



Climate Change & Bay Area Human Health Facts, Figures and Science-Based Storylines

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Introduction

The purpose of this document is to focus greater attention on the substantial impacts of climate change on human health in the Bay Area.

We present, in a digestible format, facts, figures, and links to key documents, drawn from a number of excellent reports by local, state and national experts. [Click on the many links in the document to get in-depth information from the source reports.](#)

Our hope is that Bay Area stakeholders will use this information to build compelling narratives that will eventually bring increased resources to these critical human issues.

We intend for this V 1.2 to be improved and expanded by Bay Area stakeholders. Please send your additions, corrections and other comments to CRI at bruce@climatereadinessinstitute.org.

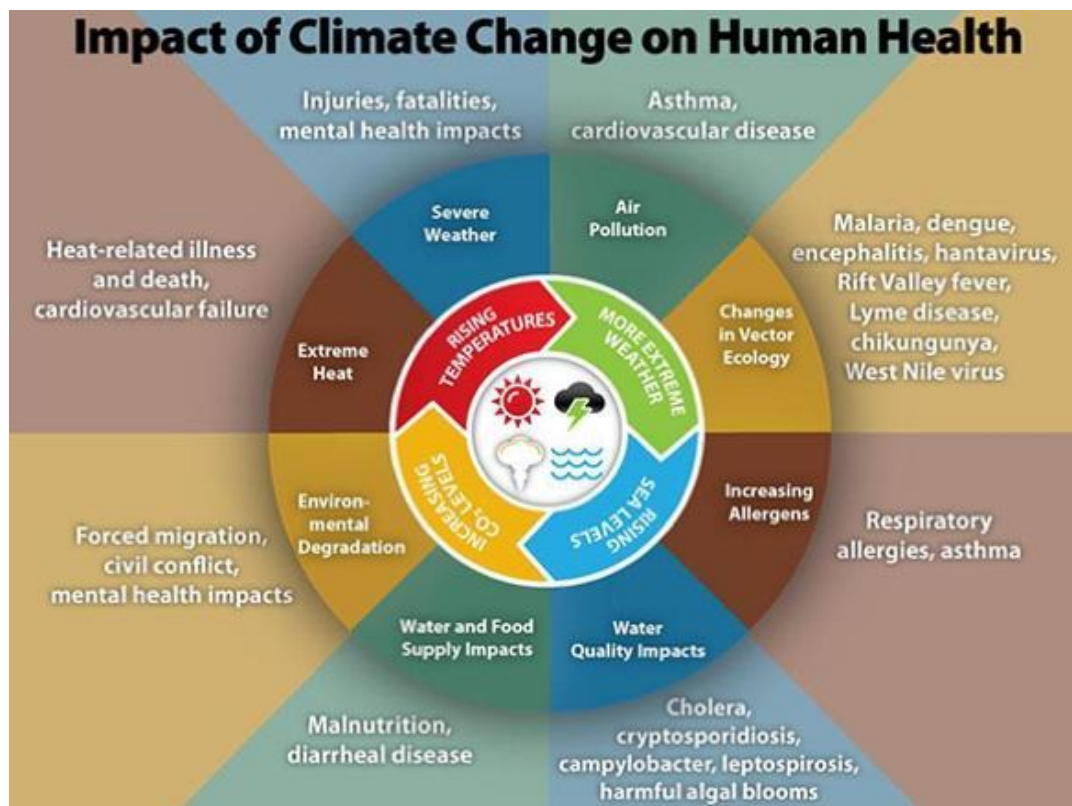
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1. Climate Change is A MAJOR Human Health Issue

Climate change will impact Bay Area public health in many ways, both direct and indirect, creating new threats to Bay Area residents, as well as exacerbating a variety of existing problems.

The chart below, from the Center for Disease Control and Prevention, illustrates how our changing climate (inner ring) is producing various effects (middle ring) that result in direct impacts on human health (outer ring).



More info: [Centers for Disease Control and Prevention](https://www.cdc.gov/climateandhealth/)

In the Bay Area, rising temperatures, extreme storm events, drought, rising sea levels and other climate impacts are expected to increase health problems from air pollution, drive up heat-related illnesses and deaths, and increase vector-borne diseases. Mental health may be further stressed by repeated disasters in an increasingly uncertain world. Our food and energy networks may be disrupted by serious drought, storms and other events elsewhere in the U.S. and overseas. Bay Area medical facilities may be knocked out of service by flooding and extreme storms, and may be overburdened by thousands of climate refugees moving to our region from more severely impacted areas.

“Climate change is expected to have major repercussions for public health throughout California. Specifically, in the Bay Area, climate change effects on environmental conditions that affect public health include increased frequency of extreme heat events (to which the region is not accustomed historically), increased air pollution, reduced and changed timing in precipitation (which could result in droughts), and flooding aggravated by sea level rise (SLR) and high-intensity runoff events. Public health could further be affected by climate through less-extreme winters in cities, expanded ranges for vector- and tick-borne diseases, and increased air pollution (from wildfires, pollen, and/or higher ozone concentrations), among others.”

MORE INFO: [Climate Change Impacts, Vulnerabilities and Adaptation in SF Bay Area](#) page 45

There is much we can do to prepare the Bay Area for the health impacts of climate change and local, state and federal agencies are taking action. In Section 7, we spotlight reports, plans and web sites that illustrate current work by county health departments, the California Department of Public Health and other stakeholders.

2. The Bay Area’s Climate is Already Changing and These Changes Are Projected to Grow Substantially in the Coming Decades

Temperature

California’s annual average temperature has increased about 1.5°F in last 100 years. Much of that increase has occurred in the last 30-40 years.

MORE INFO: [Indicators of Climate Change in California 2013, Cal-EPA pg. 37](#)

Statewide, nighttime temperatures are rising faster than daytime temperatures, and heat waves are resulting in increasingly hot, humid nights rather than just hot days. (Higher nighttime temperatures do not give people a chance to cool down before the next wave of daytime heat, making them more susceptible to heat-related illness.)

MORE INFO: [Indicators of Climate Change in California 2013, Cal-EPA pg. 37](#)

MORE INFO: [California Climate Extremes Workshop Report 2011, Scripps Institution of Oceanography](#) pg. 7

Averaged across the Bay Area, mean annual temperature has increased nearly 1°F in the last 30 years over the previous 30-year period.

MORE INFO: [High Resolution Climate-Hydrology Scenarios for the San Francisco Bay Area](#)

By 2050, Bay Area annual average temperatures are projected to increase by an additional 2.7°F. Post-2050, projections show a wide range of substantial increases, between 3.6°F – 10.8°F, depending upon how much we can cut emissions.

MORE INFO: [Climate Change Impacts, Vulnerabilities and Adaptation in SF Bay Area](#), pg. 19

The number of very hot days and severe heat waves are projected to increase significantly across the region by mid-century, even in cooler areas like San Francisco and Oakland.

MORE INFO: [Cal-Adapt Heat Tool](#)

Precipitation/Drought

Extremes are increasing at both ends of the water spectrum in the Sierra where, over the last 35 years, the region has experienced the wettest and the driest years in more than 100 years of record keeping.

MORE INFO: [Public Policy Institute of California Water Policy Center](#)

A recent NASA study has found that a mega-drought of three decades would be “extremely likely” in the second half of the 21st century in the Southwest and California if emissions continue at the current pace.

MORE INFO: [Safeguarding California Implementation Plan](#), pg 40

Flooding: Sea Level Rise and Extreme Storms

Sea level at the Golden Gate has risen 8 inches over the last 100 years.

MORE INFO: [Indicators of Climate Change in California 2009](#), pg 91

California’s official sea level rise guidance (NRC 2012) projects an additional 2-12 inches locally by 2030 (2000 baseline), 5-24 inches by 2050 and 17 to 66 inches by 2100. The likely projections are 6 inches for 2030, 11 inches for 2050 and 36 inches by 2100.

MORE INFO: [State of California Sea Level Guidance](#)

However, there are great uncertainties concerning these projections linked to the melting of the massive Greenland and Antarctica ice sheets. New research shows that the West Antarctic ice sheet *alone* has the potential to contribute more than 3 feet of sea-level rise by 2100, another foot per decade in the mid-22nd Century and nearly 50 feet by 2500, if emissions continue unabated.

MORE INFO: [Pollard new sea level rise research](#)

Climate change is expected to alter the frequency and severity of extreme storm events.

“Atmospheric river” storm events, which bring 35-45% of California’s precipitation, are expected to increase in frequency and intensity later this century.

MORE INFO: [California Climate Extremes Workshop Report](#) pg. 9

Extreme Events

“In the last 5 years, California has experienced some of the most extreme events in its recorded history—a severe 4-year drought, a dramatic reduction in the Sierra Nevada winter snowpack,

five of the state's 20 largest forest fires since 1932 (when accurate record-keeping began), and two years back-to-back of the hottest average temperatures.”

MORE INFO: [Safeguarding California Implementation Plans](#), pg 49

3. Climate Change Will Produce a Number of Significant and Specific Impacts on Bay Area Human Health.

3A. Higher Temperatures Will Produce More Air Pollutants and Reduce Air Quality

Air pollutants' effects on health

“Ground-level ozone can exacerbate chronic respiratory diseases and cause short-term reductions in lung function. Exposure to particulate matter can aggravate chronic respiratory and cardiovascular diseases, alter host defenses, damage lung tissue, lead to premature death, and possibly contribute to cancer.”

MORE INFO: [The potential impacts of variability and change on air pollution-related health effects in the U.S.](#)

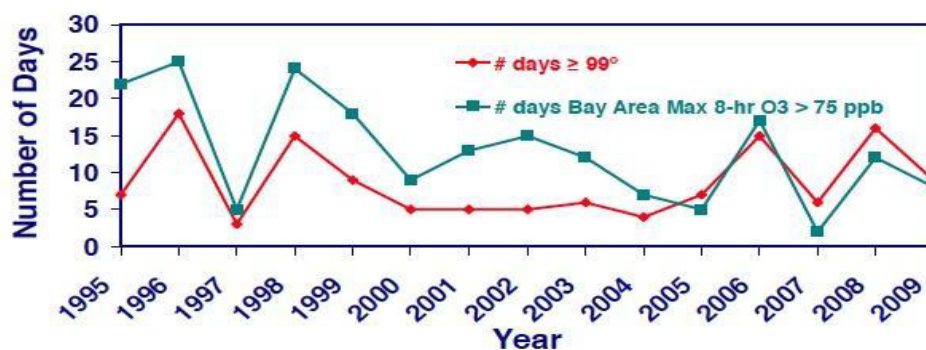
“Urban pollution is now a serious public health hazard. Laboratory studies confirm epidemiologic evidence that air pollution adversely affects lung function in asthmatics. Damage to airway mucous membranes and impaired mucociliary clearance caused by air pollution may facilitate access of inhaled allergens to the cells of the immune system, thus promoting sensitization of the airway.”

MORE INFO: [Urban Air Pollution and Climate Change as Environmental Risk Factors of Respiratory Allergy: An Update](#)

Higher temperatures mean higher ozone levels

The number of days with high ozone levels correlates very closely with years when the Bay Area experiences high temperatures.

High Heat Days and Ozone Exceedances



MORE INFO: [Bay Area Air Quality Management District 2010 Clean Air Plan](#)

Higher Bay Area temperatures will increase ozone formation

“The Bay Area Air Quality Management District modeled the impacts of a 2°C (3.6°F) increase in Bay Area temperatures on regional ozone levels. The modeling found that an increase in average temperature of 2°C would by itself (without any increase in biogenic emissions from plants and trees) increase the Bay Area maximum ozone by 4 parts per billion (ppb). At the same time, an increase in biogenic emissions due to a temperature increase of 2C would by itself (without any increase in temperature) also increase the Bay Area maximum ozone by 4 ppb. Therefore, a 2°C temperature increase, in combination with the expected increase of the biogenic emissions due to the temperature increase, would increase the Bay Area maximum ozone by 8 ppb. This suggests that the potential increase in ozone levels due to climate change may offset 10 years or more of ozone emissions control efforts in the Bay Area between now and 2050.”

MORE INFO: [*The Effects of Climate Change on Emissions and Ozone in Central California.*](#)

Bay Area Air Quality Is More Strongly Influenced by Climate Change Than Inland Regions

“Using a chemical transport model simulating ozone concentrations in central California, we evaluate the effects of variables associated with future changes in climate and ozone precursor emissions, including (1) increasing temperature; (2) increasing atmospheric water vapor; (3) increasing biogenic VOC emissions due to temperature; (4) projected decreases in anthropogenic NO_x, VOC, and CO emissions in California for 2050; and (5) the influence of changing ozone, CO, and methane at the western boundary. Climatic changes expected for temperature, atmospheric water vapor, and biogenic VOC emissions each individually cause a 1-5% increase in the daily peak ozone.”

