CHAPTER 5
GREENHOUSE GAS AND CLIMATE CHANGE

The City's natural resources form an important part of its unique character and quality of life. This chapter addresses the topics of air quality, greenhouses gases, and climate change.

This chapter includes the following topics:

5.1 Air Quality

5.2 Greenhouse Gases

5.3 Climate Change and Resiliency Planning

5.1 AIR QUALITY

This section discusses the regulatory setting, regional climate, topography, air pollution potential, and existing ambient air quality for criteria air pollutants, toxic air contaminants, odors, and dust. This section also discusses the applicable federal and state ambient air quality standards and attainment statuses, recent trends in ambient air quality, and the nature and location of existing sensitive receptors. Information presented in this section is based in part on information gathered from the South Coast Air Quality Management District (SCAQMD) and the California Air Resources Board (CARB).

Federal Regulatory Setting

Air quality with respect to criteria air pollutants and toxic air contaminants (TACs) within the South Coast Air Basin (SCAB) is regulated by such agencies as the SCAQMD, CARB, and Federal EPA. Each of these agencies develops rules, regulations, policies, and/or goals to attain the goals or directives imposed through legislation. Although the EPA regulations may not be superseded, both State and local regulations may be more stringent.

U.S. Environmental Protection Agency

At the Federal level, EPA has been charged with implementing national air quality programs. EPA's air quality mandates are drawn primarily from the Federal Clean Air Act (FCAA), which was enacted in 1963. The FCAA was amended in 1970, 1977, and 1990.

The FCAA required EPA to establish primary and secondary national ambient air quality standards (NAAQS). The FCAA also required each state to prepare an air quality control plan referred to as a State Implementation Plan (SIP). The Federal Clean Air Act Amendments of 1990 (FCAAA) added requirements for states with nonattainment areas to revise their SIPs to incorporate additional control measures to reduce air pollution. The SIP is periodically modified to reflect the latest emissions inventories, planning documents, and rules and regulations of the air basins as reported by their jurisdictional agencies. EPA has responsibility to review all state SIPs to determine conformity to the mandates of the FCAAA and determine if implementation will achieve air quality goals. If the EPA determines a SIP to be inadequate, a Federal Implementation Plan (FIP) may be prepared for the nonattainment area that imposes additional control measures. Failure to submit an approvable SIP or to implement the plan within the mandated timeframe may result in sanctions being applied to transportation funding and stationary air pollution sources in the air basin.

Federal Hazardous Air Pollutant Program

Title III of the FCAA requires the EPA to promulgate national emissions standards for hazardous air pollutants (NESHAPs). The NESHAP may differ for major sources than for area sources of HAPs (major sources are defined as stationary sources with potential to emit more than 10 tons per year [TPY] of any HAP or more than 25 TPY of any combination of HAPs; all other sources are considered area sources). The emissions standards are to be promulgated in two phases. In the first phase (1992–2000), the EPA developed technology-based emission standards designed to produce the maximum emission reduction achievable. These standards are generally referred to as requiring maximum available control technology (MACT). These Federal rules are also commonly referred to as MACT standards, because they reflect the Maximum Achievable Control Technology. For area sources, the standards may be different, based on generally available control technology. In the second phase (2001–2008), the EPA is required to promulgate health risk–based emissions standards where deemed necessary to address risks remaining after implementation of the technology-based NESHAP standards. The FCAAA required the EPA to promulgate vehicle or fuel standards containing reasonable requirements that control toxic emissions, at a minimum to benzene and formaldehyde. Performance criteria were established to limit mobile-source emissions of toxics, including benzene, formaldehyde, and 1,3-butadiene. In addition, §219 required the use of reformulated gasoline in selected U.S. cities (those with the most severe ozone nonattainment conditions) to further reduce mobile-source emissions.

State Regulatory Setting

In 1992 and 1993, the California Air Resources Board (CARB) requested delegation of authority for the implementation and enforcement of specified New Source Performance Standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAPS) to the following local agencies: Bay Area and South Coast Air Quality Management Districts (AQMDs). EPA's review of the State of California's laws, rules, and regulations showed them to be adequate for the implementation and enforcement of these Federal standards, and EPA granted the delegations as requested.

California Air Resources Board

CARB is the agency responsible for coordination and oversight of State and local air pollution control programs in California and for implementing the California Clean Air Act (CCAA), which was adopted in 1988. The CCAA requires that all air districts in the State endeavor to achieve and maintain the CAAQS by the earliest practical date. The act specifies that districts should focus particular attention on reducing the emissions from transportation and area-wide emission sources, and provides districts with the authority to regulate indirect sources.

CARB is primarily responsible for developing and implementing air pollution control plans to achieve and maintain the NAAQS. CARB is primarily responsible for statewide pollution sources and produces a major part of the SIP. Local air districts are still relied upon to provide additional strategies for sources under their jurisdiction. The CARB combines this data and submits the completed SIP to EPA.

Other CARB duties include monitoring air quality (in conjunction with air monitoring networks maintained by air pollution control and air quality management districts), establishing CAAQS (which in many cases are more stringent than the NAAQS), determining and updating area designations and maps, and setting emissions standards for new mobile sources, consumer products, small utility engines, and off-road vehicles.

Transport of Pollutants

The California Clean Air Act, Section 39610 (a), directs the CARB to "identify each district in which transported air pollutants from upwind areas outside the district cause or contribute to a violation of the ozone standard and to identify the district of origin of transported pollutants." The information regarding the transport of air pollutants from one basin to another was to be quantified to assist interrelated basins in the preparation of plans for the attainment of State ambient air quality standards. Numerous studies conducted by the CARB have identified air basins that are impacted by pollutants transported from other air basins (as of 1993). Among the air basins affected by air pollution transport from the SCAB are the South Central Coast Air Basin, the Mojave Desert Air Basin, the Salton Sea Air Basin, and the San Diego County Air Basin. The SCAB was also identified as an area impacted by the transport of air pollutants from the South Central Coast region (CARB, 2001).

State Toxic Air Contaminant Programs

California regulates TACs primarily through the Tanner Air Toxics Act (AB 1807) and the Air Toxics Hot Spots Information and Assessment Act of 1987 (AB 2588). The Tanner Act sets forth a formal procedure for CARB to designate substances as TACs. This includes research, public participation, and scientific peer review before CARB can designate a substance as a TAC. To date, CARB has identified over 21 TACs, and adopted the EPA's list of HAPs as TACs. Most recently, diesel exhaust particulate was added to the CARB list of TACs. Once a TAC is identified, CARB then adopts an Airborne Toxics Control Measure for sources that emit that particular TAC. If there is a safe threshold for a substance at which there is no toxic effect, the control measure must reduce exposure below that threshold. If there is no safe threshold, the measure must incorporate best available control technology (BACT) to minimize emissions. None of the TACs identified by CARB have a safe threshold.

The Hot Spots Act requires that existing facilities that emit toxic substances above a specified level:

1. Prepare a toxic emission inventory;
2. Prepare a risk assessment if emissions are significant;
3. Notify the public of significant risk levels; and
4. Prepare and implement risk reduction measures.

CARB has adopted diesel exhaust control measures and more stringent emission standards for various on-road mobile sources of emissions, including transit buses and off-road diesel equipment (e.g., tractors and generators). In February 2000, CARB adopted a new public transit bus fleet rule and emission standards for new urban buses. These new rules and standards provide for: 1) more stringent emission standards for some new urban bus engines beginning with 2002 model year engines, 2) zero-emission bus demonstration and purchase requirements applicable to transit agencies, and 3) reporting requirements with which transit agencies must demonstrate compliance with the urban transit bus fleet rule. Upcoming milestones include the low sulfur diesel fuel requirement, and tighter emission standards for heavy-duty diesel trucks (2007) and off-road diesel equipment (2011) nationwide. Over time, the replacement of older vehicles will result in a vehicle fleet that produces substantially less TACs than under current conditions. Mobile-source emissions of TACs (e.g., benzene, 1-3-butadiene, and diesel PM) have been reduced significantly since 2000, and is being reduced further in California through a progression of regulatory measures [e.g., Low Emission Vehicle/Clean Fuels and Phase II reformulated gasoline regulations) and control technologies. With implementation of CARB's Risk Reduction Plan, it is expected that diesel PM concentrations will be reduced by 85% in 2020 from the estimated year 2000 level. Adopted regulations are also expected to continue to reduce formaldehyde emissions from cars and light-duty trucks. As emissions are reduced, it is expected that risks associated with exposure to the emissions will also be reduced.

Local Regulatory Setting

South Coast Air Quality Management District

The SCAQMD shares responsibility with CARB for ensuring that all state and federal ambient air quality standards are achieved and maintained over an area of approximately 10,743 square miles. This area includes all of Orange County and Los Angeles County except for the Antelope Valley, the non-desert portion of western San Bernardino County, and the western and Coachella Valley portions of Riverside County.

The SCAQMD reviews projects to ensure that they do not (1) cause or contribute to any new violation of any air quality standard; (2) increase the frequency or severity of any existing violation of any air quality standard; or (3) delay the timely attainment of any air quality standard or any required interim emission reductions or other milestones of any federal attainment plan.

SCAQMD is responsible for controlling emissions primarily from stationary sources. SCAQMD maintains air quality monitoring stations throughout the South Coast Air Basin. In coordination with the Southern California Association of Governments (SCAG), SCAQMD is also responsible for developing, updating, and implementing the Air Quality Management Plan (AQMP) for the South Coast Air Basin. An AQMP is a plan prepared and implemented by an air pollution district for a county or region designated as nonattainment of the national and/or California ambient air quality standards.

In 2003, an AQMP was prepared by SCAQMD to bring the South Coast Air Basin, as well as portions of the Salton Sea Air Basin under SCAQMD jurisdiction, into compliance with the 1-hour O_3 and PM_{10} national standards. The 2003 AQMP also replaced the 1997 attainment demonstration for the federal CO standard and provided a basis for a maintenance plan for CO for the future. It also updated the maintenance plan for the federal NO_2 standard, which the South Coast Air Basin has met since 1992.

