (out of City total of 151,962)	993 / (1%)	3,599/ (2.3%)	--	12,486/ (8.2%)	32,431/ (21.3%)	--

Source: Summarized from Adapting to Rising Tides Subregional Pilot Project, 2013

Climate Change and Extreme Weather Adaptation Options for Transportation Assets in the Bay Area Pilot Project (2014)

Building on results of risk profiles created in the ART Transportation Vulnerability and Risk Assessment Pilot Project, this Pilot Project, led by BCDC, MTC, BART and Caltrans and funded by the Federal Highways Administration (FHWA), conducted a refined vulnerability assessment for three focus areas: the San Francisco-Oakland Bay Bridge Peninsula, the Oakland Coliseum Area, and the State Route 92 Corridor.[3] The three focus areas were identified as a confluence of major regional transportation assets, and are interwoven into other important regional and community assets

The refined vulnerability assessment expanded the future water level scenarios used to assess SLR exposure, and made a clear distinction between temporary and permanent flooding. This refinement allowed for a better understanding of storm and Bay conditions that could cause water levels to surpass flood thresholds, based on existing Bayfront infrastructure. Based on vulnerability study results, high-level climate adaptation options were created. The findings for the Oakland focus areas' vulnerability assessments are summarized below.

- San Francisco-Oakland Bay Bridge Peninsula (Bay Bridge Touchdown): The area is expected to be permanently inundated by 36 inches of SLR. The area is also identified as vulnerable to temporary flooding due to combined scenarios of SLR and extreme tide events. Two inland areas, including a residential neighborhood near Peralta Street and 14th Street in West Oakland, that are not hydraulically connected to the Bay were identified as vulnerable to future temporary storm flooding.

- Coliseum Area: Of the three focus areas, the Coliseum Area was identified as having the greatest vulnerability. The banks of the Damon Slough and its tributaries are often at capacity during high-tide events under existing conditions, and the coincidental occurrence of high tide and storm surges cause temporary flooding in the low-lying nearby Oakland Coliseum Complex. The Oakland Coliseum Complex is expected to be permanently inundated by 48 inches of SLR in this study.

ART Oakland/Alameda Resilience Study (2015)

The ART Oakland/Alameda Resilience Study focused on the Coliseum and Bay Farm Island neighborhoods. Six key planning issues were identified during the Vulnerability and Risk Assessment phase of the study. These issues affect multiple assets, cross sectors and jurisdictional boundaries, and require early, coordinated effort to address. Later phases of the study focused on these key planning issues because of their timeliness, complexity, and the criticality of their consequences.

1. Access on and off Bay Farm Island (City of Alameda) and to and from Oakland International Airport (City of Oakland) is already limited due to the island's geography; is vulnerable to future flooding and seismic events; and will affect the economy, public health and safety, and community function if disrupted.

2. Housing, community members, and community facilities are vulnerable to existing and future flooding, as well as seismic events.

3. The Oakland Coliseum facilities, transportation assets, and neighborhood are vulnerable to both existing and future flooding due to at-capacity flood control channels and rising Bay water levels.

4. Oakland International Airport is vulnerable to future flooding and seismic events, both in its facilities, and through its dependence on other assets.

5. The Oakland/Alameda study area contains shoreline habitat, including habitat for the endangered California Ridgeway's Rail. However, much of this habitat exists in the form of fringing marshes, which are not predicted to persist, given SLR, sediment projections, and surrounding land uses.

6. Permitting and regulatory issues along the shoreline and with multiple owners and jurisdictions may delay or impede adaptation.

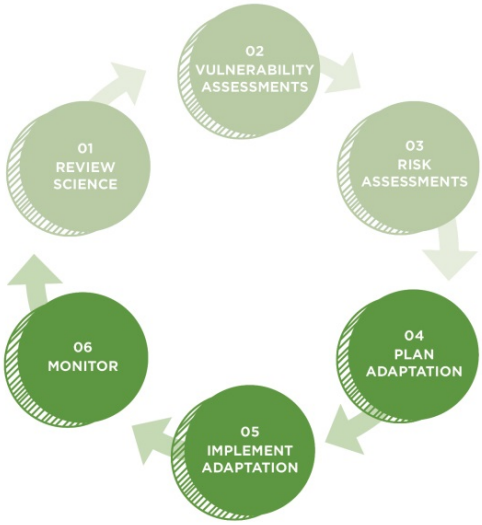
SUMMARY

The vulnerability of community facilities to SLR has been assessed through the ART Pilot Project. An updated assessment with the most recent SLR scenarios and mapping could help provide an enhanced understanding the timing of temporary flooding and/or inundation and thus help prioritize vulnerable assets and develop adaptation strategies. In addition, a community engagement process could help provide a more robust and up-to-date inventory of community assets. As such, a vulnerability assessment of community facilities and assets, with the latest SLR mapping, combined with robust community participation in the identification of assets, would yield significant value.

To date, there has been uneven coverage of Oakland neighborhoods for vulnerability assessments. The Coliseum area has been the focus of considerable work from the ART Program, which is important because it is low-lying and home to significant regional infrastructure and vulnerable communities. Additional vulnerability assessments could help improve the understanding of vulnerability for other Oakland neighborhoods that are vulnerable to SLR impacts, including West Oakland and Jack London Square.

5. SUMMARY OF EXISTING CLIMATE-SMART DEVELOPMENT ACTIVITIES

This section provides a summary of existing climate-smart development activities, including documents that feature adaptation strategies for Oakland, examples of additional adaptation strategies with potential applications in Oakland, and adaptation strategies already being implemented. "Climate-smart development" most closely relates to Steps 4, 5, and 6 of the adaptation process.



ADAPTATION STRATEGY RESOURCES

Several studies have developed adaptation strategies that are applicable to climate-smart development in Oakland. Table 3 provides additional detail on these studies.

Table 3: Existing Adaptation Strategy Documents for Oakland

Name of Study, Date, Lead	Details
Adapting to Rising Tides Alameda County Subregional Project (2012) BCDC	Provides adaptation responses for vulnerabilities identified across five broad asset categories: overarching, community land use, transportation, utilities, shorelines. Includes possible planning mechanisms, governance structures, or collaborative approaches that could be used to implement actions.
Climate Change and Extreme Weather Adaptation Options for Transportation Assets (2014): BCDC, MTC, BART, Caltrans	Provides a compendium of over 125 adaptation strategies and five detailed strategies for transportation assets in three focus areas, including the Bay Bridge Touchdown and the Coliseum.
Long-Term Disaster Recovery Plan (2015); ABAG	Strategies are focused mostly on seismic events, but some are applicable to recovery from a coastal flood event.
Stronger Housing, Safer Communities (2015); ABAG, BCDC	The Strategies Manual includes 40 strategies to address flooding and seismic hazards, housing vulnerabilities, and community vulnerabilities.
Oakland/Alameda Resilience Study (Available 2016); BCDC	Includes adaptation responses for vulnerabilities identified in four sectors: schools, childcare facilities, senior case facilities, and communities.
Oakland Local Hazard Mitigation Plan (2016): City of Oakland	Includes 21 high-priority strategies for hazard mitigation. Four strategies for the Port of Oakland and four for the City of Oakland specifically address flooding and the effects of future SLR.

EXAMPLES OF CLIMATE-SMART DEVELOPMENT STRATEGIES

The following examples are of climate smart development strategies from the Climate Change and Extreme Weather Adaptation Options for Transportation Assets (2014) study.[29]

Bay Bridge Touchdown Living Levee

The San Francisco-Oakland Bay Bridge touchdown (Bay Bridge touchdown) is located south of Emeryville along the northern boundary of the Oakland Outer Harbor. The area includes the Bay Bridge touchdown, the westbound portion of the toll plaza, and the intersection of interstate highways I-580, I-80, and I-880. Previous analysis shows that this area is expected to be permanently inundated by 36 inches of SLR. The area is also identified as vulnerable to temporary flooding due to combined scenarios of SLR and extreme tide events.

To protect against future flooding and inundation, the study recommends installation of a living levee immediately north of I-80 at the Bay Bridge touchdown; and the installation of a breakwater offshore of Radio Beach. The living levee will protect against future inundation and flooding due to SLR and storm surge. The breakwater will reduce wave heights and protect the area from future wave overtopping and wave-induced erosion. In addition to protecting transportation assets, the levee could provide a regional solution to protect adjacent neighborhoods. The levee could also impede coastal stormwater flows that may overtop low-lying roadways near the Maze, and offer flood protection to areas of West Oakland that are currently vulnerable to temporary flooding during to coastal storm events.

Damon Slough Living Levee

Damon Slough is an ACFCD facility which runs adjacent to the Oakland Coliseum and drains directly into San Leandro Bay. The slough is fed by upstream tributaries Arroyo Viejo Creek and Lion Creek, which have large urban watersheds. The banks of Damon Slough are at capacity during King Tide events under existing conditions, and the coincidental occurrence of high tide and storm surges causes temporary flooding in the low-lying nearby Oakland Coliseum Complex. Previous inundation analyses showed that the I-880 Damon Slough Bridge and the Oakland Coliseum Complex are expected to be permanently inundated by 48 inches of SLR.

To protect the surrounding assets from existing flooding and future permanent inundation, the study recommends that a living levee system be constructed along both sides of Damon Slough, shown in Figure 5. Adding to the need and opportunity for this levee is proposed development as envisioned in the Coliseum Area Specific Plan.[7] A conceptual levee design and cost estimate were developed to accommodate at least a mid-century SLR magnitude coupled with a 100-year extreme tide event. The living levee system design can also be adaptively managed to support higher rates of SLR in the future.

Figure 5: Layout and Footprint of a Living Levee System Along Damon Slough

EXAMPLES OF IMPLEMENTATION

Some climate-smart development strategies have already moved into implementation. Below are examples of adaptation strategies that have been initiated or are ongoing.

Coliseum Specific Plan

The Coliseum Specific Plan was adopted in 2015 to plan for the next 25 years of development at the Oakland Alameda County Coliseum Complex, and its environs. The plan establishes policies that new development in the area will take into account projected SLR. It calls for new development to design flood protection for a near-term 16 inches of SLR. For SLR greater than 18 inches, the plan calls for providing an adaptive approach, including the incorporation of retreat space and setbacks and designing for livable/floodable areas along the shoreline in parks, walkways, and parking lots. Developing a long-term adaptive approach for SLR up to 66 inches plus future storm surge and consideration of increased magnitude of precipitation events is also included. The plan also established that future developments incorporate a suite of shoreline protection measures (such as a living levee in Damon Slough), protective setbacks, location of all critical infrastructures above the base flood elevation, and other adaptation strategies.

Oakland Airport Perimeter Dike Improvement

A 4.5-mile-long perimeter dike forms the southwestern shoreline of the airport property. The structure provides flood and shoreline protection to the main passenger and cargo runway (Runway 12-30). Parts of the airfield are below sea level. The dike was constructed in the 1950s with additions in 1970s using dredge material from the Bay. Portions of the dike currently do not meet Federal Emergency Management Agency (FEMA) certification flood standards, and portions are susceptible to liquefaction during seismic events.

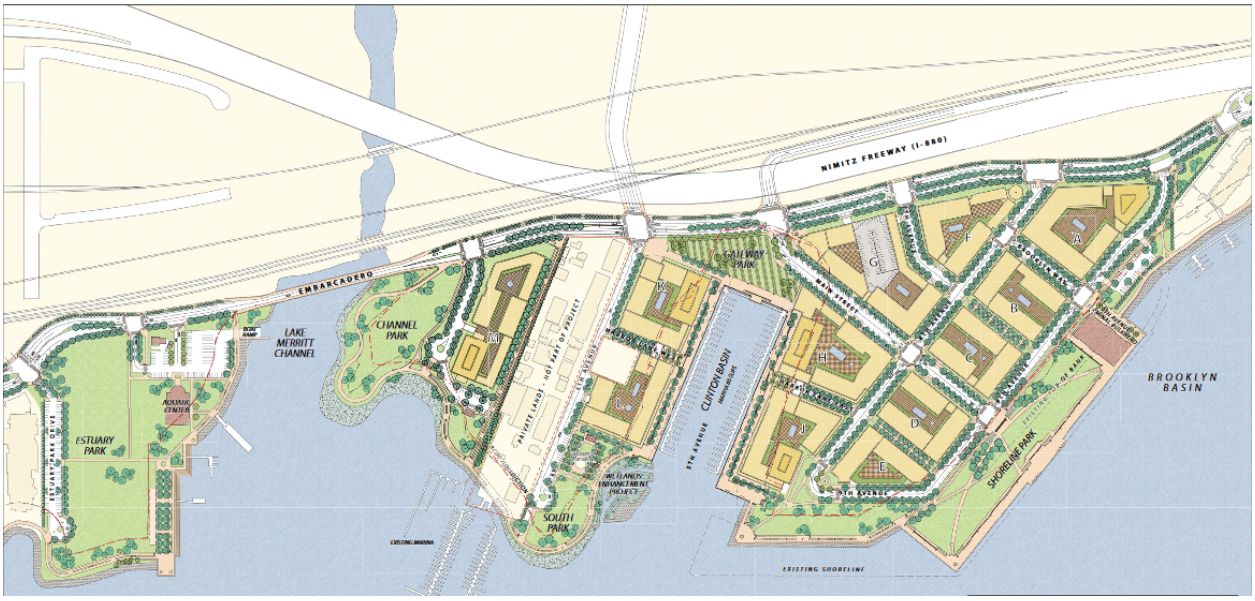
The Airport Perimeter Dike FEMA and Seismic Improvement project proposes improvements addressing SLR and 100-year flood protection by raising the dike crest, improving the crest structure, controlling seepage, and improving the seaward slope of the dike. As of August 2016, the project is currently in the second phase of final design, and has completed the California Environmental Quality Act process to identify potential environmental impacts. Construction of the project is projected to begin early to mid-2017.

