Appendix G

Climate Risk Screening Study

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Memorandum

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Subject	San Francisco Veterans Affairs Medical Center Long Range Development Plan—Climate Risk Screening		
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This memorandum summarizes climatic risk factors for the San Francisco Veterans Affairs Medical Center (SFVAMC) existing Fort Miley Campus and potential Mission Bay Campus assets as relevant for the proposed Long Range Development Plan. The risk factors consider current climatic trends and predicted future changes in climate specific to the San Francisco Bay Area. Several opportunities to reduce climatic risks are also provided for consideration by VA. The memorandum covers climate change factors and trends, then screens climatic risk for the Fort Miley Campus and potential Mission Bay Campus, and finally provides a range of conclusions and opportunities for supporting long range development planning. In addition, a climate risk factors sensitivity screening matrix is provided as Appendix 1.

Climate Change Factors and Trends

Given that 1) carbon dioxide (CO_2) accounts for more than 75 percent of all anthropogenic GHG emissions, 2) atmospheric residence time of CO_2 is decades to centuries, and 3) the global atmospheric concentrations of CO_2 continue to increase and at a faster rate than ever previously recorded, the warming impacts of CO_2 will persist for hundreds of years after mitigation efforts to reduce GHG concentrations are implemented. Substantially higher temperatures, more extreme wildfires, and rising sea levels are just some of the direct impacts experienced in California (CNRA, 2009; CEC, 2012). As reported by the California Natural Resources Agency in 2009, despite annual variations in weather patterns, California has seen a trend of increased average temperatures, more extreme hot days, fewer cold nights, longer growing seasons, less winter snow, and earlier snowmelt and rainwater runoff. Statewide average temperatures have increased by about 1.7 degrees Fahrenheit (°F) from 1895 to 2011, and a larger proportion of total precipitation is falling as rain instead of snow (Moser, Ekstrom, and Franco, 2012). Sea levels rose by as much as seven inches along the California coast over the last century, increasing erosion and adding pressure to the state's infrastructure, water supplies, and natural resources.

These observed trends in California's climate are projected to continue in the future. Research indicates that California will experience overall hotter and drier conditions with a continued reduction

in winter snow (with concurrent increases in winter rains), as well as increased average temperatures, and accelerating sea level rise. In addition to changes in average temperatures, sea level, and precipitation patterns, the frequency, intensity, and duration of extreme weather events such as heat waves, wildfires, droughts, and floods will also change (CNRA, 2009). Thus, even though the Proposed Action would result in less future operational GHG emissions (due to construction of new buildings to LEED Silver rating), the proposed ongoing medical center operation designed for long-term utility under the Proposed Action could be unprepared for inevitable climate change factors that would occur from climate change and could, thus, harm persons, property, and operations. Following is a summary of climate change factors and predicted trends specific to the San Francisco Bay Area, using the latest information available as of 2014.

Temperature/Heat

The San Francisco Bay Area is expected to experience warming over the rest of the 21st century. Consistent with statewide projections, annual average temperature in the Bay Area will likely increase by 2.7°F between 2000 and 2050 based on GHG emissions that have already been emitted into the atmosphere. By the end of the century, the increase in annual average temperature in the Bay Area may range from approximately 3.5°F to 11°F relative to the average annual temperature simulated for the 1961–1990 baseline period, depending on the GHG emissions scenarios (Cayan et al., 2012). The projected rate of warming, especially in the latter half of the 21st century, is considerably greater than warming rates derived from historical observed data.

Specific factors related to temperature/heat are summarized below.

- An increase in annual average temperature in the Bay Area has been occurring over the last several decades.
- The Bay Area is expected to see an increase in average annual temperature of 2.7°F by 2050, and 3.5°F to 11°F by 2100. Projections show a greater warming trend during the summer season. The coastal parts of the Bay Area will experience the most moderate warming trends, and locally, San Francisco is expected to see an increase of approximately 2.2°F by 2050, and 3.3°F to 5.5°F by 2100 (Cal-Adapt, 2013).
- Extreme heat events are expected to increase in duration, frequency, and severity by 2050. Extreme freeze events are expected to decrease in frequency and severity by 2100, but occasional colder-than-historical events may occur by 2050. (Cal-Adapt, 2013).

Precipitation/Rainfall/ Extreme Events

Recent studies on the effect of climate change on the long-term average precipitation for the state of California show some disagreement (e.g., Dettinger, 2005; Cayan et al., 2008; CEC, 2012; Pierce et al., 2013a, 2013b). Considerable variability exists across individual models, and examining the average changes can mask more extreme scenarios that project much wetter or drier conditions. California is expected to maintain a Mediterranean climate through the next century, with dry summers and wet winters that vary between seasons, years, and decades. Wetter winters and drier springs are also expected, but overall annual precipitation is not projected to change significantly (Pierce et al., 2013a). By mid-century, more precipitation is projected to occur in winter in the form

of less frequent but larger events (Pierce et al., 2013a, 2013b). By 2100, the majority of global climate models predict drying trends across the state (Moser et al., 2012; USGCRP, 2009; CNRA, 2009).

Specific factors related to precipitation/rainfall/extreme events are summarized below.

- Historical precipitation in the Bay Area has experienced no significant changes in rainfall depth or intensities over the past 30 years.
- The Bay Area will continue to experience a Mediterranean climate, with little change projected in annual precipitation by 2050, although a high degree of variability may persist.
- By 2100, an annual drying trend in annual precipitation is projected. The greatest decline is expected to occur during the spring months, while minimal change is expected during the winter months.
- Increases in drought duration and frequency coupled with higher temperatures, as experienced in 2012, 2013, and 2014, increases the likelihood of wildfires.
- California is expected to see increases in the magnitude of extreme events, including increased precipitation delivered from atmospheric river events, which would bring high levels of rainfall during short time periods – increasing the chance of flash floods. The Bay Area is also expected to see an increase in precipitation intensities, but possibly through less frequent events (Cayan et al., 2008).

Sea Level

This summary draws on the best available data for climate science and the potential effects of sea level rise in California as of 2014. In March 2013, the Ocean Protection Council adopted the 2012 National Research Council (NRC) Report *Sea-level Rise for the Coasts of California, Oregon, and Washington: Past Present and Future* as the best available science on sea level rise for the state (OPC, 2013). The California Coastal Commission also supported the use of the NRC 2012 report as best available current science, noting that the science of sea level rise is continually advancing, and future research may enhance the scientific understanding of how the climate is changing, resulting in updating sea-level-rise projections (CCC, 2013, in review). The NRC report includes discussions of historic sea-level-rise observations, three sea-level-rise projections for the coming century, and insight into the potential impacts of a rising sea for the California coast.

Additional resources provide information on sea level rise and impacts specific to California and the Bay Area. These include peer-reviewed academic articles, the California Coastal Commission *Draft Sea-Level Rise Policy Guidance* (public review draft released on October 14, 2013), and globally relevant information from the latest release of the IPCC Fifth Assessment Report, for which the summary for policymakers was released on September 27, 2013.

Records from satellite altimeters, tide gauges, and ocean temperature measurements infer a long-term increase in sea levels of the Pacific Coast. It is estimated that on average, the coast of California has experienced 8 inches (20 centimeters) of sea level rise over the past century, which is comparable to the global average (CCC, 2013, in review).

The most recent climate science report, *Sea Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future*, has estimated that sea levels along the U.S. Pacific Coast would increase up to 66 inches by 2100 (NRC, 2012).

Specific factors related to precipitation/rainfall/extreme events are summarized below.

- Global sea level has risen 8 inches over the past century.[1]
- Based on the latest IPCC report, the Fifth Assessment Report, global sea level is now expected to rise an additional 11–39 inches by 2100.

According to the latest NRC report, the Bay Area is expected to see 11 additional inches (range of 5–24 inches) of sea level rise by 2050, and approximately 36 inches (range of 17–66 inches) by 2100 (NRC, 2012). The likelihood of sea level rise to occur by certain timeframes is described as:

- 12 inches of sea level rise is "most likely" by 2050;
- 24 inches of sea level rise by 2050 represents the upper uncertainty bound;
- 36 inches of sea level rise "most likely" by 2100;
- 48 inches of sea level rise by 2100 is within the upper 85% confidence interval; and
- 66 inches of sea level rise by 2100 represents the upper uncertainty bound (NRC, 2012).