“Projected reductions in anthropogenic emissions of 10–50% in NO_x and 50–70% in VOCs and CO have the greatest single effect, reducing ozone by 8–15% in urban areas. Changes to the chemical boundary conditions lead to ozone increases of 6% in the San Francisco Bay area and along the west coast but only 1–2% inland. Simulations combining climate effects predict that ozone will increase 3–10% in various regions of California. This increase is partly offset by projected future emissions reductions, and a combined climate and emissions simulation yields ozone reductions of 3–9% in the Central Valley and almost no net change in the San Francisco Bay area. We find that different portions of the model domain have widely varying sensitivity to climate parameters. *In particular, the San Francisco Bay region is more strongly influenced by temperature changes than inland regions, indicating that air quality in this region may worsen under future climate regimes.*”

MORE INFO: [*Influence of Future Climate and Emissions on Regional Air Quality in California*](#)

Climate change will make it harder to reduce ozone pollution

“Climate change will make it harder for any given regulatory approach to reduce ground-level ozone pollution in the future as meteorological conditions become increasingly conducive to

forming ozone over most of the United States. Unless offset by additional emissions reductions of ozone precursors, these climate-driven increases in ozone will cause premature deaths, hospital visits, lost school days, and acute respiratory symptoms.”

MORE INFO: [Impacts of Climate Change on Human Health in the United States, Page 11](#)

Vulnerable populations are at risk from poor air quality

“The two most immediate and concerning impacts for vulnerable populations continue to be extreme heat and air quality (i.e. wildfire smoke, ozone, allergens). Increased heat waves are intensifying occurrences of chronic disease and heat-related illness and will increase morbidity during the summer months. Changes in temperature will affect air quality by promoting the formation of ground-level pollutants, such as ozone or secondary aerosols (particulate matter), and these increases could offset much of the potential gains achieved through air pollution control measures, a phenomenon referred to as the ‘climate penalty’.”

MORE INFO: [Safeguarding California Implementation Plans 2015](#), pg. 114

Higher temperatures also mean more evaporative emissions that help create ozone

Higher temperatures increase evaporative emissions of volatile organic compounds from vehicles and storage tanks, and of a variety of emissions from vegetation (biogenic emissions of Reactive Organic Gas, a key precursor to ozone).

MORE INFO: [California Adaptation Strategy](#) 2009, pg. 34

Higher temperatures also change behaviors that increase air pollution

Increasing temperatures can change behaviors that increase air pollution. For example, the increased use of air conditioners in cars, offices and homes, can produce increases in emissions from power plants and vehicles.

MORE INFO: [California Adaptation Strategy](#) 2009, pg. 34

During the California drought, Bay Area winter pollution increased

During the severe drought winters of 2013-14 and 2014-15, the Air District issued 30 and 15 winter Spare the Air alerts, respectively, substantially above the average of 9 per year for the previous five years.

MORE INFO: [BAAQMD Website](#)

Spare the Air Days

Winter Spare the Air Season	Winter Spare the Air Alerts	National 24 Hour PM 10 Excess Days	CA 24 Hour PM 10 Excess Days	National 24 Hour PM 2.5 Excess Days
Nov.-Feb. 2014-2015	15	0	0	3
Nov.-Feb. 2013-2014	30	0	7	15
Nov.-Feb. 2012-2013	10	0	1	1
Nov.-Feb. 2011-2012	15	0	4	11
Nov.-Feb. 2010-2011	4	0	0	1
Nov.-Feb. 2009-2010	7	0	2	9
Nov.-Feb. 2008-2009	11	0	0	13
Nov.-Feb. 2007-2008	6	0	3	7
Nov.-Feb. 2006-2007	30	0	6	20

Source: [Bay Area Air Quality Management District](#)

Wood smoke from residential wood-burning is a major source of emissions during the winter season when the Bay Area experiences its highest particulate matter (PM) levels, as well as a major cause of population exposure to PM in residential areas.

MORE INFO: [Summary of Particulate Matter](#) (page 11)

Climate change may degrade indoor air quality

“As buildings are renovated or repairs are made to save energy or increase comfort, indoor air quality problems can be created or exacerbated. Indoor pollutants like radon, mold, particles and chemicals from a variety of sources can build up to unhealthy levels unless pollutant sources, ventilation and moisture are carefully managed. Pollutants like tobacco smoke can easily migrate from one unit to another in multi-unit buildings, and lead and asbestos, which may be disturbed during renovations or retrofits, remain serious health risks in older buildings.”

MORE INFO: [Health, Energy Efficiency and Climate Change, U.S. EPA](#)

3B. Higher Temperatures & Drought Are Fueling Wildfires That Increase Air Pollution.

Wildfire Impacts on Health

“Wildfire smoke can have serious health impacts: Exposure to wildfire smoke can cause serious health problems, such as asthma attacks and pneumonia, and can worsen chronic heart and lung diseases.”

MORE INFO: [*Where There's Fire, There's Smoke - NRDC*](#)

“Many systems are affected by wildfire smoke, predominantly through the respiratory system. Cardiovascular effects and ocular problems can also occur as well as acute burns.”

MORE INFO: [*Health Impacts of Wildfires*](#)

“People with respiratory problems like asthma or with heart disease are particularly vulnerable, as are people living in areas with already high levels of particulate pollution from roadways and industrial sources. The very youngest are also at risk: Lower birth weights are found among babies born to mothers exposed to wildfire smoke during pregnancy. Even otherwise healthy people may experience minor symptoms, such as sore throats and itchy eyes.” Corneal abrasions have also been reported; 13% of patient's fire-related presentations to the emergency department the week following Alameda County wildfires in California 1991 had corneal abrasions.”

MORE INFO: [*Health Impacts of Wildfires*](#)

“One study from Southern California describes a wildfire season that resulted in 69 premature deaths, 778 hospitalizations, 1,431 emergency room visits, and 47,605 outpatient visits, mostly for respiratory and cardiovascular health problems aggravated by smoke exposure.”

MORE INFO: [*NRDC Issue Brief: Where There's Fire, There's Smoke*](#)

Rising Temperatures in the West are Increasing Wildfire Frequency and Severity

“Large-wildfire (≥ 400 hectares (1,000 acres)) activity in western U.S. forests increased suddenly and markedly in the mid-1980s. From 1987 to 2003, wildfire frequency was nearly four times the average number, and the total area burned was more than six times the level seen between 1970 and 1986. Interannual variability in wildfire frequency is strongly associated with regional spring and summer temperature. Also, when comparing 1970-1986 with 1987-2003, the length of the yearly wildfire season (March through August) extended by 78 days, a 64 percent increase, and the duration of individual fires increased from one week to about five weeks.”

MORE INFO: [*Indicators of Climate Change in California 2009*, pg 131](#)

Climate change, development patterns, and fire risk in the Bay Area

“Under climate change scenarios, projections indicate that the Bay Area will be at risk to endure some of the highest increases in property damage (in terms of economic value) relative to the rest of the state (Westerling and Bryant 2008; Bryant and Westerling 2012). However, the distribution of how and to what degree wildfire risk increases in the region will largely be driven

by changes in land use and development. For example, Bryant and Westerling (2012) found that under a low population growth scenario with little or no increase in the interface between wildland and urban areas, modeled simulations for the Bay Area show little difference in the distribution of wildfire risk between scenarios simulated under the B1 and A2 emissions scenarios, regardless of the climate model used (in that study, NCAR PCM1 and GFDL CM2.1).”

“While population growth and development scenarios account for far more variability in residential wildfire risks than do climate scenarios, the most extreme increases in residential fire risks result from the combination of high-growth/high-sprawl/extreme climate change scenarios.”

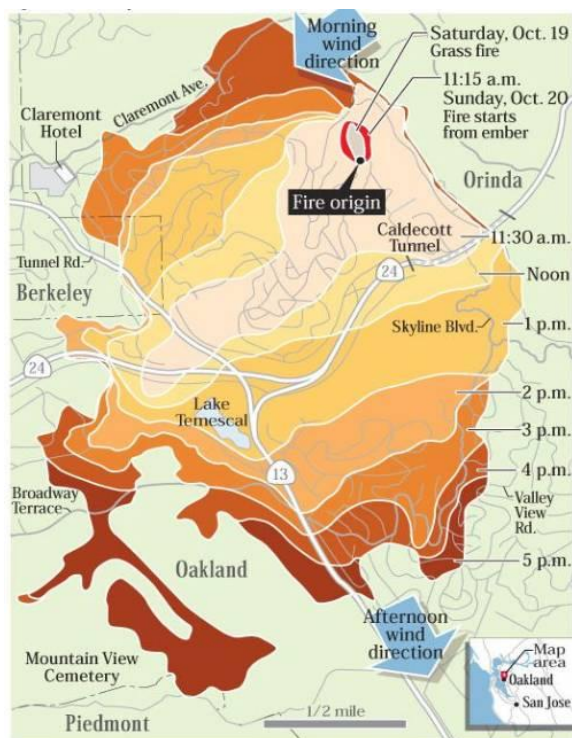
MORE INFO: [Climate Change Impacts, Vulnerabilities and Adaptation in SF Bay Area](#), pg. 25

Large Wildfires Are Common in the Bay Area

Wildfires have been common occurrences in the Bay Area over at least the past sixty years. Large wildfires occurred in 1961, 1962, 1964, 1965, 1970, 1981, 1988, 1991, and 2008. The largest fire at the urban-wildland interface in the Bay Area was in 1991 in the East Bay Hills, and it resulted in \$1.7 billion in insured property losses. The fire destroyed 3,000+ homes and killed 25 people. High winds and dry conditions were common to nearly all the large Bay Area fires.

MORE INFO: [Climate Change Impacts, Vulnerabilities and Adaptation in SF Bay Area](#)

MORE INFO: [Fire Sweeps Through Oakland Hills](#)



Source: Oakland Fire Department

DAVE JOHNSON/BAY AREA NEWS GROUP



Source: San Francisco Chronicle, October 21, 1991

Wildfires in California Are Contributing to Global Warming

“Large-scale wildfires produce large quantities of pollutants such as black carbon and methane that contribute significantly to global warming. “Short lived climate pollutants (SLCPs) are responsible for about 40 percent or more of global warming experienced to date.”

MORE INFO: [California Air Resources Board](#).

“California’s black carbon inventory uses the 10-year average from 2001-2011 of particulate matter (PM) 2.5 emissions from wildfire to represent average conditions and avoid large year-to-year variations in the inventory. Based on these methods, a typical recent wildfire year would account for two-thirds of the State’s black carbon emissions in 2013. The frequency of large fire events and the associated emissions will likely increase in the future, due to climate change, heavy fuel loading, historic fire suppression practices, and development in forested areas.”

MORE INFO: [California Air Resources Board](#)

“Black carbon emissions can be significantly decreased by reducing the frequency of large wildfires while methane emissions can be reduced by removing downed trees and biomass from the forest.”

MORE INFO: [Safeguarding California Implementation Plans](#) pg 68

3C. Higher Temperatures Will Increase Bay Area Heat-Related Illnesses and Deaths.

High Heat Impacts on Health

“The public health risks associated with extreme heat events vary across the Bay Area’s communities, and among the individuals within communities. The most direct and prevalent health issues across the spectrum of heat-related illnesses and deaths include heat stress, heat exhaustion, heat stroke, heat cramps, heat edema (swelling in the legs), and heat syncope (sudden loss of consciousness, commonly known as fainting).”

MORE INFO: [Public Health Impacts of Climate Change in California](#)

“Heat related illness is a broad spectrum of disease, from mild heat cramps to most severe -life threatening heat stroke. Virtually all heat-related illnesses and death is preventable if the appropriate prevention strategies are adopted and implemented by communities and individuals.”

MORE INFO: [Public Health Impacts of Climate Change in California](#)

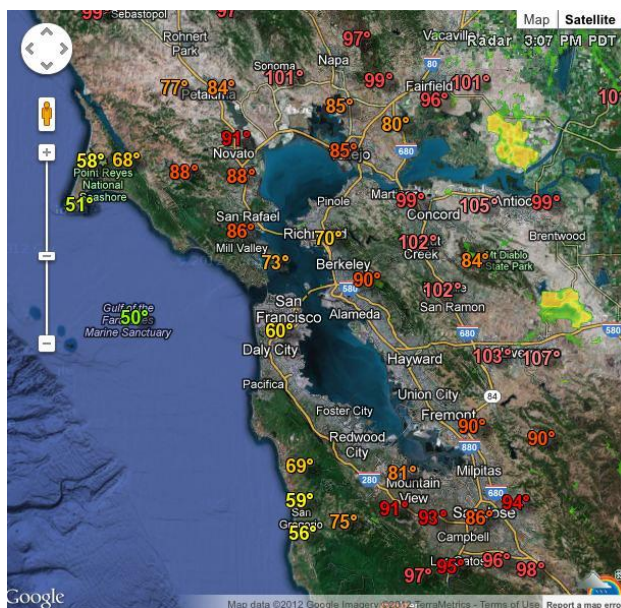
“Increased heat waves are intensifying occurrences of chronic disease and heat-related illness and will increase morbidity during the summer months.”

MORE INFO: [Safeguarding California Implementation Plans](#) pg 114

Climate change will produce more Bay Area heat-related issues

“While the region has had its share of flooding historically, heat extremes are virtually unknown in the Bay Area. This will change in the future, and because of this lack of familiarity, will pose a particular risk to local residents.”

MORE INFO: [Climate Change Impacts, Vulnerabilities and Adaptation in SF Bay Area](#) page 11



Heat waves are the deadliest disasters in California

“Over the past 15 years, heat waves have claimed more lives in the state than all other declared disaster events combined. This trend is likely to continue as the number of heat waves increase, and thereby lead to potentially hundreds of climate-related fatalities every year. Even though coastal areas will not see the greatest increases in average temperature, the largest increases in mortality rates are expected to occur in coastal cities such as Los Angeles and San Francisco, since these populations are relatively unaccustomed to extreme heat and thus less acclimatized when such events occur (e.g., less adequate access to air conditioning).”

