

Laguna Beach Climate Action and Adaptation Plan

Climate Change Vulnerability Assessment Report

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VULNERABILITY ASSESSMENT REPORT – EXECUTIVE SUMMARY

Executive Summary

The City of Laguna Beach (City) prepared a Vulnerability Assessment to analyze how climate change may harm the community and which population groups, aspects of community identity, and community assets are vulnerable.

The Vulnerability Assessment is part of Laguna Beach’s larger set of planning efforts to improve community health and safety, reduce the threat from natural hazards, and support a more sustainable community. In addition to the CAAP, the Vulnerability Assessment informs or syncs with the Local Hazard Mitigation Plan (LHMP), the General Plan Safety Element, the Emergency Operations Plan, and others. All these documents have different purposes and roles, and so each one presents information differently depending on their specific needs. However, they should all be generally in agreement about the key risks to Laguna Beach from natural hazards and the types of solutions to address these risks.

The Vulnerability Assessment identified 13 distinct hazards that pose a threat to Laguna Beach. It evaluated the degree to which population groups, aspects of community identity, and community assets are vulnerable to these hazards to identify **priority vulnerabilities**. Priority vulnerabilities are the people, natural systems, buildings, infrastructure, and community activities that will be the City’s priorities for adaptation and resilience planning based on their level of vulnerability and importance to the community. **Figure ES-1** shows the number of priority vulnerabilities associated with each of the 13 hazards.

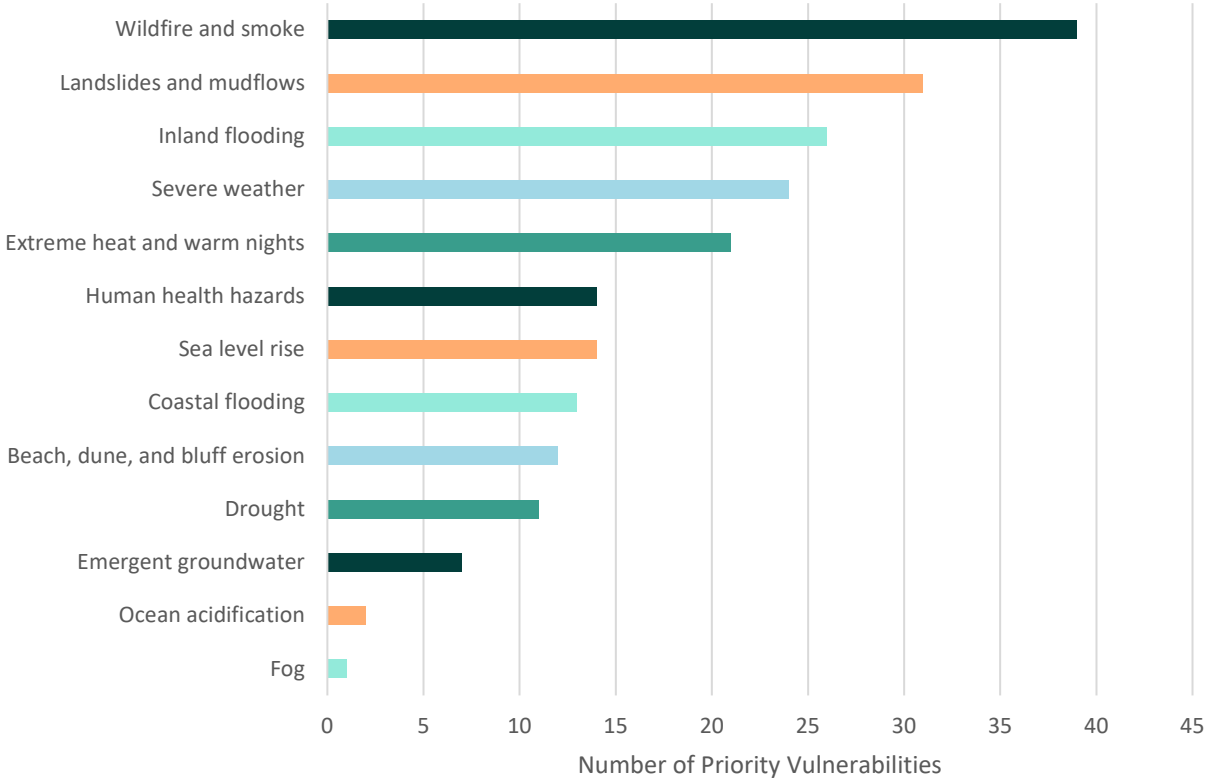
What’s the harm?

Climate change and related hazards can harm Laguna Beach in many ways. People may face death or physical or mental injury during hazard events. Hazards can damage or destroy buildings and infrastructure systems, interfering with the local economy and disrupting vital services and functions. Climate change can affect the beaches, open space areas, and other important natural resources, hurting the Laguna way of life and causing further economic harm.

If Laguna Beach cannot adapt and prepare for these changing conditions, the community risks serious damage or loss of the people and features that make it a special place, major economic harm, and very large bills for reconstruction and recovery costs.

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Figure ES-1. Hazards by Number of Priority Vulnerabilities



The Vulnerability Assessment follows the process outlined in the California Adaptation Planning Guide, with the goal of identifying the degree to which natural, built, and human systems are susceptible to harm from hazards and their current ability to respond and recover from hazard events (see **Appendix A** for additional detail). Select key insights from the Vulnerability Assessment are given below:

- **Wildfire and smoke** create the largest number of priority vulnerabilities in Laguna Beach, and can impact virtually all aspects of the community, including community identity and quality of life. Nearly all of the City of Laguna Beach and its surrounding 16,000 acres of open space are designated by CAL FIRE as a Very High Fire Hazard Severity Zone. This designation underscores the significant wildfire risk in the City. The City has a hilly terrain, significant vegetation that is fuel for wildfires and is subject to hot, dry summer and fall seasons and high-speed Santa Ana winds. These conditions are frequently involved in the most destructive fires in the region. Laguna Canyon in particular is severely vulnerable to wildfire given its steep topography, and large areas of Laguna Beach face an elevated risk. Laguna Canyon

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Road/Highway 133, which serves as a critical evacuation route, may be compromised in the event of a fire. Many artists live in studio spaces in Laguna Canyon due to a lack of affordable housing elsewhere in the community, which not only exposes them to a greater risk of wildfire, but can complicate evacuation efforts, since these spaces are not designated residential units and may not receive adequate evacuation or emergency notifications. Wildfire smoke affects populations with pre-existing health conditions like asthma, as well as workers that spend most of their workday outdoors. Laguna Beach is a coastal community whose beach and outdoor activities serve as a focal point for community identity and a critical component of the local economy, which could be impaired by wildfire smoke.

- Given the topography of Laguna Beach, the community is at high risk for **mudflows and landslides**, which is compounded by other hazards like severe storms, drought, and wildfire. According to Laguna Beach’s LHMP, approximately a third of community residents live in a landslide hazard zone, exposing them to risks of injury or property damage. Laguna Canyon Road and Pacific Coast Highway run through landslide zones, creating the risk that a landslide may block these roads and restrict ingress and egress to and from Laguna Beach. Landslides in coastal areas can also impact beaches and therefore the economy.
- **Inland flooding** due to consistent moderate or heavy rain places people and infrastructure at risk. The areas considered flood-prone are likely to expand due to climate change as heavy rainfall events are projected to occur more frequently and intensely. Laguna Beach’s most prominent flood hazard zones are along Rim Rock Drive and Laguna Canyon Road. These areas face a higher risk of flood-related injury and property damage as a result. Flooding can also exacerbate landslide risk in these zones.
- **Severe weather**, such as intense winds, lightning, and hail, can have severe impacts to populations and infrastructure as well as secondary effects such as scheduled or unplanned power outages. Severe weather is projected to occur more frequently and intensely due to climate change, damaging buildings and infrastructure and disrupting the services that depend on these structures. This can include loss of communication and economic harm. Power outages can also harm residents who depend on medical devices and interrupt electric vehicle charging, which may in turn hinder evacuation efforts if needed.

Tourism and vulnerability

Tourism is a major economic engine for Laguna Beach. The community attracts an estimated 6 million visitors annually, and almost a third of local jobs are in hospitality industries. Visitors come to Laguna Beach for world-renowned beaches, a thriving arts scene, major cultural festivals, and many other reasons.

Many natural hazards can harm Laguna Beach’s tourism economy by damaging the community’s major attractions, creating widespread economic impacts. A key goal of the CAAP is to help support the Laguna Beach economy so it can continue to thrive in future conditions.

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- The frequency of **extreme heat days** and warm nights are expected to increase with climate change. Extreme heat can cause heat-related illnesses, such as heat cramps, heat exhaustion, and heat stroke, and worsen respiratory and cardiovascular conditions. Over a quarter of Laguna Beach’s population is aged 65 or older, a population more vulnerable to health complications from heat exposure.
- **Emergent groundwater due to sea level rise** will likely flood low-lying inland areas, such as downtown Laguna Beach and areas near Aliso Creek. Emerging groundwater can damage buried infrastructure, flood below-grade structures, reduce storm and sanitary sewer capacity, release subsurface contaminants, compromise foundations, and create an urban flood hazard that can amplify overland storm flooding. This can block access and force buildings to close, resulting in economic harm to the community.
- **Beach and bluff erosion** due to sea level rise and severe storms affects infrastructure, homes, and the local economy. Shrinking beaches due to erosion would likely reduce overall quality of life in Laguna Beach and coastal tourism activity, jeopardizing the well-being of the local economy. Bluff erosion due to sea level rise and storms also impacts infrastructure and housing. By 2050, sea level rise may cause approximately 190 residential structures to be impacted by bluff erosion.

The City will use the results of the Vulnerability Assessment to help prepare the CAAP, which will help increase community resiliency from climate change-related hazards. Future work as part of the CAAP project will identify potential actions that the City and community members can take to increase resilience to climate change hazards.

VULNERABILITY ASSESSMENT REPORT

Introduction

COMMUNITY PROFILE

As noted in the 2023 LHMP, Laguna Beach is a small, coastal community in southern Orange County, California, between the Pacific Ocean and the San Joaquin Hills, approximately 45 miles southeast of downtown Los Angeles. The coastal areas of Laguna Beach sit on a series of coastal terraces with a flat coastal plain below Laguna Canyon. Laguna Beach's winding coastline forms numerous coves and beaches. Away from the coast, the city rises quickly into the ridges and canyons of the San Joaquin Hills. Although most of Laguna Beach is near the coast, the city also extends approximately five miles inland along Laguna Canyon. In the inland hillside areas, parts of the community reach elevations above 1,000 feet.

The community is connected to neighboring cities and the region by two major roadways, the Pacific Coast Highway (State Route 1) and Laguna Canyon Road (State Route 133). The Pacific Coast Highway runs the length of Laguna Beach near the coast, with two lanes in both directions. Laguna Canyon Road runs from Pacific Coast Highway through Laguna Canyon to eastern Irvine, with two lanes in both directions south of Canyon Acres Drive and one lane beyond. Major regional freeways accessible to the north and east include Interstates 5 and 405. There is a third state road through part of the community, State Route 73, which runs from Costa Mesa to Laguna Niguel through a short portion of the city's northern border, but it is only accessible to most of the community through Laguna Canyon Road.

DEMOGRAPHICS

Laguna Beach's 2021 population was estimated to be 24,090, with a median age of 53, and 27 percent of the city's population aged 65 and older. The median household income is \$135,976 and there are 13,000 households in Laguna Beach. Approximately 19 percent of households in Laguna Beach are renters. Educational attainment is high in Laguna Beach, as over 98 percent of adults have a high school diploma or equivalent, and 65 percent have a bachelor's degree or higher. Approximately 86 percent of Laguna Beach residents identify as White, 8.2 percent of residents identify as Hispanic or



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Latino, 3.2 percent of the population identify as Asian, and 0.5 percent identify as Black. English is the predominant language spoken by residents at home, although other languages spoken in Laguna Beach include Spanish, Vietnamese, French, and German.

ECONOMY

Laguna Beach is known as a vacation and tourism destination, as well as a major cultural and arts center, with over 6 million visitors annually. The city is home to several art galleries and museums, with popular centers including the Laguna Art Museum, Laguna Beach Cultural Arts Center, Laguna Playhouse, and Festival of Arts of Laguna Beach. Dozens of beaches line the southwestern portion of the city, from Irvine Cove Beach in the north to Three Arch Beach in the south. According to the U.S. Census, almost a third of jobs (approximately 30 percent) in the community are in food services and accommodation. Other major economic sectors include education (approximately 13 percent), health care (approximately 11 percent), retail trade (approximately 9 percent), and various professional and technical services (approximately 9 percent). Although Laguna Beach has a strong local economy, most community members work elsewhere. Approximately 9,160 residents are employed, although only 1,080 (approximately 12 percent) work in Laguna Beach itself. Most employed residents commute to Irvine, other communities in Orange County, and Los Angeles County.

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VULNERABILITY ASSESSMENT

WHAT IS A VULNERABILITY ASSESSMENT?

The Vulnerability Assessment identifies who and what in Laguna Beach are most at risk of being harmed by climate change and analyzes the severity of impacts from climate change hazards in the community. It analyzes Laguna Beach's people, buildings, infrastructure, community services, economic drivers, and ecosystems to determine how they may be susceptible to these hazards, as well as the way that these diverse community features combine to contribute to Laguna Beach's unique community identity and quality of life. The Vulnerability Assessment informs community members, City staff, and decision makers about potential future hazard conditions, public safety issues, and welfare concerns. This helps the community allocate resources to the people and community assets that are most vulnerable, letting the community prepare for the future by improving resilience. The City will use the findings from the Vulnerability Assessment to inform adaptation and resilience policies in the Climate Action and Adaptation Plan (CAAP).

HOW DO WE KNOW WHO AND WHAT IS VULNERABLE TO CLIMATE CHANGE?

Climate change is a result of increases in greenhouse gas (GHG) emissions from human activities, mostly from burning fossil fuels such as oil and natural gas. These gases trap heat in the lower levels of earth's atmosphere. As the level of these gases increases, they trap more heat, causing shifts in global climate patterns. This results in warmer temperatures, changes in precipitation activity, sea level rise, and oceans becoming more acidic (known as primary stressors). These changes cause shifts in other effects, such as wildfires, severe storms, extreme temperatures, and many others (known as secondary stressors). Many of these stressors involve natural hazards and other dangerous situations, threatening communities across the globe. Climate change poses significant risks to human safety and well-being, private and public property,

A **hazard** is an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural losses, damage to the environment, interruption of business, or other types of harm or loss. This vulnerability assessment assesses the potential impacts of 13 different climate change hazards.

Vulnerability describes the degree to which natural, built, and human systems are at risk of exposure to climate change impacts. Differences in exposure, sensitivity, and adaptive capacity affect an individual's or community's vulnerability to climate change. Vulnerability can increase because of physical, social, political, and/or economic factor(s).

Resilience is the capacity of any entity to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience. Adaptation actions contribute to resilience, which is a desired outcome or state of being.

Source: Governor's Office of Emergency Services, California Adaptation Planning Guide.

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economic systems, and environmental health. According to the National Oceanic and Atmospheric Administration (NOAA), climate-related disasters in the United States cost at least \$92.9 billion in 2023, including flooding throughout California in the winter of 2023. NOAA reported 28 natural disasters with a cost of at least \$1 billion in 2023, more than the previous total of 22 such disasters in 2020, and far above the annual average of 8.5 \$1 billion disasters.*

Climate change vulnerability describes the degree to which a community’s people, places, and key community activities may be harmed by climate change hazards. Vulnerability is not a static characteristic of any person or community feature but can change according to one’s likelihood of exposure to a given climate hazard, one’s sensitivity to that hazard, and the available resources to support adaptation. The Vulnerability Assessment considers each of these components to support adaptation. The Vulnerability Assessment considers each of these components to vulnerability in a series of four steps that closely resemble the process recommended in the *California Adaptation Planning Guide*, published in 2020 by the California Governor’s Office of Emergency Services: (1) characterizing the city’s exposure to current and projected climate hazards; (2) identifying potential sensitivities and potential impacts to city populations and assets; (3) evaluating the current ability of the populations and community assets to cope with climate impacts, also referred to as its adaptive capacity; and (4) identifying priority vulnerabilities based on systematic scoring. **Figure 1** presents these steps.

Figure 1. California Adaptation Planning Guide Recommended Model



Climate change is likely to affect all people and community assets in Laguna Beach. However, these effects are not evenly distributed, and some people and assets are likely to be disproportionately affected. For example, a heat wave will cause extreme temperatures across Laguna Beach, reaching

* NOAA (2024). “2023: A historic year of U.S. billion-dollar weather and climate disasters”, <https://www.climate.gov/news-features/blogs/beyond-data/2023-historic-year-us-billion-dollar-weather-and-climate-disasters>.

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all community members. However, residents without air conditioners, those on medications that make them more susceptible to extreme heat, and those who work outdoors are more vulnerable to the effects of the heat wave since they have a reduced ability to protect themselves against the hazardous conditions. The Vulnerability Assessment considered the vulnerability of the following contributors to community identity, population groups, types of building and infrastructure, economic drivers, ecosystems and natural resources, and community services:

Exposure is the presence of people, infrastructure, natural systems, and economic, cultural, and social resources in areas that are subject to harm.

Sensitivity is the degree to which a species, natural system, or community, government, and other associated systems would be affected by changing climate conditions.

Impact is a specific negative result of a climate change effect, generally on a particular population or asset. Impact is often determined by the combination of exposure and sensitivity. For example, if the effect of climate change is that droughts are likely to become more frequent and severe, a potential impact to farmers is that less water could be available for irrigation.

Adaptive capacity is the combination of the strengths, attributes, and resources available to an individual, community, society, or organization that can be used to prepare for and undertake actions to reduce adverse impacts [or] moderate harm or [to] exploit beneficial opportunities. Simply stated, it is the ability to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.

Source: Governor's Office of Emergency Services, California Adaptation Planning Guide.

COMMUNITY IDENTITY

- | | |
|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • Art-centered community • Beach-focused community • Quality of life | <ul style="list-style-type: none"> • Safe and accessible community • Greenbelt (parks and trails) |
|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|

POPULATIONS

- | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • Children under 10 years of age • Low-resourced households • Outdoor workers • People of color and linguistically isolated persons • Persons experiencing homelessness | <ul style="list-style-type: none"> • Persons living on single-access roads • Persons with limited mobility or health concerns, including those with access and functional needs • Persons without access to lifelines • Senior citizens • Short-term visitors |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

BUILDINGS AND INFRASTRUCTURE

- | | |
|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • Beach facilities • Energy and communication infrastructure | <ul style="list-style-type: none"> • Art centers and museums • Art installations • Government and community facilities |
|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|

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<ul style="list-style-type: none"> • Hazardous materials sites • Trails • Transportation infrastructure • Vehicle fuel stations • Water and wastewater infrastructure 	<ul style="list-style-type: none"> • Commercial businesses • Medical and care facilities • Homes and residential structures • Public safety buildings • Schools
ECONOMIC DRIVERS	
<ul style="list-style-type: none"> • Entertainment, cultural events, and museums • Coastal tourism • Education services 	<ul style="list-style-type: none"> • Hotels and lodging • Retail • Outdoor recreation
ECOSYSTEMS AND NATURAL RESOURCES	
<ul style="list-style-type: none"> • Beaches • Chaparral and sage brush • Estuaries • Marine Protected Areas 	<ul style="list-style-type: none"> • Oak woodlands • Parks and open space • Riparian areas
KEY SERVICES	
<ul style="list-style-type: none"> • Beach access • Emergency services • Energy delivery and communication services • Government administration and community services • Public transit access 	<ul style="list-style-type: none"> • Recreation services • Senior services • Solid waste removal • Water and wastewater

These population groups and community features are described in greater detail in **Appendix C**.

Which Climate Change Hazards Will Affect Laguna Beach?

The Vulnerability Assessment analyzes the impacts of climate change in Laguna Beach by assessing the degree to which climate change hazards can affect the city’s people, places, and operations. A **hazard** is an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural losses, damage to the environment, interruption of business, or other types of harm or loss.

The project team reviewed state and regional studies and data to identify the climate change-related natural hazards that are likely to affect Laguna Beach over the next several decades along with other safety-related planning documents such as the City’s 2023 Local Hazard Mitigation Plan (LHMP). These hazards include many that the community is already experiencing or has experienced in past years, such as the 1993 Laguna, 2018 Aliso, and 2022 Coastal fires, as well as “new” hazards that are projected to begin occurring in future years and decades as climate change continues. This section provides an overview of the 13 climate change hazards that are most likely to affect Laguna Beach,

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including coastal flooding, drought, beach/dune/bluff erosion, emergent groundwater, extreme heat and warm nights, fog, human health hazards, inland flooding, landslides and mudflows, ocean acidification, sea level rise, severe weather, and wildfire and smoke., organized by the number of priority vulnerabilities they create in Laguna Beach Additional details about each of these hazards are in **Appendix B**.



Beach and bluff erosion



Coastal flooding



Drought



Emergent groundwater



Extreme heat and warm nights



Fog



Human health hazards



Inland flooding



Landslides and mudflows



Ocean acidification



Sea level rise



Severe weather



Wildfire and smoke

The Vulnerability Assessment considers additional hazards not included in other City planning documents. Since the CAAP is a long-term plan that looks at hazardous conditions out to 2100, the Vulnerability Assessment evaluates conditions that are not present in the community now, but that are likely to occur in the future. It considers harm from climate change that occurs slowly over a long period of time, rather than being a discrete and acute “hazard event”. The Vulnerability Assessment is also only focused on climate change-related hazards, and so does not consider hazards such as earthquakes, which are not significantly affected by climate change. The following table shows how the Vulnerability Assessment and other documents consider different hazards.

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HAZARD	VULNERABILITY ASSESSMENT	LHMP	EMERGENCY OPERATIONS PLAN	SAFETY ELEMENT
Beach and bluff erosion	Included	Included (part of “Coastal hazards” section)	Not included	Included (part of “Shoreline protection” section)
Civil disturbance and riots	Not included	Included (part of “Human-caused hazards” section)	Included (part of “Human-caused hazards” section)	Not included
Coastal flooding	Included	Included (part of “Coastal hazards” section)	Included (part of “Coastal hazards and flooding” section)	Included
Cyber threats	Not included	Included (part of “Human-caused hazards” section)	Included (part of “Human-caused hazards” section)	Not included
Drought	Included	Included (part of “Extreme weather” section)	Not included	Included (part of “Climate adaptation” section)
Emergent groundwater	Included	Not included	Not included	Not included
Extreme heat and warm nights	Included	Not included	Not included	Included (part of “Climate adaptation” section)
Fog	Included	Not included	Not included	Not included
Hazardous materials release	Not included	Included	Included	Included
Human health hazards	Included	Included (part of “Disease and pest management” section)	Not included	Not included
Inland flooding	Included	Included	Included (part of “Coastal hazards and flooding” section)	Included

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HAZARD	VULNERABILITY ASSESSMENT	LHMP	EMERGENCY OPERATIONS PLAN	SAFETY ELEMENT
Landslides and mudflows	Included	Included	Included (part of “Earthquakes, liquefaction, landslides” section)	Included (part of “Seismic and geologic hazards” section)
Ocean acidification	Included	Not included	Not included	Not included
Oil spill	Not included	Not included	Included	Not included
Sea level rise	Included	Included (part of “Coastal hazards” section)	Not included	Included (part of “Shoreline protection” section)
Seismic hazards (earthquake, liquefaction, tsunami, etc.)	Not included	Included (tsunamis part of “Coastal hazards” section)	Included (part of “Earthquakes, liquefaction, landslides” section)	Included (part of “Seismic and geologic hazards” and “Shoreline protection” sections)
Severe weather	Included	Included (part of “Extreme weather” section)	Included	Included (part of “Climate adaptation” section)
Terrorism	Not included	Included (part of “Human-caused hazards” section)	Included (part of “Human-caused hazards” section)	Not included
Tree mortality	Included indirectly as part of other hazards	Included (part of “Disease and pest management” section)	Not included	Not included
Wildfire and smoke	Included	Included	Included	Included



WILDFIRE AND SMOKE

Wildfires are fires that burn in natural areas, although they can spread into developed areas between urbanized and wildland areas (called the wildland-urban interface) where they can harm people and damage property.

