3.7 Climate Change and Greenhouse Gas Emissions

This section addresses the impacts of greenhouse gas (GHG) emissions associated with CVFPP implementation on global climate change. In various locations within this section, the text describes the general effects of global climate change; however, the information below is included to provide a context for the environmental consequences of GHG emissions. The potential for global climate change to affect the proposed program is addressed separately in Section 6.6, "Effects of Global Climate Change on Program Facilities and Operations."

Emissions of GHGs are a concern because such emissions contribute, on a cumulative basis, to global climate change. Global climate change has the potential to result in sea level rise (which may result in flooding of low-lying areas), to affect rainfall and snowfall levels (which may lead to changes in water supply and runoff), to affect temperatures and habitats (which in turn may affect biological and agricultural resources), and to result in many other adverse effects. Although global climate change is inherently a cumulative impact, it is important to remember that any single project is unlikely to be able to generate sufficient GHGs by itself to have a significant impact on the environment. However, the cumulative effect of human activities has been clearly linked to quantifiable changes in the composition of the atmosphere, which in turn have been shown to be the main cause of global climate change.

Global warming is the name given to the increase in the average temperature of the Earth's near-surface air and oceans since the mid-20th century and its projected continuation. Warming of the climate system is now considered by a vast majority of the scientific community to be unequivocal, based on observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (IPCC 2007a). Global mean surface temperatures have risen by 0.74 degrees Celsius (°C) ± 0.18°C when estimated by a linear trend over the last 100 years (1906–2005). The rate of warming over the last 50 years is almost double that over the last 100 years (0.13°C ± 0.03°C versus 0.07°C ± 0.02°C per decade). The causes of this measured warming have been identified as both natural processes and the result of human actions. For the next two decades, a warming of about 0.2°C per decade is projected for a range of emissions scenarios. Even if the concentrations of all GHGs and aerosols were to be kept constant at year-2000 levels, a further warming of about 0.1°C per decade would be expected. Beyond the next two decades, temperature projections increasingly depend on specific emissions scenarios, with predicted global average temperature increases ranging from 1.8°C to 4°C by 2100 (relative to 20th century averages) (IPCC 2007a). The Intergovernmental Panel on Climate Change (IPCC) concludes that variations in natural phenomena such as solar radiation and volcanoes produced most of the warming from preindustrial times to 1950 and had a small cooling effect afterward. However, since 1950, increasing GHG concentrations resulting from human activity such as fossil fuel burning and deforestation have been responsible for most of the observed temperature increase. These basic conclusions have been endorsed by more than 45 scientific societies and academies of science, including all of the national academies of science of the major industrialized countries. Since 2007, no scientific body of national or international standing has maintained a dissenting opinion.

Increases in GHG concentrations in the Earth's atmosphere are thought to be the main cause of human-induced climate change. GHGs naturally trap heat by impeding the exit of solar radiation that has hit the Earth and is reradiated back into space as infrared radiation. Some GHGs occur naturally and are necessary for keeping the Earth's surface habitable. However, increases in the concentrations of these gases in the atmosphere above natural levels during the last 100 years have increased the amount of infrared radiation that is trapped in the lower atmosphere, intensifying the natural greenhouse effect and resulting in increased global average temperatures.

As defined in Section 38505(g) of the California Health and Safety Code, the principal GHGs of concern are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). With the exception of nitrogen trifluoride, these are the same gases named in the U.S. Environmental Protection Agency's (EPA's) Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act (see Section 3.7.2, "Regulatory Setting"). Each of the principal GHGs has a long atmospheric lifetime (1 year to several thousand years), and is globally well mixed. In addition, the potential heat trapping ability of each of these gases varies significantly from one another. On a 100-year timescale, methane is about 25 times as potent as CO_2, nitrous oxide is about 298 times as potent as CO_2, and sulfur hexafluoride is about 22,800 times more potent than CO_2 (IPCC 2007a). Conventionally, GHGs have been reported as CO_2 equivalents (CO_2e). CO_2e takes into account the relative potency of non-CO_2 GHGs and converts their quantities to an equivalent amount of CO_2 so that all emissions can be reported as a single quantity. Other human-induced radiative forcings that affect climate include changes in stratospheric and tropospheric ozone concentrations, stratospheric water vapor concentrations, aerosol concentrations, surface albedo, and linear contrails; these forcings can be direct or indirect, and can be positive or negative, resulting in net heating or cooling (IPCC 2007a). Overall radiative forcing from human activities in the past 250 years is positive, on the order of 1.6 watts per square meter. This anthropogenic contribution to radiative forcing is substantially greater than the contribution to radiative forcing estimated from natural sources over the past 250 years (0.12 watt per square meter) (IPCC 2007a).

The primary human-made processes that release these gases include burning of fossil fuels for transportation, heating, and electricity generation; agricultural practices that release methane, such as livestock grazing and crop residue decomposition; and industrial processes that release smaller amounts of high global warming potential (GWP) gases, such as sulfur hexafluoride, PFCs, and HFCs. Deforestation and land cover conversion have also been identified as contributing to global warming by reducing the Earth's capacity to remove CO_2 from the air and altering the Earth's albedo or surface reflectance.

The effects of warming of the Earth's atmosphere and oceans affect global and local climate systems. Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, in addition to temperature increases (IPCC 2007a).

Based on growing evidence, there is high confidence that the following effects on hydrologic systems are occurring: increased runoff and earlier spring peak discharge in many glacier- and snow-fed rivers, and warming of lakes and rivers in many regions, with effects on thermal structure and water quality (IPCC 2008).

There is very high confidence, based on increasing evidence from a wider range of species, that recent warming is strongly affecting terrestrial biological systems, including such changes as earlier timing of spring events (e.g., leaf-unfolding, bird migration, egg-laying); and poleward and upward shifts in ranges in plant and animal species. Based on satellite observations since the early 1980s, there is high confidence that there has been a trend in many regions toward earlier "greening" of vegetation in the spring linked to longer thermal growing seasons resulting from recent warming (IPCC 2007a).

There is high confidence, based on substantial new evidence, that observed changes in marine and freshwater biological systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. These include shifts in ranges and changes in algal, plankton, and fish abundance in high-latitude oceans; increases in algal and zooplankton abundance in high-latitude and high-altitude lakes; and range changes and earlier fish migrations in rivers (IPCC 2007a).

Changes in the ocean and on land, including observed decreases in snow cover and Northern Hemisphere sea ice extent, thinner sea ice, shorter freezing seasons of lake and river ice, glacier melt, decreases in permafrost extent, increases in soil temperatures and borehole temperature profiles, and sea level rise, provide additional evidence that the world is warming (IPCC 2007a).

This discussion and analysis of global climate change in relation to the proposed program is composed of the following sections:

- Section 3.7.1, "Environmental Setting," describes the physical conditions in the study area as they apply to global climate change and GHG emissions.

- Section 3.7.2, "Regulatory Setting," summarizes federal, State, and regional and local laws and regulations pertinent to evaluation of the proposed program's net effects of GHG emissions as they relate to global climate change.

- Section 3.7.3, "Analysis Methodology and Thresholds of Significance," describes the methods used to assess the environmental effects of the proposed program and lists the thresholds used to determine the significance of those effects.

- Section 3.7.4, "Environmental Impacts and Mitigation Measures for NTMAs," discusses GHG emissions resulting from near-term management activities (NTMAs) and identifies mitigation measures for significant environmental effects.

- Section 3.7.5, "Environmental Impacts, Mitigation Measures, and Mitigation Strategies for LTMAs," discusses GHG emissions resulting from long-term management activities (LTMAs), identifies mitigation measures for significant environmental effects, and addresses conditions in which any impacts would be too speculative for evaluation (CEQA Guidelines, Section 15145).

NTMAs and LTMAs are described in detail in Section 2.4, "Proposed Management Activities."

Because this PqEIR is a programmatic document, the environmental and regulatory settings are discussed at the program level.

3.7.1 Environmental Setting

Information Sources Consulted

Sources of information used to prepare this section include State climate change legislation, guidance, and resources, particularly the following reports and online information produced by the California Air Resources Board (CARB), DWR, and the California Natural Resources Agency (CNRA):

- *Staff Report: California 1990 Greenhouse Gas Emissions Level and 2020 Emissions Limit* (CARB 2007)
- *Climate Change Scoping Plan: A Framework for Change* (CARB 2008a)
- Online GHG inventory data for 2000–2008 (CARB 2010a, 2011)
- Online information about Senate Bill (SB) 375 regional targets (CARB 2010b)
- *Progress on Incorporating Climate Change into Planning and Management of California's Water Resources: Technical Memorandum Report* (DWR 2006)
- *Managing an Uncertain Future: Climate Change Adaptation Strategies for California's Water* (DWR 2008)
- *Water Plan Update 2009* (DWR 2010)
- *2009 California Climate Adaptation Strategy. A Report to the Governor of the State of California in Response to Executive Order S-13-2008* (CNRA 2009)

Geographic Areas Discussed

The study area for the proposed program covers a large portion of California and falls into 22 air districts, each with its own set of policies, rules, guidance, and governance. The air basins and individual air districts within the study area are shown in Figure 3.4-1 in Section 3.4, "Air Quality."

The impacts of the CVFPP's net GHG emissions on climate change are discussed for the entire program, addressing the following geographic areas within the study area:

- Extended systemwide planning area (Extended SPA) divided into the Sacramento and San Joaquin Valley and foothills and the Sacramento–San Joaquin Delta (Delta) and Suisun Marsh
- Sacramento and San Joaquin Valley watersheds
- SoCal/coastal Central Valley Project/State Water Project (CVP/SWP) service areas

Global Climate Trends and Associated Impacts

The rate of increase in global average surface temperature over the last 100 years has not been consistent; the last 3 decades have warmed at a much faster rate—on average 0.32 degree Fahrenheit (°F) per decade. Eleven of the 12 years from 1995 to 2006 rank among the 12 warmest years in the instrumental record of global average surface temperature (going back to 1850) (IPCC 2007a).

During the same period when this increased global warming has occurred, many other changes have occurred in other natural systems. Sea levels have risen by an average of 1.8 millimeters per year; precipitation patterns throughout the world have shifted, with some areas becoming wetter and others drier; tropical cyclone activity in the North Atlantic has increased; peak runoff timing of many glacial and snow-fed rivers has shifted earlier; and numerous other conditions have been observed. Although it is difficult to prove a definitive cause-and-effect relationship between global warming and certain observed changes to natural systems, there is high confidence in the scientific community that many of these changes are a direct result of increased global temperatures (IPCC 2007a).

California Climate Trends and Associated Impacts

Maximum (daytime) and minimum (nighttime) temperatures are increasing almost everywhere in California, but at different rates. The annual average *minimum* temperature for all of California has increased by 0.33°F per decade during the period 1920 to 2003, while the average annual *maximum* temperature has increased by 0.1°F per decade (Moser et al. 2009).

With respect to California's water resources, the most important effects of global warming have been changes to the water cycle and sea level rise. Over the past century, the precipitation mix between snow and rain has shifted in favor of more rainfall and less snow (Mote et al. 2005; Knowles et al. 2006), and snowpack in the Sierra Nevada is melting earlier in the spring (Kapnick and Hall 2009). The average early-spring snowpack in the Sierra Nevada has decreased by about 10 percent during the last century, a loss of 1.5 million acre-feet of snowpack storage (DWR 2008). These changes have major implications for water supply, flooding, aquatic ecosystems, energy generation, and recreation throughout the state. During the same period, sea levels along California's coast rose 7 inches (DWR 2008). Sea level rise associated with global warming will continue to threaten coastal lands and infrastructure, increase flooding at the mouths of rivers, and place additional stress on levees in the Delta. Sea level rise also will intensify the difficulty of managing the Delta as the heart of the State's water supply system. These effects on the water cycle and sea level rise, and related consequences for water quality, urban and agricultural water demand, and hydropower demand, are described in greater detail below.

Precipitation Climate change can affect precipitation by changing the overall amount of precipitation, type of precipitation (rain versus snow), and timing and intensity of precipitation events. Changes to these factors propagate through the hydrologic system in California and have the potential to affect snowpack, runoff, water supply, and flood control.

Former State Climatologist James Goodridge compiled an extensive collection of longer-term precipitation records from throughout California. These data sets were used to evaluate whether there has been a changing trend in precipitation in the state over the past century (DWR 2006). Long-term runoff records in selected California watersheds were also examined. Based on a linear regression of the data, the long-term historical trend for statewide average annual precipitation appears to be relatively flat (no increase or decrease) over the entire record. However, it appears that there might be an upward trend in precipitation toward the latter portion of the record.

These same precipitation data can be sorted into three regions—Northern, Central, and Southern California—to determine precipitation trends. Precipitation in the northern portion of the state appears to have increased slightly between 1890 and 2002; precipitation in the central and southern portions of the state over this same period shows a slight decreasing trend. All changes were in the range of 1–3 inches annually (DWR 2006). Although existing data indicate some level of change in precipitation trends in California, more analysis is likely needed to determine whether changes in California's regional annual precipitation totals have resulted from climate change or from other factors (DWR 2006).

Snowpack 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 the Sierra Nevada's snowpack. 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 California. According to the California Energy Commission (CEC) (2006a), the snowpack portion of the water supply has the potential to decline by 30–90 percent by the end of the 21st century. A study by Knowles and Cayan projects that approximately 50 percent of the statewide snowpack will be lost by the end of the century (Knowles and Cayan 2002).

On average, California's annual snowpack has the greatest accumulations from November through the end of March. The snowpack typically melts from April through July. California's reservoir managers (including CVP and SWP facilities) rely on snowmelt to fill reservoirs once the threat of large winter and early-spring storms and related flooding risks have passed.

An analysis conducted by DWR of the effect of rising temperatures on snowpack shows that a rise in average annual air temperature of 3°C (5.4°F) would likely cause snowlines to rise approximately 1,500 feet (DWR 2006:2-30). This would result in the equivalent of approximately 5 million acre-feet of water per year falling as rain rather than snow at lower elevations. The impact of this shift in precipitation patterns from snow to rain is discussed further in the next section.

Runoff Runoff is directly affected by changes in precipitation and snowpack. If the amount of precipitation falling as rain rather than snow were to increase earlier in the year, flooding potential could increase. Water that normally would be held in the Sierra Nevada snowpack until spring would flow into the Central Valley concurrently with the rain from winter storm events. This scenario would place more pressure on California's levee/flood control system (DWR 2006).