See Figure 1 for an overview map of projected sea level rise in the San Francisco Bay Area. The figure shows Sea Level Rise inundation for 66 inches of SLR for the City and County of San Francisco and was prepared by AECOM for the San Francisco Public Utilities Commission (SFPUC) in 2014. More recent projections, new coastal mapping data, and innovations in modeling additional impacts such as storm effects, have made the sea level rise mapping and affected areas more precise since the Bay Conservation and Development Commission (BCDC) published its sea level rise maps in 2009.

The additional sea level rise figures generated for this Climate Risk Screening Memo present the most recent data and projections for sea level rise for the Bay Area. They were created using the mapping data developed by AECOM for the SFPUC. The City and County of San Francisco intend to make these the "official" sea level rise maps for all city departments planning adaptation to SLR.[2]

[1] For trends in mean sea level as captured at San Francisco's tide gauge. (NOAA, 2013c).
[2] Per email correspondence with Anna Roche, Climate Change and Special Projects Manager, Wastewater Enterprise – Planning and Regulatory, San Francisco Public Utilities Commission on August 21, 2014.

Figure 1: Projected Sea level Rise Map for the San Francisco Bay showing inundation areas for a 66 inch sea level rise

Source: SFPUC, 2014

Note: The sea level rise inundation mapping and supporting technical information were developed by AECOM for the San Francisco Public Utilities Commission's Wastewater Enterprise as part of its Sewer System Improvement Program. SFPUC provided the mapping to VA for use in this Climate Risk Screening Study.

SFVAMC LRDP Climate Risk Screening

See the climate risk factors sensitivity screening matrix in Appendix 1 for an overview of assets and project elements and how they may be affected by climate change effects. The descriptions below further explain the findings shown in the overview table for the Fort Miley and potential Mission Bay project locations.

Potential Site Location related Climate Change Impacts

SFVAMC Fort Miley

The existing SFVAMC Fort Miley Campus is a 29-acre site located in the northwestern corner of San Francisco, adjacent to the outer Richmond District neighborhood. The land is federal land owned by VA and is exempt from planning regulations of the City and County of San Francisco. The Campus is bounded by Clement Street/Seal Rock Drive and the outer Richmond District neighborhood to the south, and property owned by the National Park Service (NPS) to the north, east, and west. The current uses of the existing Campus include a hospital, hoptel facilities, medical clinics, research facilities, administration/office buildings, childcare facilities, and parking facilities.

The western portion of the existing SFVAMC Fort Miley Campus is located within the California Coastal Zone, which is under the jurisdiction of the California Coastal Commission.

Sea Level Rise Exposure

The SFVAMC Fort Miley campus, despite being partially located in the coastal zone, located in distance only about 600 feet from the Ocean's edge, is located on bedrock substrate at about 350ft elevation, and thus protected from the direct (inundation) and indirect (liquefaction due to underneath soil saturation) effects of Sea Level Rise.

Storm Exposure

In its location, the SFVAMC Fort Miley Campus is rather exposed facing the Pacific Ocean, which could play a role in exposure to increased rainfall events and potentially more and/or stronger storms (through stronger wind and rainfall impacts).

Erosion

There is a steep topographical gradient on northern side of SFVAMC Fort Miley Campus as it descends to GGNRA lands. In addition, this is the only part of the Campus that is not connected to the SFPUC combined wastewater/stormwater system; as such, stormwater runs of the northern edge of the Campus over the northern slope, which could lead to erosion and landslip, especially should extreme rainfall events occur with increased frequency and or/ intensity.

Flooding/Soil Saturation

Soil saturation could occur on northern side of Campus during severe and/or prolonged rainfall events.

Wildfire Threat

The Fort Miley Campus is located at the wildland urban interface (ABAG, 2014), as shown in Figure 2, and surrounded on three sides by forested public land belonging to the National Park Service Golden Gate National Recreation Area (GGNRA), with an identified wildfire threat of "high" and "very high" (CCSF, 2008). This existing wildfire threat could further intensify, if droughts and extreme temperature events increase in severity.

Figure 2: Earthquake and Hazards Program Interactive Map showing Wildland Urban Interface and Wildfire Threats for the Fort Miley Campus Area
Source: ABAG, 2014

Mission Bay Area

For purposes of this Memorandum, the Mission Bay area includes an approximately 2.5-square-mile area bounded by Market Street on the north, Second Street and San Francisco Bay on the east, Cesar Chavez Street on the south, and Seventh/Brannan/Potrero Streets on the west. This area of San

Francisco is commonly known as a combination of the South of Market Area (SOMA), Potrero Hill, and Mission Bay. SOMA is an area with a mix of residential, office, institutional, commercial, retail, entertainment, and public uses. Potrero Hill is a neighborhood that is bordered by freeways (Interstate 280 to the east and U.S. Highway 101 and Interstate 80 to the west) and contains a mix of residential, retail, and industrial uses. Mission Bay is a major redevelopment area of the city with a mix of vacant land, biotech research facilities (including the University of California, San Francisco Mission Bay Campus), residential, and warehouse uses.

Sea Level Rise and Storm Surge Exposure

The potential SFVAMC Mission Bay Campus could be located on the Bayside and built on fill. The Mission Bay area is not considered to be within a wildland urban interface or vulnerable to the threat of wildfire as shown in Figure 3, however the lower elevation of the area considered 'Mission Bay' make it vulnerable to Sea Level rise, in particular in combination with a storm surge and/or extreme rainfall events by mid and end-of-century. Figures 4 through 6 show detailed Sea Level Rise Analysis maps for 24", 36", and 66" sea level rise scenarios respectively for the eastern half of San Francisco which encompasses the Mission Bay area.

The water levels on the inundation maps show an increase in future Mean Higher High Water (MHHW)[3] up to 66 inches (sea level rise about existing MHHW) and areas that could be inundated permanently on a regular basis by tidal action. In contrast, temporary flooding can occur when an area is exposed to episodic, short duration, extreme tide events of greater magnitude than normal tide levels. The combinations of sea level rise and storm surge scenarios that can be represented by each inundation map are listed below the permanent inundation scenario. The inundation maps for extreme tide and storm surge scenarios do not consider the duration of flooding, or the potential mechanism for draining the floodwaters from the inundated land once the extreme high tide levels recede.

In addition, hydraulically disconnected low-lying areas are displayed in green. These areas do not have an effective overland flow path to allow water to reach the area, although these areas have topographic elevations below the inundated water surface. It is possible that the low-lying areas are connected through culverts, storm drains, or other hydraulic features which are not captured within the topographic digital elevation model (DEM); therefore it is important to note that there may be an existing or future flood risk within these areas. It should be noted that all inundation maps are associated with caveats and uncertainties. Inundation maps, and the underlying associated analyses, are intended as planning level tools to illustrate the potential for flooding under future sea level rise and storm surge scenarios. Although this information is appropriate for conducting vulnerable and risk assessments, finer-grained information may be needed for detailed engineering design and implementation. Further details on the data and methods used to create the inundation maps, and the

[3] The average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch, a specific 19-year period adopted by the National Ocean Service as the official time segment over which tide observations are taken and reduced to obtain mean values (e.g., mean lower low water, etc.) for tidal datums. It is necessary for standardization, because of periodic and apparent secular trends in sea level. (NOAA, 2013b).

associated caveats and uncertainties in the inundation mapping can be found in the Climate Stressors and Impacts: Bayside Sea Level Rise Mapping Technical Memorandum (SFPUC, 2014).