MORE INFO: [California Climate Adaptation Strategy 2009](#), pg 32

Coastal Areas Had More Heat Health Issues in 2006 Heat Wave

“During the 2006 California heat wave, a greater increase in emergency room (ER) visits and hospitalizations for heat-related illnesses occurred in the normally cooler coastal counties.”

MORE INFO: [Preparing California for Extreme Heat](#), pg 4

Populations in cooler areas more at risk

“Populations in cooler areas in California may also be at greater risk because individuals are less acclimatized to heat, people are less aware of behaviors that can reduce exposure (e.g. reduce activity level or go to an air conditioned location) or reduce physiologic stress (e.g. appropriate hydration), the built environment is not designed for warmer conditions (e.g. buildings lack adequate air conditioning), and such communities may not have plans for emergency heat mitigation measures.”

MORE INFO: [Safeguarding California 2014](#), pg 194

“Acclimatization is a process whereby the healthy body gradually adapts to heat by various physiologic mechanisms over a period of several weeks of recurrent exposure to heat. People living in areas that are generally cool are at risk of heat-related illness at cooler temperatures than people who have become more acclimatized to heat and who also have more access to air conditioning.”

MORE INFO: [Preparing California for Extreme Heat](#)

Air conditioning is a major determinant of who gets heat illnesses

“At the individual level, ownership of an air conditioner can be a useful indicator of short-term coping capacity in times of extreme heat. Ostro et al. (2010) examined the effects of temperature and use of air conditioners on hospitalizations in 16 cities of California, including Sunnyvale, Santa Rosa, and Oakland in the Bay Area. They observed significant connections between heat and several disease-specific types of hospital admissions. They also found that the use of air conditioners significantly reduced the risk brought on by higher temperatures.”

MORE INFO: [Climate Change Impacts, Vulnerabilities and Adaptation in SF Bay Area](#) page 46

Urban heat islands = much higher temperatures (especially at night)

The annual mean air temperature of a city with 1 million people or more can be 1.8–5.4°F (1–3°C) warmer than its surroundings. In the evening, the difference can be as high as 22°F (12°C). Heat islands can affect communities by increasing summertime peak energy demand, air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and mortality, and water quality.

MORE INFO: [U.S. EPA HEAT ISLAND EFFECT](#)

The urban heat island effect on higher *nighttime* temperatures limits the ability of people to cool down and recover before the heat of the next day, thereby adding to the risk of illness and fatalities. Cities on average have temperatures that are 1.8—5.4°F hotter during the day than rural areas, and as high as 22°F hotter at night, due to heat that is stored in paved surfaces and the built environment and released after sundown.

MORE INFO: [Safeguarding California Implementation Plans](#) pg. 19

3D. Flooding from Rising Sea Levels and Extreme Storms Will Produce a Wide Range of Negative Health Impacts

Flooding Impacts on Health

Rising sea levels will disrupt and compromise infrastructure that are key to our health, including damage to sewage systems, contamination of drinking water supplies, disruptions in the food system, and increasing residents’ exposure to toxic materials.

Drinking water will be contaminated from extreme storms and sea level rise

“Drinking water contamination outbreaks in the U.S. are associated with extreme precipitation events. Flood waters may contain household, industrial and agricultural chemicals as well as sewage and animal waste. Flooding and heavy rainfall events can wash pathogens and chemicals from contaminated soils, farms, and streets into drinking water supplies. Flooding may also

overload storm and wastewater systems, or flood septic systems, also leading to possible contamination of drinking water systems.”

MORE INFO: [California Climate Adaptation Strategy 2009](#), pg 35

“Groundwater basins used for water supply are threatened with decreased replenishment from lowered precipitation and increased evaporation. They are also at risk of increasing extraction to meet growing supply needs. For coastal aquifers, this may increase their vulnerability to saltwater intrusion from sea-level rise. Saltwater intrusion into coastal aquifers would make some of the freshwater unusable without more intensive treatment. A combination of increased storm intensity and saltwater intrusion in the Sacramento–San Joaquin Delta could increase the risk for flood-caused levee failures, which potentially could destroy low-lying areas and contaminate freshwater supplies stored and conveyed in the delta.”

MORE INFO: [Climate Adaptation and Sea Level Rise in the San Francisco Bay Area](#)

Release of toxic materials during bayside flooding events

“The presence of land or facilities containing hazardous materials in areas at risk of inundation increases the risk of exposure to toxic chemicals for nearby residents and ecosystems. For example, sediment samples in New Orleans taken one month after Hurricane Katrina found excess levels of arsenic, lead, and the gasoline constituent benzene, all considered toxic pollutants by the U.S. EPA (Adams et al. 2007). Those living or working near these facilities may be affected by the potential release and spreading of contamination through floodwaters or through flood-related facility malfunctions.”

MORE INFO: [The Impacts of Sea Level Rise on the California Coast](#), Page 53

San Mateo and Santa Clara counties at greatest risk

“We evaluated sites containing hazardous materials at risk of flooding along the Pacific coast and the San Francisco Bay. Here, we report on a range of sites monitored by the U.S. EPA, including Superfund sites; hazardous waste generators; facilities required to report emissions for the Toxics Release Inventory; facilities regulated under the National Pollutant Discharge Elimination System (NPDES); major dischargers of air pollutants with Title V permits; and brownfield properties. An estimated 130 U.S. EPA-regulated sites are currently vulnerable to a 100-year flood event (Table 14). Nearly 60% of these facilities are located in San Mateo and Santa Clara counties. Sea-level rise will put additional facilities, people, and the environment at risk. The number of facilities at risk increases by 250% with a 1.4 m sea-level rise, with more than 330 facilities at risk of a 100-year flood event. San Mateo, Alameda, and Santa Clara counties have the highest numbers of U.S. EPA-regulated sites within future flood areas.”

MORE INFO: [The Impacts of Sea Level Rise on the California Coast](#), Page 53

Table 14. U.S. EPA-regulated sites within areas vulnerable to 100-year flood event in 2000 and with a 1.4 m sea-level rise

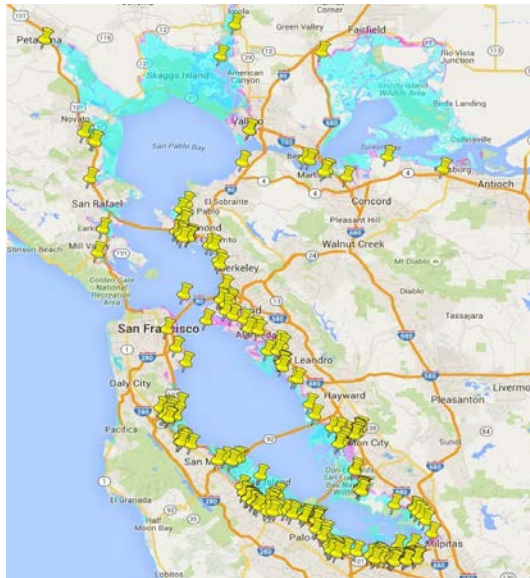
County	Sites currently at risk	Risk with 1.4 m sea-level rise
Alameda	6	63
Contra Costa	4	22
Del Norte	1	3
Humboldt	10	13
Los Angeles	13	26
Marin	1	6
Monterey	1	1
Napa	1	2
Orange	4	16
San Diego	-	13
San Francisco	-	4
San Luis Obispo	-	1
San Mateo	39	78
Santa Barbara	1	5
Santa Clara	41	53
Santa Cruz	5	6
Solano	2	5
Sonoma	-	2
Ventura	5	13
Total	134	332

Data Source: EPA Geospatial Data Access Project 2008

Note: Table combines risk for those counties along the San Francisco Bay and Pacific coast.

MORE INFO: [The Impacts of Sea Level Rise on the California Coast](#), Page 53

EPA-regulated sites that contain toxic materials that are at risk due to 100-year flood and sea level rise.



MORE INFO: [The Impacts of Sea Level Rise on the California Coast](#).

Silicon Valley storms/flooding impacts on health

“Storm surges and flooding, often related to extreme weather (precipitation) events, have the potential to cause injury and loss of life. . . The combination of SLR and coastal flooding are likely to place a range of different types of infrastructure at risk which may affect human health. Similarly, there are 41 contaminated land sites and 5 hazardous waste sites, and 3 wastewater treatment plants (processing a total of 145 million gallons each day) located in areas likely to be inundated by sea level rise and storm surge by the end of the century. Flooding at these facilities may result in hazardous materials entering the water supply and contaminating drinking water.”

MORE INFO: Silicon Valley 2.0 (CH 3PH-12)

Food-borne illnesses

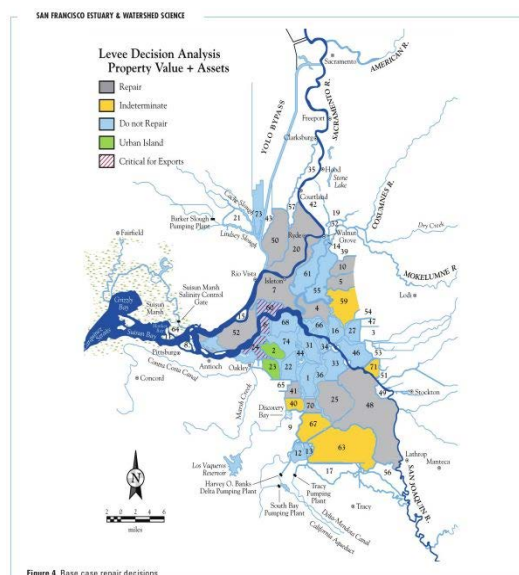
“Warming oceans and rising sea level may have a dramatic impact on both commercial and recreational shellfish harvesting. Increased water temperatures could lead to an increase in the frequency and distribution of naturally-occurring pathogens such as *Vibrio parahaemolyticus*, which has caused hundreds of illnesses linked to shellfish consumption. Likewise, increased temperatures, combined with decreased salinity from greater rainfall, could result in increases of the deadly *V. vulnificus* bacterium currently found predominantly in the Gulf of Mexico.”

MORE INFO: [California Climate Adaptation Strategy 2009](#), pg 38

Flooding in the Delta will threaten Bay Area water supplies

“These levees were not designed to resist a significant seismic event, the probability of which is greater than 60 percent over the next 50 years. They are also vulnerable to major floods and rising sea levels, all of which puts unacceptable risk on the people who live in the Delta as well as the water supply for 25 million people and 3 million acres of farmland.”

MORE INFO: [California Water Action Plan 2016 Update](#), pg 8



3E. Higher Temperatures, Flooding and Other Extreme Weather Will Increase Vector Borne Diseases.

Vectors and Human Health

“Vector-borne diseases (VBD) are infectious diseases that are transmitted to humans by animals, also called vectors, such as mosquitoes, ticks, fleas, lice, and rodents. Climate change can cause vectors or the diseases they carry to multiply or spread out more rapidly. When vectors spread to new areas where people live, work, or play, more people may be at risk of contracting VBD. This is particularly true when vectors move into places that they have never inhabited before, or conversely, when people move into areas where vectors exist.”

MORE INFO: [Vector Borne Disease and Climate Change](#)

How Climate Change Influences Vectors

“The ecology of Vector-Borne Diseases (VBD) is complex, and climate is a major factor that may influence disease transmission cycles and disease occurrence. Changes in temperature and humidity can affect where vectors proliferate. These changes can also affect the life-cycles of the pathogens they carry.

- Drought and heat
 - West Nile virus activity often appears to be greatest during La Niña conditions of drought and hot summer temperatures
- Wet conditions
 - A prolonged rainy season could make California more at risk for the introduction and establishment of exotic vectors, such as those that carry dengue and yellow fever

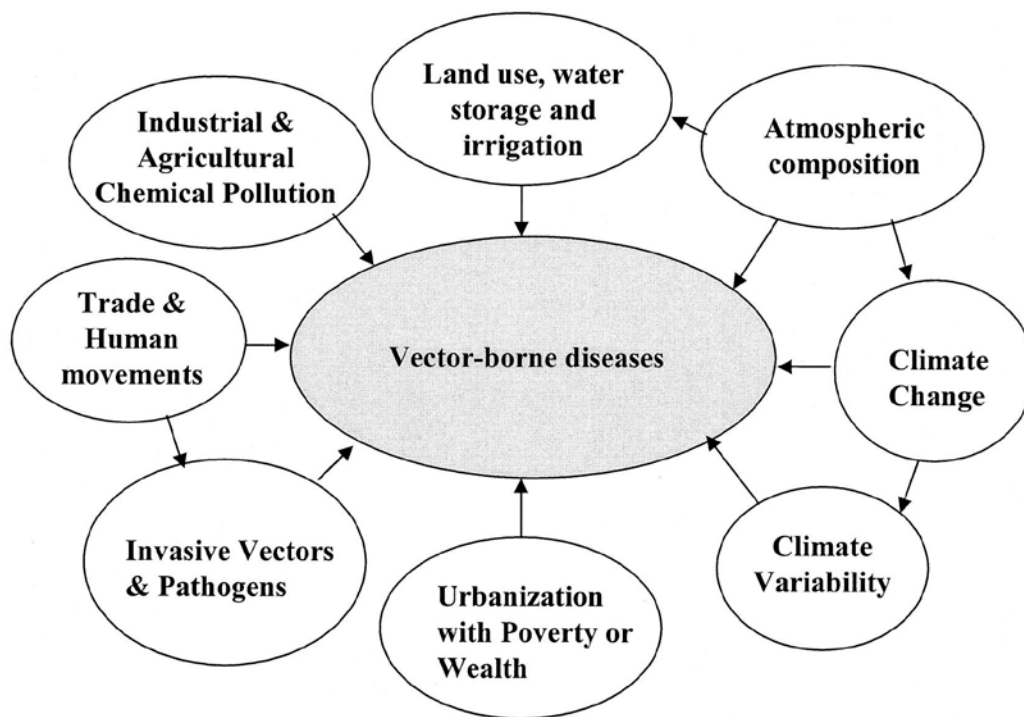
Climate change may impact the distribution of vectors- depending on whether drier or wetter habitats are more suitable for any particular vector- and may allow them to exist where they previously did not.”

