BURO HAPPOLD

West Hollywood Climate Action & Adaptation Plan

Climate Vulnerability Assessment

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00	First Draft	EA	4/2/20	SB
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Contents

1 Purpose

1.1 Introduction and Purpose

Climate vulnerability assessments (CVAs) are an integral part of adaptation planning. They allow communities to gain a baseline understanding of risks, identify the people and places most vulnerable to current and future impacts, and inform and prioritize adaptation strategies. To successfully understand a community's vulnerability, it is important to address exposure, sensitivity, and adaptive capacity at various geographic scales and across sub-populations. It is also important to consider current climate science and emission scenarios to understand how hazards may change over time.

The main purpose of this CVA is to identify the key vulnerabilities in the City of West Hollywood, in a way that optimizes the preparation of adaptation strategies. The CVA identifies these key vulnerabilities by utilizing State resources and tools such as the California Adaptation Planning Guide and Cal-Adapt. The CVA includes maps and graphics, which illustrate the proximity and scale of the risks across neighborhoods, populations, and critical infrastructure.

Key Terms

Vulnerability: Vulnerability is the degree to which a system or sub-population is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.[1]

Sensitivity: Sensitivity is the degree to which a system or sub-population is affected, either adversely or beneficially, by climate-related stimuli. Climate-related stimuli encompass all the elements of climate change, including mean climate characteristics, climate variability, and the frequency and magnitude of extremes. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise).[2]

Exposure: The nature and degree to which a system or sub-population is exposed to significant climatic variations.[3]

Adaptive capacity: Adaptive capacity is the ability of a system or sub-population to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.[4]

[1] IPCC AR4, 2007

[2] IPCC AR4, 2007

[3] IPCC AR4, 2007

[4] IPCC AR4, 2007

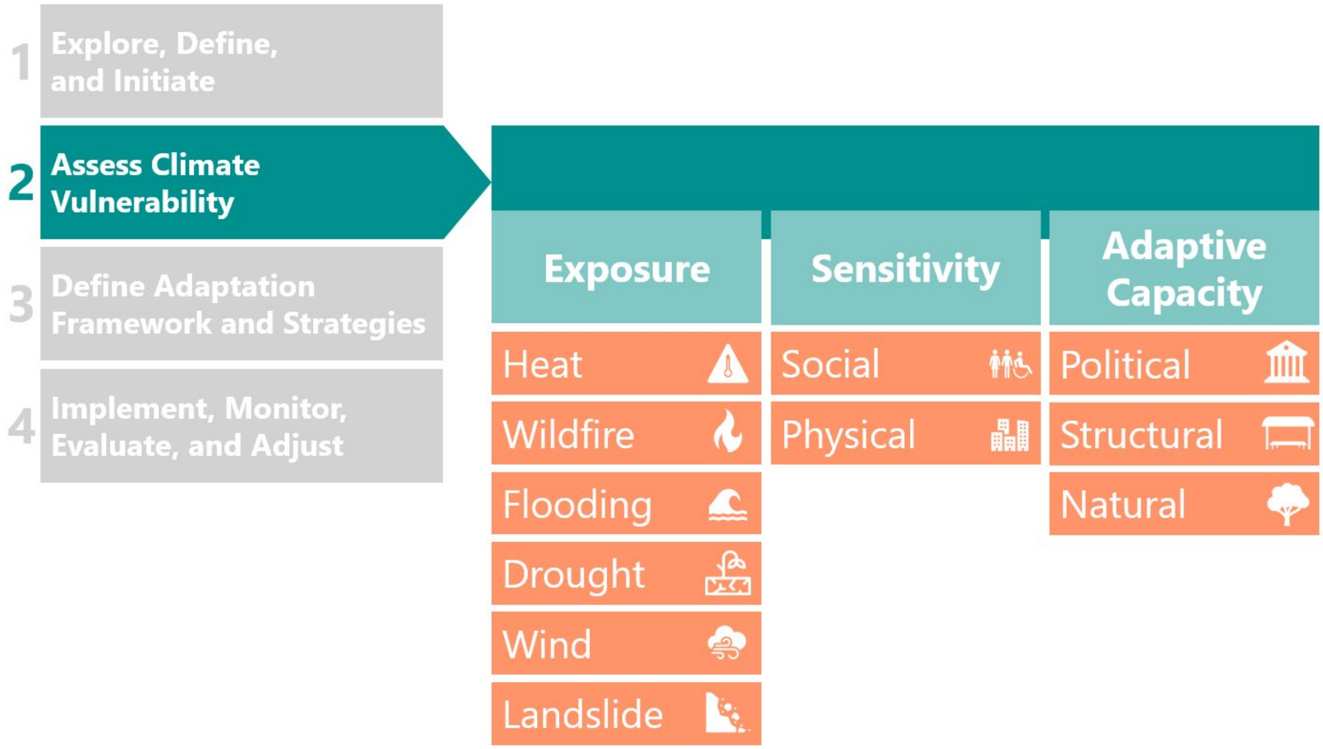

Figure 1. Phases of the Adaptation Planning Process [5]

[5] California Governor's Office of Emergency Services (Cal OES) Adaptation Planning Guide

2 Exposure

To understand a community's exposure to climate change, it is pertinent to discuss historic events, current conditions, and future projections. Changes in key **climate variables like temperature, precipitation, and wind** drive variations in frequency and severity of specific climate exposures. These key variables are highlighted below and related to specific exposures via Table 1. This table also includes the City's current ranking of priority for these (climate-related) exposures. The ranking is based off of a weighted index called the Critical Priority Risk Index (CPRI), which considers four factors: probability, magnitude/severity, warning time, and duration. Each one of these factors is assigned a value of 1 to 4, with higher numbers indicating greater risk. Since the CPRI is weighted, hazards can have final scores ranging between 1 and 4. The CPRI heavily weighs probability at 45% of the final score, magnitude/severity comes next at 30%, followed by warning time at 15%, and duration accounts for the final 10%. The CPRI is utilized by the city's planning team when discussing and planning for hazards.

It is important to note that the severity and pace of climate change may be mitigated by efforts to curb greenhouse gas emissions today. Because of this, the CVA considers two different **representative concentration pathways (RCPs),** which illustrate varying severities of future climate change (Figure 2). RCP 4.5 simulates a pathway in which emissions will peak around mid-century and then begin to decline. Under this scenario, concentrations of atmospheric carbon dioxide equivalent (CO_2e) are projected to reach somewhere between 580 and 720 parts per million (ppm). At minimum, this is a 40% increase from today's concentration of 407.4 ppm, but broadly represents the "low emissions scenario." Comparatively, RCP 8.5 illustrates a scenario in which emissions peak and plateau around 2100. In this scenario, concentrations may surpass 1000 ppm of CO_2e and global temperatures could increase as much as 4 degrees Celsius above 21st century historic averages. This is referred to as the "high emissions scenario."

Climate models can take into account different RCPs in order to predict how climate variables will change in specific regions under certain scenarios. However, there are many global climate models currently available, and it is difficult to synthesize findings and projections from all of them. For this reason, the CVA considers **four priority climate models:** HadGEM2-ES (warm/dry scenario), CNRM-CM5 (cool/wet scenario), CanESM2 (average scenario), and MIROC5 (complement scenario). These four models were selected by the California's Climate Action Team (CAT) Research Working Group as ideal for assessing future projections in California. CAT and its 11 subgroups consist of various governmental agencies and are tasked with assessing and ensuring progress toward the state's GHG targets.

Key Climate Variables

Air temperature *affects health, agriculture, energy demand and much more. Extremes of surface air temperature are particularly important for human health, especially during prolonged periods of exposure.*[6]

Precipitation *can impact humans and natural systems through its duration, intensity, frequency, or its lack of occurrence. Precipitation patterns influence water supply, and can contribute or cause risks such as floods, landslides, wildfires and droughts.*[7]

Winds *are a critical component of ocean circulation and thus are responsible for much of the global movements of heat and carbon. Extreme winds have severe social and economic impacts, and can lead to loss of human life, damage to ecosystems, and the destruction of infrastructure.*[8]

[6] The Global Climate Observing System (GCOS)

[7] The Global Climate Observing System (GCOS)

[8] The Global Climate Observing System (GCOS)

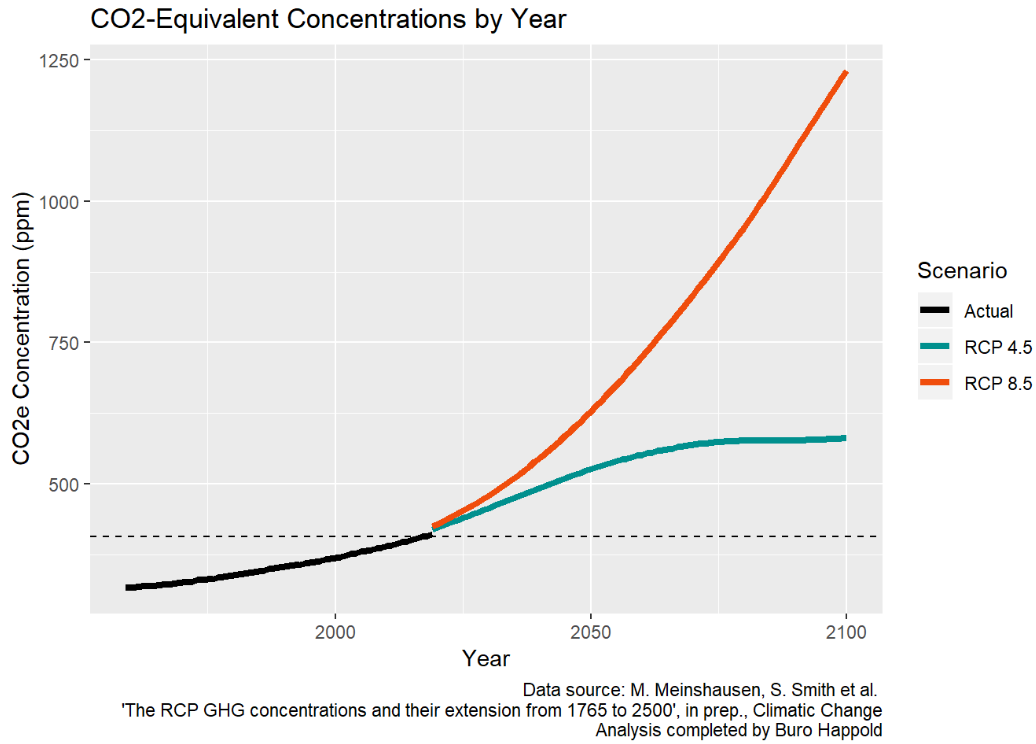

Figure 2. Projected CO2e concentrations by emission scenario (RCP 4.5 and RCP8.5)

Table 1. Exposures and Climate Variables

Exposure	**Related Climate Variables**	**Exposure's Future Direction of Change (State-wide)**	**Impact on West Hollywood (CPRI)**[9]
Extreme Heat	Temperature	Warming	2.05
Wildfires	Temperature, Precipitation, Winds	Increasing	2.6
Flooding	Precipitation, Extreme Rain Events	Precipitation is unknown, extreme events increasing	2.1
Drought	Temperature and Precipitation	Increasing	2.05
High Winds and Straight-Line Winds	Winds	Unknown	3
Landslides	Temperature and Precipitation	Increasing	2.2

[9] West Hollywood LHMP

2.1 Extreme Heat

Globally, temperatures have steadily increased since the 1950s, with five of the hottest years on record occurring in the last six years. Changes in air temperature will increase the occurrence of extreme heat, heat waves, warm nights, drought, and wildfires. When populations are exposed to extreme temperatures, **heat stress can lead to broader welfare and economic impacts** (summarized in Figure 3). This includes heat illnesses such as heat stroke, heat exhaustion, heat fatigue, and heat cramps. Heat waves have also been shown to contribute to increased mortality rates.[10] Extreme heat is the leading cause of weather-related deaths within the US, accounting for over a quarter of weather-related fatalities since 1990. During a 2006 California heat wave, mortality rates increased by 5% across the state, with a 12% increase in at-home deaths.[11] In that same heat wave, the south coast region experienced a 5.6% increase in hospitalizations during peak heat-wave days.[12] These impacts are magnified in cities due to the urban heat island effect. Average temperatures in large cities can be as much as 3 degrees Celsius hotter than their rural counterparts. This is especially important for vulnerable populations like children, older adults, the uninsured, and outdoor workers. Secondary health impacts associated with extreme heat include higher pollution concentrations and changes in distribution and prevalence of vector-borne diseases (like West Nile Virus).

Productivity and labor supply have been shown to suffer during hot days, eventually leading to **lags in economic development**. Excessive heat has also been linked to worse student performances on exams and general decline in cognitive functions.[13] These effects have been most pronounced in regions where access to adaptive technology (for example AC) is lacking. Extreme heat can lead to various other issues including increased energy demands, higher emissions, and overloading of healthcare systems. [14]

It is useful to examine annual averages for maximum and minimum temperatures. These numbers represent general shifts in temperature for a region and contribute to increases in extreme heat. In West Hollywood, annual average maximum temperature between 1961 and 1990 was 72.0 degrees Fahrenheit. This observed historic temperature is quite comparable to the County-wide average of 72.5 degrees during that same period. In West Hollywood, both **annual average maximum temperatures and minimum temperatures** are projected to rise through mid-century and late-century time periods (Figure 4). Annual average maximum temperature is expected to increase by 3.9 to 5.4 degrees Fahrenheit by mid-century and 4.8 to 7.5 by late century. Similarly, annual average minimum temperatures are expected to increase by 3.7 to 5.2 degrees Fahrenheit by mid-century and 4.6 to 7.6 by late-century.

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[10] Kovats, R.S., & Hajat, S. 2008. Heat Stress and Public Health: A Critical Review. Annu. Rev. Public Health. 29, 41–55.

[11] Joe, Lauren et al., 2016. Mortality during a Large-Scale Heat Wave by Place, Demographic Group, Internal and External Causes of Death, and Building Climate Zone. Int. J. Environ. Res. Public Health 2016, 13, 299; doi:10.3390/ijerph13030299

[12] Knowlton K, Rotkin-Ellman M, King G, Margolis HG, Smith D, Solomon G, et al. The 2006 California heat wave: impacts on hospitalizations and emergency department visits. Environ Health Perspect. 2009;117(1):61–7.

[13] Heal, G., and Park, J. 2013. Feeling the heat: Temperature, physiology & the wealth of nations, National Bureau of Economic Research.

[14] Heat Adaptation Workgroup, a subcommittee of the Public Health Workgroup. 2013. California Climate Action Team, Preparing California For Extreme Heat: Guidance and Recommendations. California Climate Action Team.