Changes in both the amount of runoff and the seasonality of the hydrologic cycle also have the potential to greatly affect the heavily managed water systems of the western United States. The hydrology of the Delta and the Sacramento and San Joaquin Valley watersheds are highly dependent on the interaction between Sierra Nevada snowpack, runoff, and management of reservoirs.

Higher snow lines and more precipitation falling in the form of rain rather than snow will increase winter inflows to reservoirs. Higher winter inflows will also likely mean that a greater portion of the total annual runoff volume will occur in the winter, will pass through reservoirs, and will be unavailable for hydropower production and water supply uses later in the year. Higher winter inflows may also diminish the ability of reservoir managers to store a portion of a year's runoff volume as annual carryover storage. Changes in reservoir operations and reduced annual storage in snowpack could reduce the amount of water available in the summer and fall to meet Delta outflow and salinity control requirements, as well as water supply needs (DWR 2006).

Sea Level Rise Another major area of concern related to global climate change is sea level rise. The worldwide average sea level appears to have risen about 0.4 to 0.7 foot over the past century, based on data collected from tide gauges around the globe, coupled with satellite measurements taken over approximately the last 15 years (IPCC 2007a).

Rising average sea level over the past century has been attributed primarily to warming of the world's oceans and the related thermal expansion of ocean waters, and the addition of water to the world's oceans from the melting of land-based polar ice (IPCC 2007a). A consistent rise in sea level has been recorded worldwide over the last 100 years. According to the *Resolution of the California Ocean Protection Council on Sea-Level Rise*, sea-level rise is expected to continue and projected to rise from 40 inches on a low average estimate to 55 inches on a high average estimate by year 2100 (OPC 2011). Other climate models estimate an even greater increase in sea level rise of 55 inches by the year 2100 (DWR 2008).

Although these projections are on a global scale, the rate of relative sea level rise experienced at many locations along California's coast correlates well with the worldwide average rate of rise observed over the past century. Various gauge stations along the California coast show an increase similar to the global trends. Data specific to the San Francisco tide gauge near the Golden Gate Bridge, using 19-year data sets, show that the mean tide level has increased by approximately 0.5 foot over the past 100 years. Therefore, it is reasonable to expect that changes in worldwide average sea level will also be experienced along California's coast through this century (DWR 2006:2-44).

However, the amount and timing of the expected future sea level rise along California's coast are uncertain. Executive Order S-13-08 directed State agencies to consider a range of sea-level-rise scenarios for the years 2050 and 2100 to assess project vulnerability, reduce expected risks, and increase resiliency to sea level rise. On March 11, 2011, the California Ocean Protection Council's (OPC's) resolution to provide guidance in assessing project vulnerability, reducing expected risks, and increasing resiliency to sea level rise was officially adopted (OPC 2011). The resolution advises State agencies to use the sea-level-rise values presented in December 2009 in the *Proceedings of National Academies of Science* publication (OPC 2011). Post-2050 ranges for sea level rise were based on IPCC GHG emissions scenarios (low, medium, and high). Table 1 of the draft resolution indicates that the average sea level rise by 2050 would be 14 inches, or 1.2 feet above 2000 levels, and by 2100 sea level rise could range from 40 inches to 55 inches (OPC 2011).

Sea level rise affecting California could increase coastal flooding and saltwater intrusion into the Delta, and disrupt wetlands (CEC 2006a). As discussed below, saltwater intrusion is of particular concern in the Delta, where pumps delivering potable water could be threatened. Some low-lying populated areas throughout the Delta inundated by sea level rise could experience population displacement and economic disruption.

Water Quality Temperature increases and sea level rise will affect water quality. Higher overall air temperatures will increase water temperatures throughout the study area—inflows into reservoirs, water stored in reservoirs, and water flowing downstream (DWR 2010:Volume 4). Higher water temperatures and variations in runoff are likely to produce adverse changes in water quality affecting human health, ecosystems, and water use (IPCC 2007a:FAR, WG2, Ch. 3:188–188). Lowering of the water levels in rivers and lakes may lead to resuspension of bottom sediments and liberation of chemicals (including increased solubility of metals), thus negatively affecting water supplies. More intense rainfall may cause suspended solids in lakes and reservoirs to increase as a result of fluvial soil erosion. In addition, nutrients and pollutants (e.g., fertilizers, pesticides, organic matter, heavy metals) may be increasingly washed from soils to water bodies (IPCC 2007a:FAR, WG2, Ch. 3:188–188).

Higher surface water temperatures may promote algal blooms and increase rates of bacterial and fungal growth, which may cause bad tastes and odors in drinking water and generate toxins. Moreover, even with enhanced phosphorus removal in wastewater treatment plants, algal growth may increase with warming over the long term. Furthermore, higher water temperatures may enhance the transfer of volatile and semivolatile compounds (e.g., ammonia, mercury, dioxins, pesticides) from surface water bodies to the atmosphere (IPCC 2007a:FAR, WG2, Ch. 3:188–188). Lastly, some water treatment processes are affected by water temperature, such as chlorination and precipitation of material out of solution. Increased temperatures could decrease treatment effectiveness by increasing solubility of salts, reducing solubility of chlorine gas, or shifting the proportions of reaction products, which could increase treatment costs.

The largest effect of sea level rise in California would likely be on water quality in the Delta (DWR 2006:5-24). Even if it were to remain within the low to middle range of current projections, the rising sea level would begin to inundate the Delta and affect salinity gradients. The increased salinity would affect water quality and fisheries in the lower reaches of the Sacramento and San Joaquin rivers. It is reasonably foreseeable that salinity and water levels in the study area would be affected by sea level rise caused by global climate change.

Urban and Agricultural Water Demand Higher overall air temperatures and increases in CO_2 emissions are also likely to change water demands. These effects will vary considerably depending on other changes in the regional and global economy, population, and land use. The most important effect is likely to be on agricultural water demands, if only because agricultural water use is by far the largest water demand in California (currently about 80 percent of all human uses combined). Higher temperatures generally increase the evapotranspiration (ET) rate, the rate at which water evaporates from water, soil, and plant surfaces. Higher temperatures and CO_2 concentrations also increase rates of plant growth and can shorten the time to plant maturity; this increased productivity would reduce overall water use by plants in the San Joaquin Valley, partially compensating for potential reductions in agricultural water supply. However, longer growing seasons with more rapid crop maturity could result in double-cropping, which would increase water demands (DWR 2010:Volume 4). Crop choice could also increase or decrease water demands depending on the type of plant utilized, as some crops (e.g., corn and rice) are more water and fertilizer intensive than others.

Increased ET rates could increase salt accumulation on plant surfaces, especially where overhead irrigation is used. Salt accumulation in surficial soils could also increase. Additional demand for irrigation water may result if salt control requirements increase (DWR 2006). Other factors related to climate change, such as possible changes in humidity, cloudiness, and wind, could also affect ET rates (DWR 2006).

The use of water for frost protection may be reduced with increasing temperatures and projected reductions in the number of days each year when frost occurs. Frost protection is typically an important consideration for orchards and vineyards (DWR 2006).

The net effect of climate change on agricultural water demand in California is unknown. However, it is likely there will be an increase in future water demand in response to increased average air temperature.

Urban water demands may also be affected by climate warming. Indoor water demand could rise if greater use is made of evaporative cooling of buildings and residences, as is common in some hot, dry areas in the southwestern United States. Increases in ET and growing-season length are likely to increase outdoor water use (DWR 2010: Volume 4).

As agricultural and urban water demands increase as a result of climate change, more energy will be needed for water transport and treatment; if the energy comes from fossil fuels rather than renewable sources, it will lead to increased GHG emissions and an adverse impact on climate change.

(See “Electricity” under “Anthropogenic Sources,” below, for further discussion.)

Hydropower Demand Climate change will affect hydropower demand (as a subset of overall electricity demand) and production (discussed above under “Snowpack” and “Runoff”). Hydropower demands are economic in nature, reflected in the price of power at different times of day and seasons of the year. Hydropower is particularly valuable for peaking power; it is one of the few large forms of storable power, and it can respond quickly to fluctuations in power demand. For this reason and because of the fluctuating availability of other renewable energy resources (e.g., wind, solar), hydroelectric power is a critical component of the State’s expansion of renewable energy resources. Energy demands are likely to increase as temperatures increase, because much power demand—particularly for peaking power—is for air conditioning. If the daily peak demand for power increases and broadens from additional air conditioning, the value of hydropower will increase. As discussed previously, increased water demand may also lead to increased hydropower demand, which again, would increase the value of hydropower. Higher temperatures are also likely to lengthen the air conditioning season, increasing hydropower demands earlier in spring and later in fall. Warming would also reduce energy and hydropower demands for heating during winter (DWR 2010:Volume 4).

Local Climate

The local climate of the study area is summarized in Section 3.4, “Air Quality.”

Sectors and Sources of Greenhouse Gas Emissions in the Study Area

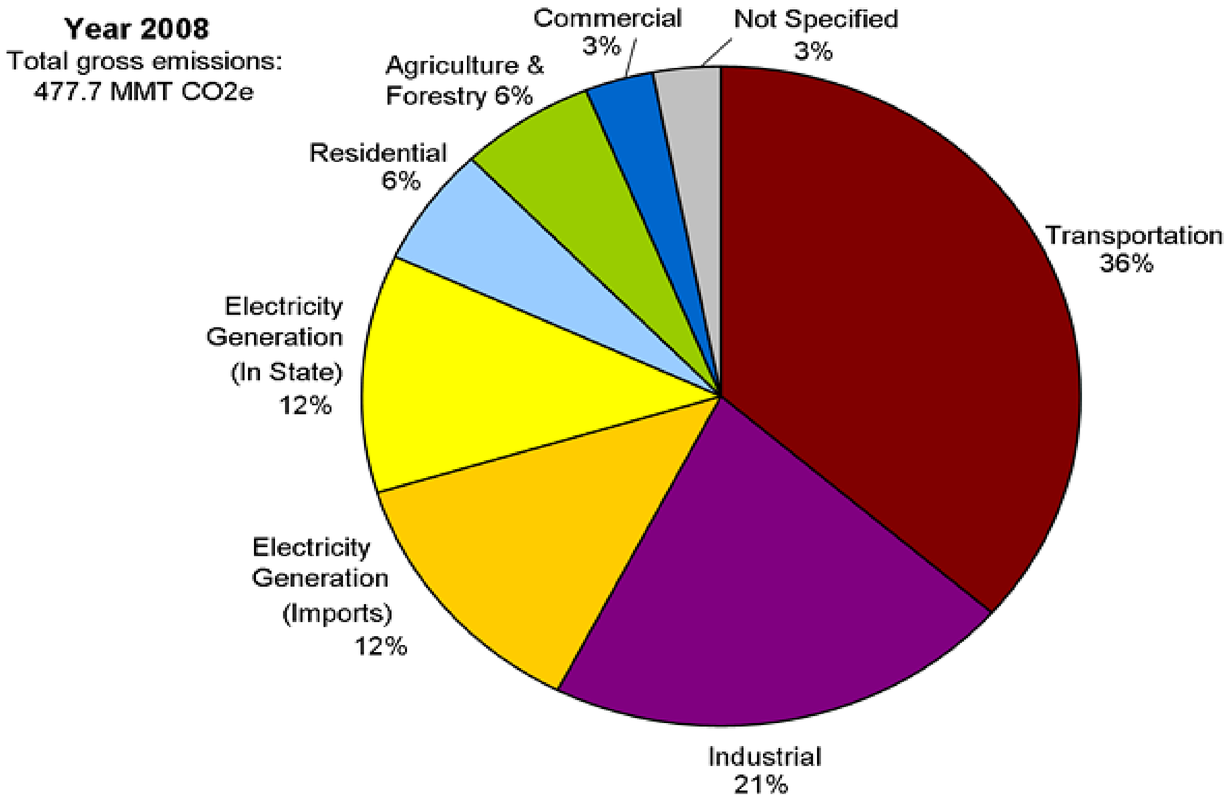
Large-scale GHG inventories have only been fully developed at the State level, rather than at the air basin level. The major categories of GHG emissions sources in California are discussed below. Several municipal and communitywide GHG emissions inventories have been developed for specific cities and counties in the study area, and are discussed briefly in the “Regional and Local” subsection of Section 3.7.2, “Regulatory Setting,” below.

It should be noted that GHG emissions are referred to throughout this PEIR section as “direct” and “indirect” emissions. Direct GHG emissions are those emissions produced at the same time as the consumption activity. For example, gasoline combustion by a motor vehicle is a direct source of GHG emissions because as the gasoline is combusted and generates GHG emissions, the vehicle gains the power at the same location. By contrast, indirect GHG emissions are those that occur at a different location from where the consumption activity occurs. The prime example of indirect GHG emissions is electricity consumption. Users consume electricity at their given locations; however, the electricity and associated GHG emissions are typically produced at a power plant at another location. On the other hand, use of natural gas for water and space heating is a direct source of GHG emissions because the natural gas is consumed on site and GHG emissions are also produced on site.

Anthropogenic Sources As the second largest emitter of GHG emissions in the United States and 12th to 16th largest in the world (compared to other nations), California contributes a substantial amount of GHGs to the atmosphere (CEC 2006b), with total gross emissions of 477.7 million metric tons (Mmt) CO_2e in 2008 (CARB 2010a). In comparison, total U.S. GHG emissions in 2008 were estimated at 7,061.1 Mmt CO_2e (EPA 2011), and data available for global emissions in 2004 estimate 49.0 gigatonnes CO_2e (or 49,000 Mmt CO_2e) (IPCC 2007b).

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 (CARB 2011).

In California, the transportation sector is the largest emitter of GHGs, followed by electricity generation (CARB 2010a, 2011) (Figure 3.7-1).



Source: CARB 2010a

Figure 3.7-1. 2008 California GHG Emissions by Sector (2000–2008 Emission Inventory)

Transportation Transportation is a major source of GHGs in California, accounting for 36 percent of the state's total GHG emissions in 2008 (CARB 2011). Transportation emissions within California are generated primarily by combustion of gasoline, diesel, and some alternative fuels by mobile sources. The indicators of vehicular activity, and resulting GHG emissions, are vehicle miles traveled (VMT) and the fuel economies of the individual vehicles composing the vehicular fleet. VMT is associated with movement of people and goods on local, regional, and statewide scales. Within the study area, VMT occurs mostly within and between the urban areas, although people and goods are also moved between urban and rural areas.