MORE INFO: [Vector Borne Disease and Climate Change](#)

Climate change in California and vectors

“Human Hantavirus Cardiopulmonary Syndrome (HCPS), Lyme disease, and West Nile virus are three VBD that climate change may impact in California. As climate conditions change to alter the ecology of vectors, it is possible for human exposure to these diseases to increase significantly.”

MORE INFO: [Vector-Borne Disease and Climate Change](#)



MORE INFO: [Global Change and Human Vulnerability to Vector Borne Diseases](#)

Climate change will have both short- and long-term effects on vectors.

“Climate change is likely to have both short- and long-term effects on vector-borne disease transmission and infection patterns, affecting both seasonal risk and broad geographic changes in disease occurrence over decades. While climate variability and climate change both alter the transmission of vector-borne diseases, they will likely interact with many other factors, including how pathogens adapt and change, the availability of hosts, changing ecosystems and land use, demographics, human behavior, and adaptive capacity. These complex interactions make it difficult to predict the effects of climate change on vector-borne diseases.”

MORE INFO: *Impacts of Climate Change on Human Health in the United States*, pg. 11

Higher Bay Area temperatures will cause changes in the geographic distribution of vectors.

Temperature and precipitation change can accelerate the spread of rodent and vector-borne disease. Mosquitoes flourish in warm and wet climates. West Nile Virus is active in the Bay Area. Since 2012, there have been three reported cases (human or dead bird) of West Nile Virus in San Francisco, six in San Mateo County, and over 350 in Santa Clara County. As temperatures rise, a year with high spring rain totals could grow the mosquito population and increase San Francisco residents’ risk for West Nile Virus. Although no cases have been reported in California, mosquitoes are also capable of transmitting Dengue Fever, Rift Valley Fever, Malaria, Japanese encephalitis, yellow fever, and Venezuelan encephalitis viruses.

MORE INFO: [San Francisco Climate & Health Profile](#)

Zika and Dengue in the Bay Area

The types of mosquitoes that can carry Zika and Dengue have been identified in the last few years for the first time in San Mateo County.

MORE INFO: [Aedes Mosquitoes in San Mateo County](#)

"We think it's only a matter of time before the viruses and the mosquitoes in California get together, and that we have infected mosquitoes, and that there's local transmission. But this won't be a very frequent occurrence. What sets these mosquitoes apart is they bite during the day, and they prefer to bite humans above any other animals. They also have an ability to breed in small bodies of water, even as small as a water bottle lid."

MORE INFO: [Santa Cruz County and Zika](#)

Vector spread may affect food security, a major health problem.

"Disease spread to crops from vectors and pests is expected to threaten food production and quality, in addition to the effects of drought and severe weather events. Combating these threats to food security will likely require increased use of pesticides and fertilizers, which leads to increased GHG emissions and concerns about human health and water quality from runoff. In times of food insecurity and rising prices, people turn to nutrient-poor, calorie-rich foods with health impacts including malnutrition and obesity."

MORE INFO: [Climate Changes Impacts and Adaptation in California](#)

3F. Higher temperatures will produce more plant pollen and lengthen allergy seasons, aggravating asthma and other respiratory and cardiovascular diseases.

Climate change and allergies linked

"Changes in temperature, precipitation and extreme weather events, may also change the production, distribution, and dispersion of airborne allergens ("aeroallergens") such as pollen, mold, and indoor allergens. While there are still no definitive conclusions on how climate will impact air-borne allergens, particularly at the regional level, models indicate that pollen will likely increase in many parts of the United States, there may be shifts in the seasonal timing of allergen production, while some allergen producing species may become extinct – new allergens may be introduced, and there may be increases in allergen content and potency. Allergies are the sixth most costly chronic disease category in the United States, collectively costing the healthcare system approximately \$21 billion annually. Pollutants and allergens can cause or aggravate a wide range of health problems including asthma and other debilitating and costly respiratory and cardiovascular diseases, which fall disproportionately on low income and persons of color."

MORE INFO: MORE INFO: [Safeguarding California 2014](#), pg 195

Warming temperatures and more carbon dioxide are increasing pollen

“Warming temperatures have lengthened the risk period for these plants up to several weeks. It means more misery for allergy sufferers because you're looking at a longer time for exposure to pollen. A rising atmospheric carbon dioxide concentration is also important because it nourishes plants, and fast-growing pollen producers like ragweed are often the quickest to avail themselves of its increasing abundance.”

[MORE INFO: Climate Change Expands Allergy Risk](#)

Science studies show link between climate change and increased pollen

“We were able to confirm that climate change is having an effect on pollen, that it is happening in real time, and we are seeing a real signal.”

[MORE INFO: Warming Temperatures Drives Up Pollen Production and Allergies](#)

Longer pollen seasons costing billions in health care

“Global warming and allergies: The lengthening pollen season may exacerbate hay-fever symptoms for some 40 million Americans with allergic disorders, which trigger health care costs of more than \$21 billion annually.”

[MORE INFO: Warming Temperatures Drives Up Pollen Production and Allergies](#)

Allergies and asthma linked

“Allergies and asthma go hand in hand the majority of the time. Determining how and when symptoms appear, whether they are seasonal or year-round, and whether they can be associated with any particular activity, place or exposure, is critical in the management of asthma.”

[MORE INFO: San Francisco Ear Nose Throat and Allergies](#)

Warmer Bay Area temperatures and drought are increasing pollen

“With the increase in temperature we see longer pollen seasons and earlier pollen seasons. Weather certainly has played a role. With this drought, some trees are under a lot of stress for lack of water, and part of a tree’s stress response is to produce more pollen. Tree pollen, which you see the first three months of year, has been more plentiful.”

[MORE INFO: Napa Valley Register](#)

North Bay bad for allergens

“The North Bay is inherently more troubled by allergens than the Bay Area’s more urban and coastal cities, due to the large amount of agricultural and wooded lands as well as the Napa Valley’s wind-channeling effect, which carries pollen greater distances.”

[MORE INFO: Napa Valley Register](#)

San Francisco and allergies

“As a temperate city with housing and infrastructure built for a cool coastal climate, higher temperatures, more extreme-heat days, and longer heat waves will test San Francisco’s health infrastructure. As extreme heat days increase, poor air quality will lead to higher rates of respiratory illness, asthma, and allergies.”

MORE INFO: [San Francisco Climate & Health Profile](#), pg iv

Dry windy and hot weather in Bay Area increasing pollen counts

“On a dry day with wind, loose pollens are scattered in the air, and if dry weather continues day after day, as it has in the Bay Area, air-borne pollens increase and become a significant source of allergens. Our current dry weather has also increased pollution, which also causes nasal and eye irritation, regardless of allergies. Of course those with underlying allergies are prone to other triggers such as cars' exhaust fumes and smoke.”

“Dry, windy and hot weather over a long period can increase the number of pollinating days”

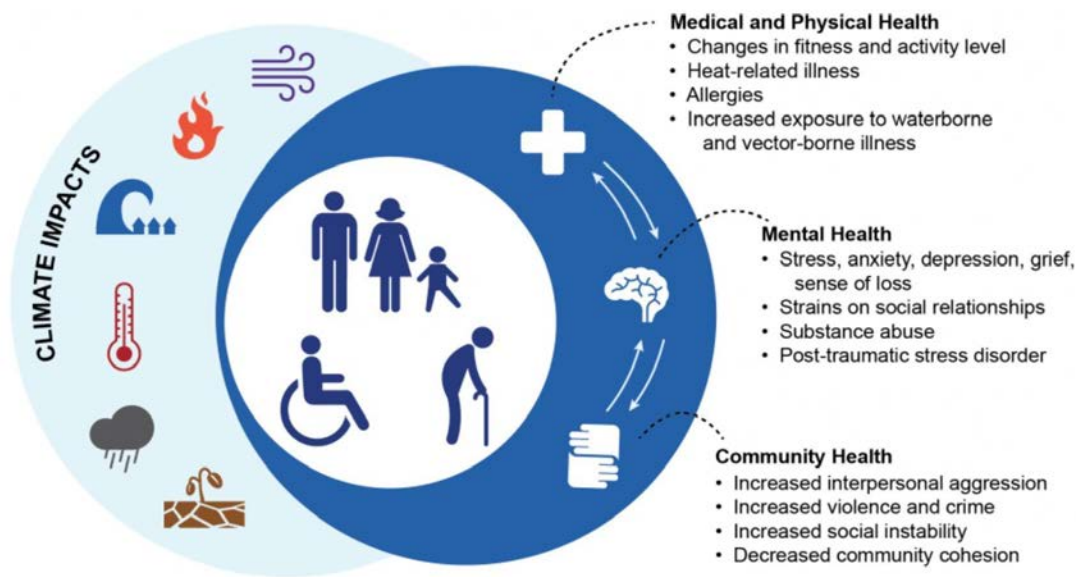
MORE INFO: [San Francisco Chronicle](#)

3G. Mental health will be negatively affected by higher temperatures, extreme weather events, sea level rise, drought and other shifts in our climate

Disasters and Mental Health

“The effects of global climate change on mental health and well-being are integral parts of the overall climate-related human health impacts. Mental health consequences of climate change range from minimal stress and distress symptoms to clinical disorders, such as anxiety, depression, post-traumatic stress, and suicide. Other consequences include effects on the everyday life, perceptions, and experiences of individuals and communities attempting to understand and respond appropriately to climate change and its implications. The mental health and well-being consequences of climate change related impacts rarely occur in isolation, but often interact with other social and environmental stressors. The interactive and cumulative nature of climate change effects on health, mental health, and well-being are critical factors in understanding the overall consequences of climate change on human health.”

MORE INFO: [Impacts of Climate Change on Public Health in the United States, U.S Global Change Research Program](#), pg. 21



MORE INFO: [Impacts of Climate Change on Public Health in the United States, U.S Global Change Research Program](#)

Climate change, anxiety, post-traumatic stress disorders, and depression

“These climate impacts have serious implications for mental health. Rates of depression, anxiety disorders, post-traumatic stress disorders (PTSD), substance abuse, and suicides are all expected to rise as the effects of climate change worsen. The effects will be felt most keenly among children, the poor, the elderly, and those with existing mental health conditions. Moreover, our current mental health system is woefully underprepared to deal with the scale and intensity of problems climate change is expected to bring.” Page 7

MORE INFO: [Climate Change, Health and Equity](#), pg 7

Extreme weather disasters and mental health

“Between 25 and 50 percent of all people exposed to an extreme weather disaster may have some adverse mental health effects, the degree of severity depending on a number of things, including the person’s age, coping capacity, and proximity to the devastation.”

MORE INFO: [Climate Change and Mental Health](#)

Communications loss can make isolation and mental health worse

“A significant power outage would impact communications. Without the ability to charge cell phones, residents will be less able to contact hospitals and clinics, family-members, and service-providers. Isolation from community exacerbates stress and mental health conditions.”

MORE INFO: [Climate and Health: Understanding the Risk](#), Page vi.

San Francisco residents and climate-related mental health issues

“All San Franciscans are at risk of increased sensitivity to mental health impacts before, during, and after hazard events. These impacts can be caused, triggered, or exacerbated by stress, isolation, or anxiety associated with hazard events.”

MORE INFO: [Climate and Health: Understanding the Risk](#), Page 15

Wildfires and mental health

Overseas studies demonstrate that large wildfires can be devastating, destroying not only lives but also livelihoods, homes and communities. This is strikingly illustrated by McFarlane et al., who looked at the mental health impact of bushfires in an Australian community. Twelve months after the fires, 42% of the population exposed to wildfires were classified as potential psychiatric cases (scored according to the General Health Questionnaire) – more than double that seen in the non-exposed population.

“A study of 357 patients who sought health care assistance (therefore not a random sample of exposed persons) after the 2003 California wildfires also gives a dramatic picture, with 33% showing symptoms of major depression and 24% showing symptoms of post-traumatic stress disorder. Property damage and physical injury during the fires were significantly – associated with psychopathology.”

MORE INFO: [Health Impacts of Wildfires](#)

Heat, drought, suicide, and migration

“Droughts are also often associated with prolonged exposure to warm, dry season. As above, it seems likely that exposure to heat can lead to increased rates of suicide attempts. Fourth, prolonged droughts can lead an individual to migrate to another region and/or pursue another vocation. This leads to acculturation stress which may further lead to suicide attempts in the farmer population.”