Brooklyn Basin

Brooklyn Basin, formerly “Oak to Ninth Mixed Use Development” consists of approximately 64 acres of waterfront property, and includes new residential units, commercial property, public and open space, and an existing wetlands restoration area (Figure 6). Construction began in 2016, and the development will be built out in four phases over a 17-year period.

The project includes two flood-protection strategies: a perimeter protection component along the shoreline; and a requirement for the interior grades of buildings. The shoreline edge is proposed to be 3 feet above the current 100-year water level; which, according to the project team, would address the SLR effects beyond mid-century levels. For the interior grades, the development plan proposes a minimum Finish Flood elevation of structures to be 3 feet above the current 100-year water level to account for SLR in the future. The proposed shoreline edge elevation would be high enough to prevent overtopping by extreme waves, according to the project team.

Figure 6: Brooklyn Basin Illustrative Plan



Source: Brooklyn Basin – Oak to 9th Development Plan, Preliminary Development Plan Submittal, 2006

Middle Harbor Enhancement

The Middle Harbor, owned by the Port of Oakland, was historically a shallow-water, subtidal marsh. In the early 20th century, it was transformed to a Naval Supply Depot, and 40-foot berths were dredged in the harbor for use as a ship basin. The Middle Harbor Enhancement Area began in 2000 with the goal of restoring the area to a shallow water habitat and ecological preserve by filling in the deep-water berths and harbor with five million cubic yards of sediment. Dredged material has been placed and is currently undergoing settlement, with beds of eelgrass to be planted on the site in 2017 (pilot) and 2018. Although this project was not originally designed as an SLR adaptation project, it will be monitored over time by the Port to assess how the restored habitat may support adaptive management of the shoreline.

San Francisco Bay Trail at Martin Luther King Jr. Regional Shoreline

Martin Luther King Jr. Regional shoreline is a popular 717-acre Bay-front park with diverse recreation opportunities and wetland habitat. It includes five miles of Bay Trail, which provides a popular and scenic pedestrian and bike trail. In 2015, ABAG and the Bay Trail Project completed a study to identify physical gaps in the Bay Trail System. The goal of the Bay Trail Project is to connect existing sections of the Bay Trail to develop a complete system of trails around the perimeter of the Bay.

Two large Bayfront gaps were identified along Doolittle Drive: an area to the north between Shoreline Park and the Doolittle Staging Area, and another to the south between the fishing dock and Doolittle Grove. A feasibility study considering many parameters, including existing conditions, environmental and regulatory requirements, and coastal engineering, was prepared to support options for connecting these sections. Five design alternatives are being considered for the project and account for existing Bay water levels and future SLR projections.

East Bay Gateway Park

Located at the foot of the new east span of the Bay Bridge on former Oakland Army Base land, the East Bay Gateway Park is currently in the early planning phase. While no date is set for the construction of the permanent park, an interim “pop up” park is proposed for opening in 2018 (Figure 7). Water quality and site remediation issues are barriers to the construction of the permanent park, which is being planned by the East Bay Regional Park District. To ensure the park is resilient to future Bay levels, a flood protection levee will be included in the park design, with consideration of measures for longer-term SLR adaptability.

Figure 7: Preliminary Rendering of Gateway Park

Source: Gateway Park Working Group, 2014

6. KEY CONTEXT FOR SEA-LEVEL RISE ROAD MAP ACTIONS

This section provides a brief overview of the context that has informed the development of actions for the SLR road map, and may inform the development and implementation of future actions. It includes information on agencies that play a regulatory role along Oakland's shoreline, and identifies major land owners, critical assets, and known vulnerable communities.

KEY AGENCIES, REGULATIONS, AND POLICIES

Effective policies on SLR will require coordination with agencies with jurisdiction along the shoreline; and compliance with regulations at local, State, and Federal levels. Over a dozen agencies, often having overlapping regulatory authority, play a role in managing Oakland's Bayfront assets. In some cases, efforts by these agencies and stakeholders are not aligned. A lack of unified and coordinated regulatory oversight can lead to the complication and delay of achievement of coastal resiliency. To establish effective and proactive SLR policies for the City of Oakland, seeks to coordinate participation with the following agencies.

Federal

The primary federal regulation pertinent to SLR is Executive Order 13690, passed by the Office of the President on January 31, 2015. This Executive Order directs Federal agencies to incorporate SLR considerations into decision making and operations. Agencies such as the Federal Aviation Administration and the Federal Transit Administration will enforce these requirements when administering grants and permits. Federal agencies with flood prevention or recovery responsibilities, including the U.S. Army Corps of Engineers (USACE) and FEMA, have adopted or are considering polices related to risk reduction around SLR. At the time of writing, Executive Order 13690 provides the most stringent Federal standards for coastal flood protection. Coastal or SLR-related projects may need authorization from the following agencies:

- **U.S. Army Corps of Engineers** issues permits and authorizations for various environmental impacts and supports levee certification decisions for the National Flood Insurance Program (NFIP), administered by FEMA.
- **Federal Emergency Management Agency** issues Flood Insurance Rate Maps (FIRMs) and administers the NFIP. Oakland is a participant in FEMA's NFIP, and received Preliminary FIRMs from FEMA in April 2015 that are expected to become effective in mid-2017. The City was also included in FEMA's non-regulatory Increased Flooding Scenario Maps[30] released in April 2016. More information on FEMA mapping can be found in Appendix A.
- **The U.S. Fish and Wildlife Service** and National Marine Fisheries Service have regulatory jurisdiction over impacts to species protected under the Federal Endangered Species Act.

State of California

The Office of the Governor has issued executive orders directing State agencies to issue climate change guidance. Coastal development within San Francisco Bay primarily falls under the jurisdiction of BCDC. The California State Lands Commission (CSLC) has jurisdiction over development and access to submerged and tidal lands, and oversees the activities of legislative grantees like the Port of Oakland. The following State agencies have developed guidance and policies related to SLR:

- **Bay Conservation and Development Commission** has regulatory jurisdiction over existing and proposed land use changes and structures within 100 feet (inland) from the Bayshore's mean high water elevation. SLR vulnerability and risk assessments are required when planning shoreline areas or designing larger shoreline projects in BCDC's jurisdiction. Risk assessments must be based on the best available estimates of future SLR. New projects on Bay fill, likely to be affected by future SLR and storm surge activity during the life of the project, must meet additional requirements, and when feasible, integrate hard shoreline protection structures with natural features that enhance the Bay ecosystem (e.g., including marsh and/or upland vegetation).

- **The California State Lands Commission** has jurisdiction over tidelands and submerged lands along the entire coast, and within 3 nautical miles offshore from the ordinary high water mark. CSLC requires SLR planning by Legislative Trust Grantees, such as the Port of Oakland; and requires grantees with average annual gross public trust revenues over $250,000 to prepare and submit a SLR plan to the CSLC no later than July 1, 2019.

- **The California Department of Fish and Wildlife (CDFW)** has regulatory jurisdiction over impacts to species protected under the California Endangered Species Act. CDFW has been active in promoting climate planning and evaluating potential climate impacts to California wildlife and its habitats.

Local

Coastal or SLR-related projects may need authorization from the following agencies:

- **Oakland Planning and Building Department** establishes regulations for development in the City of Oakland. In coordination with the Oakland Planning Commission, the department oversees compliance with Oakland's General Plan, Planning Code, and Building Code and the California Environmental Quality Act. To promote a streamlined entitlement process, the City of Oakland has prepared Specific and Area Plans for different geographic regions of the city. The Plans serve as a comprehensive vision to address common planning, zoning, and environmental issues unique to each Specific Plan area for the next 20-30 years. As shown in Figure 8, several Specific Plans guide development in areas that could be exposed to SLR.

- **Port of Oakland,** under the direction of the Port Commission, has broad regulatory authority over trust lands granted pursuant to the Burton Act. The Port has its own land use and development code (City of Oakland, 2012), and oversees the permitting of new construction and rehabilitation projects in its jurisdiction. Figure 9 shows the land that falls under the regulatory land use jurisdiction of the Port of Oakland. Jurisdictional authority of the Port includes 20 miles of waterfront, and includes ground, commercial, retail, office, industrial, and maritime industrial leases, and landmarks such as Jack London Square.

- **City of Oakland Public Works** plans, builds, and maintains Oakland's physical and environmental infrastructure to ensure it is a sustainable and desirable place to live. This includes planning, construction, operation, and maintenance of Capital Improvement Projects such as street, sewer, and storm drainage improvements and renovation of public facilities, as well as management and strategy for climate and adaptation programs as part of the Environmental Services Division.
- **Alameda Public Works** maintains and preserves public infrastructure for Alameda County. They are tasked with services such as traffic/safety, building/permitting, and flood control.
- **Alameda County Flood Control and Water Conservation District** provides flood protection for Alameda County residents and businesses. The District plans, designs, constructs, and maintains flood control projects such as natural creeks, channels, levees, pump stations, dams, and reservoirs, including facilities in Oakland.

Figure 8: City of Oakland Specific Plans

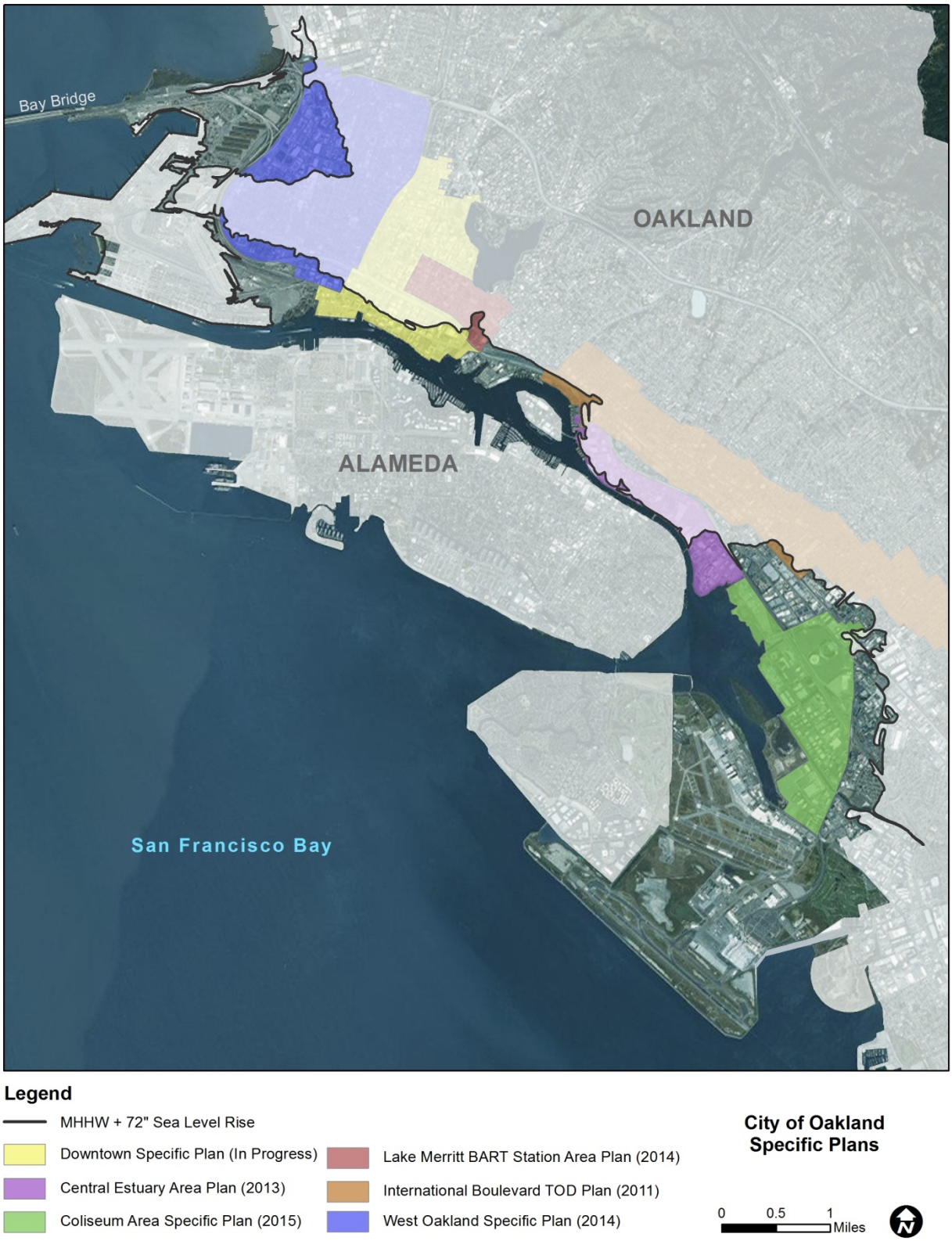


Figure 9: Port of Oakland Land Use Jurisdiction within MHHW + 72'' SLR

Disclaimer: These maps are intended as planning-level tools to illustrate the potential for coastal flooding as sea levels rise and do not represent the exact location or depth of flooding.The maps are based on model outputs and do not account for all the complex and dynamic Bay processes or future conditions.
Data Sources: AECOM, Port of Oakland

Legend

MHHW + 72" Sea Level Rise

Port of Oakland Jurisdiction

0 0.5 1 1.5 Miles

City of Oakland Port Jurisdiction

MAJOR PUBLIC LAND OWNERS

Oakland's Bayfront property is composed of both public and private properties. Public owners include local, State, and Federal agencies, such as the Port of Oakland and the East Bay Regional Park District. Private ownership includes both residential and commercial properties Figure 10 and Figure 11 show some of the major public land owners in areas that may be susceptible to SLR impacts in the long-term.