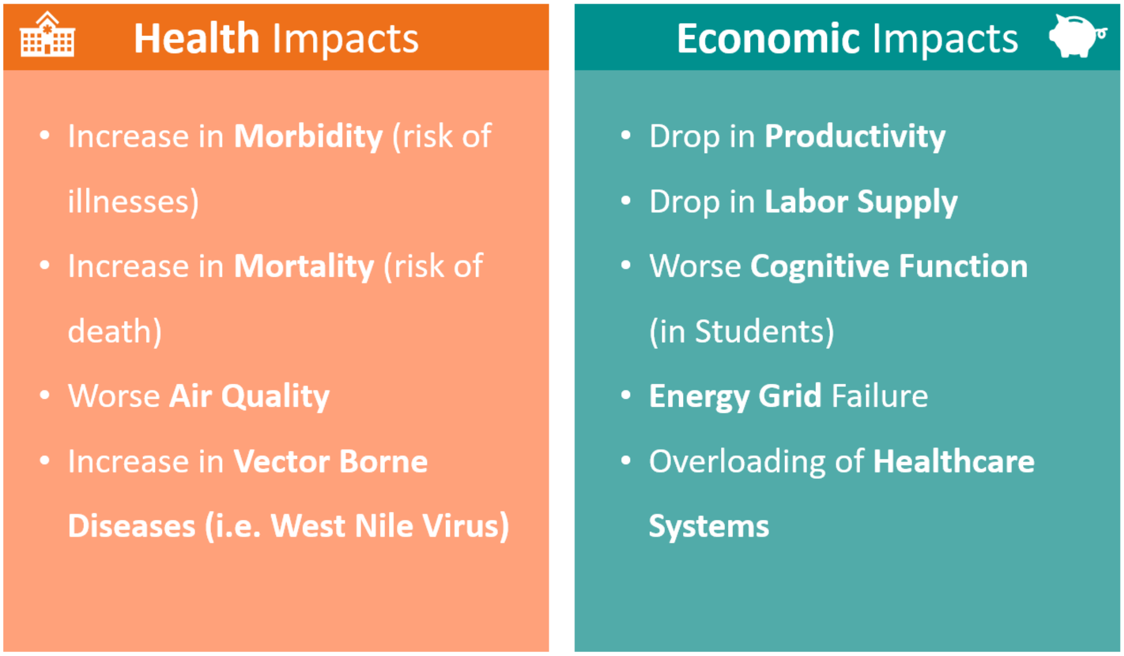

Figure 3. Summary of potential health and economic impacts of heat stress

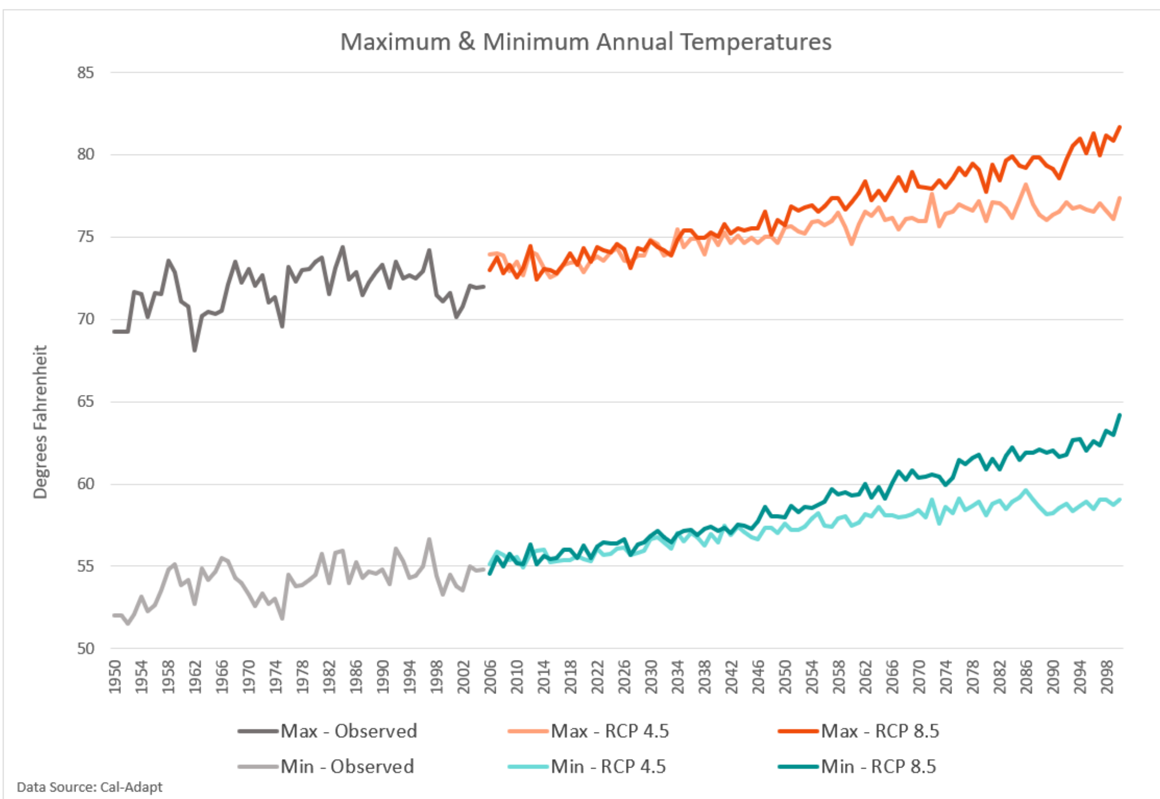

Figure 4. Annual average maximum and minimum temperature trends in West Hollywood. Trends are depicted for both RCP 4.5 and RCP 8.5 with distinctions between observed historical temperatures and modelled projections. Both maximum and minimum annual average temperatures are expected to increase in the city relative to historical observed values.
Data source: Cal-Adapt.

The frequency of **extreme heat days** is projected to increase in the region (Figure 5). In this instance, heat days are defined as days where the temperature breaches 90 degrees Fahrenheit. This threshold was set because cooling centers open up in West Hollywood at 90 degrees Fahrenheit. Historically, West Hollywood has averaged about 9 extreme heat days per year. Under RCP 4.5 this number is projected to rise to 15 events annually by mid-century (2040-69) and 20 by late-century (2070-99). Under RCP 8.5 this number rises to 21 events annually by mid-century (2040-69) and 39 by late-century (2070-99). Extreme heat days are not only expected to increase in frequency and severity but also duration. When four or more consecutive days have maximum temperatures above the 98th percentile threshold (92.8 degrees) they are considered a heat wave. Under a high-emissions scenario, annual average heat wave frequency will increase by ten-fold.

When **warm nights** follow hot days, heat related consequences are exacerbated. The body receives no respite from heat stress, and a restful night of sleep becomes less likely. In particular, warm nights have been associated with increases in strokes and increased risk to persons with chronic ischemic diseases (such as coronary heart disease).[15] In West Hollywood, the frequency of warm nights is projected to increase quite significantly (Figure 6). The 98th percentile threshold for warm nights is 68.3 degrees Fahrenheit and historically the region has averaged 4.3 per year. Under a low emissions scenario, this number is projected to rise to 19 events annually by mid-century (2040-69) and 28 by late-century (2070-99). Under a high emissions scenario this number will rise to 33 events annually by mid-century (2040-69) and 70 by late-century (2070-99). Even in the lower emissions scenario this marks a 375% increase in frequency by mid-century. Warm nights are not only expected to increase in frequency and severity but also duration. Under a worst-case scenario, duration of consecutive warm nights in the late century period will increase by ten-fold.

[15] Murage, Peninah & Hajat, Shakoor & Kovats, Sari. (2017). Effect of night-time temperatures on cause and age-specific mortality in London. Environmental Epidemiology. 1. 1. 10.1097/EE9.0000000000000005.

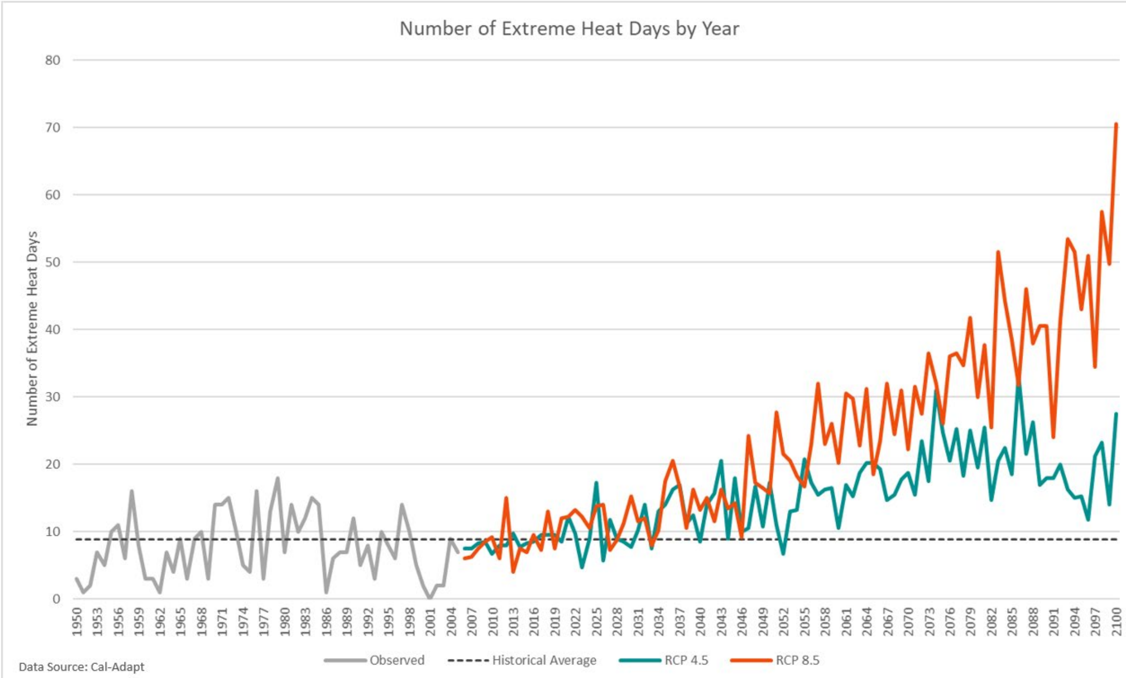

Figure 5. This graph depicts the number of extreme heat days in West Hollywood under both emission scenarios with observed historical numbers for reference. The threshold for an extreme heat day is 90 degrees Fahrenheit.
Data source: Cal-Adapt.

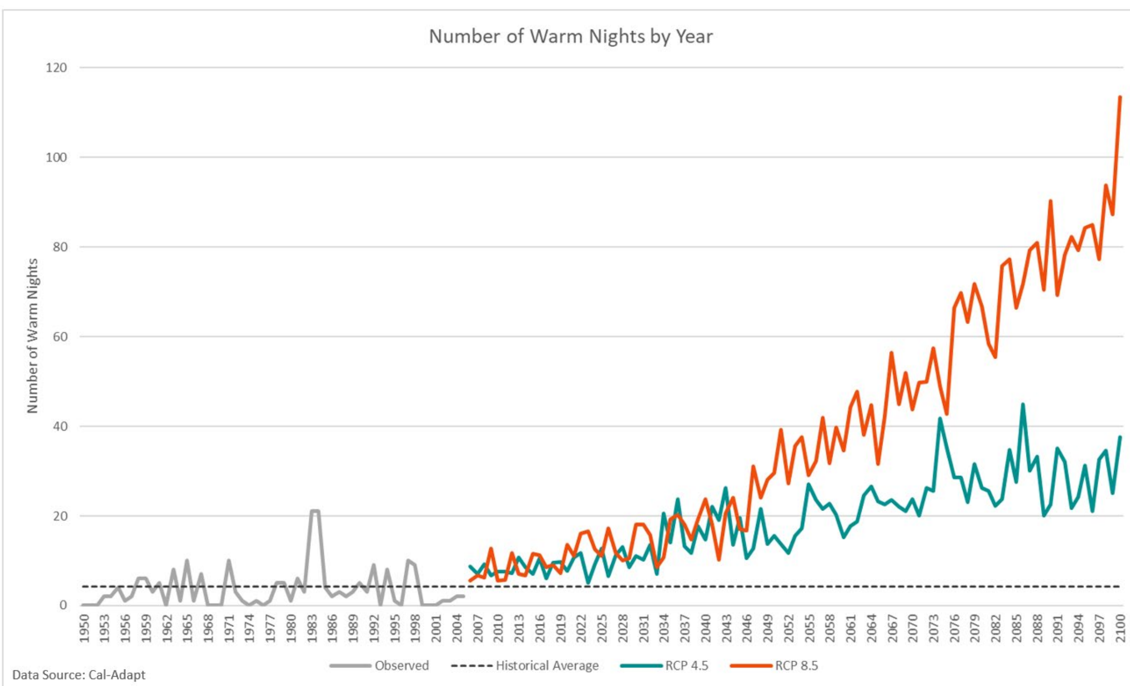

Figure 6. This graph depicts the number of warm nights in West Hollywood under both emission scenarios with observed historical numbers for reference.
Data source: Cal-Adapt.

2.2 Flooding and Storms

In Southern California, precipitation levels are largely dependent on weather patterns over the Pacific Ocean with irregular weather patterns like El Niño (which is an abnormally warm phase of the El Niño–Southern Oscillation and is associated with increased rainfall in Southern California) contributing to larger variability from year to year. While there is no state-wide discernible trend for precipitation levels, variability has increased since 1980.[16]

In the Los Angeles County region, about half of the year's annual rainfall occurs during five storms.[17] The frequency of these events still relies on large-scale weather patterns; however, some local topographies can increase their likelihood.[18] The increase in the variability of extreme dry or wet years—also known as "precipitation whiplash"—make it difficult to rely on historical means to predict a year's precipitation rate, and trend.[19] Extreme wet years are projected to increase 2.5 times by 2100, with severe storms being five times more likely to occur.[20]

These predictions hold true for the City of West Hollywood, where annual average precipitation is expected to remain quite similar in to late-century periods under both scenarios. However, when breaking down precipitation projections into 30-year averages, a revealing pattern emerges. While average precipitation remains similar, minimum precipitation is expected to decline, and maximum precipitation will increase by at least 46.8% (Figure 7).

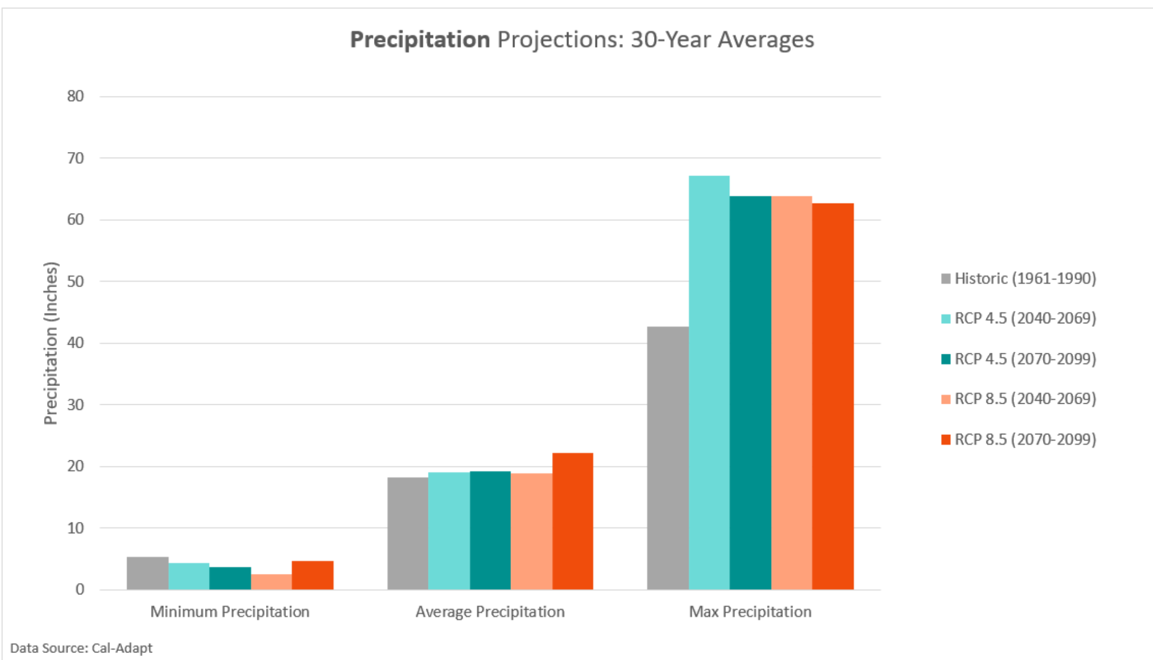

Figure 7. Annual average precipitation projections for West Hollywood using 30-year averages.

Data source: Cal-Adapt

[16] CalEPA, 2018

[17] California LA Regional Climate Assessment

[18] CalEPA 2018

[19] California LA Regional Climate Assessment; CalEPA 2018

[20] UCLA IOES

This projection indicates that the City of West Hollywood will likely experience both an increase in the severity of wet years and an increase in the severity of dry years, resulting in more precipitation **whiplash events**. These whiplash events are particularly important in that they contribute to and intensify various other climate hazards. When dry years are followed by very wet years, mudslides and landslides are more likely to occur. This is due to declines in vegetation during the dry years which otherwise offer soil stabilization. When wet years are followed by dry years, wildfires are much more likely. This is because the wet years allow a lot of new vegetation to grow, but it eventually dries out in the drought period – leading to increases in fuel sources for fire (Figure 8).

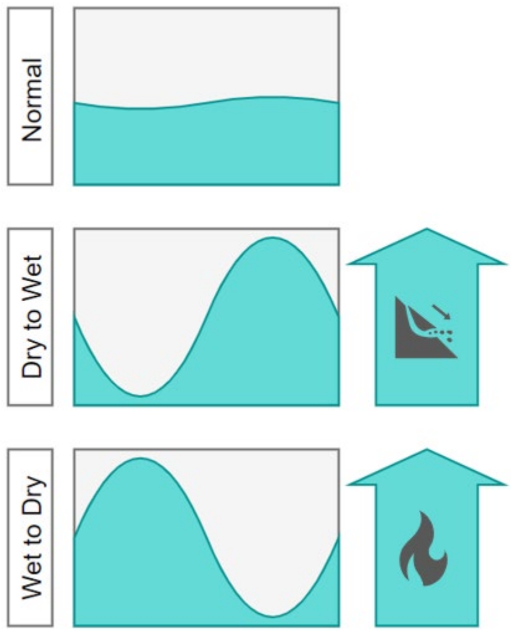

Figure 8. Illustration of whiplash events and their contribution to hazards

Atmospheric rivers (narrow corridors of concentrated moisture in the atmosphere) are largely responsible for precipitation patterns across the southern California region, and coupled with topographical influences, can create intense storms.[21] Cal-Adapt climate projections predict that the likelihood and duration of atmospheric rivers will increase, leading to increased likelihoods of flood events.[22]

The Los Angeles Basin, of which West Hollywood is a part, has historically experienced flooding during major winter storm events. West Hollywood is situated at the base of the mountains with steep narrow canyons that drain into the City. However, it is situated on relatively high ground and does not have any major waterways that are prone to flood hazards. There have not been major flood events in the City's history and predictions for future events are limited. No area of the City is within a federally mandated flood zone, although a small south-eastern portion of city is considered to have mild flood risk at 0.2%

[21] California LA Regional Climate Assessment

[22] California LA Regional Climate Assessment

annual chance of flood hazard, which can be seen in Figure 9. Localized flooding is the greatest flooding concern for West Hollywood. The base of the Hollywood Hills experiences flooding during storm events due to street grade.[23] Additionally, low topographical areas may experience flooding during larger rain events.