MORE INFO: [Mental Health Effects of Climate Change](#)

Mental illness among refugees

“The full scale of the mental health problem has only recently been recognized in Germany, where at least half of all refugees suffer from some form of definable mental illness according to a report by the Federal Chamber of Psychotherapists in September 2015. Of these, 40–50% suffer from post-traumatic stress disorder (PTSD) and 50% from depression, frequently both. One in five children suffers from PTSD.”

MORE INFO: [The Refugee Crisis Challenges National Health Care Systems](#)

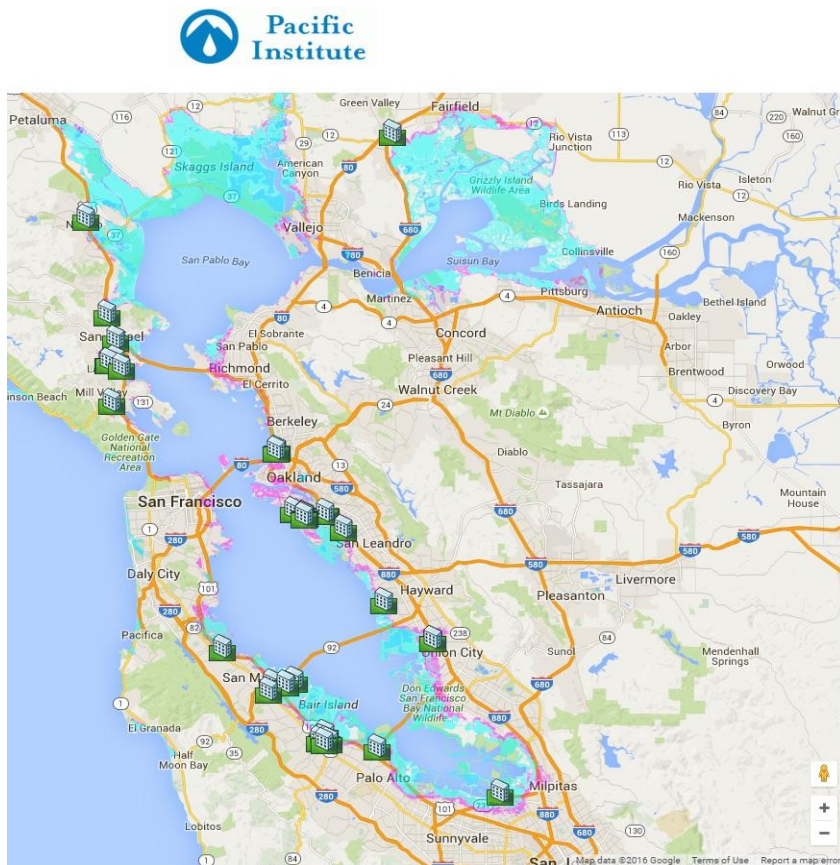
4. Climate Change Will Negatively Impact Systems On Which Our Health Depends

The infrastructure and systems that we depend on for our health and well-being will be affected by climate change, putting strains on physical and mental health. For example, access to healthcare facilities is essential for emergencies and existing health issues, but transportation networks may be flooded by extreme storms. Similarly, some drinking water supplies and food production sites will be negatively affected by climate change, creating community-wide climate/health emergencies.

Impacts on medical facilities

Extreme events will disrupt critical infrastructure--power, water, transportation, and communication--that are essential to the operations of medical and emergency services.

Healthcare facilities at risk due to sea level rise and erosion



SOURCE: [*Impacts of Sea Level Rise on the San Francisco Bay Area*](#)

Impacts on food production

Extreme weather (drought, heat, storms) in local and distant food-producing areas can increase prices, produce food shortages of important basic food items, and disrupt distribution systems. “Warmer temperatures may make crops grow more quickly, but warmer temperatures can also reduce yields. More extreme temperature and precipitation can prevent crops from growing. Extreme events, especially floods and droughts, can harm crops and reduce yields.”

MORE INFO: [Climate Impacts on Agriculture and Food Supply](#)

Impacts on biodiversity, ecosystems and health

Dry, parched Bay Area parks and open spaces will not be as attractive for healthy outdoor exercise. Loss of parks and space will reduce their cooling impact on urban heat islands. Breaks in natural ecosystems may cause outbreaks of rodents or other animals that pose health risks.

Impacts on the electricity grid (air conditioning)

Extreme weather can damage the electricity grid, leaving populations that are highly vulnerable to heat without air conditioning in their homes. “Since 1980, U.S. electricity demand has increased by more than 75%, with the largest increases in the residential and commercial sectors for space heating and cooling.” With rising temperatures and rapid population growth, the electricity demanded is only going to increase. This is a problem that is heightened in the Bay Area because we are not equipped with supplying residents excessive heating and cooling due to the fact that many buildings don’t use it.”

MORE INFO: [Climate, Extreme Heat and Electricity Demand in California](#)

Impacts on natural gas supplies (heating and cooking)

“The natural gas system in the Bay Area, the Delta, and the California coast is vulnerable to potential impacts of an extreme storm event coupled with sea level rise on natural gas pipelines. A recent study used high-resolution hydrodynamical modeling to investigate the dynamic impacts of SLR, tides, and freshwater flows (Radke et al., 2015). The research concludes that the Delta levees are nominally “prepared” for an extreme storm event (100-year event) inasmuch as modeling indicates no overtopping for a storm with 0 m SLR. But, if such a storm event were paired with a 1.4 m SLR, which is a possible high-end 2100 estimate for California, then the storm would pose extensive risk to critical natural gas infrastructure as well as other energy-related and transportation infrastructure.”

MORE INFO: [Safeguarding California Implementation Plans](#), pg 52

Impacts on transportation systems

“Transportation infrastructure is vulnerable to flooding under current conditions, and those risks will be greater in the future due to sea level rise. Under current conditions, we estimate that 800 miles of roadways and nearly 70 miles of railways along the San Francisco Bay are at risk of a 100-year flood event. A 1.0 m sea level rise will increase the risk of flooding dramatically, with

1,460 miles of roadways and 140 miles of railways at risk of flooding. With a 1.4 m sea level rise, 1,780 miles of roadways and 170 miles of railways will be at risk of flooding, more than doubling the current risk.”

MORE INFO: [Impacts of Sea Level Rise on San Francisco Bay, pg 12](#)

“As part of the ART (Adapting to Rising Tides) Subregional Project in Alameda County, transportation assets, including streets, roads, highways, light and heavy rail, bus routes, and bike/pedestrian ways were evaluated, demonstrating that ground transportation vulnerabilities could result in widespread consequences on local communities, the region, and beyond. Within the overall project area, three focus areas were selected for further planning because they were flagged as highly vulnerable during the assessment, and because critical regional transportation assets are interwoven with important regional and community assets, where solutions will need to be coordinated to achieve resilience.

- San Francisco – Oakland Bay Bridge Peninsula – Bay Bridge Touchdown Focus Area
- Oakland Coliseum Area – Coliseum Focus Area
- State Route 92 Corridor – Hayward Focus Area”

MORE INFO: [Adapting to Rising Tides: Bay Area Transportation Resilience](#)

“A power outage would impact transportation infrastructure. Residents dependent on MUNI or BART to get to health centers or pharmacies or access healthy food would be forced to find alternative methods of transportation.”

MORE INFO: [San Francisco Climate & Health Profile, Page vi.](#)

5. Climate Change Will Produce Increasing Numbers of Climate Refugees That May Impact Public Health and Health Services in the Bay Area.

Climate Change will produce substantial numbers of climate refugees

“Climate change is widely projected to cause substantial increases in the scale of human population movement in coming decades. Forecasts of the number of people who will move by around mid-century in response to the effects of climate change vary from tens of millions to 250 million people. The estimate by Myers (2002) that climate change will cause up to an additional 200 million “environmental refugees” by 2050 has become a widely accepted figure—although its empirical basis has been questioned (Brown 2008).”

MORE INFO: [Climate Change, Migration and Health](#)

Health Impacts from Refugees

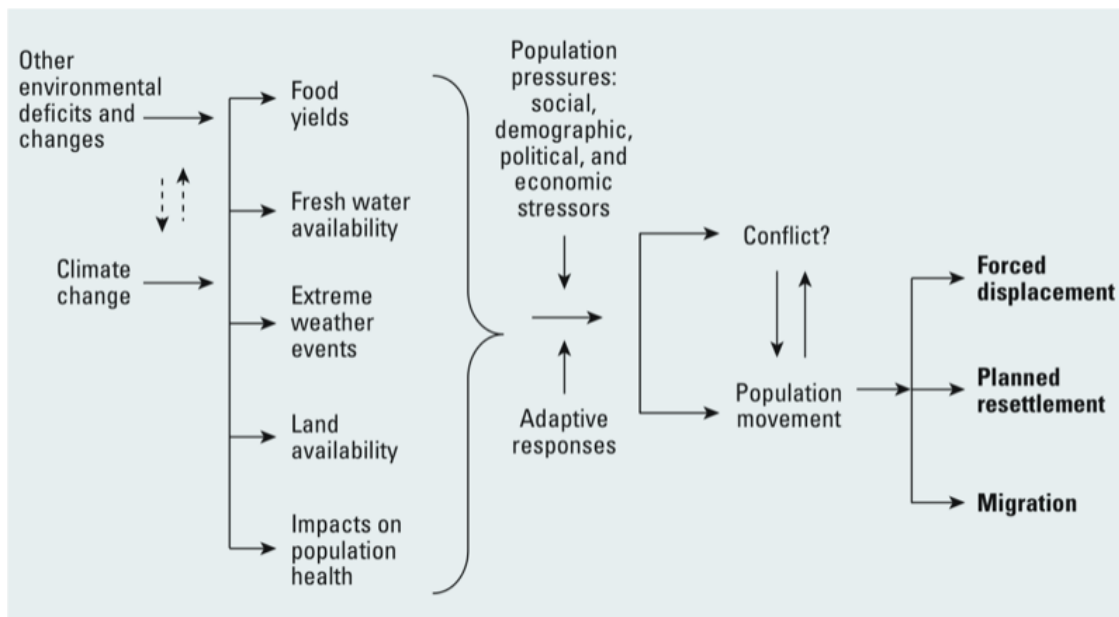
“Although the range and extent of health risks associated with future climate-related population movements cannot be clearly foreseen, the evidence of health outcomes of analogous movements

of people indicates that health risks will predominate over health benefits. This, then, is an issue of considerable geopolitical, ethical, and economic importance.”

MORE INFO: [Climate Change, Migration and Health](#)

“Climate-change-related migration is likely to result in adverse health outcomes, both for displaced and for host populations, particularly in situations of forced migration. However, where migration and other mobility are used as adaptive strategies, health risks are likely to be minimized, and in some cases there will be health gains. The health risks posed by climate-related population movements are likely to become a major source of human suffering, disability, and loss of life—an outcome that, currently, appears more likely than the much-debated possibility of increased violent conflict or state failure.”

MORE INFO: [Climate Change, Migration and Health](#)



MORE INFO: [All Ill Wind? Climate Change, Migration, and Health](#)

The International refugee crisis and climate change

“A climate refugee is a person displaced by climatically induced environmental disasters. Such disasters result from incremental and rapid ecological change, resulting in increased droughts, desertification, sea level rise, and the more frequent occurrence of extreme weather events such as hurricanes, cyclones, fires, mass flooding, and tornadoes. All this is causing mass global migration and border conflicts. For the first time, the Pentagon now considers climate change a national security risk and the term climate wars is being talked about in war-room like environments in Washington D.C.”

MORE INFO: [Climate Refugees](#)

National health systems challenged by the refugee crisis

“The refugee crisis challenges national health care systems. Countries accepting large numbers of refugees are struggling to meet their health care needs, which range from infectious to chronic diseases to mental illness.”

MORE INFO: [The Refugee Crisis](#)

“One aspect of the current refugee crisis that receives little media coverage is the health care need of refugees and migrants and the concomitant public health challenges faced by the various countries along their road to safety. The full health effects of the greatest mass migration since World War II will only become clear many years down the line.”

MORE INFO: [Refugees and health care](#)

The strain on housing supply

“At a recent meeting of the Sacramento Refugee Forum, a coalition of agencies working on resettlement, frustration over the situation was palpable. State Refugee Coordinator Sysvanh Kabkeo told the group that ‘it’s beyond my imagination’ how to find enough affordable, decent housing for the influx of refugees.”

MORE INFO: [Sacramento refugees](#)

Refugees bring many positive attributes including resilience

“Refugees never choose to leave their own countries. Amidst certain cataclysmic losses which refugees face (country, community, culture, livelihood, family, and material possessions among others), the United States is set to gain from refugees’ admirable resilience, rich cultural heritages, hardworking nature, resourcefulness and the fortitude they possess to press ahead in starting life anew.”

MORE INFO: [Refugee forum](#)

6. Climate Change Will Impact All Bay Area Residents’ Health, But Vulnerable Populations Will Be Hit Harder and Will Have a Tougher Time Recovering

Some Bay Area communities will be affected more than others

“Increases in the occurrence of heat extremes, more days with bad air quality due to higher temperatures, and possible spread of diseases will increase the threats to human health in the region. Not everyone will be equally vulnerable to these risks, however. Some segments of the population, especially those with pre-existing health conditions, the elderly, infants and children, socially isolated individuals, those not speaking English, and the poor are more sensitive than others, and/or may lack the ability to cope or prepare for such impacts.”