- **Port of Oakland** owns and maintains the Oakland International Airport, the fifth busiest commercial seaport in the U.S., the Oakland Estuary, the Embarcadero Cove, commercial property in and near Jack London Square, and several properties in the Oakland Airport Business Park.
- **City of Oakland** owns the Gateway Development Area, which is south of the Bay Bridge approach and is part of the former Oakland Army Base. The City also owns parks in West Oakland, including Raimondi Park and South Prescott Park. The City, through the former Oakland Redevelopment Agency, also owns office buildings, industrial land, and parcels of land currently used for open space, and lots adjacent to the Coliseum.
- **City of Oakland and Alameda County** jointly own the Coliseum complex, approximately 120 acres of sports/entertainment venues and surface parking lots, located between 66th Avenue and Hegenberger Road, adjacent to I-880.
- **East Bay Regional Park District** is responsible for recreational facilities, parks, and open space throughout the East Bay. Oakland parks include the Martin Luther King Jr. Regional Shoreline.
- **California Department of Transportation (Caltrans)** manages the highway system throughout the State, including vulnerable stretches of I-880 in Oakland.
- **Bay Area Rapid Transit (BART)** provides regional transportation throughout the Bay Area through an elevated and subway rail system. BART assets in West Oakland and in the Coliseum area could be vulnerable to SLR and storm surge.
- **East Bay Municipal Utility District** provides water for 1.4 million customers in Alameda and Contra Costa counties, and wastewater treatment for 650,000 customers in an 88-square-mile range along the Bay's eastern shore. The wastewater treatment plant in West Oakland, near the Bay Bridge, is vulnerable to SLR.

Figure 10: Major Land Ownership within MHHW + 72" SLR (Western Extent)

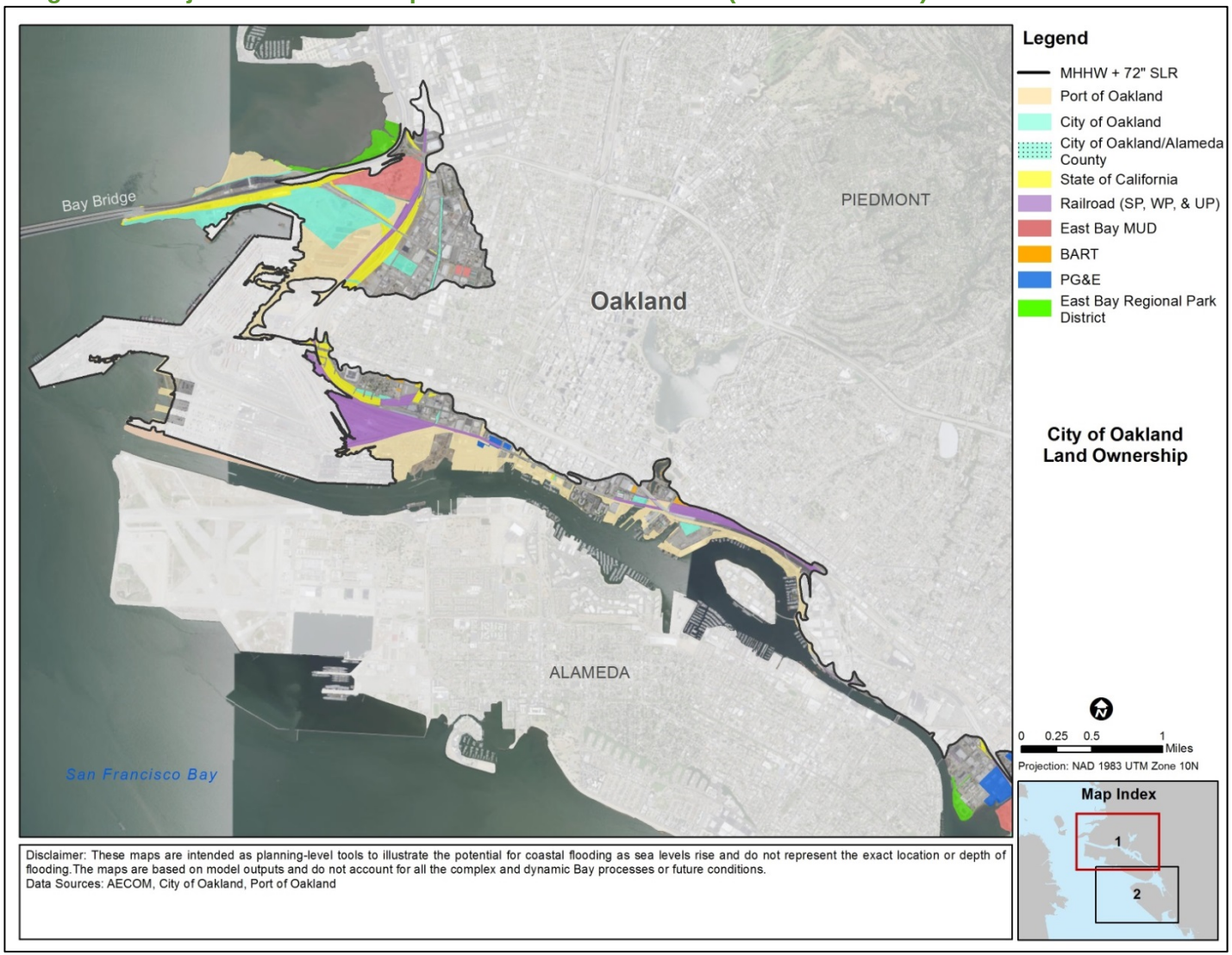
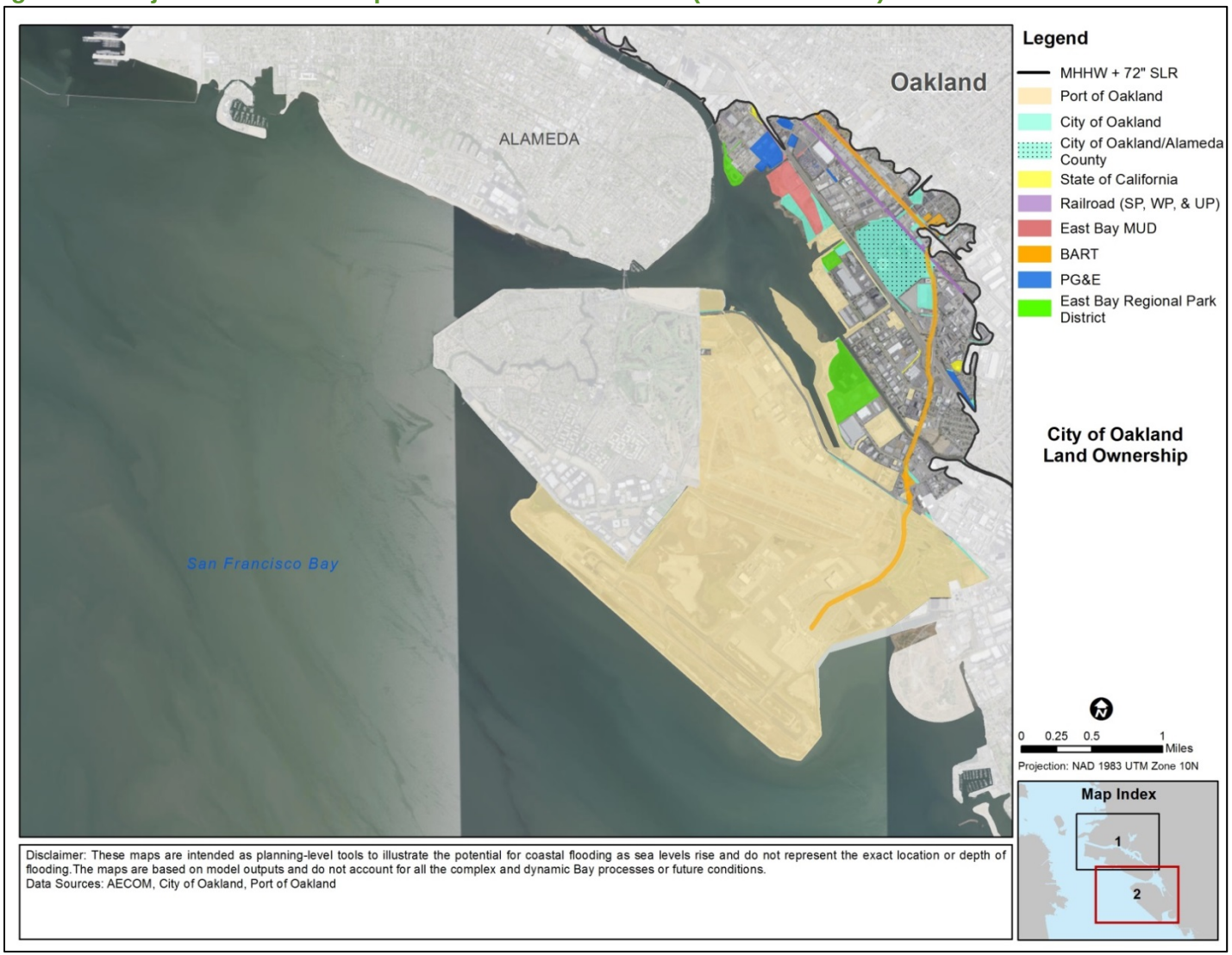


Figure 11: Major Land Ownership within MHHW + 72" SLR (Eastern Extent)



CRITICAL ASSETS

The Oakland shoreline and adjacent neighborhoods contain both critical community facilities, like fire stations and schools, as well as regionally significant infrastructure that support the Bay Area economy, such as transportation and waste infrastructure. Damage to these critical assets could have significant consequences, both for Oakland's communities and the region. Figure 12 and Figure 13 show preliminary mapping of critical assets using existing data from BCDC. The maps show that critical assets such as highways, transit stations, schools, wastewater infrastructure, and landfills may be impacted by SLR. Future vulnerability assessments can leverage these maps, adding in further critical assets as identified by the community, providing a more comprehensive picture of critical community facilities.

