Draft

Air Quality and Climate Technical Report

Shasta Lake Water Resources Investigation, California

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United States Department of the Interior
Bureau of Reclamation
Mid-Pacific Region

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Bureau of Reclamation

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Abbreviations and Acronyms

°F	degrees Fahrenheit
AB	Assembly bill
APCO	Air Pollution Control Officer
AQAP	air quality attainment plan
ARB	California Air Resources Board
BACT	best available control technology
CAA	Federal Clean Air Act
CAAA	Federal Clean Air Act Amendments of 1990
CAAQS	California ambient air quality standards
CCAA	California Clean Air Act
CEQ	Council of Environmental Quality
CEQA	California Environmental Quality Act
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
diesel PM	particulate matter from diesel-fueled engines
EO	Executive Order
EPA	U.S. Environmental Protection Agency
GHG	greenhouse gases
GWP	global warming potential
HAP	hazardous air pollutant
MACT	maximum available control technology
MMT	million metric tons
MT	metric ton
NEPA	National Environmental Policy Act
NESHAP	national emissions standards for hazardous air pollutants
NO_X	oxides of nitrogen
NO_2	nitrogen dioxide
NSVAB	Northern Sacramento Valley Air Basin
OPR	Governor's Office of Planning and Research
PM	particulate matter
$PM_{2.5}$	fine particulate matter
PM_{10}	inhalable particulate matter
ppm	parts per million

PSD	New Source Review Prevention of Significant Deterioration
ROG	reactive organic gases
SCAQMD	Shasta County Air Quality Management District
SB	Senate Bill
SIP	State implementation plan
SO_2	sulfur dioxide
State CEQA Guidelines	California Environmental Quality Act Guidelines
SVAB	Sacramento Valley Air Basin
TAC	toxic air contaminant
TCAPCD	Tehama County Air Pollution Control District
VOC	volatile organic compounds

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Chapter 1
Affected Environment

This chapter describes the affected environment related to air quality for the dam and reservoir modifications proposed under the Shasta Lake Water Resources Investigation.

Environmental Setting

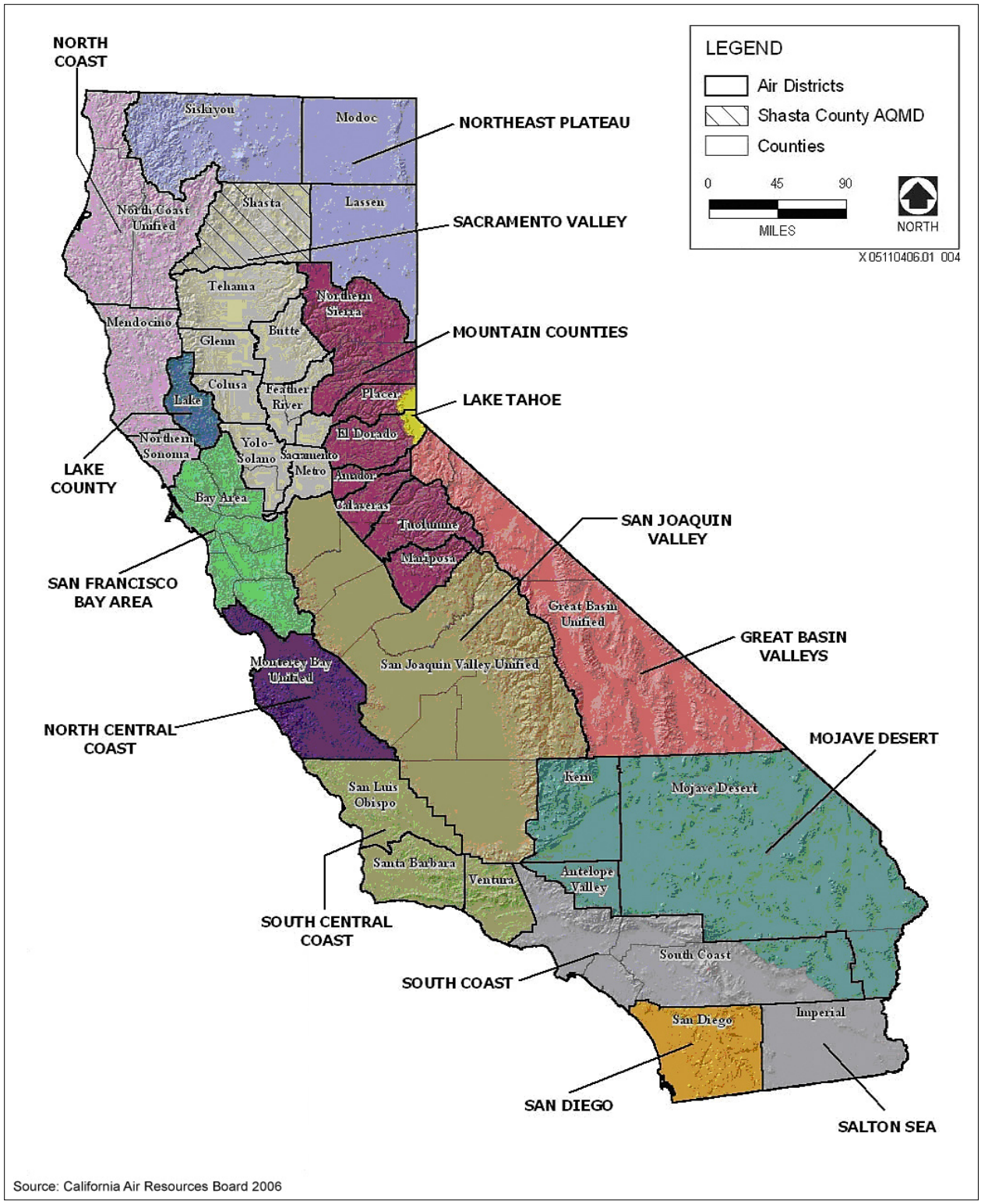
Primary Study Area

The primary study area for air quality analysis has two components – local and regional. The local area is the area immediately surrounding Shasta Dam and Shasta Lake where project construction would occur. Regionally, Shasta and Tehama Counties are located within the northern portion of the Sacramento Valley Air Basin (SVAB), which also includes all of Butte, Colusa, Glenn, Sacramento, Sutter, Yolo, and Yuba counties; the western portion of Placer County; and the eastern portion of Solano County. Figure 1-1 depicts the air basins in California, highlighting the Shasta County Air Quality Management District (SCAQMD) area. For air quality planning purposes, the region is the Northern Sacramento Valley Air Basin (NSVAB), a subarea of the SVAB. The NSVAB includes the seven counties located in the northern portion of the Sacramento Valley: Butte, Colusa, Glenn, Shasta, Sutter, Tehama, and Yuba. Therefore, the description below encompasses the entire primary study area (both Shasta Lake and vicinity and the upper Sacramento River from Shasta Dam to Red Bluff).

Climate

Air quality is affected by both the rate and location of pollutant emissions and by meteorological conditions, which influence movement and dispersal of pollutants. Atmospheric conditions, such as wind speed, wind direction, and air temperature gradients, along with local topography, provide the link between air pollutant emissions and air quality.

The NSVAB is bounded on the north and west sides by the Coast Ranges and on the east side by the southern portion of the Cascade Range and the northern portion of the Sierra Nevada. These mountain ranges reach heights of more than 6,000 feet, with peaks rising much higher. They provide a substantial physical barrier to locally created air pollution, as well as pollution transported northward on prevailing winds from the Sacramento metropolitan area (NSVPAD 2010).



Source: California Air Resources Board 2006

Figure 1-1. Air Basins in California, Including the SCAQMD Area

Although a large area of the NSVAB is located at an elevation higher than 1,000 feet above sea level, the vast majority of its populace lives and works below that elevation. The valley is often subjected to inversion layers that, coupled with geographic barriers and high summer temperatures, create a high potential for air pollution problems.

The predominant wind direction and speed, measured at the Red Bluff Station, is from the north-northwest at 9 miles per hour (ARB 1994).

Climate data from Shasta Dam covering the period of July 1948 through April 2007 (WRCC 2007) indicate all of the following:

- Average maximum monthly temperatures range from 52 degrees Fahrenheit (°F) in January to 95°F in July.
- Average minimum monthly temperatures range from 39°F in January to 68°F in July.
- Average annual rainfall is approximately 63 inches, occurring mostly from November through March.
- Average annual snowfall is 4.4 inches.

Criteria Air Pollutants

Concentrations of the following air pollutants are used as indicators of ambient air quality conditions: ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), respirable and fine particulate matter (PM_{10} and $PM_{2.5}$), and lead. Because these are the most prevalent air pollutants known to be deleterious to human health, and extensive health-effects criteria documents are available, they are commonly referred to as "criteria air pollutants."

Source types, health effects, and future trends of each criteria air pollutant are described briefly below.

Ozone Ozone is a photochemical oxidant, a substance whose oxygen combines chemically with another substance in the presence of sunlight, and is the primary component of smog. Ozone is not directly emitted into the air, but is formed through complex chemical reactions between precursor emissions of reactive organic gases (ROG) and oxides of nitrogen (NO_X) in the presence of sunlight. ROG are volatile organic compounds (VOC) that are photochemically reactive. ROG emissions result primarily from incomplete combustion and the evaporation of chemical solvents and fuels. NO_X are a group of gaseous compounds of nitrogen and oxygen that results from the combustion of fuels.

Ozone located in the upper atmosphere (stratosphere) acts in a beneficial manner by shielding the earth from harmful ultraviolet radiation that is emitted by the sun. However, ozone located in the lower atmosphere (troposphere) is a major health and environmental concern. Meteorology and terrain play a major

role in ozone formation. Generally, low wind speeds or stagnant air coupled with warm temperatures and clear skies provide the optimum conditions for formation. As a result, summer is generally the peak ozone season. Because of the reaction time involved, peak ozone concentrations often occur far downwind of the precursor emissions. Therefore, ozone is a regional pollutant that often affects large areas. In general, ozone concentrations over or near urban and rural areas reflect an interplay of emissions of ozone precursors, transport, meteorology, and atmospheric chemistry (Godish 2004).