Industry/Manufacturing Industrial, commercial, and residential land uses generate GHG emissions from all of the following:

- Transportation (i.e., VMT—see description above)
- Energy consumption (e.g., consumption of electricity and natural gas from lighting, heating, cooling, and appliance use)

- Water use (and associated energy use required for pumping, treatment, transmission, and wastewater treatment)
- Emissions associated with waste (methane and nitrous oxide emissions from wastewater treatment plants and landfills)
- Refrigerant use (emissions of high-GWP GHGs from leaky components and at the end of life of refrigeration and air conditioning equipment)

Within the context of California's GHG inventory, emissions from the industrial, commercial, and residential sectors are limited to on-site fuel combustion (to avoid double-counting emissions within other sectors such as transportation, electric power, recycling and waste, and high-GWP). On-site fuel combustion within the industrial, commercial, and residential sectors consists mainly of natural gas combustion. Combustion of other fuels, such as wood, coal, diesel, gasoline, kerosene, liquid petroleum gas, and ethanol, is included in the inventory; however, the GHG emissions from those fuels are minor compared with the emissions resulting from natural gas combustion. On-site fuel combustion from the industrial, commercial, and residential sectors accounted for 30 percent of California's total GHG inventory in 2008. The main contributors of GHG emissions to these sectors are industrial sources (21 percent) involved in petroleum extraction and refining, mining, cement production, and other manufacturing processes (CARB 2011).

Electricity The electricity sector consists of electricity generated within California and electricity imports. In 2008, 24 percent of the state's GHG emission inventory came from electricity generation (CARB 2011).

Large amounts of electric power are required to treat and distribute water to end users in California, particularly to those in the southern part of the state; water is moved 3,000 feet up and over the Tehachapi Mountains to reach users in Southern California (CEC 2005). Treatment of wastewater requires additional electricity.

Hydroelectric power is an important source of electricity in California, accounting for about 14.5 percent of the state's total electricity in 2007. California has nearly 400 hydroelectric plants, which are located mostly in the Sierra Nevada and have a total dependable capacity of about 14,000 megawatts (MW) of capacity. The state also imports hydropower-generated electricity from the Pacific Northwest. The amount of hydroelectricity produced varies each year and is largely dependent on rainfall (CEC 2008). Because hydroelectric power is renewable, it does not result in GHG emissions associated with its production, unlike fossil-fuel combustion used to generate electricity.

Agriculture and Forestry

Agriculture Agriculture is a net GHG generator, meaning that annual GHG emissions associated with agricultural practices outweigh any possible long-term carbon storage in crop plants, woody plants (such as fruit and nut trees), and soil biomass.

The agriculture sector's GHG emissions result from energy use, soil management (see below), burning of agricultural residue, enteric fermentation (animal digestion), manure management, and rice cultivation (flooded soil). The agricultural sector emits a relatively small amount of CO_2 compared to other sectors, and is the largest source of emissions of both methane and nitrous oxide in California (CARB 2007). The potency of methane and nitrous oxide as GHGs relative to CO_2 (GWP of 23 and 296, respectively) was described previously; see the introduction to this section of the PEIR.

The agricultural sector emitted 28.1 Mmt of CO_2e in 2008, about 6 percent of the state's total GHG emissions (CARB 2011). Within this sector, methane is emitted primarily by enteric fermentation, although burning of agricultural residue, manure management, and rice cultivation also contribute. (Biogenic CO_2 emissions from residue burning are not counted toward the GHG inventory.) The largest source of CO_2 emissions is fuel combustion in agricultural equipment, although electricity used to heat and cool buildings and pump water also results in the indirect generation of CO_2. Agricultural soil management (which consists of processes that increase the availability of nitrogen in the soil, such as fertilizer application and manure management) is responsible for most emissions of nitrous oxide within the agriculture sector and the state as a whole.

Forestry The forestry sector is unique because it includes not only emissions of CO_2 and nitrous oxide from activities in forests and on rangelands (e.g., harvests, fires, and land use conversion), but also removal of atmospheric CO_2 by photosynthesis, which is then bound (sequestered) in plant tissues. Methane and nitrous oxide are not removed from the atmosphere by plants because they are not "fixed" like CO_2 and nitrogen. The inventory balances the CO_2 emissions and atmospheric removal of CO_2 by vegetation by using an atmospheric CO_2 flux approach—determining the total of GHG emissions to the atmosphere and CO_2 removal by photosynthesis (CARB 2007:Appendix B).

California's GHG inventory currently focuses on forested lands; therefore, CO_2 removal and emissions on nonwoody croplands are not reported, pending further study (CARB 2007:Appendix B). CARB estimated the net CO_2 flux from the forestry sector to be about -4 Mmt CO_2e in 2008 (CARB 2007:Appendix B; CARB 2011).

Recycling and Waste During the life cycle for tangible goods, GHGs are generated from primary production to transport, delivery, use, and final disposal (end of life). Anaerobic decomposition of landfilled organic waste forms roughly an even mix of CO_2 and methane as a byproduct of degradation. Methane emissions from landfills are the chief pollutant of concern for this category because they have a higher GWP than CO_2 emissions, as described previously. The CO_2 generated from landfills, whether through anaerobic decomposition, oxidation in cover material, or landfill gas combustion, is considered biogenic and is accounted for in the atmospheric CO_2 flux (CARB 2007). Landfills are the second highest emitter of methane statewide, releasing 6.7 Mmt CO_2e as methane in 2008 as a result of the degradation of organic waste. Those emissions accounted for about 1.4 percent of the state's GHG emissions in that year (CARB 2011).

Construction Construction emissions are generated when materials and workers are transported to and from construction sites and when machinery is used for construction activities such as trenching, grading, dredging, paving, and building. Emissions from construction activities are generated for shorter periods than operational emissions; however, GHGs remain in the atmosphere for hundreds of years or more, so once released, they contribute to global climate change unless they are removed through absorption by the oceans or by terrestrial sequestration.

Construction emissions are not accounted for in a separate category in the California GHG inventory (or other inventories that use IPCC GHG emissions sectors for accounting purposes). However, based on the category "Transportation—Not Specified," which includes off-road vehicles and associated diesel fuel combustion, construction emissions accounted for a maximum of 0.4 percent of California's GHG inventory between 2000 and 2008 (CARB 2011).

Biogenic Sources Biogenic sources of GHGs are organisms that generate GHGs. The organisms of natural ecosystems not only emit GHGs (e.g., CO_2 and CH_4) to the atmosphere as a byproduct of their activities, but also remove GHGs from the atmosphere (particularly CO_2) and store carbon derived from GHGs in a wide variety of molecules in their bodies and byproducts. Most of this removal, transformation, storage, and release of GHGs is completed by plants and microbes (e.g., bacteria and fungi). Important factors that affect these processes include disturbances such as fire and burial of plant materials; the productivity and growth of different types of plants (e.g., herbaceous versus woody plants); and, in soil and water, the temperature, acidity, and availability of oxygen. These factors differ between upland and riparian, wetland, and open-water ecosystems.

The following sections briefly describe how these ecosystems exchange GHGs with the atmosphere and store carbon.

Upland and Riparian Upland and riparian ecosystems may be dominated by herbaceous or woody plants. Incorporation of plant materials into soil usually is a slow process (Schaetzl and Anderson 2005). Annual plant growth and storage of carbon in wood can be substantial (COLE Development Group 2011a, 2011b), and fire often rapidly releases substantial quantities of stored CO_2 to the atmosphere (Carle 2008).

In upland and riparian ecosystems, plants remove substantial quantities of carbon from the atmosphere each year to support their growth (primary production). Most of this carbon is soon released back to the atmosphere through decomposition; the exception is carbon that is incorporated into woody stems and roots. Most decomposition occurs under relatively aerobic (oxygenated) and often acidic conditions; thus, emissions of methane are relatively small. However, during decomposition, a very small portion of the carbon from primary production is incorporated into the soil in a form that resists further decay, and thus remains sequestered from the atmosphere for many years. Because of the slow accumulation of the decay-resistant byproducts of decomposition, upland soils often store large amounts of carbon. Therefore, in uplands dominated by herbaceous plants, the removal of carbon from the atmosphere for primary production is roughly balanced by the loss that occurs through decomposition and potential uses such as grazing (IPCC 2006).

In uplands dominated by woody plants, however, large amounts of carbon other than soil carbon may also be stored. Wood can remain part of living plants for years and can require multiple years to decompose. Furthermore, woody plants attain much larger sizes than herbaceous plants. Thus, the amount of CO_2 removed from the atmosphere and stored in woody vegetation can be substantial; this is the cause of the forestry sector's large net removal of carbon from the atmosphere. For example, mature coniferous forests in the Sacramento and San Joaquin Valley watersheds may contain more than 40 metric tons (mt) per acre of carbon in aboveground wood (COLE Development Group 2011a).

For decades after woody plants are established at a site, the mass of wood accumulates until the loss of stored carbon from the death and decomposition of older trees and shrubs equals the growth of younger plants, or until fire or another disturbance that removes stored carbon occurs. In addition to resulting in substantial emissions of CO_2, fire converts some wood to charcoal, which is resistant to decay and thus represents long-term storage of carbon.

Riparian vegetation includes herbaceous and shrub-dominated scrubs, woodlands, and forests. Forests develop in undisturbed riparian areas that have access to groundwater during the growing season (including portions of most riparian areas in the Extended SPA). These are rapidly growing forests of relatively large trees, although riparian trees do not attain the heights of the conifers that dominate many upland forests in the watersheds. During the first 50 years of their development, riparian forests in the Extended SPA sequester about 57 mt per hectare, or approximately 23 mt carbon per acre. Therefore, the riparian forests could annually sequester roughly 0.46 mt carbon per acre (COLE Development Group 2011b).

Riparian areas are part of a stream or river system, and riparian vegetation generally is more productive than the plants and microbes of aquatic ecosystems. Therefore, riparian ecosystems may export an ecologically significant amount of organic material (containing stored carbon) to aquatic systems.

Wetlands Wetlands are dominated by herbaceous, nonwoody plants. Fire is less frequent and intense than in uplands and riparian areas, but burial of plant materials occurs regularly in many wetlands. GHG emissions in wetlands, particularly methane emissions, differ from those in upland and aquatic ecosystems. The activities of most organisms in wetlands take place under water, where oxygen is more limited than in terrestrial environments. Reduced or anaerobic conditions, particularly in sediments, can lead to microbial methane production.

Large amounts of CO_2 are removed from the atmosphere and stored in wetlands, but in unmanaged freshwater wetlands this effect can be largely offset by methane emissions from wetlands (Mitsch and Gosselink 2007; Boon 2006). In fresh emergent wetlands, such as the Delta’s tidal and nontidal marshes, most primary production becomes submerged; because limited oxygen is available under these conditions, decomposition proceeds only slowly. As a consequence, dead and partially decomposed roots, stems, and leaves accumulate as peat. Some of this material also may be exported to connected aquatic ecosystems. When wetlands are inundated, particularly during prolonged warmer temperatures, anaerobic conditions in the carbon-rich soils can cause relatively large amounts of methane to form. The tissues of emergent plants provide pathways for much of this methane to move from sediments to the atmosphere. Consequently, wetlands can emit large amounts of methane to the atmosphere.

Wetlands typically sequester carbon and emit methane. Because methane has a GWP approximately 23 times that of CO_2 over a 100-year time horizon, wetlands can be a net source of GHGs, or a sink, depending on the relative amounts of CO_2 sequestered and methane emitted. Wetlands in the Delta have been studied and determined to be net sinks of GHG emissions under most conditions, even when considering the high GWP of their released emissions. Wetlands also emit small amounts of nitrous oxide, the emissions of which increase substantially when these lands are drained.

Substantial portions of the historic wetlands that have been lost in California were freshwater tidal marshes in the Delta that were drained for farming, mostly before World War II. This conversion exposed large areas of peat soil to oxidation by microorganisms, which converted the peat into CO_2 and released it into the atmosphere. This process has been a major cause of land subsidence and continues to this day, although at a reduced rate compared to historic rates (Drexler et al. 2009).

Open Water Open-water ecosystems include the waters of oceans, streams, rivers, lakes, and ponds. These ecosystems typically produce less organic matter through photosynthesis than upland, riparian, and wetland ecosystems, but receive inputs of organic materials from these ecosystems (Wetzel 2001). The primary production of aquatic ecosystems and inputs from other ecosystems are decomposed in the water column and underlying sediment, or are buried in the sediment. The low-oxygen, organic matter–rich conditions of these sediments are similar to conditions in wetland sediments; however, relatively little methane is emitted to the atmosphere from open-water ecosystems. Methane emissions from open water are much smaller than emissions from wetland ecosystems for two reasons: in open-water ecosystems, emergent plants do not provide a direct connection to the atmosphere; and in the water that separates sediments from the atmosphere, most methane is transformed into other compounds (e.g., CO_2) (Boon 2006). Additionally, along the coast of California, anaerobic oxidation of methane can reduce methane emissions from marine environments. Overall, aquatic ecosystems emit and remove GHGs at lower rates than upland, riparian, and wetland ecosystems.

3.7.2 Regulatory Setting

The following text summarizes federal, State, and regional and local laws and regulations pertinent to evaluation of the proposed program's net GHG emissions and impacts on global climate change.

Federal

Supreme Court Ruling on California Clean Air Act Waiver EPA is the federal agency responsible for implementing the Clean Air Act (CAA). The U.S. Supreme Court ruled on April 2, 2007, that CO_2 is an air pollutant as defined under the CAA, and that EPA has the authority to regulate emissions of GHGs. See the discussion of Assembly Bill (AB) 1493 in

Table 3.7-1, presented below in the discussion of State regulations, for further information on California's CAA waiver.

Supreme Court Ruling on *American Electric Power Co., Inc., et al. v. Connecticut et al*. A collection of eight states, the City of New York, and three private land trusts sued several energy firms, identifying them as the top "greenhouse gas" emitters in the country, and bringing a nuisance action against them. The basis of the nuisance action was that the energy companies' GHGs contribute to global warming and therefore produce a host of climate change–related harms to the states' and the land trusts' properties.

The case ultimately reached the U.S. Supreme Court, which ruled 8–0 that Congress had "displaced," through the CAA, any federal common law of public nuisance governing global warming that otherwise might have been available to the plaintiffs. The Supreme Court remanded the case to the Second Circuit for a determination of whether the plaintiffs could proceed with their state-law public nuisance claims.