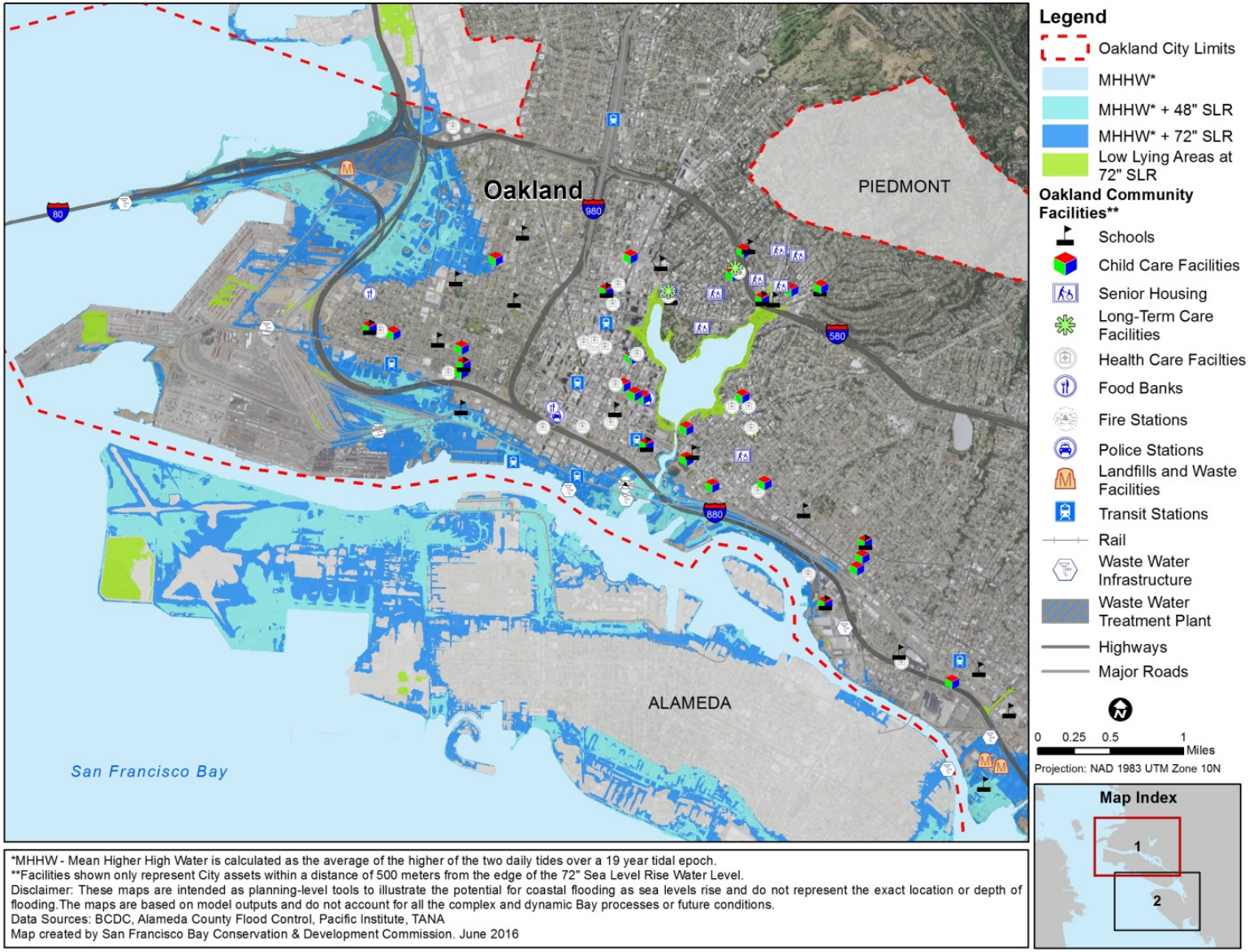
Table 4 summarizes the number of critical assets impacted by the MHHW + 48 and 72-inch SLR scenarios based on existing data from BCDC. The table shows that a significant number of the solid waste and waste water facilities in Oakland are anticipated to be at risk from SLR. Even temporary flooding of waste and/or waste water facilities could have impacts on public health and the local and regional economy.

Table 4. Summary of Critical Assets Impacted*

Community Facilities	Total Number (citywide)	Number at Risk from Sea Level Rise	
		48"	**72"**
Emergency Response Facilities			
Fire Stations	8	1	1
Facilities Serving At-Risk Populations			
Food Banks	15	0	1
Health Care Facilities	121	0	4
Facilities Serving Vulnerable, Less Mobile Populations			
Child Care Facilities	149	0	3
Schools	84	1	2
Waste Facilities			
Landfills and Waste Facilities	9	2	8
Waste Water Treatment Plants	2	2	2
Waste Water Infrastructure	11	4	7
Transportation Infrastructure			
Transit Stations	12	1	3

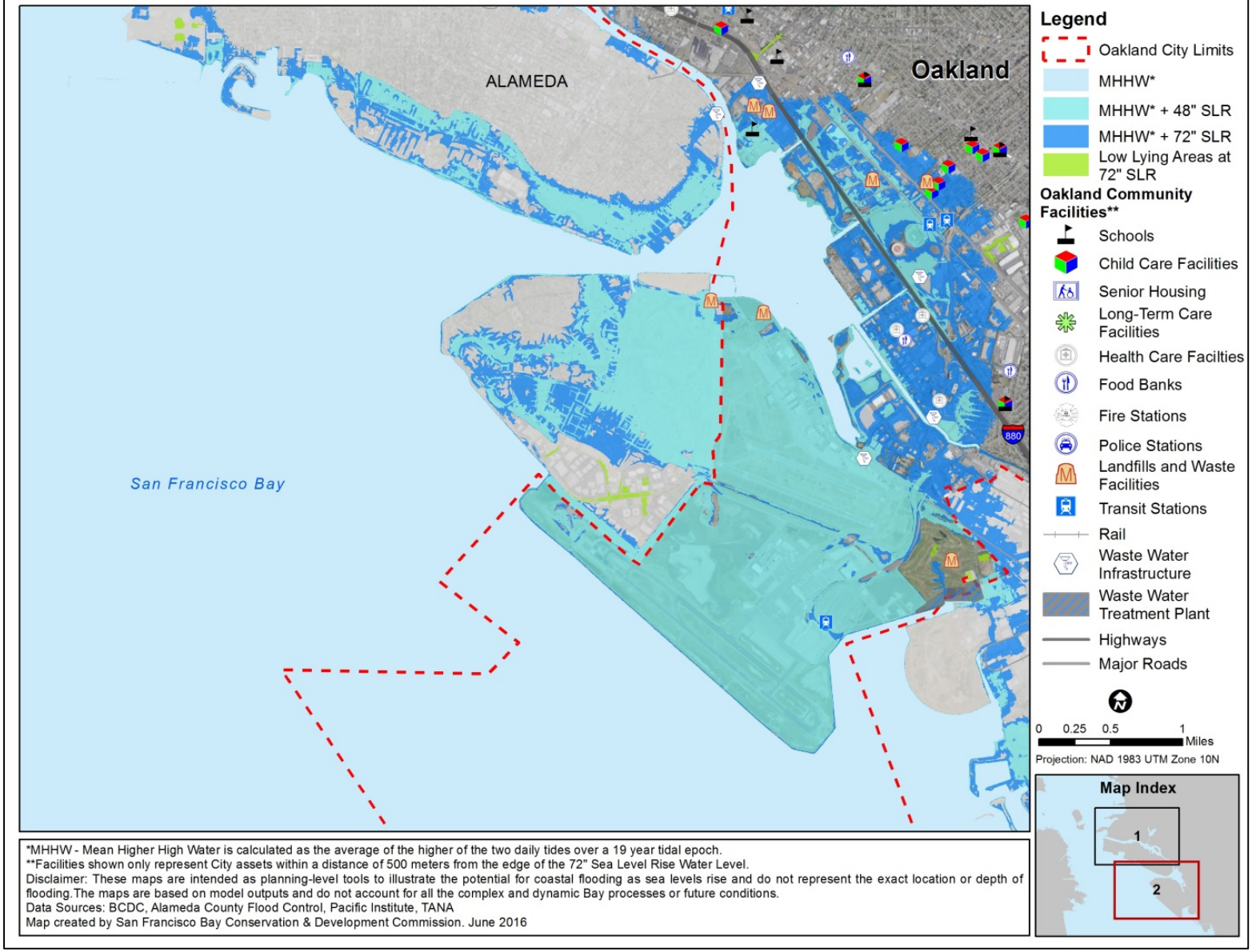
Source: BCDC, 2016
*Community facilities data intended as a planning-level tool and may not be comprehensive and can be updated with new information when available

Figure 12: Critical Community Facilities and SLR (Western Extent)



*MHHW - Mean Higher High Water is calculated as the average of the higher of the two daily tides over a 19 year tidal epoch.
**Facilities shown only represent City assets within a distance of 500 meters from the edge of the 72" Sea Level Rise Water Level.
Disclaimer: These maps are intended as planning-level tools to illustrate the potential for coastal flooding as sea levels rise and do not represent the exact location or depth of flooding.The maps are based on model outputs and do not account for all the complex and dynamic Bay processes or future conditions.
Data Sources: BCDC, Alameda County Flood Control, Pacific Institute, TANA
Map created by San Francisco Bay Conservation & Development Commission. June 2016

Figure 13: Critical Community Facilities and SLR (Eastern Extent)



*MHHW - Mean Higher High Water is calculated as the average of the higher of the two daily tides over a 19 year tidal epoch.
**Facilities shown only represent City assets within a distance of 500 meters from the edge of the 72" Sea Level Rise Water Level.
Disclaimer: These maps are intended as planning-level tools to illustrate the potential for coastal flooding as sea levels rise and do not represent the exact location or depth of flooding.The maps are based on model outputs and do not account for all the complex and dynamic Bay processes or future conditions.
Data Sources: BCDC, Alameda County Flood Control, Pacific Institute, TANA
Map created by San Francisco Bay Conservation & Development Commission. June 2016

VULNERABLE COMMUNITIES

Several factors contribute to a community's vulnerability to SLR, including transportation access, housing, language, race, and income. For example, households without a vehicle will be more vulnerable to SLR, because they may not be able to use alternative routes to get to work if road access is disrupted due to increased incidences of periodic flooding. Renters are also more vulnerable than homeowners, since they may not know they are in a flood-prone area, or are less likely to flood-proof buildings and buy insurance because the decision to make major home improvements and financial gains typically lies with the property owner.[17]

Race and income are also key indicators of vulnerability. People of color are less likely to own their homes and less likely to speak English "well" or "well at all." [14] Additionally, according to the 2015 American Community Survey, the median income of White households ($67,191) is nearly 50% greater than the median income of African American ($45,217) and 35% greater than Latino ($49,682) households in California. The correlation of lower income and race, and the over-representation of communities of color among those without legal residency and without health insurance, increases these communities' vulnerability to SLR and potential challenges in recovering from a coastal flood.[17]

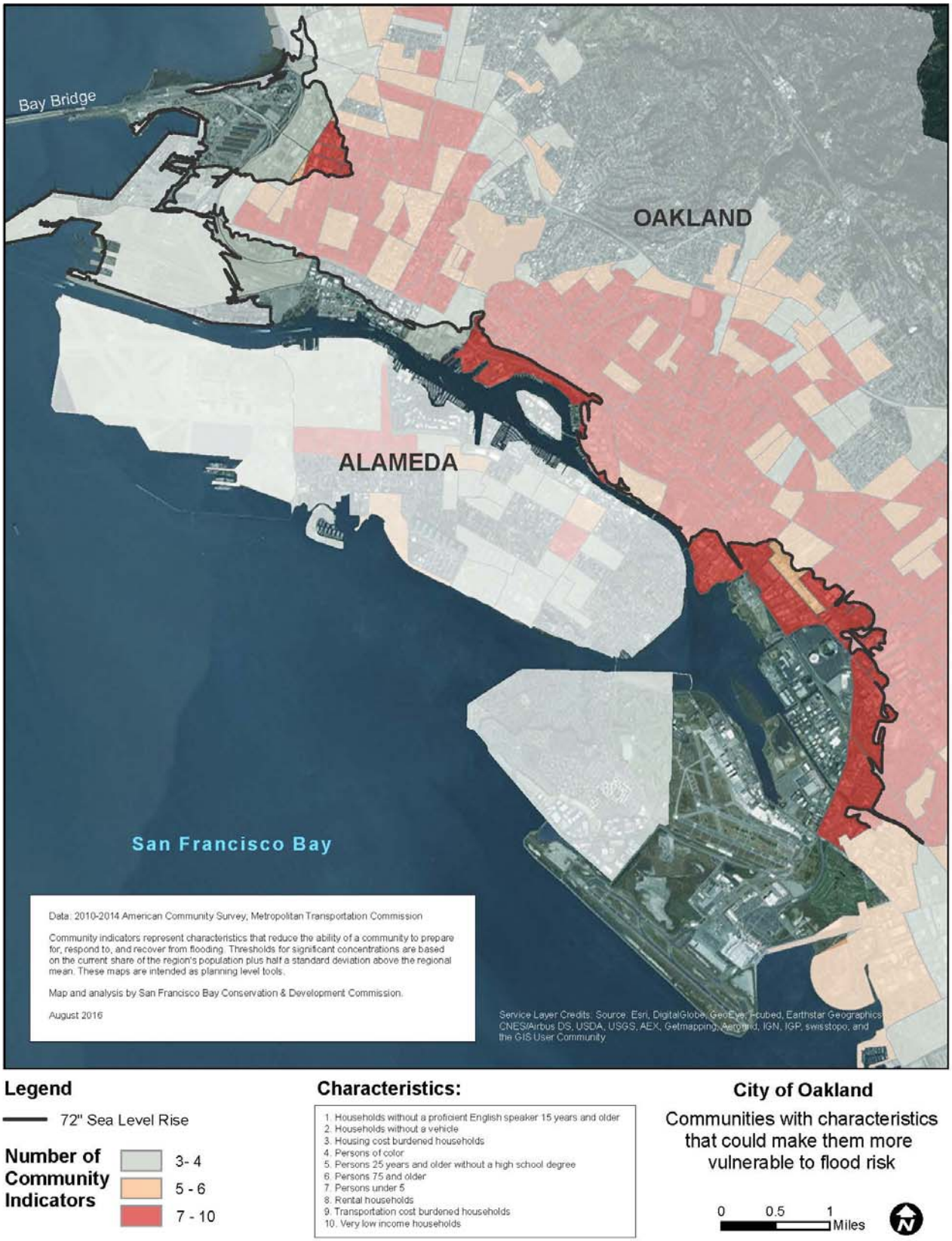
ABAG and BCDC developed a community vulnerability score as part of the Stronger Housing, Safer Communities (2015) project that is a summary of 10 socio-economic indicators that affect individuals' and households' ability to prepare, respond to, and recover from a disaster.[5] For this Road Map, BCDC provided mapping of the indicators for Oakland, shown in Figure 14. These indicators, also listed in Figure 14, collectively present one picture of the community's vulnerability. The map illustrates that census blocks near the Oakland shoreline which may be exposed to future flood events tend to have a high number of indicators of community vulnerability. For the residents of the Clawson neighborhood of West Oakland, and parts of Havenscourt and the industrial and commercial businesses and employees around the Coliseum, this finding highlights the need to pursue strategies that enhance the adaptive capacities of communities that are both physically and socially vulnerable to SLR impacts.