The adverse health effects associated with exposure to ozone pertain primarily to the respiratory system. Scientific evidence indicates that ambient levels of ozone affect not only sensitive receptors, such as asthmatics and children, but healthy adults as well. Exposure to ambient levels of ozone ranging from 0.10 to 0.40 part per million (ppm) for 1–2 hours has been found to significantly alter lung functions by increasing respiratory rates and pulmonary resistance, decreasing tidal volumes (signs), and impairing respiratory mechanics. Ambient levels of ozone above 0.12 ppm are linked to symptomatic responses that include such symptoms as throat dryness, chest tightness, headache, and nausea. Ozone also inhibits the immune system's ability to defend against infection (Godish 2004).

Emissions of the ozone precursors ROG and NO_X have decreased over the past several years as a result of more stringent motor-vehicle standards and cleaner burning fuels. Consequently, peak 1-hour and 8-hour ozone concentrations in the SVAB have declined overall by about 17 percent since 1986. However, peak ozone values in the SVAB have not declined as rapidly over the last several years as they have in other urban areas. This can be attributed to influx of pollutants into the SVAB from other urbanized areas, making the region both a transport contributor and a receptor of pollutants. Emissions from the Sacramento metropolitan area contribute to pollution in the NSVAB (ARB 2009a).

Carbon Monoxide CO is a colorless, odorless, and poisonous gas produced by incomplete burning of carbon in fuels, primarily from mobile (transportation) sources. In fact, 77 percent of the nation's CO emissions are from mobile sources. The other 23 percent consist of CO emissions from wood-burning stoves, incinerators, and industrial sources. The highest concentrations are generally associated with cold, stagnant weather conditions that occur during winter. In contrast to ozone, which tends to be a regional pollutant, CO problems tend to be localized.

CO enters the bloodstream through the lungs by combining with hemoglobin, which normally supplies oxygen to the cells. Adverse health effects associated with exposure to CO concentrations include such symptoms as dizziness, headaches, and fatigue (EPA 1996). CO exposure is especially harmful to individuals who suffer from cardiovascular and respiratory diseases.

Nitrogen Dioxide NO_2 is a brownish, highly reactive gas that is present in all urban environments. The major human-made sources of NO_2 are combustion devices, such as boilers, gas turbines, and mobile and stationary reciprocating internal-combustion engines. NO_2 forms quickly from emissions from cars, trucks and buses, power plants, and off-road equipment. In addition to contributing to the formation of ground-level ozone and fine particle pollution, NO_2 is linked with a number of adverse effects on the respiratory system (EPA 2010a). The combined emissions of nitric oxide and NO_2 are referred to as NO_X, which are reported as equivalent NO_2. Because NO_2 is formed and depleted by reactions associated with photochemical smog (ozone), the NO_2 concentration in a particular geographical area may not be representative of the local NO_X emission sources.

Inhalation is the most common route of exposure to NO_2. Because NO_2 has relatively low solubility in water, the principal site of toxicity is in the lower respiratory tract. The severity of the adverse health effects depends primarily on the concentration inhaled rather than the duration of exposure. An individual may experience a variety of acute symptoms, including coughing, difficulty with breathing, vomiting, headache, and eye irritation, during or shortly after exposure. After a period of approximately 4 – 12 hours, an exposed individual may experience chemical pneumonitis or pulmonary edema with breathing abnormalities, cough, cyanosis, chest pain, and rapid heartbeat. Severe, symptomatic NO_2 intoxication after acute exposure has been linked on occasion with prolonged respiratory impairment, with such symptoms as chronic bronchitis and decreased lung functions.

Sulfur Dioxide SO_2 is produced by such stationary sources as coal and oil combustion, steel mills, refineries, and pulp and paper mills. The major adverse health effects associated with SO_2 exposure pertain to the upper respiratory tract. SO_2 is a respiratory irritant with constriction of the bronchioles occurring with inhalation of SO_2 at 5 ppm or more. On contact with the moist mucous membranes, SO_2 produces sulfurous acid, which is a direct irritant. Concentration rather than duration of the exposure is an important determinant of respiratory effects. Exposure to high SO_2 concentrations may result in edema of the lungs or glottis and respiratory paralysis.

Particulate Matter Respirable particulate matter with an aerodynamic diameter of 10 micrometers or less is referred to as PM_{10}. PM_{10} consists of particulate matter (PM) emitted directly into the air, such as fugitive dust, soot, and smoke from mobile and stationary sources, construction operations, fires, and natural windblown dust, and PM formed in the atmosphere by condensation and/or transformation of SO_2 and ROG. $PM_{2.5}$ includes a subgroup of finer particles that have an aerodynamic diameter of 2.5 micrometers or less (EPA 2011a).

The adverse health effects associated with PM_{10} depend on its specific composition. For example, health effects may be associated with metals,

polycyclic aromatic hydrocarbons, and other toxic substances adsorbed onto fine particulate matter (which is referred to as the "piggybacking effect"), or with fine dust particles of silica or asbestos. Generally, adverse health effects associated with PM_{10} may result from both short-term and long-term exposure to elevated concentrations and may include breathing and respiratory symptoms, aggravation of existing respiratory and cardiovascular diseases, alterations to the immune system, carcinogenesis, and premature death (EPA 2011b). $PM_{2.5}$ poses an increased health risk because the particles can deposit deep in the lungs and contain substances that are particularly harmful to human health.

Direct emissions of both PM_{10} and $PM_{2.5}$ increased in the SVAB between 1975 and 2000 and are projected to increase through 2020. These emissions are dominated by areawide sources, primarily because of development. Direct emissions of PM from mobile and stationary sources have remained relatively steady (ARB 2009a).

Lead Lead is a metal found naturally in the environment and 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 (as discussed in detail below), 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.

Mobile sources were formerly the main contributor to ambient lead concentrations in the air. In the early 1970s, the U.S. Environmental Protection Agency (EPA) set national regulations to gradually reduce the lead content in gasoline. As a result of EPA's regulatory efforts to remove lead from gasoline, emissions of lead from the transportation sector declined by 95 percent and levels of lead in the air decreased by 94 percent between 1980 and 1999 (EPA 2010b). Today, the highest levels of lead in air are usually found near lead smelters. The major sources of lead emissions to the air today are ore and metals processing and leaded aviation gasoline.

Lead emissions and ambient lead concentrations have decreased dramatically in California over the past 25 years. The rapid decrease in lead concentrations can be attributed primarily to phasing out the lead in gasoline. This phase-out began during the 1970s, and subsequent California Air Resources Board (ARB) regulations have eliminated virtually all lead from gasoline now sold in California. All areas of the state are currently designated as attainment for the State lead standard (EPA does not designate areas for the national lead standard). Although the ambient lead standards are no longer violated, lead emissions from stationary sources still pose "hot spot" problems in some areas. As a result, ARB has identified lead as a toxic air contaminant.

Monitoring Station Data and Criteria Pollutant Attainment Area Designations

Concentrations of criteria air pollutants are measured at several monitoring stations in Shasta County. The Redding Health Department and Shasta Lake stations are the closest to the project construction area with recent data for ozone and PM. In general, the ambient air quality measurements from these stations are representative of the study area's air quality. Table 1-1 summarizes the air quality data from the most recent 3 years.

Table 1-1. Summary of Annual Ambient Air Quality Data (2009 – 2011)

	2009	2010	2011
OZONE			
Redding Health Department Monitoring Station			
California maximum concentration (1-hour/8-hour average, ppm)	0.084/0.069	0.077/0.065	0.073/0.065
Number of days State 1-hour/8-hour standard exceeded	0/0	0/0	0/0
Number of days national 1-hour/8-hour standard exceeded	0/0	0/0	0/0
FINE PARTICULATE MATTER ($PM_{2.5}$)			
Redding Health Department Monitoring Station			
California maximum concentration ($\mu g/m^3$)	20.2	10.7	18.8
Number of days national standard exceeded (measured[a])	0	0	0
RESPIRABLE PARTICULATE MATTER (PM_{10})			
Redding Health Department Monitoring Station			
Maximum concentration ($\mu g/m^3$)	32.6	23.8	34.2
Number of days State standard exceeded (measured/calculated[a])	0/0	*/0	0/0
Number of days national standard exceeded (measured/calculated[a])	0/0	0/0	0/0
Shasta Lake Monitoring Station			
Maximum concentration ($\mu g/m^3$)	32.2	28.3	30.7
Number of days State standard exceeded (measured/calculated[a])	0/0	*/0	0/0
Number of days national standard exceeded (measured/calculated[a])	0/0	0/0	0/0

Source: ARB 2012

Note:

[a] Measured days are those days that an actual measurement was greater than the level of the State daily standard or the national daily standard. Measurements are typically collected every 6 days. Calculated days are the estimated number of days that a measurement would have been greater than the level of the standard had measurements been collected every day. The number of days above the standard is not necessarily the number of violations of the standard for the year.

Key:

– = insufficient data available to determine value.

$\mu g/m^3$ = micrograms per cubic meter

$PM_{2.5}$ = fine particulate matter with an aerodynamic diameter of 2.5 micrometers or less

PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less

ppm = parts per million

Both ARB and EPA use this type of monitoring data to designate areas according to their attainment status for criteria air pollutants. The purpose of

these designations is to identify those areas with air quality problems and thereby initiate planning efforts for improvement. The three basic designation categories are "nonattainment," "attainment," and "unclassified." "Unclassified" is used in an area that cannot be classified on the basis of available information as meeting or not meeting the standards. In addition, the California designations include a subcategory of the nonattainment designation, "nonattainment-transitional," that is given to nonattainment areas that are progressing and nearing attainment. The most current attainment designations for Shasta County are shown in Table 1-2 for each criteria air pollutant.

Toxic Air Contaminants

Toxic air contaminants (TAC), or in Federal terms hazardous air pollutants (HAP), are air pollutants that may cause or contribute to an increase in mortality or in serious illness, or that may pose a hazard to human health. TACs are usually present in minute quantities in the ambient air; however, their high toxicity or health risk may pose a threat to public health even at low concentrations.