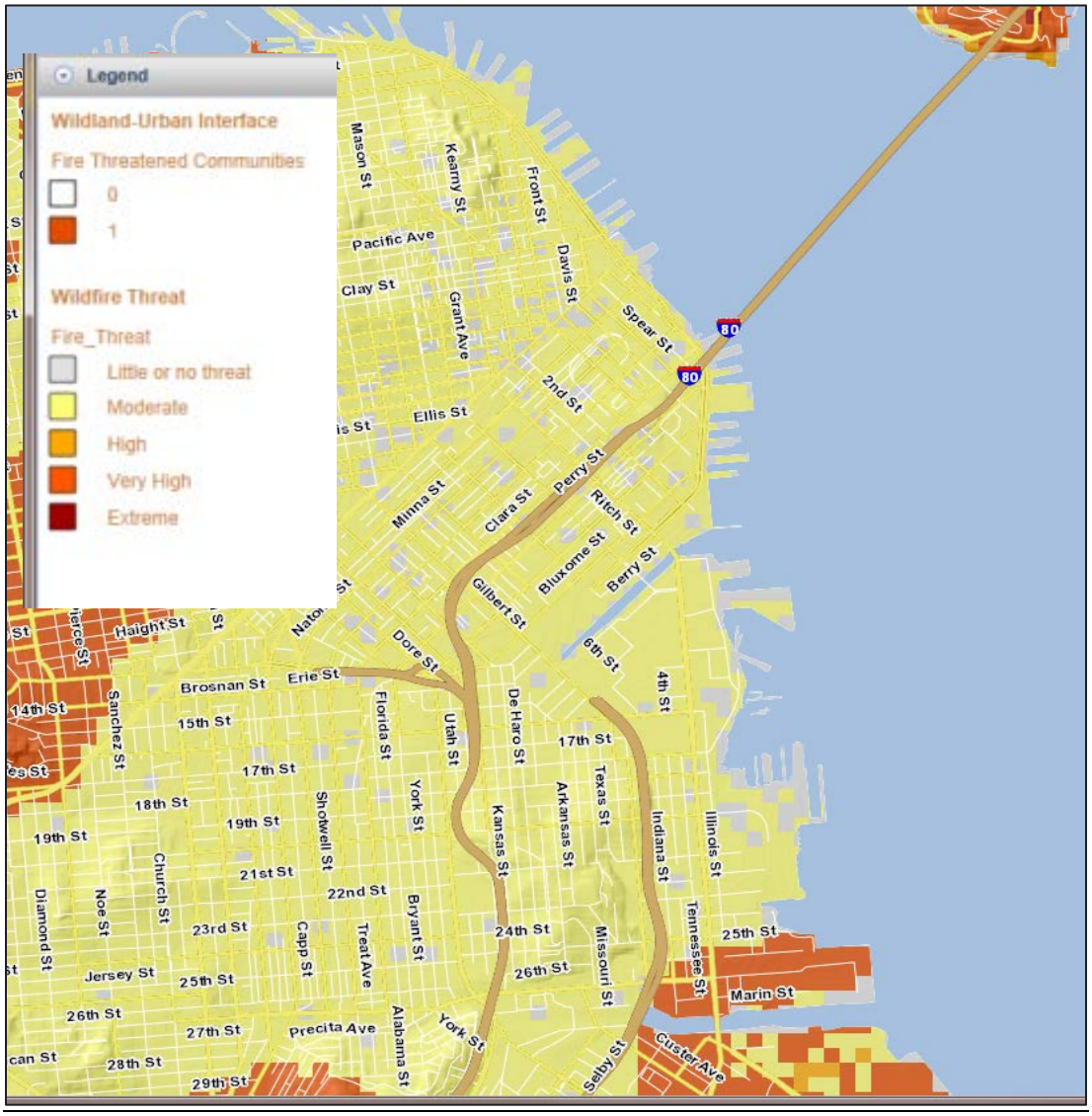

Figure 3: Earthquake and Hazards Program Interactive Map showing no Wildland Urban Interface or Wildfire Threats for the Mission Bay Area

Source: ABAG, 2014

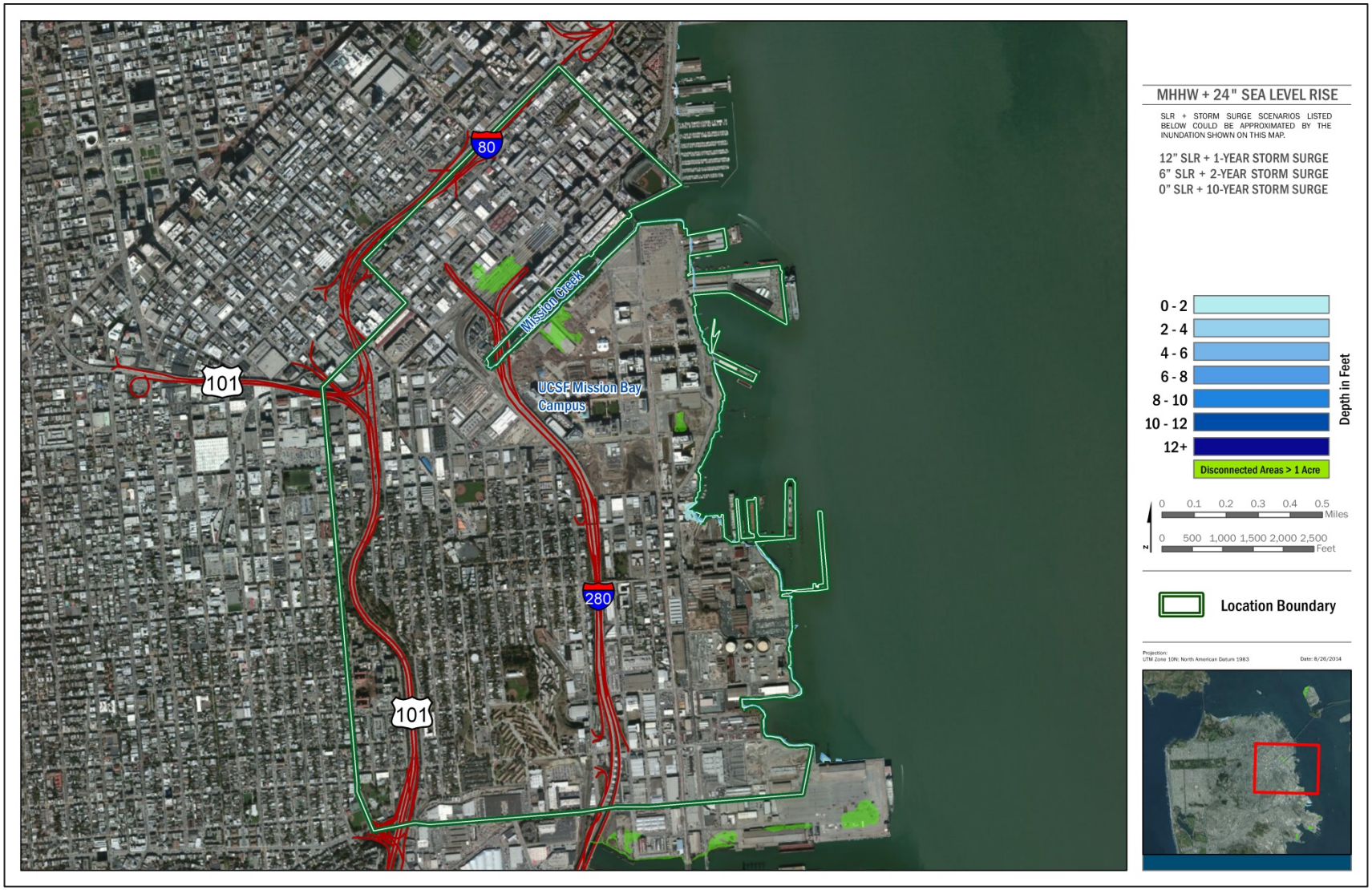

Figure 4: Eastern San Francisco Permanent Inundation Areas due to 24 Inches of Sea Level Rise or Temporary Inundation due to Storm Surge at Lower Levels of Sea Level Rise

Source: SFPUC, 2014

Note: The sea level rise inundation mapping and supporting technical information were developed by AECOM for the San Francisco Public Utilities Commission's Wastewater Enterprise as part of its Sewer System Improvement Program. SFPUC provided the mapping to VA for use in this Climate Risk Screening Study.