Figure 13 provides just one picture of community vulnerability to SLR, and many other factors may contribute to a community's vulnerability or resilience. Future vulnerability assessments in Oakland may further explore indicators and mapping of community vulnerability to develop targeted adaptation strategies. Additional maps of community vulnerability indicators are provided in Appendix B.

SUMMARY

This complex picture of regulatory jurisdictions, land ownership, critical assets, and vulnerable communities underscores that adaptation in Oakland will need to be a collaborative process. Adaptation responses that are effective, efficient, and equitable will require that all those impacted by SLR and potentially affected by adaptation responses, are able to fully participate and co-create solutions. This complex picture also highlights that SLR adaptation planning and implementation in Oakland will continue to take place at multiple scales, be led by different agencies and resident or business groups, and focus on different types of assets. Venues where these efforts can be shared and periodically taking stock of what has been accomplished to-date, where the gaps lie, and stakeholder priorities will continue to be of value to all parties

Figure 14: Indicators of Community Vulnerability in Oakland



Legend

72" Sea Level Rise

Number of Community Indicators

- 3- 4
- 5 - 6
- 7 - 10

Characteristics:

1. Households without a proficient English speaker 15 years and older
2. Households without a vehicle
3. Housing cost burdened households
4. Persons of color
5. Persons 25 years and older without a high school degree
6. Persons 75 and older
7. Persons under 5
8. Rental households
9. Transportation cost burdened households
10. Very low income households

City of Oakland

Communities with characteristics that could make them more vulnerable to flood risk

0 0.5 1 Miles

7. PRIORITY ACTIONS

The following are immediate next steps that have been prioritized by the City of Oakland. They are organized according to the themes described in Section 1 and summarized in Figure 15.

IDENTIFY AND PURSUE ENGAGEMENT AND COLLABORATION OPPORTUNITIES

Maximize Opportunities for Engagement and Collaboration in SLR Road Map Actions

"It Takes a Town" Workshop for the development of a community engagement toolkit

Photo by: Ayushi Roy, City of Oakland

Opportunities for engagement have been highlighted in many of the following actions and in Figure 15. In the near-term, opportunities to engage and collaborate with community members about SLR will be maximized through planning processes already under way, such as the Downtown Specific Plan (Plan Downtown) and community-led initiatives such as RCI. Once the Citywide Vulnerability Assessment and Adaptation Plan processes are initiated, a public engagement and community collaboration strategy will be developed, engaging the community to identify vulnerabilities and work alongside the City in developing adaptation strategies. The City will also leverage the community engagement principles developed by Rebuild by Design, and local organizations, including the WOEIP and StreetWyze. These principles are described in Appendix C.

Collaborate with Local Organizations Working on SLR

Many organizations in the Bay Area and Oakland are working on SLR adaptation and building the resilience of vulnerable communities. Oakland will develop a plan for continuing collaboration with these groups with maximum effect and mutual benefit, leveraging the community engagement toolkit described above. These organizations may include, but are not limited to, OCAC, RCI, BCDC ART Program, BARC, and Movement Strategy Center.

Communicate SLR Impacts to the Community

An action identified in the 2012 Energy Climate Action Plan (ECAP) that will continue to remain a priority is to educate the Oakland community about SLR impacts, to lay the foundation for public discussion of future planning decisions and adaptation strategies. In partnership with local community groups, the City will seek to communicate information about SLR impacts to the Oakland community,

particularly those who may be most vulnerable, such as communities of color and low-income communities, to build greater local capacity to participate in the development of vulnerability assessments and adaptation strategies.

Participate in Resilient by Design Bay Area Challenge

The Resilient by Design Bay Area Challenge aims to bring together hundreds of government representatives, community leaders, and technical experts from Oakland, the Bay Area, and around the globe to address SLR and resiliency challenges that affect the Bay.[31] As the most extensive open forum for dialogue and collaboration the area has ever convened around SLR and resilience, the design challenge will seek to utilize the creative capacity of international design firms to create implementable solutions for the region. A key feature of the project is to reflect the Bay Area's diverse populations and communities. By addressing both vulnerabilities and community needs, Resilient by Design will provide realistic solutions to challenges faced by many underserved Bay Area communities. Design teams will create comprehensive community engagement plans that emphasize neighborhood participation and feedback to ensure equitable treatment and engagement of all stakeholders. This level of stakeholder involvement will foster a final design that reflects the community's vision, and therefore has broad and long-term public support for implementation. Ideas developed for the Oakland shoreline as part of the competition could feed into the Adaptation Plan development process. The Challenge is launching in Fall 2017. The City of Oakland also serves on the executive board of the challenge.

PARTICIPATE IN REGIONAL COORDINATION

Participate in Caltrans Sustainable Transportation Planning Grant Program

The Caltrans Sustainable Transportation Planning Grant was created to support Caltrans' mission to provide a safe, integrated, and efficient transportation system while also promoting sustainability. MTC, BCDC, and BARC received $1.2 million from this grant opportunity to evaluate transportation vulnerability due to SLR and extreme tides. Oakland is planning to participate in a regional working group to help develop resilience goals, evaluate criteria, questions, and data needs for this project. It is expected that the project will be conducted over three years, starting in Fall 2017. Results from this project will feed into the next Plan Bay Area.

Participate in Regional SLR Adaptation Groups

As described earlier, CHARG provides a forum for ongoing discussions to develop and implement regional flood protection solutions to SLR and extreme tides through working groups on funding, policy, technical, adaptation strategies, and implementation. Oakland's participation in CHARG will enhance interagency collaboration on research priorities, policies involving future flood protection, and regional adaptation strategies. The City will also collaborate with Climate Readiness Institute (CRI) at U.C. Berkeley, also described previously, as a resource to link the City's information and research needs with University researchers and students.

BETTER UNDERSTAND NEIGHBORHOOD VULNERABILITIES

Leverage New SLR Mapping

SLR mapping for Alameda County has been updated and improved in 2017 as part of the expansion of the ART Program to all nine Bay Area Counties. The mapping updates for Alameda County include incorporating updated topographic data that consider grade improvements completed since 2010. Additional scenarios have been mapped to increase consistency with regional SLR planning efforts. These mapping updates enhance the understanding of which assets may be exposed to SLR, and in what timeframe. The City of Oakland will review these maps and incorporate them into any on-going vulnerability assessments.

Enable and Use Community-Generated Data

The City will seek opportunities for residents of Oakland neighborhoods to provide additional information critical to SLR mapping efforts, including additional factors affecting localized flooding, such as areas of illegal dumping, environmental contamination of soils, infrastructure conditions, and unique neighborhood attributes that will improve understanding of the flooding potential in vulnerable communities. This activity could be facilitated through a partnership with a digital provider so community partners can map hot spots for creek or coastal-caused flooding they are already experiencing in their neighborhoods.

Volunteers Kayak the Oakland Estuary for Creek to Bay Day

Photo credit: Lech Naumovich

Monitor Updates of SLR Projections

As scientists gain a better understanding of the drivers behind SLR at global and local scales, projected rates of SLR are regularly updated. To ensure Oakland's coastal community and assets are protected using the best-available science, Oakland will continue to monitor updates of SLR projections, with particular attention given to publications from the State of California, the National Academy of Sciences, and the National Research Council.

Identify Funding to Complete a Citywide Vulnerability and Risk Assessment

East Oakland and the Coliseum Area have undergone vulnerability assessments as part of the ART Program. However, additional areas of the shoreline, such as West Oakland, the Central Estuary, and Jack London Square, are vulnerable and would benefit from similar analysis. The City will identify funding to complete vulnerability and risk assessments for portions of the shoreline, including adjacent neighborhoods and assets that have not yet been studied. This effort will ensure that all coastal communities in the City have access to information regarding future climate vulnerabilities, and have completed the first steps toward developing a more resilient future. SLR maps for the City will be leveraged from the expanded ART SLR mapping

effort (described previously). In addition, the City will coordinate with the Port of Oakland in relation to their upcoming SLR vulnerability assessments for areas of collaboration or leveraged information. The Port will be assessing its maritime facilities, and developing an implementation plan for near- and long-term SLR adaptation strategies (as required by AB 691 [2013] for public trust lands by 2019). The City will seek to partner with OCAC and other local groups to ensure that residents in Oakland's vulnerable communities are engaged in the vulnerability assessment process. In addition, the City will collaborate with all appropriate local, County, and regional agencies.

Identify Funding to Develop a Citywide Comprehensive Adaptation Strategy

The completion of Citywide vulnerability and risk assessments will provide valuable input for the development of an Adaptation Strategy. The Adaptation Strategy will identify and select potential new policies, as well as asset-, neighborhood- or district-scale physical strategies, depending on identified risks. It is likely that feasibility studies and cost-benefit analyses will be required to identify the most appropriate physical interventions. This Strategy will consider and support existing geographic-specific SLR planning efforts under way in Oakland, such as any plans in development for the Port. This effort will be coordinated with updates to the City's ECAP to ensure consistency in climate change responsiveness and planning. The City will collaborate with Bay regional adaptation efforts, including CHARG, academia, the OCAC and other engaged groups to ensure that residents in Oakland's vulnerable communities are afforded an opportunity to help define the scope and approach of the Adaptation Strategy. The City will work with ACFCD to identify threshold(s) for local, sub-regional, and/or regional adaptation strategies, and to jointly develop the Comprehensive Adaptation Strategy.

Identify Funding to Complete a Cost-of-Inaction Study for Critical Public and Private Sector Assets

A cost-of-inaction study will provide a better understanding of the economic risk of SLR, storm surge, and watershed flooding in Oakland. A cost-of-inaction study answers the question: if no special actions are taken to prepare for SLR or a major watershed flood, what would be the economic consequences? By understanding the economic risks of SLR and flood-related impacts to critical assets, stakeholders can make better-informed decisions about how to balance the cost of inaction with the cost of up-front adaptation. The City Administrator's Office will identify a partner to assist in this analysis.

Update Watershed Modeling to Include Climate Change Stressors

Oakland's 2006 Storm Drainage Master Plan included GIS based inventory and mapping, field investigations and hydraulic modeling, and recommendations for capital improvements and expanded inventory data collection and maintenance programs. The Master Plan identified assets that need to be upgraded, and projects and maintenance that could reduce flood risks. Due to a lack of funding, many recommendations have not been implemented. Updating the 2006 master plan, including developing an up-to-date Hydrological and Hydraulic (H&H) model of the City's 15 major watersheds to include new information regarding changes in climate and rising tides, will help the City better understand how its infrastructure will perform under changing storm scenarios. The updated H&H watershed modeling will incorporate climate change stressors, including both changes in future precipitation patterns, and rising Bay water levels. A scope of work has been prepared identifying the tasks needed to bring the H&H model up to date,

including incorporating climate change, once funding has been identified. The City will continue to collaborate with Alameda County Flood Control District (ACFCD) modeling and watershed planning.