According to *The California Almanac of Emissions and Air Quality* (ARB 2009a), the majority of the estimated health risk from TACs can be attributed to relatively few compounds, the most important being PM from diesel-fueled engines (diesel PM). Diesel PM differs from other TACs in that it is not a single substance, but rather a complex mixture of hundreds of substances. Although diesel PM is emitted by diesel-fueled internal-combustion engines, the composition of the emissions varies depending on engine type, operating conditions, fuel composition, lubricating oil, and whether an emission control system is present. Unlike the other TACs, no ambient monitoring data are available for diesel PM because no routine measurement method currently exists. However, ARB has made preliminary concentration estimates based on a PM exposure method. This method uses the ARB emissions inventory's PM_{10} database, ambient PM_{10} monitoring data, and the results from several studies on chemical speciation to estimate concentrations of diesel PM. Of the TACs for which data are available in California, diesel PM, benzene, 1,3-butadiene, acetaldehyde, carbon tetrachloride, hexavalent chromium, para-dichlorobenzene, formaldehyde, methylene chloride, and perchloroethylene pose the greatest known health risks. Dioxins are also considered to pose substantial health risk.

Table 1-2. Ambient Air Quality Standards and Designations

Pollutant	Averaging Time	California		National Standards [a]		
		Standards [b,c]	Attainment Status (Shasta County) [d]	Primary [c,e]	Secondary [c,f]	Attainment Status (Shasta County) [g]
Ozone	1-hour	0.09 ppm (180 µg/m^3)	N (Moderate)	*Note h*	Same as primary standard	–
	8-hour	0.070 ppm	–	0.075 ppm (147 µg/m^3)		U/A
Carbon monoxide	1-hour	20 ppm (23 mg/m^3)	U	35 ppm (40 mg/m^3)	–	U/A
	8-hour	9 ppm (10 mg/m^3)		9 ppm (10 mg/m^3)		
	8-hour (Lake Tahoe)	6 ppm (7 mg/m^3)	–	–	–	–
Nitrogen dioxide (NO_2)	Annual Arithmetic Mean	0.030 ppm (57 µg/m^3)	–	0.053 ppm (100 µg/m^3) [i]	Same as primary standard	U/A
	1-hour	0.18 ppm (339 µg/m^3)	A	0.100 ppm (188 µg/m^3) [i]		–
Sulfur dioxide (SO_2)	24-hour	0.04 ppm (105 µg/m^3)	A	–	–	U
	3-hour	–	–	–	0.5 ppm (1300 µg/m^3) [j]	
	1-hour	0.25 ppm (655 µg/m^3)	A	0.075 ppm (196 µg/m^3) [j]	–	–
Respirable particulate matter (PM_{10})	Annual Arithmetic Mean	20 µg/m^3	N	–	Same as primary standard	U/A
	24-hour	50 µg/m^3		150 µg/m^3 [f]		
Fine particulate matter ($PM_{2.5}$)	Annual Arithmetic Mean	12 µg/m^3	U	15 µg/m^3	Same as primary standard	U/A
	24-hour	–	–	35 µg/m^3		
Lead [k]	30-day Average	1.5 µg/m^3	A	–	–	–
	Calendar Quarter	–		1.5 µg/m^3	Same as primary standard	A
	Rolling 3 Month Average	–		0.15 µg/m^3		
Sulfates	24-hour	25 µg/m^3	A	No national standards		
Hydrogen sulfide	1-hour	0.03 ppm (42 µg/m^3)	U			
Vinyl chloride [k]	24-hour	0.01 ppm (26 µg/m^3)	U/A			
Visibility-reducing particle matter	8-hour	Extinction coefficient of 0.23 per kilometer—visibility of 10 mi or more	U			

Table 1-2. Ambient Air Quality Standards and Designations (contd.)

Sources: ARB 2011b, 2012; EPA 2011c

Notes:

[a] National standards (other than ozone, particulate matter, and those based on annual averages or annual arithmetic means) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration in a year, averaged over 3 years, is equal to or less than the standard. The PM10 24-hour standard is attained when 99 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. The PM2.5 24-hour standard is attained when 98 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. Contact the U.S. Environmental Protection Agency (EPA) for further clarification and current Federal policies.

[b] California standards for ozone, CO (except Lake Tahoe), SO2 (1- and 24-hour), NO2, particulate matter, 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.

[c] Concentration expressed first in units in which it was promulgated (i.e., parts per million (ppm) or micrograms per cubic meter (µg/m3)). Equivalent units given in parentheses are based upon a reference temperature of 25 degrees Celsius (°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.

[d] Unclassified (U): A pollutant is designated unclassified if the data are incomplete and do not support a designation of attainment or nonattainment.

Attainment (A): A pollutant is designated attainment if the State standard for that pollutant was not violated at any site in the area during a 3-year period.

Nonattainment (N): A pollutant is designated nonattainment if there was a least one violation of a State standard for that pollutant in the area.

Nonattainment/Transitional (NT): A subcategory of the nonattainment designation. An area is designated nonattainment/transitional to signify that the area is close to attaining the standard for that pollutant.

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

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

[g] Nonattainment (N): Any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant.

Attainment (A): Any area that meets the national primary or secondary ambient air quality standard for the pollutant.

Unclassifiable (U): Any area that cannot be classified on the basis of available information as meeting or not meeting the national primary or secondary ambient air quality standard for the pollutant.

[h] The 1-hour ozone national ambient air quality standard was revoked on June 15, 2005, for all areas in California.

[i] To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 part per million (ppm) (effective January 22, 2010). Note that the EPA standards are in units of parts per billion (ppb). California standards are in units of ppm. To directly compare the national standards to the California standards, the units can be converted from ppb to ppm. In this case, the national standards of 53 ppb and 100 ppb are identical to 0.053 ppm and 0.100 ppm, respectively.

[j] On June 2, 2010, EPA established a new 1-hour SO2 standard, effective August 23, 2010, which is based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations. EPA also proposed a new automated Federal Reference Method (FRM) using ultraviolet technology, but will retain the older pararosaniline methods until the new FRM have adequately permeated State monitoring networks. EPA also revoked both the existing 24-hour SO2 standard of 0.14 ppm and the annual primary SO2 standard of 0.030 ppm, effective August 23, 2010.

The secondary SO2 standard was not revised at that time; however, the secondary standard is undergoing a separate review by EPA. Note that the new standard is in ppb. California standards are in ppm. To directly compare the new primary 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.

[k] The California Air Resources Board has identified lead and vinyl chloride as toxic air contaminants with no threshold 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.

Key:

$\mu g/m^3$ = micrograms per cubic meter

mg/m^3 = milligrams per cubic meter

ppm = parts per million

Diesel PM poses the greatest health risk among the TACs described above. Based on receptor modeling techniques, ARB estimated its health risk in 2000, the latest year estimated, to be 360 excess cancer cases per million people in the SVAB. Since 1990, the health risk associated with diesel PM has been reduced by 52 percent. Overall, levels of most TACs, except para-dichlorobenzene and formaldehyde, have decreased since 1990 (ARB 2009a).

Extended Study Area

Lower Sacramento River and Delta

The lower Sacramento River and Sacramento–San Joaquin River Delta areas are within the SVAB and the San Joaquin Valley Air Basin. These basins are Federal and State nonattainment areas for ozone, PM_{10}, and $PM_{2.5}$.

CVP/SWP Service Areas

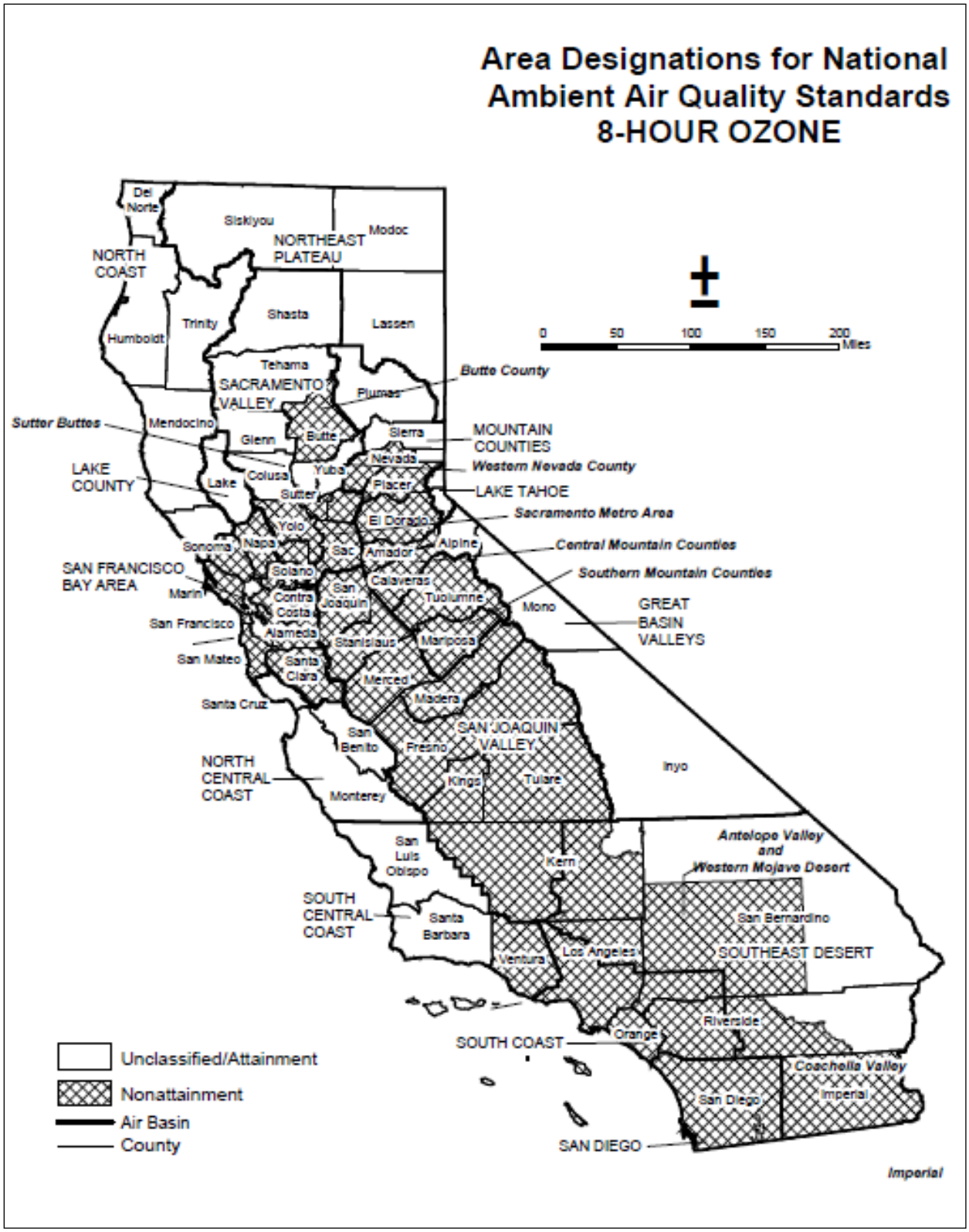
The service areas of the Central Valley Project and State Water Project extend beyond the Central Valley into the San Francisco Bay Area, North Central Coast, South Central Coast, and Mountain Counties Air Basins (see Figures 1-1 and 1-2). Federal and State ozone attainment designations for all California counties and air basins are shown in Figures 1-3 and 1-4. Federal PM_{10} attainment designations are shown in Figure 1-5.