A subsequent AQMP for the Basin was adopted by SCAQMD on June 1, 2007. The goal of the 2007 AQMP was to lead the South Coast Air Basin into compliance with the national 8-hour O_3 and $PM_{2.5}$ standards. The 2007 AQMP outlined a detailed strategy for meeting the national health-based standards for $PM_{2.5}$ by 2015 and 8-hour O_3 by 2024 while accounting for and accommodating future expected growth. The 2007 AQMP incorporated significant new emissions inventories, ambient measurements, scientific data, control strategies, and air quality modeling. Most of the reductions were to be from mobile sources, which are currently responsible for about 75 percent of all smog and particulate-forming emissions.

The SCAQMD approved the 2012 AQMP on December 7, 2012. The 2012 AQMP incorporated the latest scientific and technological information and planning assumptions, including the 2012–2035 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) and updated emission inventory methodologies for various source categories. The 2012 AQMP outlines a comprehensive control strategy that meets the requirement for expeditious progress toward attainment with the 24-hour $PM_{2.5}$ federal ambient air quality standard with all feasible control measures and demonstrates attainment of the standard by 2014. The 2012 AQMP also updates the 8-hour O_3 control plan with new emission reduction commitments from a set of new control measures that implement the 2007 AQMP's Section 182 (e)(5) commitments. The goal of the Final 2012 AQMP is to lead the Basin into compliance with the national 8-hour O_3 and $PM_{2.5}$ standards.

The SCAQMD approved the Final 2016 AQMP on March 3, 2017. The 2016 AQMP includes transportation control measures developed by SCAG from the 2016–2040 RTP/SCS, as well as the integrated strategies and measures needed to meet the NAAQS. The 2016 AQMP demonstrates attainment of the 1-hour and 8-hour O_3 NAAQS as well as the latest 24-hour and annual $PM_{2.5}$ standards.

The SCAQMD has also prepared the 2010 Clean Communities Plan (Formerly the Air Toxics Control Plan), the Air Quality Monitoring Network Plan, the Vision for Air: A Framework for Air Quality and Climate Plan.

The SCAQMD is responsible for limiting the amount of emissions that can be generated throughout the basin by various stationary, area, and mobile sources. Specific rules and regulations have been adopted by the SCAQMD Governing Board that (1) limit the emissions that can be generated by various uses and activities; and (2) identify specific pollution reduction measures, which must be implemented in association with various uses and activities. These rules regulate the emissions of not only the federal and state criteria pollutants, but also TACs and acutely hazardous materials. The rules are also subject to ongoing refinement by SCAQMD.

Among the SCAQMD rules applicable to the project are Rule 403 (Fugitive Dust), Rule 1113 (Architectural Coatings), and Rule 1403 (Asbestos Emissions from Demolition/Renovation Activities). Rule 403 requires the use of stringent best available control measures (BACMs) to minimize PM_{10} emissions during grading and construction activities. Rule 1113 requires reductions in the VOC content of coatings. Compliance with SCAQMD Rule 1403 requires the owner or operator of any demolition or renovation activity to have an asbestos survey performed prior to demolition and to provide notification to the SCAQMD prior to commencing demolition activities.

City of Lake Forest General Plan

The existing City of Lake Forest General Plan identifies multiple policies related to air quality. All current goals and policies can be accessed in the existing General Plan.

Environmental Setting

South Coast Air Basin

Lake Forest is located within the South Coast Air Basin (SCAB). The South Coast Air Basin is regulated by a single air quality management district: the Southern California Air Quality Management District (SCAQMD). The SCAQMD consists of Orange County, the western portion of Los Angeles County, the southwestern portion of San Bernardino County, and the western portion of Riverside County. Air quality in this area is determined by such natural factors as topography, meteorology, climate, as well as existing air pollution sources and ambient conditions. These factors along with applicable regulations are discussed below. The combination of topography, low mixing height, abundant sunshine, and emissions from the second-largest urban area in the United States give the Basin the worst air pollution problem in the nation.

Climate, Topography, and Air Pollution Potential

The clean air challenge in the South Coast has always been formidable. Complex terrain and weather patterns make the region a natural sink for the accumulation of emissions and sustained high pollution levels. Along the coastal area, better air quality prevails because of the relatively mild climate, cooler temperatures, and a pattern of onshore airflow. However, in the inland portion of the air basin, a combination of abundant sunshine, warm temperatures, and poor vertical air mixing is conducive to the formation of ozone, commonly referred to as "smog." The problem is further aggravated by the surrounding mountains that act together with the weather and air pollutant emissions.

The accumulation of smog is further heightened by the extent of exposure to elevated pollution levels. The South Coast Air Basin is the nation's second largest urban area and California's largest metropolitan region. It includes the southern two-thirds of Los Angeles County, all of Orange County, and the western urbanized portions of Riverside and San Bernardino counties. The South Coast Air Basin is home to over 40 percent of the total State population, or about 16 million people, and over 10 million vehicles. Fifty thousand heavy duty diesel trucks travel nearly 10 million miles through the region annually, and well over 50,000 diesel engines are used to move goods and power construction and mining equipment.

Air quality for all pollutants in the Basin continues to improve, with recent years registering the lowest levels since measurements began over six decades ago. During the 1960s, maximum 1-hour concentrations were well above levels considered safe for public health -- more than four times the current health standard. In recent times, the maximum measured concentrations are less than one-third of those peak concentrations. Moreover, long-term ozone air quality trends continue to show an overall improvement. The number of days above both the one and eight-hour standards has also declined dramatically.

Because of weather patterns and geography, residual pollution from the South Coast Air Basin is transported to several downwind air basins -- the Mojave Desert, the Salton Sea, the South Central Coast, and San Diego. As ozone precursor emissions in the South Coast Air Basin decrease over time, the transport impact on the downwind areas will also decline.

The majority of annual rainfall in the South Coast Air Basin occurs between November and April. Summer rainfall is minimal and is generally limited to scattered thunder showers in coastal regions and slightly heavier showers in the eastern portion of the Basin and along the coastal side of the mountains. Lake Forest has a Mediterranean climate with moderate, dry summers. The average July high temperature in Lake Forest is 90 degrees Fahrenheit, and the average January low temperature is 44 degrees Fahrenheit. The City receives about 19 inches of rain per year.

The Basin experiences a persistent temperature inversion (increasing temperature with increasing altitude) as a result of the Pacific high. This inversion limits the vertical dispersion of air contaminants, holding them relatively near to the ground. As the sun warms the ground and the lower air layer, the temperature of the lower air layer approaches the temperature of the base of the inversion (upper) layer until the inversion layer finally breaks, allowing vertical mixing with the lower layer. This phenomenon is observed in mid to late afternoons on hot summer days. Winter inversions frequently break by midmorning.

The combination of stagnant wind conditions and low inversions produces the greatest pollutant concentrations. On days of no inversion or high wind speeds, ambient air pollutant concentrations are lowest. During periods of low inversions and low wind speeds, air pollutants generated in urbanized areas are transported predominantly onshore into Riverside and San Bernardino counties. In the winter, the greatest pollution problem is the accumulation of CO and nitrogen oxides (NOx) due to low inversions and air stagnation during the night and early morning hours. In the summer, the longer daylight hours and the brighter sunshine combine to cause a reaction between hydrocarbons and NOx to form photochemical smog.

Existing Ambient Air Quality: Criteria Air Pollutants

The California Air Resources Board (CARB) and the U.S. Environmental Protection Agency (EPA) currently focus on the following air pollutants as indicators of ambient air quality: ozone (O_3), particulate matter (PM), nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), and lead (Pb). Because these are the most prevalent air pollutants known to be deleterious to human health, they are commonly referred to as "criteria air pollutants." Sources and health effects of the criteria air pollutants are summarized in Table 5-1.

Table 5-1 Common Sources of Health Effects for Criteria Air Pollutants

Pollutants	Sources	Effects on Health and Environment
Ozone (O3)	Atmospheric reaction of organic gases with nitrogen oxides in sunlight	Health: Aggravation of respiratory and cardiovascular diseases; reduced lung function; increased cough and chest discomfort. Environment: Crop, forest and ecosystem damage; damage to materials, including rubber, plastics, fabrics, paint and metals.
Fine Particulate Matter (PM10 and PM2.5)	Stationary combustion of solid fuels; construction activities; industrial processes; atmospheric chemical reactions	Health: Reduced lung function; aggravation of respiratory and cardiovascular diseases; increases in mortality rate; reduced lung function growth in children; premature death.
Nitrogen Dioxide (NO2)	Motor vehicle exhaust; high temperature stationary combustion; atmospheric reactions	Health: Aggravation of respiratory illness (e.g. lung irritation; enhanced allergic responses).
Carbon Monoxide (CO)	Incomplete combustion of fuels and other carbon-containing substances, such as motor vehicle exhaust; natural events, such as decomposition of organic matter	Health: Aggravation of some heart diseases; reduced tolerance for exercise; impairment of mental function (e.g. light-headedness); headaches; birth defects; death at high levels of exposure.
Sulfur Dioxide (SO2)	Combination of sulfur-containing fossil fuels; smelting of sulfur-bearing metal ore; industrial processes	Health: Aggravation of respiratory diseases (including asthma); reduced lung function.
Lead (Pb)	Contaminated soil	Health: Learning disabilities in children; nervous system impairment; impaired mental functioning; brain and kidney damage.

Source: California Air Resources Board, 2017a

Ozone (O3), or smog, is not emitted directly into the environment, but is formed in the atmosphere by complex chemical reactions between reactive organic gases (ROG) and nitrous oxide (NOX) in the presence of sunlight. Ozone formation is greatest on warm, windless, sunny days. The main sources of NOX and ROG, often referred to as ozone precursors, are combustion processes (including motor vehicle engines), the evaporation of solvents, paints, and fuels, and biogenic sources. Automobiles are the single largest source of ozone precursors in the SCAB. Tailpipe emissions of ROG are highest during cold starts, hard acceleration, stop-and-go conditions, and slow speeds. They decline as speeds increase up to about 50 mph, then increase again at high speeds and high engine loads. ROG emissions associated with evaporation of unburned fuel depend on vehicle and ambient temperature cycles. Nitrogen oxide emissions exhibit a different curve; emissions decrease as the vehicle approaches 30 mph and then begin to increase with increasing speeds.