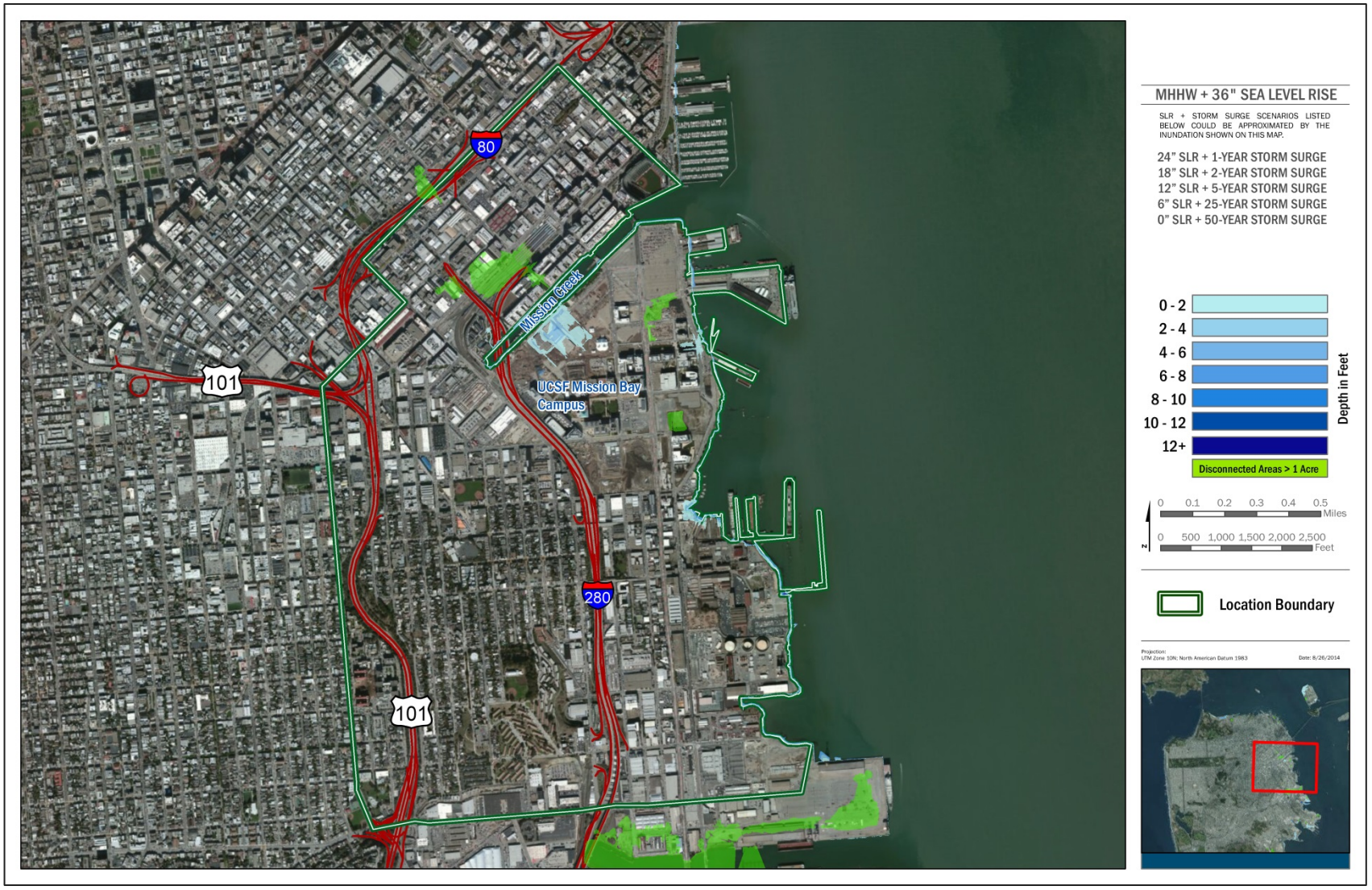

Figure 5: Eastern San Francisco Permanent Inundation Areas due to 36 Inches of Sea Level Rise or Temporary Inundation due to Storm Surge at Lower Levels of Sea Level Rise

Source: SFPUC, 2014

Note: The sea level rise inundation mapping and supporting technical information were developed by AECOM for the San Francisco Public Utilities Commission's Wastewater Enterprise as part of its Sewer System Improvement Program. SFPUC provided the mapping to VA for use in this Climate Risk Screening Study.

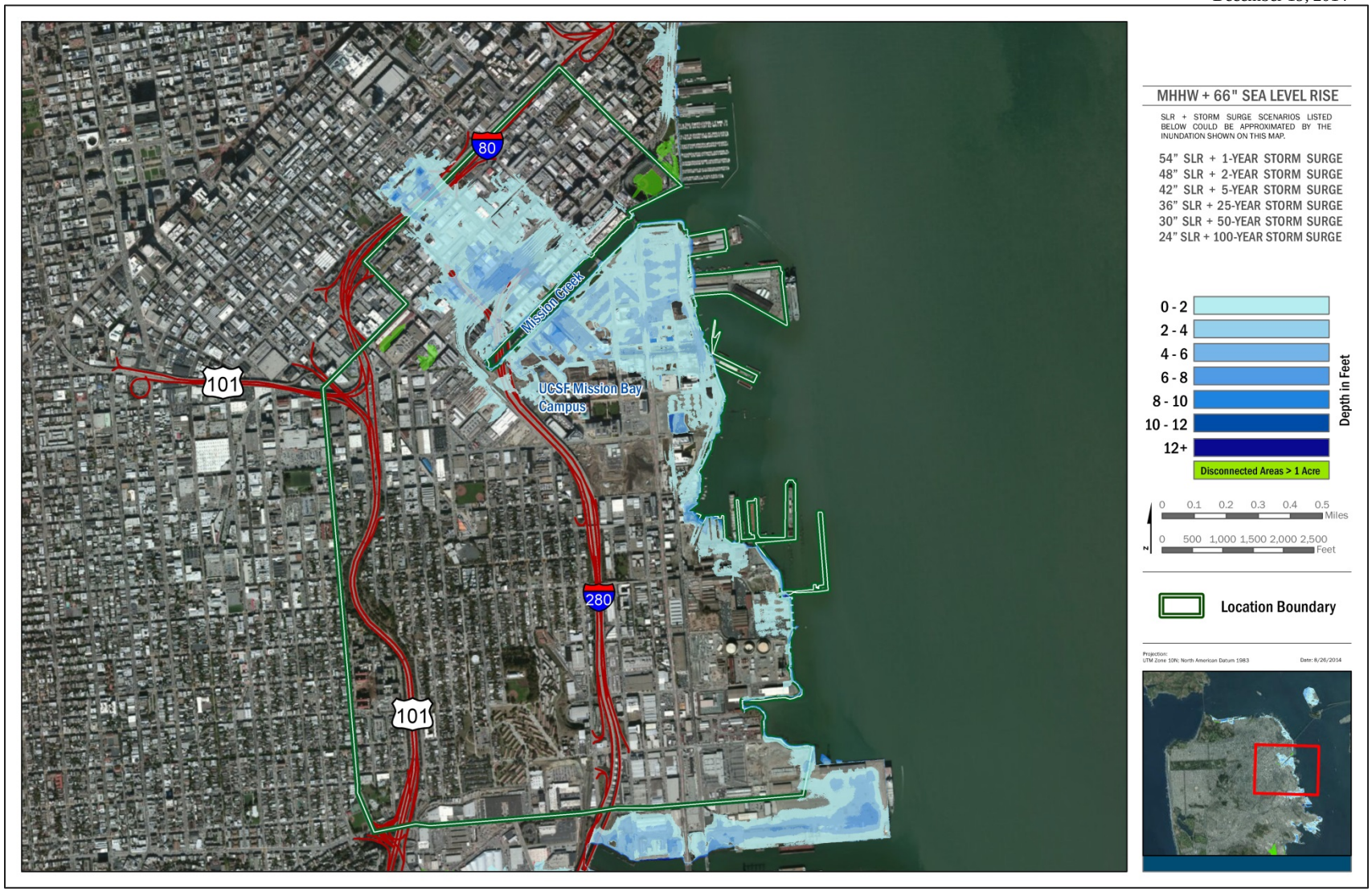

Figure 6: Eastern San Francisco Permanent Inundation Areas due to 66 Inches of Sea Level Rise or Temporary Inundation due to Storm Surge at Lower Levels of Sea Level Rise.

Source: SFPUC, 2014

Note: The sea level rise inundation mapping and supporting technical information were developed by AECOM for the San Francisco Public Utilities Commission's Wastewater Enterprise as part of its Sewer System Improvement Program. SFPUC provided the mapping to VA for use in this Climate Risk Screening Study.

As these maps show, a significant portion of the potential SFVAMC Mission Bay Campus development area is at risk for temporary inundation in the short term during storm events and permanent inundation in the longer term. The worst case scenario for end-of century, combining sea level rise of 66 inches (in addition to MHHW) with the event of a 100-year storm surge, has not been mapped.

Liquefaction

The location of the potential SFVAMC Mission Bay Campus on fill could also cause the groundwater level to rise through sea level rise, which in turn could increase the risk of liquefaction and related increased shaking potential/ instability of assets during a seismic event.

Storm Exposure

The potential SFVAMC Mission Bay Campus, located on the east side of the San Francisco Peninsula and facing the San Francisco Bay, is much less exposed to the open ocean. However, being located at low elevation, the increased likelihood of storm surge[4] coupled with Sea Level Rise could intensify temporary inundation (see Figures 4 through 6).