The topography of Laguna Beach is extremely conducive to wildfires. The community is bordered by natural, undeveloped hillsides, and the developed areas are very narrow, so much of the community is very close to these hillsides. All the canyon and hillside areas in Laguna Beach, as well as some parts of the coastal terraces, are identified in CAL FIRE Very High Fire Hazard Severity Zones (VHFHSZ). In some places, the VHFHSZ extends south of Pacific Coast Highway to the coastline (**Figure 2**).

In October of 1993 the Laguna Fire burned over 16,000 acres and destroyed 441 buildings in and near Laguna Beach, prompting widespread evacuations. The community has also experienced more recent fires, including the 2018 Aliso fire and 2022 Coastal fire, although these have fortunately been much less destructive. Recent wildfires have increased fire insurance costs in Laguna Beach, which may impose financial strain for those living in fire hazard areas.

Laguna Beach is often affected by Santa Ana winds blowing through the Santa Ana Mountain range. Santa Ana winds are a major contributor to accelerating the spread of wildfires in California. Climate change is expected to increase temperatures and more frequent and intense drought conditions. This will likely increase the amount of dry plant matter available for fuel, increasing the risk of wildfire statewide. In the hills of Laguna Beach, which are already highly prone to wildfires, climate change is not expected to substantially increase the number of acres burned annually. However, increases in fuel supplies could cause wildfires to move faster or spread into more-developed areas, which could increase the threat to Laguna Beach. Smoke is a byproduct of wildfires made up of gases and very small particles, usually no bigger than a few microns, and can travel for hundreds of miles. Wildfire, and associated smoke, is projected to increase with climate change due to higher temperatures and drought.

Wildfire Evacuation

Given the large area of Laguna Beach that is highly vulnerable to wildfire, effective evacuation planning is a key community concern. In the event of an emergency, most community members would likely evacuate in either direction along the Pacific Coast Highway, and Laguna Canyon Road would serve as the evacuation route for residents in the canyon. If the Pacific Coast Highway is inaccessible, the only way out of Laguna Beach is through Laguna Canyon Road, which could easily become congested due to its limited capacity.

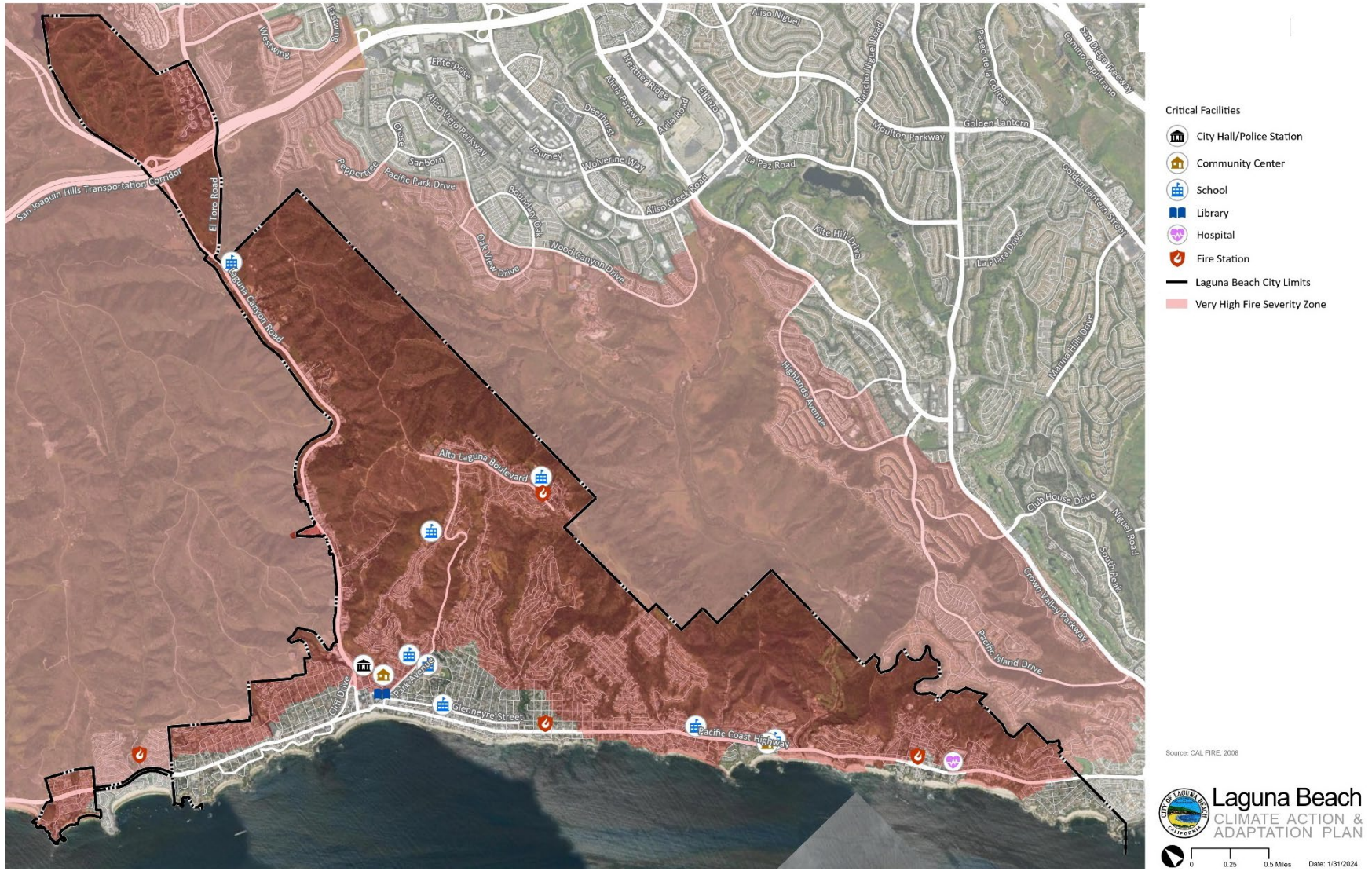
The City conducted a detailed study of times to evacuate the community during a wildfire in 2021. Evacuation times vary by time of day and year, but fully evacuating all of Laguna Beach could take upwards of four hours.

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Wildfire and Smoke Adaptive Capacity

- Zone-specific evacuation plans.
- Measure LL spending includes augmenting fire protection and emergency response services and utility undergrounding.
- Evacuation route widening around Bluebird Canyon Drive.
- A robust alert and warning plan that includes multiple different emergency alerting platforms: Wireless Emergency Alerts, AlertOC, Nixle, Downtown Outdoor Warning System, and Emergency Alert System, which work with evacuation plans to provide guidance for the evacuation of a neighborhood or the entire city.
- Orange County benefits from County of Orange Area Safety Task Force (COAST), an interagency organization, which was formed in 2013 to facilitate a more comprehensive, and effective approach to addressing wildfire issues in Orange County.
- A vegetation management program that details specific fuel modification zones and treatment methods.
- The Wildfire Mitigation and Fire Safety Report, describing the community's risk from wildfires, existing programs, and resources to protect against wildfire hazards, and a series of additional mitigation measures that the community can consider. These measures include permit streamlining, traffic control systems to improve evacuation, new firefighting equipment, and undergrounding of several electricity lines.

Figure 2: Wildfire Hazard Areas



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LANDSLIDES AND MUDFLOWS

A landslide happens when the side of a hill or mountain becomes unstable, causing soil and rocks to slide down the slope. When a landslide's soil is very wet, the event is called a mudflow. Wildfire and heavy rain, both of which are projected to occur more often due to climate change, exacerbate landslide risk. Landslides can harm people and damage buildings and vital infrastructure. Given the large area of Laguna Beach that is moderately to highly susceptible to landslide (**Figure 3**), landslide damage could have significant community-wide impacts.

Landslide and Mudflows Adaptive Capacity

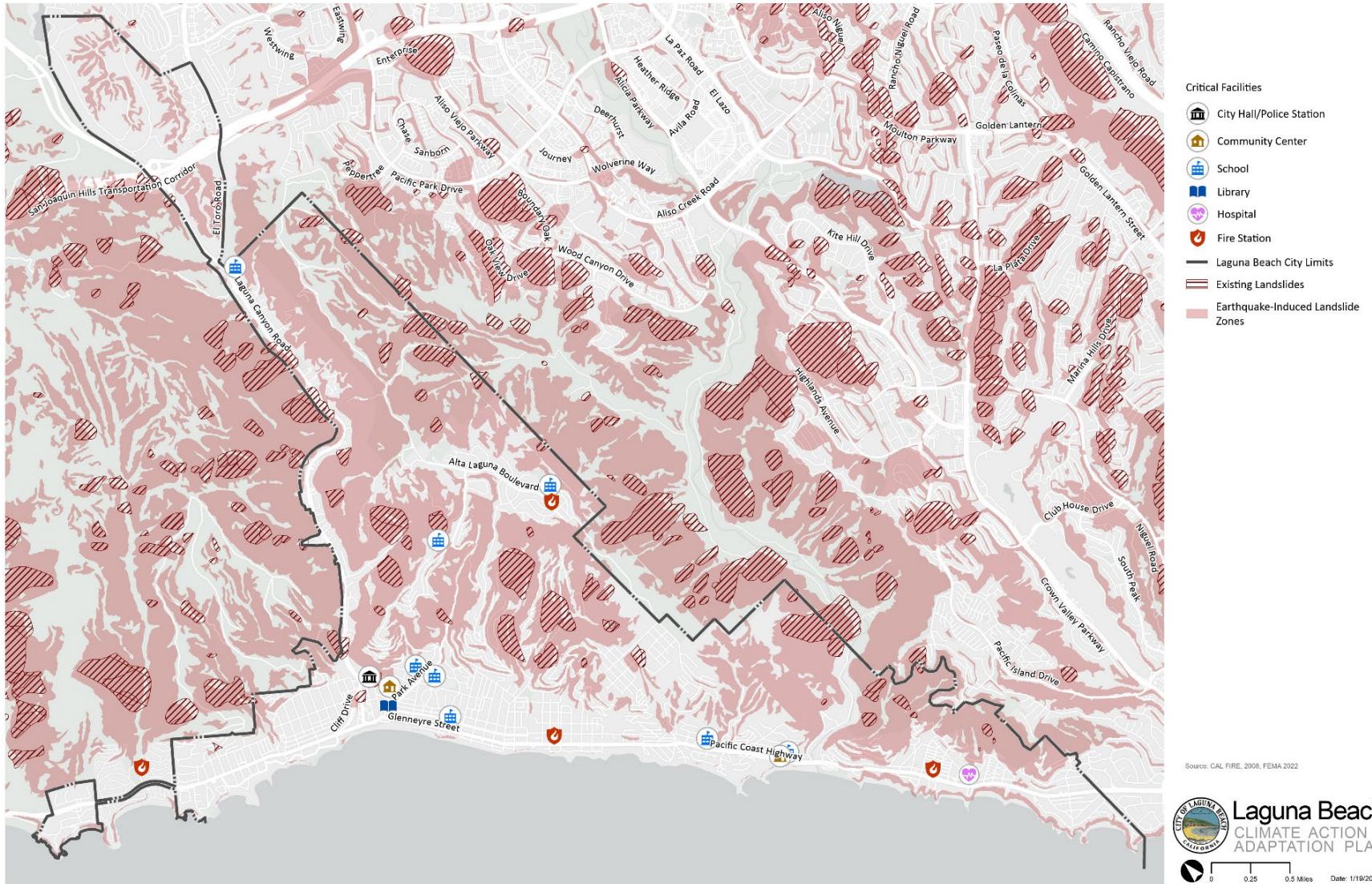
Under the City's Fuel Modification Zone (FMZ) program, the preponderance of roots of perennial plants will be left in place to minimize erosion. Mulch and other erosion control measures (such as straw wattles and/or jute netting) will be installed as necessary for additional protection without being obtrusive. Laguna Beach can also distribute warnings about landslides through the citywide alert systems.



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Figure 3: Landslide Hazard Areas



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INLAND FLOODING

An inland flood occurs when there is too much water on the ground to be carried away by drains or creeks or to soak into the soil. They are often caused by heavy rainfall, but can also result from breaks in water infrastructure, such as pipes or water tanks.

Floodwaters can be deep enough for people to drown and moving fast enough to sweep people away. Moving water can damage buildings with its force (in extreme cases, it may move entire structures) or carry large debris. When water gets into buildings, it can cause extensive damage, ruining building materials, furniture, and electronics, and exposing residents to toxic materials, pathogens, and mold. Standing and moving water can be barriers to movement, isolating people and hindering evacuation, rescue, or relief efforts. This is of particular concern in Laguna Canyon and Downtown, where floodwaters can isolate neighborhoods and cut off access for evacuating residents and emergency responders.

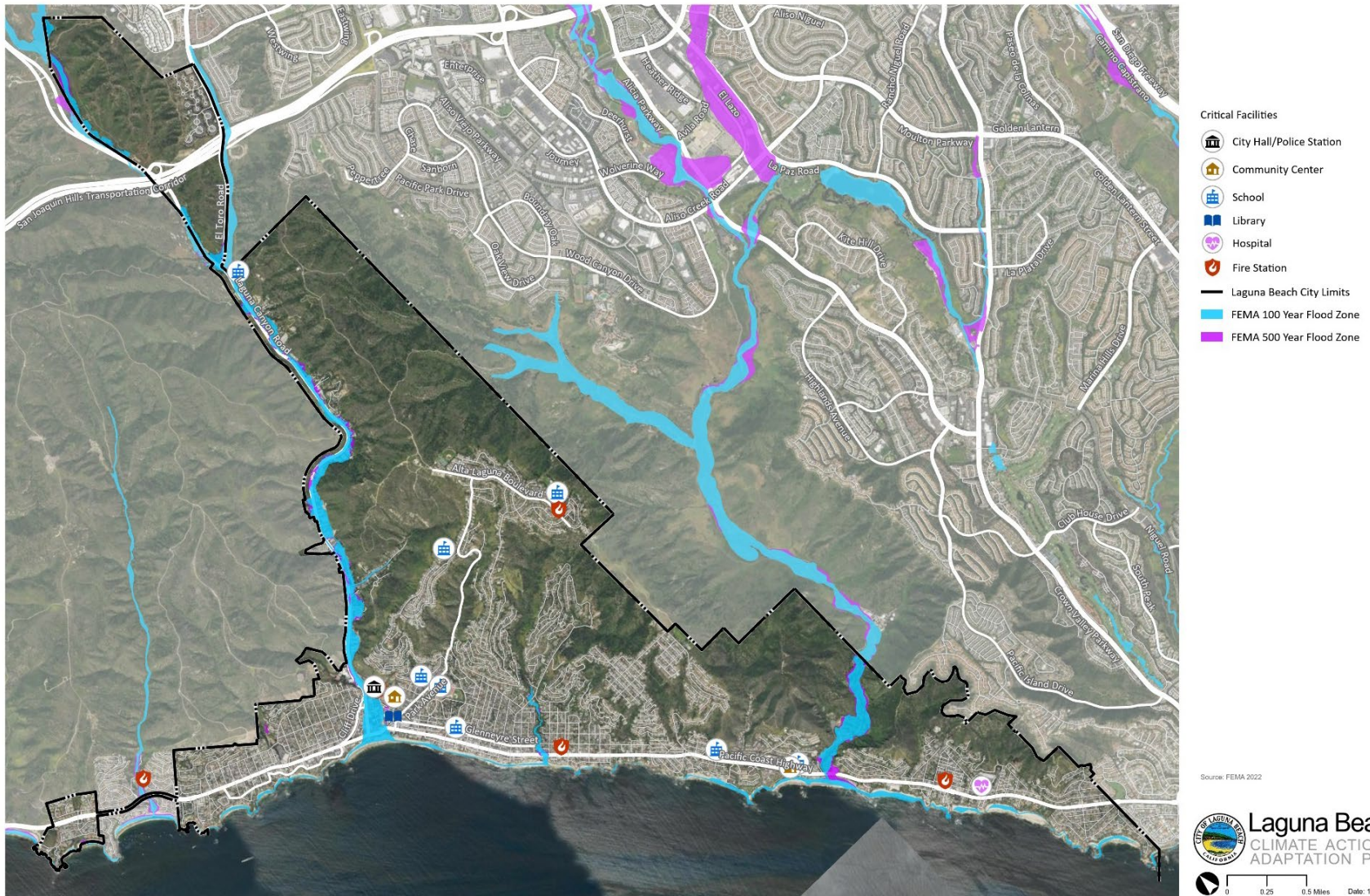
Laguna Beach contains 1-year, 100-year, and 500-year flood zones (areas where a storm of this severity have a 100 percent, 1 percent, and 0.2 percent chance of occurring in any given year, respectively). However, such storms may occur more frequently than their names suggest. For example, parts of Southern California experienced a 1,000-year storm (those with a 0.1 percent chance of occurring in any given year) in December 2023, followed by another storm of similar magnitude only a month later. **Figure 4** shows maps of the 100-year and 500-year flood zones in Laguna Beach. Laguna Beach's largest flood hazard zones are along Rim Rock Drive and along Laguna Canyon Road. The areas considered flood-prone are likely to expand due to climate change as heavy rainfall events are projected to occur more frequently and intensely.

Inland Flooding Adaptive Capacity

- Floodgates in the downtown area are required as per the City Code and inspected by Code Enforcement.
- Maintenance of the Laguna Canyon Channel, including debris removal, inspection, vegetation clearing, and outreach to owners of private property.
- Sandbags are available at fire stations, the City Corporate Yard, and the Aliso Beach parking lot.
- Central Local Drainage Area Fund: A special fund established in the 2023-24 budget. All fees collected via this program shall be expended for the construction of local drainage facilities within the Central Local Drainage Area.
- Laguna Beach participates in the National Flood Insurance Program. This program allows property owners to buy flood insurance through a network managed by the Federal Emergency Management Agency (FEMA). The City agrees to adopt and implement regulations on development in flood-prone areas to reduce the local flood risk.

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Figure 4: Inland Flooding Hazard Areas



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SEVERE WEATHER

Severe weather in Laguna Beach includes intense winds, lightning, hail, and related events. Severe storms can harm people, buildings, and infrastructure. Intense rains can cause floods, which can damage buildings and create a risk of personal injury or drowning and increase the risk of erosion and landslides. Should high wind coincide with especially hot and dry temperatures, Southern California Edison and San Diego Gas and Electric may elect to pre-emptively shut off power to certain neighborhoods to reduce wildfire risk. Laguna Beach has experienced several of these public safety power shutoff (PSPS) events.

Severe Weather Adaptive Capacity

The City of Laguna Beach provides emergency warnings, including severe weather alerts, through AlertOC and via radio, social media, vehicle public address systems, and door-to-door canvassing. The City is also working with Southern California Edison to underground power lines and encourage community members to install battery energy storage systems at homes and businesses to reduce the chances of power disruption.

Severe winter storms could affect any part of Laguna Beach, although variations in intensity throughout the storm system may result in somewhat more or less severe weather between neighborhoods. Severe weather is projected to occur more frequently and intensely due to climate change.

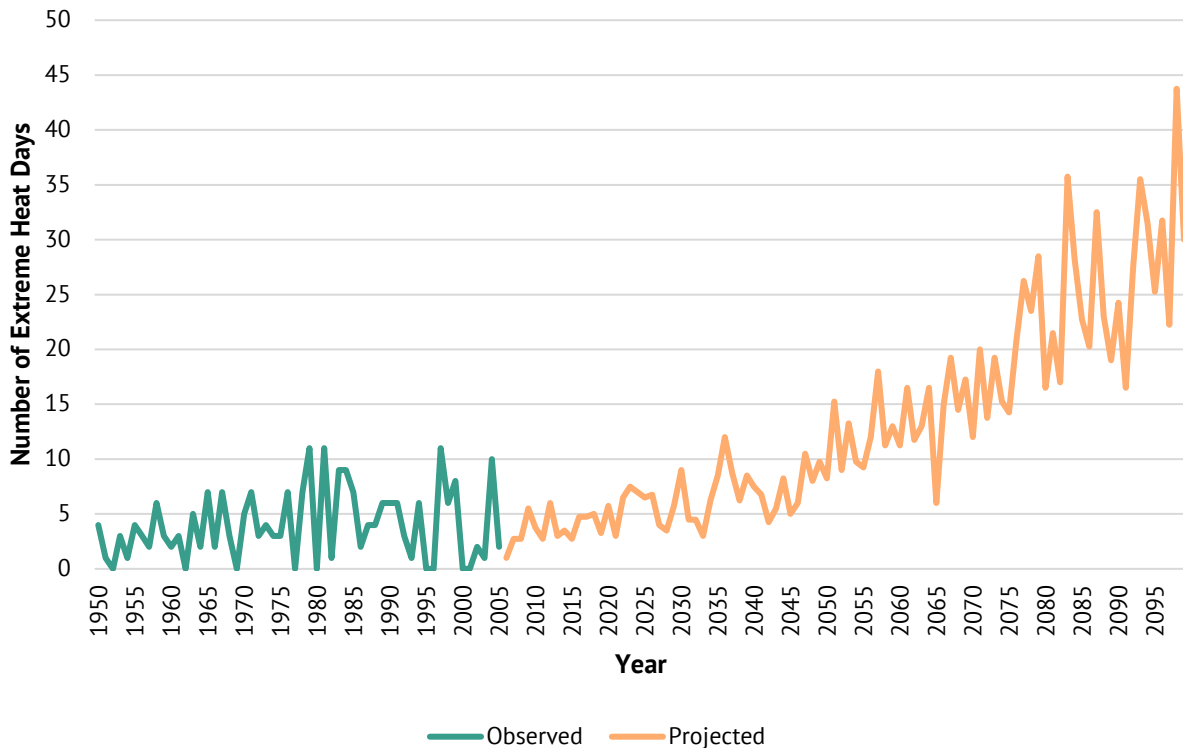


EXTREME HEAT AND WARM NIGHTS

Extreme heat occurs when temperatures rise significantly above normal levels, which in Laguna Beach is 88.1 degrees Fahrenheit (°F). Historically, Laguna Beach has experienced an average of three extreme days per year. Under climate change, these numbers are expected to increase to ten days per year by the middle of this century (2035 to 2064) and to 24 days per year by the end of the century (2070 to 2099), as shown in **Figure 5**.