Mandatory Greenhouse Gas Reporting Rule On September 22, 2009, EPA released the Final Rule on Mandatory Reporting of Greenhouse Gases (Reporting Rule) (Vol. 74, No. 209 of the *Federal Register*, pages 56259–56519; the types of facilities that are required to report their GHGs are listed on pages 56260–56261). The Reporting Rule was 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 facilities in the study area that emit 25,000 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 the facility's GHG emissions. The Reporting Rule also mandates recordkeeping and administrative requirements so that EPA may verify annual GHG emissions reports.

Endangerment and Cause and Contribute Findings On December 7, 2009, the EPA Administrator signed two distinct findings regarding GHGs under CAA Section 202(a):

- **Endangerment Finding—**The current and projected concentrations of the six key well-mixed GHGs—CO_2, methane, nitrous oxide, HFCs, PFCs, and sulfur hexafluoride—in the atmosphere threaten the public health and the 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 the GHG pollution that threatens public health and welfare.

It should be noted that EPA's Endangerment and Cause and Contribute Finding is currently under legal challenge on the basis of uncertainties surrounding climate science, the use of scientific assessments to make findings, and consideration of various policies before making the finding, among others.

State

CARB is the agency responsible for coordinating and overseeing State and local programs to control air pollution. Various State and local 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. Table 3.7-1 summarizes major State laws and executive orders addressing climate change. The most important of these are discussed in more detail below.

Table 3.7-1. Summary of State Laws and Executive Orders that Address Climate Change

Legislation Name	Signed into Law or Ordered	Description	Relevance
SB 1771	9/2000	Established California Climate Registry to develop protocols for voluntary accounting and tracking of GHG emissions.	In 2007, DWR began tracking GHG emissions for all departmental operations.
AB 1493	7/2002	Directed CARB to establish fuel standards for noncommercial vehicles that would provide the maximum feasible reduction of GHGs.	This law has resulted in the reduction of GHG emissions from travel by noncommercial vehicles.
SB 1078, SB 107, EO S-14-08, EO-S-21-09, and SBX1-2	9/2002, 9/2006, 11/2008, 9/2009, and 4/2011	Established renewable energy goals as a percentage of total energy supplied in the state. CARB approved a Renewable Electricity Standard regulation on September 23, 2010. SBX1-2 set the renewables portfolio standard target to 33 percent by December 31, 2020.	These laws and executive orders have resulted in the reduction of GHG emissions from purchased electrical power.
EO S-3-05 and AB 32*	6/2005 and 9/2006	Established statewide GHG reduction targets and biennial science assessment reporting on climate change impacts and adaptation and progress toward meeting GHG reduction goals.	Projects must be consistent with statewide GHG reduction plan; reports will provide information for analyses of adaptation to climate change.
SB 1368	9/2006	Established GHG emission performance standards for base-load electrical power generation.	This law has resulted in the reduction of GHG emissions from purchased electrical power.
EO S-1-07	1/2007	Established Low Carbon Fuel Standard.	This law has resulted in the reduction of GHG emissions from transportation activities.
SB 97*	8/2007	Directed the Governor's Office of Planning and Research to develop guideline amendments for the analysis of climate change in CEQA documents.	The guidelines provide advice on how to prepare a climate change analysis in all CEQA documents.
SB 375	9/2008	Requires metropolitan planning organizations to include sustainable community strategies in their regional transportation plans.	This law has resulted in a reduction of GHG emissions associated with housing and transportation.
EO S-13-08 *	11/2008	Directed the Natural Resources Agency to work with the National Academy of Sciences to produce a California Sea Level Rise Assessment Report. Directed Climate Action Team to develop a California Climate Adaptation Strategy.	Information in the reports will provide information for analyses of adaptation to climate change.

Source: Data provided by DWR CEQA Climate Change Committee in 2010
Note:
*Key laws and orders, elaborated further below.
Key:
AB = Assembly Bill
CARB = California Air Resources Board
CEQA = California Environmental Quality Act
DWR = California Department of Water Resources
EO = Executive Order
GHG = greenhouse gas
SB = Senate Bill

California Environmental Quality Act 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 habitats.

Senate Bill 97 The provisions of SB 97, enacted in August 2007 as part of the State budget negotiations and codified at Section 21083.05 of the California Public Resources Code, direct the Governor's Office of Planning and Research (OPR) to propose CEQA guidelines "for the mitigation of GHG emissions or the effects of GHG emissions." SB 97 directed OPR to develop such guidelines by July 2009, and directed the State Resources Agency (now CNRA), the agency charged with adopting the CEQA Guidelines, to certify and adopt such guidelines by January 2010. In April 2009, OPR prepared draft CEQA guidelines and submitted them to CNRA (see below). On July 3, 2009, CNRA began the rulemaking process established under the Administrative Procedure Act. CNRA adopted those guidelines on December 30, 2009, and the guidelines became effective March 18, 2010.

The CNRA-adopted amendments for GHGs fit within the existing CEQA framework for environmental analysis. That framework calls for lead agencies to determine baseline conditions and levels of significance and to evaluate mitigation measures. The adopted guideline amendments do not identify a threshold of significance for GHG emissions, nor do they prescribe assessment methodologies or specific mitigation measures. The guidelines 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.

CEQA Guidelines Section 15064.4, *Determining the Significance of Impacts from Greenhouse Gas Emissions*, encourages lead agencies to consider three questions to assess the significance of GHG emissions: (1) Will the project increase or reduce GHGs as compared to baseline? (2) Will the project's GHG emissions exceed the lead agency's threshold of significance? and (3) Does the project comply with regulations or requirements to implement a statewide, regional, or local GHG reduction or mitigation plan? Section 15064.4 of the CEQA Guidelines 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.

CEQA Guidelines Section 15126.4, *Consideration and Discussion of Mitigation Measures Proposed to Minimize Significant Effects*, includes considerations for lead agencies related to feasible mitigation measures to reduce GHG emissions. These considerations include but are not limited to project features, project design, or other measures that are incorporated into the project to substantially reduce energy consumption or GHG emissions. Another such consideration is compliance with the requirements in a previously approved plan or mitigation program for the reduction or sequestration of GHG emissions, where complying with those requirements will avoid or substantially lessen the project's potential impacts. Yet another consideration is measures that sequester carbon or carbon-equivalent emissions. Where mitigation measures are proposed for reduction of GHG emissions through off-site measures 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 CEQA Guidelines, a new set of environmental checklist questions (VII. *Greenhouse Gas Emissions*) was added to CEQA Guidelines Appendix G. The new set asks whether a project would:

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

b) Conflict with an 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 investigating a statewide threshold of significance for GHG emissions, OPR engaged the CARB technical staff to recommend a methodology for setting thresholds of significance. In October 2008, CARB released *Preliminary Draft Staff Proposal: Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases under the California Environmental Quality Act* (CARB 2008b). This draft proposal included a conceptual approach for thresholds associated with industrial, commercial, and residential projects. For nonindustrial projects, the steps to concluding that an impact related to climate change would be less than significant generally include analyzing whether the project is exempt under existing statutory or categorical exemptions; complies with a previously approved plan or target; meets specified minimum performance standards; and falls below an as-yet-unspecified annual emissions level (CARB 2008b). 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 nonindustrial projects. However, for industrial projects a quantitative annual emissions limit for less-than-significant impacts is established at ~7,000 mt CO_2e. To date, these standards have not been adopted or finalized as a basis to evaluate the significance of a project's contribution to climate change.

Executive Order S-3-05 Executive Order (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 2007a).

EO S-3-05 also dictated that the Secretary of the California Environmental Protection Agency coordinate oversight of efforts to meet these targets with the Secretary of the Business, Transportation and Housing Agency; Secretary of the California Department of Food and Agriculture; Secretary of CNRA; Chairperson of CARB; Chairperson of CEC; and President of the California Public Utilities Commission. This group was subsequently named the Climate Action Team (CAT).

As laid out in EO S-3-05, the CAT has submitted biannual reports to the governor and State legislature describing progress made toward reaching the emissions targets. The CAT's third biannual report, issued in December 2010, also addressed on the effects of climate change on California's resources.

Assembly Bill 32 and Climate Change Scoping Plan

AB 32 In 2006, California passed AB 32, the California Global Warming Solutions Act of 2006 (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 CARB 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.

- By June 30, 2007, CARB had to publish a list of early-action GHG emission reduction measures.

- Before January 1, 2008, CARB 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, CARB had to adopt regulations to implement the early-action measures.

- In December 2007, CARB approved the 2020 emission limit (1990 level) of 427 Mmt CO_2e of GHGs. The 2020 target requires the reduction of 80 Mmt CO_2e, or approximately 16 percent below the State's October 2010 estimated "business-as-usual" 2020 emissions of 507 Mmt CO_2e.

- Also in December 2007, CARB 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 CARB has met all of the statutorily mandated deadlines for promulgation and adoption of regulations.

Climate Change Scoping Plan On December 11, 2008, pursuant to AB 32, CARB adopted the *Climate Change Scoping Plan* (Scoping Plan) (CARB 2008a). Key elements of and recommended actions in the Scoping Plan are listed in Appendix F, "Climate Change—Key Scoping Plan Elements, Best Management Practices, and Thresholds," of this PEIR. This plan outlines how emissions reductions will be achieved from substantial sources of GHGs via regulations, market mechanisms, and other actions. Six key elements, outlined in the Scoping Plan, are identified to achieve emissions reduction targets:

- Expanding and strengthening existing energy efficiency programs as well as building and appliance standards

- Achieving a statewide renewable-energy mix of 33 percent

- Developing a California cap-and-trade program that links with other Western Climate Initiative partner programs to create a regional market system

- Establishing targets for transportation-related GHG emissions for regions throughout California, and pursuing policies and incentives to achieve those targets

- Adopting and implementing measures pursuant to existing State laws and policies, including California's clean-car standards, goods movement measures, and the Low Carbon Fuel Standard

- Creating targeted fees, including a public goods charge on water use, fees on high-GWP gases, and a fee to fund the administrative costs of the State's long-term commitment to AB 32 implementation

The Scoping Plan also included 39 recommended measures that were developed to reduce GHG emissions from key sources and activities while improving public health, promoting a cleaner environment, preserving natural resources, and ensuring that the impacts of the reductions are equitable and do not disproportionately affect low-income and minority communities. These measures also put the State on a path to meet the long-term goal of reducing California's GHG emissions to 80 percent below 1990 levels by 2050. The measures in the approved Scoping Plan have been developed; implementation of these measures is in the initial stages, with the aim of meeting the first 2020 emission reduction target.

Executive Order S-13-08 and Climate Change Adaptation Strategy
Executive Order S-13-08   EO S-13-08, issued November 14, 2008, directs CNRA, DWR, OPR, CEC, 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 impacts 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 the California transportation system to sea level rise; and to develop a California Climate Change Adaptation Strategy.

The *State of California Sea-Level Rise Interim Guidance Document* was released in October 2010.

The Coastal and Ocean Resources Working Group for the Climate Action Team (CO-CAT) is a working group composed of senior-level staff from

California State agencies with ocean and coastal resource management responsibilities. CO-CAT's task is to encourage the State's ability to adapt to climate change impacts on ocean and coastal resources while supporting implementation of global warming emission-reduction programs.

CO-CAT is a forum for State agencies to share information and coordinate on actions, including implementation of the ocean and coastal resources chapter of the 2009 California Climate Adaptation Strategy.

In July 2010, CO-CAT created a Sea-Level Rise Task Force and worked with the OPC Science Advisory Team and Ocean Science Trust to develop a Sea-Level Rise Interim Guidance Document.

The Resolution of the OPC on Sea-Level Rise was adopted on March 11, 2011, upon the recommendations of CO-CAT. The resolution provided baseline projections of sea level rise for the years 2030, 2050, 2070, and 2100 based on the Sea-Level Rise Interim Guidance Document. (See "Sea Level Rise" in Section 3.7.1, "Environmental Setting," for recommended sea-level-rise values.) The projections are expected to provide consistent sea-level-rise values to be used by State agencies for adaptation planning purposes, and will be refined in future CO-CAT guidance documents. Furthermore, the resolution directs OPC to work with State agencies and stakeholders to identify actions to (1) address areas of greatest need for coastal and ocean climate-change adaptation, (2) support the development of regional sea-level-rise adaptation plans, (3) collaborate with other entities to enhance data collection and monitoring to improve adaptation decision making, and (4) continue to support the development and application of climate change modeling assumptions to encourage coordination among different planning agencies.

2009 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 impacts on seven specific sectors: public health, biodiversity and habitat, ocean and coastal resources, water management, agriculture, forestry, and transportation and energy infrastructure. The strategy also provides recommendations on how to manage against those threats.

This strategy was developed in direct response to EO S-13-08 (described above), which specifically asked CNRA to identify how State agencies can respond to rising temperatures, changing precipitation patterns, sea level rise, and extreme natural events. As data continue to be developed and collected, the State's adaptation strategy will be updated to reflect current findings.

The following are several of the key preliminary recommendations outlined in the *2009 California Climate Adaptation Strategy* (CNRA 2009):

1. *Water management adaptation.*
    a. *Aggressively increase water use efficiency, because climate change will create greater competition for limited water supplies needed to accommodate future growth.*
2. *As directed by the recently signed water legislation (Senate Bill X7-7), State agencies must implement strategies to achieve a statewide 20 percent reduction in per capita water use by 2020, expand surface and groundwater storage, implement efforts to fix Delta water supply, quality, and ecosystem conditions, support agricultural water use efficiency, improve statewide water quality, and improve Delta ecosystem conditions and stabilize water supplies as developed in the Bay Delta Conservation Plan.*
    a. *Practice and promote integrated flood management.*
    b. *Plan for and adapt to sea-level rise.*
3. *Integrate land use planning and climate adaptation planning. Land use decisions are a central component of preparing for and minimizing climate change impacts. Local and regional governments and planning efforts must be integral parts of the adaptation process. Identify vulnerable areas and consider project alternatives that avoid substantial new development in areas that cannot be adequately protected (planning, permitting, development, and building) from flooding, wildfire and erosion due to climate change.*
4. *Ensure communities are healthy to build resilience to increased spread of disease and temperature increases.*

Both adaptation and mitigation are needed for addressing climate change, and should complement, rather than conflict with, one another (Figure 3.7-2).