Ozone levels usually build up during the day and peak in the afternoon hours. Short-term exposure can irritate the eyes and cause constriction of the airways. Besides causing shortness of breath, it can aggravate existing respiratory diseases such as asthma, bronchitis, and emphysema. Chronic exposure to high ozone levels can permanently damage lung tissue. Ozone can also damage plants and trees, and materials such as rubber and fabrics.

Particulate Matter (PM) refers to a wide range of solid or liquid particles in the atmosphere, including smoke, dust, aerosols, and metallic oxides. Respirable particulate matter with an aerodynamic diameter of 10 micrometers or less is referred to as PM10. PM2.5 includes a subgroup of finer particles that have an aerodynamic diameter of 2.5 micrometers or less. Some particulate matter, such as pollen, is naturally occurring. In the SCAB, most particulate matter is caused by combustion, factories, construction, grading, demolition, agricultural activities, and motor vehicles. Extended exposure to particulate matter can increase the risk of chronic respiratory disease. PM10 is of concern because it bypasses the body's natural filtration system more easily than larger particles and can lodge deep in the lungs. The EPA and the State of California revised their PM standards several years ago to apply only to these fine particles. PM2.5 poses an increased health risk because the particles can deposit deep in the lungs and contain substances that are particularly harmful to human health. Motor vehicles are currently responsible for about half of particulates in the SCAB. Wood burning in fireplaces and stoves is another large source of fine particulates.

Nitrogen Dioxide (NO2) is a reddish-brown gas that is a by-product of combustion processes. Automobiles and industrial operations are the main sources of NO2. Aside from its contribution to ozone formation, nitrogen dioxide can increase the risk of acute and chronic respiratory disease and reduce visibility. NO2 may be visible as a coloring component of a brown cloud on high pollution days, especially in conjunction with high ozone levels.

Carbon Monoxide (CO) is an odorless, colorless gas. It is formed by the incomplete combustion of fuels. The single largest source of CO in the SCAB is motor vehicles. Emissions are highest during cold starts, hard acceleration, stop-and-go driving, and when a vehicle is moving at low speeds. New findings indicate that CO emissions per mile are lowest at about 45 mph for the average light-duty motor vehicle and begin to increase again at higher speeds. When inhaled at high concentrations, CO combines with hemoglobin in the blood and reduces the oxygen-carrying capacity of the blood. This results in reduced oxygen reaching the brain, heart, and other body tissues. This condition is especially critical for people with cardiovascular diseases, chronic lung disease or anemia, as well as fetuses. Even healthy people exposed to high CO concentrations can experience headaches, dizziness, fatigue, unconsciousness, and even death.

Sulfur Dioxide (SO2) is a colorless acid gas with a pungent odor. It has potential to damage materials and it can have health effects at high concentrations. It is produced by the combustion of sulfur-containing fuels, such as oil, coal, and diesel. SO2 can irritate lung tissue and increase the risk of acute and chronic respiratory disease.

Lead (Pb) is a metal found naturally in the environment as well as in manufactured products. The major sources of lead emissions have historically been mobile and industrial sources. As a result of the phase-out of leaded gasoline, metal processing is currently the primary source of lead emissions. The highest levels of lead in air are generally found near lead smelters. Other stationary sources are waste incinerators, utilities, and lead-acid battery manufacturers.

Twenty years ago, mobile sources were the main contributor to ambient lead concentrations in the air. In the early 1970s, the EPA set national regulations to gradually reduce the lead content in gasoline. In 1975, unleaded gasoline was introduced for motor vehicles equipped with catalytic converters. The EPA banned the use of leaded gasoline in highway vehicles in December 1995. As a result of the EPA's regulatory efforts to remove lead from gasoline, emissions of lead from the transportation sector and levels of lead in the air decreased dramatically.

Ambient Air Quality Standards and Designations

The current Federal and State ambient air quality standards and attainment standards are presented in Table 5-2.

Table 5-2 Ambient Air Quality Standards and Designations

Pollutant	Averaging Time	California[1]		National Standards[2]		
		Standards[3]	Attainment Status	Primary[3,4]	Secondary[3,5]	Attainment Status
Ozone (O_3)[6]	1-hour	0.09 ppm (180 µg/m^3)	N	–	Same as Primary Standard	N (Extreme)
	8-hour	0.070 ppm (137 µg/m^3)	N	0.070 ppm (137 µg/m^3)		P
Carbon Monoxide (CO)	1-hour	20 ppm (23 mg/m^3)	A	35 ppm (40 mg/m^3)	–	A
	8-hour	9 ppm (10 mg/m^3)		9 ppm (10 mg/m^3)		
Respirable Particulate Matter (PM_{10})[7]	Annual Arithmetic Mean	20 µg/m^3	N	–	Same as Primary Standard	A
	24-hour	50 µg/m^3		150 µg/m^3		
Fine Particulate Matter ($PM_{2.5}$)	Annual Arithmetic Mean	12 µg/m^3	N	15 µg/m^3	Same as Primary Standard	N
	24-hour	–	–	35 µg/m^3		
Sulfur Dioxide (SO_2)[9]	Annual Arithmetic Mean	–	–	0.030 ppm (for certain areas)[11]	–	U/A
	24-hour	0.04 ppm (105 µg/m^3)	–	0.14 ppm (for certain areas)[11]	–	
	3-hour	–	–	–	0.5 ppm (1300 µg/m^3)	
	1-hour	0.25 ppm (655 µg/m^3)	–	75 ppb (196 µg/m^3)	–	
Nitrogen Dioxide (NO_2)[10]	Annual Arithmetic Mean	0.030 ppm (57 µg/m^3)	A	0.053 ppm (100 µg/m^3)	Same as Primary Standard	A
	1-hour	0.18 ppm (339 µg/m^3)	A	100 ppb (188 µg/m^3)	–	U/A
Lead[10,11]	30-day Average	1.5 µg/m^3	–	–	–	–
	Calendar Quarter	–	–	1.5 µg/m^3	Same as Primary Standard	–
	Rolling 3-Month Average	–	–	0.15 µg/m^3	Same as Primary Standard	N (Partial)
Sulfates	24-hour	25 µg/m^3	A	No National Standards		
Hydrogen Sulfide	1-hour	0.03 ppm (42 µg/m^3)	A			
Vinyl Chloride[10]	24-hour	0.01 ppm (26 µg/m^3)	A			

Pollutant	Averaging Time	California[1]		National Standards[2]		
		Standards[3]	Attainment Status	Primary[3,4]	Secondary[3,5]	Attainment Status
Visibility-Reducing PM[12]	8-hour	See footnote 12	–			

A = Attainment; N = Nonattainment; P = Designation Pending; U = Unclassifiable; – = No Data.

1. California standards for ozone, carbon monoxide (except 8-hour Lake Tahoe), sulfur dioxide (1 and 24 hour), nitrogen dioxide, and particulate matter (PM_{10}, $PM_{2.5}$, and visibility reducing particles), are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

2. National standards (other than ozone, particulate matter, and those based on annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration measured at each site in a year, averaged over three years, is equal to or less than the standard. For PM_{10}, the 24 hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 µg/m3 is equal to or less than one. For PM2.5, the 24 hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. Contact the U.S. EPA for further clarification and current national policies.

3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

4. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.

5. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

6. On October 1, 2015, the national 8-hour ozone primary and secondary standards were lowered from 0.075 to 0.070 ppm.

7. On December 14, 2012, the national annual $PM_{2.5}$ primary standard was lowered from 15 µg/m^3 to 12.0 µg/m^3. The existing national 24-hour $PM_{2.5}$ standards (primary and secondary) were retained at 35 µg/m^3, as was the annual secondary standard of 15 µg/m^3. The existing 24-hour PM10 standards (primary and secondary) of 150 µg/m^3 also were retained. The form of the annual primary and secondary standards is the annual mean, averaged over 3 years.

8. To attain the 1-hour national standard, the 3-year average of the annual 98th percentile of the 1-hour daily maximum concentrations at each site must not exceed 100 ppb. Note that the national 1-hour standard is in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the national 1-hour standard to the California standards the units can be converted from ppb to ppm. In this case, the national standard of 100 ppb is identical to 0.100 ppm.

9. On June 2, 2010, a new 1-hour SO_2 standard was established and the existing 24-hour and annual primary standards were revoked. To attain the 1-hour national standard, the 3-year average of the annual 99th percentile of the 1-hour daily maximum concentrations at each site must not exceed 75 ppb. The 1971 SO_2 national standards (24-hour and annual) remain in effect until one year after an area is designated for the 2010 standard, except that in areas designated nonattainment for the 1971 standards, the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standards are approved.

Note that the 1-hour national standard is in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the 1-hour national standard to the California standard the units can be converted to ppm. In this case, the national standard of 75 ppb is identical to 0.075 ppm.

10. The ARB has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

11. The national standard for lead was revised on October 15, 2008 to a rolling 3-month average. The 1978 lead standard (1.5 µg/m^3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

12. In 1989, the ARB converted both the general statewide 10-mile visibility standard and the Lake Tahoe 30-mile visibility standard to instrumental equivalents, which are "extinction of 0.23 per kilometer" and "extinction of 0.07 per kilometer" for the statewide and Lake Tahoe Air Basin standards, respectively.

Sources: California Air Resources Board, 2016; SCAQMD, 2016.

Monitoring Data

The SCAQMD, together with CARB, operates a regional air quality monitoring network that regularly measures the concentrations of the major criteria air pollutants. Air pollutant monitoring data is available at https://arb.ca.gov/adam. The SCAB still has some of the worst air quality in the nation because of regionally specific characteristics, including: climate and topography, mobile sources like cars and trucks, a large industrial sector, and two major ports. Neither Federal nor State ambient air quality standards have been violated in recent decades for nitrogen dioxide, sulfur dioxide, sulfates, hydrogen sulfide, and vinyl chloride.