Predictions for extreme weather events show that no major trend changes are expected under either scenario. However, as noted above for patterns in precipitation, whiplash events are expected to increase. When years with elevated numbers of extreme rain events follow dry years, the likelihood and severity of mudslides and flooding increases. This is largely due to reductions in vegetation during dry years, which otherwise stabilize soil. Conversely, dry years that follow upticks in extreme rain events can lead to wildfires. This is due to increased presence of fuel sources for wildfire in the form of dry vegetation.

West Hollywood has several areas in which the water table is high, particularly the south western portion of the city (Figure 10). [24] This can lead to several different impacts including basement flooding, the need for dewatering during construction, and oversaturation. Basement flooding occurs when the basement or subterranean area is not flood-proofed, or the water table is recharged to a level that brings water into basements. Dewatering is a process that decreases the water table level to allow for dry soil conditions for construction (temporary) or to allow for the utilization of basement space (permanent). The process involves treating the water (so it complies with water standards) and then using a pump to remove it from the identified area, either to a drainage area where it reenters the ground or is removed via stormwater drains. Dewatering in West Hollywood has raised concerns about lowering the water table enough to harm vegetation and trees, as well as posing the question of whether dewatered groundwater should be reused onsite. After heavy rainstorms, the ground can become oversaturated more easily. This can increase seepage into subterranean areas and bring the water table higher than its normal level.

[23] West Hollywood LHMP

[24] West Hollywood Environmental Impact Report (EIR) for the General Plan and Climate Action Plan (2010)

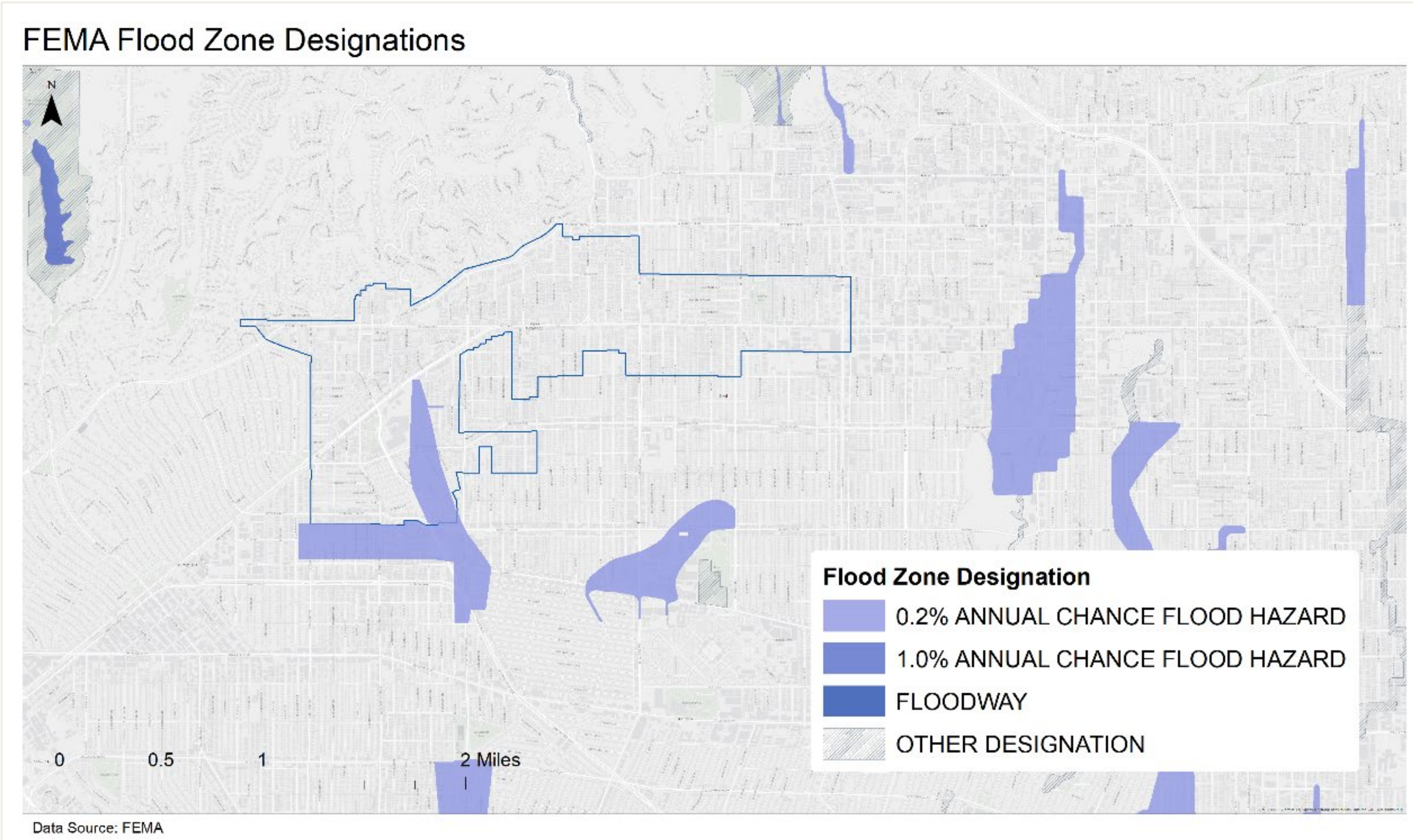

Figure 9. FEMA Flood Zones in West Hollywood

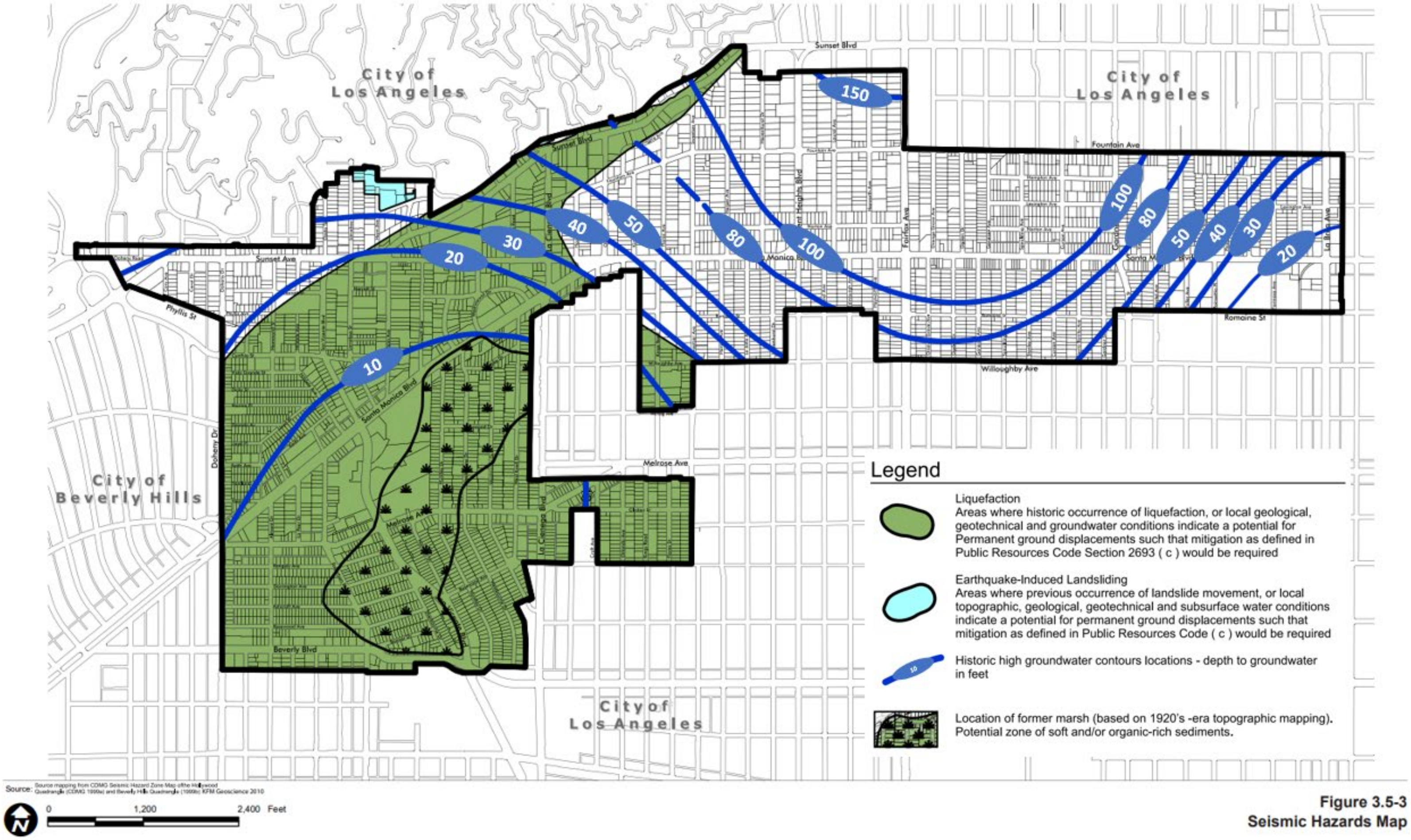

Figure 10. A map depicting the historic high groundwater contours (in blue) with depth to groundwater in feet. The south western portion of the city has the highest water table (at 10 feet), was a former marsh, is prone to liquefaction, and is partially in a 500-year flood FEMA designated zone. This map also depicts regions which are susceptible to seismic induced landslides (light blue). Two areas in the northern portion of the City are given this designation. Source: West Hollywood's Minimum Prescriptive Foundation Design.

Source: West Hollywood Environmental Impact Report (EIR) for the General Plan and Climate Action Plan (2010).

2.3 Drought

Drought is a regional phenomenon in which there is a shortage of water supply for a prolonged period, resulting from abnormally low rainfall and temperature patterns. The presence of drought is generally measured by water levels like precipitation, snowpack, and ground water. California, and particularly Southern California, has a long history of extended periods of drought. Although it is typically a regional issue, drought causes local impacts including those to urban water use, agriculture, biodiversity, and electricity generation (hydroelectricity).[25] Overall, there is consensus that there will be increased occurrence of two major contributors to drought: prolonged, high temperatures and decreased precipitation.[26] In addition, atmospheric circulation patterns that can redirect moisture away from California have increased in frequency.[27]

The State experienced a drought from 2007 to 2009, which was the first time a State-wide emergency declaration was issued.[28] Later from 2012 to 2016, California experienced its most severe drought, coinciding with extremely warm temperature years and low snowpack levels, amplifying its effects.[29] In 2014, the Governor declared a State of Emergency and asked residents to voluntarily reduce their water usage by 20%. Subsequently in 2015, mandatory water restrictions were put into place, and the drought was declared over in 2017. During this drought, the State experienced drinking water shortages and restricted access to potable water.[30] The availability of hydroelectricity dropped from 12% of to 6% of market share, increasing energy costs by $2 billion.[31] Agriculture was also hit hard during this event, including lost jobs and fallowed land.[32]

Though there is a long history of drought in the State, and region, it is difficult to predict drought. Overall, extreme dry years, where drought is likely to occur, will increase 2.4 times by 2100.[33] Drought requires multiple factors to occur, concurrently. There are a few tools that can be used to anticipate drought in the short-term (or 3 month) outlook or longer-term outlook. The US Drought Monitor Index (USDMI), is not a forecast, but a status update of the drought scenario across the country. The USDMI accounts for recent rainfall and is updated weekly. It indicates severity of drought ranging from D0 to D4 in increasing severity. While Los Angeles County currently (May 8, 2020) is not in a drought, it has spent much of the last two decades in one (Figure 11).

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[25] USGS, California Water Science Center

[26] CalEPA, 2018

[27] CalEPA, 2018

[28] West Hollywood LHMP

[29] CalEPA, 2018

[30] CalEPA, 2018

[31] CalEPA, 2018

[32] CalEPA, 2018

[33] UCLA IOES

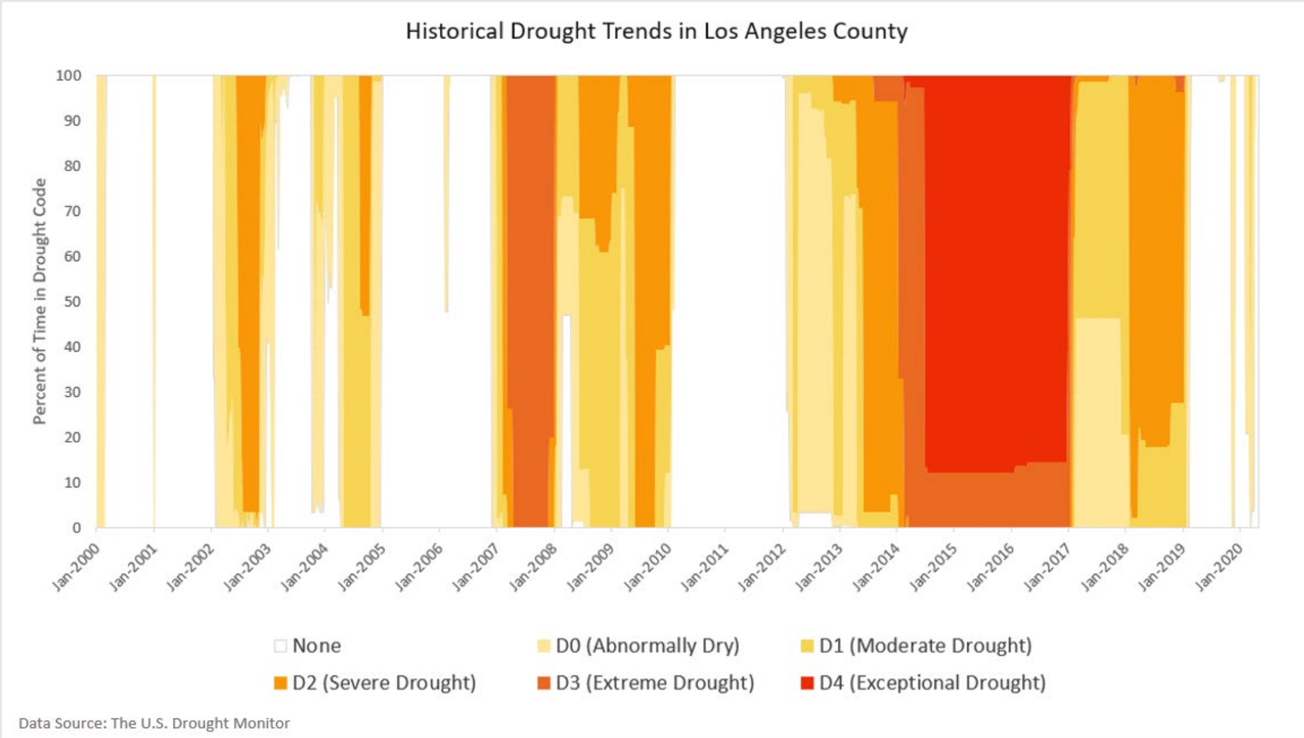

Figure 11. Historical drought trend for Los Angeles County over the last 20 years (January 2000 to May 2020).
Data source: United States Drought Monitor (USDM).

2.4 Wildfires

Wildfire has multiple indicators, including precipitation/drought, vegetation, winds, topography and spatial location among others. According to some models, Southern California region is anticipated to experience increased frequency, severity and acres burned of wildfires in the future.[34] However, using different models there is little consensus over how climate change will impact future wildfires in terms of frequency and severity.[35]

Historically, 80% of wildfires occur during Summer and Fall, and a quarter of fires occur during Santa Ana wind periods.[36] LA County and the Southern California region in general have experienced significant wildfires in the past few years, including the Thomas Fire and the Woolsey Fire.

While Cal-Adapt projections show an overall declining trend in area burned in West Hollywood, Los Angeles County is projected to see an increase in area burned of approximately 16% by mid-century (in a low emissions scenario). The Hollywood Hills which border the City to the north are characterized by low density development, and difficult to navigate roads. These hills, which are just outside of the City's borders are designated as a very high fire hazard severity zone (FHSZ), making the northernmost portion of the City susceptible to immediate risks from an adjacent fire in the Hollywood Hills – whether as a direct impact to infrastructure and people or through wildfire smoke.[37] Regions designated as very high FHSZs that are within the West Hollywood vicinity can be seen in Figure 12.