Complementary and Conflicting Adaptation and Mitigation Actions

Favorable Actions ↔			*Unfavorable Actions*
Favorable for Adaptation and Mitigation Efforts	***Favorable for Mitigation, but Unfavorable for Adaptation Efforts***	***Favorable for Adaptation, but Unfavorable for Mitigation Efforts***	***Unfavorable for Adaptation and Mitigation Efforts***
• *Energy Demand Management* • *Energy Efficient Buildings* • *Water Conservation* • *Biodiversity-Oriented Forestry* • *"Smart Growth"* • *Development in Cooler Regions*	• *Forestry with Nonnative Species* • *Urban Forestry (shade trees) with High Water Demand* • *Some Biofuels Production*	• *Meeting Peak Energy Demand with Fossil Fuels* • *Wastewater Recycling and Desalination* • *Groundwater Banking* • *Increased Air Conditioner Use* • *Use of Drainage Pumps in Low-Lying Areas*	• *Development in Floodplains* • *Traditional "Sprawl" Development* • *Development in Hotter Regions*

Source: Adapted from CNRA 2009:14

Figure 3.7-2. Complementary and Conflicting Adaptation and Mitigation Actions

DWR's Climate Change Adaptation Strategies for California's Water

DWR developed a series of climate adaptation strategies for State and local water managers to improve their capacity to handle climate change. Their report, entitled *Climate Change Adaptation Strategies for California's Water* (CCASCW), identifies the following strategies applicable to the project (DWR 2008):

- **Strategy 2**—Fully Develop the Potential of Integrated Regional Water Management
  - One of the goals of the proposed program is to link the flood protection system with the water supply system, as well as to identify opportunities for reservoir reoperation in conjunction with groundwater flood storage.
- **Strategy 4**—Practice and Promote Integrated Flood Management
  - The proposed program contains goals to practice integrated flood management using a variety of structural and nonstructural approaches to achieve multiple goals and objectives from a systemwide perspective: reducing flood risks and consequences, reducing long-term system maintenance requirements, and improving systemwide riverine ecosystem functions, groundwater storage, recreation, and hydropower. Features or actions would be

  incorporated to accommodate for hydrologic uncertainty, including that caused by climate change.

- **Strategy 5**—Enhance and Sustain Ecosystems
  - The proposed program contains goals to promote ecosystem functions by incorporating flood management system improvements that integrate the recovery and restoration of key physical processes, self-sustaining ecological functions, native habitats, and species, including conservation strategies to improve the quantity, biotic diversity, and connectivity of riparian, wetland, floodplain, and emergent and shaded riverine aquatic habitats.
- **Strategy 6**—Expand Water Storage and Conjunctive Management of Surface and Groundwater Resources
  - As mentioned above, one of the goals of the proposed program is to identify opportunities for reservoir reoperation in conjunction with groundwater flood storage.
- **Strategy 7**—Fix Delta Water Supply, Quality, and Ecosystem Conditions
  - The proposed program contains goals to protect the lands of the Delta from flooding, which would result in improved water quality.
- **Strategy 9**—Plan for and Adapt to Sea Level Rise
  - The proposed program contains goals to factor climate change into its design and planning.

In addition, DWR has adopted a Sustainability Policy to promote changes in their business and operational practices. The Sustainability Policy, which applies only to DWR activities, affects facilities, vehicle fleets, recycling and waste management in DWR buildings, and environmental preferable procurement, among other efforts. Furthermore, DWR has established quantitative goals for sustainability that relate to carbon emissions, water, wastewater, energy, and waste. Specifically, sustainability targets of achieving an emissions level of 50 percent below 1990 levels by 2020 and 80 percent below 1990 levels by 2050 have been established for DWR operations.

Regional and Local

The CARB Scoping Plan (December 2008) states that local governments are “essential partners” in the effort to reduce GHG emissions. The Scoping Plan also acknowledges that local governments have “broad influence and, in some cases, exclusive jurisdiction" over activities that contribute to substantial direct and indirect GHG emissions through their planning and permitting processes, local ordinances, outreach and education efforts, and municipal operations. Many of the proposed measures to reduce GHG emissions rely on local government actions. The Scoping Plan encourages local governments to reduce GHG emissions by approximately 15 percent from current levels by 2020 (CARB 2008a).

Regional GHG Emission Reduction Targets and Transportation Planning SB 375, enacted in 2008, enhances California's ability to reach its AB 32 goals by promoting land use planning with the goal of more sustainable communities. SB 375 requires CARB to develop regional GHG emission reduction targets for passenger vehicles. CARB is to establish targets for 2020 and 2035 for each region covered by one of California's 18 metropolitan planning organizations (MPOs) (CARB 2010b). Each MPO then prepares a "sustainable communities strategy" (SCS) that demonstrates how the region will meet its GHG reduction target through integrated land use, housing and transportation planning. Once adopted by the MPO, the SCS will be incorporated into that region's federally enforceable regional transportation plan. CARB is also required to review each final SCS to determine whether it would, if implemented, achieve the GHG emission reduction target for its region. If the combination of measures in the SCS will not meet the region's target, the MPO must prepare a separate "alternative planning strategy" to meet the target. The alternative planning strategy is not a part of the regional transportation plan (CARB 2010b).

CARB adopted final GHG emission reduction targets on September 30, 2010 (CARB 2010b). The 2010 regional transportation plan guidelines incorporating SB 375 were adopted by the California Transportation Commission on April 7, 2010 (California Transportation Commission 2010).

Climate Action Plans, Sustainability Action Plans, and General Plans for Cities and Counties Numerous climate action plans and sustainability action plans have been developed for cities and counties in the study area (Table 3.7-2). These plans usually involve setting goals for GHG emission reductions and adopting implementation measures to achieve those goals.

Additionally, cities in the study area that are updating their general plans have included climate change goals, policies, and objectives; however, these are more appropriately addressed at the project level and are not listed in Table 3.7-2.

Table 3.7-2. California Cities and Counties in the Study Area with Climate Action Plans and Sustainability Action Plans

City or County	Climate Action Plan or Sustainability Action Plan
Cities	
Davis	Greenhouse Gas Emissions Inventory
Fresno	Fresno Green
Sacramento	Sustainability Implementation Plan
Stockton	Stockton Goes Green
Woodland	Greenhouse Gas Inventory
Counties	
Contra Costa	Municipal Climate Action Plan
Sacramento	Climate Action Plan Phase I
Solano	Climate Action Plan Community Toolkit
Yolo	Climate Action Plan

Source: Data compiled by AECOM in 2011

Should a place-based project be defined and pursued as part of the proposed program, and should the CEQA lead agency be subject to the authority of local jurisdictions, the applicable county and city policies and ordinances would be addressed in a project-level CEQA document as necessary.

Air Districts' GHG Rules, Guidelines, and Significance Thresholds As discussed previously, the study area falls within 22 air districts. The three air districts with the largest populations are the Sacramento Metropolitan Air Quality Management District (SMAQMD), the Bay Area Air Quality Management District (BAAQMD), and the San Joaquin Valley Air Pollution Control District (SJVAPCD). These three air districts have developed more rules and guidance than the other air districts in the study area. BAAQMD has adopted updated CEQA guidelines with thresholds of significance for GHGs, for various project-level and plan-level land uses. Other air districts, such as SMAQMD, have CEQA guidance for GHGs, but do not yet have (or are in the process of developing) GHG thresholds. SJVAPCD has adopted CEQA streamlining and best performance standards for GHGs; alternatively, for projects other than stationary-source projects, a threshold consisting of a 29 percent reduction in GHG emissions from business as usual may be used.

BAAQMD is currently the only air district in California that has adopted numeric thresholds of significance for GHGs. Those thresholds are summarized in Appendix F (BAAQMD 2011).

Because this is a program-level EIR covering numerous air basins, a detailed discussion of all local air district rules, regulations, guidance, and thresholds related to GHG emissions is not included. However, during the course of project-level CEQA analyses for individual CVFPP actions, all applicable local air district rules, regulations, and guidance (including significance thresholds) would be adhered to with respect to GHGs.

All CVFPP actions occurring in any city or county in the study area that has adopted a climate action plan or general plan would need to consider the applicable requirements of any such plans, as well as local air district rules, regulations, policies, and guidance. It should be noted that existing rules, regulations, policies, and guidance of local governments and air districts focus on land use (i.e., residential and commercial building projects) and stationary-source (industrial) emissions. They do not specifically address the types of projects that would be recommended under the CVFPP.

Additional Technical Advisory Information

OPR Technical Advisory, CEQA, and Climate Change 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 GHG emissions that could be generated by a proposed project, analyze the impacts of those emissions to determine whether they would be significant, and identify feasible mitigation measures or alternatives that would reduce any adverse impacts to a less-than-significant level.

The technical advisory provides OPR's perspective on the emerging role of CEQA in addressing climate change and GHG emissions. The advisory recognizes that approaches and methodologies for calculating GHG emissions and determining their significance are rapidly evolving. OPR concludes that climate change is ultimately a cumulative impact because 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 make a determination of cumulative significance (OPR 2008).

The technical advisory points out that neither CEQA nor the 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 recommends 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 the lead agency to evaluate a proposed project's GHG emissions:

- Determine whether the project may generate GHG emissions; if so, quantify or estimate the emissions by type or source. Calculations, modeling, or estimates of GHG emissions should include the emissions associated with vehicular traffic, energy consumption, water usage, and construction activities (OPR 2008).

- Assess whether the emissions are "cumulatively considerable" even though the 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).

- If the lead agency determines that emissions are a cumulatively considerable contribution to a significant cumulative impact, investigate and implement ways to mitigate the emissions (OPR 2008). OPR 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 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 2008).

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). The technical advisory includes a list of GHG reduction measures in Attachment 3 that can be applied on a project-by-project basis.

California Air Pollution Control Officers Association In January 2008, the California Air Pollution Control Officers Association (CAPCOA) 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.

Although it is 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 CARB mandatory reporting level for Cap and Trade program)
- 25,000 mt CO_2e per year (the CARB 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

CAPCOA also issued a document containing model GHG mitigation policies for general plans (CAPCOA 2009), and more recently, a report on quantifying GHG mitigation measures at the project level (CAPCOA 2010). CAPCOA notes that most of the measures in its 2010 report were discussed previously in the association's previous documents and cross-references those documents for more information (CAPCOA 2010).

San Francisco Bay Conservation and Development Commission The mission of the San Francisco Bay Conservation and Development Commission (BCDC) is to protect and enhance San Francisco Bay and to encourage its responsible use.

BCDC has adopted a strategic plan that includes ongoing goals and short-term objectives, including a 3-year goal to develop and implement a regional proactive strategy for climate change adaptation (BCDC 2011). Some of the elements of the 3-year goal are research on sea level rise, amendments to San Francisco Bay Plan policies, and legislation on sea level rise that will empower, fund, and direct BCDC to prepare a sea-level-rise adaptation strategy for San Francisco Bay and Suisun Marsh. Other goals include local and international partnerships to address sea level rise, a subregional adaptation pilot project, and local government assistance for adaptation planning (BCDC 2011).

3.7.3 Analysis Methodology and Thresholds of Significance

This section provides a program-level evaluation of the direct and indirect GHG emissions that contribute to the cumulative impact on global climate change from implementing management actions included in the proposed program. The potential effects of global climate change on the proposed program are discussed separately in Subsection 6.6, "Effects of Global Climate Change on Program Facilities and Operations," of Chapter 6.0, "Other CEQA-Required Sections and Additional Material."

The proposed management actions are expressed as NTMAs and LTMAs. The methods used to assess how different categories of NTMAs and LTMAs could affect global climate change are summarized in "Analysis Methodology"; thresholds for evaluating the significance of potential impacts are listed in "Thresholds of Significance." Potential effects related to each significance threshold are discussed in Section 3.7.4, "Environmental Impacts and Mitigation Measures for NTMAs," and Section 3.7.5, "Environmental Impacts, Mitigation Measures, and Mitigation Strategies for LTMAs."

Analysis Methodology

Impact evaluations were based on a review of the management actions proposed under the CVFPP, expressed as NTMAs and LTMAs in this PEIR, to determine whether these actions could potentially result in impacts related to global climate change. NTMAs and LTMAs are described in more detail in Section 2.4, "Proposed Management Activities." The overall approach to analyzing the impacts of NTMAs and LTMAs and providing mitigation is summarized below and described in detail in Section 3.1, "Approach to Environmental Analysis"; analysis methodology specific to climate change and GHG emissions is described below. NTMAs can consist of any of the following types of activities:

- Improvement, remediation, repair, reconstruction, and operation and maintenance of existing facilities
- Construction, operation, and maintenance of small setback levees
- Purchase of easements and/or other interests in land
- Operational criteria changes to existing reservoirs that stay within existing storage allocations
- Implementation of the vegetation management strategy included in the CVFPP

- Initiation of conservation elements included in the proposed program
- Implementation of various changes to DWR and Statewide policies that could result in alteration of the physical environment

All other types of CVFPP activities fall within the LTMA category. NTMAs are evaluated using a typical "impact/mitigation" approach. Where impact descriptions and mitigation measures identified for NTMAs also apply to LTMAs, they are also attributed to the LTMAs, with modifications or expansions as needed. However, because many LTMAs are more general and conceptual, additional impacts are described in a broader qualitative format. Impacts of LTMAs that are addressed in this qualitative format are those considered too speculative for detailed evaluation, consistent with Section 15145 of the CEQA Guidelines. Following the narrative description of these additional LTMA impacts is a list of suggested mitigation strategies that could be employed, indicating the character and scope of mitigation actions that might be implemented if a future project-specific CEQA analysis were to find these impacts to be significant.

Implementation of the proposed program would result in generation, reduction, sequestration, and avoidance of GHG emissions. Specific examples are listed below.

- Construction-related, operational, and maintenance-related activities associated with the proposed program would directly generate GHG emissions.
- Operational activities associated with certain management actions could result in direct and indirect generation of GHG emissions as well as the potential for direct and indirect reductions in GHG emissions. (For example, increasing agricultural easements could cause a net increase in flooded soil area and GHG emissions from these flooded soils, while actions that would increase the efficiency of levee maintenance could reduce maintenance-related GHG emissions relative to existing conditions.)
- If the proposed program were not implemented, flood risk reductions resulting from the program would not occur and there would be a greater risk of flooding than with the program. Failures of a flood protection system can result in substantial GHG emissions from activities such as emergency response and recovery and community repair and reconstruction. For example, Hurricane Katrina and associated flooding destroyed approximately 300,000 homes (IPCC 2007a). Post-Katrina reconstruction efforts were such a substantial

draw on construction equipment, personnel, and materials that the cost of building construction temporarily increased across the southern United States (IPCC 2007a). Had the flood event been prevented, GHG emissions associated with disaster response activities and repairs and reconstruction would not have occurred.