The closest air quality monitoring site to Lake Forest is located in Mission Viejo (at 26081 Via Pera), within ¼ mile southeast of Lake Forest. It is important to note that the Federal ozone 1-hour standard was revoked by the EPA and is no longer applicable for Federal standards. Data obtained from this monitoring site between 2014 and 2016 is shown in Table 5-3.

Table 5-3 Ambient Air Quality Monitoring Data (Mission Viejo – 26081 Via Pera)

Pollutant	Cal. Primary Standard	Fed. Primary Standard	Year	Days Exceeded State/Fed Standard
Ozone (O3) (1-hour)	0.09 ppm for 1 hour	NA	2016 2015 2014	5 / 0 2 / 0 4 / 0
Ozone (O3) (8-hour)	0.07 ppm for 8 hour	0.07 ppm for 8 hour	2016 2015 2014	13 / 13 8 / 8 10/ 10
Particulate Matter (PM10)	50 ug/m3 for 24 hours	150 ug/m3 for 24 hours	2016 2015 2014	* / 0 * / * 0 / 0
Particulate Matter (PM2.5)	No 24 hour State Standard	35 ug/m3 for 24 hours	2016 2015 2014	7.3 / 7.3 7.0 / 7.0 * / *

Sources: California Air Resources Board (ADAM) Air Pollution Summaries, 2014-2016.

ppm = parts per million.

Ug/m3 = microns per cubic meter.

** = There was insufficient (or no) data available to determine the value*

The SCAQMD and CARB also provide statistics from its air quality monitoring network for the SCAB as a whole. Data obtained for the SCAB between 2014 and 2016 is shown in Table 5-4.

Table 5-4 Ambient Air Quality Monitoring Data (in the South Coast Air Basin)

Pollutant	Cal. Primary Standard	Fed. Primary Standard	Year	Days Exceeded State/Fed Standard
Ozone (O3) (1-hour)	0.09 ppm for 1 hour	NA	2016 2015 2014	83 / 0 71 / 0 74 / 0
Ozone (O3) (8-hour)	0.07 ppm for 8 hour	0.07 ppm for 8 hour	2016 2015 2014	132 / 132 115 / 8 129 / 10
Particulate Matter (PM10)	50 ug/m3 for 24 hours	150 ug/m3 for 24 hours	2016 2015 2014	* / * 123.8 / 6.6 128.5 / 1.0
Particulate Matter (PM2.5)	No 24 hour State Standard	35 ug/m3 for 24 hours	2016 2015 2014	* / 7.3 * / 17.6 * / *

Sources: California Air Resources Board (ADAM) Air Pollution Summaries, 2014-2016.
ppm = parts per million.
Ug/m3 = microns per cubic meter.
** = There was insufficient (or no) data available to determine the value*

Emissions Inventory

CARB estimates emissions of criteria air pollutants for the entire South Coast Air Basin. The results of these emissions are provided in Table 5-5, below. All emissions are represented in tons per day, and reflect the most current data provided to the ARB.

Table 5-5 2012 Estimated Annual Average Emissions (SCAB)

Stationary Sources	TOG	ROG	CO	NOX	SOX	PM	PM10	PM2.5
Fuel Combustion	52.5	11.3	48.6	45.1	6.8	5.9	5.7	5.6
Waste Disposal	646.2	12.6	1.0	2.1	0.5	0.3	0.2	0.2
Cleaning and Surface Coatings	82.4	34.1	0.1	0.1	0.0	1.5	1.5	1.4
Petroleum Production and Marketing	79.9	29.0	5.1	1.3	2.1	2.6	1.7	1.5
Industrial Processes	11.9	10.1	0.5	0.4	0.3	15.9	10.8	6.3
Total Stationary Sources	872.9	97.2	55.2	49.1	9.7	26.2	19.9	15.1
Areawide Sources	**TOG**	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**PM10**	**PM2.5**
Solvent Evaporation	119.9	101.9	-	-	-	0.0	0.0	0.0
Miscellaneous Processes	53.3	13.3	54.0	20.6	0.5	174.9	92.6	28.4
Total Areawide Sources	173.2	115.1	54.0	20.6	0.5	174.9	92.6	28.4
Mobile Sources	**TOG**	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**PM10**	**PM2.5**
On-road Motor Vehicles	176.0	157.3	1323.8	318.7	2.0	28.1	27.5	14.5
Other Mobile Sources	111.1	98.4	680.1	125.9	4.6	8.8	8.4	7.1
Total Mobile Sources	287.0	255.7	2003.9	444.7	6.6	36.8	35.9	21.6
Total for South Coast Air Basin	1333.1	468.1	2113.1	514.3	16.8	238.0	148.4	65.1

Source: California Air Resources Board, 2016 SIP Emission Projection Data (accessed April 2018)

Existing Ambient Air Quality: Toxic Air Contaminants

In addition to the criteria air pollutants listed above, another group of pollutants, commonly referred to as toxic air contaminants (TACs) or hazardous air pollutants can result in health effects that can be quite severe. Many TACs are confirmed or suspected carcinogens, or are known or suspected to cause birth defects or neurological damage. Additionally, many TACs can be toxic at very low concentrations. For some chemicals, such as carcinogens, there are no thresholds below which exposure can be considered risk-free.

It is important to understand that TACs are not considered criteria air pollutants and thus are not specifically addressed through the setting of ambient air quality standards. Instead, the EPA and CARB regulate hazardous air pollutants (HAPs) and TACs through statutes and regulations that generally require the use of the maximum or best available control technology (MACT and BACT) to limit emissions. MACT and BACT standards, in conjunction with additional rules set forth by the SCAQMD, establish the regulatory framework for regulating TACs. The SCAQMD maintains approximately 23 rules regulating toxics and other non-criteria pollutants.

Industrial facilities and mobile sources are significant sources of TACs. Sources of TACs go beyond industry. Various common urban facilities also produce TAC emissions, such as gasoline stations (benzene), hospitals (ethylene oxide), and dry cleaners (perchloroethylene). Automobile exhaust also contains TACs such as benzene and 1,3-butadiene. Diesel particulate matter has also been identified as a TAC by the CARB. Diesel PM differs from other TACs in that it is not a single substance but rather a complex mixture of hundreds of substances. SCAQMD research indicates that mobile-source emissions of diesel PM, benzene, and 1,3-butadiene represent a substantial portion of the ambient background risk from TACs in the SCAB.

Sensitive receptors, which include children, the sick, and the elderly, may be especially impacted by TACs. Sensitive receptors located within Lake Forest include: residences, schools, and senior care facilities. However, sources of TACs (such as industrial facilities and gasoline stations) are generally located at a sufficient distance from sensitive receptors that the potential for substantial deleterious health effects to these sensitive receptors from TACs is minimized.

Examples of current SCAQMD Rules relating to TACs are as follows: SCAQMD Rule 1401 requires a new source review of TACs from new permit units, relocations, or modifications to existing permit units which emit TACs. Rule 1401.1 provides requirements for new and relocated TAC-emitting facilities near schools. Rule 1403 provides work practice requirements to limit asbestos emissions from building demolition and renovation activities. Rule 1404 reduces the level of hexavalent chromium emissions allowed from cooling towers. Rule 1469-1 provides limitations on spraying operations using coatings containing chromium. Additionally, Rule 1472 provides requirements for facilities with multiple stationary emergency standby diesel-fueled internal combustion engines.

Existing Ambient Air Quality: Odors and Dust

Other areas of concern related to air quality in the SCAB include the nuisance impacts of odors and dust. Objectionable odors may be associated with a variety of pollutants. Common sources of odors include wastewater treatment plants, landfills, composting facilities, refineries and chemical plants. Similarly, nuisance dust may be generated by a variety of sources including quarries, agriculture, grading and construction. Odors rarely have direct health impacts, but they can be very unpleasant and can lead to anger and concern over possible health effects among the public. Dust emissions can contribute to increased ambient concentrations of PM10, and can also contribute to reduced visibility and soiling of exposed surfaces.

Each year the SCAB receives thousands of citizen complaints about objectionable odors. One particularly large source of numerous odor complaints from 1995 through 2017 has been the Sunshine Canyon Landfill. SCAQMD inspectors must confirm odors in the presence of sufficient numbers of public complainants, then trace the odors to the operation of a unique source before enforcement action can be taken against the verified source of odors. Based on this evidence, a SCAQMD inspector may issue a Notice of Violation (NOV) against the source of nuisance odors for creating a public nuisance, in violation of SCAQMD Rule 402 and California Health and Safety Code Section 41700.

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5.2 GREENHOUSE GASES

Various gases in the Earth's atmosphere, classified as atmospheric GHGs, play a critical role in determining the Earth's surface temperature. Solar radiation enters Earth's atmosphere from space, and a portion of the radiation is absorbed by the Earth's surface. The Earth emits this radiation back toward space, but the properties of the radiation change from high-frequency solar radiation to lower-frequency infrared radiation.

Naturally occurring greenhouse gases include water vapor (H2O), carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and ozone (O3). Several classes of halogenated substances that contain fluorine, chlorine, or bromine are also greenhouse gases, but they are, for the most part, solely a product of industrial activities. Although the direct greenhouse gases CO2, CH4, and N2O occur naturally in the atmosphere, human activities have changed their atmospheric concentrations. From the pre-industrial era (i.e., ending about 1750) to 2011, concentrations of these three greenhouse gases have increased globally by 40, 150, and 20 percent, respectively (IPCC, 2013).

This section addresses greenhouse gases and sets the framework for analysis of this important topic in the General Plan.

Greenhouse Gases and Climate Change Linkages

Greenhouse gases, which are transparent to solar radiation, are effective in absorbing infrared radiation. As a result, this radiation that otherwise would have escaped back into space is now retained, resulting in a warming of the atmosphere. This phenomenon is known as the greenhouse effect. Among the prominent GHGs contributing to the greenhouse effect are carbon dioxide (CO2), methane (CH4), ozone (O3), water vapor, nitrous oxide (N2O), and chlorofluorocarbons (CFCs).