Potential Energy Related Climate Change Impacts

SFVAMC Fort Miley

The main electric service provider is Pacific Gas & Electric (PG&E), although VA is increasingly adding renewable energy sources, such as solar power and geothermal heating and cooling generation for its Fort Miley Campus. In addition, the SFVAMC's electrical needs are also supported by an existing backup power system consisting of three stationary engine generators, which serve as critical and life-safety loads for Buildings 200 and 203, and all other critical loads on the existing SFVAMC Fort Miley Campus in Building 205, as well as a generator in Building 17 that supplies back-up power. One portable trailer-mounted 1,000-kW engine-generator is available for use in the event of failure at any stationary unit. The overall total backup power system capacity is more than 50 percent of the expected full future load, making the backup system's capacity adequate to support future critical and life-safety power needs.

SFVAMC Fort Miley Campus still receives most of its electricity through the existing power distribution system, which consists of PG&E service cables, metal-clad switchgear, substations and load centers, various switchboards, panel boards, and motor control centers. From 2006 through 2011, the Campus had an average electricity demand of approximately 22,144 megawatt-hours (MWh) per year.

[4] Storm surge is the abnormal rise in seawater level during a storm, measured as the height of the water above the normal predicted astronomical tide. The surge is caused primarily by a storm's winds pushing water onshore. The amplitude of the storm surge at any given location depends on the orientation of the coast line with the storm track; the intensity, size, and speed of the storm; and the local bathymetry. (NOAA 2013a)

A new 255kW solar photo-voltaic (PV) system was installed in the fall of 2013. The solar canopy consists of 1,022 Samsung modules integrated into a steel structure that was built on top of an existing parking garage. In addition to providing clean, renewable energy, the solar canopy also creates additional shaded parking for 85 vehicles. In addition, Ground Source Heat Pump (GSHP) systems (i.e., geothermal systems) were installed in June 2012 to help VA meet the overall federal goal of increased renewable energy use at the VA medical centers. These systems function by transferring heat between the steady temperature of the earth (approximately 57° F in the SFVAMC Fort Miley area) and site buildings, providing a source of heating during the winter and a means to reject excess heat (cooling) in the summer. In the closed-loop system that was installed in several buildings, heat transfer occurs via circulating a fluid (i.e., typically water) between a loop of pipe buried in the ground and a heat pump at or in the building (VA, 2011).

Change in extreme temperature events

Extreme heat events conditions are defined by summertime weather that is substantially hotter and/or more humid than average for a location at that time of year (EPA, 2006). These conditions, which can increase the incidence of mortality and morbidity in affected populations, are expected to increase in duration, frequency, and severity by 2050, potentially affecting specific high-risk groups[5] such as Veteran patients, especially elderly persons and extremely ill persons. Due to San Francisco's temperate climate, most people don't view San Francisco as a place of concern for extreme heat events, but San Francisco is vulnerable due to the lack of physiologic and technologic adaptations. It typically takes human biology two weeks to adapt to temperature extremes. Since San Francisco does not regularly experience extreme heat events for extended durations, as a population, residents bodies have a more difficult time thermo-regulating, which can cause heat stress and increase risk of heat related illness and sometimes death. In San Francisco, there are also generally fewer technologic adaptations, because the housing stock is less likely to have central air conditioning due to its age and the typically cooler climate (SFDPH, 2010).

A surface temperature map for the City of San Francisco depicted in a report prepared for the Department of Health (SFDPH, 2010) identifies the western portion of San Francisco, including the SFVAMC area as having cooler existing surface temperatures than the eastern portion of the city, in particular in the vegetated open space areas, confirming the heat island effect. The proximity to vegetated open spaces and cloud/fog cover influence cooler surface temperatures, contrasted by higher surface temperatures in built environments portions of the city, including the Mission Bay Area.

[5] Specific high-risk groups typically experience a disproportionate number of health impacts from EHE conditions. The populations that have physical, social, and economic factors and the specific actions that make them at high risk include: Older persons (age > 65), Infants (age < 1), the homeless, The poor, People who are socially isolated, people with mobility restrictions or mental impairments, people taking certain medications (e.g., for high blood pressure, depression, insomnia), people engaged in vigorous outdoor exercise or work or those under the influence of drugs or alcohol. (EPA 2006)

The forecasted increase in extreme heat events due to climate change, with increasingly multi-day-periods of hot days and hot nights will likely have an effect on the electricity use of the SFVAMC to ensure safe temperatures for patients (high-risk groups) and staff, through HVAC use and supplementing the geothermal cooling mechanism, where necessary.

Also, coupled with increased drought durations, extreme heat events can increase the wildfire hazard of the adjacent wildland areas of the SFVAMC (see site location review above.)

Change in Intensity of Storms

An increase in storm events (strong winds and rain) could cause potential damage to the PV panels and exposed above-ground electrical conveyance assets (poles, cables).

Mission Bay

Electricity to the Mission Bay area is served by the Potrero and Embarcadero Substations. PG&E's primary distribution line rights-of-way run parallel with local streets.

Sea Level Rise and Storm Surge Exposure

PG&E' electricity conveyance assets such as substations, cables, low-lying switchboxes and vaults may be susceptible to temporary and permanent inundation through seawater as a result of sea level rise, more frequent high tides and storm surges. Longer-term exposure to sea water may cause corrosion and water intrusion into the assets, which may result in power-outages and extended time for repairs (PG&E, 2013).

Potential Water related Climate Change Impacts

The existing SFVAMC Fort Miley Campus and the Mission Bay area are served by the San Francisco Public Utilities Commission (SFPUC). Approximately 96 percent of SFPUC's water supply is conveyed through the Regional Water System, which is made up of a combination of runoff into local Bay Area reservoirs and diversions from the Tuolumne River through the Hetch Hetchy Water and Power Project. A small portion of San Francisco's water demand is also met by locally produced groundwater and secondary-treated recycled water.

The Bay Area is forecasted to continue to experience a Mediterranean climate, with little change projected in annual precipitation by 2050, (although a high degree of variability may persist) and experiencing a drying trend by 2100. The greatest decline is expected to occur during the spring months, while minimal change is expected during the winter months. These predictions would likely impact the water supply which originates mostly from run-off.

SFVAMC Fort Miley

Water Supply and Wastewater

SFPUC provides water to the existing SFVAMC Fort Miley Campus. The water system infrastructure supporting the Campus, which serves the Campus's potable water and fire-suppression water needs, was originally constructed in 1934; however, several building additions and expansions, which also

included expansions of the original water distribution system, have been completed since that time. The system distributes water throughout the Campus via a loop system. The system consists of the following components:

- One 500,000-gallon reservoir located in Building 29 (on the southwestern part of the Campus)
- Three pumps, including a primary pump (P-1), a secondary pump (P-2), and a fire pump (P-3) located in Building 30 (pump station) (adjacent to Building 29 on the southwestern part of the Campus)
- One 40,000-gallon water tower located in Building 206 (on the northwestern part of the Campus)

The reservoir is fed from the City's water distribution system through primary and secondary connection points located on Clement Street. From the reservoir, the primary and secondary pumps (P-1 and P-2) pressurize the existing SFVAMC Fort Miley Campus's loop water system and feed the water tower. The water tower back-feeds the distribution system when the pumps are not running. The water tower also holds 40,000 gallons of water for purposes of emergency backup water supply in case of an emergency that cuts off the Campus' water supply from SFPUC.

Between 2004 and 2011, the existing SFVAMC Fort Miley Campus had an average water demand of approximately 46.6 million gallons per year, or approximately 0.13 mgd.

Mission Bay

The total water demand associated with Alternative 2 long-term projects at the potential new SFVAMC Mission Bay Campus through 2027 is projected to be 23.7 million gallons per year (0.065 mgd). However, should the SFVAMC implement water conservation measures to achieve the VA SSPP's maximum reduction targets, the total water demand for Alternative 2 long-term projects at the potential new campus would be 19.0 million gallons per year (0.052 mgd).

The overall total (existing, short-term, and long-term) projected water demand at both campuses under Alternative 2 is estimated to be 80.6 million gallons per year (0.221 mgd). However, with implementation of conservation measures for existing, short-term, and long-term project water demands to meet the VA SSPP's maximum targets, the total projected water demand for both campuses under Alternative 2 would be 64.5 million gallons per year (0.177 mgd).