Net GHG emissions cannot be quantified at the program level without a high degree of speculation regarding the magnitude, duration, and timing of both NTMAs and LTMAs. Consequently, the discussion below qualitatively evaluates the relative quantities of GHG emissions generated, reduced, sequestered, or avoided by each proposed management action. Impact evaluations were based on qualitative assessments of the individual management actions and of whether the program, taken as a whole, could result in substantial net GHG emissions that would have an adverse impact on global climate change, relative to existing conditions.

Most management actions involving policies, regulations, or permitting are not expected to affect GHG emissions in the study area. The exceptions are actions that would enforce or strengthen policies or regulations that could prohibit new development in floodplain areas, particularly urban areas in the Extended SPA with concentrated populations and associated economic assets. Other policies and regulations, permitting, and finance and revenue–related actions could affect GHG emissions if they were to affect current storage operations and/or involve system modifications. However, the GHG emissions associated with storage and system modifications are discussed separately as operational emissions.

Proposed management actions would not involve construction or changes in operation and maintenance in the portion of the SoCal/coastal CVP/SWP service areas located outside of the Sacramento and San Joaquin Valleys or watersheds and foothills; therefore, that geographic area is not discussed in detail in this section.

Thresholds of Significance

The cumulative effect of human activities has been clearly linked to quantifiable changes in the composition of the atmosphere, which in turn have been shown to be the main cause of global climate change (IPCC 2007a). Legislation and executive orders on the subject of climate change in California have provided a statewide context and process for evaluating impacts of GHG emissions and have established statewide GHG reduction targets. Further, given the nature of environmental consequences from GHGs and global climate change, the State has determined that GHG emissions, as they are related to global climate change, are a source of adverse environmental impacts in California and should be addressed under CEQA. It is unlikely that any single project could generate sufficient GHGs by itself to have a significant impact on the environment. Therefore, the analysis of the environmental effects of GHG emissions from the proposed program is presented below as an analysis of cumulative impacts.

DWR has not established a quantitative significance threshold for GHG emissions; instead, each project is evaluated on a case-by-case basis using the most up-to-date methods of calculation and analysis. The impact of the proposed program related to climate change should be evaluated using the criteria listed below. The significance criteria should not be used as individual thresholds, but as guidance and support for an ultimate significance determination. According to Appendix G of the CEQA Guidelines, a project could result in a significant impact if it would do either of the following compared to existing conditions:

- Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment
- Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs

Based on the criteria from CEQA Guidelines Appendix G listed above, and on the size, scope, and purpose of the program alternatives, the following significance criteria are used to determine the significance of GHG emissions from the proposed program:

- Whether the program has the potential to substantially conflict with or is essentially consistent with plans to reduce or mitigate GHGs, including the following:
  - The six key elements of CARB's Scoping Plan
  - The 39 recommended actions in the Scoping Plan
- Whether the relative amounts of GHG emissions during implementation of the proposed program are substantial compared to the amount of GHG emissions for major facilities that are required to report GHG emissions (i.e., 25,000 mt CO_2e/year). Please note, however, that 25,000 mt CO_2e is not being held up as a quantitative significance threshold, but rather as one criterion by which the significance of a future project may be judged.
- Whether the proposed program has the potential to contribute to a lower carbon future, such as the following:
  - The design of the proposed program is inherently energy efficient.

- All applicable best management practices (BMPs) that would reduce GHG emissions are incorporated into the design of the proposed program.
- The proposed program would implement or fund its fair share of a mitigation strategy designed to alleviate climate change.
- Implementing the proposed program would improve processes or efficiency, resulting in a net reduction in GHG emissions.

3.7.4 Environmental Impacts and Mitigation Measures for NTMAs

This section describes the net effects of GHG emissions associated with NTMA implementation on global climate change. For each impact discussion, the environmental effect is determined to be either less than significant, significant, potentially significant, or beneficial compared to existing conditions and relative to the thresholds of significance described above. These significance categories are described in more detail in Section 3.1, “Approach to Environmental Analysis.”

Examples of potential mitigation strategies are provided after the following qualitative impact discussions to disclose the nature and extent of mitigation actions that might be necessary to address any significant or potentially significant impacts. Actual implementation, monitoring, and reporting of the PEIR mitigation measures would be the responsibility of the project proponent for each site-specific project. For those projects not undertaken by, or otherwise subject to the jurisdiction of, DWR or the Central Valley Flood Protection Board (Board), the project proponent generally can and should implement all applicable and appropriate mitigation measures. The project proponent is the entity with primary responsibility for implementing specific future projects and may include DWR; the Board; reclamation districts; local flood control agencies; and other federal, State, or local agencies.

Because various agencies may ultimately be responsible for implementing (or ensuring implementation of) mitigation measures identified in this PEIR, the text describing mitigation measures below does not refer directly to DWR but instead refers to the “project proponent.” As discussed above, this term is used to represent all potential future entities responsible for implementing, or ensuring implementation of, mitigation measures.

In the time frame addressed by the NTMAs (i.e., 0–5 years after CVFPP approval), changes in flooded soil areas, completed restoration of riparian habitat, restriction of further development in floodplains, and operation and maintenance of large new facilities under the proposed program would not be expected to occur to a substantial degree. (They may still be initiated in the near term, as defined by NTMAs.) Therefore, nearly all GHG emissions related to NTMAs would be construction related and associated with in-place levee reconstruction and/or improvements.

Impact CLM-1 (NTMA): *Net Construction-Related and Operational Greenhouse Gas Emissions*

The net construction-related and operational GHG emissions associated with the NTMAs are analyzed separately below. Net emissions consider direct emissions from program activities, as well as prevented or offset emissions resulting from the avoidance of other activities, and GHG sequestration. Net GHG emissions associated with the entire program over 20 years or more relative to existing conditions are evaluated below in Section 3.7.5, “Environmental Impacts, Mitigation Measures, and Mitigation Strategies for LTMAs.”

Construction-Related Greenhouse Gas Emissions

Construction equipment and material delivery trucks would be driven and worker trips would occur during in-place levee reconstruction or improvements, or both. The resulting fossil fuel combustion would emit GHGs.

As discussed in Section 3.7.1, “Environmental Setting,” each of the principal GHGs has a long atmospheric lifetime (1 year to several thousand years), and is globally well mixed. GHGs (primarily CO_2 from combustion of fossil fuels) would be emitted during construction for only a short period. Once released, however, most would remain in the atmosphere indefinitely, until they were sequestered by the ocean or terrestrial sinks.

The GHG emissions associated with mining, production, and transport of the construction materials used to reconstruct or improve levees could range from low to high. For example, the only emissions generated by taking soil from local sources to construct levee improvements would originate from handling and transport. Conversely, use of manufactured or processed materials (e.g., concrete, dam pieces, building materials) would involve GHG emissions from mining of virgin materials, production/manufacturing, and transportation of materials. The actual life-cycle emissions would depend on the types and locations of materials used. Therefore, when choosing the types and locations of construction materials to use for NTMAs, the project proponent could take these factors into consideration in an effort to minimize GHG emissions from mining, production, and transport of material. It should be noted that decisions made to reduce GHG emissions often parallel decisions made to reduce construction costs. For example, selecting a soil borrow site closer to a construction site reduces fuel use in transporting material, reducing both GHG emissions and construction costs. Although making decisions that minimize life-cycle emissions can result in a substantial reduction in GHG emissions, the information behind each piece of construction material is difficult to obtain. Therefore, this aspect of GHG emissions is stated for informational and potential reduction purposes, but is not meant to be used as a main reduction strategy.

Comparison to Similar Previously Evaluated Projects To provide context on the magnitude of construction emissions that would occur as part of the proposed program, similar previously evaluated projects are discussed below. It should be noted that these example projects are not meant to simulate the construction emissions that would occur as part of the proposed program. Rather, they represent similar activities that would occur as part of the proposed program. The level of GHG emissions would likely vary between the example projects and proposed program. For example, even if a project under the proposed program would involve the same magnitude of earth moving as an example project, GHG emissions would differ from the example project if the source for the earthen material (e.g., a borrow site) were closer to or farther from the construction site than under the proposed project (i.e., more or less fuel burned to transport material to the construction site).

Example 1: Phase 4b Landside Improvements Project, Natomas Levee Improvement Program The construction-related GHG emissions for the Phase 4b Landside Improvements Project of the Natomas Levee Improvement Program (Sacramento Area Flood Control Agency) (SAFCA 2010) were estimated to be approximately 5,000 mt CO_2 per year, or about 25,000 mt CO_2 over 5 years. The estimated maximum construction-related emissions of GHGs measured about 14,000 mt CO_2 in a single year. The Phase 4b Landside Improvements Project is a relatively large project among the examples provided here and relative to other flood-risk reduction projects conducted over the last 5 years; this project has involved repairs and improvements along 16 miles of levees.

Example 2: Reclamation District 17 Levee Improvement Program Construction-related GHG emissions associated with the Reclamation District 17 Levee Improvement Program (USACE and RD 17 2011) were estimated to range from approximately 1,250 to 2,750 mt CO_2 per year, or about 6,250–13,750 mt CO_2 over 5 years. This levee improvement program involves construction of about 3 miles of seepage berms, cutoff walls, and chimney drains.

Example 3: West Sacramento Levee Improvements Program Construction-related GHG emissions associated with the West Sacramento

Levee Improvements Program were estimated, specifically for the California Highway Patrol (CHP) Academy and The Rivers early implementation projects. Levee repairs and improvements for the CHP Academy involved about 1.23 miles of levees; construction-related GHG emissions were calculated to be 1,170 mt CO_2 over about 4 months. Levee repairs and improvements for The Rivers involved about 0.85 mile of levees; construction-related GHG emissions were calculated to be 1,620 mt CO_2 over about 4.7 months. Therefore, construction-related GHG emissions associated with the West Sacramento Levee Improvements Program were estimated to range from approximately 3,510 to 4,136 mt CO_2 per year, or about 17,550 to 20,680 mt CO_2 over 5 years (USACE and WSAFCA 2011).

The three levee improvement projects referenced above involved different levels of levee repairs and improvements, but are likely representative of the types of repairs and improvements that may be performed as NTMAs under the CVFPP. Based on the modeling of construction emissions performed for the example projects, GHG emissions would exceed 25,000 mt CO_2 (for 1 or more years of construction, depending on the intensity in a given year) if several NTMAs of sufficient size were implemented during the same year. For example, if NTMAs would involve five such projects per year, over the course of 5 years, the construction-related GHG emissions associated with the CVFPP could range from 31,250 to 125,000 mt CO_2, or 6,250–25,000 mt CO_2 per year. Conversely, if the NTMAs would not reach this level of construction intensity (i.e., five levee repair and improvement projects occurring in one year), it is likely that annual construction emissions would be below 25,000 mt CO_2 per year.

Avoided GHG Emissions from Flood Protection Provided by NTMA Levee Repairs and Improvements GHGs emitted during near-term program construction would not be immediately offset by GHG emissions avoided through flood-risk protection, or by GHGs sequestered as a result of NTMAs and LTMAs implemented under the CVFPP's conservation element. However, it is likely that NTMA levee repairs and improvements would provide future flood-risk protection, as well as carbon sequestration (owing to restoration of riparian habitat associated with levee repair and improvement). Providing flood protection would result in net avoided GHG emissions associated with emergency response and rebuilding of flooded communities, and some amount of sequestered GHGs associated with conservation.

The National Association of Homebuilders has estimated GHG emissions embodied in new-home construction (from material production and transport to home construction) to be 51.4 mt CO_2e per home (NAHB 2008). A levee breach during a 100-year flood event has the potential to damage thousands of homes in the Sacramento metropolitan area, based on recent floodplain maps (DWR 2011). Assuming that 5,000 homes may suffer 25 percent damage from a 100-year flood, the GHG emissions associated with the materials and construction required to repair the damage total about 64,250 mt CO_2e. These emissions only address reconstruction of damaged homes. Response to, and reconstruction after, a flood event would generate substantial additional emissions associated with activities such as emergency response, clearing and cleaning of damaged areas, repair of nonresidential structures, and infrastructure repair.

The assumption of 5,000 homes represents a levee failure in a moderately urbanized area. For example, a levee breach in the Three Rivers Levee Improvement Authority (TRLIA) project area at a 100-year flood stage elevation was estimated to inundate approximately 4,000 homes (USACE 2008). Improvements in the TRLIA project area would provide long-term protection that, over time, could prevent multiple 100-year events. This is only a moderately developed area with extensive agricultural lands (9,500 acres of agricultural land). The RD 17 levee system protects approximately 10,670 residential units as well as a large amount of agricultural land (approximately 6,345 acres) (USACE 2011). Depending on the location of a levee failure and the water surface elevation at the time, a large number of these residential units could be inundated during a flood event. Further, even with the lower rate of development at the time of this writing, residential units in these areas will continue to increase with time. Therefore, a greater number of houses will be exposed to flooding threats in the future. A flood event in a highly urbanized area, such as the Sacramento central city, could result in damage to substantially more homes; however, for the flood-related emission scenario provided here, modeling of a moderate level of damage was desired rather than a worst-case scenario. It should also be noted that each of these areas discussed above are being considered separately. In reality, a 100-year event could cause levee breaches in multiple areas. Therefore, the assumption used to estimate number of houses affected by a flood event is conservatively low.

The assumption that the homes, on average, would experience 25 percent damage acknowledges the fact that during a catastrophic flood event different areas are exposed to different depths of floodwaters. Some homes and structures near the source of the floodwaters may be almost completely submerged and irreparable. Other areas may have less than a foot of floodwaters enter homes, and repair costs could be relatively small compared to the total value of the residence. The actual average damage percentage experienced during a flood event is dependent on a variety of factors including topography in the flood area, whether homes are designed to be flood resistant (e.g., elevated), and period of time floodwaters are present. The 25 percent damage estimate was selected as a simple expression of the fact that partial damage to homes is more common than total losses during a flood event.

Based on the reasoning above, it is rational to conclude that under the NTMAs, construction-related GHG emissions could be substantially offset by future avoided GHG emissions associated with preventing damage from a 100-year flood in a developed area. This discussion only pertains to a 100-year flood event. In the case of a more severe (than 100-year) event, reconstruction areas could greatly exceed even all of those mentioned above, and emissions could greatly exceed the construction emissions associated with the example construction projects.