Emissions of GHGs contributing to global climate change are attributable in large part to human activities associated with the industrial/manufacturing, utility, transportation, residential, and agricultural sectors. In California, the transportation sector is the largest emitter of GHGs, followed by the industrial sector (California Air Resources Board, 2017b).

As the name implies, global climate change is a global problem. Unlike criteria air pollutants and toxic air contaminants, which are pollutants of regional and local concern,GHGs are global pollutants. Global pollutants are pollutants that have international impacts and affect the ecosystem on a world-wide scale. In regard to global pollutants, California produced approximately 440 million gross metric tons of carbon dioxide equivalents (MMTCO2e) in 2015 (California Air Resources Board, 2017b). By 2020, California is projected to produce 509 MMTCO2e per year (California Air Resources Board, 2014).

Carbon dioxide equivalents are a measurement used to account for the fact that different GHGs have different potential to retain infrared radiation in the atmosphere and contribute to the greenhouse effect. This potential, known as the global warming potential of a GHG, is also dependent on the lifetime, or persistence, of the gas molecule in the atmosphere. Expressing GHG emissions in carbon dioxide equivalents takes the contribution of all GHG emissions to the greenhouse effect and converts them to a single unit equivalent to the effect that would occur if only CO2 were being emitted.

Consumption of fossil fuels in the transportation sector was the single largest source of California's GHG emissions in 2015, accounting for 39% of total GHG emissions in the state. This category was followed by the industrial sector (23%), the electricity generation sector (including both in-state and out of-state sources) (29%) and the agriculture sector (8%), the residential sector (6%), and the commercial sector (5%) (California Air Resources Board, 2017b).

Effects of Global Climate Change

The effects of increasing global temperature are far-reaching and extremely difficult to quantify. The scientific community continues to study the effects of global climate change. In general, increases in the ambient global temperature as a result of increased GHGs are anticipated to result in rising sea levels; which could threaten coastal areas through accelerated coastal erosion, threats to levees and inland water systems and disruption to coastal wetlands and habitat.

If the temperature of the ocean warms, it is anticipated that the winter snow season would be shortened. Snowpack in the Sierra Nevada provides both water supply (runoff) and storage (within the snowpack before melting), which is a major source of water supply for the state. The snowpack portion of the supply could potentially decline by 70% to 90% by the end of the 21st century (Cal EPA, 2006). This phenomenon could lead to significant challenges securing an adequate water supply for a growing state population. Further, the increased ocean temperature could result in increased moisture flux into the state. However, any additional moisture flux would likely increasingly come in the form of rain rather than snow in the high elevations. The possible increased precipitation could lead to increased potential and severity of flood events, placing more pressure on California's levee/flood control system.

Sea level has risen approximately seven inches during the last century and it is predicted to rise an additional 22 to 35 inches by 2100, depending on the future GHG emissions levels (Cal EPA, 2006). If this occurs, resultant effects could include increased coastal flooding, saltwater intrusion and disruption of wetlands (Cal EPA, 2006). As the existing climate throughout California changes over time, mass migration of species, or failure of species to migrate in time to adapt to the perturbations in climate, could also result. Under the emissions scenarios of the Climate Scenarios report (Cal EPA, 2006), the impacts of global warming in California are anticipated to include, but are not limited to, the following.

Public Health

Higher temperatures are expected to increase the frequency, duration, and intensity of conditions conducive to air pollution formation. For example, days with weather conducive to ozone formation are projected to increase from 25 to 35 percent - under the lower warming range, to 75 to 85 percent- under the medium warming range. In addition, if global background ozone levels increase as predicted in some scenarios, it may become impossible to meet local air quality standards. Air quality could be further compromised by increases in wildfires, which emit fine particulate matter that can travel long distances depending on wind conditions. The Climate Scenarios report indicates that large wildfires could become up to 55 percent more frequent if GHG emissions are not significantly reduced.

In addition, under the higher warming scenario, there could be up to 100 more days per year with temperatures above 90oF in Los Angeles and 95oF in Sacramento by 2100. This is a large increase over historical patterns and approximately twice the increase projected if temperatures remain within or below the lower warming range. Rising temperatures will increase the risk of death from dehydration, heat stroke/exhaustion, heart attack, stroke, and respiratory distress caused by extreme heat.

Water Resources

A vast network of man-made reservoirs and aqueducts capture and transport water throughout the State from northern California rivers and the Colorado River. The current water distribution system relies on Sierra Nevada snow pack to supply water during the dry spring and summer months. Rising temperatures, compounded by potential decreases in precipitation, could severely reduce spring snow pack, increasing the risk of summer water shortages.

The State's water supplies are also at risk from rising sea levels. An influx of saltwater would degrade California's estuaries, wetlands, and groundwater aquifers. Saltwater intrusion caused by rising sea levels is a major threat to the quality and reliability of water within the southern edge of the Sacramento/San Joaquin River Delta, a major state fresh water supply. Global warming is also projected to negatively impact other spheres of the California economy, especially agriculture. California farmers are projected to lose as much as 25 percent of the water supply they need, negatively impacting agricultural production. Global warming may also decrease the potential for hydropower production within the state (although the effects on hydropower are uncertain) and seriously harm winter tourism. Under the lower warming range, the ski season at lower elevations could be reduced by as much as 1 month. If temperatures reach the higher warming range and precipitation declines, there might be many years with insufficient snow for skiing and snowboarding.

If GHG emissions continue unabated, more precipitation will fall as rain instead of snow, and the snow that does fall will melt earlier, reducing the Sierra Nevada spring snow pack by as much as 70 to 90 percent. Under the lower warming scenario, snow pack losses are expected to be only half as large as those expected if temperatures were to rise to the higher warming range. How much snow pack will be lost depends in part on future precipitation patterns, the projections for which remain uncertain. However, even under the wetter climate projections, the loss of snow pack would pose challenges to water managers, hamper hydropower generation, and nearly eliminate all skiing and other snow-related recreational activities.

Agriculture

Increased GHG emissions are expected to cause widespread changes to the agriculture industry, reducing the quantity and quality of agricultural products statewide. Although higher carbon dioxide levels can stimulate plant production and increase plant water-use efficiency, California's farmers will face greater water demand for crops and a less reliable water supply as temperatures rise. Crop growth and development will change, as will the intensity and frequency of pest and disease outbreaks. Rising temperatures will likely aggravate ozone pollution, which makes plants more susceptible to disease and pests and interferes with plant growth.

Plant growth tends to be slow at low temperatures, increasing with rising temperatures up to a threshold. However, faster growth can result in less-than optimal development for many crops, so rising temperatures are likely to worsen the quantity and quality of yield for a number of California's agricultural products. Products likely to be most affected include wine grapes, fruits and nuts, and milk.

In addition, continued global warming will likely shift the ranges of existing invasive plants and weeds and alter competition patterns with native plants. Range expansion is expected in many species while range contractions are less likely in rapidly evolving species with significant populations already established. Should range contractions occur, it is likely that new or different weed species will fill the emerging gaps. Continued global warming is also likely to alter the abundance and types of many pests, lengthen pests' breeding seasons, and increase pathogen growth rates.

Forests and Landscapes

Global warming is expected to intensify this threat by increasing the risk of wildfire and altering the distribution and character of natural vegetation. If temperatures rise into the medium warming range, the risk of large wildfires in California could increase by as much as 55 percent, which is almost twice the increase expected if temperatures stay in the lower warming range. However, since wildfire risk is determined by a combination of factors, including precipitation, winds, temperature, and landscape and vegetation conditions, future risks will not be uniform throughout the state. For example, if precipitation increases as temperatures rise, wildfires in Southern California are expected to increase by approximately 30 percent toward the end of the century. In contrast, precipitation decreases could increase wildfires in northern California by up to 90 percent.

Moreover, continued global warming will alter natural ecosystems and biological diversity within the state. For example, alpine and sub-alpine ecosystems are expected to decline by as much as 60 to 80 percent by the end of the century as a result of increasing temperatures. The productivity of the state's forests is also expected to decrease as a result of global warming.

Rising Sea Levels

Rising sea levels, more intense coastal storms, and warmer water temperatures will increasingly threaten the state's coastal regions. Under the higher warming scenario, sea level is anticipated to rise 22 to 35 inches by 2100. Elevations of this magnitude would inundate coastal areas with saltwater, accelerate coastal erosion, threaten vital levees and inland water systems, and disrupt wetlands and natural habitats.

Federal Regulatory Setting

Clean Air Act

The Federal Clean Air Act (FCAA) was first signed into law in 1970. The law was substantially amended In 1977, and again in 1990. The FCAA is the foundation for a national air pollution control effort, and it is composed of the following basic elements: National ambient air quality standards (NAAQS) for criteria air pollutants, hazardous air pollutant standards, state attainment plans, motor vehicle emissions standards, stationary source emissions standards and permits, acid rain control measures, stratospheric ozone protection, and enforcement provisions.

The EPA is responsible for administering the FCAA. The FCAA requires the EPA to set standards (NAAQS) for several problem air pollutants based on human health and welfare criteria. Two types of NAAQS were established: primary standards and secondary standards. Primary standards under the NAAQS protect public healthsecondary standards protect the public welfare from non-health-related adverse effects such as visibility reduction.

Energy Policy and Conservation Act

The Energy Policy and Conservation Act of 1975 sought to ensure that all vehicles sold in the U.S. would meet certain fuel economy goals. Through this Act, Congress established the first fuel economy standards for on-road motor vehicles in the United States. Pursuant to the Act, the National Highway Traffic and Safety Administration, which is part of the U.S. Department of Transportation (USDOT), is responsible for establishing additional vehicle standards and for revising existing standards.