[34] California LA Regional Assessment

[35] California LA Regional Assessment

[36] California LA Regional Assessment

[37] West Hollywood LHMP

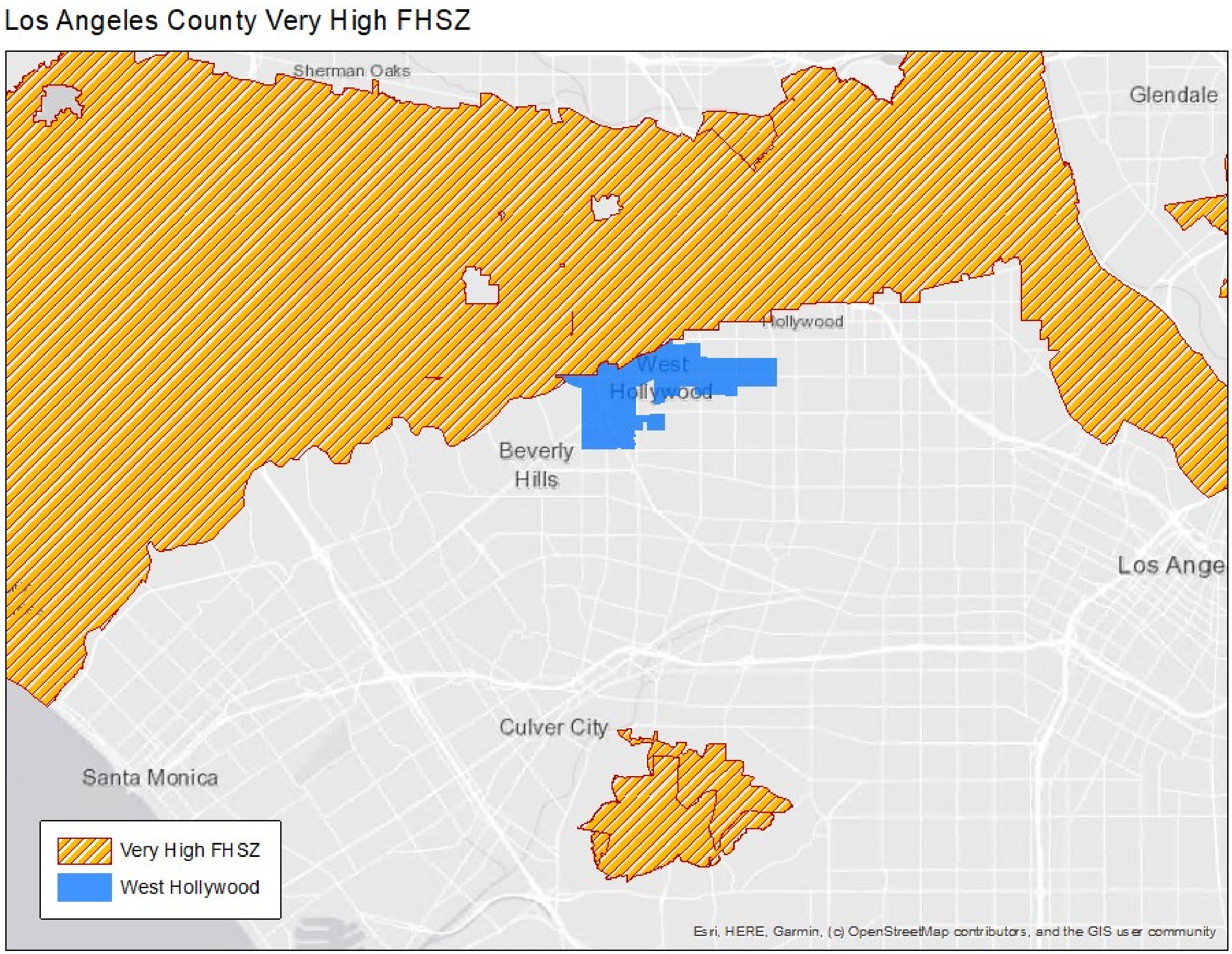

Figure 12. West Hollywood in relation to Los Angeles County's Very High Fire Hazard Severity Zones (FHSZ)

2.5 Landslides

Landslides refer to slope failures in natural rock or soil slopes and typically occur where a plane of weakness exists in the earth materials and elevated groundwater conditions exist.[38] Non-seismic landslides are caused by rainfall or rapid snow melt. As these occurrences are tied to rainfall amounts, their occurrence is tied strongly precipitation.

The majority of West Hollywood has no susceptibility to soil slip according to a 2003 USGS study, however northern areas have low and moderate slip susceptibility levels (Figure 10).[39] There have been no major landslides in the City of West Hollywood. In 2019, there was a small landslide that occurred north of West Hollywood in the Hollywood Hills that damaged three homes and required five homes to be evacuated.[40] In 2017, a mudslide occurred north of the City, in the Hollywood Hills, which damaged vehicles and a home.[41]

2.6 High Winds and Straight-Line Winds

Strong winds generally result from large pressure gradients but can also be influenced by topographies. Flatter surfaces like lakes and oceans allow wind to maintain speed with little resistance. Buildings may also act as wind channels through which winds pick up speed. High winds can also result from thunderstorms or when the storm cloud collapses (downburst winds). High winds are characterized by speeds of 50 mph or greater, either sustaining or gusting.[42]

In West Hollywood, Santa Ana winds are of concern because of their contribution and intensification of wildfire. The Santa Ana winds are strong, extremely dry winds that affect coastal Southern California. They originate inland from cool, dry high-pressure air masses in the Great Basin. However, there are no significant trends as to their frequency, intensity and duration as measured between 1948 and 2010. There is no consensus on how the Santa Ana winds could change, though there is agreement that the change in land-sea temperature gradient, which partly drives the winds could weaken in the future.

High winds pose risk to infrastructure and people. They can damage property, power lines, and trees – resulting in economic costs, injuries, power outages, and road blockages. In 2016, a large tree fell and totaled two cars, damaging a third. In 2017, the City was under a wind advisory in anticipation of high wind speeds.[43]

2.7 Sea Level Rise

The City of West Hollywood is not within a sea level rise area, however coastal California has, and will continue to experience sea level rise. The trend thus far has been an increase of 0.39 inches per decade, as far as long-term projects there is uncertainty due to potential emissions changes. The 50th percentile project under a RCP4.5 scenario is 7.3 inches, while under a RCP8.5 scenario the increase could be 25.4 inches.[44]

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[38] West Hollywood LHMP

[39] West Hollywood LHMP

[40] CBS 2019

[41] LAist 2017

[42] West Hollywood LHMP

[43] West Hollywood LHMP

[44] California LA Regional Climate Assessment

3 Sensitivity

3.1 Social Vulnerability

Climate change impacts people differently, even within a small community like West Hollywood. In order to identify priority areas (those of high risk) it is common practice to overlay sensitivity and exposure. In this context, sensitivity refers to the degree to which populations and sub-populations are susceptible to climate hazards. Indicators of social vulnerability are used to analyze the degree of sensitivity of various strata of communities. This step is critical in the overall vulnerability assessment and helps inform region and issue specific adaptation policies, goals and actions. In total, 12 indicators of social vulnerability were utilized in this assessment. These indicators, along with their data sources and relevant hazards are listed in Table 2.

Table 2. Social Vulnerability Sub-populations and Indicators

Indicator	Data	Relevant Hazard(s)
Children	Age Under 5	All Hazards
Disabled	Persons with disability	Flooding, Landslides, Wildfire
Education	No high school diploma	All Hazards
Older adults	Age Over 65	All Hazards
Limited English	Persons with limited English	All Hazards
No Vehicle	Households without access to a vehicle	Heat, Wildfire, Landslides
Outdoor Workers	Persons working outdoors (occupation)	Heat
Poverty	Persons below poverty	All Hazards
Race and Ethnicity	Non-white persons	All Hazards
Unemployed	Unemployed persons	All Hazards
Uninsured	Persons without health insurance	Heat, Landslides, Wildfire

Data source for all indicators: American Community Survey, 2018 5-Year Estimates

Broader context on social vulnerability

The City of West Hollywood is generally less vulnerable than other parts of the region when considering both exposure and social vulnerability, however the eastern part of the City displays slightly higher concentrations of sensitive subpopulations. When examining individual indicators on a census tract level, the city has higher prevalence than the County in the following three indicators: older adults, disabled persons, and persons without access to a vehicle (Figure 13). Persons without access to a vehicle may find it harder to mobilize during emergencies like wildfire or flooding since they need to rely on public transit. Vehicles can also act as a shelter from exposures such as extreme heat or air pollution. The intention is not to imply that personal vehicles are the answer to the vulnerability, but that the indicator is a valuable piece of the vulnerability puzzle and can inform adaptation strategies. For example, communities or sub-populations that have both low access to vehicles and low access to public transit can be prioritized for public transit improvement projects.

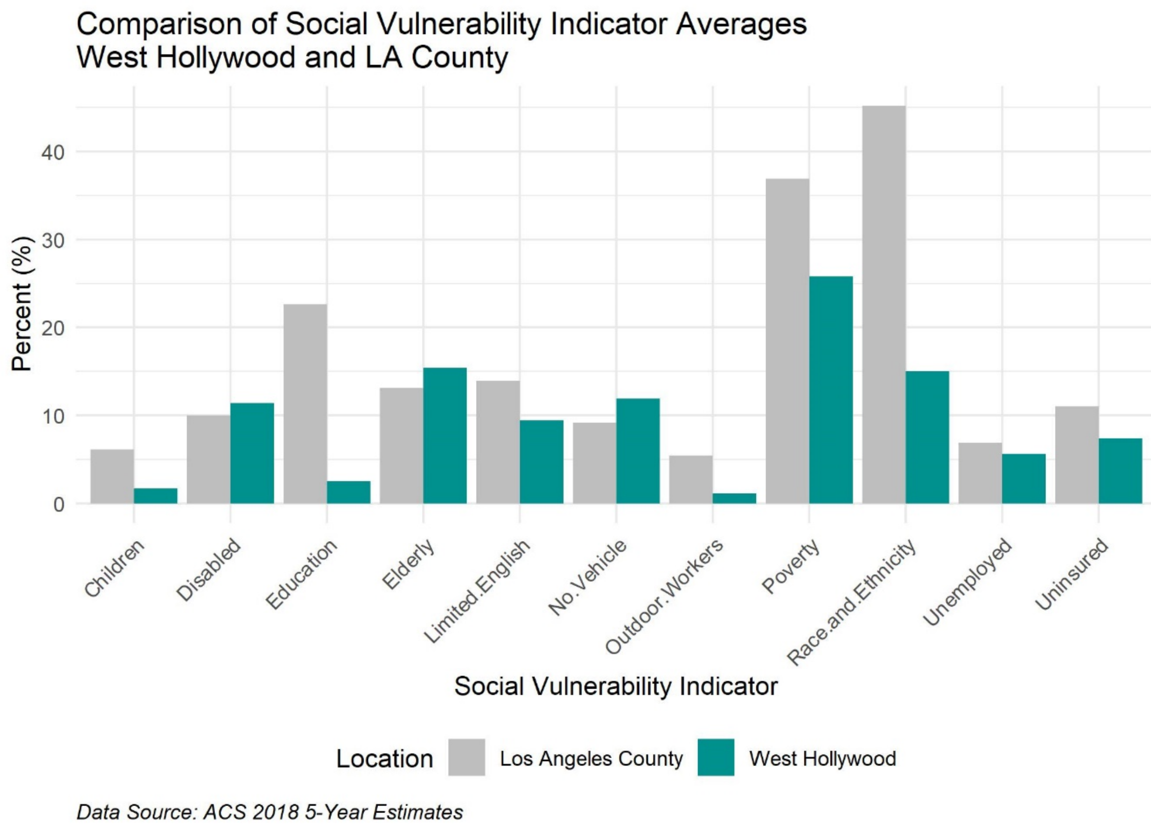


Figure 13. A side-by-side comparison of social vulnerability indicator averages for Los Angeles County and West Hollywood

An additional analysis was completed by examining the prevalence of relevant social vulnerability indicators at each census tract in West Hollywood and comparing them to the County average. As illustrated by Figure 14, this can help identify any disparities within the City of West Hollywood itself. At a quick glance, the two census tracts in the eastern portion of the city (7001.01 and 7001.02) appear to be more vulnerable in the following indicators: percent disabled, percent older adults, percent with limited English-speaking ability, percent without vehicle access, and poverty. A select number of these social indicators are also mapped individually in Figure 16, Figure 17, Figure 18, and Figure 19.

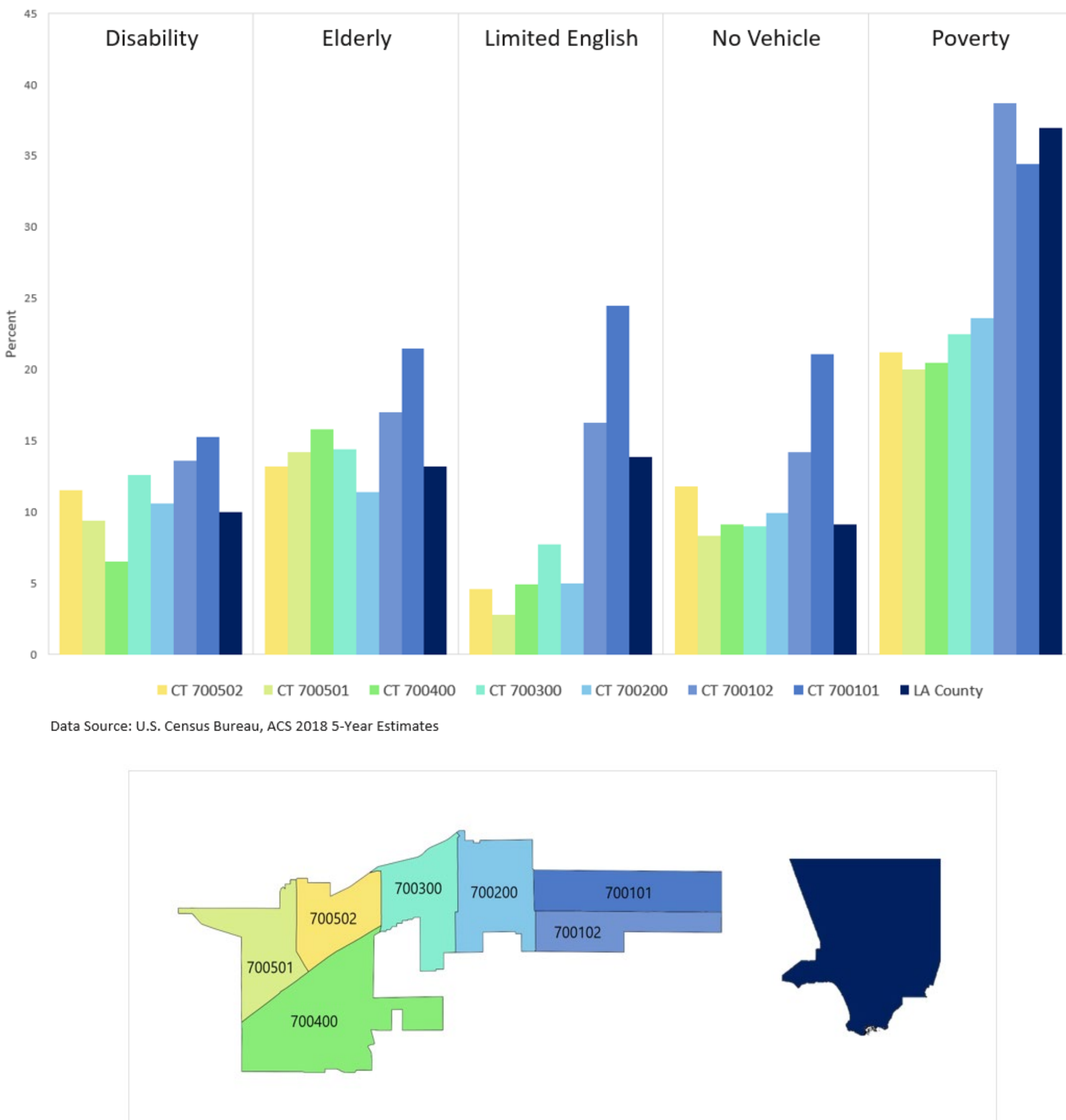


Figure 14. Comparison of key social indicators across census tracts in West Hollywood with Los Angeles County averages for reference. Census tracts 7001.01 and 7001.02 are consistently higher than the rest of the tracts in the City and have higher percent of persons with disability, older adults, limited English, and no vehicle access than the County (with 7001.02 also having a higher poverty rate than the County).

Social Vulnerability Indexing

A vulnerability index was used to assess the degree of social vulnerability to climate change for each census tract in Los Angeles County. The vulnerability index is a composite score derived from all 12 indicators discussed above (Table 2). To generate this vulnerability index, a well-known methodology called SoVI® was utilized.[45] This index was then mapped for Los Angeles County using quantiles (Figure 15). Additional information regarding the methodology can be found in the Appendix (The SoVI® Methodology).