Additionally, GHGs would be sequestered in the long term if conservation strategies associated with NTMAs were implemented (i.e., by enhancing, restoring, and creating riparian forest corridors associated with existing and new levees or alternative vegetation areas). As described previously in Section 3.7.1, "Environmental Setting," riparian forests in the Extended SPA sequester roughly 57 mt CO_2 per hectare, or approximately 23 mt CO_2 per acre, in the first 50 years of their development, or approximately 0.46 mt CO_2 per acre annually. Sequestering 125,000 mt CO_2 (a high-end estimate of NTMA emissions) would require a net gain of several thousand to tens of thousands of acres of riparian forest depending on the time frame in which completing the sequestration was desired (e.g., 10 years versus 50 years). Because of the uncertainty of future implementation and actual sequestration value, at this time the proposed program is not assuming any sequestration benefit from proposed habitat enhancements.

The exact amount and timing of sequestration and emissions offsets needed to compensate for GHG emissions associated with NTMA construction is not currently known. Based on similar types of emissions associated with other flood-risk reduction projects, the proposed program's construction-related GHG emissions could be substantial if multiple projects were to be undertaken concurrently. However, at some time in the future, these emissions would likely be offset to a great degree (if not completely) based on the extent and number of NTMA projects, by both avoided GHG emissions associated with flood protection and sequestered GHG emissions associated with restoration of riparian habitat.

Also, in assessing GHG emissions, CARB's Scoping Plan includes a comprehensive set of actions designed to reduce overall GHG emissions in California. (See the previous discussion of the Scoping Plan in the discussion of "Assembly Bill 32 and Climate Change Scoping Plan" in Section 3.7.2, "Regulatory Setting.") Some of these actions would have an impact on the emission-generating activities discussed above. The Scoping Plan assumes that implementing the light-duty-vehicle GHG standards (known as the "Pavley standards" or "Pavley"), the Low Carbon Fuel Standard (LCFS), and energy efficiency measures such as the Renewable Portfolio Standard would reduce emissions. Therefore, the project's GHG emissions associated with construction worker vehicles and construction-related fuel use would be reduced through these statewide measures. In addition, the emissions associated with the use of electrified equipment and electrical energy sources for construction activities would be reduced by the Renewable Portfolio Standard. The phased reduction in the use of heavy-duty vehicles could specifically reduce construction-related emissions. Implementing the measures in the Scoping Plan would reduce GHG emissions associated with the proposed program.

Although mobile source–related GHG emissions during construction of NTMAs would be reduced by the Scoping Plan measures, implementing the following mitigation options, as described in Section 3.4, "Air Quality," where they are applicable to specific program activities, would further reduce emissions of GHGs and criteria pollutants:

- Develop and implement a construction-worker trip reduction plan to achieve average vehicle ridership of 1.5 persons or greater.
  - Range of Effectiveness: Varies depending on the numbers of workers and travel distances
- Implement a shuttle service to and from retail services and food establishments during lunch hours, or employ a catering service to bring lunch to the project site.
  - Range of Effectiveness: Varies depending on the numbers of workers and travel distances
- Use alternative-fueled (e.g., compressed natural gas, liquefied natural gas, propane, biodiesel) or electricity-powered construction equipment where feasible. (As described under "Exhaust Emissions" in Mitigation Measure AQ-1 (NTMA) in Section 3.4, "Air Quality," this measure has the potential co-benefits of reducing emissions of reactive organic gases and toxic air contaminants/fine particulate matter with an aerodynamic resistance diameter of 2.5 micrometers or less (i.e., $PM_{2.5}$). The potential exists for an increase in emissions of oxides of nitrogen.)
  - Range of Effectiveness: 0–22 percent reduction in GHG emissions (CAPCOA 2010)

In addition, DWR has developed preconstruction, construction, and final design BMPs for reduction of GHG emissions. These preconstruction and final design and construction BMPs are designed to ensure that individual projects are evaluated and their unique characteristics taken into consideration when determining if specific equipment, procedures, and or material requirements are feasible and efficacious for reducing GHG emissions from the project. These BMPs have been incorporated into Mitigation Measure CLM-1a (NTMA) below.

Operational Greenhouse Gas Emissions

Following construction of the proposed program's facilities as part of the NTMAs, operation of these facilities could result in an incremental increase in GHG emissions from pumps (indirect electricity use); building heating, cooling, lighting, and water use (indirect use of electricity and direct gas use); and worker maintenance trips (fuel use). In addition, changing current reservoir operations as part of the NTMAs' storage-related management activities could alter the amount of electricity used, vehicle miles traveled, or other aspects of the operation and maintenance of these facilities, and therefore add to the associated GHG emissions generated. The amount of energy, number of trips, and VMT required for the new facilities and operations is not known and cannot be estimated without a high level of speculation. However, it is presumed that for most NTMAs, project proponents would replace existing structures, pumps, and facilities rather than constructing entirely new facilities. (For example, an existing levee segment would be replaced with a setback levee and a drainage pump that is relocated as a result of levee widening would be replaced.) Replacing older pumps and facilities could result in reduced GHG emissions relative to existing conditions if operational conditions or capacities would remain unchanged in the near term. (New equipment, buildings, and vehicles would be more energy and fuel efficient than those they would replace.) Additionally, because some levee segments could be removed, emissions associated with maintaining those levees would cease to exist. Although levee removal would reduce or stop maintenance activities for those levee segments, other replacement or setback levees would be constructed to maintain a proper level of flood protection. At the time of this writing, it cannot be determined whether the new levees would require greater, lesser, or equal levels of maintenance activities; however, new levee segments built to modern design and engineering standards would likely require a less substantial maintenance effort than levees constructed 50 years or more ago. As mentioned above under the discussion of construction-related GHG emissions, CARB's Scoping Plan includes actions designed to reduce overall GHG emissions in California, among them the Pavley standards and LCFS. Those enforceable Scoping Plan measures that apply to operational activities would be implemented under the proposed program. Implementing Pavley/LCFS would also reduce emissions from worker vehicles during operation and maintenance of the proposed program. Similarly, for program operations, implementing Scoping Plan measures such as the Renewable Portfolio Standard would reduce operational GHG emissions associated with buildings, water pumping, etc.

Conclusion

The following can be determined when applying the three significance criteria established for this project:

- The construction-related and operational GHG emissions associated with NTMAs would not conflict with or be inconsistent with any current plan to reduce or mitigate GHGs.

- These emissions could potentially exceed the 25,000-mt CO_2e level if multiple NTMAs were under construction simultaneously and emissions from each NTMA were looked at additively.

- Implementation of NTMAs would contribute to a lower carbon future because they would be expected to require very small amounts of electricity, most operating completely passively, and therefore being inherently energy efficient.

- Implementation of NTMAs would improve processes and efficiency by reducing flood risk and likely reducing future GHG emissions resulting from flooding or flood damage remediation.

Based on the evaluation of how the proposed program would meet these criteria, those emissions that remain would likely be offset to a substantial degree by avoided future GHG emissions from future flood damage prevention or sequestered as a result of conservation. Therefore, relative to existing conditions, the impact of the net change in GHG emissions would not be considered to be a cumulatively considerable incremental contribution to the significant cumulative impact on global climate change from GHG emissions. This impact would be **less than significant**. In addition, the program’s overall construction-related and operational emissions would be reduced further through implementation of statewide policies (CARB Scoping Plan), the air quality mitigation measures in this PEIR, and preconstruction, and final design and construction BMPs for reduction of GHG emissions.

Although this impact would be less than significant, operational emissions could be reduced further by implementing various relatively common practices. Although not required to reduce Impact CLM-1 (NTMA) to a less-than-significant level, Mitigation Measures CLM-1a (NTMA) and CLM- 1b (NTMA) are provided below to describe additional actions that could further reduce operational GHG emissions.

Mitigation Measure CLM-1a (NTMA): ***Implement Greenhouse Gas–Reducing Construction BMPs***

DWR has developed preconstruction, construction, and final design BMPs for reduction of GHG emissions. These preconstruction and final design and construction BMPs are designed to ensure that individual projects are evaluated and their unique characteristics taken into consideration when determining if specific equipment, procedures, and or material requirements are feasible and efficacious for reducing GHG emissions from the project.

As applicable and appropriate, the following BMPs will be applied:

- **BMP 1**—Evaluate project characteristics, including location, project work flow, site locations, and equipment performance requirements, to determine whether specifications of the use of equipment with repowered engines, electric drive trains, or other high-efficiency technologies are appropriate and feasible for the project or specific elements of the project.

- **BMP 2**—Evaluate the feasibility and efficacy of performing on-site material hauling with trucks equipped with on-road engines.

- **BMP 3**—Ensure that all feasible avenues have been explored for providing an electrical server drop to the construction site for temporary construction power. When generators must be used, use alternative fuels, such as propane or solar, to power generators to the maximum extent feasible.

- **BMP 4**—Evaluate the feasibility and efficacy of producing concrete on-site and specify that batch plants be set up on-site or as close to the site as possible.

- **BMP 5**—Evaluate the performance requirements for concrete used on the project, and specify concrete mix designs that minimize GHG emissions from cement production and curing while preserving all required performance characteristics.

- **BMP 6**—Minimize idling time by requiring that equipment be shut off after 5 minutes when not in use (as required by the State airborne toxics control measure, Title 13, Section 2485 of the California Code of Regulations). Provide clear signage that posts this requirement for workers at the entrances to the site and provide a plan for the enforcement of this requirement.

- **BMP 7**—Maintain all construction equipment in proper working condition and perform all preventative maintenance. Required maintenance includes compliance with all manufacturer's recommendations, proper upkeep and replacement of filters and mufflers, and maintenance of all engine and emissions systems in proper operating condition. Maintenance schedules shall be detailed in an air quality control plan prior to commencement of construction.

- **BMP 8**—Implement a tire inflation program on jobsite to ensure that equipment tires are correctly inflated. Check tire inflation when equipment arrives on-site and every 2 weeks for equipment that remains on-site. Check vehicles used for hauling materials off-site weekly for correct tire inflation. Procedures for the tire inflation program shall be documented in an air quality management plan prior to commencement of construction.

- **BMP 9**—Develop a project-specific rideshare program to encourage carpools, shuttle vans, transit passes, and/or secure bicycle parking for construction worker commutes.

- **BMP 10**—Reduce electricity use in temporary construction offices by using high-efficiency lighting and requiring that heating and cooling units be Energy Star compliant. Require that all contractors develop and implement procedures for turning off computers, lights, air conditioners, heaters, and other equipment each day at close of business.

- **BMP 11**—For deliveries to project sites where the haul distance exceeds 100 miles and a heavy-duty class 7 or class 8 semi-truck or 53-foot or longer box-type trailer is used for hauling, a SmartWay certified truck will be used to the maximum extent feasible.

- **BMP 12**—Minimize the amount of cement in concrete by specifying higher levels of cementitious material alternatives, larger aggregate, longer final set times, or lower maximum strength where appropriate and while preserving all required performance characteristics.

- **BMP 13**—Develop a project-specific construction debris recycling and diversion program to achieve a documented 50 percent diversion of construction waste.

Mitigation Measure CLM-1b (NTMA): ***Implement Greenhouse Gas–Reducing Operational Practices***

Incremental operational GHG emissions would likely be reduced in the near term relative to existing conditions through the replacement of older equipment, buildings, and vehicles. Even so, although Impact CLM-1 (NTMA) would be less than significant, the project proponent will implement the measures listed below—where needed, feasible, and appropriate—to minimize operational GHG emissions for replacement and new CVFPP facilities associated with NTMAs. Not all mitigation measures listed below may be applicable to each management action. Rather, these mitigation measures serve as an overlying mitigation framework to be utilized for specific management actions. The applicability of mitigation measures would vary based on the lead agency, location, timing, and nature of each management action.

- Implement all current standards and/or requirements as part of any DWR sustainability plan or guidelines.
- Use renewable energy generated on site (i.e., solar, wind, hydroelectric).
- Use alternative fuels for maintenance vehicles and equipment.
- Use energy-efficient equipment for operation and maintenance of proposed facilities (e.g., pumps, hydraulic equipment, maintenance equipment). Equipment and operation of equipment will conform to U.S. Department of Energy best practices, Consortium for Energy Efficiency initiatives and guidance, and National Electrical Manufacturers Association standards where possible.
- Require proposed buildings to exceed California Building Standards Code Title 24 energy efficiency standards by 20 percent or more.

Implementing this mitigation measure would further reduce Impact CLM-1 (NTMA) and it would remain **less than significant.**

3.7.5 Environmental Impacts, Mitigation Measures, and Mitigation Strategies for LTMAs

This section describes the net effects on global climate change of GHG emissions associated with LTMAs. LTMAs include a continuation of activities described as part of NTMAs and all other actions included in the proposed program, and consist of all of the following types of activities:

- Widening floodways (through setback levees and/or purchase of easements)
- Constructing weirs and bypasses

- Constructing new levees
- Changing operation of existing reservoirs
- Achieving protection of urban areas from a flood event with 0.5 percent risk of occurrence
- Changing policies, guidance, standards, and institutional structures
- Implementing additional and ongoing conservation elements

Actions included in LTMAs are described in more detail in Section 2.4, "Proposed Management Activities."

Impacts and mitigation measures identified above for NTMAs would also be applicable to many LTMAs and are identified below. The NTMA impact discussions and mitigation measures are modified or expanded where appropriate, or new impacts and mitigation measures are included if needed, to address conditions unique to LTMAs. The same approach to future implementation of mitigation measures described above for NTMAs and the use of the term "project proponent" to identify the entity responsible for implementing mitigation measures also apply to LTMAs.

In addition, as described previously and in Section 3.1.2, "Analysis Methodology," because many LTMAs are more general and conceptual, additional impacts of those LTMAs are also described below in a broader qualitative format, along with a list of suggested mitigation strategies that could be applied to these impacts. This more general analysis is provided in the subsection titled "LTMA Impact Discussions and Mitigation Strategies."

LTMA Impacts and Mitigation Measures

Impact CLM-1 (LTMA): ***Net Construction-Related and Operational Greenhouse Gas Emissions***

Where LTMAs would serve as a continuation of NTMAs, this impact would be the same as Impact CLM-1 (NTMA). Additionally, LTMAs related to levee repair and improvement, and associated incremental GHG emissions, are not expected to differ substantially from those that would occur under existing conditions. (Repairs and improvements would occur on a longer time scale as a result of reduced funding opportunities and programmatic planning.)