Since 1990, the fuel economy standard for new passenger cars has been 27.5 mpg. Since 1996, the fuel economy standard for new light trucks (gross vehicle weight of 8,500 pounds or less) has been 20.7 mpg. Heavy-duty vehicles (i.e., vehicles and trucks over 8,500 pounds gross vehicle weight) are not currently subject to fuel economy standards. Compliance with federal fuel economy standards is determined on the basis of each manufacturer's average fuel economy for the portion of its vehicles produced for sale in the U.S. The Corporate Average Fuel Economy (CAFE) program, which is administered by the EPA, was created to determine vehicle manufacturers' compliance with the fuel economy standards. The EPA calculates a CAFE value for each manufacturer based on city and highway fuel economy test results and vehicle sales. Based on the information generated under the CAFE program, the USDOT is authorized to assess penalties for noncompliance.

Energy Policy Act of 1992 (EPAct)

The Energy Policy Act of 1992 (EPAct) was passed to reduce the country's dependence on foreign petroleum and improve air quality. EPAct includes several parts intended to build an inventory of alternative fuel vehicles (AFVs) in large, centrally fueled fleets in metropolitan areas. EPAct requires certain federal, state, and local government and private fleets to purchase a percentage of light duty AFVs capable of running on alternative fuels each year. In addition, financial incentives are included in EPAct. Federal tax deductions will be allowed for businesses and individuals to cover the incremental cost of AFVs. States are also required by the act to consider a variety of incentive programs to help promote AFVs.

Energy Policy Act of 2005

The Energy Policy Act of 2005 was signed into law on August 8, 2005. Generally, the act provides for renewed and expanded tax credits for electricity generated by qualified energy sources, such as landfill gas; provides bond financing, tax incentives, grants, and loan guarantees for a clean renewable energy and rural community electrification; and establishes a federal purchase requirement for renewable energy.

Intermodal Surface Transportation Efficiency Act (ISTEA)

ISTEA (49 U.S.C. § 101 et seq.) promoted the development of intermodal transportation systems to maximize mobility as well as address national and local interests in air quality and energy. ISTEA contained factors that metropolitan planning organizations (MPOs), such as SACOG, were to address in developing transportation plans and programs, including some energy-related factors. To meet the ISTEA requirements, MPOs adopted explicit policies defining the social, economic, energy, and environmental values that were to guide transportation decisions in that metropolitan area. The planning process was then to address these policies. Another requirement was to consider the consistency of transportation planning with federal, state, and local energy goals. Through this requirement, energy consumption was expected to become a criterion, along with cost and other values that determine the best transportation solution.

The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)

SAFETEA-LU (23 U.S.C. § 507), renewed the Transportation Equity Act for the 21st Century (TEA-21) of 1998 (23 U.S.C.; 49 U.S.C.) through FY 2009. SAFETEA-LU authorized the federal surface transportation programs for highways, highway safety, and transit. SAFETEA-LU addressed the many challenges facing our transportation system today—such as improving safety, reducing traffic congestion, improving efficiency in freight movement, increasing intermodal connectivity, and protecting the environment—as well as laying the groundwork for addressing future challenges. SAFETEA-LU promoted more efficient and effective federal surface transportation programs by focusing on transportation issues of national significance, while giving state and local transportation decision makers more flexibility to solve transportation problems in their communities. SAFETEA-LU was extended in March of 2010 for nine months, and expired in December of the same year. In June 2012, SAFETEA-LU was replaced by the Moving Ahead for Progress in the 21st Century Act (MAP-21), which will take effect October 1, 2012.

U.S. Federal Climate Change Policy

The U.S. EPA published the latest version of the Climate Change Indicators report in 2016, in collaboration with more than 40 government agencies, academic institutions, and other organizations, to compile a key set of indicators related to the causes and effects of climate change. The U.S. EPA also currently administers multiple programs that encourage voluntary GHG reductions, including "ENERGY STAR", "Climate Leaders", and Methane Voluntary Programs. However, as of this writing, there are no adopted federal plans, policies, regulations, or laws directly regulating GHG emissions.

State Regulatory Setting

Assembly Bill 1493

In response to AB 1493, CARB approved amendments to the California Code of Regulations (CCR) adding GHG emission standards to California's existing motor vehicle emission standards. Amendments to CCR Title 13 Sections 1900 (CCR 13 1900) and 1961 (CCR 13 1961), and adoption of Section 1961.1 (CCR 13 1961.1), require automobile manufacturers to meet fleet average GHG emission limits for all passenger cars, light-duty trucks within various weight criteria, and medium-duty passenger vehicle weight classes beginning with the 2009 model year. Emission limits are further reduced each model year through 2016. For passenger cars and light-duty trucks 3,750 pounds or less loaded vehicle weight (LVW), the 2016 GHG emission limits are approximately 37 percent lower than during the first year of the regulations in 2009. For medium-duty passenger vehicles and light-duty trucks 3,751 LVW to 8,500 pounds gross vehicle weight (GVW), GHG emissions are reduced approximately 24 percent between 2009 and 2016.

CARB requested a waiver of Federal preemption of California's Greenhouse Gas Emissions Standards. The intent of the waiver is to allow California to enact emissions standards to reduce carbon dioxide and other greenhouse gas emissions from automobiles in accordance with the regulation amendments to the CCRs that fulfill the requirements of AB 1493. The EPA granted a waiver to California to implement its greenhouse gas emissions standards for cars.

California Executive Orders S-3-05 and S-20-06, and Assembly Bill 32

On June 1, 2005, Governor Arnold Schwarzenegger signed Executive Order S-3-05. The goal of this Executive Order is to reduce

California's GHG emissions to: 1) 2000 levels by 2010, 2) 1990 levels by 2020 and 3) 80% below 1990 levels by 2050.

In 2006, this goal was further reinforced with the passage of Assembly Bill 32 (AB 32), the Global Warming Solutions Act of 2006. AB 32 sets the same overall GHG emissions reduction goals while further mandating that CARB create a plan, which includes market mechanisms, and implement rules to achieve "real, quantifiable, cost-effective reductions of greenhouse gases." Executive Order S-20-06 further directs State agencies to begin implementing AB 32, including the recommendations made by the State's Climate Action Team.

Assembly Bill 1007

Assembly Bill 1007 (Pavley, Chapter 371, Statutes of 2005) directed the CEC to prepare a plan to increase the use of alternative fuels in California. As a result, the CEC prepared the State Alternative Fuels Plan in consultation with State, Federal, and local agencies. The plan presents strategies and actions California must take to increase the use of alternative non-petroleum fuels in a manner that minimizes costs to California and maximizes the economic benefits of in-state production. The Plan assessed various alternative fuels and developed fuel portfolios to meet California's goals to reduce petroleum consumption, increase alternative fuels use, reduce greenhouse gas emissions, and increase in-state production of biofuels without causing a significant degradation of public health and environmental quality.

Assembly Bill 2140

Under the Federal Disaster Mitigation Act of 2000, each municipality must develop a Local Hazard Mitigation Plan (LHMP) or participate in a multi-jurisdictional LHMP in order to be eligible for pre- disaster mitigation grants or post-disaster recovery assistance from the federal government. AB 2140 authorizes local governments to adopt their LHMP's with the safety elements of their General Plans. Integration or incorporation by reference is encouraged through a post-disaster financial incentive which authorizes the state to use available California Disaster Assistance Act funds to cover local shares of the 25% non-federal portion of grant-funded post-disaster projects.

Bioenergy Action Plan – Executive Order #S-06-06

Executive Order #S-06-06 establishes targets for the use and production of biofuels and biopower and directs state agencies to work together to advance biomass programs in California while providing environmental protection and mitigation. The executive order establishes the following target to increase the production and use of bioenergy, including ethanol and biodiesel fuels made from renewable resources: produce a minimum of 20 percent of its biofuels within California by 2010, 40 percent by 2020, and 75 percent by 2050. The executive order also calls for the state to meet a target for use of biomass electricity.

Governor's Low Carbon Fuel Standard (Executive Order S-01-07)

Executive Order (EO) S-01-07 establishes a statewide goal to reduce the carbon intensity of California's transportation fuels by at least 10 percent by 2020 through establishment of a Low Carbon Fuel Standard. The Low Carbon Fuel Standard is incorporated into the State Alternative Fuels Plan and is one of the proposed discrete early action GHG reduction measures identified by CARB pursuant to AB 32.

Executive Order B-30-15

On April 29, 2015, Governor Jerry Brown issued Executive Order (EO) B-30-15, which establishes a State GHG reduction target of 40 percent below 1990 levels by 2030. The new emission reduction target provides for a mid-term goal that would help the State to continue on course from reducing GHG emissions to 1990 levels by 2020 (per AB 32) to the ultimate goal of reducing emissions 80 percent under 1990 levels by 2050 (per EO S-03-05). This is in line with the scientifically established levels needed in the U.S. to limit global warming below 2 degrees Celsius – the warming threshold at which scientists say there will likely be major climate disruptions. EO B-30-15 also addresses the need for climate adaptation and directs State government to:

Incorporate climate change impacts into the State's Five-Year Infrastructure Plan;

Update the Safeguarding California Plan, the State climate adaptation strategy, to identify how climate change will affect California infrastructure and industry and what actions the State can take to reduce the risks posed by climate change;

Factor climate change into State agencies' planning and investment decisions; and

Implement measures under existing agency and departmental authority to reduce GHG emissions.

Climate Action Program at Caltrans

Caltrans prepared a Climate Action Program in response to new regulatory directives. The goal of the Climate Action Program is to promote clean and energy efficient transportation, and provide guidance for mainstreaming energy and climate change issues into business operations. The overall approach to lower fuel consumption and CO_2 from transportation is twofold: (1) reduce congestion and improve efficiency of transportation systems through smart land use, operational improvements, and Intelligent Transportation Systems; and (2) institutionalize energy efficiency and GHG emission reduction measures and technology into planning, project development, operations, and maintenance of transportation facilities, fleets, buildings, and equipment.

The reasoning underlying the Climate Action Program is the conclusion that “the most effective approach to addressing GHG reduction, in the short-to-medium term, is strong technology policy and market mechanisms to encourage innovations. Rapid development and availability of alternative fuels and vehicles, increased efficiency in new cars and trucks (light and heavy duty), and super clean fuels are the most direct approach to reducing GHG emissions from motor vehicles (emission performance standards and fuel or carbon performance standards).”