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Figure 5: Observed and Projected Extreme Heat Days in Laguna Beach

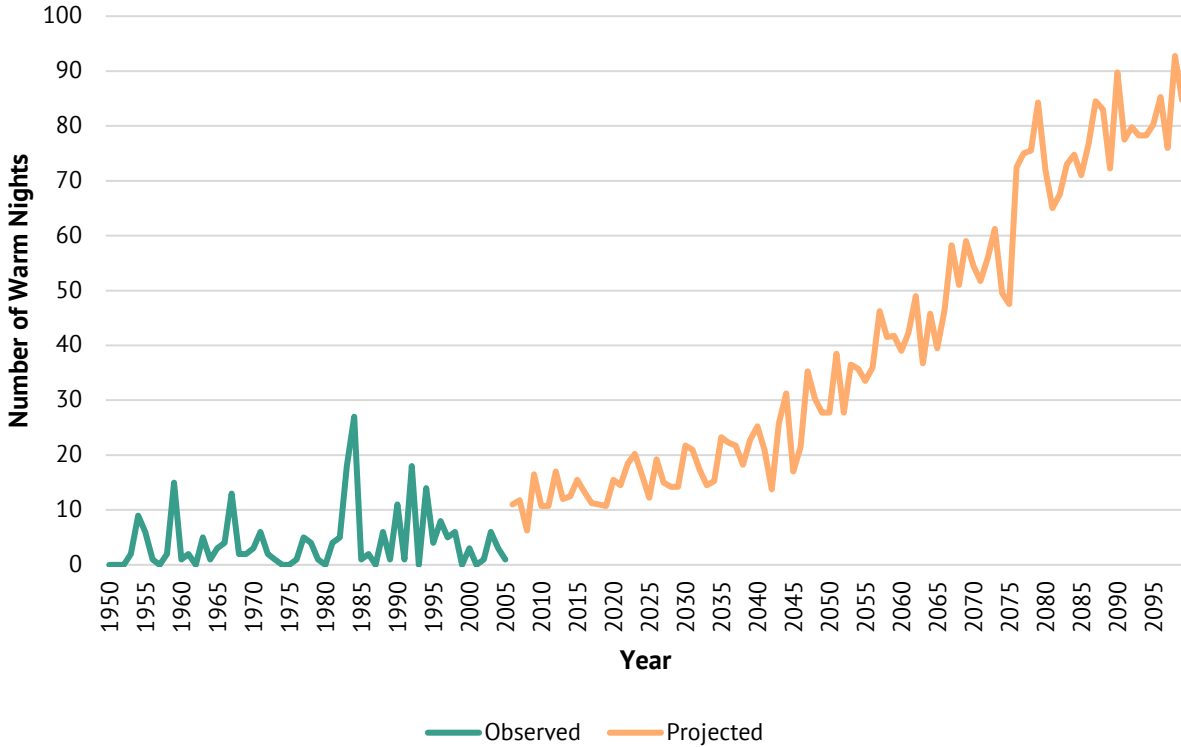


Due to a lack of data from weather stations near Laguna Beach after 2006, it is not possible to show observed data after 2006. Note that climate projections of future extreme heat days do not precisely sync with observed data.

Warm nights occur when minimum temperatures remain significantly above normal levels (65.2°F in Laguna Beach) during nighttime hours. Extreme heat and warm nights are expected to occur more frequently due to climate change. Historically, Laguna Beach has experienced an average of five warm nights per year. Under climate change, these numbers are expected to increase to 31 nights per year by the middle of this century (2035 to 2064) and to 73 nights per year by the end of the century (2070 to 2099), as shown in **Figure 6**.

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Figure 6: Observed and Projected Warm Nights in Laguna Beach



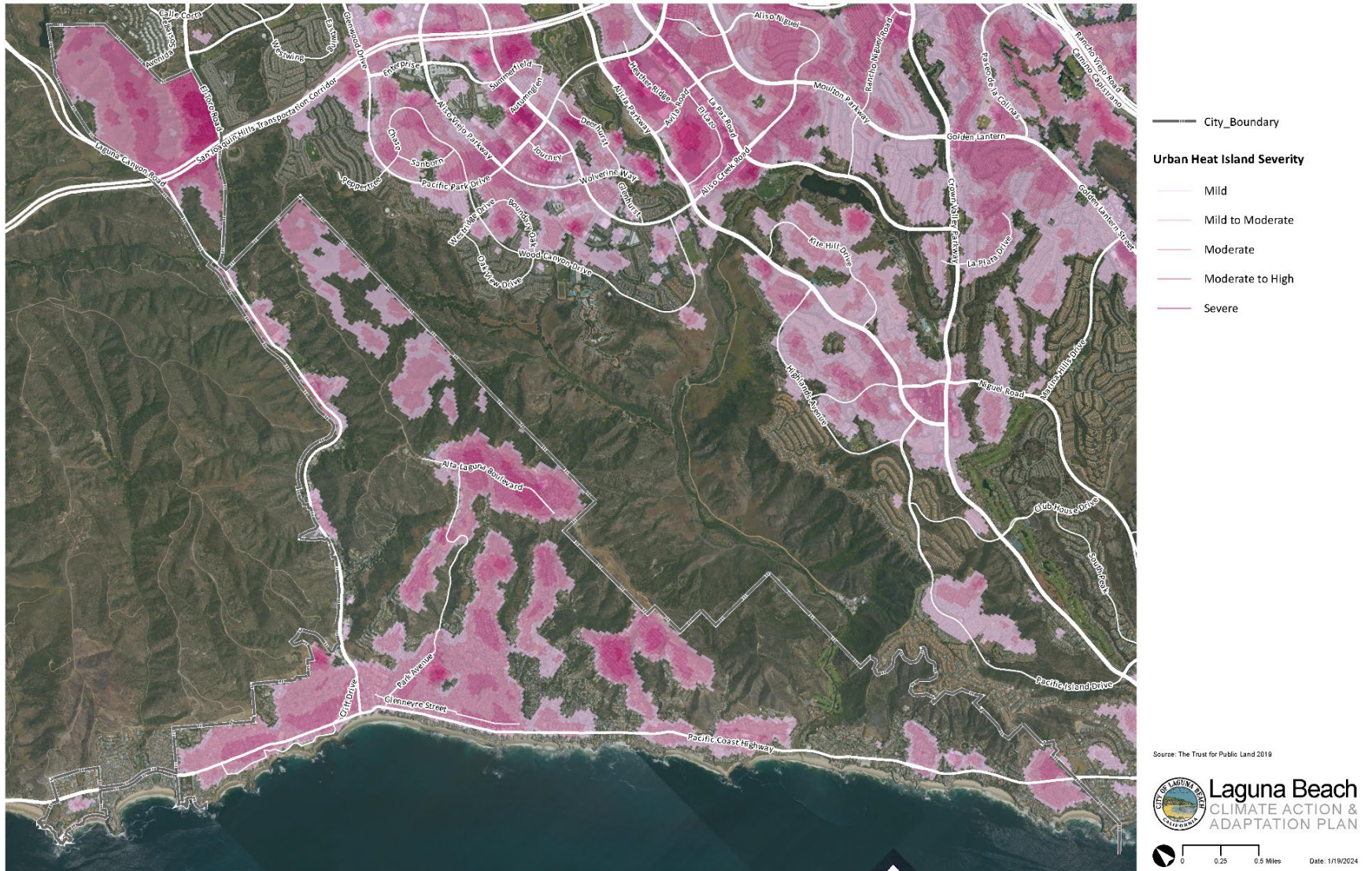
Due to a lack of data from weather stations near Laguna Beach after 2006, it is not possible to show observed data after 2006. Note that climate projections of future warm nights do not precisely sync with observed data.

Extreme heat can cause heat-related illnesses, such as heat cramps, heat exhaustion, and heat stroke, and worsen respiratory and cardiovascular conditions. In severe instances, extreme heat can be fatal. Extreme heat can also have indirect effects on the community, including more visitors traveling to the area to escape high temperatures further inland and strain on the power grid as more households use air conditioning and fans to cool spaces. Due to the city’s historically mild climate, many homes in Laguna Beach lack air conditioning. Limited residential access to air conditioning may exacerbate community risk to high heat. Due to the chronic, long-term nature of this hazard, short-term safety documents, such as the LHMP, do not identify this as a hazard in Laguna Beach.

Some areas of Laguna Beach are more vulnerable to high heat than others. These areas, known as urban heat islands, are areas where the average temperature is hotter than the average temperature for Laguna Beach as a whole. As shown in **Figure 7**, these urban heat islands are near Laguna Beach High School, Poplar Street north of High Drive, in the neighborhood surrounding Top of the World Elementary School, the intersection of Noria Street and Capistrano Avenue, and the intersection of Santa Ana Street and Cortez.

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Figure 7: Urban Heat Islands in Laguna Beach



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Extreme Heat Adaptive Capacity

- The City provides cooling centers at the Laguna Beach Library and Susi Q Center.
- Weatherization and energy efficiency programs are provided by SoCalGas, Southern California Edison, and SoCalREN.
- The Laguna Beach CERT team provides education and outreach about the risks of extreme heat.
- The City of Laguna Beach encourages property owners to retain, maintain, and preserve the aesthetic character and health of significant trees on their property. A robust tree canopy helps reduce heat impacts.



HUMAN HEALTH HAZARDS

Human health hazards are bacteria, viruses, parasites, and other organisms that can cause diseases in people. Climate-related human health hazards are usually diseases carried by animals that are considered pests, such as mice and rats, mosquitos, and ticks. Warmer temperatures and increased precipitation increase pest populations by expanding pest ranges and hours of activity and accelerating pest life cycles. Human health hazards that are of concern to Laguna Beach and the region include West Nile Virus, Zika Virus, and ticks.

Areas where pests gather could pose a greater danger to humans who live nearby or visit regularly. Mosquitoes, for example, are known to congregate around pools of standing water as this is where they lay their eggs. Any pools or other bodies of standing water in Laguna Beach likely pose an increased risk to anyone who regularly spends time near these locations of being bitten by a mosquito and potentially being infected by a mosquito-borne disease. Diseases and pests affect everyone in Laguna Beach to some degree, from a mild inconvenience to a fatal condition.

Human Health Hazards Adaptive Capacity

- The Laguna Beach Community Clinic - The mission of the Laguna Beach Community Clinic is to provide excellent medical care regardless of the patient's ability to pay.
- Efforts of the Orange County Mosquito and Vector Control District to test and control the pest population.
- Orange County Health Care Agency services including clinics, Environmental Health Division, Communicable Disease Control Division, and immunization/vaccines. Can help refer people to affordable health care services.
- Families Together of Orange County and Orange County Free Clinic offer free or affordable health services.

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SEA LEVEL RISE

Sea level rise, the gradual increase in average high tide lines, is expected to increase the frequency and intensity of coastal flooding (flooding along the Laguna Beach shoreline). Sea levels in Laguna Beach are projected to rise as much as 1.8 feet by 2050 and 6.7 feet by 2100, as shown in **Figures 8** and **9**.

Depending on the exact nature of future climate conditions, sea level rise and coastal flooding during a significant storm[†] could combine to impact significant portions of the Laguna Beach coastline, flooding up to 85 homes and 24 streets as far inland as Downtown Laguna Beach. **Figures 8** and **9** highlight the additional areas that could be temporarily inundated during a 100-year storm with 1.8 or 6.7 feet of sea level rise.[‡]

[†] The 100-year storm was used to model and project the relationship between sea level rise and storm events in this report. A 100-year storm is a storm that, based on historical conditions, has a 1 percent chance of occurring each year.

[‡] The best available source for mapped sea level rise modeling does not currently show a 1.8-foot scenario. The maps in this Vulnerability Assessment show projected sea level rise at 1.6 feet, which is the closest available geospatial data alternative. Descriptions of specific areas affected by sea level rise in 2050 in this Vulnerability Assessment refer to areas affected by 1.6 feet of sea level rise, although this Vulnerability Assessment still supports planning for projected sea level rise of 1.8 feet by 2050.

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Figure 8: 2050 Sea Level Rise (1.8 feet)



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Figure 9: 2100 Sea Level Rise (6.7 feet)



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COASTAL FLOODING

Coastal flooding is flooding that occurs along the Laguna Beach shoreline due to wave run-up, storm surge, and high tides during coastal storms or king tide events. Strong storms over the Pacific Ocean can also contribute to coastal flooding, even if the storms do not cause any clouds, rainfall, or other storm-related conditions in Laguna Beach. Sea level rise, discussed later in this report as a separate hazard, is likely to make coastal flooding worse. Depending on the exact nature of future climate conditions, sea level rise and coastal flooding during a significant storm[§] could combine to impact significant portions of the Laguna Beach coastline, flooding up to 85 homes and 24 streets as far inland as Downtown Laguna Beach. The sea level rise section discusses the adaptive capacity issues associated with coastal flooding and maps the areas that may be affected by coastal flooding.



BEACH AND BLUFF EROSION

Beach and bluff erosion are the processes that wear down or carry away rocks, soil, and sands from beaches and cliffs along the coast due to wave action, wind, and rain. Intense storms and higher seas create larger winds, waves, and floods, leading to increased coastal erosion. Waves and winds can carry away beach sand little by little, shrinking scenic beaches along the Laguna Beach shoreline. Absent natural or human-made shoreline protection, beach sand is the primary buffer to protecting sea cliffs and coastal development. A narrower beach is less able to function as a buffer from wave action and coastal flooding, so beach erosion can increase the risk of bluff erosion when the beach is at the base of a cliff.

Erosion exposes infrastructure and public access sites to tides and storms. Bluff erosion causes parks or yards built on top of the bluffs to shrink over time. Erosion also weakens or hollows out areas under any structures, which may lead to a partial or complete collapse. If buildings and facilities on a beach or bluff have poor drainage, this can make erosion worse. The eroding bluffs can cause rocks and other debris to fall on the beach, creating a risk of serious injuries or fatalities. In recent years there have been two instances of large

Beach and Bluff Erosion Adaptive Capacity

The City is exploring a Zoning Code amendment to create a Bluff Overlay District. While much of the city's coastline is erosion-resistant, the Bluff Overlay District provides an opportunity to regulate future oceanfront development in a manner that acknowledges historical development patterns, while remaining protective of a site's coastal resources.

[§] The 100-year storm was used to model and project the relationship between sea level rise and storm events in this report. A 100-year storm is a storm that, based on historical conditions, has a 1 percent chance of occurring each year.

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rocks falling onto local beaches, although they fortunately occurred at a time when no one was on the beach.

Much of the Laguna Beach coastline has experienced little to no erosion (less than 2.4 inches/year) over the past 35 to 40 years because the beaches are backed by relatively erosion-resistant bedrock. This makes the Laguna Beach coastline unique compared to other reaches of the Southern California coast, reducing the rate of erosion and retreat of the coastline, which helps make the city's beaches popular with residents and visitors alike. However, projected loss of beach width area due to sea level rise may accelerate cliff erosion rates.



DROUGHT

A drought occurs when conditions are drier than normal for an extended period, making less water available for people and ecosystems. While there is uncertainty in future precipitation predictions, climate change is projected to result in more frequent and severe droughts, partly due to the greater variability in precipitation levels.

Laguna Beach's water comes from multiple sources, including local groundwater and imported water from the Sierra Nevada (via the State Water Project), Colorado River, and Owens River. Laguna Beach receives water from the South Coast Water District (south Laguna Beach only) and Laguna Beach County Water District (remainder of the community), both of which use a mix of local and imported groundwater and surface water. Droughts are regional events, so all parts of Laguna Beach face the same drought risk. Given the distributed nature of Laguna Beach's surface water sources, it is possible for the city to experience a "long distance drought", in which drought conditions in the Sierra Nevada or along the Colorado River watershed may impact the city's water supply.

Droughts can harm landscapes because plants do not get the water they need to survive. In severe cases, droughts may lead to a human health risk if available water supplies are insufficient to meet basic needs. Drought causes soil to dry out, causing soil compaction and preventing the absorption of water into the ground, which may increase flood risk and make soils more susceptible to erosion.

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Drought Adaptive Capacity

Both the South Coast Water District and Laguna Beach County Water District have developed programs to promote water efficiency and conservation and improve the resilience of the water supply, treatment, and delivery system to drought. Existing programs and measures include water waste prevention ordinances, water metering, water conservation pricing, public education and outreach, leak reduction programs, implementation of efficient irrigation at new developments, residential rebate programs for high-efficiency toilets, and turf removal and replacement rebate programs.

The South Coast Water District (SCWD) has implemented an extensive recycled water distribution system to irrigate parks, golf courses, and greenbelts. Current recycled water customers include the Montage Resort, Lang Park, The Ranch Golf Course & Bungalows, Monarch Links Golf Course at the St. Regis Resort, Niguel Shores Community Association, Dana Hills High School, the City of Dana Point parks, Golden Lantern and Town Center medians, Gloria Dei Lutheran Church, Lantern Bay Villas Homeowners Association (HOA), Lantern Bay Estates, Cape Cove HOA, Ritz Cove, Pacific Coast Highway median areas, County of Orange landscapes, and numerous other greenbelt areas in private HOAs. SCWD customers used 845 acre-feet of recycled water in 2020. SCWD is also currently pursuing construction of a regional ocean desalination plant in Dana Point called the Doheny Desalination Project.

The Laguna Beach County Water District has adopted a Water Use Efficiency and Water Supply Shortage Contingency Program that prescribes water conservation rules and regulations. The District's water-saving activities include water waste prevention ordinances, advanced metering infrastructure, conservation pricing, public outreach and education, and water conservation program coordination and staffing support. While these measures are important, it should also be noted that certain water conservation measures, such as water conservation pricing, can have a disproportionate burden on low-resourced households who may struggle to afford both higher water bills and water-efficient appliances.

EMERGENT GROUNDWATER

Emergent groundwater is where rising sea levels push the water table above the ground surface, which can cause ponding and surface flooding. Emergent groundwater is projected to occur in and near Aliso Creek and the low-lying areas east of Main Beach bounded loosely by Broadway Street, 3rd Street, and Mermaid Street (**Figure 10**). In these low-lying areas, flooding from below by emergent groundwater could occur long before coastal floodwaters overtop the shoreline. Emergent groundwater flooding can



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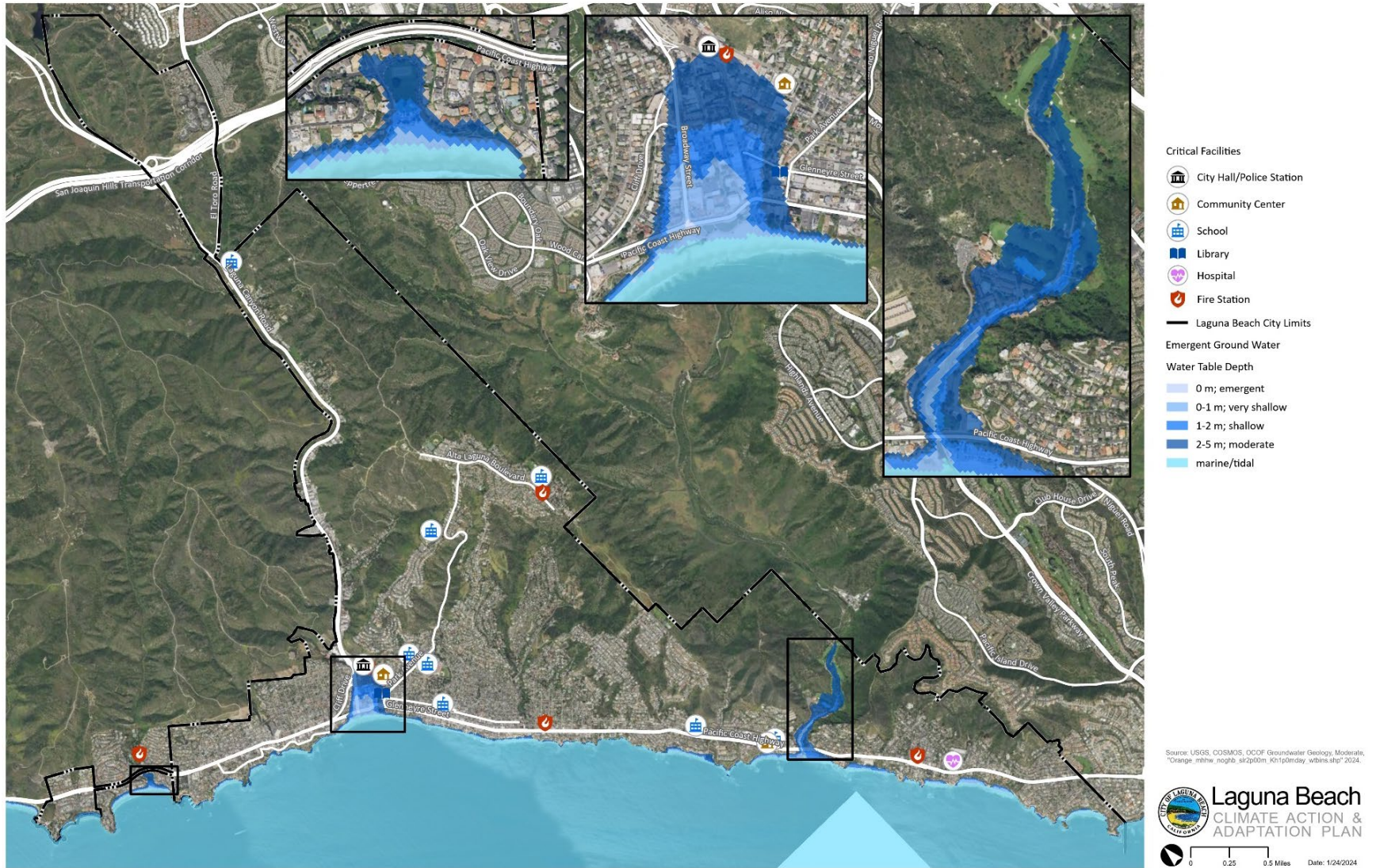
occur during dry weather (known as “sunny day flooding”), or during periods of heavy rainfall.

Emerging groundwater can damage buried infrastructure, flood below grade structures, reduce storm drain capacity, release subsurface contaminants, compromise foundations, and emerge above ground as an urban flood hazard. During heavy rainfall, emergent groundwater issues can amplify overland storm flooding.^{1,2,3} As sea level rises, groundwater inundation will prevent infiltration and drainage. It is likely that the downtown of Laguna Beach may be characterized by standing pools of brackish water, especially at high tide. This may affect traffic, walkways, and any movement in the area, including locations with high numbers of short-term visitors and tourists. Rising groundwater also makes soil more likely to lose structural integrity during an earthquake, increasing the severity of potential liquefaction impacts to buildings and infrastructure.

Emergent Groundwater Adaptive Capacity

Many of the flood-protection efforts in Laguna Beach can also help to reduce the threat posed by emergent groundwater. The City maintains flood monitoring plans and identifies capital improvements to address emergent groundwater and saltwater intrusion in the stormwater system. The Clean Water Compliance Programs, Water Quality Improvement Plan, and the City’s Jurisdictional Runoff Management Plan/Local Implementation Plan can all support these efforts.

Figure 10: Emergent Groundwater Hazard Areas



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OCEAN ACIDIFICATION

Ocean acidification, or the ocean becoming more acidic, refers to the ocean absorbing carbon dioxide (CO₂) from the atmosphere. Once absorbed, the CO₂ reacts with seawater to form an acid called carbonic acid. Ocean acidification is best known for its osteoporosis-like effects on shellfish, which makes building and maintaining shells difficult for these creatures, causing harm to the ocean food web. Ocean acidification may also cause illness in humans who eat shellfish. Estimates of future carbon dioxide levels indicate that the surface waters of the ocean could be nearly 150 percent more acidic by the end of this century if global emissions are not significantly reduced. There are no specific local programs or efforts to address ocean acidification.



FOG

Fog is a very low cloud— usually low enough to touch the ground—that forms when the air near the surface reaches the right temperature for water vapor in the air to condense into a cloud. In Laguna Beach fog provides a cooling effect for the area and coastal vegetation with water supply. Climate change is likely to decrease the frequency and extent of fog. A reduction in fog may exacerbate the effects of drought and extreme heat. There are no specific local programs or other actions that help address the risks associated with fog.