Water Supply

SFPUC is evaluating the potential implementation of the water enterprise and sewer system improvement program to address issues of aging infrastructure and system deficiencies related to climate change, and to improve operational efficiency and reduce community impacts.

Storm Water Management/ Offsite Discharge

San Francisco's wastewater collection and conveyance infrastructure is overseen by the SFPUC as well. This infrastructure consists of a combined sewer system that collects both sewage and stormwater, collecting, conveying, treating, and discharging all of the dry-weather domestic wastewater and urban runoff flows and wet-weather flows. The system uses natural watershed areas

wherever possible to take advantage of gravity flow for the collection, transport, treatment, and discharge of wastewater and stormwater. (SFPUC, 2010). The wastewater and stormwater that flow to facilities for treatment are ultimately discharged into San Francisco Bay or the Pacific Ocean through outfall structures along the shoreline. (SFPUC, 2009).

SFVAMC Fort Miley

The existing sanitary sewer system at the SFVAMC Fort Miley Campus collects and conveys wastewater from building lateral connections to the site's combined sewer system and eventually to SFPUC's combined sewer interceptor on Clement Street. Stormwater runoff is collected from parking lots, streets, pedestrian walkways, landscaped areas, and building roofs. It is then concentrated in gutters and drain pipes and conveyed to SFPUC's combined sewer interceptor on Clement Street. A small separate storm drainage system conveys stormwater off-site on the north side of the Campus along the slope facing the Golden Gate Bridge.

Erosion

Major and minor landslides, as well as surface slumping, have historically occurred on the slope below the northern portion of the SFVAMC campus due to high rainfall, seismic movement, and land erosion. The North Slope Seismic/Geologic Stabilization Project was completed at the Campus to remove and replace the existing storm drain system that discharges stormwater onto the north slope. The pipelines discharge to energy dissipaters which reduce the erosional forces of the water. Two retaining walls were installed as part of the project and the slope gradient was reduced which lessened slide potential and eliminated areas where water previously ponded.

The energy dissipaters consist of rock rip-rap embedded in concrete and underlain with overlapping sheets of a puncture-resistant vapor barrier. The project also reduced the slope gradient which reduced slide potential and eliminated areas where water previously ponded. Two retaining walls were installed as part of the project and following construction, native shrubs and trees were planted below the retaining walls. A long-term monitoring and maintenance plan has been put into effect to maintain the drainage system in good repair so that it is effective in controlling localized erosion.

Despite the recent storm drain improvements which were completed as part of the North Slope Seismic/Geologic Stabilization Project, climate change related extreme rainfall conditions may exasperate the erosion issues in this area again.

Storm Exposure

Extreme rainfall events (such as Atmospheric River storms) may also increase in intensity, which in combination of a preceding drought could increase the likelihood of stormwater accumulation due to debris and blockages of usual effluents, as well as flash flooding, which could create temporary flooding and erosion issues beyond the known location at the north slope discussed above.

Mission Bay

Historically, the Mission Bay area was part of San Francisco Bay, with the bay waters at ordinary high tide roughly being bounded by Townsend Street on the north, Eighth Street on the west, and

16th Street on the south. Marshes, with intersecting sloughs, penetrated as far north as Mission Street between Seventh and Eighth Streets, and Folsom Street between Fourth and Eighth Streets. (Sharpsteen, 1941). Mission Creek once was a navigable body of water that flowed from Mission Dolores to San Francisco Bay. In 1854 the California Legislature declared Mission Creek to be a navigable stream; although it has been filled in, it retains the designation today (Sharpsteen, 1941). The only remaining portion of Mission Creek above ground is the Mission Creek Channel that drains into China Basin.

Stormwater from the Mission Bay area is part of the Bayside Drainage and is collected in the combined sewer system and treated at the City's Southeast Water Pollution Control Plant before being discharged to San Francisco Bay. Combined sewer transport and storage structures are located underground around the Mission Creek Channel and up the shoreline, and connecting pipes, tunnels, and force mains are used to transport flows to the Southeast Water Pollution Control Plant. As part of the Mission Bay Redevelopment Plans, a separate stormwater system is being developed in this area to handle flows generated from larger storms.

Sea Level Rise and Storm Surge Exposure

Sea-level rise, and in the short-term, storm surge, may cause backflows for stormwater and additionally impede the operation of the combined sewer system overflows, leading to flooding and pooling of un- or only minimally treated sewerage and storm water.

SFPUC is examining potential climate change and in particular Sea Level Rise effects on its Wastewater Infrastructure, as the vulnerability is increased in low-lying coastal areas. As the Sea Level Rise Maps produced for the SFPUC show, some of the important infrastructure, such as the Southeast Water Pollution Control Plant, the waste water treatment plant for the Mission Bay Area would likely be affected by Sea Level Rise related inundation by the end of century. Inundation with sea water would likely cause operational impacts, such as power outages, corrosion-related impacts and rendering the plant and important conveyance infrastructure inoperable.

Potential Transportation related Climate Change Impacts

In addition to the public transportation network and being able to arrive by private vehicle or taxi, SFVAMC provides a variety of local, regional, and intercity shuttle services through several different operating schemes, including services operated directly by SFVAMC staff, services operated jointly with the University of California San Francisco (UCSF), services contracted out to third-party for-profit companies (Bauer's Transportation), and services provided by the Disabled American Veterans (DAV) Volunteer Transportation Network (VTN). These services operate weekdays only (Mondays through Fridays) but serve a wide variety of Campus users, including patients, employees/staff, and visitors, as well as affiliated faculty, students, and guests of UCSF.

Storm Exposure

Extreme rainfall events may impede vehicular, bicycle and pedestrian traffic in the short term, and potentially cause flooding, water pooling, and longer term impacts by causing damage to the roadways.

Potential Building related Climate Change Impacts

SFVAMC Fort Miley

The 29-acre SFVAMC Fort Miley Campus contains 38 buildings and hosts a fluctuating daily population of approximately 5000 people, including around ~1500 temporary in-/outpatients and ~3500 employees, including UCSF staff.

Existing buildings include the following:

• One inpatient hospital building

• One outpatient clinical building

• Research buildings with sensitive medical research equipment

• Two "hoptel[6]" buildings (short-term patient accommodations)

• A Community Living Center

• Administrative/office buildings with sensitive medical information

• Various storage, infrastructure, and other facilities

• Parking garage structures

• Emergency Operations Center, which can function as regional emergency operations center in case of emergency

• A helipad at the northwestern corner of the Campus; which can be used for national emergency situations

Storm Exposure

The location on the bluff overlooking the Pacific Ocean, make some of the buildings more exposed to increased rainfall events and potentially more and/or stronger storms (through stronger wind and rainfall impacts).

Flooding/Soil Saturation/Drought

Soil saturation could occur on northern side of Campus during severe and/or prolonged rainfall events, leading to further erosion despite soil stabilization efforts. In contrast, long periods of droughts and extreme heat events in exchange with intense rainfall events may cause potential

[6] A hoptel is an overnight, shared lodging facility for eligible Veterans receiving health care services. This temporary lodging is available to Veterans who need to travel 50 or more miles from their home to the existing SFVAMC Fort Miley Campus.

impacts on the ground and some building materials (drying leading to cracking and moisture leading to expansion).

Wildfire Threat

As described above, The Fort Miley Campus is located at the wildland urban interface (ABAG 2014) and surrounded on three sides by forested public land belonging to the GGNRA, with an identified wildfire threat of "high" and "very high" (CCSF 2008). This existing wildfire threat could further intensify, if droughts and extreme temperature events increase in severity, also potentially threatening the buildings and infrastructure, such as emergency operations center and the use of the helipad (see site location review above.)

Change in Extreme Temperature Events

The forecasted increase in extreme heat events due to climate change, with increasingly multi-day-periods of hot days and hot nights will likely have an effect on the electricity use of the SFVAMC to ensure safe temperatures for patients (high-risk groups) and staff and sensitive medical research materials, through HVAC use and supplementing the geothermal cooling mechanism, where necessary.

Mission Bay

See Climate Change impacts discussion under "Site Location" above.