Global Study Area – Climate Change

Attributing Climate Change – The Physical Scientific Basis

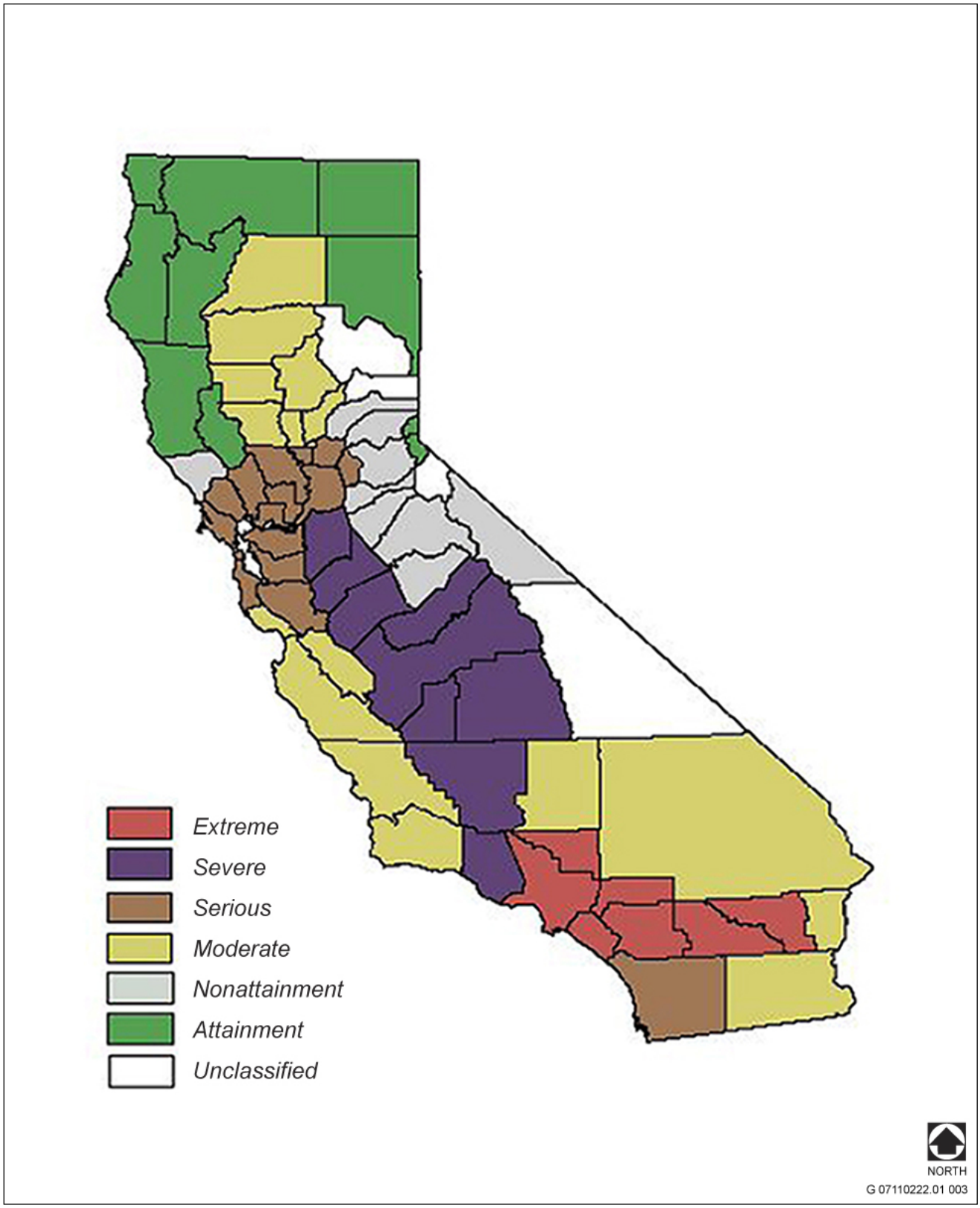
Various gases in the earth's atmosphere, classified as atmospheric greenhouse gases (GHG), play a critical role in determining the earth's surface temperature. Solar radiation enters the earth's atmosphere from space. A portion of the radiation is absorbed by the earth's surface, and a smaller portion of this radiation is reflected back toward space. This absorbed radiation is then emitted from the earth, not as high-frequency solar radiation, but as lower frequency infrared radiation. The frequencies at which bodies emit radiation are proportional to temperature. The earth has a much lower temperature than the sun; therefore, the earth emits lower frequency radiation. Most solar radiation passes through GHGs; however, infrared radiation is absorbed by these gases. As a result, radiation that otherwise would have escaped back into space is instead "trapped," resulting in a warming of the atmosphere. This phenomenon, known as the greenhouse effect, is responsible for maintaining a habitable climate on Earth. Without the greenhouse effect, Earth would not be able to support life as we know it.

Figure 1-2. Central Valley Project and State Water Project Service Areas



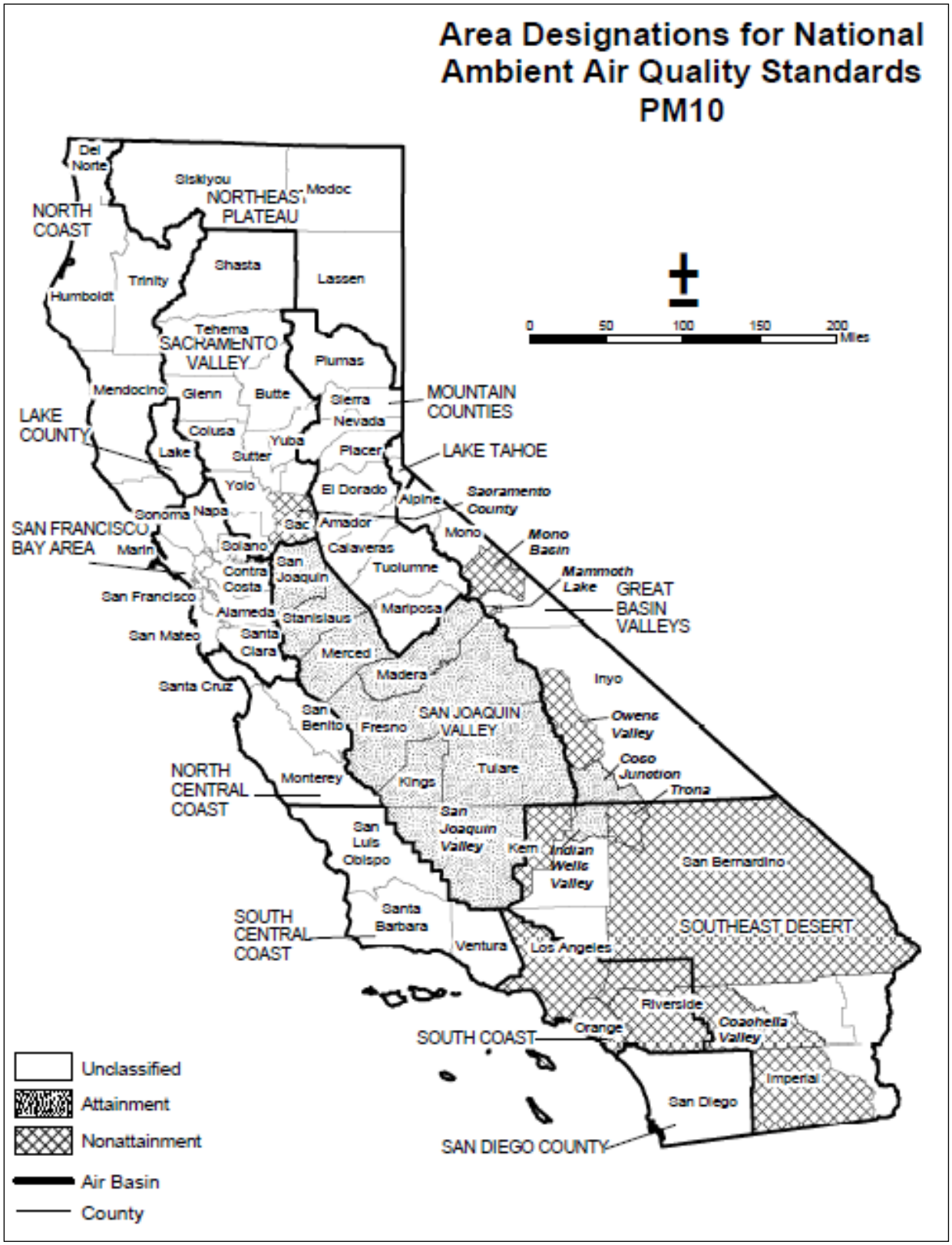
Source: ARB 2011b

Figure 1-3. Area Designations for National Ambient Air Quality Standards – 8-Hour Ozone



Source: ARB 2011b

Figure 1-4. State Nonattainment Area Classification – Ozone



Source: ARB 2011b

Figure 1-5. Area Designations for National Ambient Air Quality Standards – PM_{10}

Prominent GHGs contributing to the greenhouse effect are carbon dioxide (CO_2), methane, nitrous oxide, hydrofluorocarbons, chlorofluorocarbons, and sulfur hexafluoride. Human-caused emissions of these GHGs that exceed natural ambient concentrations are responsible for intensifying the greenhouse effect and have led to a trend of unnatural warming of the earth's climate, known as global climate change or global warming (Ahrens 2003). It is extremely unlikely that global climate change of the past 50 years can be explained without the contribution from human activities (IPCC 2007).