MORE INFO: [Climate Change Impacts, Vulnerabilities and Adaptation in SF Bay Area](#) page 11

“Although climate change impacts will affect all San Franciscans, not all San Franciscans will suffer the impacts evenly. Though exposure to climate conditions influences health related impacts, many other factors, such as physiology, ethnicity, infrastructure, behavior, and social and demographic characteristics can compound that risk. These factors can affect either the immediate exposure to climate related health impacts, the sensitivity of someone to a given exposure, and/or access to treatment. These risks often exacerbate pre-existing economic, racial, or social societal divisions. The socio-economic stratification of climate change impacts is known as the ‘Climate Gap’.”

MORE INFO: [San Francisco Climate & Health Profile](#), Page 11

“The urban poor are most vulnerable to climate change as its impacts amplify socioeconomic and racial disparities. The degree to which San Franciscans are impacted by climate change often depends on his-or-her age, race, income, language, educational attainment, housing conditions, and pre-existing physical conditions such as diabetes and mobility disabilities.”

MORE INFO: [San Francisco Climate & Health Profile](#), Page iv

“After analysis of environmental, demographic and socioeconomic infrastructure and individual pre-existing indicators, the profile concludes that there are certain neighborhoods in San Francisco that will be disproportionately affected by climate change: Chinatown & Downtown, Bayview Hunters Point, South of Market (SOMA), Excelsior, Crocker Amazon, Visitacion Valley and Treasure Island.”

MORE INFO: [San Francisco Climate & Health Profile](#), Page iv

“The following groups are mainly at risk of “classic” heat related illness: young children, the elderly, persons with pre-existing chronic diseases (e.g. respiratory, cardiovascular, diabetes) (Green, 2010), pregnant women (Basu et al., 2010), those who are socially isolated and those who have a disability. The elderly are at higher risk due to reduced ability to acclimatize to changing temperatures, for example reduced sweating, diminished thirst response even when dehydrated and higher likelihood of pre-existing chronic health conditions. Heat-related deaths have been shown to be greater for those with cardiovascular diseases, as well as for African-Americans, infants, children and the elderly (Basu and Ostro, 2008).”

MORE INFO: [Preparing California for Extreme Heat](#), pg 5

MORE INFO: [Association Between High Ambient Temperatures and Risk of Stillbirth in California](#)

Financial and organizational barriers exist in low-income communities

“For lower income individuals and communities, the challenges of responding and adapting to climate are even greater. Drought, flooding, fires, and heat waves all pose health, economic, and logistical challenges to disadvantaged communities that may lack the financial and organizational resources to respond to and recover from a disaster.”

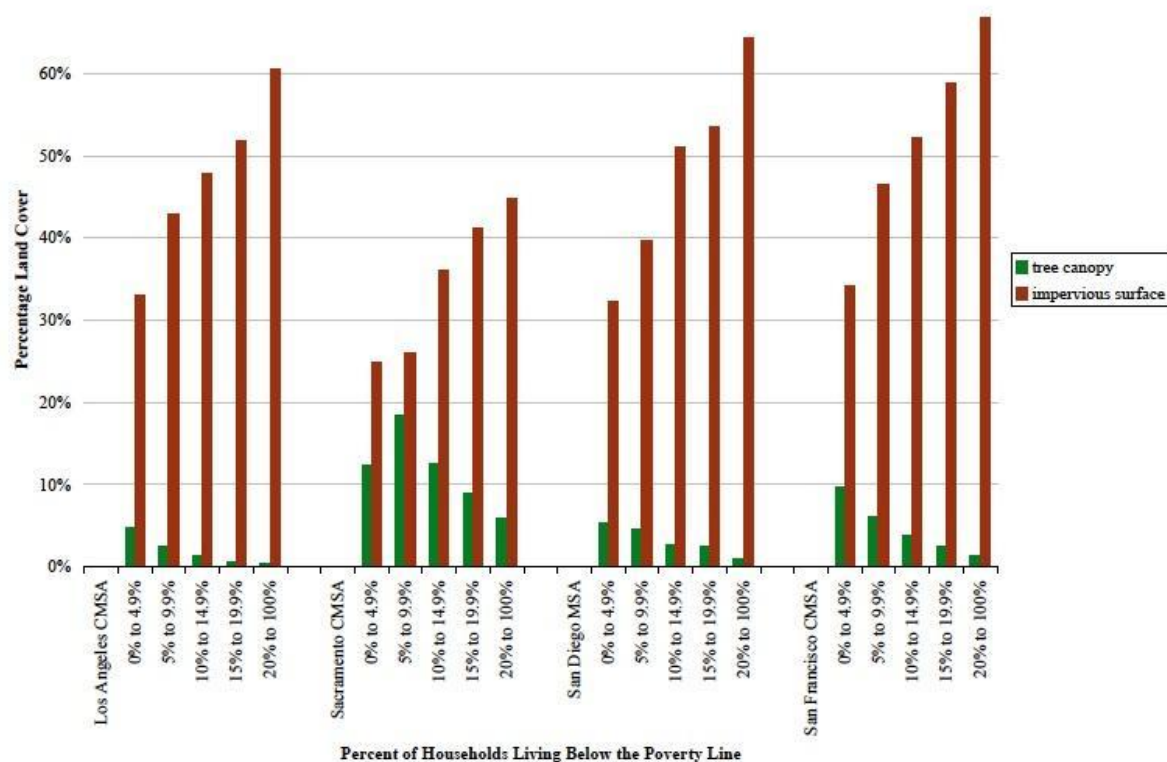
MORE INFO: [Safeguarding California Implementation Action Plans](#), pg 9

Urban heat islands are exacerbated in low-income neighborhoods

“Jerrett et al. (2012) also applied a previously developed method (Su et al. 2009) to quantify how regional environmental inequalities (represented by race and socioeconomic status) aligned with heat stress, air pollution, and adaptive capacity. This analysis aimed to expose any areas of social inequality. Very little inequality was found for heat stress, but more so for air pollution. Inequality was especially high in terms of the distribution of wealth and poverty as indicators of adaptive capacity. However, the strongest inequalities were found in the structural factors affecting people’s coping capacity, whereby poor and non-white populations tended to live in areas with less tree cover, more impervious surfaces, and lower levels of penetration of air conditioning. These three factors are related to a greater urban heat island effect aggravating regional heat extremes and lower capacity to cope with those extreme temperatures.”

MORE INFO: [Climate Change Impacts, Vulnerabilities and Adaptation in SF Bay Area](#) page 47

Land Cover and Poverty



MORE INFO: [Mapping Climate Change Exposures, Vulnerabilities and Adaptation to Public Health Risks in the San Francisco and Fresno Regions, 2012 Jerrett et al.](#) pg. 12

“The most intense urban heat island effects are often seen in neighborhoods where dense land use and impervious, paved surfaces predominate and trees, vegetation and parks are less common. Access to the cooling effects of urban greening and open space is often most

limited for low-income urban communities. Strategies that can reduce the urban heat island effect include increasing urban greening (such as trees, parks, gardens and green roofs), and using lighter-colored or cooler materials (such as porous pavements and cool roofs). Building insulation may also help by protecting the occupants from temperature extremes. These Strategies can make a significant difference in temperatures and health risks in urban areas.”

MORE INFO: [Preparing California for Extreme Heat](#), pg 5

Aging population = growing heat risk in the Bay Area

“Human vulnerability to future heat events in the developed world, including California, is projected to include a future population that is collectively much more heat vulnerable than at present. This is due to non-climatic factors such as an unprecedented rate of population that is aging. People who are age 65 and older are expected to more than double from 40 million to over 88 million, and will comprise 20% of the US population, and those over 85 are expected to triple to more than 19 million, while the whole US population is projected by the Census Bureau (Census 2010) to increase by around 41 % between 2010 and 2050. The elderly are most susceptible to heat and with a steady population over 65 years of age from 2000 through 2099, the increase in mortality due specifically to a warming climate is projected to be 1.9 times (San Francisco) to 7.5 times (San Diego) greater than current levels by the 2090s under the A1FI scenario. Demographic changes account for the largest relative increases in heat-related mortality in the most vulnerable age groups (Sheridan, et al. 2012).”

MORE INFO: [Safeguarding California Implementation Action Plans](#), pg 115

Outdoor workers at risk in the Bay Area

“For workers, exertional heat illness occurs across a wide age range and in numerous industries and occupations, including: agriculture, construction, firefighting, warehousing, delivery, and service work. Although a significant number of California workers have experienced severe heat related illness and death during heat waves in recent years, exertional work-related heat-illness is believed to be under-reported and not well captured by existing data systems.”

MORE INFO: [Preparing California for Extreme Heat](#), pg 8

People of color more likely to live near hazardous waste facilities

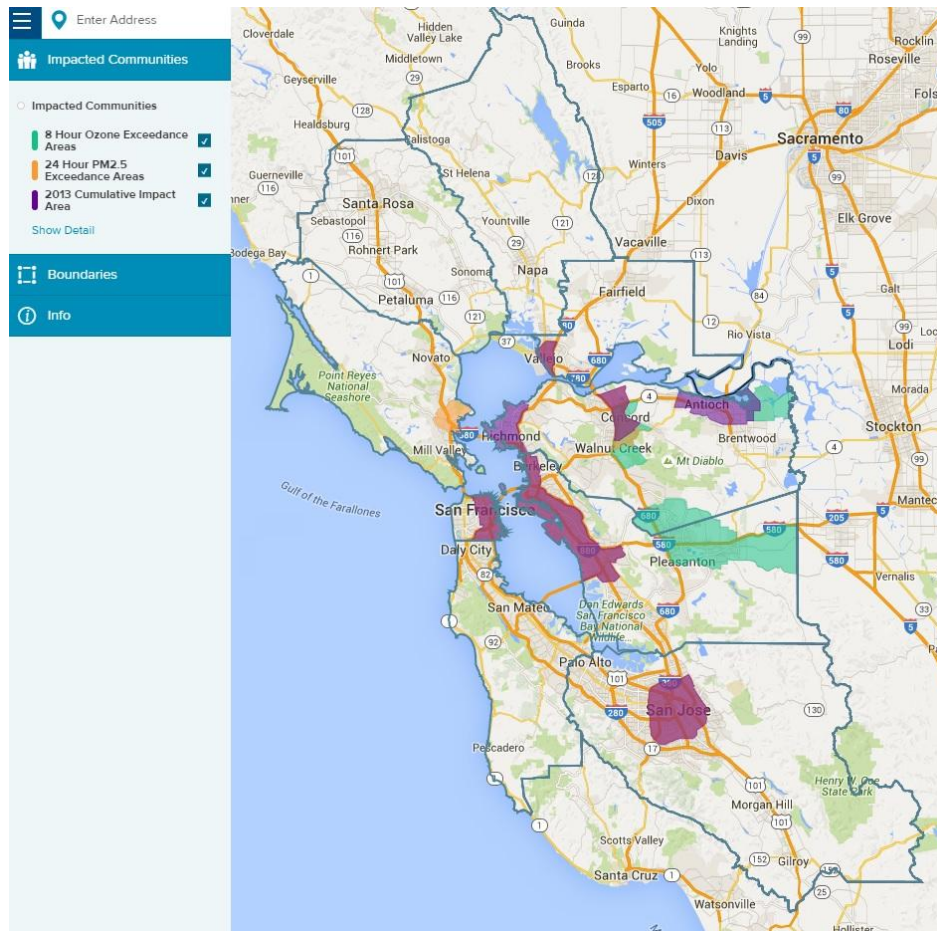
“In California as a whole, the population living within 3 kilometers (1.8 miles) of a commercial hazardous waste facility is disproportionately (81%) people of color compared to communities without such facilities (51% people of color). A national study (Bullard et al. 2007) concluded that ‘race continues to be an independent predictor of where hazardous wastes are located, and it is a stronger predictor than income, education, and other socioeconomic indicators’.”

MORE INFO: [Impacts of Sea Level Rise Along the California Coast](#), pg 50

Some Bay Area communities have higher air pollution levels

“While overall air pollution continues to decrease in the Bay Area, some communities still experience higher pollution levels than others.” The map below, from the Air District’s Community Air Risk Evaluation (CARE) Program, shows impacts communities for ozone and particulate matter (PM) 2.5.

MORE INFO: [BAAQMD CARE Program](#)



Lack of vehicles raises vulnerability during disasters

“While black and Latino households comprised 7% and 22% of California’s households in 2000, respectively, they comprised 13% and 32% of the households with no vehicle (U.S. Census Bureau 2000), and, people of color are also overrepresented among low-income Californians. Their higher rates of characteristics associated with vulnerabilities during the time of a disaster raise the possibility that communities of color and low-income people will be disproportionately affected.”

MORE INFO: [Impacts of Sea Level Rise Along the California Coast](#), pg 50

Job loss, food insecurity etc. from climate change

Climate-related loss of jobs will increase food insecurity, cause some individuals to lose their homes, and produce other life- and health-changing situations, particularly for low-income individuals.

“Extreme heat events could have devastating health consequences for farm workers, the backbone of California agriculture, who are employed at peak numbers during the hottest months of the year. Farm workers are generally economically vulnerable and often lack health insurance, further exacerbating their risks of exposure to extreme weather conditions.”