ENABLE CLIMATE-SMART DEVELOPMENT

Incorporate SLR Considerations in Plan Downtown Oakland

The City of Oakland is preparing a new specific plan for the downtown area to guide its future growth. Unlike the General Plan, which contains policies for the entire city, a specific plan focuses on regulations customized for a particular area, based on its unique characteristics. Plan Downtown Oakland will provide guidance on linking development, land use, transportation, economic development, housing, public spaces, culture, arts, and social equity to achieve a vibrant future for the downtown area. As part of the development of Plan Downtown Oakland, the City is facilitating opportunities for the public to determine the future of Oakland's downtown waterfront community, including adaptive management for SLR. The plan area includes the Jack London District, which is particularly vulnerable to SLR, as well as the west side of Lake Merritt and the channel. Modeled on the Coliseum Specific Plan, Plan Downtown Oakland will incorporate policies that encourage new development projects to incorporate adaptive management strategies for SLR and storm surge, where appropriate. It will also consider SLR in infrastructure and land use decisions. The City will collaborate with regional groups in developing language and strategies to guide implementation of the plan's SLR components.

Incorporate SLR Considerations in General Plan Land Use Transportation + Element

The Land Use + Transportation Elements (LUTE) is a key component of Oakland's General Plan, providing a long-range integrated transportation/land use strategy for the City. LUTE designates the type, location, and intensity of land uses and development within City limits. LUTE was adopted in 1998; and starting in 2018, will be comprehensively reviewed and updated to address the next 20 years of Oakland's development. The next update of LUTE will analyze and incorporate SLR and storm surge in Oakland as mandated by Senate Bill 379 (2015), which requires climate change and SLR to be considered in general plan updates.

Explore Incorporating SLR Considerations in Update to the Green Building Ordinance

In compliance with California's Green Building Code, the City of Oakland adopted green building standards for private development projects in 2010. The Green Building Ordinance focuses on improving energy efficiency, natural resource conservation, and increased economic vitality through sustainable design. The City will explore options for incorporating SLR and other climate resilience considerations into a future update of the City's green building standards to help increase the resilience of new building projects to future climate conditions.

Develop SLR Guidance for the Capital Improvement Program

The Capital Improvement Program (CIP) prioritizes the repair and replacement of existing and new assets for the City of Oakland. The CIP comprises three areas of investment: infrastructure, equipment, and information technology. It is formally reviewed, and if necessary, revised every

two years. Various policy tools have been developed by other cities (including San Francisco and Baltimore) in recent years for aligning SLR risk with capital planning, including requiring capital projects in an SLR inundation area to address SLR-related flooding impacts and integrating lifecycle cost analysis in CIP project reviews. As also identified in *Resilient Oakland*, these and other tools are available as Oakland seeks to align infrastructure investment with risks and needs associated with increased flooding and vulnerability.

Roll Out / Support City Staff and Local Developer Training

It will be important that staff and developers working in Oakland understand the SLR considerations they will be expected to address in their projects. An engagement and training program should be developed for capacity-building within City departments; and for local developers to facilitate understanding of Oakland's approach to SLR, and to ensure that staff and developers are consistent in their response to SLR guidance and policies. The Urban Sustainability Director's Network has developed climate preparedness training aimed at transportation and water department City staff, which could be leveraged. The RCI is also a potential partner for ongoing staff training needs. They are holding a series of six hands-on policy workshops regarding resilience and equity issues in 2016-2017, including a workshop on SLR that was held in July 2016.

City staff attending a resilience workshop

Incorporate SLR Considerations in the Disaster Recovery Framework

A Disaster Recovery Framework describes how a city will recover from disasters that result in large-scale impacts, requiring the need for complex and extended recovery operations. Recognizing that climate change has the potential to adversely affect the frequency and magnitude of local hazards, such as flooding, FEMA's National Disaster Recovery Framework has recommended that local governments revise disaster strategies to include adaptation to long-term climate risks. The City is in the process of developing its Disaster Recovery Framework (DRF), which is expected to be complete by fall 2017. Incorporating SLR-related flooding risks into Oakland's DRF would promote increased coordination, information sharing, and ultimately, enhanced long-term resilience to potential coastal flood disasters.

Leverage Measure AA Funding for Wetland Restoration

Measure AA is a $12-per-year parcel tax over 20 years that is projected to raise about $25 million per year to restore wetlands and protect shorelines throughout the Bay Area. The money will help to prevent floods, promote conservation, restore 15,000 acres of wetlands and create 25 miles of new Bay trails. In 2016-2017, The San Francisco Bay Restoration Authority will be determining the award criteria for project funding; and it is anticipated that request for project proposals will likely be released in summer or fall 2017. Priority Conservation Areas on the Oakland shoreline

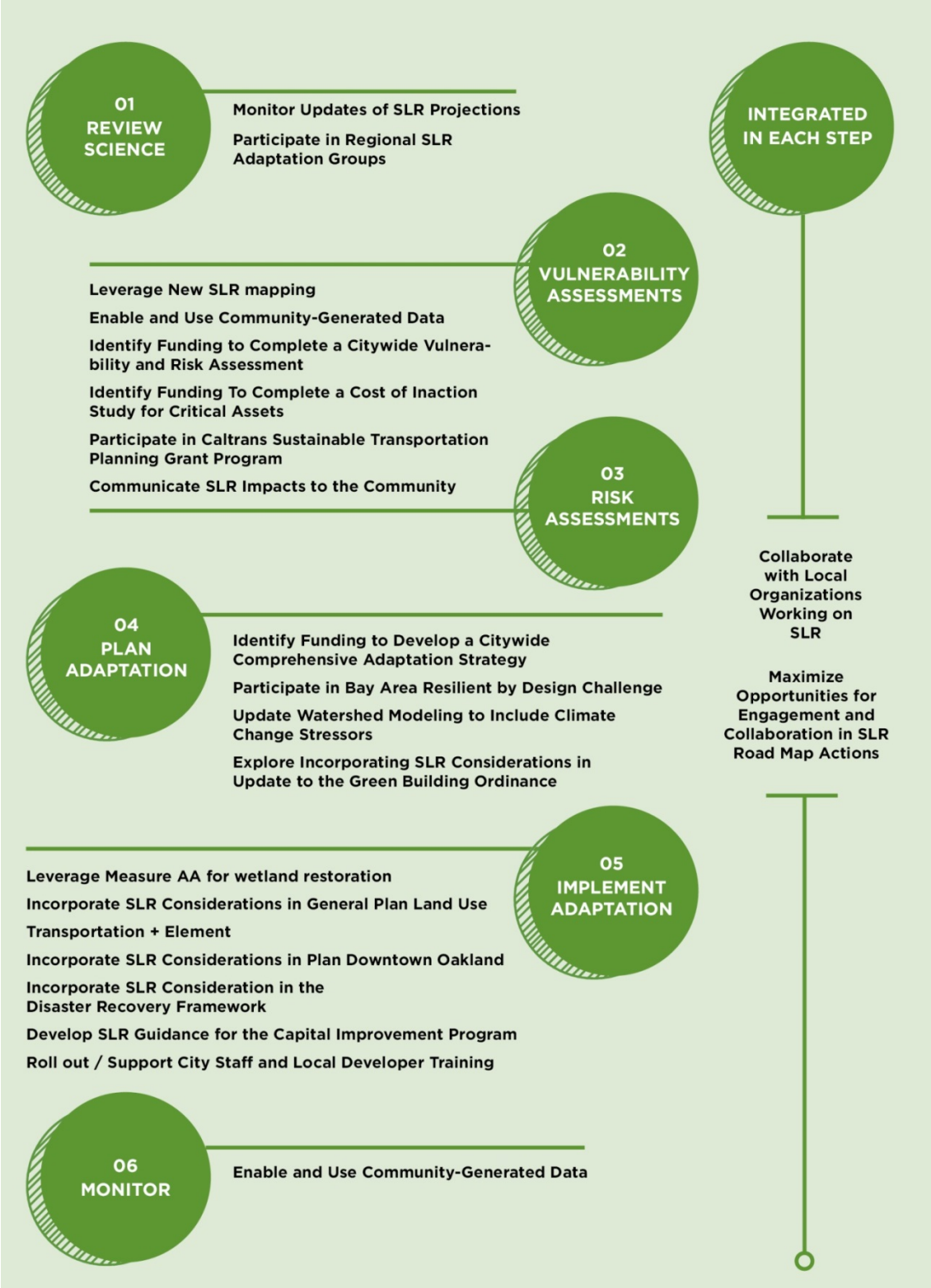
may be especially good candidates for Measure AA funding. Oakland projects that are anticipated to be eligible for wetland restoration grants include:

- Lower Sausal Creek – Restoration and enhancement of tidal wetland habitat at the mouth of Sausal Creek and along the shoreline of the Alameda Channel at Fruitvale Bridge Park, including restoration of habitats for wildlife and water quality; improvements to public access and wildlife viewing opportunities; stabilization of eroding shoreline; public outreach and education; volunteer stewardship; and long-term monitoring and maintenance.
- Martin Luther King Jr. Regional Shoreline – Installation and maintenance of trash collection facilities near the mouths of East, Elmhurst, and Damon creeks to improve wildlife habitat and water quality.
- Oakland Gateway Shoreline – Restoration of eroding shoreline, removal of contaminated Bay Fill, improvement of water quality, enhancement of tidal wetlands, establishment of Bay upland transitional areas, and development of public access to restored areas.

Oakport Project – Creation of tidal wetlands and enhancement of an existing 6-8 acre seasonal wetland for wildlife. It is located on two City-owned undeveloped parcels along Martin Luther King Shoreline, near Damon Slough and Damon Marsh. The City proposes to create tidal wetlands on the non-developed upland areas of the Oakport site and to enhance the existing seasonal wetlands.

Martin Luther King Jr. Regional Shoreline near Oakport is a candidate for wetland restoration funding through Measure AA.

Figure 15: Summary of SLR Road Map Actions



8. NEXT STEPS

The City will ensure that the strategies and actions of this SLR Road Map are completed, by convening an interagency task force with representatives from departments, such as Public Works, Planning and Building, Emergency Management, City Administrator's Office, and others. This task force can help ensure that each action is assigned to the appropriate department, funding opportunities are actively sought, and departments are sharing information and working collaboratively on actions.

Table 5, below, shows a preliminary timeline for implementation of Road Map actions. The task force may also track progress and update the timeline, as needed.

The City will also update its ECAP to reflect the recommendations of this Road Map. The ECAP was adopted by Council in 2012, and was written with extraordinary community engagement. The 2016 update to the ECAP seeks to reprioritize action items, and revise language, where necessary. This Road Map will inform the 2016 update, providing detail on new priorities and opportunities.

The City Administrator's Office, as part of its effort to strengthen engagement opportunities between the community and government, will also continue to develop strategies for ensuring that communities of color and lower-income residents have greater access to participation in government processes, including SLR research adaptation design, and decision-making. In the near-term, the community engagement toolkit in development at the time of this writing (August 2016) will provide a road map for more effective engagement with Oakland's communities that may be most vulnerable to SLR. In addition, the lessons learned from the community engagement components of all SLR Road Map actions will be reviewed in an ongoing manner so that the City and partners continue help Oakland adapt to SLR in an inclusive and equitable manner.