To provide a method of quantifying GHG emissions, the standard unit of carbon dioxide equivalent (CO_2e), or CO_2 equivalent, was developed. The definition of CO_2e is "The quantity of a given GHG multiplied by its total global warming potential (GWP). This is the standard unit for comparing the degree of warming that can be caused by GHGs" (CCAR 2009). The GWP of a GHG is dependent on the lifetime, or persistence, of the gas molecule in the atmosphere compared to CO_2. The GWP of methane is 23; the GWP of nitrous oxide is 296. Therefore, methane and nitrous oxide are more potent GHGs than CO_2. Expressing emissions in CO_2e takes the contributions of all GHG emissions to the greenhouse effect and converts them to a single unit equivalent to the effect that would occur if only CO_2 were being emitted. The most common quantity unit for CO_2e is million metric tons (MMT). In some reports, CO_2e is written as CO_2e, and million metric tons is written as MMT CO_2e.

Climate change is a global problem. GHGs are global pollutants, unlike criteria air pollutants and TACs, which are pollutants of regional and local concern. Whereas pollutants with localized air quality effects have relatively short atmospheric lifetimes (about 1 day), GHGs have long atmospheric lifetimes (1 year to several thousand years). GHGs persist in the atmosphere for long enough time periods to be dispersed around the globe. Although the exact lifetime of any particular GHG molecule is dependent on multiple variables and cannot be pinpointed, it is understood that more CO_2 is emitted into the atmosphere than is sequestered by ocean uptake, vegetation, and other forms of sequestration. Of the total annual human-caused CO_2 emissions, approximately 54 percent is sequestered through ocean uptake, uptake by Northern Hemisphere forest regrowth, and other terrestrial sinks within a year, whereas the remaining 46 percent of human-caused CO_2 emissions remains stored in the atmosphere (Seinfeld and Pandis 1998).

Effects of GHGs are borne globally, as opposed to localized air quality effects of criteria air pollutants and TACs. The quantity of GHGs that it takes to ultimately result in climate change is not precisely known; suffice it to say that the quantity is enormous, and no single project alone would be expected to measurably contribute to a noticeable incremental change in the global average temperature, or to global, local, or micro climate. From the standpoint of the California Environmental Quality Act (CEQA), GHG effects related to global climate change are inherently cumulative.

Feedback Mechanisms and Uncertainty Many complex mechanisms interact within Earth's energy budget to establish the global average temperature and global and regional climate conditions. For example, increases in atmospheric temperature would lead to increases in ocean temperature. As atmospheric and ocean temperatures increase, sea ice and glaciers are expected to melt, adding more freshwater to the ocean and altering salinity conditions. Both increases in ocean temperature and changes in salinity would be expected to lead to changes in circulation of ocean currents. Changes in current circulation would further alter ocean temperatures and alter terrestrial climates where currents have changed. Several interacting atmospheric, climatic, aquatic, and terrestrial factors affecting global climate change are described below. These factors result in feedback mechanisms that could potentially increase or decrease the effects of global climate change. There is uncertainty about how some factors may affect global climate change because they have the potential to both intensify and neutralize future climate warming. Examples of these conditions are described below.

Direct and Indirect Effects of Aerosols Aerosols, including particulate matter, reflect sunlight back to space. As air quality goals for PM are met and fewer PM emissions occur, the cooling effect of aerosols would be reduced, and the greenhouse effect would be further intensified. Similarly, aerosols act as cloud condensation nuclei, aiding in cloud formation and increasing cloud lifetime. Under some circumstances (see discussion of the cloud effect below), clouds efficiently reflect solar radiation back to space. With a reduction in PM emissions, including aerosols, the direct and indirect positive effect of aerosols on clouds would be reduced, potentially further amplifying the greenhouse effect.

The Cloud Effect As global temperature rises, the capacity of the air to hold moisture increases, possibly facilitating cloud formation. As stated above, clouds can efficiently reflect solar radiation back to space. If an increase in cloud cover occurs at low or middle altitudes, resulting in clouds with greater liquid water content such as stratus or cumulus clouds, more radiation would be reflected back to space than under current conditions. This would result in a negative feedback mechanism, in which the increase in cloud cover resulting from global climate change acts to balance the amount of further warming. If clouds form at higher altitudes in the form of cirrus clouds, however, these clouds allow more solar radiation to pass through than they reflect and ultimately act as a GHG themselves. This results in a positive feedback mechanism, in which the side effect of global climate change (an increase in cloud cover) acts to intensify the warming process. Because of the conflicting feedback mechanisms to which increasing cloud cover can contribute, this cloud effect is an area of relatively high uncertainty for scientists when projecting future global climate change conditions.

Other Feedback Mechanisms As global temperature continues to rise, methane gas trapped in permafrost is expected to be released into the atmosphere.

As identified above in the description of CO_2e, methane is approximately 23 times as efficient a GHG as CO_2; therefore, this release of methane would accelerate and intensify global climate change if current trends continue. Additionally, as the surface area of polar and sea ice continues to diminish, Earth's albedo, or reflectivity, also is anticipated to decrease. More incoming solar radiation likely will be absorbed by the earth rather than be reflected back into space, further intensifying the greenhouse effect and associated global climate change. These and other positive and negative feedback mechanisms are still being studied by the scientific community to better understand their potential effects on global climate change. It is not known at this time how much of an increase in global average temperature may result from the interaction of all the pertinent variables. Although the amount and rate of increase in global average temperature are uncertain, there is no longer much debate within the scientific community that global climate change is occurring and that human-caused GHG emissions are contributing to this phenomenon.

Attributing Climate Change—Greenhouse Gas Emission Sources and Sinks

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 (ARB 2011d). In California, the transportation sector is the largest emitter of GHGs, followed by electricity generation (ARB 2011d). Emissions of CO_2 are byproducts of fossil fuel combustion. Methane, a highly potent GHG, results from off-gassing (the release of chemicals under ambient or greater pressure conditions) associated with agricultural practices and landfills. CO_2 sinks, or reservoirs, include vegetation and the ocean, which absorb CO_2 through sequestration and dissolution, respectively, two of the most common processes of CO_2 sequestration.

As the second largest emitter of GHG emissions in the United States and 14th highest and 19th highest per capita in the world (compared to other nations), California contributes a substantial amount of GHGs to the atmosphere (ARB 2011d). Emissions of CO_2 are typically byproducts of fossil-fuel combustion and are attributable in large part to human activities associated with the transportation, industry/ manufacturing, electricity and natural gas consumption, and agriculture sectors (ARB 2009b). In California, the transportation sector is the largest emitter of GHGs, followed by electricity generation (ARB 2011d).

Effects of Climate Change

According to the Intergovernmental Panel on Climate Change, which was established in 1988 by the World Meteorological Organization and the United Nations Environment Programme, global average temperature is expected to increase by 3–7°F by the end of the century, depending on future GHG emission scenarios (IPCC 2007). Resource areas other than air quality and atmospheric temperature could be indirectly affected by the accumulation of GHG emissions. For example, an increase in the global average temperature is

expected to result in a decreased volume of precipitation falling as snow in California and an overall reduction in snowpack in the Sierra Nevada. Snowpack in the Sierra Nevada provides both water supply (runoff) and storage (within the snowpack before melting), which is a major source of supply for the state. According to the California Energy Commission (CEC 2006b), the snowpack portion of the water supply could potentially decline by 30–90 percent by the end of the 21st century. A study cited in a report by the California Department of Water Resources anticipates that approximately 50 percent of the statewide snowpack will be lost by the end of the century (Knowles and Cayan 2002). Although current forecasts are uncertain, it is evident that this phenomenon could lead to significant challenges in securing an adequate water supply for a growing population. An increase in precipitation falling as rain rather than snow also could lead to increased potential for floods because water that would normally be held in the Sierra Nevada until spring could flow into the Central Valley concurrently with winter storm events. This scenario would place more pressure on California's levee/flood control system (DWR 2006).

Another outcome of global climate change is sea level rise. Sea level rose approximately 7 inches during the last century (CEC 2006b), and it is predicted to rise an additional 7–22 inches by 2100, depending on the future levels of GHG emissions (IPCC 2007). If this occurs, resultant effects could include increased coastal flooding, saltwater intrusion (especially a concern in the low-lying Sacramento–San Joaquin River Delta, where pumps delivering potable water could be threatened), and disruption of wetlands (CEC 2006b). As the existing climate throughout California changes over time, the ranges of various plant and wildlife species could shift, expand, or be reduced, depending on the favored temperature and moisture regimes of each species. In the worst cases, some species would become extinct or be extirpated from the state if suitable conditions are no longer available.

The Shasta Dam project site is situated approximately 1,000 feet above sea level and thus would not be directly affected by the potential sea level rise predicted to occur over the next 100 years.

Existing GHG Emissions

Sources of GHG emissions associated with existing operations include vehicles used for operation and maintenance of the dam and recreation areas, vehicles used by recreational visitors, and fossil fuel-powered boats on Shasta Lake.

Regulatory Framework

Air quality in Shasta County is regulated by such agencies as EPA, ARB, and SCAQMD. Each of these agencies develops rules, regulations, policies, and/or goals to comply with applicable legislation. Although EPA regulations may not be superseded, both State and local regulations may be more stringent.

Federal

Criteria Air Pollutants

At the Federal level, EPA implements national air quality programs. EPA's air quality mandates are drawn primarily from the Federal Clean Air Act (CAA), which was enacted in 1970 and most recently amended in 1990.

The CAA required EPA to establish primary and secondary national ambient air quality standards, as shown in Table 1-2. The CAA 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 (CAAA) added requirements for states with nonattainment areas to revise their SIPs to incorporate additional control measures to reduce air pollution. The SIP is modified periodically to reflect the latest emissions inventories, planning documents, and rules and regulations of the air basins as reported by their jurisdictional agencies. EPA reviews all SIPs to determine whether they conform to the mandates of CAA and its amendments, and whether implementation will achieve air quality goals. If EPA determines a SIP to be inadequate, a Federal implementation plan that imposes additional control measures may be prepared for the nonattainment area. Failure to submit an approvable SIP or to implement the plan within the mandated time frame may result in the application of sanctions to transportation funding and stationary air pollution sources in the air basin.