MORE INFO: calclimate.org

Climate change may increase Bay Area inequality

“Climate change poses immense challenges for achieving health equity because, while all people are impacted by climate, populations that are socially and economically vulnerable will bear a disproportionate burden. These communities already experience higher rates of chronic disease and lower life expectancy, and have fewer resources to plan and prepare for the additional impacts of climate change, presenting them with additional challenges for readiness, response and recovery. Health equity and environmental justice are therefore important goals in the state’s climate adaptation and resilience planning efforts.”

MORE INFO: [Safeguarding California 2014](#), pg 193

“Increased governmental spending on climate change infrastructure protection could directly affect low-income communities by diverting funds away from badly-needed improvements in education, social programs, public transportation, other critical sectors.”

MORE INFO: [Environmental Health and Equity Impacts from Climate Change and Mitigation Policies in California](#), Shonkoff et al, 2009, pg 12

7. Taking Action on Health and Climate: Key Reports & Web Sites

Introduction

Sections 1-6 of this document summarized key “evidence” for the important impacts of climate change on human health in the Bay Area.

Section 7 presents some very good news — that health experts from county health departments to the federal governments are increasingly turning their attention to climate-related health issues.

Two important caveats:

1. This section focuses on *reports, plans and web sites*. CRI does not have the resources at this time to identify and summarize all health/climate *actions* being taken by health departments and other agencies.
2. This section focuses on documents and web sites that *explicitly link health and climate*. We recognize that health departments and others are also taking actions to generally improve health, particularly among vulnerable communities, that will build resilience to climate impacts. For example, all efforts to improve living conditions in disadvantaged communities will help individuals to be more resilient to heat, drought and other climate impacts.

This is a “living document” that we invite you to improve and expand. Send your additions for Section 7 to CRI for inclusion in the next edition by emailing bruce@climatereadinessinstitute.org.

National

Impacts of Climate Change on Human Health in the United States — A Scientific Assessment

This excellent and comprehensive report was published by the U.S Global Change Research Program in 2016. Nine web-based chapters on specific health topics, a 24-page Executive Summary and the full report are available [here](#). The report includes a number of excellent graphics.

“The purpose of this assessment is to provide a comprehensive, evidence-based, and, where possible, quantitative estimation of observed and projected climate change related health impacts in the United States. The USGCRP Climate and Health Assessment has been developed to inform public health officials, urban and disaster response planners, decision makers, and other stakeholders within and outside of government who are interested in better understanding the risks climate change presents to human health.”

Centers for Disease Control and Prevention — Climate Ready States and Cities Initiative

This CDC web site describes how the federal CDC is working to support state, county and city health departments to investigate and prepare for climate change impacts on health.

“CDC’s [BRACE framework](#) (Building Resilience Against Climate Effects) provides guidance to states and cities to develop strategies and programs to confront the health implications of climate change. In approaching the health implications of climate change it is of paramount importance

to find ways to understand and incorporate complex atmospheric data and both short and long range climate projections into public health planning and response activities. Coupling atmospheric data and projections with epidemiologic analysis enables a jurisdiction to more effectively anticipate, prepare for and respond to a range of climate sensitive health impacts.”

US Climate & Health Alliance

The US Climate and Health Alliance is a national network of health and public health organizations and professionals dedicated to addressing the threats of climate change to health. The Alliance’s mission is to amplify the health voice on a wide range of issues related to climate change and health, and to advance climate solutions that benefit health and equity, at all levels of governance.

The Alliance works to:

- Advance efforts to mitigate climate change, while promoting and demonstrating the health benefits of reducing GHG emissions and building climate resilience;
- Build the capacity of medical, nursing, public health and community health students and professionals to take action on issues related to climate change and health;
- Integrate health and equity into climate solutions and policies;
- Support health professionals to advocate on climate mitigation, adaptation, preparedness, and resilience policies and programs;
- Educate the public and policy makers on the health threats of climate change and the health benefits of climate action;
- Promote healthy, equitable, and sustainable communities.

The US Climate and Health Alliance is an affiliate of the [Global Climate and Health Alliance](#) and partners with sister organizations in many other nations to advocate for effective action to promote healthy, equitable, and sustainable communities.

Climate Change, Health and Equity: Opportunities for Action

This 2015 60-page report by the Public Health Institute includes action recommendations for public health departments and other entities.

“Climate change and health inequities are the greatest global health threats of the 21st century. In this report, we explore the many ways in which climate change, health, and equity are connected. With input from more than a hundred public health professionals and community health, equity, and environmental justice advocates and support from The Kresge Foundation, we developed a conceptual framework to help us see how these issues are linked, and to identify opportunities and recommendations for action.”

Conveying the Human Implications of Climate Change: A Climate Change Communication Primer for Public Health Professionals

This excellent, 52-page report was written by Edward Maibach with Matthew Nisbet and Melinda Weathers.

“Fortunately, public health professionals have many opportunities to help the public and other decision-makers better understand the human implications of climate change, and to correct the misperception that climate change primarily harms the non-human world. Americans value good health and the well-being of their community members. We are positioned to explain how the rapidly emerging threats associated with climate change are connected with individual and community health. By communicating the potential of global climate change to harm human health in communities across America, and by conveying the potential to improve human health through actions that limit climate change, we can enhance public understanding of the full scope of the problem, and help enable appropriate responses by individuals and communities.”

Climate Change and Public Health Protection and Promotion Act

Comprehensive proposal, introduced in the U.S. Senate by Senator Ed Markey and in the House by Congresswoman Lois Capps, that includes information on what public health departments can do to be more prepared for climate change.

“To direct the Secretary of Health and Human Services to develop a national strategic action plan to assist health professionals in preparing for and responding to the public health effects of climate change, and for other purposes.”

The Health Impacts of Climate Change on Americans - The White House

This short summary, released in 2014, highlights key climate change impacts on health and outlines the key actions being taken by federal agencies to (a) protect health by cutting pollution and (b) support preparation for climate change impacts.

“While no single step can reverse the effects of climate change, we have a moral obligation to future generations to leave them a planet that is not irrevocably polluted and damaged. Through steady, responsible action to cut carbon pollution, we can protect our children’s health and begin to slow the effects of climate change so that we leave behind a cleaner, more stable environment. That is why, last year, President Obama put forward a Climate Action Plan to cut the carbon pollution that causes climate change and in turn affects public health. The Plan includes steps to cut carbon pollution, help prepare the United States for the impacts of climate change, and continue American leadership in international efforts to combat global climate change.”

U.S. EPA Climate Change & Health Web Site

The U.S. EPA has produced a summary of health impacts from climate change as part of their overall climate change site. The section includes graphics and references to science reports for more information.

“The severity of these health risks will depend on the ability of public health and safety systems to address or prepare for these changing threats, as well as factors such as an individual's behavior, age, gender, and economic status. Impacts will vary based on a where a person lives, how sensitive they are to health threats, how much they are exposed to climate change impacts, and how well they and their community are able to adapt to change.”

Why We Need Climate, Health and Equity in All Policies

A three-page 2014 commentary by Public Health Institute's Linda Rudolph and Solange Gould.

“Climate change, health equity, social and environmental justice, sustainability: These are each hugely important and complex issues in their own right. But we cannot afford to address them separately: The root causes are the same, the stakes too high, the need for action too urgent, and the opportunities for synergy too great.”

California

2009 California Climate Adaptation Strategy

The state's first comprehensive climate adaptation report includes a 15-page section on public health, led by the Department of Public Health, that outlines 9 strategies for addressing public health and climate issues in California.

“The Public Health Climate Change Adaptation Work Group, in concert with the Department of Public Health, has identified the following priorities for public health adaptation for climate change. The near- term actions referenced below are those identified actions which can be initiated by 2010 (contingent on available and sustained funding). The long-term actions include those recommended actions that will require support from the state and collaboration with multiple state agencies and are identified as cross- sector strategies.”

Safeguarding California: Reducing Climate Risk (2014)

The state's second comprehensive look at climate adaptation risks and strategies contains a 25-page chapter on Public Health that includes a section on “Highlights of Steps Taken to Date and Success Stories.”

“CDPH and others have worked to create linkages and find ways to integrate climate mitigation and climate adaptation into today’s health protection and health promotion programs at the state and local level in California.”

Safeguarding California: Implementation Action Plans (2015)

The state’s third major report on climate adaptation contains “implementation action plans” from 9 different sectors. The Public Health Sector plan is a 27-page summary that takes a broad look at current and needed actions to promote health and equity while adapting to climate change in California.

The implementation plan articulates how the State of California can integrate climate adaptation into its public health planning and work, as well as how the work of other state non-health agencies and departments can improve public health. It starts with a vulnerability assessment, then details current actions underway to promote health equity in climate change adaptation, then discusses gaps in current efforts and recommendations for action, including research needs. It concludes with possible indicators of vulnerability or resilience and indicators of actions taken and capacity built, to measure progress. The appendices include resources on vulnerability to health impacts of climate change, and a table comparing the vulnerability indicator metrics of seven different sources.

Preparing California for Extreme Heat: Guidance and Recommendations

Excellent 30-page report by the Climate Action Team’s Public Health Workgroup, co-chaired by Cal-EPA and the Department of Public Health.

“As the climate changes in California, extreme heat is projected to be a growing problem that will have health, economic, ecological, and social impacts. Actions taken by government agencies and other entities in the coming years could mitigate the effects of extreme heat and reduce resulting disabilities and deaths. This document provides guidance for incorporating extreme heat projections, based on current climate change models, into planning and decision making in California.”

Climate Change and Health Equity Program of the California Department of Public Health Office of Health Equity

The Climate Change and Health Equity Program (CCHEP) embeds health and equity in California climate change planning, and embeds climate change and equity in public health planning. CCHEP works with local, state, and national partners to assure that climate change mitigation and adaptation activities have beneficial effects on health while not exacerbating already existing unfair and preventable differences in health status of some groups (health inequities). CCHEP implements California’s climate change laws and executive orders, contributing health equity considerations.

Climate change creates significant and evolving challenges to human health and well-being. While climate change will touch everyone, some people are particularly vulnerable to its impacts, especially the very young, elderly, those with chronic diseases and disabilities, some communities of color, immigrants, people facing homelessness, tribal communities and nations, and those with limited resources. Climate change poses a variety of public health risks, including increased heat, wildfire smoke, drought, outdoor and indoor air quality, water quality, sea level rise, allergens, extreme weather events, flooding, workplace safety, infectious and vector borne diseases, limitations on health services, displacement, challenges to mental health, and food safety and food security.

Climate change and health inequities share similar root causes: the inequitable distribution of social, political, and economic power. These power imbalances result in systems (economic, transportation, land use, etc.) and conditions that drive both health inequities and greenhouse gas (GHG) emissions. As a result, we see communities with inequitable living conditions, such as low-income communities of color living in more polluted areas, facing climate change impacts that compound and exacerbate existing vulnerabilities. Fair and healthy climate action requires addressing the inequities that create and intensify community vulnerabilities, through strategically directing extra investments in improving living conditions for and with people facing disadvantage. The CCHEP provides health equity input into California's plans for transportation, housing, land use planning, and other systems that affect both health outcomes and vulnerability to climate change impacts.

Integrating Public Health Into Climate Action Planning

50-page document from the California Department of Public Health that provide guidance for local governments undertaking climate action planning.

“We provide a number of examples of strategies that integrate public health objectives, and health departments and community-based organizations that are making efforts to improve community health and reduce GHG emissions. The specific language a local jurisdiction develops for its climate plan's health policies should optimally be the result of conversations and long-term partnerships with health organizations that link and coordinate sustainable and healthy community efforts.”

CalBRACE: California Building Resilience Against Climate Effects

CalBRACE is project of the Climate Change and Health Equity Program at the California Department of Public Health. The purpose of the CalBRACE Project is to elevate health equity principles as an integral component of climate change adaptation planning, and to provide tools and leadership to help local health departments in California participate in multi-sector planning for the impacts of climate change. CalBRACE is responding to the reality that climate change is happening now, and some communities are bearing disproportionate health impacts. The

program seeks to improve living conditions of communities facing health inequities to reduce underlying vulnerability to climate change health impacts.

CalBRACE collaborates with other state health departments, California Department of Public Health programs, key public health and equity stakeholders, among others, to develop and implement effective climate adaptation and health strategies for California.

Outcomes and Activities:

- Developed Climate and Health Profile Reports for all 58 California Counties, forecasting climate impacts (i.e., extreme heat, sea level rise, wildfires, drought, and air quality) and health risks.
- Developed vulnerability assessment reports for 11 counties, which characterize locations and communities vulnerable to climate impacts with 22 indicators to assist in identifying and prioritizing effective strategies for local and state climate resilience (see list of indicators on next page).
- Provide technical assistance to 11 counties on adaptation planning with a health equity lens.
- Initiated a Public Health Community of Practice (forum) on communications and engagement for BRACE state grantees.
- Contributed to the *Safeguarding California: Implementation Action Plans* – Public Health Chapter, identifying priorities, vulnerabilities, and interventions to increase public health resilience and protect California’s people from health risks from climate change impacts.

Bay Area

[Climate Change Impacts, Vulnerabilities and Adaptation in the San Francisco Bay Area](#)

This 60-page report, produced in 2012 by Susanne Moser and Julie Ekstrom for the State of California, summarizes numerous scientific studies on the SF Bay Area includes a 6-page section on public health.

[Bay Area Regional Health Inequities Initiative - Climate Fact Sheets](#)

BARHII produced 5 “quick guides” on climate change, equity and health.