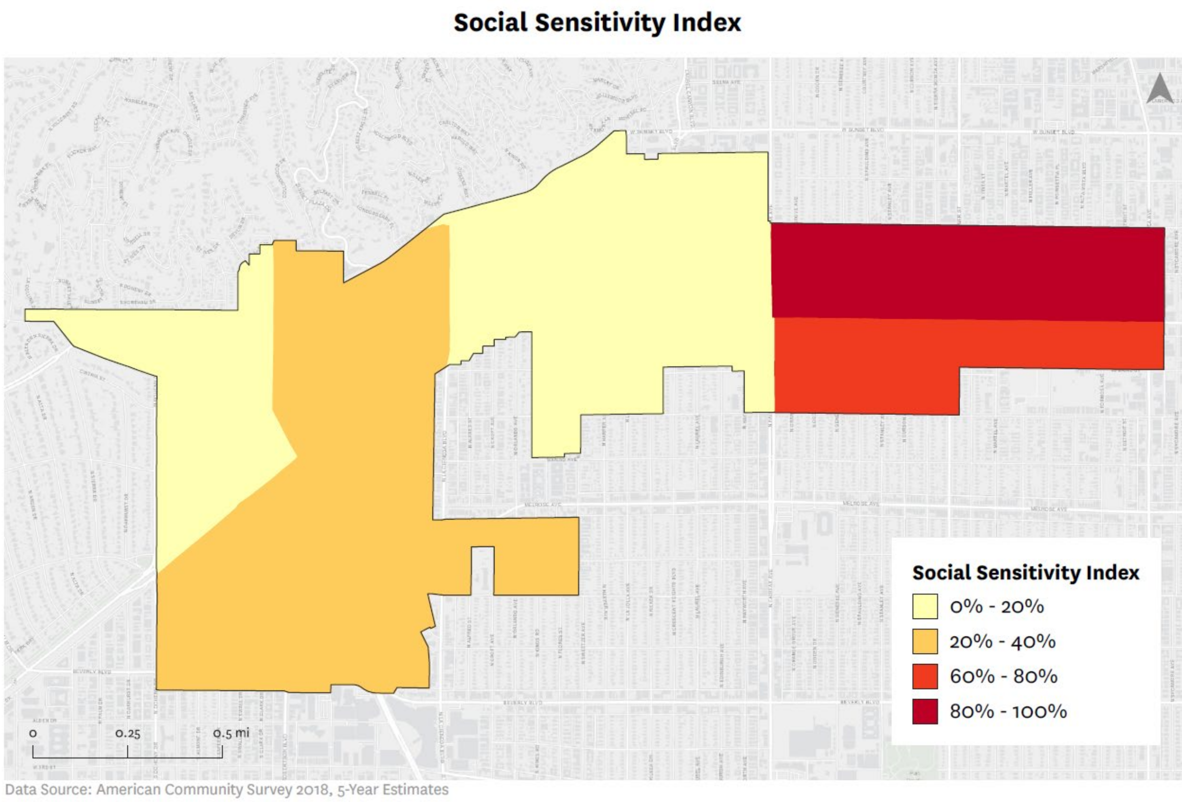


Figure 15. Social Vulnerability Index for West Hollywood

[45] Cutter, S.L., Boruff, B.J. and Shirley, W.L. (2003), Social Vulnerability to Environmental Hazards*. Social Science Quarterly, 84: 242-261. doi:10.1111/1540-6237.8402002

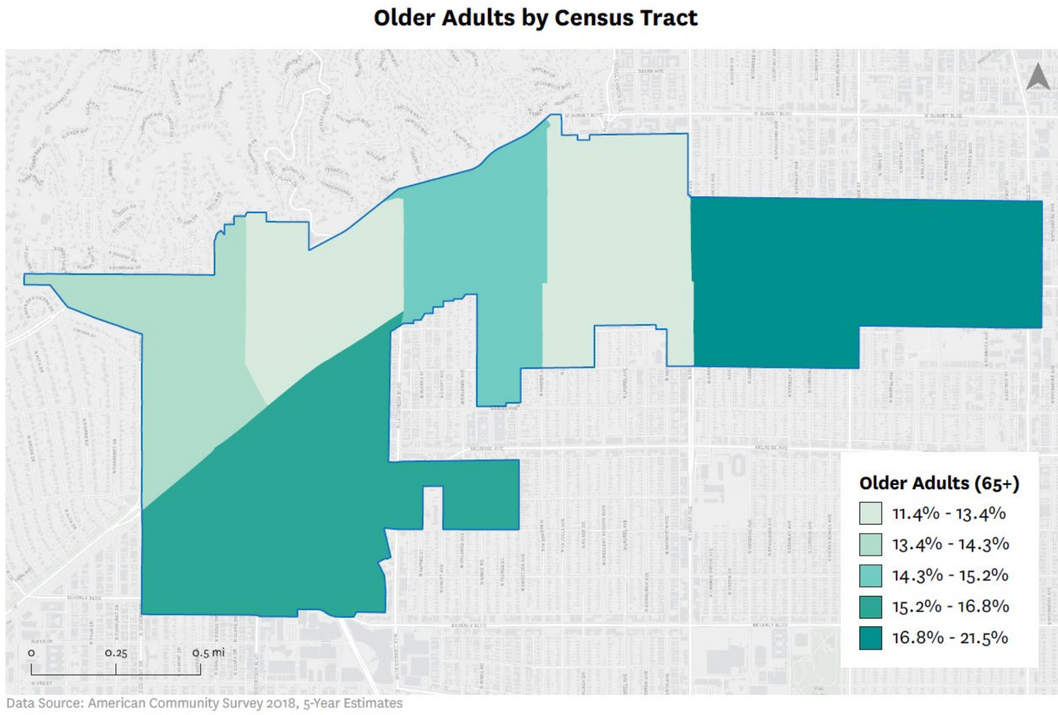


Figure 16. Percent of older adults (65+) by census tract in West Hollywood

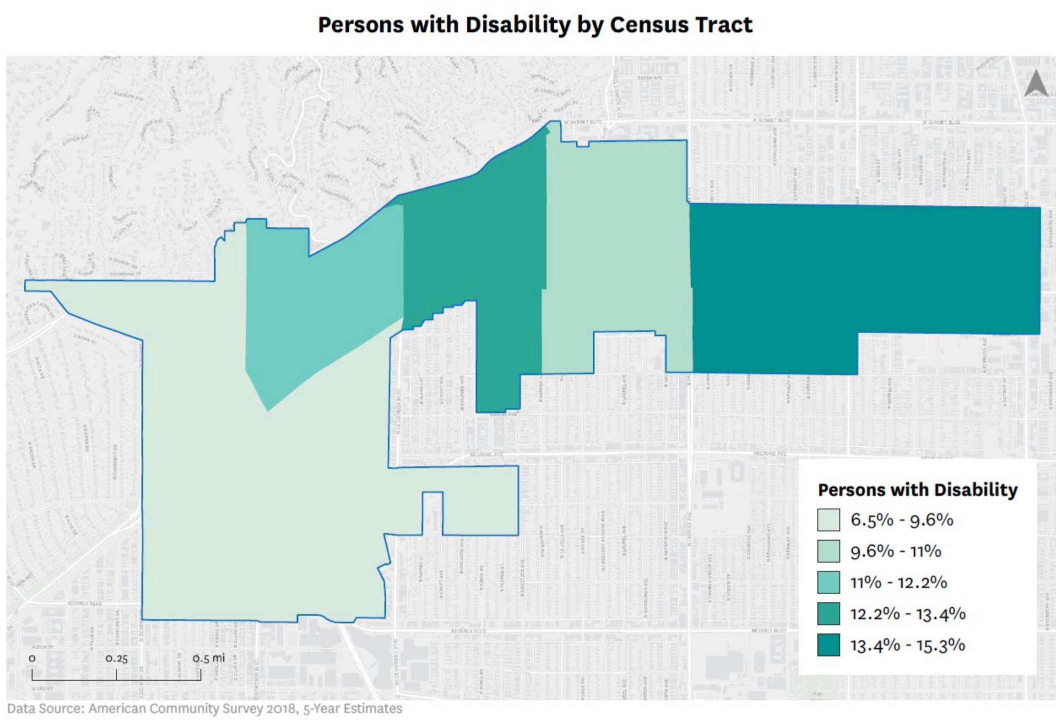


Figure 17. Percent Disabled by census tract in West Hollywood

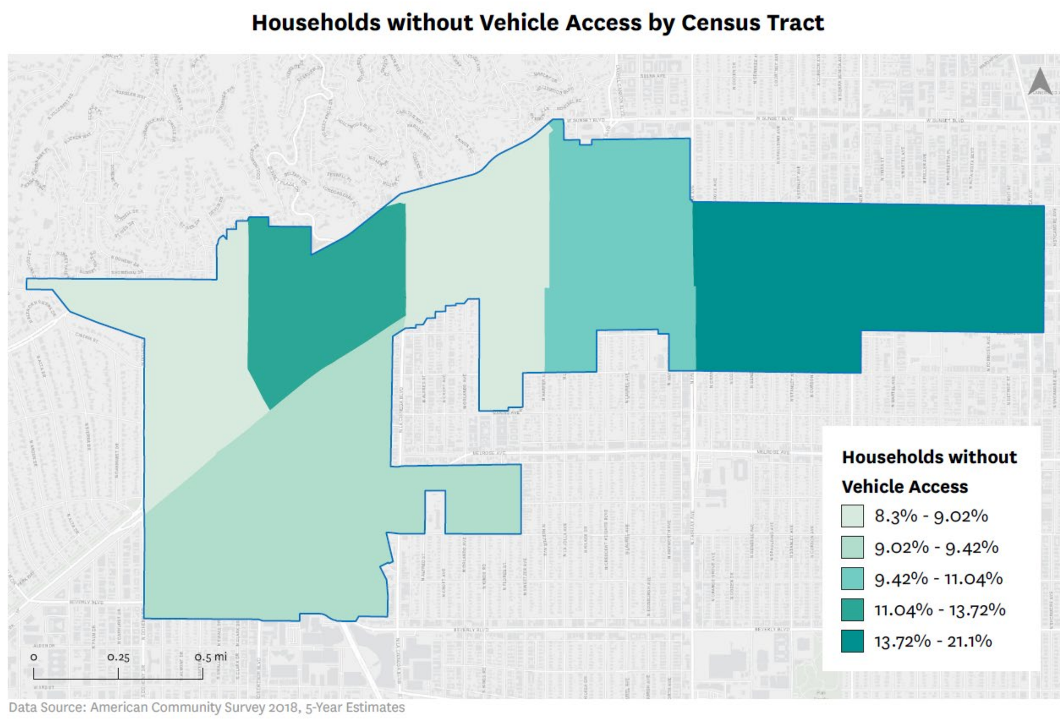


Figure 18. Percent Without Vehicle Access by census tract in West Hollywood

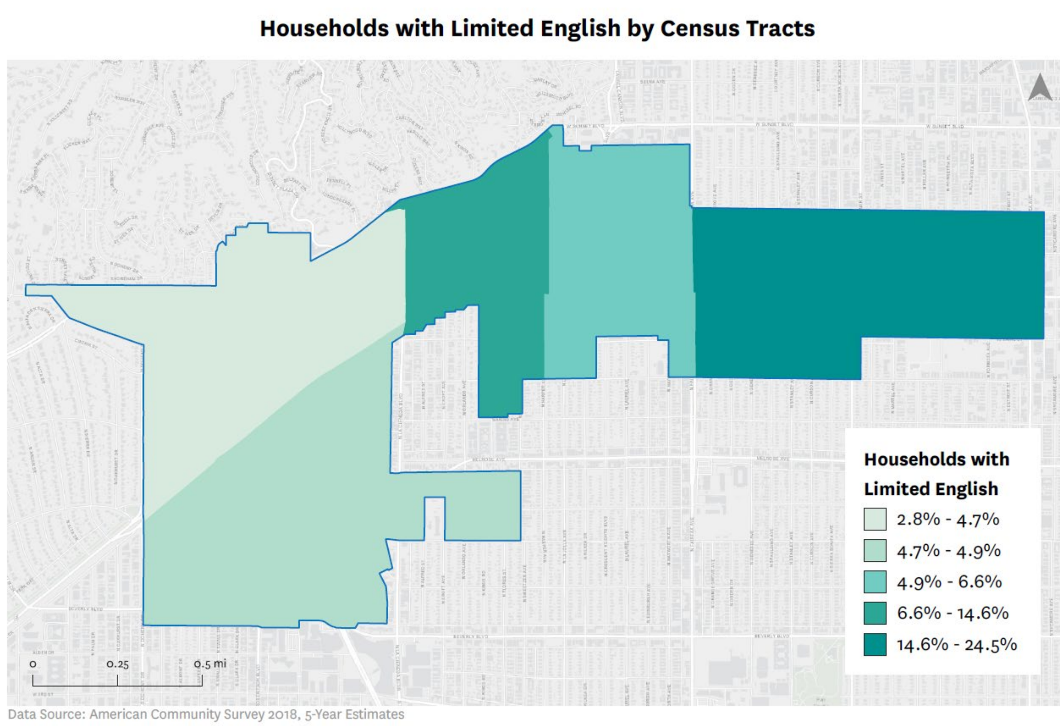


Figure 19. Percent of Households with Limited English by census tract in West Hollywood

Homelessness and Housing Types

Individuals experiencing homelessness were not captured as part of the social vulnerability index, yet they are a highly vulnerable group. Precarious housing, or lack thereof, compound the impacts of nearly all climate exposures, which can lead to increased morbidity and mortality. The homeless population in West Hollywood (estimated through point-in-time counts) has increased over the years.[46] In 2019, the most recent available data showed 131 individuals experiencing homelessness. In 2018, there were 96 individuals recorded experiencing homelessness, 99 in 2017, and 76 in 2016. The increase is consistent with the general LA County upward trend. However, since much of the houseless population in Los Angeles is transient, point-in-time counts don't necessarily capture true annual averages for houseless individuals in the city.

Different housing types and ownership can also contribute to vulnerabilities. Renters for example, are less secure in their housing. They are less insulated from surges in housing prices and have fewer tenant protections than homeowners. In many places, low income renters may feel pressured to move out as more affluent tenants move in and pay higher rents.[47] In West Hollywood, the average homeownership rate is 21.3%. In comparison, the average for Los Angeles County is 45.8%, and the national average is 65.1%. The map below (Figure 20) illustrates the percentage of renters by census tract in the city. The map shows that there is a higher percentage of renters in the eastern portion of the city, but that the western portion also has a relatively high number of renters compared to the rest of the county. An additional map (Figure 21) shows the distribution of residential housing types in West Hollywood, with single family residences predominantly existing in the west side of the City.

[46] Los Angeles Homeless Services Authority total point-in-time county of individuals experiencing homelessness

[47] SPARCC, Protecting Renters from Displacement and Unhealthy and Climate-Vulnerable Housing