Table 5: Preliminary Implementation Timeline

	2017	2018		2019	
	Aug-Dec	Jan-June	July-Dec	Jan-June	July-Dec
Integrated in Each Step					
Collaborate with Local Organizations Working on SLR					
Maximize Opportunities for Engagement and Collaboration in SLR Road Map Actions					
Climate Science Review					
Monitor Updates of SLR Projections					
Participate in Regional SLR Adaptation Groups					
Vulnerability Assessment and Risk Assessment					
Leverage New SLR mapping					
Enable and Use Community-Generated Data					
Identify Funding to Complete a Citywide Vulnerability and Risk Assessment					
Identify Funding To Complete a Cost-of-Inaction Study for Critical Assets					
Participate in Caltrans Sustainable Transportation Planning Grant Program					
Communicate SLR Impacts to the Community					
Plan Adaptation					
Identify Funding to Develop a Citywide Comprehensive Adaptation Strategy					
Participate in Bay Area Resilient-by-Design Challenge					
Update Watershed Modeling to Include Climate Change Stressors					
Explore Incorporating SLR Considerations in Update to the Green Building Ordinance					
Implement Adaptation					
Leverage Measure AA for Wetland Restoration					
Incorporate SLR Considerations in General Plan Land Use Transportation + Element					
Incorporate SLR Considerations in Plan Downtown Oakland					
Incorporate SLR Consideration in the Disaster Recovery Framework					
Update the Energy and Climate Action Plan					
Develop SLR Guidance for the Capital Improvement Program					
Roll-out / Support City Staff and Local Developer Training					
Monitor					
Enable and Use Community-Generated Data					

ACKNOWLEDGEMENTS

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APPENDIX A: THE EFFECT OF SEA LEVEL RISE ON INSURANCE RATES

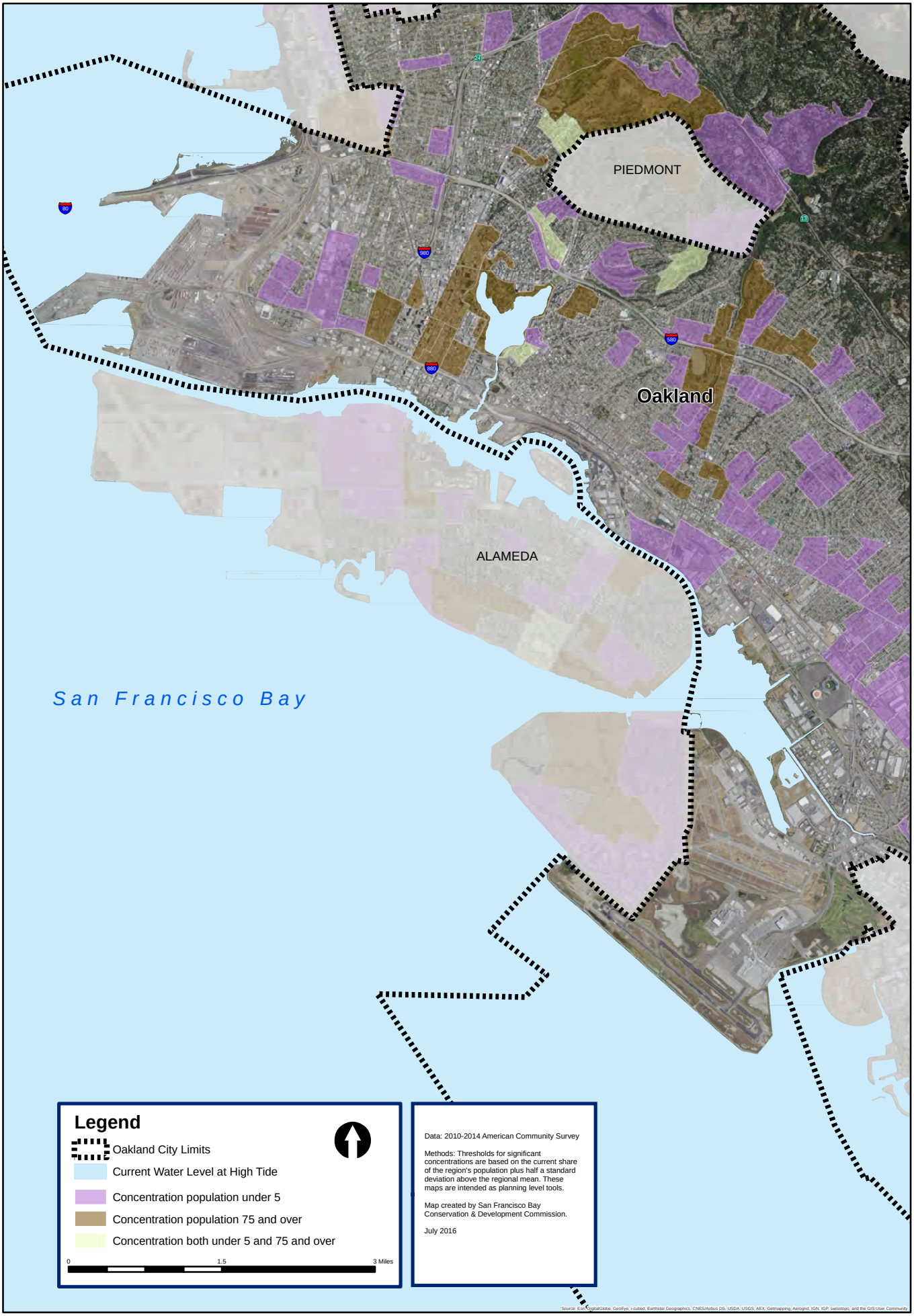
Oakland is a participant in the Federal Emergency Management Agency's (FEMA's) National Flood Insurance Program, and received updated Preliminary Flood Insurance Rate Maps (FIRMs) in April 2015 that are expected to become effective in mid-2017. The coastal hazards on the FIRMs for Oakland were last updated in 1984. The preliminary maps are based on new coastal and wave hazard analysis that represents the current conditions. The FIRMs do not include future sea-level rise projections. When the updated FIRMs become effective, any Oakland properties newly mapped in a Special Flood Hazard Area (SFHA) that have federally backed loans will be required to purchase flood insurance. In addition, properties that were previously mapped in an SFHA may be mapped in a higher hazard zone and subject to increased insurance rates. Although there is no set time interval when FEMA updates its FIRMs, the next revision will be based on new wave and water-level observations, which will include the effects of any sea-level rise that has occurred. As Bay water levels continue to rise, it is possible that flood hazard zone boundaries will expand landward of their existing position, and coastal hazards will increase, with the release of each updated FIRM.

In April 2016, FEMA released new, non-regulatory mapping products that depict increased coastal flooding scenarios for all nine Bay Area counties, including Alameda County. The maps complement the FIRMs and provide additional information on how the boundary of the 1-percent-annual-chance coastal floodplain may change with 1-foot, 2-foot, and 3-foot increases in Bay water levels. These are non-regulatory maps for informational and planning purposes, and are not for determining existing or future flood insurance rates. To see the April 2016 map products, they are available at http://www.r9map.org/Pages/San-Francisco-Coastal-Bay-Study.aspx.

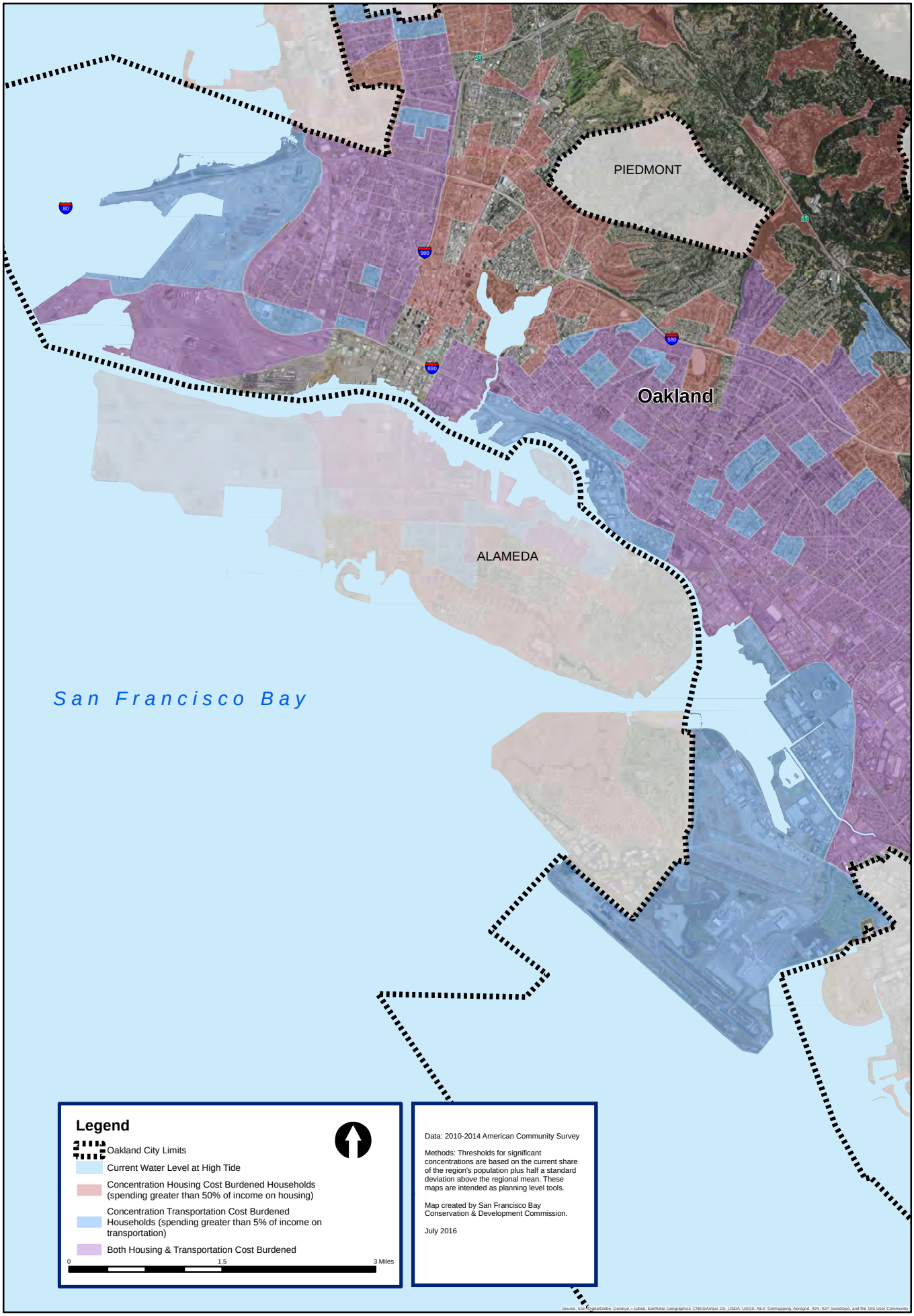
APPENDIX B: ADDITIONAL COMMUNITY VULNERABILITY MAPS

The following maps illustrate census block data for a collection of vulnerability indicators of neighborhoods near the Oakland shoreline. Vulnerability indicators were mapped for the following factors: age, cost burden, income, education, non-English speaking, people of color, home ownership, and access to a vehicle. The information described in these maps was used to create F, which shows collectively how the indicators combine to affect community vulnerability.