Potential Cultural Heritage related Climate Change impacts

SFVAMC Fort Miley

The existing SFVAMC Fort Miley Campus was formerly part of the Fort Miley Military Reservation on Point Lobos, which the U.S. Army acquired in 1893. In 1932, the U.S. Army transferred 25 acres (eventually 29 acres total) of land to VA for the Campus. The remaining portion of Fort Miley, east and west of the existing Campus, contains buildings and artillery bunkers and was not included in the land transfer to VA. These Fort Miley lands near the Campus, East Fort Miley and West Fort Miley, are owned by NPS and are part of the Golden Gate National Recreation Area (GGNRA) (NPS, 2011). East Fort Miley and West Fort Miley were listed in the National Register of Historic Places in 1980.

The northern and eastern portions of the SFVAMC Fort Miley Campus compose a historic district. This SFVAMC Fort Miley Historic District encompasses 12 acres of the Campus and contains 14 contributing buildings or structures (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 18, 20, and the flagpole and base), and 11 noncontributing buildings or structures (14, 25, 26, T-27, T-28, 31, 32, 33, 202, 210, and 212). The boundaries of the historic district correspond to the areas that retain the highest degree of architectural integrity and historic landscaping. The period of significance for the historic district is 1934 to 1941.

Extreme Rainfall/Storm Exposure

The historic buildings are in moderate to good condition, however remain exposed to the decaying influence of weather. An increased risk of exposure to extreme rain fall events and storms (wind)

through climate change may further impact the historic buildings in particular, for example by impacting the integrity of the roofing, creating internal flooding risk.

Wildfire Threat

As discussed above, increased drought frequency and extreme heat events may also result in an increased risk of exposure to wildfire from the surrounding wildlands.

Mission Bay Area

The Mission Bay area was originally an open bay and marshy area. Starting in the late 19th century, the area was filled in to allow for development as an industrial tract. Southern Pacific Railroad used the site for several decades and constructed several tracks and spurs in the immediate area. It remained industrial until into the late 20th century, when it was redeveloped to include more dense mixed-use buildings, consisting of high-end residences, retail establishments, offices, studios, and research facilities. Currently, this area is being developed with a 43-acre University of California, San Francisco (UCSF) Research Campus and a 14.5-acre UCSF Medical Center.

As the buildings for the SFVAMC in the Mission Bay Area are not yet constructed, cultural resource impacts from climate change are not applicable.

Potential Environment Related Climate Change Impacts

SFVAMC Fort Miley

Habitat within the SFVAMC Fort Miley Campus is largely developed and consists of landscaped and planted trees; however, the areas along the northern, eastern, and western perimeters of the Campus property are less developed. The vegetation assemblages observed on the property in 2008 and 2012 by AECOM staff were primarily nonnative and included a high-level tree canopy of Monterey pine (*Pinus radiata*) and Monterey cypress (*Cupressus macrocarpa)* (VA, 2010a). As mentioned in Chapter 2.0, "Alternatives," there are currently an estimated 232 trees within the landscaped portions of the Campus (VA, 2010b). Dominant tree species on the Campus include Monterey pine (71 individuals), purpleleaf plum (*Prunus cerasifera 'Atropurpurea'*; 25 individuals), Monterey cypress (21 individuals), Japanese flowering cherry (*Prunus serrula*; 19 individuals), and Lagunaria (*Lagunaria patersonii*; 17 individuals). The remaining trees consist of small numbers of various nonnative and native trees used as landscaping throughout the Campus. Large nonnative tree[7] cover comprises about 30.2 acres (nearly 50 percent of the study area). Cape ivy (*Delairea odorata*), a nonnative species, infested about 6.3 acres (or about 10 percent) of the study area.

Annual Rainfall/ Drought

Projected changes in reduced annual rainfall and increased frequencies of droughts and extreme heat events will likely increase the need for watering of trees and perennial plant cover to keep it alive.

[7] In the study, Monterey cypress and Monterey pine were considered "nonnative," because they are not historically native to the San Francisco Peninsula. Eucalyptus (*Eucalyptus globulus*) was the third most frequent nonnative tree species found.

Mission Bay

Mission Bay is an urban area that was developed for industrial uses including rail yards, truck terminals, construction-related operations, warehouses, and maritime activities. Development has occurred in the area, but vacant areas remain. Open areas of Mission Bay are vegetated predominantly with nonnative, annual species of grasses and forbs. The Mission Bay planning area encompasses the entire Mission Creek Channel (Figure 2-5 in Chapter 2.0, "Alternatives"). A minor amount of wetland vegetation in the form of a fringe of pickleweed (Salicornia virginica) occurs above the high-tide line on the unlined, dirt banks of the Mission Creek Channel. Nonnative annual grasses and forbs common to disturbed urban areas occur on the channel sides above the pickleweed. For the 1996 LRDP EIR Mission Bay, potential new sites were surveyed on foot to assess the potential for occurrence of sensitive species. Wildlife typical of the Mission Bay area includes domesticated rock dove (Columba livia) and muscovy duck (Cairina moschata), and common native bird species including mourning dove (Zenaida macroura), mallard (Anas platyrhynchos), and killdeer (Charadrius vociferous). Other species of native water birds would be expected to occur along the Mission Creek Channel, including egrets, herons, and ducks. (UCSF, 1996).

Because of the Mission Bay area's history of development and industrial uses, limited to no natural vegetation or habitat communities remain in the area. Waterfront in this area is generally developed and contains riprap, seawalls, or other development to control tidal influence from San Francisco Bay.

Annual Rainfall/ Drought

Projected changes in reduced annual rainfall and increased frequencies of droughts and extreme heat events will likely increase the need for watering of planted vegetation to keep it alive.

Sea Level Rise

As the high-tide line rises, the small patches of pickleweed may resettle on higher ground, if space is available or likely disappear, should hard protective surfaces (such as a sea wall) be constructed along the Mission Bay channel.

Conclusions/Opportunities for Planning Considerations

Fort Miley Campus

Extreme Heat Events

To adapt to extreme heat events, SFVAMC will need to ensure thermo-regulated environments in their buildings for their vulnerable patients and employees. This will likely require a high energy load while the rest of the City and County of San Francisco would have similar energy demand, which could add stress to the system (i.e., lead to brownouts). The existing geothermal cooling and generators remain important systems to ensure stable environments, however any planning measures that can be undertaken to reduce the heat island effect (e.g. through light-colored building materials that reflect heat instead of absorbing it, shading-structures, and planted areas) could help reduce future extreme heat event impacts and energy demand by lowering surface temperatures.

Wildfire Threat

- *Secure Buildings*
  - Update fire sprinkler systems
  - Update HVAC systems and geothermal cooling
  - implement LEED building credits/BMPs to reduce heat island effect
- *Secure Backup Electricity Needed to Ensure A/C During Heat Waves*
- *Secure Backup Water Supply/Water Tower*
- *Maintain Foliage on the Campus*
  - Ensure proper defensible space around perimeter of Fort Miley Campus
  - Annual foliage survey followed by thinning and/or removal actions if deemed hazardous, dying, or dead
  - Work with Other Jurisdictions/Agencies to Maintain Foliage On Their Adjacent Property

    VA should continue to coordinate with local jurisdictions (City and County of San Francisco and GGNRA) and agencies (California Coastal Commissions, SFPUC, and SF Recreation and Parks Department) in terms of adaptation to projected wildfire risk that could affect the SFVAMC Fort Miley Campus and the Veterans, employees, and public utilizing this Campus. Specifically, VA should work to protect existing and planned buildings, structures, and infrastructure within the Campus by maintaining and/or removing problematic foliage or contributing funding for such work and by renovating its infrastructure systems so that they are resilient and adaptable over time.

Mission Bay Area

Sea Level Rise

Adaptation strategies to projected sea level rise include mechanisms to protect and defend infrastructure and buildings already in place by constructing sea walls and levees or developing buildings and infrastructure that can adapt to the sea level (e.g., floating buildings and development).[8] Coordination with the City and County of San Francisco and the Bay Conservation and Development Commission to protect existing and planned buildings and infrastructure at the potential SFVAMC Mission Bay Campus from sea level rise by building or contributing funding for flooding impedance infrastructure and by renovating its buildings and infrastructure so that they would remain resilient and adaptable over time is also a strategy. This may lead to future planning efforts that could include construction of infrastructure to impede sea level rise or elevation of the topography in the Mission Bay area in a manner that prevents sea level rise from inundating the low-lying parts of the Mission Bay are. However, such efforts are speculative at this time, and these short term options do not account for local roadways and other infrastructure connecting any potential VA development in the Mission Bay to the rest of San Francisco and the SFPUC and PG&E systems. As sea level rise is projected to continue for centuries (likely beyond the end of the century) the only viable long-term option will likely be managed retreat from the inundated areas and ceasing new land use development in such areas. As such, in regards to climate risk and associated sea level rise risk, the current

[8] Note that San Francisco's AT&T Ballpark, which is also located in the Mission Bay/SOMA area was constructed as able to float in order to adapt to both potential earthquakes and potential sea level rise.