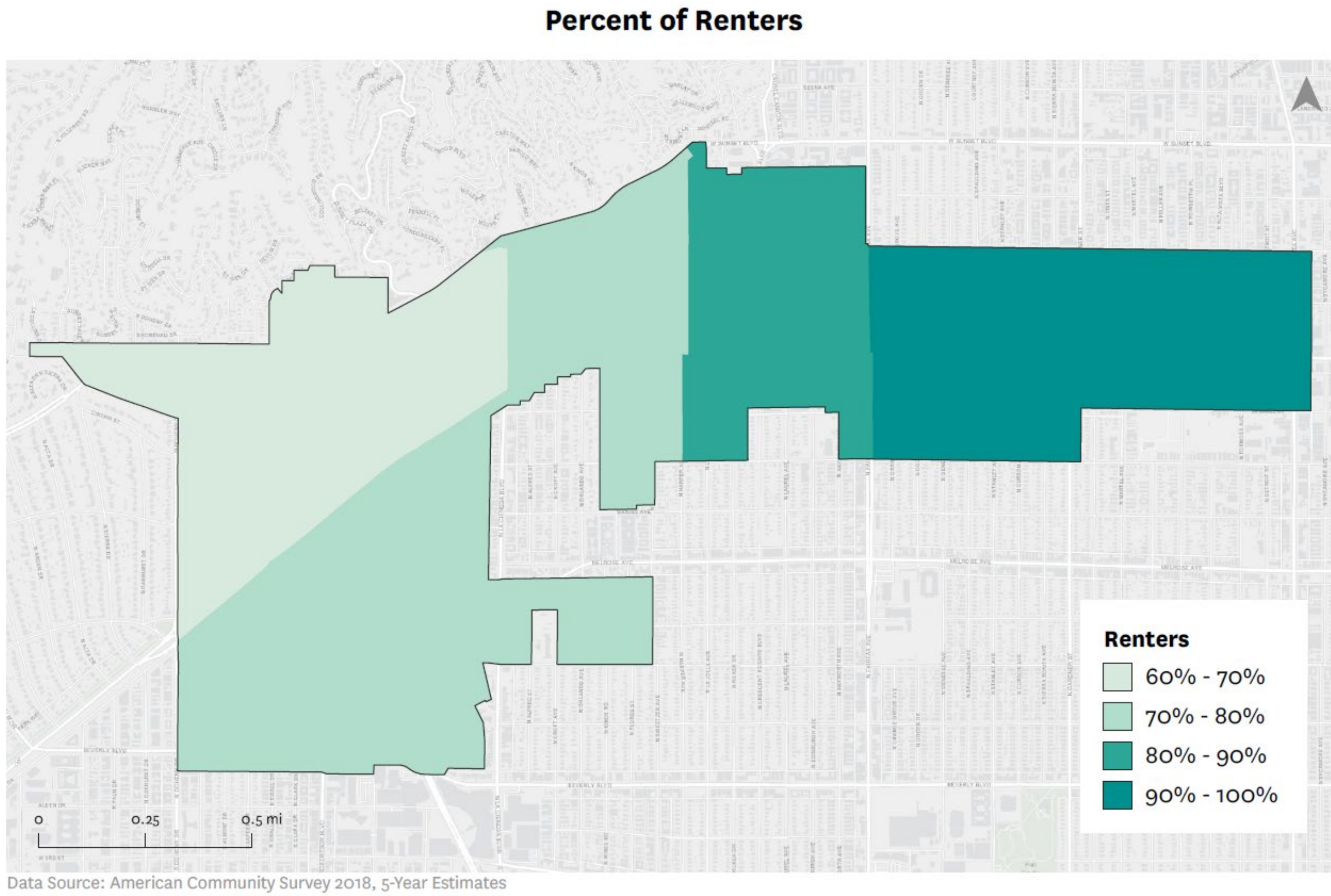
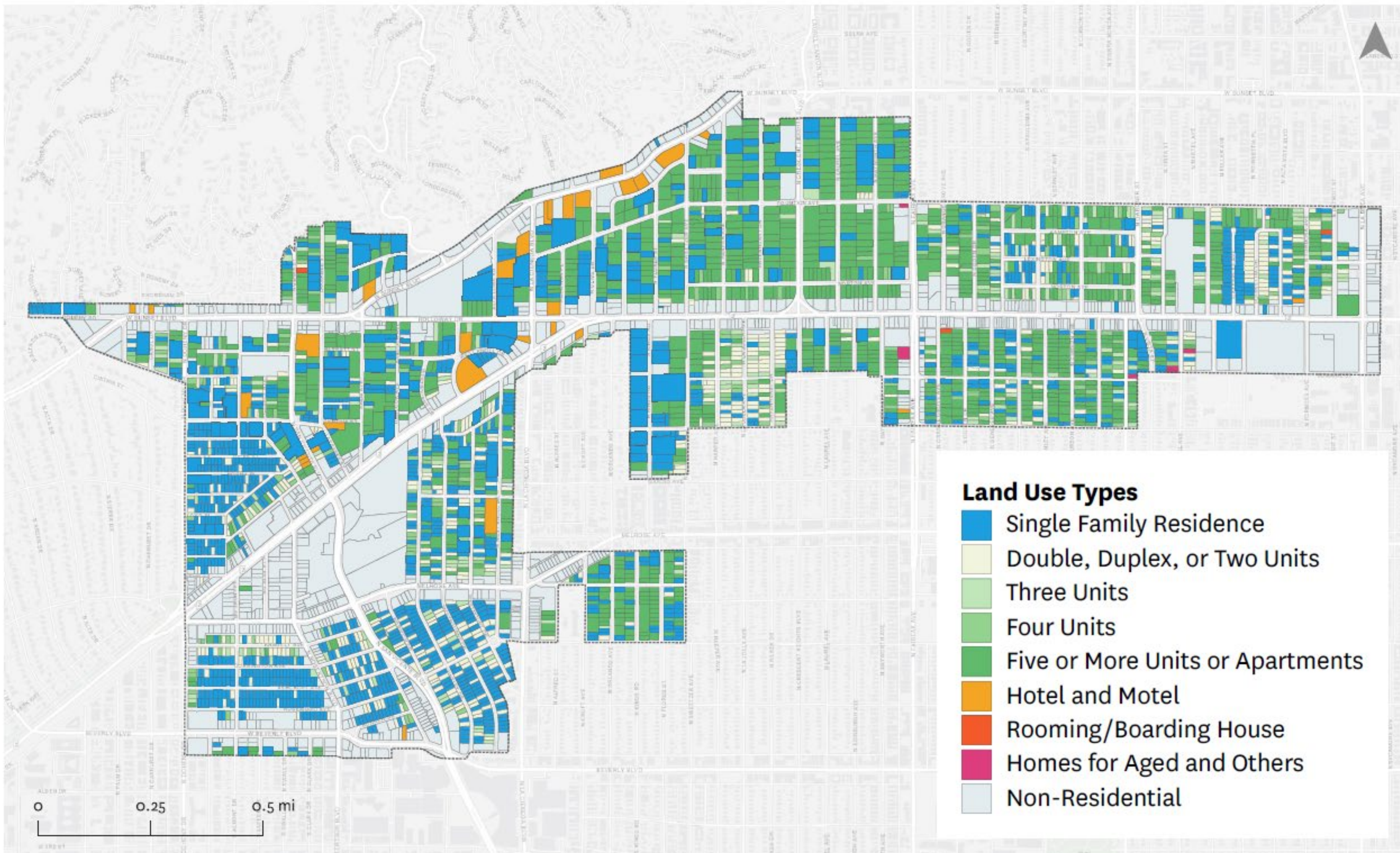


Figure 20. Percent of Renters by Census Tract

Land Use Types



Data Source: Los Angeles County Office of the Assessor

Figure 21. Residential Housing Types in West Hollywood

Climate Migration

While there have been documented cases of natural hazard induced migration in the United States, it is difficult to measure. Migration due to sudden onset natural hazards, for example hurricanes or large storms, can be temporary or permanent depending on the hazard and circumstance. Migration directly related to climate change, whether that is slow-onset changes or sudden-onset events (wildfires, storms, etc.), is not as well researched. In California, wildfires and sea level rise are of concern to populous areas. Population movements in response to these events can be discerned as forced displacement or voluntary migration.

A large amount of housing in the State is prone to wildfires. Unlike flooding, there are no state buyout programs for wildfire prone properties that could pre-empt post disaster movements. There are limited examples of domestic sea level rise migration, usually these conditions are found in southern states.[48] These kinds of buyouts arise from, "managed retreat" or long-term processes that involve negotiations between the government and entire neighborhoods.[49] Storms, or frequent flooding, can also lead to "managed retreat" or displacement, whether en masse or at an individual level.[50]

3.2 Structural Vulnerability

Structural vulnerability refers to the degree to which physical assets within a community are susceptible to climate hazards. Structural vulnerability assessments focus on (but are not limited to) utility assets, transportation assets, hospitals, public spaces, historic buildings, water supply and stormwater management, schools, and fire and police departments. These structures and institutions are critical in that they provide necessary services for a community and contribute to its emergency preparedness. For that reason, it is essential to understand not only which climate hazards impact key structures, but also to what degree and how that may change in the future. This allows municipalities to make informed decisions about how to address structural vulnerabilities, whether that includes physical changes like retrofits and installations, or more political solutions like zoning and regulatory updates.

Public Facilities and Critical Infrastructure

Critical public facilities include city hall, several parks, a maintenance facility, parking structures, libraries, a police station, and two fire stations. Other critical facilities include schools, religious institutions, senior housing, HIV/AIDS assistance, disability assistance, and low-income housing. A full list of these facilities is listed in the appendix, under the Critical Facilities Table section.

The map below (Figure 22) highlights some critical infrastructure in West Hollywood, including government facilities, disaster routes, and parcels with buildings improved/renovated prior to 1978. These buildings are highlighted because SB 331 was passed that year, enacting Title 24 (California Building Standards Code) which mandated uniform buildings standards across the state. This new title created stricter energy efficiency and buildings standards overall. Buildings built before this time may be less equipped to deal with climate threats such as extreme heat and flooding. Critical facilities include government facilities, police stations, fire stations, and hospitals. These facilities are considered essential city assets, especially during emergencies. The map also includes buildings that are occupied predominantly by vulnerable populations, such as education institutions, senior homes, HIV/AIDS assistance, disabled living assistance, and low-income housing. Lastly, the map highlights any locations that are registered with the National Register of Historic Places.

[48] NRDC

[49] NRDC; Koslov

[50] Koslov

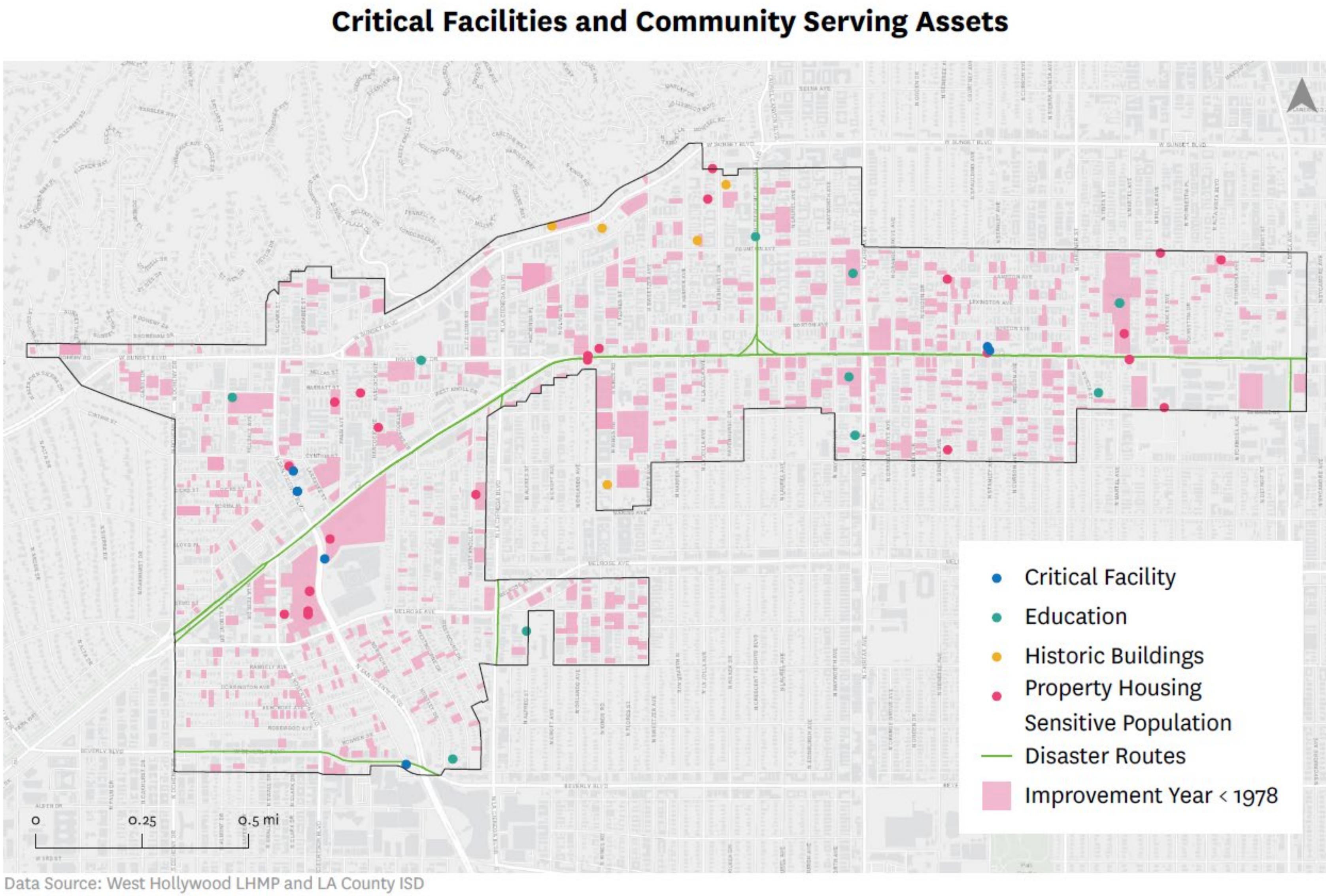


Figure 22. Critical and vulnerable infrastructure in West Hollywood

Electrical Grid and Grid Resilience

Energy demand and consumption often increase during periods of extreme heat. This can result in disruptions, failures, and blackouts if demand surpasses the system's capacity. Peak demand for electricity also comes with an increased cost to consumers, disproportionately impacting those in lower socioeconomic status.

West Hollywood receives its electricity from the Clean Power Alliance through Southern California Edison (SCE) Distribution System. The City is served by 18 electrical circuits, some of which experience interruptions and need repair. The number and frequency of power outages has increased over the past few years. In 2019 the average West Hollywood customer was without power for 148 minutes, compared to 178 minutes for the SCE system wide average.[51] These outages are often summarized using the System Average Interruption Duration Index (SAIDI), which shows the average sustained interruption time (in minutes) per year, normalized by number of customers serviced. Circuits that experience more failures and interruptions can be prioritized in future improvement projects to minimize the overall risks to the area. Recent SAIDI trends are summarized below in Figure 23 .

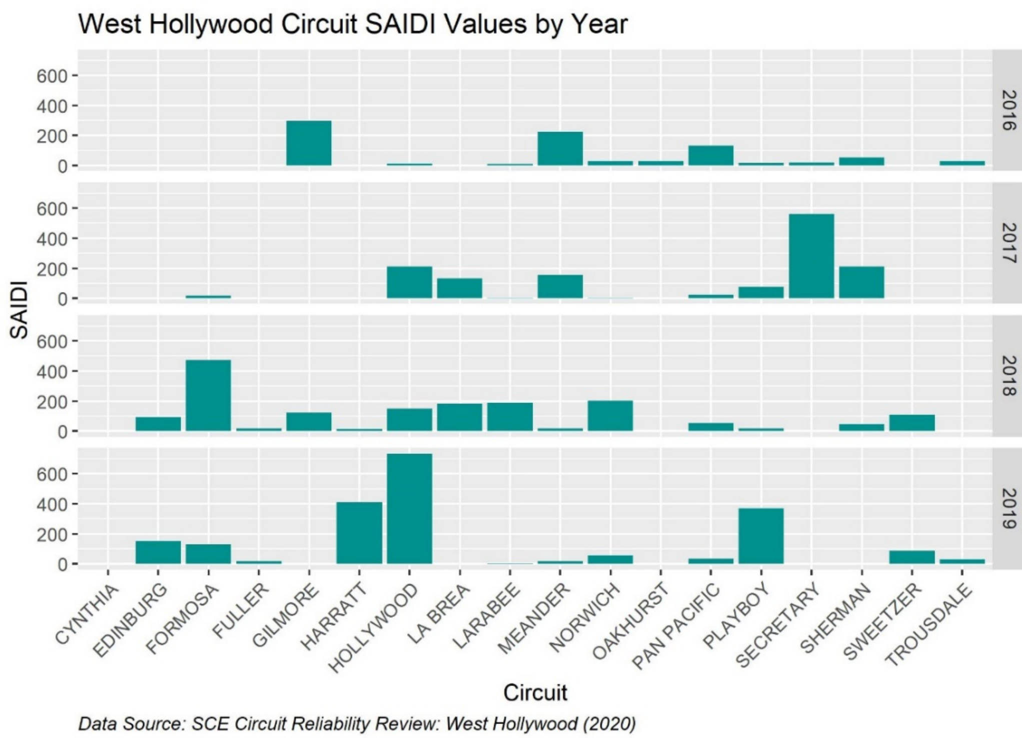


Figure 23. System Average Interruption Duration Index (SAIDI) for each circuit in West Hollywood over the last four years.
Data source: Southern California Edison's Circuit Reliability Review for the City of West Hollywood (2020)

As of January 2020, based on the California Solar Statistics reported for each city and utility in the State, there was a total solar generation capacity of over 580 kW in the City of West Hollywood, including both community-wide and city-owned solar.[52] Residential rooftop photovoltaic (PV) systems make up 58% percent of the city's solar capacity with 335 kW. The City has installed 135 kW of solar PV on municipally-owned- buildings, making up 23% percent of solar capacity. Commercial PV systems make up the remaining 19% capacity with 113 kW installed. While commercial PV systems make up the smallest percentage, the capacity has almost doubled since 2017 from 62 kW installed.

[51] SCE's West Hollywood Circuit Reliability Review 2020

[52] California Distributed Generation Statistics (https://www.californiadgstats.ca.gov/downloads/)

Water Supply

Water supply in California is largely dependent on temperature and precipitation. Increased variability in precipitation along with rising temperatures and more frequent droughts leads to eventual water scarcity. Snowpack in California mountains provides essential water storage, but earlier warming and lack of precipitation threaten this resource. These projections impact the availability of imported water for both drier and wetter years. Adaptation strategies that consider a combination of water conservation and increasing local water supply and capture will be key to responding to these greater extremes.

West Hollywood receives its potable water from the Los Angeles Department of Water and Power (LADWP) and adjacent Beverly Hills Public Works (BPW). BPW provides water for the western portion of West Hollywood, with 90% of the supply originating from the Metropolitan Water District (MWD).[53] Water from MWD is sourced from the Jensen and Weymouth surface water treatment plants (located in Sylmar and La Verne). The remaining 10% of the supply is sourced from Beverly Hills' groundwater wells, which is treated by their own water treatment plant. The eastern portion of West Hollywood receives its water from LADWP, who currently purchase approximately 59% of their water supply from the MWD. MWD provides water to about 19 million customers across southern California through imported (Sacramento River, San Joaquin River, and Colorado River) and local sources.

Stormwater Management

Stormwater systems may be stressed during extreme rain events, leading to overflows and increased pollutants like sediments and nutrients in waterways.[54] Figure 24 illustrates the gravity mains and catch basins in West Hollywood, showing whether the infrastructure is maintained by the City of Los Angeles (city), the Los Angeles County Flood Control District (LAFCD), or a private entity.

Transportation

The Climate-Smart Cities (created by the Trust for Public Land) assesses transit priority areas by overlaying several layers. These layers include connections between low-income communities and job rich districts, medical facilities, shopping centers, and high-quality transit. They also include connections between bike/walk communities and job rich districts, medical facilities, and shopping centers, as well as transit that would provide access to education facilities and help solve first/last mile issues. These "connect priorities" were mapped for the city of West Hollywood to highlight areas in which priorities range from moderate to very high (Figure 26). Regions in which connect priorities are very high would benefit most from improvements or additions of transit options.