Hazardous Air Pollutants

Air quality regulations also focus on TACs, or in Federal parlance, HAPs. In general, for those TACs that may cause cancer, there is no concentration that does not present some risk. In other words, there is no threshold level below which adverse health effects may not be expected to occur. This contrasts with the criteria air pollutants, for which acceptable levels of exposure can be determined and for which the ambient standards have been established (Table 1-2). Instead, EPA and ARB regulate HAPs and TACs, respectively, through statutes and regulations that generally require the use of the maximum or best available control technology (MACT and BACT) for toxics to limit emissions. These statutes and regulations establish the regulatory framework for TACs.

EPA has programs for identifying and regulating HAPs. Title III of the CAAA directed EPA to promulgate national emissions standards for HAPs (NESHAP). The NESHAP may differ for major sources of HAPs than for area sources. Major sources are defined as stationary sources with potential to emit more than 10 tons per year of any HAP or more than 25 tons per year of any combination of HAPs; all other sources are considered area sources. The emissions standards were to be promulgated in two phases. In the first phase (1992–2000), EPA developed technology-based emission standards designed to produce the maximum emission reduction achievable. These standards are generally referred to as requiring MACT. For area sources, the standards may be different, based on generally available control technology. In the second phase (2001–2008),

EPA was required to promulgate health risk–based emissions standards where deemed necessary to address risks remaining after implementation of the technology-based NESHAP standards.

The CAAA also required EPA to promulgate vehicle or fuel standards containing reasonable requirements that control toxic emissions of benzene and formaldehyde at a minimum. Performance criteria were established to limit mobile-source emissions of toxics, including benzene, formaldehyde, and 1,3-butadiene. In addition, Section 219 required the use of reformulated gasoline in selected areas with the most severe ozone nonattainment conditions to further reduce mobile-source emissions.

General Conformity

The 1990 Amendments to CAA Section 176 requires EPA to promulgate rules to ensure that Federal actions conform to the appropriate SIP. These rules are known as the General Conformity Rule (40 Code of Federal Regulations Parts 51.850–51.860 and 93.150–93.160). Any Federal agency responsible for an action in a nonattainment/maintenance area must determine whether that action conforms to the applicable SIP or is exempt from General Conformity Rule requirements.

Shasta County, where the proposed action would occur, is neither a nonattainment area nor a maintenance area for the national ambient air quality standards. Therefore, the General Conformity Rule is not applicable to the project.

Greenhouse Gases

Mandatory Greenhouse Gas Reporting Rule On September 22, 2009, EPA released its final Greenhouse Gas Reporting Rule (Reporting Rule). The Reporting Rule is a response to the fiscal year 2008 Consolidated Appropriations Act (House Bill 2764; Public Law 110-161), which required EPA to develop "…mandatory reporting of greenhouse gases above appropriate thresholds in all sectors of the economy…" The Reporting Rule applies to most entities that emit 25,000 metric tons (MT) CO_2e or more per year. Since 2010, facility owners have been required to submit an annual GHG emissions report with detailed calculations of facility GHG emissions. The Reporting Rule also mandates recordkeeping and administrative requirements for EPA to verify annual GHG emissions reports.

U.S. Environmental Protection Agency Endangerment and Cause of Contribute Findings On December 7, 2009, the EPA Administrator signed two distinct findings regarding GHGs under Section 202(a) of the CAA:

- **Endangerment Finding** – The current and projected concentrations of the six key well-mixed GHGs – CO_2, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride – in the

atmosphere threaten the public health and welfare of current and future generations.

- **Cause or Contribute Finding** – The combined emissions of these well-mixed GHGs from new motor vehicles and new motor vehicle engines contribute to GHG pollution, which threatens public health and welfare.

Council on Environmental Quality Draft NEPA Guidelines Because of uneven treatment of climate change under the National Environmental Policy Act (NEPA), the International Center for Technology Assessment, Natural Resources Defense Council, and Sierra Club filed a petition with the Council on Environmental Quality (CEQ) in March 2008. The petition requested that climate change analyses be included in all Federal environmental review documents. In October 2009, President Barack Obama signed Executive Order 13514, "Federal Leadership in Environmental, Energy, and Economic Performance." The goal of this executive order is "to establish an integrated strategy towards sustainability in the Federal Government and to make reduction of GHG emissions a priority for Federal agencies" (FedCenter 2011).

In response to the petition and subsequent Executive Order (EO) 13514, CEQ issued guidance on including GHG emissions and climate change impacts in environmental review documents under NEPA. CEQ's guidance (issued February 18, 2010) suggests that Federal agencies consider opportunities to reduce GHG emissions caused by proposed Federal actions, adapt their actions to climate change impacts throughout the NEPA process, and address these issues in the agencies' NEPA procedures. The following are the two main factors to consider when addressing climate change in environmental documentation:

- The effects of a proposed action and alternative actions on GHG emissions
- The impacts of climate change on a proposed action or alternatives

CEQ notes that "significant" national policy decisions with "substantial" GHG impacts require analysis of their GHG effects. That is, the GHG effects of a Federal agency's proposed action must be analyzed if the action would cause "substantial" annual direct emissions; would implicate energy conservation or reduced energy use or GHG emissions; or would promote cleaner, more efficient renewable-energy technologies. Qualitative or quantitative information on GHG emissions that is useful and relevant to the decision should be used when deciding among alternatives.

CEQ states that if a proposed action would cause direct annual emissions of more than 25,000 MT CO_2e, a quantitative and qualitative assessment may be meaningful to decision makers and the public. If annual direct emissions would

be less than 25,000 MT CO_2e, Federal agencies are encouraged to consider whether the action's long-term emissions should receive similar analysis.

Greenhouse Gas Permitting Requirements on Large Industrial Facilities
On May 13, 2010, EPA issued the Prevention of Significant Deterioration and Title V Greenhouse Gas Tailor Rule (EPA 2010a). This final rule sets thresholds for GHG emissions that define when permits under the New Source Review Prevention of Significant Deterioration (PSD) and Title V Operating Permit programs are required for new and existing industrial facilities.

The rule establishes a schedule that will initially focus permitting programs on the largest sources and then expands to cover the largest sources of GHG that may not have been previously covered by the CAA for other pollutants (EPA 2010b). During Step 1, from January 2, 2011 to June 30, 2011, only sources currently subject to the PSD permitting program (i.e., those that are newly-constructed or modified in a way that significantly increases emissions of a pollutant other than GHGs) would be subject to permitting requirements for their GHG emissions under PSD; and, for these projects, only GHG increases of 75,000 tons (68,039 MT) per year or more of total GHG, on a CO_2e basis, would need to determine the BACT for their GHG emissions. Similarly for the operating permit program, only sources currently subject to the program (i.e., newly constructed or existing major sources for a pollutant other than GHGs) would be subject to Title V requirements for GHG. During this time, no sources would be subject to Clean Air Act permitting requirements due solely to GHG emissions.

Step 2 will build on Step 1. During Step 2, from July 1, 2011 to June 30, 2013, PSD permitting requirements will cover for the first time new construction projects that emit GHG emissions of at least 100,000 tons (90,718 MT) per year even if they do not exceed the permitting thresholds for any other pollutant. Modifications at existing facilities that increase GHG emissions by at least 75,000 tons (68,039 MT) per year will be subject to permitting requirements, even if they do not significantly increase emissions of any other pollutant. In Step 2, operating permit requirements will, for the first time, apply to sources based on their GHG emissions even if they would not apply based on emissions of any other pollutant. Facilities that emit at least 100,000 tons (90,718 MT) per year of CO_2e will be subject to Title V permitting requirements.

As part of this rule, EPA also commits to undertake another rulemaking, to begin in 2011 and conclude no later than July 1, 2012. That action will consist of an additional Step 3 for phasing in GHG permitting. Step three, if established, will not require permitting for sources with GHG emissions below 50,000 tons (45,359 MT) per year.

State

ARB coordinates and oversees State and local air pollution control programs in California and implements the California Clean Air Act (CCAA).

Criteria Air Pollutants

The CCAA, which was adopted in 1988, required ARB to establish California ambient air quality standards (CAAQS) (Table 1-2). The CCAA requires that all local air districts in the state endeavor to achieve and maintain CAAQS by the earliest practical date. The act specifies that local air districts should particularly focus on reducing emissions from transportation and areawide sources, and authorizes districts to regulate indirect sources. Among ARB's other responsibilities are to oversee local air district compliance with California and Federal laws; approve local air quality plans; submit SIPs to EPA; monitor air quality; determine and update area designations and maps; and set emissions standards for new mobile sources, consumer products, small utility engines, off-road vehicles, and fuels.

Toxic Air Contaminants

TACs in California are regulated primarily through the Tanner Air Toxics Act (Assembly Bill (AB) 1807 (Statutes of 1983)) and the Air Toxics Hot Spots Information and Assessment Act (AB 2588 (Statutes of 1987)). AB 1807 sets forth a formal procedure for ARB to designate substances as TACs. Research, public participation, and scientific peer review must be completed before ARB can designate a substance as a TAC. To date, ARB has identified more than 21 TACs and has adopted EPA's list of HAPs as TACs. Most recently, diesel PM was added to the ARB list of TACs.

Once a TAC is identified, ARB then adopts an Airborne Toxics Control Measure for sources that emit that particular TAC. If a safe threshold exists 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 BACT to minimize emissions.

AB 2588 requires existing facilities emitting toxic substances above a specified level to do all of the following:

- Prepare a toxic emissions inventory.
- Prepare a risk assessment if emissions are significant.
- Notify the public of significant risk levels.
- Prepare and implement risk reduction measures.

Greenhouse Gases

Various statewide initiatives to reduce California's contribution to GHG emissions have raised awareness that, even though the various contributors to and consequences of global climate change are not yet fully understood, global climate change is under way, and real potential exists for severe adverse environmental, social, and economic effects in the long term. The most relevant laws and orders are discussed in more detail below.

California Environmental Quality Act and SB 97 CEQA requires lead agencies to consider the reasonably foreseeable adverse environmental effects of projects they are considering for approval. GHG emissions have the potential to adversely affect the environment because they contribute to global climate change. In turn, global climate change has the potential to: raise sea levels, affect rainfall and snowfall, and affect habitat.