CASCADING AND COMPOUNDING HAZARDS

Each hazard considered in the vulnerability assessment has the potential to significantly affect the health, functionality, and well-being of Laguna Beach's communities, services, ecosystems, and infrastructure. However, these hazards do not exist in isolation. The effects of any given climate change hazard can have cascading or compounding effects on the city's populations, infrastructure, and ecosystems, meaning that impacts can be amplified, and the city can become more vulnerable to the impacts of additional climate hazards. Hazards compound when multiple types of hazards take place at the same time, such as when a landslide occurs during a severe storm. Cascading hazard effects play out over longer time scales, as the effect of one hazard modifies the city's ecosystems or infrastructural networks in a way that increases vulnerability to future hazards. **Figure 11** provides an example of these cascading effects.

Figure 11: Example of Cascading Effects



Examples of cascading effects specific to Laguna Beach include:

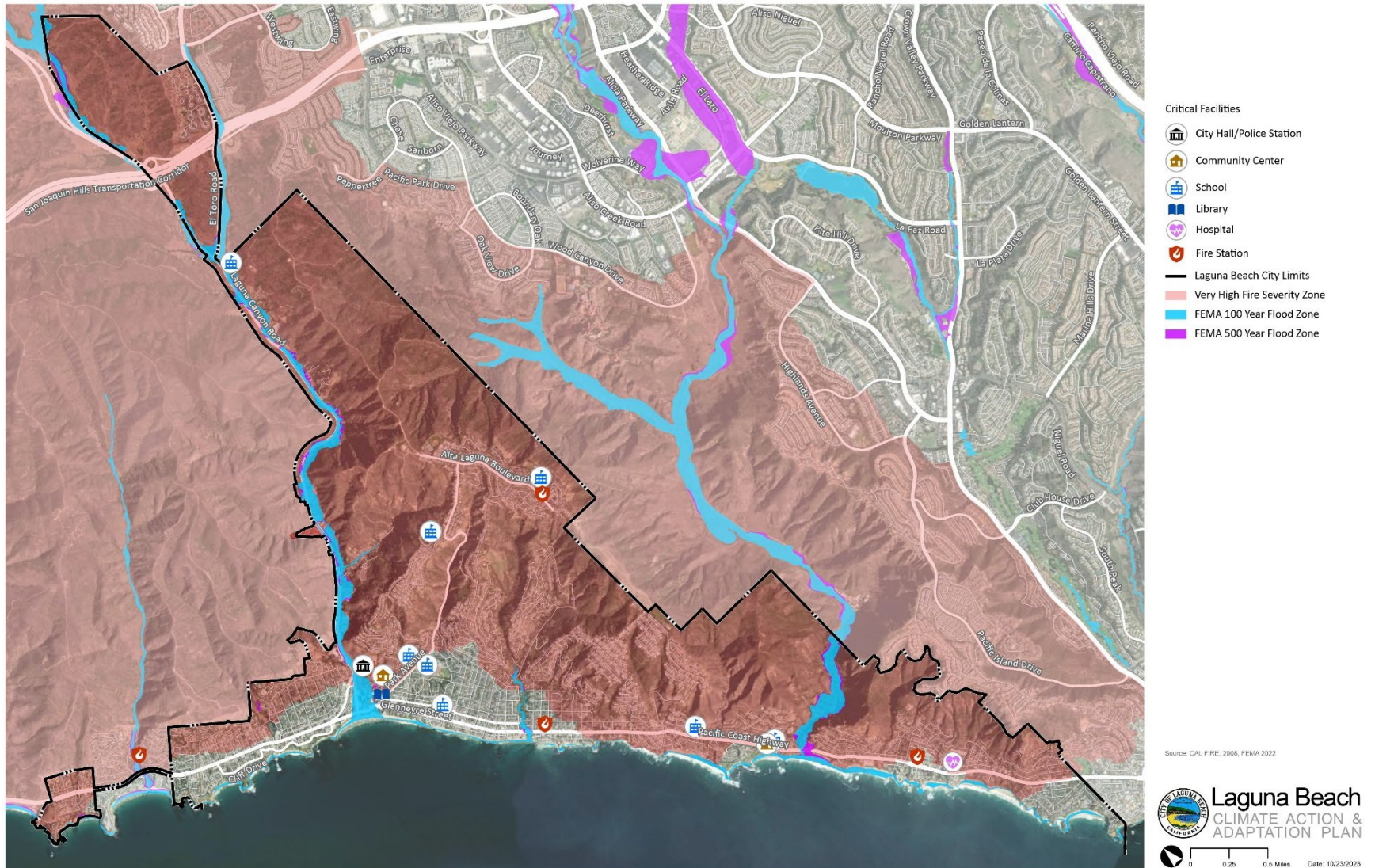
- Projected sea level rise will exacerbate the high tides and potentially increase the frequency and extent of hazardous areas associated with coastal flooding events. Coastal flooding in turn can accelerate beach and bluff erosion and coastal landslides. Rising sea levels may also infiltrate groundwater basins, contributing to the emergent groundwater that may exacerbate flood risk and increase groundwater salinity levels. Potential groundwater declines due to drought could also facilitate saltwater intrusion.
- Drought conditions dry out local vegetation, especially when coupled with high temperatures, making them more susceptible to wildfire. Larger and more intense wildfires are more likely to damage homes and businesses, block roads, damage energy and communication infrastructure, and endanger public health. The combined effects of drought, heat, wind, and wildfire may also make the community more likely to lose power when these events coincide. Larger fires can hinder plant regrowth and make the community more susceptible to severe landslides, which happened after the 1993 Laguna fire as a result of only mild rainfall. Declines in vegetative cover or plant vitality due to drought may also increase community-wide exposure to extreme heat.
- Changing precipitation patterns favoring less frequent, more intense storms exacerbate both drought and flood risk. Higher-intensity storms are also more likely to cause landslides, which can also block or damage flood control infrastructure and thus further exacerbate flood risk.
- Reduced fog cover exacerbates the risks posed by extreme heat and may reduce moisture available to ecosystems, making plant life more vulnerable to drought.

Awareness of the cascading and compounding nature of these hazards helps identify both priority hazards and those assets and populations that may be especially vulnerable when hazards interact or coincide. For instance, low-resourced households, particularly those located in mapped hazard areas, may not have sufficient financial resources to adequately address the compound effects of flooding and landslide, or high heat, wildfire, and drought. While planning for hazard response and allocating resources, it is important to keep in mind that emergency services and key infrastructures such as roads, electric poles and wires, and flood control structures must be resilient to the potentially compounding effects of multiple hazards.

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Considering the interactive nature of climate hazards can also help identify locations that are most vulnerable. For example, there are several locations in Laguna Beach that are vulnerable to both flooding and wildfire. These areas, shown in **Figure 12**, are mostly along Laguna Canyon Road and Aliso Creek.

Figure 12: Fire Hazard and Flood Zones



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What are Laguna Beach’s Priority Vulnerabilities?

The following section presents the results of the Vulnerability Assessment, highlighting the people and community features that were identified as priority vulnerabilities. Priority vulnerabilities are the people, natural systems, buildings, infrastructure, and community activities that will be the City’s priorities in adaptation and resilience planning. Identification of priority vulnerabilities considers the difference between the potential levels of impact to and existing adaptive capacity of a given population or community asset, the size of the given population, the role that the asset plays in maintaining community-wide well-being, and the potential of the population or asset to be impacted by compounding or cascading effects of interacting hazards.





The CAAP and other planning documents that rely on this Vulnerability Assessment should direct resources to the people and assets identified as priority vulnerabilities, helping them to better plan for, resist, and recover from these changing hazard events. The populations and assets of greatest concern to Laguna Beach are senior citizens, persons with limited mobility and health concerns, and members of the local artist community. At the same time, the City should not neglect other populations and assets, including those who are not priority vulnerabilities. The lack of the priority vulnerability designation does not mean that there is no risk of harm, and Laguna Beach will likely still need to provide support and assistance to reduce the threat to these populations and assets.

Priority vulnerabilities are organized into the following categories, as shown in **Table 1**: people; coastal resources and community features; arts and culture; buildings, infrastructure, and services; and greenbelts and other ecosystems. Priority vulnerabilities of greatest concern are shown in bold text. A table showing results for all community features is available in **Appendix D**.

Table 1: Organization of Priority Vulnerabilities

<p>PEOPLE</p> 	Children
	Local artists
	Low-resourced households
	Low-resourced people of color and linguistically isolated individuals
	Individuals living on single-access roads
	Outdoor workers and individuals experiencing homelessness
	Persons with limited mobility and health concerns
	People without access to lifelines
	Senior citizens
	Short-term visitors

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COASTAL RESOURCES AND COMMUNITY FEATURES 	Beaches
	Beach facilities
	Beach access
	Coastal tourism
	Marine protected areas
	Outdoor recreation
ARTS AND CULTURE 	Art centers and museums
	Art installations
	Entertainment, cultural events, and museums
BUILDINGS, INFRASTRUCTURE, AND SERVICES 	Energy and communication infrastructure and services
	Flood protection and stormwater infrastructure and services
	Hazardous material sites
	Homes
	Medical and care facilities, emergency, and senior services
	Retail and commercial buildings and activity
	Transportation infrastructure and services
	Water and wastewater infrastructure and services
GREENBELTS AND OTHER ECOSYSTEMS 	Chaparral and sage brush
	Oak woodlands
	Outdoor recreation
	Parks and open space
	Recreation services
	Trails

PEOPLE



Climate change will affect the health, prosperity, happiness, and well-being of all members of Laguna Beach. However, not all people will experience the effects of any given climate hazard at the same time or in the same way. The people in Laguna Beach most likely to be impacted by climate change include children, local artists, low-resourced households, low-resourced people of color, and linguistically isolated individuals, individuals living on single-access roads, outdoor workers and individuals experiencing homelessness, persons with limited mobility and health concerns, persons without access to lifelines, senior citizens, and short-term visitors.

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As noted above, there are three populations who are considered particularly vulnerable and are of the greatest concern to Laguna Beach: senior citizens, persons with limited mobility and health concerns, and local artists.

Senior Citizens

Senior citizens (age 65+), who make up about a quarter of Laguna Beach residents, often face challenges in planning for and responding to emergency conditions. This can include difficulties evacuating, obtaining resources, and making changes to their home to better resist the effects of hazards. Some senior citizens have underlying medical conditions or rely on medication that can compound these challenges. Senior citizens often face similar difficulties as persons with limited mobility or health concerns, as discussed previously.

Senior citizens also receive, on average, less income than middle-aged adults. While some continue to work in high-income positions or have ample financial resources due to retirement funds or other investments, many have limited, fixed incomes, which can increase their vulnerability to hazard events. According to the American Community Survey, senior-headed households in Laguna Beach have incomes 34 percent below those with a household between 45 and 64 years of age, and 14 percent below Laguna Beach's median household income.

CERT partners with Lifelong Laguna's Aging-in-Place project, the City, and Habitat for Humanity to perform wellness checks on seniors and complete Home Modification Assessments. The goal of this project is to help seniors make repairs to their homes focused on health, safety, and accessibility. These measures could include simple modifications to improve home resiliency to heat, and wellness checks on seniors could be conducted before and after heat events to ascertain level of preparedness and recovery needs.

According to the City's Local Hazard Mitigation Plan, 23 percent of households in Laguna Beach include at least one senior citizen. Additionally, according to the American Community Survey, approximately 13 percent of households in Laguna Beach are senior citizens living alone. Seniors living alone face additional challenges, as they may not be able to get the necessary assistance to prepare for and respond to hazardous conditions.

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Most vulnerable to:



Beach and bluff erosion



Coastal flooding



Drought



Extreme heat and warm nights



Human health hazards



Inland flooding



Landslides and mudflows



Sea level rise



Severe weather



Wildfire and smoke

Persons with limited mobility or health concerns

Persons with reduced mobility and individuals with chronic illnesses or disabilities, including those with access and functional needs, may face barriers to receiving emergency alerts, evacuating, obtaining support resources, as well as installing appliances and making retrofits or structural improvements to their homes to improve resilience.

Persons with chronic health problems may have weaker immune systems due to pre-existing conditions or medications that make it more difficult to fight off new illnesses. Allergens and vector-borne illnesses can exacerbate existing illnesses, which can create difficulties in existing or new treatment. These individuals also experience increased sensitivity to the health effects of heat. Those with chronic health conditions may have higher vulnerability to health effects of smoke exposure.

Approximately 27 percent of Laguna Beach's population is aged 65 years or older. Approximately 9 percent of the city's noninstitutionalized population has some form of disability.

Source: American Community Survey, 2022, 5-Year Estimate.

According to the City's Local Hazard Mitigation Plan, 12 percent of households in flood hazard areas include an individual with a disability. According to American Community Survey data, 15 percent of Laguna Beach households in or near the Pacific Coast Highway have at least one person with a disability. Potential flooding and inundation of roads may make it harder for these people to travel to health care or for emergency services to reach them. These individuals may be more likely to be injured or become ill due to flooding and may be reliant on medications or medical devices that may be lost, damaged, or rendered inoperable due to a flood. Those who rely on electricity to operate medical devices or store medication may be especially vulnerable in the event of a public safety power shutoff or other loss of power, which may become more likely during periods of extreme heat, severe weather, flooding, wildfire, and landslide.

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The Orange County Transportation Authority (OCTA) provides funds through the Enhanced Mobility for Seniors and Disabled grant program to provide affordable transportation. Sally's Fund, based in Laguna Beach, was awarded funds in 2022 to cover additional training for drivers, plus expanded community outreach.

The City has the opportunity to coordinate with OCTA and organizations such as Sally's Ride to engage with persons with limited mobility or health concerns to plan for hazardous conditions, such as flooding.

Most vulnerable to:



Beach and bluff erosion



Coastal flooding



Drought



Extreme heat and warm nights



Human health hazards



Inland flooding



Landslides and mudflows



Sea level rise



Severe weather



Wildfire and smoke

Local artists

The arts are a core part of Laguna Beach, made possible by the local artists who have helped make the city internationally known for its arts culture. Climate change poses a significant threat to these vital members of the community, who are already facing a number of other challenges. Many artists lack a steady and reliable income, which hinders their ability to make improvements to their homes so they can be better prepared for natural hazard events. These financial strains can be exacerbated by medical costs, particularly if they lack effective health insurance, and illnesses can further reduce artists' ability to work and earn income. More generally, damage to studios, galleries, and other arts venues directly harms local artists, who may be unable to exhibit their work elsewhere. Major disasters can also reduce tourism activity in Laguna Beach, depriving artists of income and recognition.

The high cost of housing in Laguna Beach has hit local artists particularly hard. Moving out of Laguna Beach is often not an option, as some events, such as the Sawdust Art Festival's summer show, require that artists be full-time residents of the city. As a result, many artists have moved into studio spaces in Laguna Canyon to save on housing costs. These spaces are in a Very High Fire Hazard Severity Zone, as well as areas prone to flooding and landslides, significantly increasing the

VULNERABILITY ASSESSMENT REPORT

artists' exposure to natural hazards. Many of these studio spaces are also not designated as residential units, which can complicate emergency response efforts as emergency managers may not be aware that people are living in these spaces, and so these artists may not receive evacuation notices or assistance, or other emergency notifications.

There is significant overlap between the vulnerability of local artists and the vulnerability of local arts and culture (discussed further below). However, given the threats faced by the artists themselves, this Vulnerability Assessment highlights local artists as a distinct and separate priority vulnerability.

Most vulnerable to:



Drought



Extreme heat
and warm nights



Human health
hazards



Inland flooding



Landslides and
mudflows



Severe weather



Wildfire and
smoke

Artist Adaptive Capacity

Like many other low-resourced community members, local artists are often eligible for various incentives and rebate programs that can help increase their resilience to natural hazards. Local artists are eligible for grants from the Laguna Beach Arts Commission that can provide further support. However, income-based incentives may not work for all artists, who might have income levels too high to be eligible for such incentives, but which can be low enough to still cause hardships given Laguna Beach's high costs of living. Artists living in studio spaces may not be eligible for programs that help to retrofit or improve residences, as studios are generally not considered residential spaces.

In addition to these three population groups, there are several other populations in Laguna Beach who are identified as having priority vulnerability.

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Children Under 10 Years of Age

Approximately six percent of Laguna Beach’s population is under the age of 10.⁴ Children’s high susceptibility to the health effects of heat and smoke and extensive time spent outdoors, increase their vulnerability to climate change hazards. Especially young children may not recognize flooding or be aware of flood dangers, and physically are more likely to be harmed by floodwaters than larger adults. Children may also be unaware of hazard warnings and may not know how to prepare.

While children may live all over Laguna Beach, schools are common congregation points. There are six schools in the City’s wildfire hazard zone and one school in the 100-year floodplain. Four schools face elevated landslide risk and could be damaged in the event of a landslide.⁵

Approximately 5.7 percent of Laguna Beach households are below the poverty level and 2.3 percent of households are overcrowded. Approximately 4.29 percent of households are cost-burdened, meaning that they spend more than 30 percent of their income on rent, mortgage, and other housing needs. Poverty rates are slightly higher in downtown Laguna Beach.

Source: American Community Survey, 2022 5-Year Estimate; CalEnviroScreen 4.0 Indicator Maps.

Most vulnerable to:



Extreme Heat and Warm Nights



Inland Flooding



Landslides and mudflows



Wildfire and Smoke

Low-resourced households

This category includes low-income households, households in poverty, low-resourced households, including low-income households, those in poverty, overcrowded households,** and cost-burdened household.** Low-resourced households may lack sufficient resources to invest in home repairs and weatherization improvements, air conditioning and efficient appliances, health care, and other means to prepare for and recover from extreme events. Low-resourced households may be more likely to

** Overcrowding is typically defined as more than one person per room, based on the Census Bureau’s definition of “room,” which excludes bathrooms, porches, balconies, foyers, halls, or half-rooms. Severe overcrowding occurs when there are more than 1.5 persons per room.

** For housing costs to be considered affordable, a household’s total housing costs should not exceed 30 percent of household income, according to the US Department of Housing and Urban Development. Households paying more than 30 percent of income toward housing are considered housing “cost-burdened,” and those with housing costs that exceed half of their income are considered “severely cost-burdened.”

VULNERABILITY ASSESSMENT REPORT

live in homes that are vulnerable to pest infestation, which increases the risk of contracting disease. These households may be financially strained by medical costs and inability to work due to illness. During drought, low-resourced households may be especially vulnerable to increases in water price due to water conservation pricing and may be unable to afford water-efficient appliances.

An estimated 98 residents live in the flood hazard areas in Laguna Beach, primarily in the 100-year flood zone, as shown in **Figure 6**. Lower-income persons in flood-prone areas may be unable to afford flood insurance premiums or flood-proofing improvements to their homes, so they may face disproportionate harm from flood events. Even if their homes are not directly damaged by floodwaters, members of low-resourced households may be disproportionately affected by flooding's impact on the community, such as damages to workplaces, inability to reach workplaces due to blocked or damaged roads, or damage to or inability to reach providers of social services.

Similarly, low-resourced households may be unable to afford measures to improve their home's wildfire resiliency through home hardening and expanding defensible space and may be disproportionately impacted by wildfire impacts to the community.

Most vulnerable to:



Drought



Extreme heat
and warm nights



Human health
hazards



Inland flooding



Landslides and
mudflows



Severe weather



Wildfire and
smoke

VULNERABILITY ASSESSMENT REPORT

Outdoor workers and individuals experiencing homelessness

Outdoor workers and individuals experiencing homelessness may both spend significant time outdoors, which may bring individuals into direct contact with extreme heat, wildfire, flooding, human health hazards, severe weather, and landslides.

Depending on the nature of their work, outdoor workers may be wearing heavy gear or engaging in manual labor, which can exacerbate heat-related health risks. Outdoor work may also be delayed or interrupted due to hazard events, potentially increasing economic stress for these individuals.

Depending on their financial situation, members of these communities may struggle to obtain timely and adequate medical care, and outdoor workers may experience financial hardship if they are unable to work due to injury or illness. Individuals experiencing homelessness may struggle to find adequate shelter to reduce hazard exposure.

Approximately 3 percent of Laguna Beach's labor force works in construction, natural resources, outdoor recreation, and other fields that are likely to involve outdoor work.

According to Orange County's 2022 Point-in-Time Summary, approximately 83 individuals are experiencing homelessness in Laguna Beach (55 sheltered, 28 unsheltered).

Sources: American Community Survey, 2022 5-Year Estimate; Orange County, "Everyone Counts: 2022 Point In Time Summary".

Most vulnerable to:



Extreme Heat and Warm Nights



Human Health Hazards



Severe Weather



Wildfire and Smoke

People living on single-access roads

This group refers to those households whose sole means of ingress to or egress from their homes are highways or arterial roads for high-speed traffic. Single-access roads typically include limited or no access to adjacent properties, some degree of separation between opposing flows of traffic, prohibition of slow modes of transport such as walking or biking, and very few or no intersecting cross-streets or level crossings. Extreme wind, wildfire, landslides, and coastal flooding may isolate those living on single-access roads by knocking over trees, power lines, or other structures onto single access roads, rendering them unsafe or impassable. If wind knocks over a power line, individuals living on single access roads may also have to face the hazard of a downed power line and lose access to electricity. Persons residing in homes on single-access roads have limited evacuation routes during or after a hazardous event and, if roads are blocked or damaged, they may be harder to reach by emergency services and other forms of support.

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Single-access roads directly adjacent to the coastline that may be impacted by coastal flooding and sea level rise include those listed in **Table 2**.

Table 2: Projected Single-Access Road Flooding Under Different Coastal Flooding and Sea Level Rise Scenarios

Sea Level Rise Scenarios	SINGLE-ACCESS ROADS PROJECTED TO EXPERIENCE COASTAL FLOODING		
	Without a storm	1-year storm	100-year storm
With current sea levels	N/A	Agate Street Cleo Street Diamond Street Laguna Avenue Marine Way Mountain Road Pearl Street	Agate Street Blue Bird Canyon Drive Cleo Street Diamond Street Laguna Avenue Marine Way Mountain Road Pearl Street St Anns Drive
With levels of sea level rise projected by 2050	Agate Street Blue Bird Canyon Drive Cleo Street Diamond Street Laguna Avenue Marine Way Moss Street Mountain Road Oak Street Pearl Street	unknown	Agate Street Anita Street Blue Bird Canyon Drive Cleo Street Diamond Street Laguna Avenue Marine Way Moss Street Mountain Road Oak Street Pearl Street St Anns Drive The Strand
With levels of sea level rise projected by 2100	Agate Street Anita Street Barranca Cliff Drive Blue Bird Canyon Drive Cleo Street Diamond Street Dumond Drive Laguna Avenue Marine Way	unknown	Agate Street Anita Street Barranca Cliff Drive Blue Bird Canyon Drive Cleo Street Diamond Street Dumond Drive Fairview Street Jasmine Street

VULNERABILITY ASSESSMENT REPORT

Sea Level Rise Scenarios	SINGLE-ACCESS ROADS PROJECTED TO EXPERIENCE COASTAL FLOODING		
	Without a storm	1-year storm	100-year storm
	Moss Street Mountain Road Oak Street Ocean Front Park Drive Pearl Street		Laguna Avenue Marine Way Moss Street Mountain Road Oak Street Park Drive Pearl Street St Anns Drive Thalia Street The Strand

At 1.6 feet of sea level rise, about 10 single-access roads are projected to be impacted by bluff erosion. At 6.7 feet of sea level rise, approximately 28 roads and alleys that are single-access roads are projected to be impacted by bluff erosion.

Most vulnerable to:



Coastal flooding



Dune, beach, and bluff erosion



Landslides and mudflows



Sea level rise



Severe weather



Wildfire and smoke

People of color and linguistically isolated people

Low-resourced people of color often face disparities in living conditions and institutionalized bias that reduce economic prosperity and may cause members of this community to live in homes that are more susceptible to climate hazards. Low-resourced people of color may live in structures that are not well insulated, are not flood-proofed,

Approximately 16 percent of Laguna Beach’s population identifies as non-white, and 7 percent identify as Hispanic or Latino.