Senate Bill 97

Senate Bill 97 (Chapter 185, 2007) required the Governor’s Office of Planning and Research (OPR) to develop recommended amendments to the State CEQA Guidelines for addressing greenhouse gas emissions. OPR prepared its recommended amendments to the State CEQA Guidelines to provide guidance to public agencies regarding the analysis and mitigation of greenhouse gas emissions and the effects of greenhouse gas emissions in draft CEQA documents. The Amendments became effective on March 18, 2010.

Senate Bill 375

SB 375 requires CARB to develop regional greenhouse gas emission reduction targets to be achieved from the automobile and light truck sectors for 2020 and 2035. The 18 metropolitan planning organizations (MPO) in California will prepare a “sustainable communities strategy” to reduce the amount of greenhouse gas emission in their respective regions and demonstrate the ability for the region to attain CARB’s reduction targets. CARB would later determine if each region is on track to meet their reduction targets. In addition, cities would have extra time -- eight years instead of five -- to update housing plans required by the State.

Senate Bill 32

An update to Assembly Bill 32 was passed in August 2016, which extends the state’s targets for reducing greenhouse gases from 2020 to 2030. Under Senate Bill (SB) 32, the state would reduce its greenhouse gas emissions to 40 percent below 1990 levels by 2030.

Senate Bill 379

As California confronts climate change impacts, local governments are now required, in accordance with Senate Bill 379, to include a climate change vulnerability assessment, measures to address vulnerabilities, and comprehensive hazard mitigation and emergency response strategy within their Land Use and Safety Elements. Communities may use the safety element as a vehicle for defining “acceptable risk” and the basis for determining the level of necessary mitigation. Policies may include methods of minimizing risks, as well as ways to minimize economic disruption and expedite recovery following disasters.

Regional Regulatory Setting

South Coast Air Quality Management District (SCAQMD)

SCAQMD adopted a “Policy on Global Warming and Stratospheric Ozone Depletion” on April 6, 1990. The policy commits the SCAQMD to consider global impacts in rulemaking and in drafting revisions to the Air Quality Management Plan. In March 1992, the SCAQMD Governing Board reaffirmed this policy and adopted amendments to the policy to include the following directives:

- Phase out the use and corresponding emissions of chlorofluorocarbons, methyl chloroform (1,1,1- trichloroethane or TCA), carbon tetrachloride, and halons by December 1995.
- Phase out the large quantity use and corresponding emissions of hydrochlorofluorocarbons by the year 2000.
- Develop recycling regulations for hydrochlorofluorocarbons (e.g., SCAQMD Rules 1411 and 1415).
- Develop an emissions inventory and control strategy for methyl bromide
- Support the adoption of a California GHG emission reduction goal.

SCAQMD released draft guidance regarding interim CEQA GHG significance thresholds in 2008. Within its October 2008 document, SCAQMD proposed the use of a percent emission reduction target to determine significance for commercial/residential projects that emit greater than 3,000 MT CO_2e per year. On December 5, 2008, the SCAQMD Governing Board adopted the staff proposal for an interim GHG significance threshold for stationary source/industrial projects where SCAQMD is the lead agency.

Existing Greenhouse Gas Emissions in Lake Forest

The City of Lake Forest does not have any plans, policies, regulations, significance thresholds, or laws addressing climate change at this time. Additionally, the City has not calculated a greenhouse gas emissions baseline for the community or for City government operations, nor has the City developed a Climate Action Plan or other planning document regulation GHGs.

Development of GHG emissions inventories for the City of Lake Forest are expected to occur in future years. GHG emissions within the City of Lake Forest are closely tied to trends within the region of Orange County and the State of California. In general, the biggest GHG emissions sectors (e.g. building energy and on-road transportation) tend to be affected most heavily by State and regional-level regulations and initiatives (as opposed to local policies). This means that the local government has limited control over the magnitude of local-level GHG emissions. Nevertheless, the City of Lake Forest has control over policy decisions that can substantially reduce the community's overall GHG emissions. For example, the local government has substantial control over current and future land uses, parking policies, building energy efficiency and renewable energy requirements, recycling initiatives, and water and wastewater reduction plans and policies. The City of Lake Forest also has substantial control over its own government operations, including energy usage within County-operated buildings, County vehicle fleet usage, and street lighting. The City of Lake Forest will continue to work closely with neighboring jurisdictions and Orange County to reduce community-wide and municipal-level GHG emissions under its control.

Qualified Greenhouse Gas Analysis

The City of Lake Forest's General Plan Update will include preparation of a qualified Greenhouse Gas Analysis which will be used to evaluate potential impacts associated with buildout of the preferred plan and identification of appropriate mitigation strategies. This analysis will be prepared as part of the Land Use Alternatives Report and Environmental Impact Report associated with Phase 2 and Phase 3 of the General Plan Update project, respectively. The intent of this section is to record applicable federal, state, regional requirements related to greenhouse gas and climate change planning and set the stage for the quantified assessment to be completed in these subsequent tasks.

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5.3 CLIMATE CHANGE AND RESILIENCY PLANNING

This section addresses hazards associated with climate change as well as resiliency planning and adaptation strategies. Information in this section is primarily from the Los Angeles County Department of Public Health Framework for Addressing Climate Change in Los Angeles County, the California State Legislature's Senate Environmental Quality Committee Report on Southern California Regional Adaptation Efforts to Climate Change Impacts, and the University of California Los Angeles (UCLA) Institute of the Environment and Sustainability Climate Change in the Los Angeles Region Project.

Climate change is currently having global and local impacts that are occurring in response to greenhouse gas (GHG) emissions from human activities, as noted in the 5th assessment of the Intergovernmental Panel on Climate Change (IPCC). These global changes are manifesting in varied environmental health and infrastructure consequences for different countries, regions, and states, necessitating a change in public policy decision making in order to adapt to a new environment.

Over the next century, increasing atmospheric greenhouse gas (GHG) concentrations are expected to cause a variety of changes to global climate conditions, including sea level rise (SLR) and storm surge in coastal areas, increased riverine flooding, and higher temperatures more frequently (leading to extreme heat events and wildfires), particularly in inland areas. Local impacts stemming from climate related conditions range from impacts to water quality and supply, public health, air quality, wildfires and infrastructure.

Because local governments largely determine the shape of development through land-use plans, regulations, and implementing decisions, local governments play an important role in developing climate change strategies including resiliency planning and adaptation. Inasmuch as local governments play an important role in adaptation strategies through local land use plans and policies, many climate adaptation strategies will need to be coordinated as part of a larger regional, or statewide strategy requiring cooperation by many local governments, and decision making and regulatory bodies.

Environmental Setting

Until recently, the most robust climate change research has focused on large regions and global conditions, and information about climate change and how if effects regional areas has been less well known. While global climate models are incredibly useful for understanding climate change on global and continental scales, they are too low in spatial resolution to help understand climate impacts on smaller scales, particularly in areas like the Los Angeles region, whose complex topography creates microclimates that a global climate model cannot account for.

The most comprehensive study of climate change in the Los Angeles area to date, the Climate Change in the Los Angeles Region Project was conducted by Center for Climate Science Faculty Director Alex Hall and his research group at UCLA between 2010 and 2015. Researchers at UCLA used a technique to downscale approximately three dozen latest-generation global climate models at 1.2-mile resolution over the greater Los Angeles region. Focusing on two future periods, 2041–2060 and 2081–2100, researchers analyzed changes in various aspects of climate—temperature, extreme heat, precipitation, snowfall, and runoff from precipitation in the region's mountains—under two different scenarios of greenhouse gas emissions. The "business as usual" scenario represents a continued rise in emissions of heat-trapping greenhouse gases, and the "mitigation" scenario represents aggressive action to curb emissions over the coming decades. Key Findings from this research include:

At mid-century under the Business As Usual scenario, average temperatures over the region's land areas rise by 4.3°F, compared with a reference period of 1981–2000.

Warming is not uniform across the LA region. Valleys and inland areas warm more than areas near the coast.

The number of days hotter than 95°F increases across the region, but to a greater extent in the interior compared with coastal areas.

At mid-century, temperature changes in the Mitigation scenario are 70% of those in Business As Usual scenario. That warming doesn't differ greatly between the two scenarios means significant effects of climate change are inevitable.

At the end of the century, there's a much larger difference between the two scenarios. In the Mitigation scenario, temperatures level off, and by end-century, average temperatures are about 3°F warmer than in 1981–2000. Under Business As Usual, end-century average temperatures will be 8.2°F warmer than they were in 1981–2000. This stark difference indicates that global action to reduce greenhouse gas emissions would have significant benefits.

Average annual precipitation totals do not change significantly in either time period or scenario. (Note: Further studies are required for a holistic analysis of precipitation changes. In California, precipitation varies greatly from year to year, so changes to the average are just one part of the story. Other projects by the Center for Climate Science are assessing changes to the distribution of precipitation events and the effects of climate change on drought.)

Because temperature increases cause a greater share of winter precipitation to fall as rain instead of snow, snowfall in the region's mountains will be reduced. At mid-century under Business As Usual, elevations below about 6,500 feet lose half their snowfall compared with 1981–2000, while higher elevations lose up to 30%. At the end of the century under Business As Usual, lower elevations stand to lose 80% of the snowfall they received in 1981–2000.

Other studies have indicated a variety of changes to local climate conditions as a result of climate change are expected to occur leading to several local conditions that may affect southern California including the City of Lake Forest including: increased urban flooding, higher temperatures, more frequent heat waves (leading to extreme heat events), increased risk of wildfire, water quality and water supply impacts, impacts to regional air quality, and other public health Impacts.

Flooding

Precipitation change is a climate variable that is directly affected by changes in global atmospheric and oceanic temperatures. Projected changes in precipitation include annual trend changes as well as extreme precipitation events.