Senate Bill 97 Senate Bill (SB) 97 was enacted in August 2007 as part of the State budget negotiations and is codified at Section 21083.05 of the California Public Resources Code. SB 97 directs the Governor's Office of Planning and Research (OPR) to propose guidance in the California Environmental Quality Act Guidelines (State CEQA Guidelines) "for the mitigation of GHG emissions or the effects of GHG emissions." SB 97 directed OPR to develop text for the State CEQA Guidelines by July 2009. This legislation also directed the State Resources Agency (now Natural Resources Agency)—the agency charged with adopting the State CEQA Guidelines—to certify and adopt such guidelines by January 2010. In April 2009, OPR prepared draft CEQA Guidelines amendments and submitted them to the Natural Resources Agency (see below). On July 3, 2009, the Natural Resources Agency began the rulemaking process established under the Administrative Procedure Act.

The Natural Resources Agency recommended amendments for GHGs to fit within the existing CEQA framework for environmental analysis, which calls for lead agencies to determine baseline conditions and levels of significance and evaluate mitigation measures. The amendments to the State CEQA Guidelines do not identify a threshold of significance for GHG emissions, nor do they prescribe assessment methodologies or specific mitigation measures. The amendments encourage lead agencies to consider many factors in performing a CEQA analysis, but preserve the discretion that CEQA grants lead agencies to make their own determinations based on substantial evidence.

Section 15064.4, "Determining the Significance of Impacts from Greenhouse Gas Emissions," of the State CEQA Guidelines encourages lead agencies to consider three factors to assess the significance of GHG emissions:

1. Will the project increase or reduce GHGs as compared to the baseline?

2. Will the project's GHG emissions exceed the lead agency's threshold of significance?

3. Does the project comply with regulations or requirements to implement a statewide, regional, or local GHG reduction or mitigation plan?

Section 15064.4 also recommends that lead agencies make a good-faith effort, based on available information, to describe, calculate, or estimate the amount of GHG emissions associated with a project.

Section 15126.4, "Consideration and Discussion of Mitigation Measures Proposed to Minimize Significant Effects," of the State CEQA Guidelines lists considerations for lead agencies related to feasible mitigation measures to reduce GHG emissions. Among those considerations are the following:

- Project features, project design, or other measures that are incorporated into the project to substantially reduce energy consumption or GHG emissions

- Compliance with the requirements in a previously approved plan or mitigation program to reduce or sequester GHG emissions, when the plan or program provides specific requirements that will avoid or substantially lessen the potential impacts of the project

- Measures that sequester carbon or carbon-equivalent emissions

Section 15126.4 also specifies that where mitigation measures are proposed to reduce GHG emissions through off-site actions or purchase of carbon offsets, these mitigation measures must be part of a reasonable plan of mitigation that the relevant agency commits itself to implementing.

In addition, as part of the amendments and additions to the State CEQA Guidelines, a new set of environmental checklist questions (VII. Greenhouse Gas Emissions) was added to Appendix G of the State CEQA Guidelines. The new set asks whether a project would do either of the following:

1. Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?

2. Conflict with any applicable plan, policy or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases?

Preliminary Draft Staff Proposal: Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases under CEQA CEQA gives discretion to lead agencies to establish thresholds of significance based on individual circumstances. To assist in that exercise, and because OPR believes the unique nature of GHGs warrants investigation of a statewide threshold of significance for GHG emissions, OPR asked ARB technical staff to recommend a methodology for setting thresholds of significance. In October 2008, ARB released *Preliminary Draft Staff Proposal: Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases* under the California Environmental Quality Act (ARB 2008a). This draft proposal included a conceptual approach for thresholds associated with industrial, commercial, and residential projects. For nonindustrial projects, the steps to presuming a less-than-significant impact related to climate change generally involve analyzing whether the project the steps to presuming a less-than-

significant climate change impact generally involve analyzing whether the project meets the following criteria (ARB 2008a):

- Is exempt under existing statutory or categorical exemptions
- Complies with a previously approved plan or target
- Meets specified minimum performance standards
- Falls below an as-yet-unspecified annual emissions level

The performance standards focus on construction activities, energy and water consumption, generation of solid waste, and transportation. For industrial projects, the draft proposal recommends a tiered analysis procedure similar to the procedure for analyzing nonindustrial projects. However, for industrial projects a quantitative limit for less-than-significant impacts is established at approximately 7,000 MT CO_2e per year. These standards have not yet been adopted or finalized as a basis for evaluating the significance of a project's contribution to climate change.

Overall, as directed by SB 97, the Natural Resources Agency adopted Amendments to the CEQA Guidelines for GHGs emissions on December 30, 2009. On February 16, 2010, the Office of Administrative Law approved the Amendments, and filed them with the Secretary of State for inclusion in the California Code of Regulations. The Amendments became effective on March 18, 2010.

Executive Order S-3-05 EO S-3-05 made California the first state to formally establish GHG emissions reduction goals. EO S-3-05 includes the following GHG emissions reduction targets for California:

- By 2010, reduce GHG emissions to 2000 levels.
- By 2020, reduce GHG emissions to 1990 levels.
- By 2050, reduce GHG emissions to 80 percent below 1990 levels.

The final emission target of 80 percent below 1990 levels would put the state's emissions in line with estimates of the required worldwide reductions needed to bring about long-term climate stabilization and avoidance of the most severe impacts of climate change (IPCC 2007).

EO S-3-05 also dictated that the Secretary of the California Environmental Protection Agency coordinate oversight of efforts to meet these targets with all of the following:

- The Secretaries of the Business, Transportation, and Housing Agency; California Department of Food and Agriculture; and California Natural Resources Agency
- The Chairpersons of ARB and the California Energy Commission
- The President of the California Public Utilities Commission

This group was subsequently named the Climate Action Team.

As laid out in EO S-3-05, the Climate Action Team has submitted biannual reports to the Governor and State legislature describing progress made toward reaching the targets. The Climate Action Team is finalizing its second biannual report on the effects of climate change on California's resources.

Assembly Bill 32 In 2006, California passed the California Global Warming Solutions Act of 2006 (AB 32; California Health and Safety Code, Sections 38500 et seq.). AB 32 further details and puts into law the midterm GHG reduction target established in EO S-3-05—reduce GHG emissions to 1990 levels by 2020. AB 32 also identifies ARB as the State agency responsible for the design and implementation of emissions limits, regulations, and other measures to meet the target.

The statute lays out the schedule for each step of the regulatory development and implementation, as follows:

- By June 30, 2007, ARB had to publish a list of early-action GHG emission reduction measures.
- Before January 1, 2008, ARB had to identify the current level of GHG emissions by requiring statewide reporting and verification of GHG emissions from emitters and identify the 1990 levels of California GHG emissions.
- By January 1, 2010, ARB had to adopt regulations to implement the early-action measures.

In December 2007, ARB approved the 2020 GHG emission limit (1990 level) of 427 MMT CO_2e. The 2020 target requires the reduction of 169 MMT CO_2e, or approximately 30 percent below California's projected "business-as-usual" 2020 emissions of 596 MMT CO_2e.

Also in December 2007, ARB adopted mandatory reporting and verification regulations pursuant to AB 32. The regulations became effective January 1, 2009, with the first reports covering 2008 emissions. The mandatory reporting regulations require reporting for major facilities, those that generate more than

25,000 MT CO_2e per year. To date ARB has met all of the statutorily mandated deadlines for promulgation and adoption of regulations.

Climate Change Scoping Plan In December 2008, ARB adopted its Climate Change Scoping Plan, which contains the main strategies California will implement to achieve reduction of approximately 118 MMT of CO_2e, or approximately 22 percent from the state's projected 2020 emission level of 545 MMT of CO_2e under a business-as-usual scenario (this is a reduction of 47 MMT CO_2e, or almost 10 percent, from 2008 emissions). ARB's original 2020 projection was 596 MMT CO_2e, but this revised 2020 projection takes into account the economic downturn that occurred in 2008 (ARB 2011e). In August 2011, the Scoping Plan was re-approved by ARB, and includes the Final Supplement to the Scoping Plan Functional Equivalent Document, which further-examined various alternatives to Scoping Plan measures. The Scoping Plan also includes ARB-recommended GHG reductions for each emissions sector of the state's GHG inventory. ARB estimates the largest reductions in GHG emissions to be achieved by implementing the following measures and standards (ARB 2011e):

- improved emissions standards for light-duty vehicles (estimated reductions of 26.1 MMT CO_2e),
- the Low-Carbon Fuel Standard (15.0 MMT CO_2e),
- energy efficiency measures in buildings and appliances (11.9 MMT CO_2e), and
- a renewable portfolio and electricity standards for electricity production (23.4 MMT CO_2e).

ARB has not yet determined what amount of GHG reductions it recommends from local government operations; however, the Scoping Plan does state that land use planning and urban growth decisions will play an important role in the state's GHG reductions because local governments have primary authority to plan, zone, approve, and permit how land is developed to accommodate population growth and the changing needs of their jurisdictions. (Meanwhile, ARB is also developing an additional protocol for community emissions.) ARB further acknowledges that decisions on how land is used will have large impacts on the GHG emissions that will result from the transportation, housing, industry, forestry, water, agriculture, electricity, and natural gas emission sectors. The Scoping Plan states that the ultimate GHG reduction assignment to local government operations is to be determined (ARB 2008b). With regard to land use planning, the Scoping Plan expects approximately 3.0 MMT CO_2e will be achieved associated with implementation of SB 375, which is discussed further below (ARB 2011e).

Executive Order S-13-08 EO S-13-08, issued November 14, 2008, directs the California Natural Resources Agency, the California Department of Water Resources, OPR, the California Energy Commission, the State Water Resources Control Board, the California Department of Parks and Recreation, and California's coastal management agencies to participate in planning and research activities to advance California's ability to adapt to the effects of climate change. The order specifically directs agencies to work with the National Academy of Sciences to initiate the first California sea-level-rise assessment and to review and update the assessment every 2 years after completion; immediately assess the vulnerability of California's transportation system to sea level rise; and to develop a climate change adaptation strategy for California.

California Climate Change Adaptation Strategy Developed through cooperation and partnership among multiple State agencies, the 2009 *California Climate Adaptation Strategy* summarizes the best known science on climate change effects. The strategy describes effects of climate change on seven specific sectors—public health, biodiversity and habitat, ocean and coastal resources, water management, agriculture, forestry, and transportation and energy infrastructure—and recommends ways to manage against those threats.