“To support the capacity-building of local health departments, the Built Environment Committee (BEC) has completed the development of a series of five short guides which include information on why climate change is a public health and equity issue, the environmental and health co-

benefits of climate change action, how to get involved in climate change action planning, and tangible steps to address climate change.”

Bay Area Sea Level Rise Programs (Web Sites)

There are a growing number of Bay Area projects to address flooding from sea level rise and extreme storm events and many of these projects are assessing risks to human health and to hospitals, public transit and other critical health-related infrastructure. Example projects include [BCDC’s Adapting to Rising Tides](#), [Sea Change San Mateo County](#), Silicon Valley 2.0 and [C-SMART](#) and [BayWAVE](#) in Marin County.

ABAG Resilience Program

The Association of Bay Area Governments’ Resilience Program runs a number of projects to protect community health and well-being from earthquakes, climate change and other major impacts. For example, *Stronger Housing, Safer Communities* focuses on housing and community vulnerability for flooding from sea level rise and seismic events.

9 Bay Area Counties

NOTE: The county-level information on the following pages is a STARTER LIST, the result of an initial web search supplemented by email inquiries to local health stakeholders. Please help to expand this section by emailing PDF’s and web links to bruce@climatereadinessinstitute.org.

ALAMEDA

Climate and Health Profile Report: Alameda County

This report, produced as part of the CalBRACE program by the California Department of Public Health and UC Davis, includes projections for Alameda County’s climate, describes links between climate and health, identifies vulnerable subgroups, outlines current Alameda County health conditions, and identifies strategies and action for adapting to climate change.

Immediate Health Effects of an Urban Wildfire

6-page summary of a study on health impacts from the 1991 Oakland-Berkeley Hills wildfire.

CONTRA COSTA

Climate and Health Profile Report: Contra Costa County

This report, produced as part of the CalBRACE program by the California Department of Public Health and UC Davis, includes projections for Contra Costa County’s climate, links between

climate and health, vulnerable subgroups in the population, current Contra Costa County health conditions, and strategies and action for adapting to climate change.

Climate Change Vulnerability in Contra Costa County: A Focus on Heat

This report looks at a variety of information by census tract to evaluate differences in the vulnerability of communities throughout the county. A comparison of census tracts based on several social, economic, medical, biological and environmental characteristics highlights important differences in how extreme heat will likely affect the health of residents. A combination of the factors in this report shows the following communities to be at the greatest health risk from extreme heat:

- ☐ West County – Richmond,
- ☐ San Pablo and North Richmond
- ☐ East County – Pittsburg, Bay Point and Antioch
- ☐ Concord’s Monument District
- ☐ Walnut Creek’s Rossmoor area
- ☐ Bethel Island

“This report is designed to provide potential partners with an overview of some of the major ways that climate change could impact health in Contra Costa County. It focuses on extreme heat, which poses major health threats associated with climate change, with a special emphasis on vulnerability and health equity. The goal is to stimulate further discussion, planning, collaboration and programs to reduce the impacts of climate change and build resilience in Contra Costa’s communities.”

Contra Costa County ART Project

BCDC’s Adapting to Rising Tides Program (ART) is convening and staffing an adaptation planning project in west and central Contra Costa County, from Richmond to Bay Point. Using the ART approach, staff and stakeholders are working together to understand how current and future coastal and riverine flooding will affect shoreline communities and infrastructure.

The project will investigate how flooding may impact transportation and utility networks, industrial facilities and employment sites, residential neighborhoods and community facilities, and shoreline park and recreation facilities. The consequences of flooding, both within and beyond the project area, will be considered, and in particular the potential for disproportionate impacts on certain community members.

Health Co-Benefits Analysis — Contra Costa County Climate Action Plan

The analysis qualitatively evaluated the greenhouse gas mitigation measures contained in the Climate Action plan against nine criteria of health co-benefits and identified which mitigation measures supported four priority health outcomes that could be supported by CAP implementation.

MARIN

Climate and Health Profile Report: Marin County

This report, produced as part of the CalBRACE program by the California Department of Public Health and UC Davis, includes projections for Marin County's climate, links between climate and health, vulnerable subgroups in the population, current Marin County health conditions, and strategies and action for adapting to climate change.

Marin County - Climate and Adaptation Web Site

Marin County released its Climate Action Plan in mid-2015. Health is mentioned throughout the report and [Chapter 8: Climate Change Adaptation](#) includes information on public health and climate impacts.

“Across California, health advocates and the CalBRACE program are quantifying the climate benefits of various health strategies by forecasting exposures and population vulnerabilities at a local/regional level, conducting a health risk assessment, assessing interventions, and developing an implementation plan. These efforts will contribute to making the public health system more prepared for the impacts of climate change. Marin Health and Human Services, local hospitals (including Marin General and Kaiser Permanente), and health centers could be the primary groups that may lead the implementation of the CalBRACE model in the county. Countywide plans may also include coordination with the Community Development Agency, senior living facilities, community service centers, and the California Department of Public Health.”

NAPA

Climate and Health Profile Report: Napa County

This report, produced as part of the CalBRACE program by the California Department of Public Health and UC Davis, includes projections for Napa County's climate, links between climate and health, vulnerable subgroups in the population, current Napa County health conditions, and strategies and action for adapting to climate change.

SAN FRANCISCO

San Francisco Climate and Health Program

Since 2010, the San Francisco Department of Public Health's Climate and Health Program has

assessed how climate change will impact San Francisco, connected climate impacts to health outcomes, and identified populations most vulnerable to those health outcomes. SFDPH has crafted interventions to help both vulnerable populations and the City prepare for the health outcomes of climate change, and engaged City and community partners to foster a culture of climate adaptation. Some examples of SPDPH's work include:

[San Francisco Climate & Health Profile](#)

This report summarizes many of the ways climate change is expected to impact San Francisco, which populations are most and least resilient to these impacts, and identifies neighborhoods where these populations live.

[Extreme Heat Vulnerability Assessment](#)

[Flood Health Vulnerability Assessment](#)

These two reports investigate and trace the pathways that link these specific climate impacts to health outcomes and vulnerable populations.

[Community Resiliency Indicator System](#)

[Flood Health Index](#)

[Heat Vulnerability Index](#)

These documents systematically compare the resiliency and vulnerability of San Francisco neighborhoods in order to allocate resources, plan interventions, and advocate for policies and programs.

[Extreme Heat Emergency Operations Plan](#)

[Flood Emergency Operations Plan.](#)

SFDPH worked with its City partners to develop emergency plans for heat and floods.

Public Engagement and Outreach

SFDPH has produced community engagement and outreach material, including the [San Francisco Flood Vulnerability Interactive Story Map](#), an [interactive website that explored the relationships between climate change and mold and respiratory illness](#), and [extreme heat training modules](#).

SAN MATEO

[San Mateo County Sea Level Rise Vulnerability Assessment](#)

Often referred to as “ground zero” for sea level rise, San Mateo County is one of the most vulnerable regions of the bay area. The County of San Mateo has initiated a sea level rise vulnerability assessment which is part of a long-term resilience strategy to ensure our communities, ecosystems, and economies are prepared for climate change. The goal of the assessment is to identify vulnerable assets on the bay and coast side of San Mateo County peninsula, determine types of impacts, issue initial recommendations on adaptation measures,

and improve flooding and sea level rise mapping.

The report will also include a section on health impacts of Sea Level Rise and social vulnerabilities among San Mateo County residents to sea level rise.

[Climate and Health Profile Report: San Mateo County](#)

This report, produced as part of the CalBRACE program by the California Department of Public Health and UC Davis, includes projections for San Mateo County's climate, links between climate and health, vulnerable subgroups in the population, current San Mateo County health conditions, and strategies and action for adapting to climate change.

[Get Healthy San Mateo County “Strategies for Building Healthy, Equitable Communities 2015-2020”](#)

Get Healthy San Mateo County works to create healthy, equitable communities by focusing on work that helps advance Place-based Primary Prevention, Health Equity, and Collaboration. Get Healthy San Mateo County is a local collaborative of community-based organizations, County agencies, cities, schools, and hospitals working together to advance policy change to prevent diseases and ensure everyone has equitable opportunities to live a long and healthy life. The collaborative is supported by staff at San Mateo County Health System's Health Policy and Planning Division.

One of the priorities for building healthy, equitable communities included in the [“Strategies for Building Healthy, Equitable Communities 2015-2020”](#) document is to create vibrant Complete Neighborhoods that make it easy for residents to be healthy in their everyday lives. Complete Neighborhoods promote healthy by creating opportunities for people to safely walk and bike to places for work, school, recreation and shopping on a daily basis as opposed to driving thereby increasing everyday physical activity. When people drive less, air pollution declines while slowing the negative impacts of climate change. In addition, A goal under the complete neighborhood priority is to have an “environment that is clean and communities are resilient to climate change.”

SANTA CLARA

[Climate and Health Profile Report: Santa Clara County](#)

This report, produced as part of the CalBRACE program by the California Department of Public Health and UC Davis, includes projections for Santa Clara County's climate, links between climate and health, vulnerable subgroups in the population, current Santa Clara County health conditions, and strategies and action for adapting to climate change.

[Silicon Valley 2.0 Climate Adaptation Guidebook](#)

Santa Clara County has produced a climate adaptation guidebook which includes a 14-page section on public health as part of the multi-year Silicon Valley 2.0 project.

“The Public Health asset sector includes three sub-focus areas: general populations, vulnerable population, and healthcare facilities and professionals located in Santa Clara County. This section presents a summary of vulnerabilities for public health assets in regards to changes in climate variables, which includes temperature change, precipitation change, extreme heat, wildfire, and sea level rise.”

[Santa Clara County Public Health Department: Priorities and Goals](#)

The Santa Clara County Public Health Department explicitly states that they will “advance racial and health equity to eliminate health disparities,” and one of the proposed actions to fulfill this goal is to “build county capacity and community awareness to mitigate and address climate change health effects.” The SCCPHD has created a working document to show the [strategic priority implementation plan](#) for their priorities and goals.

Santa Clara County held focus groups for the community to hear their concerns about climate change and their health. Attached is the [climate change focus group recruitment flyer](#), which were posted in the community. It is encouraging leaders in the community to voice their concerns.

SOLANO

[Climate and Health Profile Report: Solano County](#)

This report, produced as part of the CalBRACE program by the California Department of Public Health and UC Davis, includes projections for Solano County’s climate, links between climate and health, vulnerable subgroups in the population, current Solano County health conditions, and strategies and action for adapting to climate change.

[Solano County General Plan - Chapter 5: Public Health and Safety](#)

One of the major strategies in the Public Health and Safety chapter is “promoting development that works with nature to slow global climate change and its impact on nature and reduce human risks associated with environmental hazards, including hazards created or increased by climate change.” There are related plans, programs, and agencies mentioned in the chapter to implement the change needed to fight climate change and improve public health and safety.

SONOMA

Climate and Health Profile Report: Sonoma County

This report, produced as part of the CalBRACE program by the California Department of Public Health and UC Davis, includes projections for Sonoma County's climate, links between climate and health, vulnerable subgroups in the population, current Sonoma County health statuses, and strategies and action for adapting to climate change.

Climate Ready Sonoma County: Climate Hazards and Vulnerabilities

This assessment is an initial screening by the county to determine what is most threatened by climate change. The report highlights that public health is extremely vulnerable to climate change. Sonoma's response to their many vulnerabilities is to integrate, expand, and evaluate current efforts challenging climate change in order to adapt and mitigate effectively. These efforts will promote public health, safety and prosperity.

The Sonoma County Department of Health Services created the presentation titled, [Climate Change and Public Health](#). This presentation is a quick overview of the impacts that climate will have on health. It includes vector borne diseases, vulnerable populations, respiratory illnesses, and more.

8. Research Gaps: What Research is Needed to Better Understand Bay Area Climate/Health Issues and Actions Needed?

A working group of health/climate stakeholders convened in early 2016 by CRI and the Bay Area Regional Health Inequities Initiative (BARHII) proposed the following research topics as an initial "research needs list" for the Bay Area.

1. What interventions are *effective* for health/climate issues? (Not just another list of possible strategies.) What are the best roles for health departments in those strategies?
2. What does a Resilient Community look like for health? In practical terms, what does the future we want actually look like?
3. What are the health equity issues for various potential climate strategies for both GHG reduction and adaptation/resilience?
4. What are the likely mental health issues related to climate change in the Bay Area?

5. How can we get more and better information on health and vulnerable communities and provide it to decision-makers?
6. What are the biggest health-related “bang for the buck” strategies for urban heat islands?
7. What are the health impacts of (physical) displacement of individuals and families due to implementation of GHG reduction strategies (e.g., infill development/smart growth)?
8. What are the likely impacts on health of broader out-of-Bay Area climate changes that affect food supplies and prices?
9. What are the population shifts that will occur — climate refugees in California, nationally and globally— and how can we scale our health efforts to meet that increased volume?
10. What are the local, sub-regional climate projections for health strategy planning? What should a given county be prioritizing for action?
11. How will increased heat affect air pollution in various sub-regions of the Bay Area? Also, how will changing wintertime conditions (drought, low winds, etc.) affect air pollution?
12. How will climate change substantially affect *existing* health department programs?
13. What are the longer-term impacts of heat and drought on trees, soil moisture and other health-related natural systems?
14. What are the opportunities to generate health co-benefits from various climate adaptation and mitigation strategies?
15. What are the health impacts of extreme storms and other severe weather?