Riverine and local flooding is influenced by precipitation and local conditions, such as ground cover and soil conditions. Riverine flooding occurs when heavy rainfall causes rivers or creeks to overtop their banks and inundate surrounding areas during extreme weather events. Urban flooding commonly occurs when local stormwater infrastructure is overwhelmed during extreme precipitation events. As described previously, , rainfall averages are expected to vary only slightly from current conditions in the

Los Angeles Region, however, local model predictions include more extreme precipitation events, which in turn cause flood risks to worsen, increasing the likelihood of damaging infrastructure, increasing erosion, and overwhelming sewage treatment systems, which may reduce water quality and impact public health.

Water Supply and Quality

According to the Los Angeles Regional Water Quality Control Board's Los Angeles Region Framework for Climate Change Adaptation and Mitigation, overall mean precipitation amounts are expected to change very little, however it is expected that climate change will likely impact water demand, supply, and quality of both surface and ground water.

The Los Angeles Region Framework notes that mountains around Los Angeles are expected to lose at least 31% of snowfall, which will melt faster with increasing temperatures and begin melting 16 days earlier on average. With decreased stream flows and higher temperatures, impacts could include a reduction of fish habitat, increased surface water temperatures, pollutant levels, and sedimentation, intensified algal growth, and subsequently, more harmful algal blooms. For groundwater, the potential for salt water intrusion into aquifers with sea level rise could be worsened by overpumping. The decreased water quality could further deteriorate as pollutant concentrations increase due to reduced water levels and recharge from drought and diminished snowpack.

Wildfires

Wildfire occurs as a result of conditions affected by complex interactions between primary variables (including precipitation, and temperature) and other factors (including changes in cover type). Wildfires are unplanned, natural occurring fires and may be caused by lightning, accidental human ignitions, arson, or escaped prescribed fires. Weather is one of the most significant factors in determining the severity of wildfires; natural fire patterns are driven by conditions such as drought, temperature, precipitation, and wind, and also by changes to vegetation structure and fuel (i.e., biomass) availability. Wildfires pose a great threat to life and property, particularly when they move from forest or rangeland into developed areas.

Climate change is projected to increase the frequency of wildfire events, the extent of burned areas across California, and the duration of wildfire seasons. Wildfire seasons are projected to begin earlier in the spring due to drier and warmer spring conditions on average, potentially requiring longer periods for firefighting services. Greater inter-annual variability in temperature and precipitation may also affect wildfire intensity. For example, multiple wet years can result in larger fuel buildup in landscapes. This may result in increasingly intense and frequent wildfires, if followed by drought years. Wildfire risk will also vary depending on population growth and land use characteristics, including rates of residential expansion and infrastructure into fire prone areas over the next century.

In recent decades, Southern California has experienced an increase in the area burned by wildfires. According to the Southern California Fires Interdisciplinary Project, the southern California fires in 2003, were widely considered a 100-year event, and the 2007 fires, were responsible for billions of dollars in costs from firefighting, property damage, environmental erosion, ecosystem services, and human health impacts. By 2050, the region's fire season is projected to last three weeks longer with an increase of 20-30% in the annual amount of acreage burned (Yue et al. 2013).

Wildfires also contribute to reduced air quality, through the elevated levels of particulate matter and ozone pollution, with implications for public health. Wildfire smoke can result in both short-term and long-term health impacts, from minor lung and eye irritation to premature death. Research on health impacts from the 2003 Southern California wildfires showed an increase in hospital admissions for respiratory problems during the fires, including asthma attacks, acute bronchitis, and chronic obstructive pulmonary disorder (COPD), with small increases in cardiovascular admissions. The research further suggested that improved prevention measures are needed to reduce illness in vulnerable populations (Finlay, Elise et al 2012).

Extreme Heat

Temperature is a climate variable, and is directly affected by changes in global atmospheric and oceanic temperatures. While trends in average annual temperature are an important indicator of climate change, extreme temperature events have greater impacts on society due to their episodic nature. Therefore, vulnerability and risk assessment tends to specifically focus on extreme heat events and not on average temperature changes. The IPCC defines extreme heat events as a period of abnormally hot weather. While extreme heat events can have various durations, CalAdapt defines an extreme heat event as a period of five or more consecutive extreme heat days. CalAdapt defines an extreme heat day in a given region as a day in April through October where the maximum temperature exceeds the 98th historical percentile of maximum temperatures for that region based on daily temperature data from 1961 to 1990. The 98th historical percentile of maximum temperatures varies by locality and inland areas tend to be at a greater risk of extreme heat events when compared to areas near the coast.

Increasing numbers of extreme heat days are projected in the coming decades. The Public Health-Related Impacts of Climate Change in California report points out that increasing high heat days from climate change have a number of impacts on communities, including direct heat-related mortalities and worsening of chronic health conditions (Drechsler et al. 2006). Southern California already experiences energy shortages, and higher demand from more frequent and intense high heat days could further impact health.

As noted by the Union of Concerned Scientists (UCS) in the 2012 report Preparing for Climate Change Impacts in Los Angeles: Strategies and Solutions for Protecting Local Communities, extreme heat days can lead to dehydration, heat exhaustion, and fatal heat stroke, in addition to worsening existing medical conditions, including respiratory disease, diabetes, kidney and heart disease. They report that recent research has shown that Los Angeles County has the largest number of residents in California who will be exposed to extreme heat days and at greatest risk for related health problems. Reasons for this high amount of risk include a combination of lack of air conditioning or shaded areas, outdoor work exposure to air pollutants, and preexisting health conditions.

Additionally, a 2011 report by the UCS discusses the climate penalty on ozone, demonstrating how increasing temperatures could increase ozone pollution. In 2020 alone, impacts from ozone formation associated with this penalty could result in nearly 443,000 additional cases of serious respiratory illness and cost over $729 million.

Increased Risk and Spread of Diseases

In addition to the health impacts related to air and water quality, warmer temperatures and drought conditions can contribute to the spread of diseases by aiding development and spread of the vectors that transmit them (Drechsler et al. 2006). A vector-borne disease (VBD) is one caused by a virus, bacteria, or protozoan that spends part of its life cycle in a host species (e.g. mosquitoes, ticks, fleas, rodents), which subsequently spreads the disease to other animals and people.

Regional research assessments have previously concluded that climate change and variability are highly likely to influence current VBD spread, including both short-term outbreaks and shifts in long-term disease trends. For example, as temperatures rise, mosquito reproductive cycles are shortened, allowing more breeding cycles each season, and viral transmission rates rise sharply (Githeko et al. 2000). Mosquitoes are an increasing vector of concern, particularly those species that have been introduced from other countries because changes in temperature and precipitation conditions can allow exotic species to become established in places where they could not previously survive year-round.

In Los Angeles County, there are three invasive mosquito species including the Asian tiger mosquito, which has been identified in the San Gabriel Valley. These invasive mosquitoes bite aggressively during the day and can spread a variety of disease, including chikungunya, yellow fever, and dengue, as seen with recent outbreaks in Florida and Texas. As noted in a recent Special Report on invasive mosquitoes in Los Angeles County by the San Gabriel Valley and Los Angeles Mosquito and Vector Control Districts, once established, the mosquitoes can reproduce in extremely small amounts of water and are very difficult to control.

The California Department of Public Health further notes three vector-borne diseases that climate change may impact in the state: Hantavirus, Lyme disease, and West Nile Virus (WNV). As the ecology of vectors changes with climate, exposure to disease in people may increase significantly.

Climate Change and Resiliency Planning Efforts

State

Key documents that summarize climate impacts in sectors and regions and provide adaptation guidance include the 2014 Safeguarding California report, focused at the state level, and the 2012 Adaptation Planning Guide to support local governments and regional collaboratives. Additionally, Cal-Adapt was designed to be a web-based climate adaptation planning tool for local planning efforts with downscaled climate change scenarios and research for regions within California.

Local and Regional Efforts in Climate Adaptation

In Southern California, there are a number of regional collaboratives, agencies, academic institutions, and local governments engaged in climate change mitigation, adaptation, and research. A subset of the work from these many stakeholder groups is highlighted here.

The Alliance of Regional Collaboratives for Climate Adaptation (ARCCA), a network of regional collaboratives across the state, includes two in Southern California: the Los Angeles Regional Collaborative for Climate Action and Sustainability (LARC) and the San Diego Regional Climate Collaborative.

LARC, with support from the UCLA Institute of the Environment and Sustainability (IoES), fosters a network of local and regional decision-makers in the Los Angeles County region for both climate mitigation and adaptation work across sectors and locally focused research on impacts. Members include groups from academia, cities, Los Angeles County, regional agencies, nonprofits, and businesses. Part of LARC's goals includes serving as a convening body to ensure consistency in performance, collaboration, and coordination of climate actions to maximize limited resources. They also facilitate the exchange of the latest scientific research, best practices for policy development, information systems, and education efforts. One example of this is LARC's ongoing development of the Framework, a resource to support local development of climate actions by providing regional information synthesis across sectors on vulnerabilities, adaptation strategies, and applicable federal, state, and local mandates.

Additionally, the state and regional water boards have been working to coordinate climate action planning. The Los Angeles Regional Water Quality Control Board's document, Los Angeles Region Framework for Climate Change Adaptation and Mitigation, notes that the regional board has been engaging in a dialogue with state and federal colleagues to develop a framework for adaptation within their programs. The framework is a living document meant to be updated and expanded, in addition to serving as the first step in developing a regional climate action plan for the Board.

The Los Angeles County Department of Public Health (DPH) has a focus on inter-departmental collaboration, which has led to the development of a "Five-Point Plan to Reduce the Health Impacts of Climate Change." The Plan includes the following goals to:

- Inform and engage the public.
- Promote local policies that support the design of healthy and sustainable communities.
- Provide guidance on local climate preparedness.
- Build the capacity of departmental staff and programs.
- Adopt best management practices within departments.

An example of the DPH's work includes their Los Angeles Climate & Health Workshop Series to build healthier and more resilient communities. This series was developed in collaboration with LARC and materials are provided as a template for other public health departments to train their staff. For the public, the DPH has developed reports to inform residents about specific, local-level health impacts of climate change and how they can reduce their contributions to climate change. As noted in these reports, addressing climate change requires "the foresight, commitment, and creativity of a host of agencies" working together.

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