Source: American Community Survey, 2022 5-Year Estimate.

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or lack air conditioning, increasing their exposure to extreme heat, high indoor air temperatures, and flooding.

Nationally, members of the Hispanic and Latino community are 21 percent more likely than whites to live in urban heat islands, and about 30 percent of Hispanic households do not have air conditioning,⁶ conditions that can increase the likelihood of contracting heat-related illnesses. Further, over 40 percent of Hispanic and Latino households are energy insecure, meaning that they cannot afford the energy required to heat and cool their homes and refrigerate food and medicine without experiencing economic distress.⁷ The Hispanic and Latino community has the highest uninsured rates in the United States,⁸ meaning that members of this community are less likely to have access to healthcare services to prevent or treat disease.

Approximately 83 percent of the population living within 0.25 miles of Pacific Coast Highway identify as White Alone. The median household income for households living in this area, which could be affected by coastal flooding, was over \$190,000 in 2023. Low-resourced households and People of Color are thus generally not expected to be the most at risk to residential coastal flooding.

Nationwide, Hispanic and Latino and Black communities receive disproportionately less aid following natural disasters compared to white communities and are the hardest hit in terms of property and income losses.⁹ Additionally, members of Hispanic or Latino communities typically have high participation in outdoor occupations which may increase exposure to hazards such as severe weather, extreme heat, and wildfire.

Members of linguistically isolated communities may not have equitable access to health information, medical care, and information about local hazard prevention and recovery resources. Additionally, members of linguistically isolated communities are more likely to work in unregulated environments or live in conditions that increase the chances of catching a vector-borne illness. Due to linguistic barriers, concerns about immigration status, and racial and ethnic prejudice, low-resourced people of color and linguistically isolated individuals may feel unsafe or uncomfortable seeking out government support services.¹⁰ Immigrants of all statuses are less likely to be offered employer-sponsored health insurance. Historically, undocumented immigrants have not been able to use public insurance like Medicare and Medicaid.¹¹ As of January 1, 2024, undocumented persons are eligible for Medi-Cal. However, this information may not be widely known among immigrant communities.

Approximately 2 percent of Laguna Beach's total adult population is not fluent in English. Spanish is the most spoken language besides English, and approximately 27 percent of Laguna Beach's Spanish speakers are not fluent in English. Linguistically isolated individuals are equally distributed throughout Laguna Beach.

Source: American Community Survey, 2022, 5-Year Estimate; CalEnviroScreen 4.0 Indicator Maps.

VULNERABILITY ASSESSMENT REPORT

Most vulnerable to:



Drought



Extreme heat
and warm nights



Human health
hazards



Inland flooding



Landslides and
mudflows



Sea level rise



Severe weather



Wildfire and
smoke

Persons without access to lifelines

In the event of an emergency, limited access to resources such as a personal or family vehicle or phone and internet service can significantly reduce resident's ability to evacuate, contact emergency services, and receive emergency alerts. People without access to transportation are often at higher risk during a wildfire event because wildfires can move at rapid speeds, sometimes requiring immediate evacuation. People who are unable to drive or do not have a vehicle may have little time to make other arrangements.

Approximately 3.7 percent of Laguna Beach households lack personal vehicle access, 0.4 percent lack telephone service, and 4.7 percent do not have an internet subscription.

Source: American Community Survey, 2022 5-Year Estimate.

VULNERABILITY ASSESSMENT REPORT

Most vulnerable to:



Wildfire and smoke

Short-term visitors

With approximately 6 million visitors each year, the City relies on short-term visitors for tourism and business revenue.¹² Tourists and other visitors may lack familiarity with hazard conditions, hazardous areas, evacuation and alert programs, and other health and safety resources in Laguna Beach, increasing their vulnerability to flooding, heat, landslide, severe weather, and wildfire.

Laguna Beach often acts as a receiving community for other parts of the southern California and Orange County region, meaning that people may temporarily or permanently relocate to Laguna Beach. This is usually the case with extreme heat when people from inland areas come to Laguna Beach and other coastal communities to escape dangerous high temperatures. Visitors tend to peak during the spring and summer months, which overlap with the periods when extreme heat and wildfire is most likely. The short-term visitor population may increase significantly if residents of warmer, inland communities come to Laguna Beach to cool off during a region-wide extreme heat event. A sudden increase in the temporary visitor population during times of extreme heat or wildfire could strain public health and emergency response services beyond levels that local services typically prepare for. The 1993 Laguna fire prompted widespread evacuation of the community, including of short-term visitors, but it occurred on a Wednesday in late October, outside of peak visitor times. More recently, lightning storms during the peak summer season required that emergency responders evacuate 40,000 to 60,000 people from local beaches, close to two to three times as many people as Laguna Beach's entire resident population.

Laguna Beach State Marine Reserve (SMR) and Laguna Beach State Marine Conservation Area (SMCA) are two adjoining marine protected areas that extend offshore of Laguna Beach in Orange County on California's south coast. Laguna Beach SMR protects more than six square miles of rocky and sandy habitats, including diverse rocky intertidal and shallow kelp reefs out to depths of more than 1,200 feet.

Hazards such as flooding, sea level rise, wildfire, landslide, and severe weather may reduce demand for tourism. A reduction in tourism levels could have significant ripple effects on the city's economy, especially in industries that serve tourists, including hotels, arts venues, and outdoor recreation.

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While short-term visitors may go all over Laguna Beach, hotels are common congregation points. See the discussion of hotel vulnerability in the Buildings, Infrastructure, and Services section below for additional information.

Most vulnerable to:



Coastal flooding



Extreme heat
and warm nights



Human health
hazards



Inland flooding



Landslides and
mudflows



Severe weather



Wildfire and
smoke

COASTAL RESOURCES AND COMMUNITY FEATURES



Laguna Beach's ribbon of 26 beaches is one of its most well-known and beloved features. Each beach is a rich and delicate ecosystem home to a variety of coastal creatures, as well as host to surfers, artists, nature enthusiasts, and everyone looking for a place to relax and cool off. However, climate change threatens the safety, longevity, and health of these unique places.

Flooding and loss of beach area in Laguna Beach will occur with high tide events and will worsen with projected sea level rise. With current sea levels, a 1-year storm event (typical nuisance flooding) is likely to substantially inundate beaches, especially in the northern portions of the city. A 100-year storm event (a more substantial storm) would fully inundate beaches across the city. However, by 2100, a 100-year storm event, combined with 6.7 feet of sea level rise, is projected to fully flood downtown. Reduction in beach area will accelerate erosion of bluffs, which in turn can exacerbate landslide hazards. Beaches may be substantially impacted by a projected 6.7 feet of sea level rise, especially during storm events. Towards the century's end, permanent inundation of existing habitats, that currently receive intermittent tidal action, may substantially alter coastal habitats.

VULNERABILITY ASSESSMENT REPORT

Sea level rise may also change the composition of ocean water as rising seawater mixes with chemicals and other hazardous substances on land. Contaminants from hazardous locations, such as fuel station underground tanks, may mix with emergent groundwater runoff that could enter the ocean. These toxic substances could jeopardize the health of marine life and alter the species composition of Marine Protected Areas and beach ecosystems.^{13, 14} Additionally, ocean acidification can create conditions that eat away at the minerals that oysters, clams, lobsters, shrimp, and other marine life use to build their shells and skeletons.¹⁵

Bluff erosion may create hazardous conditions for public beach access. At a projected 6.7 feet of sea level rise, substantial erosion of bluffs may lead to collapse, damaging or destroying adjoining public facilities such as stairs and ramps that provide access to and from the beach. Beach facilities, amenities, and public access points could also be damaged or made inaccessible by flooding, sea level rise, and severe weather. Road closures due to landslides, wildfire, severe weather, and flooding could also reduce beach access.



Potential damage from coastal flooding are projected to occur at Irvine Cove Beach/Cameo Cove, Crescent Bay (Barranca Street restrooms), Shaw Cove (Fairview Street access), Fishermen's and Diver's Cove beach access, North Main Beach public access, Main Beach (boardwalk) Cleo Street public access, Central Coast (Thalia Street, Anita Street, and Brooks Street public access), Bluebird Coast public access stairs, Woods Cove (Cactual Point public access and Diamond Street public access stairs), Victoria Beach (Durmond Drive public access ramp), Aliso Beach (public access walkway), and Mussel Cove (stairs).

Damage to beaches, beach facilities, and coastal roads, as well as declines in coastal ecosystem health, reduce opportunities for coastal recreation and tourism. Coastal tourism and outdoor recreation represent a significant portion of Laguna Beach's economy. An economic impact study in 2012 estimated that the losses to Laguna Beach from projected sea level rise is \$15 million.¹⁶ Impacts to these industries could jeopardize the economic well-being of the entire community, which would make it harder to recover from disaster and to continue to invest in resiliency. Wildfire, landslide, inland flooding, and other widespread or severe emergencies may also negatively impact coastal tourism.

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Beaches and healthy coastal ecosystems are Laguna Beach’s first line of defense against coastal flooding. Loss of habitat and reductions in the structural integrity of beaches, exacerbating coastal flood risk for all near-shore residents, workers, visitors, and businesses. If the City’s beaches and beach facilities are kept healthy and safe, beaches may serve as sources of artistic inspiration, homes for coastal creatures, powerful economic drivers, flood absorbers, and all-natural cooling centers on high heat days for decades to come.



Most vulnerable to:



Beach, dune, and bluff erosion



Coastal flooding



Emergent groundwater



Inland flooding



Landslides



Ocean acidification



Sea level rise



Severe weather



Wildfire and smoke

VULNERABILITY ASSESSMENT REPORT

ARTS AND CULTURE



Laguna Beach has a storied history as a thriving artistic enclave. This legacy is alive and well today, as Laguna Beach continues to serve as a home for established and aspiring artists, as well as a sweeping variety of art galleries, museums, and artistic events.

Entertainment and cultural venues are highly vulnerable to inland flooding and landslides. The locations of the Sawdust Festival, Festival of Arts, and Laguna Art A Fair, as well as the Laguna Playhouse, are in a flood hazard zone and could be damaged by floodwaters. Over 20 art galleries are also known to reside in mapped flood hazard zones. Over 40 of Laguna Beach’s art museums and galleries are in or close to landslide hazard zones of at least moderate severity and could be damaged in the event of a landslide. At least 14 of Laguna Beach’s art museums and galleries are in or near mapped wildfire hazard zones. Buildings and art installations can be damaged or destroyed by wildfire or severe weather, and outdoor events could be affected by smoke exposure. Many members of Laguna Beach’s arts community live in the canyon, a known wildfire and flood hazard area, and may struggle to cover rising home insurance costs associated with rising wildfire and flooding risk. Extreme heat may damage outdoor art installations, increase mechanical demands for art museums and galleries, and increase operating costs for art-related institutions.



Even if buildings and art are not directly damaged by hazards, arts and entertainment events may be canceled or delayed by severe weather and power outages caused by severe weather, wildfire, flooding, and landslides. These hazards may also block or damage roadways, which may reduce the accessibility of arts and culture venues. Human health hazards may decrease demand for arts and cultural events.

Damage to arts, cultural, and entertainment sites may negatively impact the economic security of those in the arts and entertainment industry, reduce the size and vitality of Laguna Beach’s artistic community, and reduce the City’s income from tourism and related activities.

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Art-Focused Adaptive Capacity

Laguna Beach’s Wildfire Mitigation and Fire Safety Report recommends conducting community outreach at art venues for evacuation procedures to reach the vulnerable individuals who frequent these locations. Arts venues may thus serve as an opportunity to improve the community’s adaptive capacity.

The Laguna Beach Arts Commission provides small grants to help financially support artists. Individual festivals and arts groups may also provide financial support. These and similar programs may help artists obtain the resources necessary to reduce their vulnerability to climate hazards.

Most vulnerable to:



Extreme heat and warm nights



Human health hazards



Inland flooding



Landslides and mudflows



Severe weather



Wildfire and smoke

BUILDINGS, INFRASTRUCTURE, AND ACTIVITIES

Laguna Beach relies on a complex network of buildings and infrastructure to provide vital services and conduct daily activities. Community components discussed in this section include energy and communication infrastructure and services, flood protection and stormwater infrastructure and services, hazardous materials sites, homes, medical care facilities and associated services, retail and commercial buildings and activity, transportation infrastructure and services, water infrastructure and services, and wastewater infrastructure and services.



Energy and communication infrastructure and services

All over Laguna Beach, residents, visitors, and workers use the City’s energy and communication infrastructure and services to work, play, and remain healthy and safe. Southern California Edison, San Diego Gas and Electric, and SoCalGas provide electricity and natural gas services to Laguna Beach. Cox Communications and

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Frontier Communications provide cable, internet, and telephone services. These company's power lines and electrical poles, transformers, cell towers, and natural gas pipelines play a vital role in supporting health and well-being in Laguna Beach.

Energy and communication infrastructure is highly vulnerable to landslides, wildfire, and severe weather, all of which can down or destroy power lines and force the shut-off of natural gas supplies. Downed or damaged infrastructure may damage roads and buildings, which may potentially injure people and require road closures. Damaged infrastructure may also create fire hazards. This infrastructure may also be damaged by floodwaters and extreme heat.

Telecommunications antennas are across the open space surrounding inland Laguna Beach. Electronic radio equipment is typically housed in masonry or metal enclosures, often without any additional features to protect exposed antennas and wiring, which may be damaged by wildfire. This infrastructure supports communication services for a significant proportion of Laguna Beach. Key facilities are located on the Laguna Beach County Water District "Ridge Reservoir", on the West Ridge Trail east of Laguna Canyon Road and Sun Valley Drive. This facility is not surrounded by any fuel modification zones and its antennas are exposed.¹⁷ Almost all the city's radio transmissions relay through the radio repeater located at the Moorhead Reservoir on the hill northwesterly of the Festival of the Arts. This location is surrounded by open space and may be exposed to wildfire.¹⁸ The City maintains a back-up radio system running from City Hall to Fire Station #3 at Top of the World, which transmits radio signals to Loma Ridge and the County's radio system. Fire Station #3 is not a fire resistive structure and could be vulnerable in the event of a wildfire.¹⁹

The City's Wildfire Mitigation and Fire Safety Report recommends creating fuel modification zones around telecommunications/radio facilities at the Moorhead and Ridge Reservoir sites and investigating fire-resistive improvements to emergency radio facilities. These measures would improve the adaptive capacity of this infrastructure.

Most local telecommunications companies maintain small installations along Laguna Canyon Road, which fill the gaps in coverage caused by the terrain of the canyon and provide additional capacity for the higher demand for service along main roadways. These sites are typically attached to existing utility poles and could be subject to damage from wildfire. However, if damaged, it is likely that only localized parts of the canyon would be affected. There are numerous other antenna sites in Laguna Beach, but most are on buildings along Coast Highway and would not be subject to the first impacts of a wildfire.²⁰

The Morro Substation and both communication facilities identified in the City's LHMP are located in a landslide hazard zone and could be damaged by landslides.²¹ Bluff collapse can damage equipment at the base of communication towers and can even topple the towers. Projected bluff retreat associated with a projected two meters of sea level rise is not expected to impact major facilities;

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however, supporting infrastructure (lines either overhead or underground) located in projected bluff retreat areas would be substantially impacted.

Existing initiatives, such as the Bluebird Canyon Underground Utility District, South Coast Highway Underground Utility District, Park Avenue Underground Utility District, and Diamond Street Utility Undergrounding can reduce utility's exposure to severe weather, landslides, and wildfire.

SCE's 2023-2025 Wildfire Mitigation Plan outlines strategies to make the grid more resilient to wildfire and improve post-wildfire recovery. Over the past five years, SCE has installed cover conductors, sectionalizing the grid. This effort is estimated to have reduced wildfire risk 85 percent from 2018 levels.

Water exposure in the form of sea level rise and emergent groundwater may corrode energy delivery and communications infrastructure. With 6.7 feet of sea level rise, two energy delivery and communication facilities are projected to be permanently inundated. However, loss of or damage to these facilities is unlikely to significantly affect City communications as a whole. Electricity infrastructure in Laguna Beach is generally high enough above sea level to not be in immediate danger from coastal flooding, sea level rise, or emergent groundwater. However, SCE has expressed that improving resilience to and planning for sea level rise is an important long-term concern. Investment in improving energy infrastructure resilience to sea level rise, coastal flooding, and emergent groundwater may increase energy costs for Laguna Beach customers. Extreme heat can physically damage and reduce the performance and longevity of electrical equipment, which is designed to operate within a specified temperature for optimal performance. Extreme heat event may also trigger an increase in air conditioning use, which overloads the electric grid and cause rolling power outages. Both SCE and SDG&E implement PSPS programs, in which power is temporarily disabled to reduce wildfire risk during high-risk conditions, including extreme heat. Loss of power during an extreme heat event may have significant health impacts for the Laguna Beach community. Damage to or failure of electricity and communication infrastructure could interrupt energy and communication services, which would in turn impact health, safety, and business activity throughout the community.

In September 2022, the city experienced a widespread power outage in which 3,000 homes lost power. While the cause of this outage is unknown, it coincided with a period of extreme heat.

Source: Hutchings, K. "Power outage hits 3,000 homes in Laguna Beach". *The Orange County Register*, September 5, 2022.

<https://www.ocregister.com/2022/09/05/citywide-power-outage-hits-3000-homes->

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Most vulnerable to:



Beach and bluff erosion



Emergent groundwater



Extreme heat and warm nights



Inland flooding



Landslides and mudflows



Severe weather



Wildfire and smoke

Flood protection and stormwater infrastructure and services

Laguna Beach’s stormwater infrastructure plays an important role in reducing the community’s vulnerability to flooding. While this infrastructure is designed to be resilient to exposure to large volumes of water, heavy flooding may overwhelm these systems, and they may also be damaged by floodwaters or debris. Most of the storm drains in Laguna Beach are built to handle a 25-year flood and could be overwhelmed in more severe events, leading to localized flooding. Historically, the flood control channel in Laguna Canyon has been able to handle only between five and 43 percent of the water from a 100-year flood; recent upgrades at certain locations have expanded capacity in certain areas. Stormwater infrastructure may also be blocked or damaged by landslides and severe weather, both of which might coincide with flooding.

Flood and stormwater infrastructure in or adjacent to bluffs may be damaged or destroyed by increased erosion. At a projected 1.6 feet of sea level rise, 50 storm drains may be impacted by bluff erosion. At a projected 6.7 feet of sea level rise, 101 storm drains may be impacted by bluff erosion. Increased exposure to saltwater due to sea level rise and emergent groundwater may also overwhelm and damage stormwater infrastructure. With 1.6 feet of sea level rise, 11 storm drains are projected to be permanently inundated. With 6.7 feet of sea level rise, 17 storm drains are projected to be permanently inundated. When stormwater infrastructure is located underground, structural damage may not be visible unseen until a pipe break or structural collapse occurs.²²

Significant failure or damage to flood control and stormwater infrastructure could significantly increase community flood risk and exposure community members to associated health and safety hazards.

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Most vulnerable to:



Beach and bluff erosion



Coastal flooding



Emergent groundwater



Inland flooding



Landslides and mudflows



Sea level rise



Severe weather

Hazardous materials sites

Hazardous materials sites could be damaged or inundated by floodwaters, increasing the potential that materials could be released to the community. According to the State Water Board's Geotracker database, one site at 793 Laguna Canyon Road and six permitted underground storage tanks are near flood hazard areas. If hazardous materials are released by floodwaters, they could be quickly dispersed across the affected area, which would cause health concerns.

Most vulnerable to:



Inland Flooding

Homes

Most of Laguna Beach's homes are in or close to wildfire-prone areas. A large-scale wildfire could have severe impacts on the community's homes, with profound impacts on the well-being and structure of the entire community. A major wildfire could result in long-term reductions in housing availability.

Most homes in Laguna Beach are in or adjacent to a landslide hazard zone of at least moderate severity. The prevalence of these zones means a high number of homes could be impacted by a landslide. Severe weather can exacerbate risk to homes by saturating soil and increasing landslide risk.

Approximately 75 percent of Laguna Beach homes were built before 1980. These older homes were built prior to the establishment of contemporary building safety codes and may be more vulnerable to hazards such as landslide, flooding, and severe weather.

Source: American Community Survey, 2022, 5-Year Estimates.

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These effects may be especially pronounced immediately following a drought because excessive ground drying can increase the risk of landslides. Residential structures may also be damaged by landslides or mudflows resulting from wildfires.

Few of the city's residential structures are in a mapped flood hazard zone. Residential vulnerability to coastal flooding and sea level rise is summarized in **Table 3**. With levels of sea level rise projected by 2050, approximately 190 homes and related structures may be impacted by bluff erosion. At levels of sea level rise projected by 2100, 370 structures may be affected. Floods can cause structural damage, such as loose or buckling floors and roof or foundation cracks. Appliances including heating, ventilation and air conditioning system, water heaters, and refrigerators can be compromised by flood water. Floodwaters may facilitate mold growth, with potentially health consequences for residents.

Table 3: Residential Coastal Flooding Under Different Flood Scenarios

SEA LEVEL RISE SCENARIOS	NUMBER OF RESIDENTIAL STRUCTURES PROJECTED TO EXPERIENCE COASTAL FLOODING		
	Without a storm	1-year storm	100-year storm
With current sea levels	0	6	15
With levels of sea level rise projected by 2050	13	unknown	22
With levels of sea level rise projected by 2100	49	unknown	85

While there is a risk to all homes in Laguna Beach, homes built prior to 1980 before the advent of the modern building code are particularly at risk, especially if they have not been well-maintained. Most houses in Laguna Beach were built before 1960. In some neighborhoods, including areas around Bluebird Park and north of Monterey Drive, the median age of homes is from the 1940s. Older homes often lack insulation that can help maintain a comfortable indoor temperature during extreme heat events. Some older homes may also lack cooling resources such as air conditioning. Extreme heat coinciding with drought and high winds may make homes more vulnerable to wildfire. Older homes may also be more vulnerable to damage from severe weather.

Under the City's Building and Fire Code, new construction must meet the current wildland-urban interface standard for construction in high-hazard areas. This standard was significantly upgraded in 2008 and requires new development to include landscape fuel modification measures.

The City's Wildfire Mitigation and Fire Safety Report recommends investigating incentives to improve the wildfire resistance of existing residences. Bringing existing residences into conformance with modern building codes related to wildfire would significantly improve resilience.

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Damage to or destruction of homes would have severe impacts on health, quality of life, and well-being in Laguna Beach. Those hardest hit may be those who lack the financial resources to improve the resilience of their homes or to repair after a disaster strikes. Residents of older homes may also be more vulnerable.

Most vulnerable to:



Beach and bluff erosion



Extreme heat and warm nights



Landslides and mudflows



Sea level rise



Severe weather



Wildfire and smoke

Hotels and lodging

Hotel buildings are vulnerable to physical damage from flooding, landslides, severe weather, and wildfire. One hotel is known to currently be vulnerable to coastal flooding. With 6.7 feet of sea level rise and a 100-year storm event, four hotels may be vulnerable to coastal flooding. There are 16 hotels in or near mapped landslide hazard zones and Montage Laguna Beach (a hotel and major employment center) is in the city's mapped wildfire hazard zone.

Even if an individual building is not physically harmed, climate hazards could significantly impact hotel operations by damaging or blocking roads and interrupting delivery of power and other utilities. Loss of power may lead to financial losses and could endanger guests who may not be familiar with local hazard conditions and may not know how to evacuate or reach local support and medical services. A large-scale disaster could reduce interest in tourism in the area, potentially with long-lasting consequences for the tourism sector and those who rely on it.