Impervious Surfaces

Impervious surfaces are surfaces which water cannot penetrate. Most notably, impervious surfaces contribute to urban heat island effects and can worsen the impacts of flooding. These impacts include reductions in water quality, worse erosion, and poor ability to replenish groundwater.[55] Across Los Angeles County, average impervious surface percentage for census tracts is 58.9%. West Hollywood census tracts average 72.3% and range from 68.1% to 77.3%, with census tract 7001.02 having the highest percent (Figure 25). Areas with especially high levels of impervious surfaces would benefit most from the addition of adaptive measures such as such as bioswales, increased vegetation, and additional tree canopy.[56]

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[53] BPW's 2017 Annual Drinking Water Report

[54] EPA, Climate Change Adaptation Resource Center

[55] The California Healthy Places Index (HPI) - https://healthyplacesindex.org/policy-actions/impervious-surfaces/

[56] The California Healthy Places Index (HPI) - https://healthyplacesindex.org/policy-actions/impervious-surfaces/

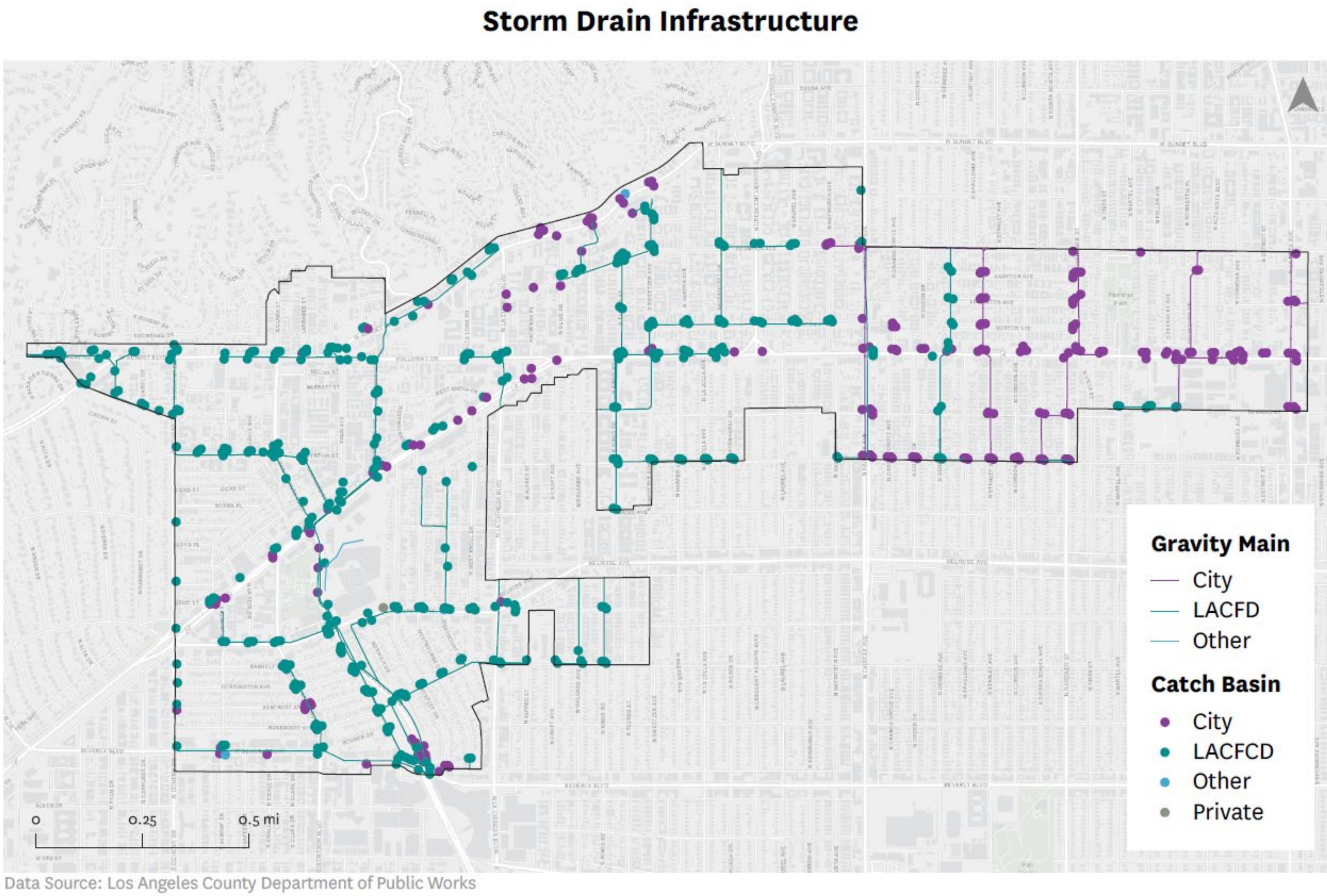
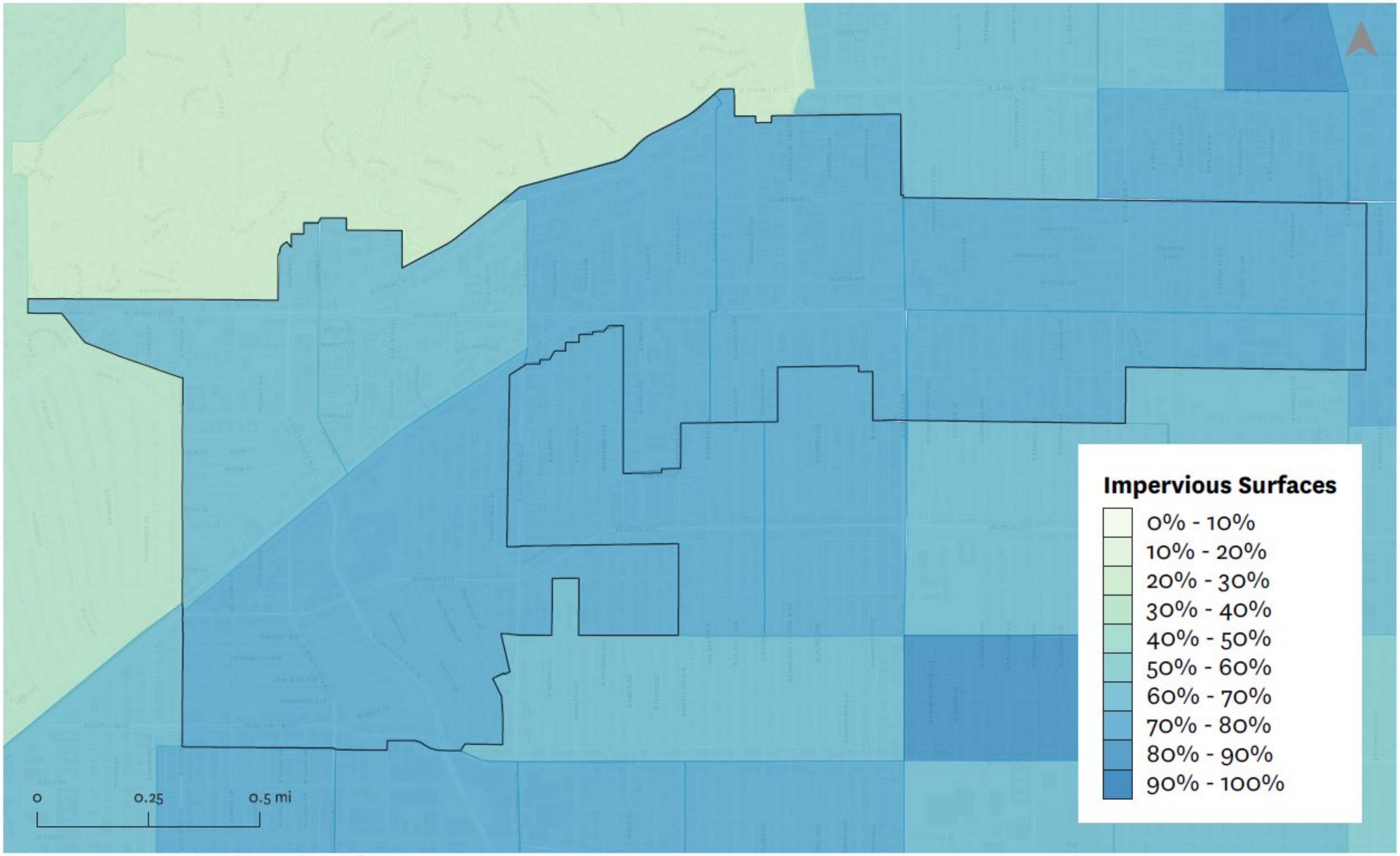


Figure 24. Storm Drain System

Impervious Surfaces



Data Source: NLCD 2011 Land Cover (CONUS)

Figure 25. Map depicting the percentage of impervious surfaces in West Hollywood

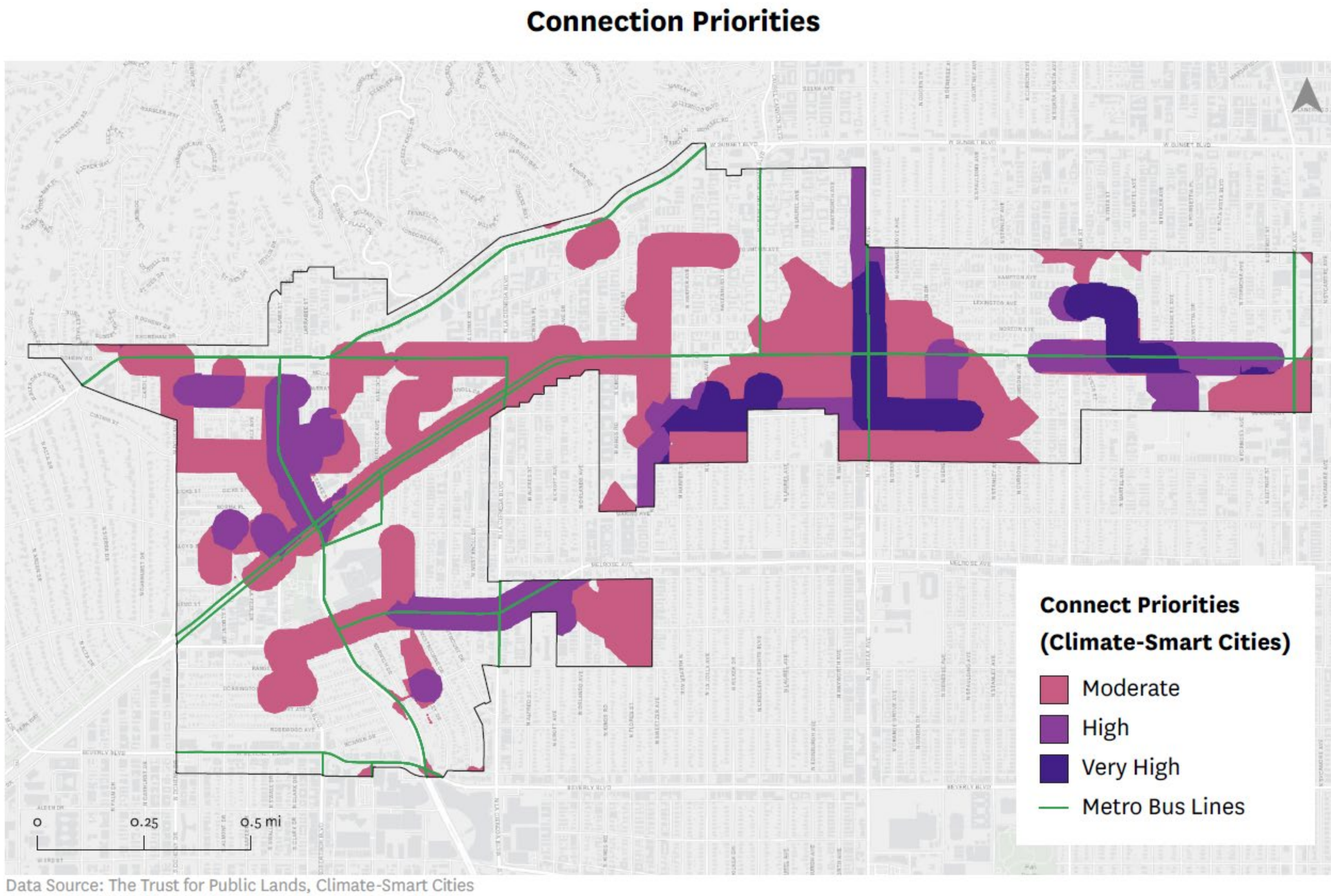


Figure 26. Connect Priorities (Climate-Smart Cities) for West Hollywood

Source: Climate-Smart Cities

4 Adaptive Capacity

It is apparent that communities in Southern California are already feeling the impacts of climate change, and adaptive capacity acts as a shield against them. More formally, adaptive capacity describes an existing ability to mitigate or cope with damage caused by climate exposures. Adaptation can take on structural, natural, and/or political forms. For example, tree canopy, green space, cooling centers, air conditioning ownership, grid resilience, and roof albedo help illustrate adaptive capacity to heat. Indicators of social cohesion are also relevant to adaptive capacity in that they promote networks and resilience within a community. It should also be noted that while some adaptation measures may equitably protect all residents of a community, many do not. This section describes West Hollywood's existing adaptive capacity in order to better inform subsequent adaptation planning.

Existing (and Past) Hazard Mitigation Actions and Projects

- Santa Monica Boulevard Renovation
- Sunset Boulevard Renovation
- Traffic Signals Update
- County of Los Angeles Holly Hills Storm Drain Project
- Annual tree root maintenance

Existing Plans and Documents Related to Climate Hazards

- City of West Hollywood Emergency Plan
- City of West Hollywood General Plan 2035 and Environmental Impact Report (EIR)
- City of West Hollywood Municipal Code: Title 13. Building Code
- City of West Hollywood Strategic Plan: Vision 2020
- "West Hollywood Is Prepared" - Disaster Preparedness Handbook
- City "Live Work Play" Emergency Preparedness Brochure – English and Russian
- Water Engineering & Technical Services Division: Emergency Response Plan (Emergency Notification List)
- City of West Hollywood Ordinances
- City Critical Facilities List
- City Zoning Districts
- City Hazards Map

Table 3. Measures of Social Connectedness in West Hollywood

Measures of Social Connectedness by Census Tract

Tract	Voter Turnout (%)	Financial Institutions	Park Access	Computer & Internet Access
	Percent Turning Out	# of Credit Unions	Acres of Parks Per 1000 People	Percent without Access
CT 700101	65.9%	1	1.3	21.0%
CT 700102	65.7%	1	0	23.8%
CT 700200	70.8%	1	0	6.9%
CT 700300	72.9%	0	0.3	6.1%
CT 700400	69.7%	2	1.1	10.0%
CT 700501	70.0%	9	0	7.6%
CT 700502	69.6%	3	0	9.2%

Data Source: The USC Price Center for Social Innovation - Neighborhood Data for Social Change

Analysis by Buro Happold

In the map below (Figure 27), tree canopy is mapped by block groups in West Hollywood and sorted by quantiles. This acts as a proxy for current tree canopy shade, which mitigates the effects of extreme heat events and reduces urban heat island. This means that block groups with higher percentages of tree canopy cover are expected to remain cooler during extreme heat events. The map also shows green space, which contributes to the reduction of urban heat island and improves stormwater retention. Lastly, West Hollywood cooling centers are depicted. Plummer Park is the primary designated cooling center during days in which the temperature exceeds 90 degrees Fahrenheit. The West Hollywood Library is also shown since it acts as a pseudo-cooling center for the western portion of the city during extreme heat events.

Roof albedo is also modelled and mapped for West Hollywood (Figure 28) and represents the solar reflectivity of a surface. Roofs with higher reflectivity like tree canopy, reduces the impacts from extreme heat, energy demands, and urban heat islands. An additional analysis was conducted in which roof reflectivity was grouped by census tract and land use type. The results showed that government buildings in census tract 7003 and recreational facilities in census tract 7005.01 have relatively low reflectivity. These structures could be a good starting point for potential cooling improvements.