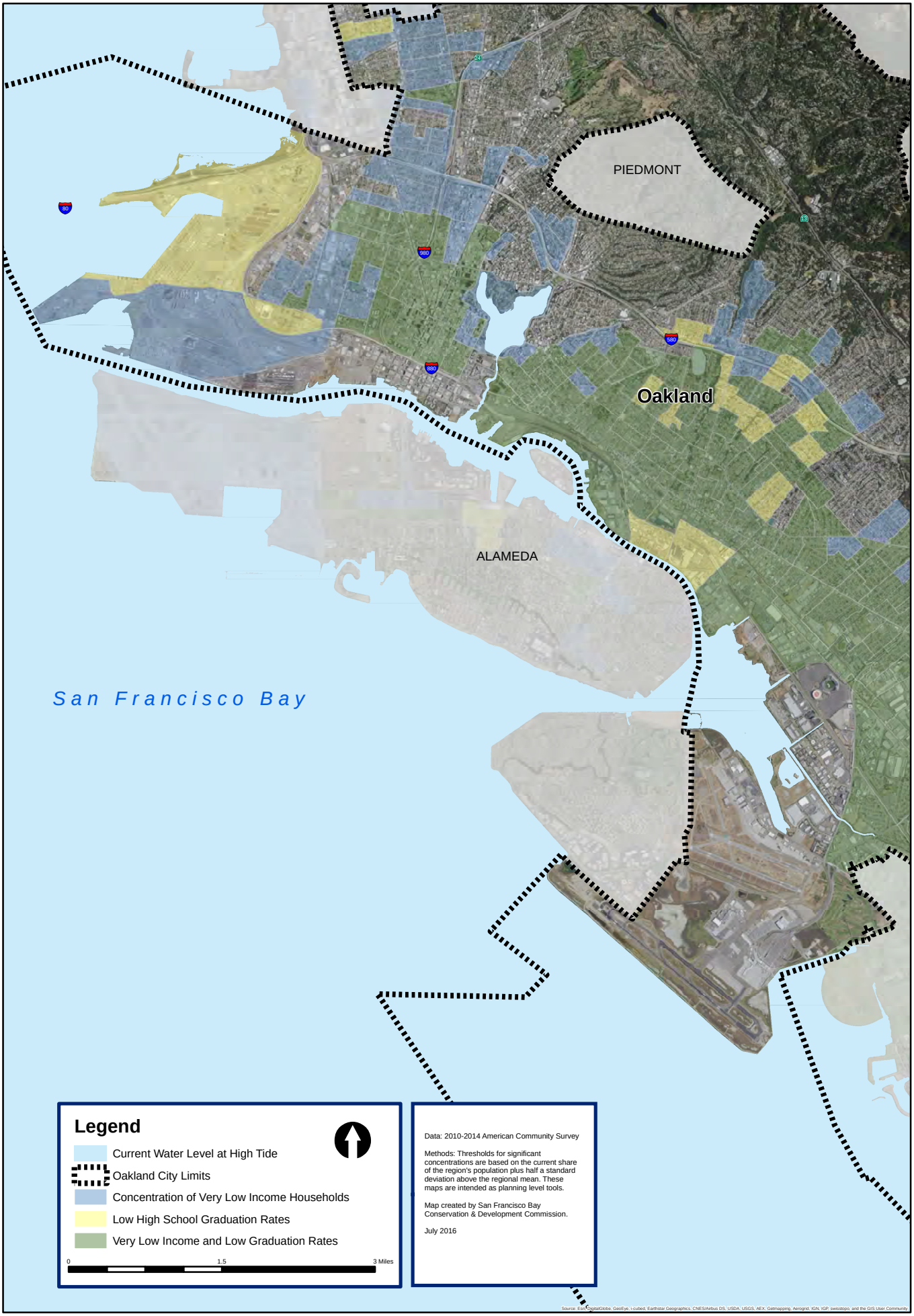
Oakland Community Indicators: Age



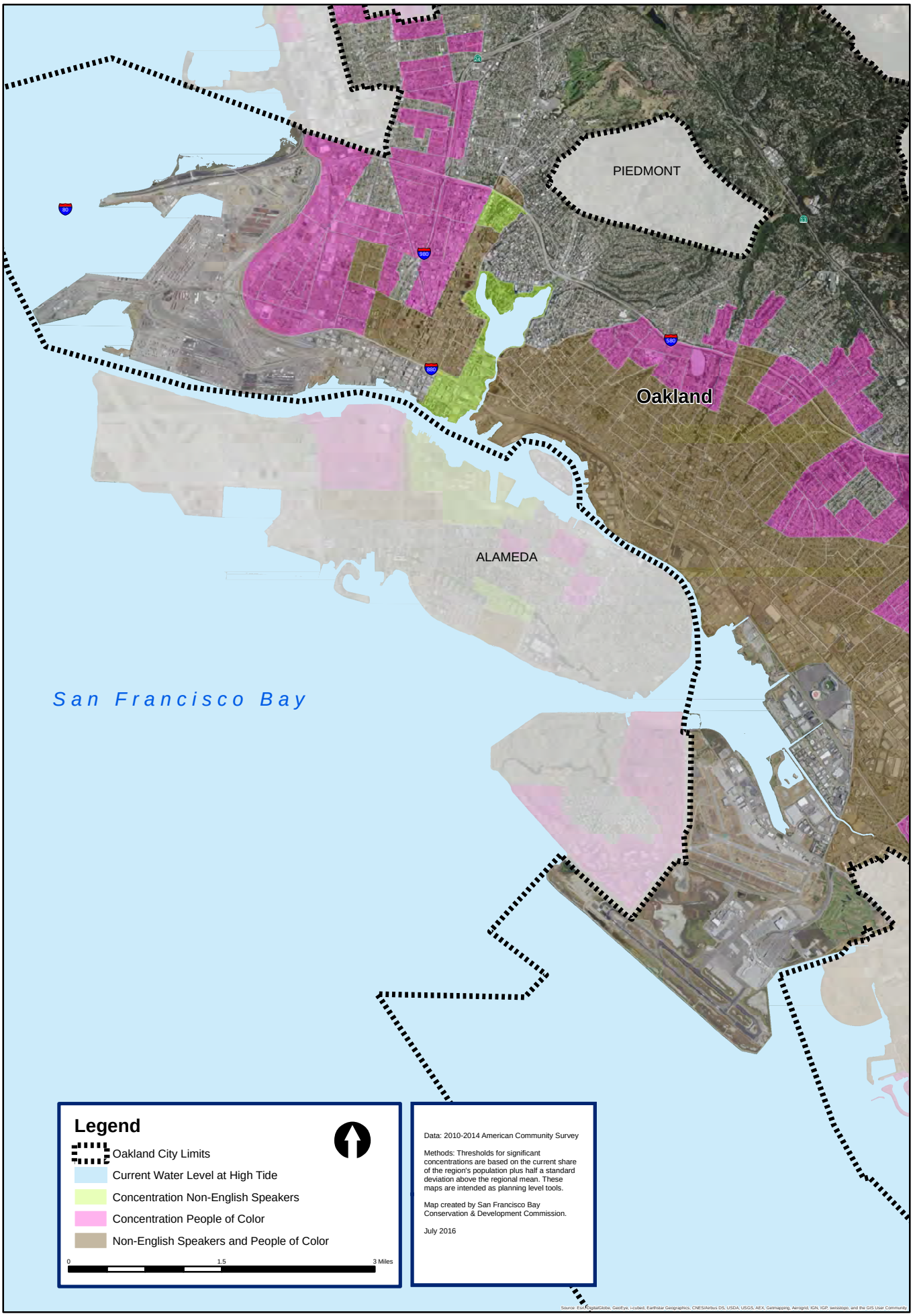
Oakland Housing & Transportation Cost Burden



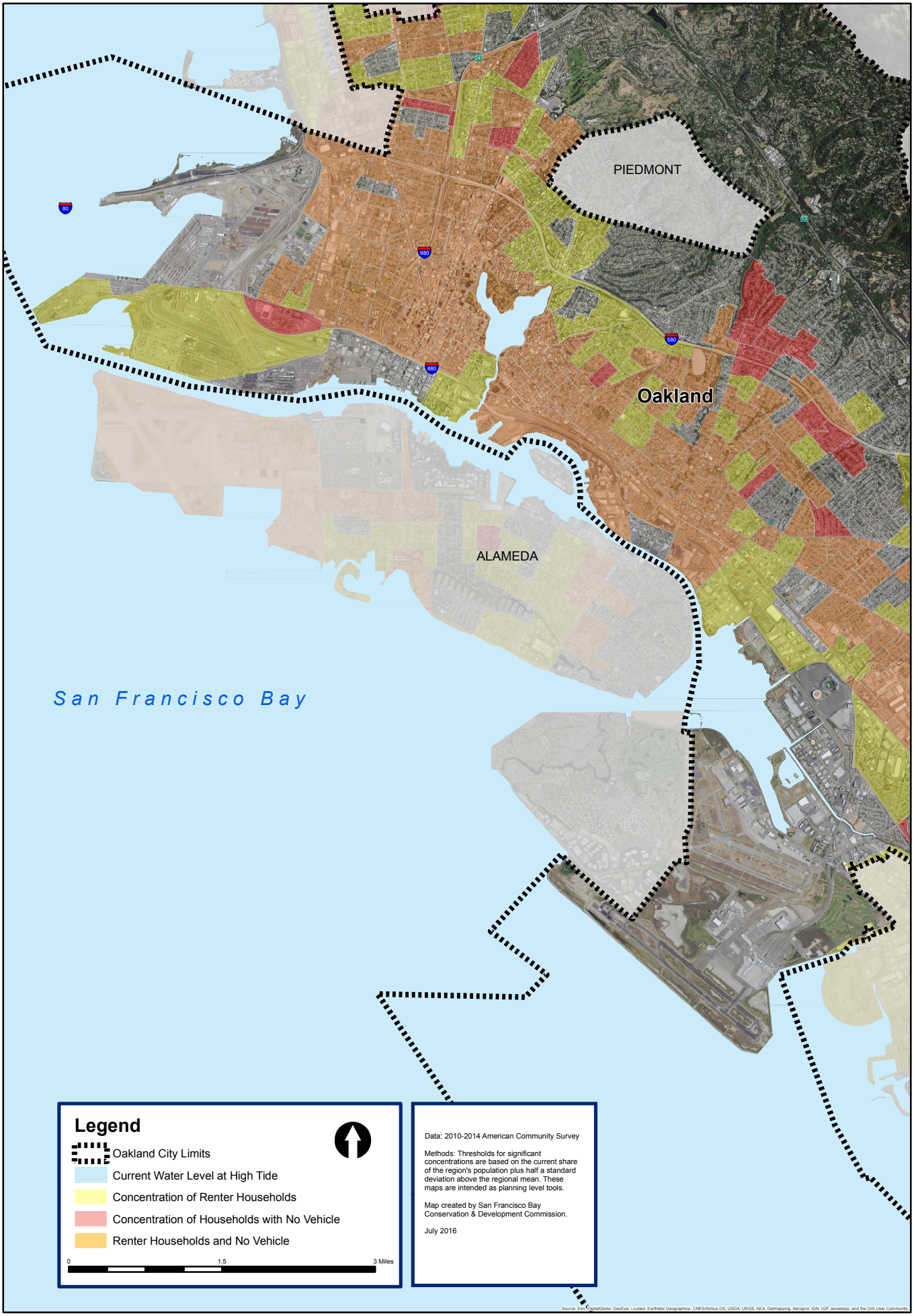
Oakland Education & Income



Oakland Limited English Speakers & People of Color



Oakland Renters & Access to Vehicles



APPENDIX C: COMMUNITY ENGAGEMENT PRINCIPLES

The following community engagement principles developed by Rebuild by Design, and local organizations, including the WOEIP and StreetWyze.

RESILIENT OAKLAND: IT TAKES A TOWN
10 KEY FINDINGS

MOBILIZE TALENT

DIVERSIFY OUTREACH

IMPROVE ACCESSIBILITY

KNOW THE HISTORY

FOSTER A SAFE SPACE

ENSURE EQUITY

SET EXPECTATIONS

CREATE TRANSPARENCY

DEFINE SUCCESS

INSTITUTIONALIZE

ABOVE: Margaret Gordon of West Oakland Environmental Indicators Project and Emi Wang, Greenlining Institute

In Fall 2016, the City of Oakland, The West Oakland Environmental Indicators Project (WOEIP), Rebuild by Design, and Streetwyze embarked upon a series of **workshops to understand how Oakland residents can better engage with the City.** Together, with over 55 City leaders and local organizations, we **examined which engagement practices have and have not worked in the past.**

We created a collective understanding of the practice of engagement in Oakland and are **developing guidelines and principles for a future engagement strategy,** the beginning of which is outlined below. The conversation gave way to many concrete suggestions on how the City and Community can work better together to allow both sides to move past original divergent agendas so that affected stakeholders can become a true partner with government.

1. MOBILIZE TALENT

Ensure the right stakeholders are at the table from the beginning, including people who are affected by the problems being discussed, and tapping into local knowledge and expertise in relevant subject areas.

2. DIVERSIFY OUTREACH

A robust communication and outreach process should utilize various methods to encourage participation; residents can get involved in multiple ways. Possible methods include: in-person meetings, online surveys, crowdsourcing ideas, and multiple locations for meetings at different times of different days.

3. IMPROVE ACCESSIBILITY

Strive to create the broadest possible access. This includes considering where and when meetings are held, and in how information is accessed before and after meetings. Use multiple platforms to reach different people in the ways that work best for them i.e. utilizing a combination of in-person or digital: email, newsletters, blogs, social media, webinars, etc. to reach those who are connected via computer and fliers, handouts, etc. to reach those who are less digitally accessible. Meetings should be in locations convenient for the community, provide food, translation if the community uses languages other than English. Funding should be available if organizations are asked to take time out of their work to help organize. Minutes should be posted publically. Residents should know who to contact with questions and follow up.

4. FOSTER A SAFE SPACE

Acknowledge that there is mistrust on both sides of the process and build a safe space for moving forward.

5. KNOW THE HISTORY

The process needs to ensure that existing city and community expertise is captured and utilized. Use intensive research to establish the multiple issues that lead to the problem we are trying to solve. Outreach processes should include a review of the background of the problem or issue. Both City and community attendees should be able to add their perspective to what the problem is, to create an understanding of the history of the problem, including what has already been done to address it, and who is working in this space.

6. ENSURE EQUITY

Understand and explicitly state how the community and leadership define equity. Design the decision-making process to ensure equity amongst all the involved groups, based on that definition.

7. SET EXPECTATIONS

Acknowledge that when both sides do not set and manage each other's expectations from the outset, it's difficult to build a safe space to move the process forward.

8. CREATE TRANSPARENCY

Communication of practices and policy between government and community should be transparent and accessible by ensuring that both sides are listening to each other, using shared (non-jargon) language, and having a space for both community members and City staff to report what they are doing. Sharing who is responsible for the outreach process and the outcome increases understanding and transparency into the process.

9. DEFINE SUCCESS

Meetings should have realistic goals, with measurable metrics that encourage active participation.

10. INSTITUTIONALIZE

Institutionalize community engagement into the public planning process. Create processes that include steps and best practices that can be used by everybody. Ensure City workers are well-trained and understand that community outreach is part of their job at the time of hiring. City budget could include funding for community outreach and engagement, and for staff training in effective and equitable engagement.

BELOW: Brian Beveridge of West Oakland Inicators Project moderates a panel on past engagement in Oakland at the first workshop.

OVER 55 CITY LEADERS AND LOCAL ORGANIZATIONS PARTICIPATED IN THE FIRST TWO WORKSHOPS.

LEADERSHIP

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Jennifer Lucky
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Jessie Warner, City of Oakland
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Jennifer West, TransForm
Mike Wetzel, City of Oakland
Joanna Winter, City of Oakland

RESILIENT OAKLAND

West Oakland Environmental Indicators Project

Streetwyze

100 RESILIENT CITIES + REBUILD BY DESIGN

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