Drought, extreme heat, and human health hazards may also impact hotel operations. Drought and extreme heat can both increase operational costs from water and energy use. Cleaning procedures may have to be adjusted in response to drought conditions. Depending on the nature of the human health hazard, hotels may facilitate the spread of disease, and hotel operations may have to change to reduce disease risk. Widespread public health emergencies may also reduce tourist activity.

Hotels and tourism are key parts of Laguna Beach's economy. Impacts to this industry could cause financial hardship for those it employs and those who rely on them.

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Most vulnerable to:



Drought



Extreme heat
and warm nights



Human health
hazards



Landslides and
mudflows



Severe weather



Wildfire and
smoke

Medical and care facilities, emergency, and senior services

Medical and emergency facilities and services include hospitals, medical offices and clinics, ambulance services, and firefighting services, building, and equipment. The City's senior services also play an important role in supporting community health and well-being. During an emergency, medical and emergency services may be the first place that people turn to protect their health and safety. These services rely on power, water, communication, and transportation infrastructure and services, and any damage to or interruption of these facilities and services could have negative consequences for the providers of medical care and emergency services and those who need them. Beach and bluff erosion, emergent groundwater, sea level rise, wildfire, flooding, landslide, and severe weather could all interfere with the operation of medical and emergency facilities and services and could prevent these services from meeting the needs of the community.

The City of Laguna Beach maintains its own Police, Fire, and Public Works Departments. These locally controlled services are allocated to match anticipated seasonal demands. Due to the high number of visitors, the City maintains a higher staffing level at these departments than a typical city of similar population. Local resources are augmented by mutual-aid agreements with surrounding cities, agencies, counties, and the State. Mutual-aid agreements provide access to specialty equipment, such as fire-fighting aircraft and heavy equipment that would not otherwise be feasible for a city of Laguna Beach's size to own. Since additional resources are likely to be needed during a fire emergency, the City increases staffing during Red Flag Warnings.

Road inundation due to flooding, sea level rise, and emergent groundwater may cut off evacuation routes and reduce access to emergency facilities and services. Many of the city's major roadways traverse wildfire hazard zones. Roadways can be blocked by flames or closed to provide access for emergency responders, making it more difficult to travel. Emergency services requiring beach access during

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storms or high tide could be exposed to more hazardous situations due to increased risk of bluff collapse or landslide. Bluff collapse caused by bluff erosion could result in immediate and substantial demand for emergency services that could expose personnel to high levels of risk.

Medical facilities could be damaged or cut off from the community during an emergency. Two of the city's fire stations are in a high fire hazard area and may not be able to provide a response in the event of a major fire. Fire Station #3 is not a fire resistive structure and could be vulnerable in a wildfire event.²³



Wildfires, floods, landslides, extreme heat, human health incidents, and other emergencies would all increase demand for emergency and health services, potentially straining these services beyond their current capacity, and loss of these services would therefore significantly increase community-wide hazard vulnerability. Some individuals, such as those with disabilities, health conditions, and seniors, may be more reliant on emergency and medical services than the general population and may therefore experience heightened vulnerability if these services are unavailable or overwhelmed with calls for assistance.

Emergency responders can be exposed to hazardous conditions, resulting in health impacts and injury. Community exposure to major disasters can result in physical and mental health impacts, such as anxiety, depression, and post-traumatic stress disorder, that can linger even after the period of acute danger is over.^{24, 25, 26} Prolonged physical and mental illness and distress could lead to long-term increases in demand for medical care and social support.

Most vulnerable to:



Beach and bluff erosion



Coastal flooding



Emergent groundwater



Extreme heat and warm nights



Human health hazards

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Landslides and mudflows



Sea level rise



Wildfire and smoke

Retail and commercial buildings and activity



Laguna Beach is home to a rich and bustling retail and commercial economy. Retail and commercial buildings can be damaged by severe weather, landslides, wildfire, flooding, and sea level rise. Relatively few of Laguna Beach's retail establishments, restaurants, and other commercial buildings fall in mapped flood hazard areas. However, sea level rise may exacerbate flood risk in

areas near the coastline. With 6.7 feet of sea level rise and a 100-year storm event, five retail or restaurant structures are projected to be impacted by coastal flooding.

Significant retail establishments are in or near landslide hazard areas. Facilities in or close to landslide and/or wildfire hazard areas include Boat Canyon Shopping Center, Village Faire Shoppes, Pepper Tree Lane, The Shops at the Old Pottery Place, and Laguna Lumberyard Mall. The Boat Canyon Shopping Center is also in a mapped wildfire hazard zone. The Laguna Lumberyard Mall is in a mapped flood hazard zone and mapped wildfire hazard zone.

Retail and commercial establishments are vulnerable to the effects of power outage, such as those due to severe weather, extreme heat, and wildfire. Any extreme event, such as wildfire, landslide, severe weather, and flooding, may reduce retail activity. Damage to buildings and reductions in revenue may cause financial hardship for local business owners, employees, and those that rely on them. If damage is severe, the effects could be long-lasting, as about 25 percent of businesses do not reopen after disasters.²⁷

The City recently amended Municipal Code Section 25.38 to require commercial businesses and owners of properties in Special Flood Hazard Areas (SFHA) to install contingency floodproofing devices. A similar provision has been required for properties in the downtown for many years. The City's Floodplain Management Ordinance also requires all business owners of commercial properties in Special Flood Hazard Areas to have a Contingency Floodproofing Measures Plan.

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Most vulnerable to:



Landslide and mudflows



Severe weather

Transportation infrastructure and services

Laguna Beach's roads, electric vehicle chargers, bus stops, and transportation services play a pivotal role in supporting community health, safety, and well-being. These systems span the city and are especially vulnerable to flooding, sea level rise, emergent groundwater, severe weather, wildfire, landslides, and human health hazards.

Roadways can be damaged or blocked by wildfire, landslides, flooding, and as an effect of severe weather if severe weather knocks debris into the road. In an extreme scenario, these hazards could block multiple roads in the community, potentially significantly reducing evacuation opportunities and slowing the delivery of healthcare and other emergency services.

Sea level rise and flooding may damage pavement,^{28,29,30} potentially increasing road maintenance costs and creating unsafe driving, walking, and biking conditions.³¹ The 100-year floodplain includes parts of Laguna Canyon Road, and damage to this roadway could severely impact the integrity of roadways and interrupt traffic flow in the community. Flooding can also impact neighborhood access roads that are narrow and have poor drainage, causing long-term delays and requiring costly clean-up. Access to and from the city can become challenging if one or more of the three main access points into and out of the city are closed.



Roads most vulnerable to coastal flooding include Agate Street, Cleo Street, Diamond Street, Laguna Avenue, Marine Way, Mountain Road, Pearl Street, and St Anns Drive. With 1.8 feet of sea level rise and associated rises in groundwater levels, which could occur by 2050, Anita Street, Blue Bird Canyon Drive, Broadway Place, Oak Street, the Strand, and Village Lane would also be vulnerable. With 6.7 feet of sea level rise and associated emergent groundwater, which could occur by 2100, vulnerable areas would expand to include 2nd Street, 3rd Street, Beach Street, Country Club Road, Dumond Drive, Fairview Street, Forest Street, Glennfrye Street, Jasmine Street, Loma, Mermaid Street, Ocean Avenue,

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Ocean Front, Park Avenue, Park Drive, Thalia Street, and parts of the Coast Highway. At a projected 6.7 feet of sea level rise, three fuel station structures may be impacted by groundwater emergence.

Public vehicle fuel stations are only available along the Pacific Coast Highway and at or near the Laguna Canyon Road intersection. In an extreme hazard situation where access to Pacific Coast Highway is limited, emergency vehicles and those evacuating the city may not be able to access fuel stations in city boundaries and fuel deliveries may be limited. Due to the time required to charge electric vehicles and the geographically limited physical location of public chargers, electric vehicle drivers may not be able to recharge in time during evacuations. Electric vehicle charging could also be restricted or unavailable during PSPS events or other types of power outages, including those triggered by extreme heat, wildfire, and severe weather. If flooded, vehicle fuel stations may become inoperable and may release hazardous materials that may harm humans and ecosystems. At 6.7 feet of sea level rise with a 100-year storm event, one fuel station structure is projected to be impacted by coastal flooding.

Many members of the Laguna Beach community use public transportation services and infrastructure to conduct their daily activities and reach jobs, friends, and vital health and support services. The Laguna Beach Transit Center is in the 100-year floodplain and could be damaged by floodwaters. Damage to this facility could significantly curtail the community's ability to access transit services. Roadway closures could also result in the suspension of Orange County Transportation Authority bus routes to and from inland Orange County, impacting households without vehicles. In the event of a widespread public health emergency, transit services may be impacted by driver shortages and demand for public transit may decline.

Damage to the City's transportation infrastructure and interruption of transportation services could have profound consequences for health and well-being in Laguna Beach. Damage to or reduction of these infrastructures and services may prevent people from reaching jobs, health care, and recreation opportunities. Damage may be time consuming and costly to repair, and widespread damage may result in declines in economic activity.

Most vulnerable to:



Coastal Flooding



Emergent groundwater



Extreme heat and warm nights



Human health hazards



Inland flooding

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Landslides and
mudflows



Sea level rise



Severe weather



Wildfire and
smoke

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Water infrastructure and services

The Laguna Beach County Water District provides water to central and northern Laguna Beach and the South Coast Water District provides water services to South Laguna. Every day, Laguna Beach relies on these services and their supportive pipelines, pump stations, and treatment facilities for drinking water, recreation, cooking, cleaning, business operations, and to meet medical needs. Water infrastructure may be damaged by flooding, emergent groundwater, sea level rise, landslides, and wildfire. Meanwhile, drought conditions may affect the City's ability to provide water services.

Both the Laguna Beach County Water District and South Coast Water District have made significant investments in improving resilience to wildfire. The City's Wildfire Mitigation and Fire Safety Report recommends improving the fire resistivity of water pumps and generators and to install an emergency generator at Pump Station 3 in the South Coast Water District.

The Laguna Beach County Water District headquarters is located in the 500-year flood zone and could be damaged by flooding.³² Many water pipelines are buried, and changes in the water content of supporting soil due to flooding, emergent groundwater, and sea level rise could damage this infrastructure. Exposure to saltwater or contaminated groundwater especially could damage water utilities. Because this infrastructure is underground, damage may not be visible until a break or structural collapse occurs. Water lines in the bluff erosion zone would be substantially impacted.

Several water tanks are in wildfire prone areas. Even though they are constructed on non-combustible materials, the high temperatures associated with wildfire can still cause extensive damage to this infrastructure. Post wildfire conditions can exacerbate flooding and landslide hazards, further impacting infrastructure in these areas. According to the City's Local Hazard Mitigation Plan, three of the City's key water facilities are in a landslide hazard zone and could be damaged by a landslide.

Given the important role that the water system plays in combating fire, damage to this system could exacerbate community wildfire vulnerability. When planning for wildfire mitigation and fire safety, it is important to remember that the water systems of both water districts are designed to provide potable water to the citizens and adequate water flow to combat structure fires, but not to combat major wildfires. Fighting wildfire can necessitate the movement and storage of large volumes of water, which could be orders of magnitude above the volumes currently available.³³

During drought, water use restrictions could reduce the amount of water that residents and commercial facilities receive and increase costs for water and other goods. Laguna Beach relies on a variety of sources for water, including the Colorado River, State Water Project, and local groundwater. While this diversity of supplies increases the resilience of the water systems, all three of these sources may be affected by droughts occurring across the city, county, state, and broader western region. Drought has had a severe impact on the flows of the Colorado River, and drought combined with sea level rise can dramatically change water availability in the Delta region, which is a key component of the State Water Project. Groundwater is more resilient to short-term drought but can still be impacted

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by the lower recharge rates and increased demand associated with drought, which in turn may make groundwater more vulnerable to saltwater intrusion and sea level rise. As discussed above, the City and its water providers have significantly invested in wastewater recycling and desalination to improve the resilience of the water system.

Most vulnerable to:



Beach and bluff erosion



Coastal flooding



Drought



Emergent groundwater



Inland flooding



Landslides and mudflows



Sea level rise



Wildfire and smoke

Wastewater infrastructure and services

The South Orange County Wastewater Authority provides wastewater services to all of Laguna Beach, although the City of Laguna Beach operates the community's sewer system that delivers wastewater to treatment facilities. Similar to water infrastructure and services, the wastewater infrastructure and services in Laguna Beach, as well as those in surrounding communities that provide service to the community, are at risk of harm from flooding, emergent groundwater, sea level rise, landslides, and wildfire. Drought can also affect wastewater services by reducing the flow in sewer pipes, which can cause damage or service interruptions.

Several parts of Laguna Beach's sewer system are already vulnerable to damage or inundation due to coastal flooding, and sea level rise and severe weather may increase the proportion of the system that is at risk. Coastal erosion may further expose infrastructure located near the coast. At a projected 1.6 feet of sea level rise, 31 of Laguna Beach's nearly 3,000 sewer mains may be impacted by bluff erosion. At a projected 6.7 feet of sea level rise, 69 sewer mains may be impacted by bluff erosion. Emergent groundwater may cause saltwater to erode sewer pipes in Downtown Laguna Beach and other at-risk areas. A number of sewer lift stations are in wildfire hazard zones. Damages to wastewater management systems may have widespread effects on community health if people or the environment are exposed to untreated wastewater.

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Most vulnerable to:



Beach and bluff erosion



Coastal flooding



Drought



Emergent groundwater



Inland flooding



Landslides and mudflows



Sea level rise



Wildfire and smoke



COMMUNITY GREENBELTS AND OUTDOOR SPACES

Laguna Beach’s greenbelt and outdoor spaces consists of chaparral and sage brush, oak woodland, and riparian habitats, along with parks and other open space areas. This includes areas outside of Laguna Beach city limits that make up the community’s greenbelt, such as Crystal Cove State Park, Laguna Coast Wilderness Park, and Aliso and Wood Canyons Park. Outdoor recreation is another important part of Laguna Beach’s greenbelt community.

Warmer temperatures increase plant’s water demands, which means that plant species may be especially vulnerable to the combined effects of extreme heat and drought. Some plants may drop leaves in response to extreme heat, which may leave these ecosystems prone to further damage. Warmer temperatures also increase the population growth rates of plant insects and pathogens, making plants more vulnerable to disease.

While many of Laguna Beach’s ecosystem and natural areas are resilient to dry weather, such as the chaparral and sage brush habitats, exceptional drought may strain plant and animal communities in many habitats beyond their ability to adapt, causing habitat loss. Root systems of trees can be weakened by prolonged drought conditions, and when rain does return, trees can be more easily



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downed by strong winds and flooding. Drought may also make plant communities more vulnerable to pests, diseases, and wildfire.

Oak woodlands may be affected by declines in fog cover. Lower relative humidity and increased temperatures from reductions in fog could increase plant evapotranspiration rates in oak woodlands, raising soil water deficits and increasing risks of wildfire. Therefore, oak woodlands are especially vulnerable to the combined effects of fog reduction and drought. Some oak species are adapted to dryer and hotter conditions, although prolonged dry and hot conditions may strain this ecosystem.

Laguna Beach's many unique landscapes and plant communities may also increase the community's wildfire risk. High wind, coupled with drought and high temperatures, could significantly increase chaparral and sage brush's susceptibility to catch fire, and lightning strikes may ignite wildfires in woodland areas. Plants that have been weakened due to disease may also be more vulnerable to wildfire. Open and otherwise undeveloped space may serve as the location of electrical and other key infrastructure, which could both spark and be damaged by wildfire. Laguna Beach's extensive open space areas increase the risk of ignition and wildfire spread.

Laguna Beach's greenbelts are popular recreation destinations. High temperatures may increase demand for outdoor recreation if people decide to go outside to cool off. However, severe weather, wildfire, flooding, and landslides may decrease opportunities for outdoor recreation, damage or block recreation facilities, and expose outdoor recreation workers to hazardous conditions. All three of Laguna Beach's parks are in a Very High Fire Hazard Severity Zone and could be damaged or blocked by wildfire.³⁴ Financial losses or declines in activity in this sector could reduce local revenue and financially strain individuals and households employed in outdoor recreation.

The City of Laguna Beach maintains 292 acres of vegetation management areas to reduce its high fire risk. In combination with 25 acres of privately maintained vegetation management areas, the total of 317 acres provides approximately two-thirds of the city with defensible space. Vegetative management of parks and open space can improve the adaptive capacity of these areas and help improve community-wide wildfire resilience.

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Most vulnerable to:



Drought



Extreme heat
and warm nights



Fog



Inland flooding



Landslides and
mudflows



Severe weather



Wildfire and
smoke

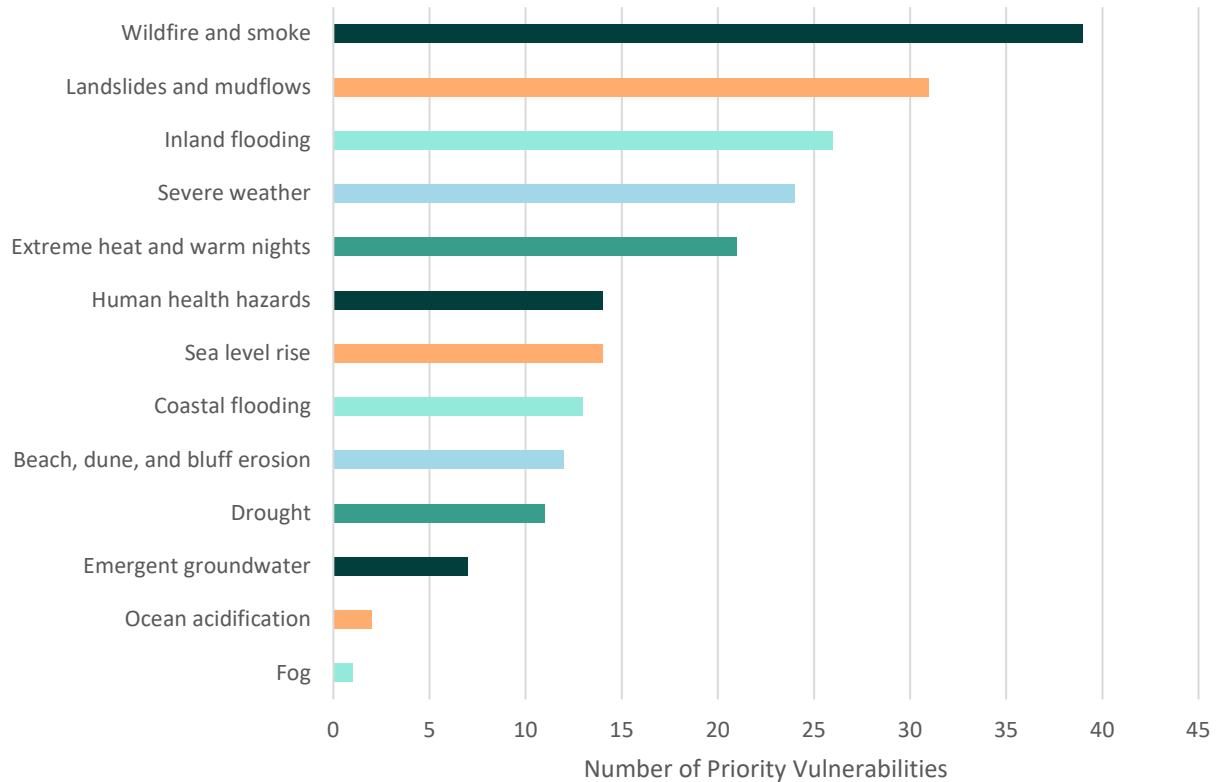
Conclusion

The Vulnerability Assessment identifies hazards most likely to harm people and community assets, as well as which members of the community and community features and services are most vulnerable to various climate change hazards. The Vulnerability Assessment examines potential vulnerabilities to 52 population groups, aspects of community identity, building types, infrastructure systems, economic drivers, ecosystems, and community services from 13 different climate hazards. Of the populations and community features assessed, 44 were determined to be priority vulnerabilities.

Overall, wildfire and smoke are the most significant hazard for these priority vulnerabilities, followed by landslides and mudflows, inland flooding, and severe weather (**Figure 13**). However, other hazards are also likely to be significant issues in specific at-risk areas or to people and assets who are uniquely susceptible.

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Figure 13: Hazards by Number of Priority Vulnerabilities



The following are the populations and assets with the greatest number of priority vulnerabilities.

COMMUNITY IDENTITY

Safe and accessible community, which is a priority vulnerability for coastal flooding, drought, beach and bluff erosion, emergent groundwater, extreme heat and warm nights, human health hazards, inland flooding, landslides and mudflows, sea level rise, severe weather, and wildfire and smoke (11 hazards in total).

Quality of life, which is a priority vulnerability for drought, emergent groundwater, extreme heat and warm nights, human health hazards, inland flooding, landslides and mudflows, severe weather, and wildfire and smoke (eight hazards in total).

Beach-focused community, which is a priority vulnerability for extreme heat and warm nights, inland flooding, landslides and mudflows, ocean acidification, sea level rise, severe weather, and wildfire and smoke (seven hazards in total).

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POPULATIONS

Senior citizens, who are a priority for coastal flooding, drought, beach and bluff erosion, extreme heat and warm nights, human health hazards, inland flooding, landslides and mudflows, sea level rise, severe weather, and wildfire and smoke (10 hazards in total).

Persons with limited mobility or health concerns, who are a priority for coastal flooding, drought, beach and bluff erosion, extreme heat and warm nights, human health hazards, inland flooding, landslides and mudflows, sea level rise, severe weather, and wildfire and smoke (10 hazards in total). **People of color and linguistically isolated persons**, who are a priority vulnerability for drought, extreme heats and warm nights, human health hazards, inland flooding, landslides and mudflows, sea level rise, severe weather, and wildfire and smoke (eight hazards in total).

Local artists, who are a priority vulnerability for drought, extreme heat and warm nights, human health hazards, inland flooding, landslides and mudflows, severe weather, and wildfire and smoke (seven hazards in total).

Low-resourced households, who are a priority vulnerability for drought, extreme heat and warm nights, human health hazards, inland flooding, landslides and mudflows, severe weather, and wildfire and smoke (seven hazards in total).

Short-term visitors, who are a priority vulnerability for coastal flooding, extreme heat and warm nights, human health hazards, inland flooding, landslides and mudflows, severe weather, and wildfire and smoke (seven hazards in total).

BUILDINGS AND INFRASTRUCTURE

Transportation infrastructure, which is a priority vulnerability for coastal flooding, emergent groundwater, inland flooding, landslides and mudflows, sea level rise, severe weather, and wildfire and smoke (seven hazards in total).

ECONOMIC DRIVERS

Coastal tourism, which is a priority vulnerability for coastal flooding, beach and bluff erosion, human health hazards, landslides and mudflows, sea level rise, severe weather, and wildfire and smoke (eight hazards in total).

ECOSYSTEMS AND NATURAL RESOURCES

Parks and open space, which is a priority vulnerability for coastal flooding, beach and bluff erosion, extreme heat and warm nights, landslides and mudflows, sea level rise, severe weather, and wildfire and smoke (seven hazards in total).

KEY SERVICES

Emergency Services, which is a priority vulnerability for coastal flooding, beach and bluff erosion, emergent groundwater, extreme heat and warm nights, human health hazards, landslides and mudflows, sea level rise, and wildfire and smoke (eight hazards in total).

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Water and wastewater services, which is a priority vulnerability for coastal flooding, drought, beach and bluff erosion, emergent groundwater, inland flooding, landslides and mudflows, sea level rise, and wildfire and smoke (eight hazards in total).