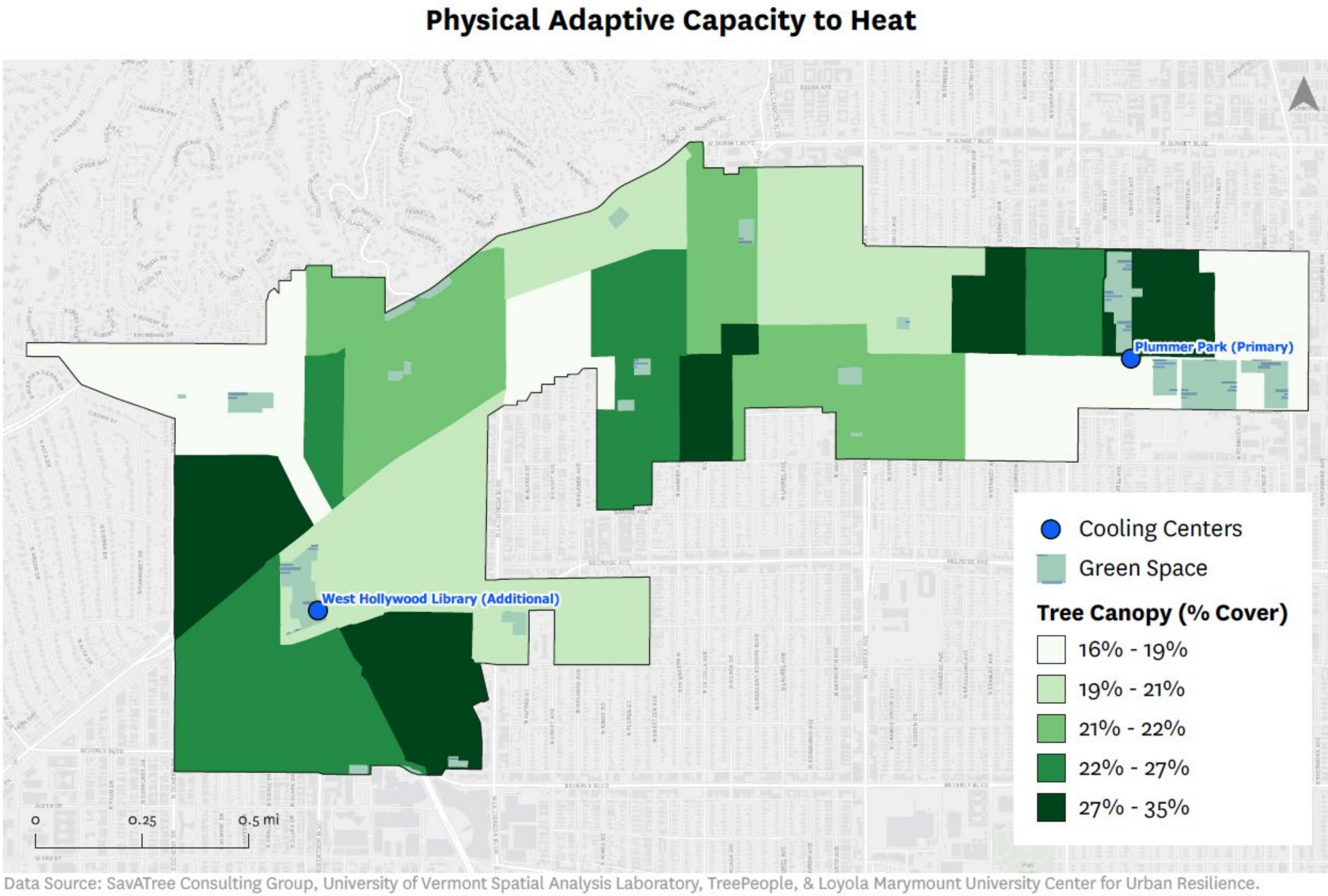
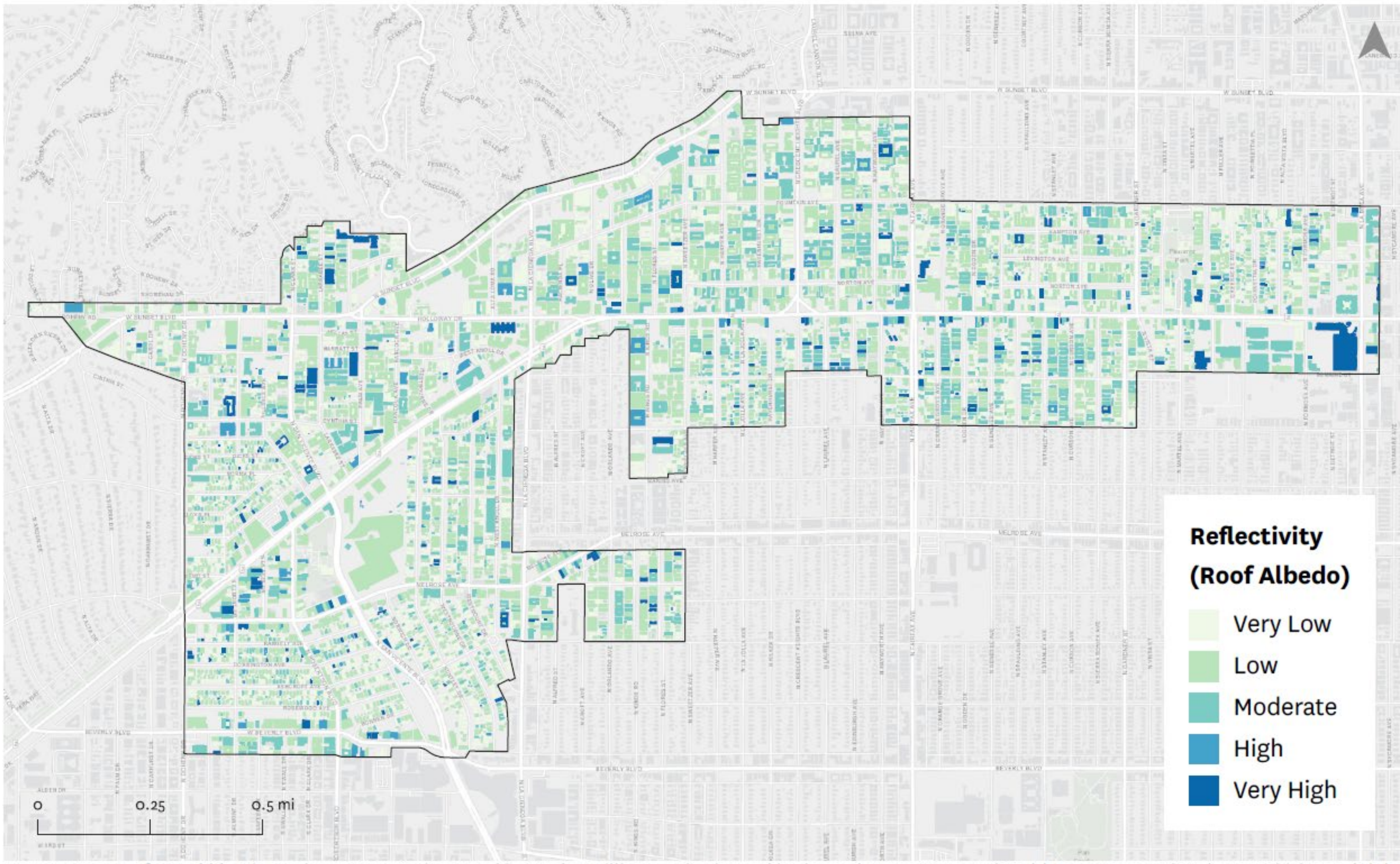


Figure 27. Physical Adaptive Capacity to Heat

Roof Albedo by Building



Data Source: Taufiq Rashid, Eric Mackres, Peter Kerins, Brookie Guzder-Williams, Eric Pietraszkiewicz and Emma Stewart (World Resources Institute); Kurt Shickman (Global Cool Cities Alliance)

Figure 28. Roof Albedo in West Hollywood

5 Vulnerabilities – Key Findings

West Hollywood is less vulnerable to climate hazards than other communities in the Los Angeles region. The city is expected to have a limited number of climate threats relative to other regions, making targeted approaches to adaptation both feasible and effective. Given these circumstances, key findings from the assessment include the identification of areas and people who are particularly vulnerable.

Still, West Hollywood's exposure to various climate hazards is expected to increase, including to heat waves and more intense rain events locally, as well as wildfires and drought regionally. West Hollywood is exposed to various hazards resulting from fluctuating heat, precipitation, and wind circulations patterns in the region. At 1.89 square miles, the City of West Hollywood is relatively small geographically. It is expected to experience similar climate hazards across the community, and thus social and structural vulnerability is a crucial tool for determining areas of priority.

Increasing temperatures and extreme heat events amplify the public health impact on populations most vulnerable to extreme heat, add stress to the electrical grid, and contribute to drought conditions and water scarcity. Based on the climate projection scenarios examined in this report, the occurrence, severity, and duration of extreme heat days is projected to increase. Extreme heat days are projected to increase from 9 days per year to 15–21 days by mid-century, and 20–39 by end of century. Populations exposed to extreme heat, particularly the children, older adults, and outdoor workers, are more vulnerable to heat-induced illnesses. Extreme heat events can also lead to infrastructure failure, power blackouts, and can overload the region's healthcare system. Recurring extreme heat events combined with low rainfall (and snowpack levels) in the region can likely lead to drought. Extended periods of drought can result in water shortages and disrupt local ecosystems, agriculture, and power supply (hydroelectric).

Projected wetter and drier precipitation extremes may lead to an increase in localized flooding as well as a larger risk of landslides and wildfires in the region. While average precipitation is expected to remain constant in West Hollywood, the gap between minimum and maximum precipitation are expected to increase leading to wetter and drier extremes. This shifting pattern is likely to increase the severity of wet and dry years and result in whiplash events. As discussed, low precipitation can lead to increased drought and wildfires and may potentially result in regional water scarcity. The city is neighbored by very high fire hazard severity zones; wildfires can impact air quality further exacerbating health impacts for vulnerable populations. Extreme wet events can cause flash flooding and stress local stormwater and sewer infrastructure systems, whereas abrupt dry-to wet transitions can increase the intensity of landslides.

West Hollywood has relatively high numbers of older adults people, disabled people, and people without access to vehicles. These three sub-population groups are more vulnerable and likely to be affected by the changing climate. These vulnerabilities exist predominantly and disproportionately in the eastern part of the city. When assessing adaptive capacity, Plummer Park, which provides tree canopy and a cooling center, helps mitigate some of these heat vulnerabilities for the local community. However, the neighboring communities to the east and south of the park still have less tree canopy with pockets of higher percentage of renters and multifamily dwellings. The cool roof data for West Hollywood show an opportunity for government buildings to improve average albedo.

Electric grid capacity and resilience will be important as temperatures increase and the city continues to decarbonize its energy sources. West Hollywood communities have been impacted by power disruptions with areas experiencing extended power outages at times. Increasing temperatures and potential power disruptions due to wildfire risk may further stress these grid capacity and reliability issues. In turn, grid resilience, and opportunities to reduce energy load and to expand distributed energy resources, will be key adaptation strategies to consider.

Community engagement will help ground truth and expand upon these initial findings. This memo presents findings based on initial data analysis. Stakeholder input from the city departments and community stakeholders will be essential to further illuminating the community's social and physical vulnerabilities and adaptive capacity. Community engagement efforts, including those focused on the eastern part of the city, can help inform the greatest adaptive needs and help ground truth the data analysis in this report.

6 Appendix

Rationale for Social Vulnerability Indicators Rationale

(From CALBRACE unless otherwise noted)

Children

Children under 5 years old are especially vulnerable to the health impacts of climate change because they are rapidly growing, both physically and mentally: their lungs are developing, they breathe at a higher rate than adults, and they spend more time outdoors. Due to physiological and developmental factors, children are disproportionately impacted from the effects of heat waves, air pollution, infectious illnesses, and trauma resulting from climate change. Children are dependent on their caregivers for response to extreme weather events such as hurricanes and floods.

Disabled

Climate change is expected to cause increased hardship for persons with physical disabilities during emergencies due to extreme weather events and displacement as a result of flooding, erosion, and agricultural disruptions. Climate change will bring a range of more frequent, long lasting and severe adverse environmental changes, which can affect the severity and incidence of mental disabilities and mental health problems.

Education

Education has broad impacts on standards of living and social interactions, with consequences for the health of individuals and communities. Through three inter-related pathways, education influences health: health knowledge and behaviors; employment and income; and social and psychological factors.

Older adults

Since aging impairs muscle strength, coordination, cognitive ability, the immune system, and the regulation of body temperature (thermoregulation), people aged 65 and older are especially vulnerable to the health impacts of climate change.

Limited English

Climate change and increasing temperatures pose a serious public health concern for people who are linguistically isolated. Linguistic isolation may hinder protective behaviors during extreme weather and disasters by limiting access to or understanding of health warnings. Additionally, natural disasters and extreme weather can lead to disruptions to management of chronic conditions for people who are socially or linguistically isolated.

No Vehicle

Vehicle ownership is a measure of mobility and access to transportation. Transportation is a critical resource for survival, because it improves access to evacuation and shelter from environmental exposures, such as wildfire, air pollution, heat waves, and flooding, allowing people to move to cooler areas or other safe areas.

Outdoor Workers

Outdoor workers are at an increased risk of experiencing the health impacts of climate change. Working in an environment that is excessively hot poses a risk factor for heat health effects among persons who work outdoors.

Poverty

Poverty limits the acquisition of basic material necessities and impacts the ability to live a healthy life. It restricts people's access to housing, food, education, jobs, and transportation. Poverty is associated with societal exclusion and higher incidence and prevalence of mental illness.

Race and Ethnicity

Race and ethnicity are important determinants of health impacts of climate change. Racial and ethnic minorities are more likely to reside in high risk geographies (such as areas with fewer public transit routes and greater wildfire and flooding threats). These populations also experience disproportionately high levels of vulnerabilities to climate change, including comorbidities, lower income, poorer physical health, multiple chronic conditions, language barriers, older adults living alone, less access to vehicle ownership, less access to air conditioning, urban tree canopy, and occupational exposures such as outdoor environments.

Unemployed[57]

Unemployed persons lack employee benefit plans which can provide income and health cost assistance in the event of personal injury or death. Unemployment may restrict access to food and housing, increase prevalence of mental illness, and worsen social inclusion.

Uninsured

Insurance coverage is a key determinant of timely access and utilization of health services, which is a fundamental pathway to improved health outcomes. Excessive heat exposure, elevated levels of air pollutants, and extreme weather conditions are expected to cause direct and indirect health impacts, particularly for vulnerable populations with limited or no access to health services.

[57] Flanagan, E. Barry et al., A Social Vulnerability Index for Disaster Management, *Journal of Homeland Security and Emergency Management,* 2011

The SoVI® Methodology

The SoVI® methodology was first developed by Dr. Cutter at the Hazards and Vulnerability Research Institute at the University of South Carolina in 2003. The method differs from others in that it attempts to limit multicollinearity between indicators and allows us to more easily examine patterns in datasets with many variables (or in this case social vulnerability indicators). It achieves this by using a statistical approach called principal components analysis. This approach reduces the dimensionality of the indicators by creating a subset of components that still explain much of the variance in the data.

For this reason, the social vulnerability index utilized in this CVA is strongly based off the SoVI® method. Minor differences between the original method and the one used in the CVA include the selection of different social vulnerability indicators and the use of a finer spatial scale (census tract instead of county).

In order to compute the overall vulnerability scores of each census tract, several steps were taken. First, indicators were all pulled into a single data frame as percentages – i.e. percentage of persons in a census tract that are experiencing poverty. Then the data was normalized using a percent rank within Los Angeles County and standardized using z-score standardization. Once these steps were finished, a principal components analysis was completed using a varimax rotation. The varimax rotation exaggerates factor loadings and makes it easier to see which indicators contribute to each principal component. Principal components were selected based on variance/eigenvalues, with a threshold of one. In total five components were selected this way. Instead of an additive model that sums all 12 indicators equally, this resulted in five principal components that alone explain 78.06% of the variation. Lastly, an overall vulnerability score was generated by summing the selected components. This score was then used in GIS software to map vulnerability by census tract in Los Angeles County. Scores were separated into quantiles to improve interpretability and aesthetics.

The SoVI® scores for West Hollywood show that the two most eastern census blocks (7001.01 and 7001.02) are in the top 60% most vulnerable census blocks in the county. Comparatively, the other census blocks are in the bottom 40% most vulnerable. This illustrates a divide in vulnerability between the West and East portions of the city.

The top contributing indicators (older adults, disabled, and no vehicle access) were also examined separately. In each of these individual maps, the two most eastern census blocks are in the top 20% most vulnerable.

Critical Facilities Table

Name	Category	Sub-Category
Fire Station #7	Critical Facility	Fire Stations
Fire Station #8	Critical Facility	Fire Stations
City Field Services Facility	Critical Facility	Government Facilities
City Hall	Critical Facility	Government Facilities
Havenhurst Park	Critical Facility	Government Facilities
Kings Road Parking Structure	Critical Facility	Government Facilities
Plummer Park Community & Senior Center	Critical Facility	Government Facilities
Plummer Park Fiesta Hall	Critical Facility	Government Facilities
Plummer Park Various Structures	Critical Facility	Government Facilities
Werle Building	Critical Facility	Government Facilities
West Hollywood 5 Story Parking Structure	Critical Facility	Government Facilities
West Hollywood Library, Council Chambers, and Community Room	Critical Facility	Government Facilities
West Hollywood Park Auditorium	Critical Facility	Government Facilities
West Hollywood Park Various Structures	Critical Facility	Government Facilities
West Hollywood Sheriff's Station	Critical Facility	Police Station
Havenhurst Apartments	Property Housing Vulnerable Populations	Disabled
Sierra Bonita Apartments	Property Housing Vulnerable Populations	Disabled
Palm View	Property Housing Vulnerable Populations	HIV/AIDS
1225 Genesee	Property Housing Vulnerable Populations	Low Income Housing
7214 Fountain	Property Housing Vulnerable Populations	Low Income Housing
7719 Willoughby	Property Housing Vulnerable Populations	Low Income Housing
Fountain Ave	Property Housing Vulnerable Populations	Low Income Housing
The Firehouse	Property Housing Vulnerable Populations	Low Income Housing
Fairfax Towers	Property Housing Vulnerable Populations	Senior
Janet L. Witkin Center	Property Housing Vulnerable Populations	Senior
Movietown Square	Property Housing Vulnerable Populations	Senior

Palm Senior	Property Housing Vulnerable Populations	Senior
West Knoll Senior	Property Housing Vulnerable Populations	Senior
Courtyard on La Brea	Property Housing Vulnerable Populations	Special Needs