Governor's Office of Planning and Research Technical Advisory In June 2008, OPR published a technical advisory on CEQA and climate change to provide interim advice to lead agencies regarding the analysis of GHGs in environmental documents (OPR 2008). The advisory encourages lead agencies to identify and quantify the GHGs that could result from a proposed project, analyze the impacts of those emissions to determine whether they would be significant, and to identify feasible mitigation measures or alternatives that would reduce any adverse impacts to a less-than-significant level. The advisory recognized that OPR would develop, and the Natural Resources Agency would adopt, amendments to the State CEQA Guidelines pursuant to SB 97. (See "California Environmental Quality Act and SB 97," above.)

The advisory provides OPR's perspective on the emerging role of CEQA in addressing climate change and GHG emissions. It recognizes that approaches and methodologies for calculating GHG emissions and determining their significance are rapidly evolving. OPR concludes in the technical advisory that climate change is ultimately a cumulative impact, and that no individual project could have a significant impact on global climate. Thus, projects must be analyzed with respect to the incremental impact of the project when added to other past, present, and reasonably foreseeable probable future projects. OPR recommends that lead agencies undertake an analysis, consistent with available guidance and current CEQA practice, to determine cumulative significance (OPR 2008).

The technical advisory points out that neither CEQA nor the State CEQA Guidelines prescribe thresholds of significance or particular methodologies for

performing an impact analysis. "This is left to lead agency judgment and discretion, based upon factual data and guidance from regulatory agencies and other sources where available and applicable" (OPR 2008). OPR states that "the global nature of climate change warrants investigation of a statewide threshold of significance for GHG emissions" (OPR 2008). Until such a standard is established, OPR advises that each lead agency should develop its own approach to performing an analysis for projects that generate GHG emissions (OPR 2008).

OPR sets out the following process for evaluating GHG emissions. First, agencies should determine whether GHG emissions may be generated by a proposed project, and if so, quantify or estimate the emissions by type or source. Calculation, modeling, or estimation of GHG emissions should include the emissions associated with vehicular traffic, energy consumption, water usage, and construction activities (OPR 2008).

Agencies should then assess whether the emissions are "cumulatively considerable" even though a project's GHG emissions may be individually limited. OPR states: "Although climate change is ultimately a cumulative impact, not every individual project that emits GHGs must necessarily be found to contribute to a significant cumulative impact on the environment" (OPR 2008). Individual lead agencies may undertake a project-by-project analysis, consistent with available guidance and current CEQA practice (OPR 2008).

Finally, if the lead agency determines that emissions are a cumulatively considerable contribution to a significant cumulative impact, the lead agency must investigate and implement ways to mitigate the emissions (OPR 2008). OPR (2008) states:

> *Mitigation measures will vary with the type of project being contemplated, but may include alternative project designs or locations that conserve energy and water, measures that reduce vehicle miles traveled (VMT) by fossil-fueled vehicles, measures that contribute to established regional or programmatic mitigation strategies, and measures that sequester carbon to offset the emissions from the project.*

OPR concludes that "A lead agency is not responsible for wholly eliminating all GHG emissions from a project; the CEQA standard is to mitigate to a level that is "less than significant" (OPR 2008). Attachment 3 to the technical advisory includes a list of GHG reduction measures that can be applied on a project-by-project basis.

California Air Pollution Officers Association In January 2008, the California Air Pollution Control Officers Association issued a "white paper" on evaluating and addressing GHGs under CEQA (CAPCOA 2008). This resource guide was prepared to support local governments as they develop their climate change programs and policies. Though not a guidance document, the paper provides

information about key elements of CEQA GHG analyses, including a survey of different approaches to setting quantitative significance thresholds. The following are some of the thresholds discussed:

- Zero (all emissions are significant)
- 900 MT CO_2e per year (90 percent market capture for residential and nonresidential discretionary development)
- 10,000 MT CO_2e per year (potential ARB mandatory reporting level for cap-and-trade program)
- 25,000 MT CO_2e per year (ARB's mandatory reporting level for the statewide emissions inventory)
- Unit-based thresholds, based on identifying thresholds for each type of new development and quantifying significance by a 90 percent capture rate

Regional and Local

Primary Study Area

Shasta County Air Quality Management District SCAQMD is the primary local agency with respect to air quality for all of Shasta County. SCAQMD attains and maintains air quality conditions in Shasta County through a comprehensive program of planning, regulation, enforcement, technical innovation, and promotion of the understanding of air quality issues. The clean-air strategy of SCAQMD is to prepare plans and programs for the attainment of ambient air quality standards, adopt and enforce rules and regulations, and issue permits for stationary sources. SCAQMD also inspects stationary sources, responds to citizen complaints, monitors ambient air quality and meteorological conditions, and implements other programs and regulations required by the CAA, CAAA, and CCAA.

Rules and Regulations All projects in Shasta County are subject to SCAQMD rules and regulations in effect at the time of construction. Specific rules applicable to the project may include the following:

- **Rule 2:1A: Permits Required** – Any person who is building, erecting, altering, or replacing any article, machine, equipment or other contrivance, or multicomponent system including same, portable or stationary and who is not exempt under Section 42310 of the California Health and Safety Code, the use of which may cause the issuance of air contaminants, shall first obtain written authority for such construction from the Air Pollution Control Officer (APCO).

- **Rule 2:7: Conditions for Open Burning** – All material to be burned must be arranged so that it will burn with a minimum of smoke and must be reasonably free of dirt, soil, and visible surface moisture. All vegetative wastes to be burned shall be ignited only with approved ignition devices and shall be free of tires, illegal residential waste, tar paper, construction debris, and combustible and flammable waste. No burning shall cause emissions to be transported into smoke sensitive areas. No burning shall be conducted when such burns, in conjunction with present or predicted meteorology, could cause or contribute to a violation of an ambient air quality standard.

- **Rule 3:15: Cutback and Emulsified Asphalt** – A person shall not manufacture, sell, offer for sale, use, or apply for paving, construction, or maintenance of parking lots, driveways, streets, or highways any rapid- or medium-cure cutback asphalt, slow-cure cutback asphalt material that contains more than 0.5 percent by volume VOCs that boil at 500°F (260 degrees Celsius) or less, or any emulsified asphalt material that contains more than 3.0 percent by volume of VOCs that evaporate at 500°F (260 degrees Celsius) or less.

- **Rule 3:16: Fugitive, Indirect, or Nontraditional Sources** – APCO may place reasonable conditions upon any source, as delineated below, that will mitigate the emissions from such sources to below a level of significance or to a point that such emissions no longer constitute a violation of Health and Safety Code Sections 41700 and/or 41701: fugitive sources, indirect sources, and nontraditional sources.

- **Rule 3:22: Asbestos** – No person shall use or apply serpentine material for surfacing in California unless the material has been tested using ARB Test Method 435 and determined to have an asbestos content of 5 percent or less. A written receipt or other record documenting the asbestos content shall be retained by any person who uses or applies serpentine material for at least 7 years from the date of use or application, and shall be provided to the APCO, or his or her designate, for review upon request.

- **Rule 3:31: Architectural Coatings** – The developer or contractor is required to use coatings that comply with the VOC content limits specified in the rule.

Criteria Pollutants SCAQMD has adopted pollutant emission thresholds and mitigation requirements that are used in the analysis of project impacts. The thresholds and mitigation requirements are discussed in Chapter 2 of this technical report.

Attainment Plan Air quality planning in the NSVAB has been undertaken on a joint basis by the air districts in seven counties. The current plan, the *Northern*

Sacramento Valley Planning Area 2009 Triennial Air Quality Attainment Plan (AQAP), is an update of plans prepared in 1994, 1997, 2000, 2003, and 2006. The purpose of the plan is to achieve and maintain healthful air quality throughout the air basin. The 2009 AQAP addresses the progress made in implementing the 2006 plan and proposes modifications to the strategies necessary to attain the CAAQS for the 1-hour ozone standard at the earliest practicable date. The 2012 update is currently in draft form.

The AQAP is based on each county's projected emission inventory, which includes stationary, areawide, and mobile sources. Emission inventories are based on general plans and anticipated development.

Toxic Air Contaminants At the local level, air pollution control or management districts may adopt and enforce ARB control measures. Under SCAQMD Rule V, Additional Procedures For Issuing Permits To Operate For Sources Subject To Title V Of The Federal Clean Air Act Amendments Of 1990, Rule 2:1, New Source Review, and Rule 2:1A, Permits Required, all sources that possess the potential to emit TACs are required to obtain permits from the district. Permits may be granted to these operations if they are constructed and operated in accordance with applicable regulations, including new-source-review standards and air-toxics control measures. SCAQMD limits emissions and public exposure to TACs through a number of programs. SCAQMD prioritizes TAC-emitting stationary sources based on the quantity and toxicity of the TAC emissions and the proximity of the facilities to sensitive receptors.

Shasta County General Plan The Air Quality Element of the *Shasta County General Plan* (2004) contains objectives and policies aimed at protecting and improving Shasta County's air quality, meeting the requirements of the Federal CAA and CCAA, and integrating planning efforts (e.g., transit, land use) to reduce air pollution contaminants, among others.

Tehama County Air Pollution Control District The southern portion of the primary study area is in Tehama County. The Tehama County Air Pollution Control District (TCAPCD) is the primary local agency with respect to air quality for Tehama County. TCAPCD has rules and regulations similar to those described for SCAQMD. TCAPCD is in the NSVAB and is therefore a participant in NSVAB's 2003 AQAP.

Extended Study Area

All areas of California are within the jurisdiction of an air pollution control district or an air quality management district. Each district has rules and regulations similar to those described above for SCAQMD. Districts that are classified as nonattainment for one or more criteria pollutants have attainment plans or similar documents as required by ARB. Most districts have guidance documents for the analysis of air quality impacts for CEQA compliance.

Global Study Area—Greenhouse Gases

There are no regional or local policies, regulations, or laws pertaining to GHG emissions.

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Chapter 2
Air Quality and Greenhouse Gas Modeling Results

Air quality and greenhouse gas modeling outputs for the comprehensive plans are provided in Attachment 1.

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Chapter 3
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