In conclusion, the Vulnerability Assessment finds that there is a significant and widespread risk to the health, safety, and well-being of the Laguna Beach community from climate change and the hazards associated with it. There is potential for direct harm to Laguna Beach residents and visitors, damage to key facilities and infrastructure that results in a loss of important services, loss of local economic drivers, and a degradation of the natural environment and resources that make Laguna Beach a special place. The community, including local decision makers, should not dismiss or downplay these risks.

It is critical, however, to point out that none of these risks are beyond Laguna Beach's ability to address. Identifying the community's vulnerability is the vital first step to developing a plan to reduce the threat posed by climate change. The CAAP will include strategies to help the community adapt to climate change hazards and improve its resilience to their effects. Other City efforts can build on these strategies, creating a unified approach to climate adaptation and resilience. With the efforts of the CAAP and other planning documents, Laguna Beach will remain a vibrant and special place that preserves its unique qualities and characteristics while embracing the future and the opportunities it presents.

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Appendix A: Vulnerability Assessment Method

In 2015, the State of California adopted Senate Bill (SB) 379, amending Section 65302(g) of the California Government Code to require the Safety Element of the General Plan to include more information about wildfire hazards, flooding risks, and short-term and long-term threats posed by climate change. SB 379 requires local governments to conduct vulnerability assessments as part of their long-range planning efforts and to prepare resilience and adaptation policies that will protect against harm caused by climate change. This Vulnerability Assessment, along with the 2023 Local Hazard Mitigation Plan (LHMP) and updates to the Safety Element in future years, will help the City of Laguna Beach meet the State’s requirements.

The State of California prepared a guidance document, the *California Adaptation Planning Guide* (APG), to assist communities in addressing climate adaptation and resilience and complying with Section 65302(g) of the California Government Code, along with the guidance in the Office of Planning and Research’s *General Plan Guidelines*. The APG is available online through the State’s Adaptation Clearinghouse (<https://resilientca.org/apg/>). The APG presents a step-by-step process for gathering the best available climate change science, completing a climate change vulnerability assessment, developing adaptation strategies, and integrating those strategies into general plans and other policy documents. The City’s Vulnerability Assessment is consistent with the guidance and recommended methods provided in the APG.

The Vulnerability Assessment primarily follows the recommended process in the *California Adaptation Planning Guide*, published in 2020 by the California Governor’s Office of Emergency Services. This includes a four-step process: (1) characterizing the city’s exposure to current and projected climate hazards; (2) identifying potential sensitivities and potential impacts to city populations and assets; (3) evaluating the current ability of the populations and assets to cope with climate impacts, also referred to as its adaptive capacity; and (4) identifying priority vulnerabilities based on systematic scoring. **Figure A-1** presents these steps.

Figure A-1: California Adaptation Planning Guide Recommended Model



STEP 1. IDENTIFY EXPOSURE

The goal of this step is to characterize the community's exposure to current and projected climate change hazards.

The climate change hazard data was derived from best available downscaled data, including the state Cal-Adapt database, the *California Adaptation Planning Guide*, the *California Fourth Climate Change Assessment*, the *State of California Sea-Level Rise Guidance*, the Coastal Storm Modeling System, the *Laguna Beach Local Hazard Mitigation Plan*, and the *County-wide Draft Community Wildfire Protection Plan*.

Projections of climate change hazards rely on multiple scenarios that reflect different levels of GHG emissions and concentrations over time. The Cal-Adapt database, which provides California-specific climate change hazard projections, uses Representation Concentration Pathway (RCP)³⁵ 4.5 for a low emissions scenario and RCP 8.5 for a high emissions scenario. The Governor's Office of Planning and Research *Planning and Investing for a Resilient California* document and the *California Adaptation Planning Guide* recommend using RCP 8.5 for analyses considering impacts through 2050 and 2100, as there are minimal differences between emission scenarios for the first half of the century and for late-century projections, this is a more conservative and risk-adverse approach. City staff used the RCP 8.5 scenario as input for global climate models on the Cal-Adapt database, the Coastal Storm Modeling System, and other resources.

STEP 2. IDENTIFY SENSITIVITIES AND POTENTIAL IMPACTS

This step involved evaluating potential future climate change impacts to community populations and assets. City staff first identified a comprehensive list of populations and assets to understand how susceptible different people, places, ecosystems, and services in the community are affected by climate change hazards. This list includes 5 contributors to community identity, 9 populations, 8 infrastructure types, 8 building types, 6 economic drivers, 7 ecosystems and natural features, and 9 key services, as listed in **Appendix B**. The evaluation of these populations and assets allowed City staff to prioritize vulnerabilities across several sectors to build resiliency for the most susceptible people and assets in the city. Following confirmation of this list, City staff developed an applicability matrix, which looked at which hazards are likely to affect which populations and assets. For example, human health hazards are likely to impact most populations, but would not physically affect buildings.

After the applicability review, City staff evaluated potential impacts to the applicable populations and community assets. To identify how severe the impacts of each relevant hazard are on the populations and community assets, City staff considered several different questions that helped ensure the assessment broadly covered a range of potential harm. Based on the results of the impact assessment, the City ranked each population and asset as experiencing low, medium, or high impacts for each relevant hazard. Impact is considered a negative quality, so a higher impact score means

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there is a higher potential for harm to a population or asset. A lower impact score means that there is a lower potential for harm to a population or asset.

STEP 3. ASSESS ADAPTIVE CAPACITY

Adaptive capacity is the ability of populations and community assets to prepare for, respond to, and recover from the impacts of climate change using existing resources and programs. Laguna Beach, Orange County, and community-based organizations already provide some of these tools and resources to both populations and community asset owners or managers. The following list describes the plans, projects, programs, initiatives that increase adaptive capacity throughout the city.

MULTI-HAZARD PLANS AND PROGRAMS

- Emergency Operations Plan methods for responding to hazardous events
- 2018 Laguna Beach Local Hazard Mitigation Plan
- 2021 General Plan Safety Element
- Emergency Operations Coordinator on staff
- CERT (Community Emergency Response Team) Program managed by Emergency Operations Coordinator
- Capital Improvement Program and Projects
- Emergency Preparedness Guide
- 2007 Laguna Beach Community Wildfire Protection Plan and Other Natural Disasters
- Emergency and Disaster Preparedness Committee

COASTAL HAZARDS

- Zoning Amendment to create a Bluff Overlay District

DROUGHT

- Laguna Beach County Water District Strategic Plan 2013-2023
- 2021 Laguna Beach County Water District 2020 Urban Water Master Plan and Water Shortage contingency Plan
- 2021 South Coast Water District 2020 Urban Water Management Plan

FLOODING

- 2014 City of Laguna Beach Overflow Emergency Response Plan

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- 2019 City of Laguna Beach Jurisdictional Runoff Management Program Local Implementation Plan

WILDFIRE

- 2021 City of Laguna Beach Wildfire Egress Study
- 2017 County-wide Draft Community Wildfire Protection Plan
- 2022 City of Laguna Beach Fuel Modification Program Summary of Fuel Modification Zones
- 2019 Wildfire Mitigation and Fire Safety Report

POPULATION SPECIFIC PROGRAMS

- Nixle emergency alerts, Alert OC
- Outdoor warning system
- Neighborhood Evacuation Maps & Routes

City staff evaluated each population and asset for adaptive capacity and ranked the adaptive capacity of each population or asset as low, medium, or high for each relevant hazard. Adaptive capacity is considered a positive attribute, so a higher adaptive capacity score will mean that a population or asset may be more adaptable to the hazard. A lower adaptive capacity score means that a population or asset may have a harder time adjusting to the changing conditions given available resources.

STEP 4. IDENTIFY PRIORITY VULNERABILITIES

The City used the impact and adaptive capacity scores for each population and asset for each relevant hazard to identify priority vulnerabilities. The identification of priority vulnerabilities was a holistic process which took into consideration factors such as the difference between each asset or population's impact and adaptive capacity scores for each hazard, the susceptibility of the population or asset to cascading or multiplicative impacts of climate change hazards, the size of the population, and the role that the asset plays in securing the well-being of the community. There are 44 distinct populations and assets that are considered priority vulnerabilities.

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Appendix B: Climate Stressors and Hazards

Climate stressors are conditions or trends related to climate variability and change that can exacerbate natural hazards. As greenhouse gas emissions build in the atmosphere and global temperatures continue to rise, primary climate stressors such as changes to precipitation or increases in temperatures at the local level are likely to become more severe. These primary climate stressors can lead to secondary climate stressors, either directly or in combination. Populations and assets may already be subject to non-climate stressors, or trends unrelated to climate that can exacerbate climate change hazards. For example, populations may face existing financial instability, language or communication barriers, and poor housing quality, which can cause more severe impacts and lower adaptive capacity when natural disasters occur.

The four primary climate stressors are (1) air temperature changes, (2) change in precipitation patterns, (3) sea level rise, and (4) ocean acidification. These changes cause shifts in other effects, such as wildfires, severe storms, extreme temperatures, and many others (known as secondary stressors). Many of these stressors involve natural hazards and other dangerous situations, threatening communities across the globe. The Vulnerability Assessment considers sea level rise, ocean acidification, and all identified secondary stressors as hazards.

The four primary climate stressors and secondary climate change hazards can also have cascading or compounding effects throughout the city. Cascading hazards are extreme events that link together hazards over days, weeks, or months, resulting in multiplied effects that cause secondary and sometimes tertiary damage, exceeding the damage of the initial hazard event.

Non-Climate Stressors

Non-climate stressors are trends unrelated to climate hazards that can exacerbate impacts or impede adaptive capacity, making populations or assets more vulnerable. They are also known as pre-existing conditions that make populations or assets more susceptible to harm from hazards because the stressors may impair their ability to prepare for, respond to, or recover from hazards. Addressing non-climate stressors can improve the adaptive capacity of populations and community assets.

*Source: United State Global Change Research Program. 2016. "U.S. Climate Resilience Toolkit".
<https://toolkit.climate.gov/>.*

PRIMARY CLIMATE STRESSORS

INCREASE IN AVERAGE TEMPERATURES

Climate models consistently predict increases in average temperature across California over this century. Maximum average temperatures in Laguna Beach are projected to increase from a historical average of 69.9 degrees Fahrenheit to 74.2 degrees Fahrenheit by mid-century and 77.4 degrees Fahrenheit by late-century.

CHANGES IN PRECIPITATION PATTERNS

Climate model projections show less frequent but more extreme daily precipitation, with year-to-year precipitation becoming more volatile and the number of dry years increasing. As the climate continues to warm, atmospheric rivers, responsible for many of the heaviest storms in California, will carry more moisture and extreme precipitation may increase. Precipitation is expected to vary from a historical annual average of 12.6 inches, to 12.5 inches by mid-century and 13.9 inches by late-century.

SEA LEVEL RISE

Sea level rise is caused by excessive greenhouse gas (GHG) emissions in the earth's atmosphere, which have increased land and ocean temperatures from historical levels. More than 90 percent of the excess heat from GHG emissions is being captured by the global ocean, leading to a subsequent increase in sea surface temperatures and ocean heat content.³⁶ These temperature increases cause thermal expansion and melting land ice, which are the primary contributors to sea level rise.

Up to the year 2050, there is a high degree of certainty regarding projected sea level rise. Beyond 2050, there is greater uncertainty in the sea level rise projections as the changes depend on global GHG emission and the response of the global climate system.³⁷ This analysis evaluates the impacts to the community from projected coastal flooding and inundation. The term flooding is used to describe when dry areas become wet temporarily – either periodically or episodically. Inundation denotes the process of a dry area being permanently drowned or submerged. The coastal flooding analyses address a range of flood scenarios differentiated by size and frequency. The introduction of two sea level rise projections helps to illustrate how increased ocean water levels will exacerbate storm events. The four coastal flooding scenarios evaluated include:

1. Nuisance flooding that could happen on a relatively frequent basis (i.e., 1-year storm event without sea level rise).
2. A less frequent, but larger flood event occurring in the near-term (i.e., 100-year storm event without sea level rise).
3. A larger flood event occurring near mid-century (i.e., 100-year storm event with 1.3 feet of sea level rise).
4. A larger flood event occurring near end of century (i.e., 100-year storm event with 6.7 feet of sea level rise).

The sea level rise inundation analyses address non-storm scenarios intended to capture the impacts from permanent water at previously dry locations. The two sea level rise projections were selected to illustrate ocean water levels towards the mid-century (1.6 feet of sea level rise) and then at the end of century (6.7 feet of sea level rise).

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The analysis assumes a “do nothing” approach, where future mitigation and potential flood protection efforts are not made. The following assumptions and caveats apply to the analysis:

- The analysis does not account for storm waves, rainfall, or other potential variations in conditions that could affect inundation at any given location.
- Storm factors such as the shifts in storm tracks, the magnitude of storm tides, and wave heights were not considered in this analysis.
- Rates of historical or future land subsidence were not incorporated into the analysis.
- The methodology is GIS-based and does not consider the complex physics of overland flow, dissipation, drainage, or potential shoreline or levee erosion associated with extreme water levels and waves.
- The durations of storms are not accounted for in the modeling of temporary flood conditions, but potential flooding can be assumed to persist for several hours, which is typical of a large storm.

OCEAN ACIDIFICATION

Oceans absorb carbon dioxide from the atmosphere and have absorbed roughly one-third of all carbon dioxide emissions related to human activities since the 1700s. This exchange helps regulate the planet’s atmospheric carbon dioxide concentrations but comes at a cost for the oceans and sea life, such as ocean acidification.

Ocean acidification is best known for its osteoporosis-like effects on shellfish, which makes building and maintaining shells difficult for these creatures. Acidification also affects other species vital to the marine ecosystem, including reef-building corals and pteropods. Estimates of future carbon dioxide levels, based on business-as-usual emission scenarios, indicate that by the end of this century, the surface waters of the ocean could be nearly 150 percent more acidic.

Ocean acidification can also harm human health. In the laboratory, many harmful algae species produce more toxins and bloom faster in acidified waters. A similar response in the wild could harm people eating contaminated shellfish and sicken fish and marine mammals. And while ocean acidification will not make seawater dangerous for swimming, it will upset the balance among the multitudes of microscopic life found in every drop of seawater. Such changes can affect seafood supplies and the ocean’s ability to store pollutants, including future carbon emissions.^{38,39}

SECONDARY CLIMATE STRESSORS

BEACH AND BLUFF EROSION

Intense storms and higher seas create more winds, waves, and floods, leading to increased coastal erosion. Waves and winds can carry away beach sand little by little, shrinking scenic beaches along the Laguna Beach shoreline. Absent natural or human-made shoreline protection, beach sand is the primary buffer to protecting sea cliffs and coastal development. A narrower beach is less able to function as a buffer from wave action and coastal flooding, so beach erosion can increase the risk of bluff erosion when the beach is at the base of a cliff.

Erosion exposes infrastructure and sensitive sites to tides and storms. Bluff erosion weakens the edges of the coastal terraces and causes parks or yards built on top of the bluffs to shrink over time. Erosion also weakens or hollows out areas under any structures, which may lead to a partial or complete collapse of the structure if the erosion progresses far enough. If buildings and facilities on a beach or bluff have poor drainage, this can make erosion worse.

Much of the Laguna Beach coastline has experienced little to no erosion (less than 0.2 feet per year) over the past 35 to 40 years. This is because the beaches are backed by relatively erosion-resistant bedrock units. This makes the Laguna Beach coastline unique compared to other reaches of the Southern California coast, reducing the rate of erosion and retreat of the coastline. While some bluff failures have occurred, those areas are localized and most have been stabilized.⁴⁰ The erosion potential has been identified as “medium” as erosion rates range from very low (less than 0.1 foot per year) in the andesite, to moderate (0.35 foot per year) in portions of the Monterey Formation.⁴¹

While the Laguna Beach formations may have historically lower erosion rates than along other areas of the California coast, the anticipated loss of backshore and nearshore areas from projected sea level rise, will likely lead to a loss of beach area as the sand is eroded. Cliff erosion rates will then potentially accelerate with the projected increases in sea level rise as waves breaking closer to the cliff allow more wave energy impacts.⁴²

COASTAL FLOODING

Coastal flooding is flooding that occurs along the Laguna Beach shoreline due to wave run-up, storm surge, and high tides during coastal storms or King Tide events. Climate change is expected to increase the frequency and intensity of coastal flooding as sea levels rise, causing strong wave action and indirectly causing higher King Tide events.

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DROUGHT

A drought occurs when conditions are drier than normal for an extended period, making less water available for people and ecosystems. Drought is a slow-onset disaster that can impact a community or region for months or years, resulting in far-reaching effects and often intersecting with other natural hazards. Droughts are an ongoing cause of expansive/shrinking soils, subsidence, and pest infestation. Droughts can also create conditions conducive to wildfires and flash-flood events. Droughts are projected to occur more frequently and for longer periods in the region due to changes in precipitation patterns with climate change.

Overall, climate change is likely to decrease precipitation levels throughout the state, although there will likely be significant variation in year-to-year rainfall, and some studies point to a minor increase in precipitation levels. Laguna Beach historically received about 12.6 inches of rainfall a year, with a typical low of 2.9 inches and high of 30.9 inches. Annual precipitation levels under climate change are projected to range between 2.6 and 34 inches per year toward the end of the century, with an average of 13.9 inches per year.⁴³

While there is uncertainty in future precipitation predictions, climate change is projected to result in more frequent and severe droughts, partly due to the greater variability in precipitation levels. Warmer temperatures mean that less precipitation will fall as snow, and that snowmelt will occur earlier in the year. The accumulated snow of the winter (known as snowpack) is a major source of water in California's dry season, but climate change is expected to reduce the water available from this source, particularly at the end of the dry season.

Laguna Beach's water supplies include multiple sources, including groundwater and imported water from the Sierra Nevada, Colorado River, and Owens River. Droughts are regional events, so all parts of Laguna Beach face the same drought risk. Laguna Beach receives water from the South Coast Water District (south Laguna Beach only) and Laguna Beach County Water District (remainder of the community), both of which use a mix of ground and surface water. Groundwater sources include the San Juan Basin and Orange County Basin. Surface water sources include the Colorado River and State Water Project that the Metropolitan Water District of Southern California distributes to the South Coast Water District and Laguna Beach County Water District. Surface water from the State Water Project travels from the Sierra Nevada through the Sacramento River-San Joaquin Delta. Given the distributed nature of Laguna Beach's surface water sources, it is possible for the city to experience a "long distance drought", in which drought conditions in the Sierra Nevada or along the Colorado River watershed may impact the city's water supply.

Droughts can harm landscapes because plants do not get the water they need to survive. In severe cases, droughts may lead to a human health risk if available water supplies are insufficient to meet basic needs. Drought causes soil to dry out, causing soil compaction and preventing the absorption of water into the ground. When precipitation returns, the soil absorbs less water, increasing runoff,

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which can lead to flooding. Dry soils are also more susceptible to erosion, especially if plants have died or no longer provide stability due to loss of roots and soil composition changes.

The chaparral, scrub, and grassland ecosystems in Laguna Beach are well adapted to drought conditions, but more frequent and/or intense drought events may harm these natural environments. This may leave these ecosystems more susceptible to pests and diseases, increasing the risk of wildfires due to drier vegetation fuels. Any open spaces with lawns or other irrigated landscapes may turn brown and die if droughts cause irrigation restrictions, which could discourage residents from using parks and open spaces.

EMERGENT GROUNDWATER

As sea levels rise, shallow groundwater tables will likely rise. Low-lying inland areas, such as downtown Laguna Beach and Aliso Creek, could flood from below by emergent groundwater long before coastal floodwaters overtop the shoreline. Emerging groundwater can damage buried infrastructure, flood below-grade structures, reduce storm sewer capacity, release subsurface contaminants, compromise foundations, and emerge above ground as an urban flood hazard that can amplify overland storm flooding.^{44,45,46} Emergent groundwater is projected to occur in and near Aliso Creek and the low-lying areas east of Main Beach bounded loosely by Broadway Street, 3rd Street, and Mermaid Street. Degradation and increased potential for flooding and inundation of low-lying infrastructure is greater towards the end of the century with over six feet of sea level rise.

As sea level rises, groundwater inundation will prevent infiltration and drainage. It is likely that the downtown area of Laguna Beach may be characterized by standing pools of brackish water, maximized at high tide. This may affect traffic, walkways, and any movement in the urbanized coastal area – the primary places used by short-term visitors and tourists.

Many critical lifeline assets, such as wastewater and stormwater pipes, as well as utility and gas lines, are buried. Even without the emergence of groundwater and flooding aboveground, changes in soil water content can have detrimental implications for these assets. There is the potential for rising groundwater levels (particularly if the groundwater is more saline or contaminated) to reduce the lifespan of buried infrastructure, utilities, and building foundations. Because these assets are buried underground, the impact of increased corrosion and a reduced lifespan often goes unseen until a pipe breaks or structural collapse occurs.⁴⁷

The Laguna Beach Local Hazard Mitigation Plan notes that despite experiencing multiple earthquakes, Laguna Beach has no record of liquefaction, which occurs when intense shaking causes saturated, sandy, and loose soils to behave like a liquid, sinking or collapsing buildings and infrastructure. Yet the presence of liquefaction-prone soils means that future earthquakes could trigger liquefaction in the community. The potential for groundwater emergence to exacerbate liquefaction puts all structures in the vicinity of potential groundwater emergence impact areas in more hazardous conditions.⁴⁸ Add groundwater rise, causing prolonged periods of soil saturation, and liquefaction risk becomes more severe.⁴⁹

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EXTREME HEAT AND WARM NIGHTS

Extreme heat occurs when temperatures rise significantly above normal levels, which in Laguna Beach is 88.1 degrees Fahrenheit. Historically, Laguna Beach has experienced an average of three extreme days per year. Under climate change, these numbers are expected to increase to 10 days per year by the middle of this century (2035 to 2064) and to 24 days per year by the end of the century (2070 to 2099).

Extreme heat can also occur in the form of warm nights when temperatures do not cool down overnight to provide community members with relief from warm days. This can cause higher electricity use during nighttime hours as community residents need more energy to cool homes. In Laguna Beach, a warm night occurs when the temperature stays above 65.2 degrees Fahrenheit. Historically, Laguna Beach has experienced an average of five warm nights per year. Under climate change, these numbers are expected to increase to 31 nights per year by the middle of this century (2035 to 2064) and to 73 nights per year by the end of the century (2070 to 2099).

Extreme heat can cause heat-related illnesses, such as heat cramps, heat exhaustion, and heat stroke, and worsen respiratory and cardiovascular conditions. In severe instances, extreme heat can be fatal. Extreme heat can also have indirect effects on the community, including more visitors traveling to the area to escape high temperatures further inland and strain on the power grid as more households use air conditioning and fans to cool spaces.

FOG

Fog is a very low cloud—usually low enough to touch the ground—that forms when the air near the surface reaches the right temperature for water vapor in the air to condense into a cloud. In Laguna Beach, fog provides a cooling effect for the area and coastal vegetation with water supply. Climate change is likely to decrease the frequency and extent of fog. A reduction in fog may exacerbate the effects of drought and extreme heat.

HUMAN HEALTH HAZARDS

Human health hazards are bacteria, viruses, parasites, and other organisms that can cause diseases in people. Climate-related human health hazards are usually diseases carried by animals that are considered pests, such as mice and rats, mosquitos, and ticks. Warmer temperatures and increased precipitation increase pest populations by expanding pest ranges and hours of activity and accelerating pest life cycles. Climate change-related human health hazards of concern in Laguna Beach include the following:

- **West Nile Virus**, a vector-borne disease, with transmission occurring because of mosquito bites from the *aedes aegypti* mosquitos.

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- **Zika Virus** is a vector-borne disease transmitted from person to person via mosquito bites.
- **Ticks** are small arachnids that feed on blood. Although the bite itself is painless, ticks can transmit diseases to the animals that they bite.