SFVAMC location at Fort Miley is, thus, a more advantageous location compared to the low-lying potential Mission Bay location.

References

Association of Bay Area Governments (ABAG). 2014. Earthquake and Hazards Program Interactive Map showing Wildland Urban Interface and Wildfire Threats for the City and County of San Francisco. Available: < http://gis.abag.ca.gov/website/Hazards/?hlyr=wui>. Accessed August 13, 2014.

Cal-Adapt. 2013. Cal-Adapt Web Tool. Available: <http://cal-adapt.org/>. Accessed August 24, 2014.

California Coastal Commission (CCC). 2013, in review. *Draft Sea-Level Rise Policy Guidance*. Available: <http://www.coastal.ca.gov/climate/SLRguidance.html>. Accessed August 24, 2014.

California Natural Resources Agency (CNRA). 2009. *2009 California Climate Adaptation Strategy: A Report to the Governor of the State of California in Response to Executive Order S-13-2008*. Available: <http://www.energy.ca.gov/2009publications/CNRA-1000-2009-027/CNRA-1000-2009-027-F.PDF>. Accessed August 24, 2014.

California Energy Commission (CEC). 2006. *Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2004.* Staff Final Report. Available: <http://www.energy.ca.gov/2006publications/CEC-600-2006-013/CEC-600-2006-013-SF.PDF>. Accessed June 2, 2011.

———. 2012. *Our Changing Climate: Vulnerability & Adaptation to the Increasing Risks from Climate Change in California.* A Summary Report on the Third Assessment from the California Climate Change Center. CEC-500-2012-007. Sacramento, CA.

California Ocean Protection Council (OPC). 2013. State of California Sea-Level Rise Guidance. Available: <http://www.opc.ca.gov/webmaster/ftp/pdf/docs/2013_SLR_Guidance_Update_FINAL1.pdf>. March 2013 Update. Accessed August 24, 2014.

Cayan, D. R., E. P. Maurer, M. D. Dettinger, M. Tyree, and K. Hayhoe. 2008. Climate Change Scenarios for the California Region. *Climatic Change 87*(1):21–42.

———. 2012. *Climate Change Scenarios for the San Francisco Bay Region*. California Energy Commission, Public Interest Energy Research Program. CEC-500-2012-042. Sacramento, CA.

City and County of San Francisco (CCSF). 2009. *San Francisco Municipal Code and Planning Code.* Codified through Ordinance No. 35-09, File No. 090097. Approved March 9, 2009. San Francisco, CA.

———. 2010 (February). *San Francisco Zoning Map.* San Francisco, CA.

———. 2011a (April). *Land Use Index of the General Plan of the City and County of San Francisco.* San Francisco, CA.

———. 2011b. *Western Shoreline Area Plan*: Coastal Zone Area, Map 1. Available: <http://www.sf-planning.org/ftp/General_Plan/images/western_shoreline/Map1.gif>. Accessed July 13, 2011.

City of San Francisco Department of Public Health, 2010. Climate and Health; Understanding the Risk: An Assessment of San Francisco's Vulnerability to Extreme Heat Events. Available: <http://www.sfhealthequity.org/component/jdownloads/finish/42/269>. Accessed August 13, 2014.

Dettinger, M. D. 2005. From Climate-Change Spaghetti to Climate-Change Distributions for 21st Century California. *San Francisco Estuary and Watershed Science*, 3(1).

Gebhard, D., R. M. Winter, and E. Sandweiss. 1973. *A Guide to Architecture in San Francisco & Northern California*. Santa Barbara, CA: Peregrine Smith, Inc.

Intergovernmental Panel on Climate Change (IPCC). 2013. Climate Change 2013- The Physical Science Basis. Working Group 1 Contribution to the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change. Available: < http://www.ipcc.ch/report/ar5/wg1/>. Accessed August 24, 2014.

Moser, S., J. Ekstrom, and G. Franco. 2012. *Our Changing Climate 2012: Vulnerability & Adaptation to the Increasing Risks from Climate Change in California*. A Summary Report on the Third Assessment from the California Climate Change Center. July. Sacramento: California Energy Commission.

National Park Service (NPS). 2011. Fort Miley Military Reservation. Available: <http://www.nps.gov/nr/travel/wwiibayarea/mil.HTM>. Accessed May 3, 2011.

National Research Council (NRC). 2012. *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future*. Washington, DC: The National Academies Press.

National Oceanic and Atmospheric Administration (NOAA). 2013a. *What is the difference between storm surge and storm tide?* Available: <http://oceanservice.noaa.gov/facts/stormsurge-stormtide.html/>. Accessed August 13, 2014.

National Oceanic and Atmospheric Administration (NOAA). 2013b. *About Tidal Datums.* Available: <http://tidesandcurrents.noaa.gov/datum_options.html>. Revised: 10/15/2013. Accessed August 24, 2014.

National Oceanic and Atmospheric Administration (NOAA). 2013c. Mean Sea Level Trend 9414290 San Francisco, California. Available: <http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=9414290> Last Modified 10/15/2013. Accessed August 24, 2014.

Pacific Gas & Electric (PG&E), 2013. EMBARCADERO-POTRERO 230 KV TRANSMISSION PROJECT PREPARED TESTIMONY PUBLIC VERSION VOLUME 1. Sept 9, 2013. Page 11-

18. Available: <https://www.pge.com/regulation/Embarcadero-Potrero230kV-TransmissionProject/Testimony/PGE/2013/Embarcadero-Potrero230kV-TransmissionProject_Test_PGE_20130909_285722.pdf >. Accessed August 12, 2014.

Pierce, D. W., T. Das, D. R. Cayan, E. P. Maurer, N. L. Miller, Y. Bao, M. Kanamitsu, K. Yoshimura, M. A. Snyder, L. C. Sloan, G. Franco, and M. Tyree. 2013a. Probabilistic Estimates of Future Changes in California Temperature and Precipitation Using Statistical and Dynamical Downscaling. *Climate Dynamics, 40*(3-4), 839–856. doi:10.1007/s00382-012-1337-9.

———. 2013b. The Key Role of Heavy Precipitation Events in Climate Model Disagreements of Future Annual Precipitation Changes in California. *Journal of Climate*, 2013.

San Francisco Public Utilities Commission (SFPUC). 2009. Low Impact Design Toolkit: How Will San Francisco Plan for Stormwater? Urban Watershed Planning Charrette, November 13, 2009.

———. 2010. San Francisco's Construction Site Runoff Pollution Prevention Procedures. Published July 11, 2006; updated December 29, 2010. Available: <http://sfwater.org/detail.cfm/MC_ID/14/MSC_ID/118/C_ID/3084>. Accessed February 21, 2011.

———. 2012. SFPUC and SFDPH Beach Water Quality Monitoring Program. First published May 1, 2008 and updated August 22, 2010. Available: <http://216.119.104.145/index.aspx?page=87/>. Accessed July 9 17, 2012.

———. 2014. *Climate Stressors and Impacts: Bayside Sea Level Rise Mapping Technical Memorandum*. Prepared for SFPUC by AECOM. June 2014.

Sharpsteen, W. C. 1941. Vanished Waters of Southeastern San Francisco Notes on Mission Bay and the Marshes and Creeks of the Potreros and the Bernal Rancho. California Historical Society Quarterly Vol. XXI(2).

U.S. Department of Veteran Affairs (VA). 2011. Environmental Assessment for the proposed Installation and Operation of Ground Source Heat Pump Systems San Francisco Veterans Affairs Medical Center, San Francisco County, California. Prepared by TTL Associates, Inc. November 22, 2011.

U.S. Environmental Protection Agency (EPA), 2006. Excessive Heat Events Guidebook. EPA 430-B-06-005 Environmental Protection Agency, Office of Atmospheric Programs. June 2006 Available: <http://www.epa.gov/heatisland/about/pdf/EHEguide_final.pdf>. Accessed August 12, 2014.

United States Global Change Research Program (USGCRP). 2009. *Global Climate Change Impacts in the United States.* Cambridge University Press.

University of California San Francisco (UCSF), *Long Range Development Plan Final Environmental Impact Report*, 1996.