Vector-borne diseases can only be spread where there is a link between the pest and the human population that could be infected. Areas where pests gather could pose a greater danger to humans who live nearby or visit regularly. Mosquitoes, for example, are known to congregate around pools of standing water as this is where they lay their eggs. Any pools or other bodies of standing water in Laguna Beach likely pose an increased risk to anyone who regularly spends time near these locations of being bitten by a mosquito and potentially being infected by a mosquito-borne disease.

Climate change is expected to bring warmer average temperatures to Laguna Beach. This may cause existing pests, including those that can carry diseases, to remain active for longer periods of the year, increasing the risk of exposure. It may also result in pest species or pathogens not currently active in Laguna Beach to migrate into the area. For example, changes in temperature and precipitation have already increased the range of mosquitoes known to carry diseases that originated in tropical areas, including yellow fever, dengue fever, and the Zika virus. At the same time, studies remain uncertain on how climate change will specifically affect several individual diseases.

Diseases and pests affect everyone in Laguna Beach to some degree, from a mild inconvenience to a fatal condition. The specific social vulnerability depends on the disease or pest infestation.

INLAND FLOODING

A flood occurs when there is too much water on the ground to be held in local water bodies, causing water to accumulate in naturally dry areas. They are often caused by heavy rainfall, though floods can also occur after an extended period of moderate rainfall or if unusually warm weather causes mountain snow to melt faster than expected. Floods that develop quickly, known as flash floods, are especially dangerous because there may be little warning that one is occurring, but floods can also build over a more extended period.

Floods are dangerous for several reasons. The floodwaters can be deep enough for people to drown and move fast enough to sweep people away. The moving water can damage buildings with its force (in extreme cases, it may move entire structures) or carry large debris that damages objects with which it collides. When water gets into buildings, it can cause extensive damage to private property, ruining building materials, furniture, electronics, and numerous other items. Standing and moving water can be barriers to movement, isolating people and hindering evacuation, rescue, or relief efforts.

Flooding hazards can potentially impact a significant amount of the community; however, less than 10 percent of this area is subject to a 100-year flood event. Climate change is expected to affect California's precipitation patterns, likely influencing future flood events. A 2017 study found that the

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number of very intense precipitation days in California is projected to more than double by the end of the century, increasing 117 percent, making it likely that flood events will become more frequent.⁵⁰

LANDSLIDES AND MUDFLOWS

When a slope becomes unstable, the soil and rocks that make up the slope slide toward the bottom. Landslides are often sudden, although some can occur slowly over a long period of time. Loose and fractured materials are more likely to slide than compact materials or solid rock, and steep slopes are at greater risk than gentle slopes. Areas that have been recently burned by wildfires are more susceptible to sliding because the fire destroys the vegetation that helps stabilize slopes.

Landslides are usually induced by either earthquakes or moisture. However, earthquakes are not linked to climate change. Moisture-induced landslides can occur when the ground soaks up so much water that it becomes loose and unstable. This is often the result of intense or long-lasting rainfall but can also result from broken pipes or overwatering landscapes. In some cases, hillside erosion from rainfall can induce instability and cause landslides. If the slide is wet enough to become mud, the event is known as a mudslide or mudflow.

Regardless of the cause or specific form, a landslide can damage or destroy any structures built on the sliding material or in its path. Infrastructure built into the soil, such as water pipes or telecommunication lines may be severed. This could potentially lead to infrastructure-induced flooding if water pipes are broken. In addition to property damage, landslides can crush or bury people, creating a risk of serious injury or death. The loose material deposited by a landslide can also block roads and waterways. Climate change may increase the frequency and/or intensity of moisture-induced landslides. Atmospheric river storms are expected to become more intense due to climate change. This will likely cause more precipitation to be absorbed by the soil of slopes in Laguna Beach, which may help destabilize hillsides and cause an increase in the frequency of landslide events. It is also possible that the increase in precipitation could destabilize areas that were mostly stable under less intense storms, which could mean that landslides could become larger.

SEVERE WEATHER

Severe weather often includes strong winds and heavy rainfall. At times, it can also include lightning, hail, and on rare occasions tornadoes. Intense rains can cause floods, which can damage buildings and create a risk of personal injury or drowning. Floodwater can also cause erosion and saturate the soil, potentially sparking landslides and mudflows. There is an equal chance of a severe winter storm affecting any part of Laguna Beach, although variations in intensity throughout the storm system may result in somewhat more or less severe weather in different neighborhoods.

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Severe storms can harm people, buildings, and infrastructure throughout Laguna Beach. Debris from severe weather events can block roadways, disrupting the local transportation network. This in turn can affect transit and emergency response personnel, who may be unable to reach certain areas of the community or may have to take alternative routes. High wind can damage or down power lines, resulting in loss of power. Should high wind coincide with especially hot and dry temperatures, Southern California Edison and San Diego Gas and Electric may elect to pre-emptively shut off power to certain neighborhoods to reduce wildfire risk. Laguna Beach has experienced several of these PSPS events.

Climate change is expected to alter rainfall patterns in Southern California, including Laguna Beach. As the climate warms, rain events are predicted to become more intense. Laguna Beach will likely experience more heavy precipitation events that lead to flooding and erosion and exacerbate the threat of these hazards.

WILDFIRE AND SMOKE

Wildfires are fires that burn in largely undeveloped and natural areas and are a regular feature of ecosystems throughout California. These fires help to clear brush and debris from natural areas and are necessary for the health of many ecosystems and various species' life cycles. However, since the early twentieth century, the common practice was to suppress naturally occurring fires in wildland areas, allowing dry plant matter and other fuels to build up.

The topography of Laguna Beach is extremely conducive to wildfires. The community is bordered by natural, undeveloped hillsides, and the developed areas are very narrow, so much of the community is very close to these hillsides. All the canyon and hillside areas in Laguna Beach, as well as some parts of the coastal terraces, are identified in CAL FIRE Very High Fire Hazard Severity Zones (VHFHSZ). In some places, the VHFHSZ extends south of Pacific Coast Highway to the coastline.

Laguna Beach is often affected by Santa Ana winds blowing through the Santa Ana Mountain range. Santa Ana winds are a major contributor to accelerating the spread of wildfires in California. Climate change is expected to increase temperatures and more frequent and intense drought conditions. This will likely increase the amount of dry plant matter available for fuel, increasing the risk of wildfire statewide. In the hills of Laguna Beach, which are already highly prone to wildfires, climate change is not expected to substantially increase the number of acres burned annually. However, increases in fuel supplies could cause wildfires to move faster or spread into more-developed areas, which could increase the threat to Laguna Beach.

Smoke is a byproduct of wildfires made up of gases and very small particles, usually no bigger than a few microns, and can travel for hundreds of miles. Wildfire, and associated smoke, is projected to increase with climate change due to higher temperatures and drought.

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Appendix C: Population and Asset Details

Climate change is likely to affect all people and community assets in Laguna Beach. However, these effects are not evenly distributed, and some people and assets are likely to be disproportionately affected. The Vulnerability Assessment considered the vulnerability of the following contributors to community identity, population groups, types of building and infrastructure, economic drivers, ecosystems and natural resources, and community services.

COMMUNITY IDENTITY

The vulnerability assessment assessed climate change's potential impact on Laguna Beach's community identity. Community identity is a holistic category, and each contributor to Laguna Beach's community identity is the result of interactions between the city's unique natural features, infrastructure systems, economic drivers, and community services. Impacts to the following contributors to community identity were assessed:

1. Art-centered community. This category considers impacts to art centers and museums, art installations, museums, and cultural events.
2. Beach-focused community. This category considers impacts to beach facilities, coastal tourism, outdoor recreation, beaches, and beach access.
3. Quality of life. This is a broad category that considers climate change's ability to potentially impact all factors to public health and safety, economic well-being, integrity of key local services and infrastructure, and opportunities for recreation in Laguna Beach.
4. Safe and accessible community. This is a broad category that considers those aspects to quality of life that significantly contribute to community safety and accessibility, such as energy and communication infrastructure and services, transportation infrastructure and services, emergency services, and medical buildings.
5. Greenbelt (parks & trails). This category includes trails, outdoor recreation, chaparral and sage brush, oak woodlands, and parks and open space.

POPULATIONS

The vulnerability assessment considered impacts to the following populations:

1. Children under 10 years of age. Approximately 5.8 percent of Laguna Beach's population is under 10 years of age.
2. Low-resourced households, including low-income households, households in poverty, cost-burdened households, and overcrowded households. Approximately 5.7 percent of Laguna Beach households are below the poverty level and 2.3 percent of households are overcrowded. Approximately 4.29 percent of households are cost-burdened, meaning that they spend more than 30 percent of their income on rent, mortgage, and other housing needs.

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3. Outdoor workers, including workers in landscaping, construction, recreation, and tourism. Approximately 3 percent of Laguna Beach’s employed population has an outdoor occupation.
4. People of color and linguistically isolated persons. Linguistically isolated persons are those who are identified in the US Census as speaking English less than “very well”. People of color are defined as those members of the community who do not identify as “White alone” in the US Census. Approximately 8.2 percent of Laguna Beach’s population identifies as Hispanic or Latino, 3.2 percent identify as Asian, and 0.5 percent identify as Black. Approximately 16 percent of Laguna Beach residents are not fluent in English.
5. Persons experiencing homelessness. Individuals experiencing homelessness are defined as those who lack fixed, adequate, and regular nighttime residence. According to the 2022 Orange County Continuum of Care Homeless Count and Survey, the city has a homeless population of 83 people (28 unsheltered and 55 sheltered). The 2022 count shows a 44 percent decrease in the homeless population from 2019. It can be assessed that the number of homeless people in the city is likely to be higher than reported, as it is extremely difficult to count people living in cars, abandoned buildings, and other deserted places. Additionally, some of the homeless population may not wish to be found.
6. Persons living on single access roads. This group refers to those households whose sole means of ingress or egress to the community are highways or arterial roads for high-speed traffic which has many or most characteristics of a controlled-access highway, including limited or no access to adjacent property, some degree of separation of opposing traffic flow, prohibition of slow modes of transport; and very few or no intersecting cross-streets or level crossings.
7. Persons with limited mobility or health concerns, including persons with chronic illnesses, and persons with disabilities and access and functional needs. Approximately 9 percent of Laguna Beach’s noninstitutionalized population has some form of disability.
8. Persons without access to lifelines, including persons without reliable access to a car, transit, or communication systems including phone and internet. Approximately 3.7 percent of Laguna Beach households lack personal vehicle access, 0.4 percent lack telephone service, and 4.7 percent do not have an internet subscription.
9. Senior citizens. Approximately 27 percent of the city’s population is aged 65 and older.
10. Short-term visitors, who visit Laguna Beach for short periods of time, and who are not permanent residents of the city. Laguna Beach receives approximately 6 million visitors per year.

ASSETS

The vulnerability assessment considered climate change’s impacts to infrastructure, buildings, economic drivers, ecosystems and natural resources, and key community services. The assets analyzed are summarized below:

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INFRASTRUCTURE

1. Beach facilities. Structures that support beach activities, including boardwalks, restrooms, sport courts, parking, lifeguard towers, stairs and guardrails, and other facilities.
2. Energy and communication infrastructure, including transmission lines, natural gas pipelines, cell towers, radio sites, and fiber optic and internet lines. SoCalGas owns a major transmission line running the length of Laguna Beach underneath Pacific Coast Highway connecting to various facilities in Huntington Beach, Dana Point, and other surrounding communities.
3. Flood control and stormwater infrastructure. Includes storm drains, channels, flood walls, and floodgates.
4. Hazardous materials sites. Includes hazardous materials sites identified by the state's GeoTracker^{51,52} and EnviroStor databases.² Approximately 51 sites have been identified by these databases, all of which are leaking underground storage tank (LUST) Cleanup Sites, Cleanup Program Sites, or Military Evaluation sites.
5. Trails, including bicycle trails, horse trails, and hiking trails.
6. Transportation infrastructure, including state highways, local roadways, bridges, and transit facilities. The two major roadways in Laguna Beach are the Pacific Coast Highway (State Route 1) and Laguna Canyon Road (State Route 133). The Pacific Coast Highway runs the length of Laguna Beach near the coast, with two lanes in both directions, and connects to Newport Beach to the northwest and Dana Point to the southeast. Laguna Canyon Road runs from Pacific Coast Highway through Laguna Canyon to eastern Irvine, with two lanes in both directions south of Canyon Acres Drive and one lane beyond. State Route 73 runs from Costa Mesa to Laguna Niguel through a short portion of the City's northern border and is only accessible to most of the community through Laguna Canyon Road.
7. Vehicle fuel stations, including gas stations and electric vehicle charge stations. There are approximately six gas stations and 31 publicly accessible electric vehicle charge stations in Laguna Beach.⁵³
8. Water and wastewater infrastructure, including potable water pipelines and treatment plants.
9. Wastewater infrastructure, including sewer pipelines, lift stations, and wastewater treatment plants.

BUILDINGS

1. Art centers and museums. This category contains buildings which house collections of art, primarily indoors. Includes Laguna Beach's nearly 100 art museums, galleries, and studios.
2. Art installations. This category includes collections of or standalone art pieces, which are located primarily outdoors.
3. Government and community facilities, including the Laguna Beach Community and Susi Q Center, Community & Recreation Center, City Hall and government offices, and the Laguna Beach branch of the Orange County library system.
4. Commercial businesses. Includes major shopping centers, office buildings, and other places where commercial activity takes place.

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5. Medical and care facilities. Includes Mission Hospital Laguna Beach, medical offices, urgent care centers, and inpatient facilities.
6. Homes and residential structures.
7. Public safety buildings, including police and four fire stations.
8. Schools, including 18 public and private schools.

ECONOMIC DRIVERS

1. Entertainment, cultural events, and museums. Includes activities related to theater, art, and music.
2. Coastal tourism. Includes activities and industries supported primarily or in part by tourists, including restaurants, cultural venues, hotels, art galleries, outdoor recreation, tour groups, and gift shops. According to the US Census, almost a third of jobs (approximately 30 percent) in the community are in food services and accommodation.
3. Education services. According to the US Census, about 13 percent of community jobs are in education.
4. Hotels and lodging. According to the US Census, almost a third of jobs (approximately 30 percent) in the community are in food services and accommodation.
5. Retail. According to the US Census, about 9 percent of community jobs are in retail trade.
6. Outdoor recreation. Includes activities taking place outdoors at parks, pools, beaches, and on trails.

ECOSYSTEMS AND NATURAL RESOURCES

1. Beaches. Includes 27 mapped beaches.
2. Chaparral and sage scrub.
3. Estuaries.
4. Marine Protected Areas. Marine protected areas (MPAs) are areas seaward of the high tide line that have been designated by law, administrative action, or voter initiative to protect or conserve marine life and habitat. Local MPAs include the Laguna Beach State Marine Reserve and State Marine Conservation Area.
5. Oak woodlands.
6. Parks and open space, including community parks, state parks, and open space areas.
7. Riparian areas.

KEY SERVICES

1. Beach access. This service is supported by the health and integrity of beach ecosystems, stability of beach facilities, and accessibility of beaches by roads.
2. Emergency services. Includes ambulance services, evacuation provision, and response to other emergency events such as fire, flooding, hazardous materials incidents, and tsunamis.
3. Energy delivery and communication services. Includes electric, natural gas, internet, phone, radio, and TV services. Most of Laguna Beach receives its electricity from Southern California

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Edison (SCE). Southern Laguna Beach (south of 2nd Avenue), is serviced by San Diego Gas and Electric (SDG&E). These companies source electricity from power plants throughout California and neighboring states and deliver it through a network of large-scale power lines and substations. The Southern California Gas Company (SoCalGas) provides natural gas service.

4. Government administration and community services. Includes operation of government buildings and facilities and operation of the City Clerk and City Manager offices, City Council, City Treasurer, municipal Boards and Commissions, and Finance and Technology, Public Works and Utilities, and Community Development Departments.
5. Public transit access. The City of Laguna Beach operates bus and trolley lines that run along Pacific Coast Highway and into city neighborhoods, with more-limited service outside of the summer tourism season. The Orange County Transportation Authority runs bus lines that connect to neighboring cities along Pacific Coast Highway and Laguna Canyon Road.
6. Recreation services. Includes services provided by the Recreation Division.
7. Senior services. Includes services providing senior health support, financial assistance, recreational opportunities, transportation assistance, and other services designed to meet the needs of seniors.
8. Solid waste removal. Includes removal and management of trash, recyclables, and compost.
9. Water and wastewater. Includes treatment and delivery of water and management of wastewater. South Coast Water District serves south Laguna Beach, generally south of Cardinal Drive, while Laguna Beach County Water District serves the rest of the community. Both districts receive water from various sources, including groundwater and imported water from the Sierra Nevada mountains, Colorado River, and Owens River.

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Appendix D: Vulnerability Assessment Matrix of Results

The following table presents a summary matrix of the results of all combinations of populations, community assets, and climate hazards assessed as part of the Vulnerability Assessment. If a cell says “Yes” on the inside, this means that the population type or community feature identified was determined to be a priority vulnerability for the given hazard. If the cell says “No” on the inside, this means that the population or community feature was determined to be vulnerable to the given climate hazard, but not a priority hazard. If the cell is gray, this means that the given population or community feature was determined to not be vulnerable to the climate hazard.

Populations and Assets		Hazard													Total Priority Vulnerabilities
		Beach and bluff erosion	Coastal flooding	Drought	Emergent groundwater	Extreme heat and warm nights	Fog	Human health hazards	Inland flooding	Landslides and mudflows	Ocean acidification	Sea level rise	Severe weather	Wildfire and smoke	
Community Identity	Art-centered community	-	-	-	-	No	-	-	Yes	Yes	-	-	No	Yes	3
	Beach-focused community	No	No	-	-	Yes	-	-	Yes	Yes	Yes	Yes	Yes	Yes	7
	Quality of life	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	-	No	Yes	Yes	8
	Safe and accessible community	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	-	Yes	Yes	Yes	11
	Greenbelt (parks and trails)	-	-	Yes	-	No	No	No	Yes	Yes	-	-	Yes	Yes	5
Populations	Children under 10 years of age	No	No	No	-	Yes	No	No	Yes	Yes	-	No	No	Yes	4
	Local artists	No	No	Yes	-	Yes	No	Yes	Yes	Yes	-	No	Yes	Yes	7
	Low-resourced households	No	No	Yes	-	Yes	No	Yes	Yes	Yes	-	No	Yes	Yes	7
	Outdoor workers	No	No	No	-	Yes	No	Yes	No	No	-	No	Yes	Yes	4
	People of color and linguistically isolated persons	No	No	Yes	-	Yes	No	Yes	Yes	Yes	-	Yes	Yes	Yes	8
	Persons experiencing homelessness	No	No	No	-	Yes	No	Yes	No	No	-	-	Yes	Yes	4
	Persons living on single access roads	Yes	Yes	No	-	No	No	No	No	Yes	-	Yes	Yes	Yes	6
	Persons with limited mobility or health concerns	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	-	Yes	Yes	Yes	10
	Persons without access to lifelines	No	No	No	-	No	No	No	No	No	-	-	No	Yes	1
	Senior citizens	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	-	Yes	Yes	Yes	10
Short-term visitors	No	Yes	No	No	Yes	No	Yes	Yes	Yes	-	No	Yes	Yes	7	
Buildings and Infrastructure	Beach facilities	-	Yes	No	-	No	-	-	No	Yes	-	Yes	No	Yes	4
	Energy and communication infrastructure	-	-	-	-	Yes	No	-	-	Yes	-	-	Yes	Yes	4
	Flood control and stormwater infrastructure	Yes	Yes	-	Yes	-	-	-	Yes	Yes	-	Yes	Yes	No	7
	Hazardous materials sites	-	-	-	-	-	-	-	Yes	No	-	-	No	No	1
	Trails	-	-	-	-	No	-	-	Yes	No	-	-	No	Yes	2
	Transportation infrastructure	-	Yes	-	Yes	No	-	-	Yes	Yes	-	Yes	Yes	Yes	7
	Vehicle fuel stations	-	No	-	Yes	Yes	-	-	Yes	Yes	-	-	Yes	Yes	6
	Water and wastewater infrastructure	-	-	No	-	No	-	-	Yes	Yes	-	-	No	Yes	3
	Art centers and museums	-	-	-	-	No	-	-	Yes	No	-	-	No	Yes	2
	Art installations	-	-	-	-	No	-	-	No	No	-	-	No	No	0
	Government and community facilities	-	-	-	No	No	-	-	No	No	-	-	No	Yes	1
	Commercial businesses	-	-	-	No	No	-	-	No	Yes	-	-	Yes	No	2

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Populations and Assets		Hazard												Total Priority Vulnerabilities	
		Beach and bluff erosion	Coastal flooding	Drought	Emergent groundwater	Extreme heat and warm nights	Fog	Human health hazards	Inland flooding	Landslides and mudflows	Ocean acidification	Sea level rise	Severe weather		Wildfire and smoke
	Medical and care facilities	-	-	-	-	No	-	-	No	Yes	-	-	No	Yes	2
	Homes and residential structures	Yes	No	-	No	Yes	-	-	No	Yes	-	Yes	Yes	Yes	6
	Public safety buildings	-	-	-	-	No	-	-	No	Yes	-	-	No	Yes	2
	Schools	-	-	-	-	No	-	-	No	Yes	-	-	No	Yes	2
Economic Drivers	Entertainment, cultural events, and museums	-	-	No	-	No	-	Yes	Yes	No	-	-	No	Yes	3
	Coastal tourism	Yes	Yes	No	-	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	8
	Education services	-	-	No	-	No	-	No	No	No	-	-	No	No	0
	Hotels and lodging	No	No	Yes	No	Yes	-	Yes	No	Yes	-	No	Yes	Yes	6
	Retail	No	No	No	No	No	-	No	No	No	-	-	No	No	0
	Outdoor recreation	No	Yes	No	-	No	No	No	Yes	Yes	-	No	Yes	Yes	5
Ecosystems and Natural Resources	Beaches	Yes	Yes	No	-	No	No	-	No	Yes	-	Yes	No	No	4
	Chaparral and sage brush	-	-	Yes	-	Yes	No	-	No	No	-	-	Yes	Yes	4
	Estuaries	-	-	No	-	No	No	-	Yes	No	-	-	Yes	No	2
	Marine Protected Areas	-	No	No	No	No	-	-	No	No	Yes	No	No	No	1
	Oak woodlands	-	-	Yes	-	Yes	Yes	-	No	No	-	-	No	Yes	4
	Parks and open space	Yes	Yes	No	-	Yes	No	-	No	Yes	-	Yes	Yes	Yes	7
	Riparian areas	-	-	Yes	-	No	No	-	Yes	No	-	-	No	No	2
Key Services	Beach access	Yes	-	-	No	-	-	-	No	Yes	-	-	No	No	2
	Emergency services	Yes	Yes	-	Yes	Yes	-	Yes	No	Yes	-	Yes	No	Yes	8
	Energy delivery and communication services	Yes	No	No	No	Yes	No	-	Yes	Yes	-	No	Yes	Yes	6
	Government administration and community services	-	-	-	-	No	-	No	No	No	-	-	No	Yes	1
	Public transit access	-	-	-	-	No	No	Yes	Yes	No	-	-	No	No	2
	Recreation services	-	-	No	-	Yes	No	Yes	No	No	-	-	No	Yes	3
	Senior services	-	-	-	-	Yes	No	No	No	No	-	-	No	Yes	2
	Solid waste removal	-	-	-	-	No	No	No	Yes	No	-	-	No	No	1
	Water and wastewater	Yes	Yes	Yes	Yes	No	No	-	Yes	Yes	-	Yes	No	Yes	8
Total Number of Priority Vulnerabilities		12	13	11	7	21	1	14	26	31	2	14	24	39	

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