However, net GHG emissions cannot be estimated for construction and operation of other types of LTMAs (e.g., flood bypasses) because it is currently unknown which and how many of these actions would be undertaken. Therefore, GHG emissions from LTMAs that are not a continuation of NTMAs are discussed below in the section titled “LTMA Impact Discussions and Mitigation Strategies,” where impacts that are too speculative for evaluation are described in a broader qualitative format and a list of potential mitigation strategies is provided. However, because this is a program-level document, significant adverse GHG emissions from LTMAs will be evaluated at the project level, where applicable.

As discussed previously in Impact CLM-1 (NTMA), various programs would reduce construction-related GHG emissions and prevent damage from a flood system failure in an urban or urbanizing areas such as Sacramento. Furthermore, net gains in riparian habitat could compensate for all or a portion of construction-related and operational emissions associated with program activities. Therefore, continuing program activities such as levee repairs, enhancements, and improvements similar to those described for the NTMAs would result in **less-than-significant** net GHG emissions.

Although this impact would be less than significant, operational emissions could be reduced further by implementing various relatively common practices. Although not required to reduce Impact CLM-1 (LTMA) to a less-than-significant level, Mitigation Measures CLM-1a (LTMA) and CLM-1b (LTMA) are provided below to allow for additional actions that could further reduce operational emissions.

Mitigation Measure CLM-1 (LTMA): ***Implement Mitigation Measures CLM-1a (NTMA) and CLM-1b (NTMA)***

Implementing this mitigation measure would further reduce Impact CLM-1 (LTMA), and it would remain **less than significant**.

LTMA Impact Discussions and Mitigation Strategies

In addition to construction-related and operational GHG emissions associated with the proposed program described above, GHG emissions associated with other LTMAs, such as land use changes, are expected to occur. Because of the more general and conceptual nature of many LTMAs, a great deal of uncertainty exists about how some LTMAs may be implemented and what environmental effects may result from their implementation. This uncertainty is to be expected for a broad, multiyear, and in some areas, conceptual program such as the CVFPP. Although these uncertainties exist, sufficient information exists to disclose additional potential impacts of LTMAs besides those discussed in the impact/mitigation pairings above. The following additional LTMA impacts are described in a broad narrative format; because of the uncertainty surrounding these impacts, no determination regarding their significance is provided. Consistent with Section 15145 of the CEQA Guidelines, these impacts are too speculative for evaluation beyond the narrative disclosure provided here.

Future project-specific CEQA evaluations for individual LTMAs will be used to determine the potential for the impacts described below to occur, determine their level of significance, and identify project-specific mitigation measures for significant impacts. Examples of potential mitigation strategies are provided after the following qualitative impact discussions to disclose the nature and extent of mitigation actions that might be necessary to address these impacts.

For more information on this approach to evaluating LTMA impacts and providing mitigation strategies, see Section 3.1.2, “Analysis Methodology.”

Global climate change is not a local or even a regional issue, but is global by nature. Therefore, impact discussions are not divided among the geographic areas in the program study area (i.e., Extended SPA, Sacramento and San Joaquin Valley watersheds, and SoCal/coastal CVP/SWP service areas), as in other sections of this PEIR. However, impact discussions are subdivided according to the type of action (i.e., operations and maintenance activities associated with storage and conveyance LTMAs, policy-related LTMAs, and other management actions).

LTMA Impact Discussions

Storage—GHG Emissions Net Balance from Operating Water Storage Facilities As indicated previously in Section 2.4.5, “Long-Term Storage-Related Management Activities,” in Chapter 2.0, “Program Description,” storage-related LTMAs consist of a continuation of storage-related NTMAs. There are no additional storage-related LTMAs. The storage-related NTMAs consist solely of operational changes to existing reservoirs that would be implemented in ways that would not cause long-term or substantial changes to water supply reliability or deliveries, hydropower production, or other program purposes. (See Section 2.6, “No Near- or Long-Term Reduction in Water or Renewable Electricity Deliveries.”) Therefore, the impacts of GHG emissions from the proposed program’s storage-related NTMAs and LTMAs and the associated mitigation measures are thoroughly described and evaluated above. A general narrative description of additional LTMA impacts and mitigation strategies, as provided below for conveyance-related LTMAs, is not required.

Storage—Consistency of Operating Storage Facilities with an Applicable Plan, Policy, or Regulation Adopted to Reduce GHG Emissions The

CEQA Guidelines require that environmental analyses evaluate both the level of GHG emissions associated with constructing and operating a project and the project's consistency with an applicable plan, policy, or regulation adopted for the purpose of reducing GHG emissions. As stated previously, the storage-related LTMAs consist solely of operational changes to existing reservoirs that would be implemented in ways that would not cause long-term or substantial changes to water supply reliability or deliveries, hydropower production, or other program purposes. These types of activities would have little to no effect on GHG emissions, while associated improvements to flood protection could assist in minimizing future GHG emissions generated by recovery from flood damage. A general narrative description of consistency with applicable plans, policies, and regulations adopted to reduce GHG emissions, as provided below for conveyance-related LTMAs, is not required.

Conveyance—Net Balance of GHG Emissions from Constructing, Operating, and Maintaining Conveyance Facilities Conveyance facilities included in the LTMAs may be of a much larger scale than those identified for NTMAs, such as constructing new flood bypasses and large setback levees or widening existing bypasses. There is a great deal of uncertainty regarding the number, type, and location of these facilities; therefore, similar uncertainty exists about the GHG emissions associated with the construction, operation, and maintenance of these facilities. There are also various mechanisms whereby each of these types of projects could both increase and decrease GHG emissions and sequestration, resulting in uncertainty regarding the net balance of GHG emissions. These mechanisms that influence net GHG emissions are described below.

Constructing, operating, and maintaining completely new facilities, such as new bypasses, would result in incremental increases in energy consumption and fuel use. The amount of fuel and energy and the number of trips and vehicle miles traveled required for construction, operation, and maintenance of the new facilities is unknown; therefore, the net increase in GHG emissions is unknown.

Expanding the conveyance system through bypasses, setbacks, and purchase of agricultural easements to expand floodways would change the net area and location of soils exposed to inundation. None of these types of activities would cause substantial amounts of soils to become permanently inundated; however, occasional periods of continuous inundation lasting for weeks or months would likely occur in some areas. Anaerobic microbial activities generate emissions of methane and nitrous oxide in inundated soils. The increase or decrease in emissions produced from these processes would depend on the incremental increases in inundated soil areas; the duration and frequency of inundation; the nutrient content of inundated soils (carbon and nitrogen); and the amount of submerged vegetation, temperature, pH, and dissolved oxygen levels. The carbon content of submerged soils may be particularly important in areas such as the Delta, where soils can contain high percentages of organic matter and therefore have a greater potential to generate methane emissions. Given the large number of variables involved in calculating potential GHG emissions from increased soil inundation, any estimates of emissions from LTMAs would be purely speculative.

Changes in land uses from flood-protected agricultural lands to agricultural lands within a floodway could also change GHG emissions. Halting agricultural operations during the flood season could reduce emissions of GHGs from a variety of agricultural processes such as soil fertilization, residue burning, and farm equipment operations. However, limiting use of agricultural lands in this way would not completely remove GHG emissions; inundated lands could generate GHG emissions from the processes described above. In addition, the need to restore agricultural lands to production after inundation events could require the use of additional energy and fuel not needed for flood-protected agricultural lands. Placing agricultural lands in a floodway could also result in changes to the crops cultivated on the land to better accommodate regular inundation. The new crops may require more or less energy and fuel for cultivation than those present before program implementation, and therefore could generate more or less GHG emissions.

It is also unclear to what extent implementing conveyance-related LTMAs could result in the conversion of agricultural land to native habitat to mitigate project-related impacts on biological resources. Where agricultural land would be converted to habitat, GHG emissions from agricultural operations would cease and newly planted vegetation could result in carbon sequestration.

If new or enhanced water conveyance facilities were constructed and operated as part of the proposed program, thus improving flood protection, this could minimize and avoid large GHG emissions associated with catastrophic flood fighting, emergency response, and flood recovery. Transporting various flood-emergency staff members and emergency generators and building new structures would generate GHG emissions. The occurrence of flood protection system failures is impossible to predict. Nevertheless, the proposed program would minimize failures to some degree, thus protecting against some level of damage associated with these events. The analysis of effects on GHG emissions from avoiding catastrophic floods (Impact CLM-1 (NTMA)) was based on emissions from the reconstruction of residential homes that could occur after a flood system failure during a 100-year flood event. Minimizing the frequency and severity of flood events from system failures could result in considerable avoidance of GHG emissions, although the exact amount cannot be determined.

Adverse impacts of operational GHG emissions could be mitigated (see the mitigation strategies listed below and in Table 3.7-3); however, the specific mechanisms and quantities of GHG emissions and reductions cannot be calculated without a high degree of speculation. For example, using renewable energy to meet operational electricity requirements throughout the study area may not be feasible until sometime in the future. Consequently, the impact of net GHG emissions resulting from construction, operation, and maintenance of storage facilities under the proposed program is too speculative for an evaluation of significance.

Given the multiple variables and unknowns described above, it is unknown whether the net GHG emissions associated with constructing, operating, and maintaining conveyance facilities included in the LTMAs would result in a net increase or decrease in GHG emissions. The extent of any increase or decrease is also unknown. If GHG emissions were to increase to a significant degree, these potentially adverse impacts may be mitigated, but the extent to which they may be mitigated is unknown. Consequently, impacts associated with net GHG emissions from constructing, operating, and maintaining conveyance facilities included in the LTMAs are too speculative for an evaluation of significance.

Conveyance—Consistency of Constructing, Operating, and Maintaining Conveyance Facilities with an Applicable Plan, Policy, or Regulation Adopted to Reduce GHG Emissions The CEQA Guidelines require that environmental analyses evaluate both the level of GHG emissions associated with constructing and operating a project and the project's consistency with an applicable plan, policy, or regulation adopted for the purpose of reducing GHG emissions.

Because the proposed program's construction-related and operational emissions associated with LTMAs are currently too speculative to estimate, it is unknown whether the program could conflict with AB 32 and the Scoping Plan or other applicable plans.

Statewide actions and measures from the Scoping Plan would also help reduce GHG emissions from fossil fuel combustion and energy used to construct, operate, and maintain conveyance facilities. Among the actions and measures that would reduce such emissions are medium and heavy-duty hybridization, anti-idling measures, electrification, and measures related to heavy-duty aerodynamic efficiency. However, the total effects of these emission reduction actions, as applied to conveyance-related LTMAs, are uncertain and too speculative for evaluation. Therefore, the consistency of LTMAs that require constructing, operating, and maintaining conveyance facilities with an applicable plan, policy, or regulation adopted to reduce GHG emissions is too speculative for an evaluation of significance.

Other Management Actions—GHG Emissions from "Nonfacility" Management Actions As described in Section 2.4.6, "Other Long-Term Management Activities," of Chapter 2.0, "Program Description," some of the "nonfacility" management actions that could be implemented as part of the LTMAs are conserving Delta marshes and agricultural lands, expanding wetlands, and implementing the urban level of flood protection standards.

With implementation of the proposed program, wetland conservation and carbon storage by Delta peat soils, marshes, grasslands, and riparian vegetation could increase, sequestering GHG emissions from the atmosphere. On the other hand, expanding wetlands could increase GHG emissions by expanding the area of inundated soils via the mechanisms described above for conveyance facilities. Increasing urban densification and reducing urban sprawl could occur with implementation of EO B-39-77 and may be supported by policies related to the urban level of flood protection. Such changes in density and sprawl would result in a decrease of VMT, energy and water use, and waste generation.

Lastly, the proposed program would result in conservation, enhancement, restoration, and creation of riparian and upland vegetation, which could sequester carbon and provide shade and some protection from water temperature increases. Resulting increases in native habitats could also help protect against associated water quality problems (increased dissolution of minerals and greater rates of biological and chemical reactions that could cause both potable water and wastewater to require additional treatment). Maintaining high water quality from the raw source (i.e., surface water, groundwater) reduces the energy requirements and subsequent GHG emissions required to treat water to drinking water standards. Given the various mechanisms by which GHG emissions could be increased or decreased by "nonfacility" LMTAs, the net change in GHG emissions resulting from these actions is unknown. Consequently, impacts associated with net GHG emissions from nonfacility management actions under the LTMAs are too speculative for an evaluation of significance.

Other Management Actions—Consistency of Other Management Actions with an Applicable Plan, Policy, or Regulation Adopted to Reduce GHG Emissions Implementing the urban level of flood protection, which is initiated with the adoption of the CVFPP, could support one of the six key elements of the Scoping Plan (CARB 2008a:17):

- Pursuing policies and incentives to achieve transportation-related GHG emissions targets for regions throughout California, if the project results in policies that ban future growth in the 200-year floodplain area within the planning area

It should be noted that the urban level of flood protection could limit or complicate development in the 200-year floodplain, but does not "ban" it as indicated in the CARB Scoping Plan. The requirements related to the urban level of flood protection could also support one of CARB's 39 recommended actions in the Scoping Plan by supporting smart growth. This would occur if the disincentive to develop in the 200-year floodplain provided by the urban level of flood protection were to lead to densification of existing development outside the floodplain.

As discussed above, GHG emissions associated with other management actions included in the LTMAs (i.e., nonfacility LTMAs) are too speculative for an evaluation of significance.. Thus, consistency with an applicable plan, policy, or regulation adopted to reduce GHG emissions is too speculative for evaluation.

Net GHG Emissions Associated with All Management Actions Under the Proposed Program The net expected change in GHG emissions associated with implementation of LTMAs, relative to existing conditions, is unknown. Thus, the GHG emissions associated with construction, operation, and maintenance of all LTMAs under the proposed program are too speculative for an evaluation of significance.

LTMA Mitigation Strategies A GHG emissions inventory will be conducted for the proposed program as more information becomes available. If generated GHG emissions substantially exceed GHG emissions reduced, avoided, or sequestered, mitigation strategies will be evaluated.

The following mitigation strategies are examples of approaches that may be considered to address significant impacts via the mechanisms described above. These mitigation strategies may be considered, as applicable, during project-level evaluation of specific LTMAs. For more information on LTMA mitigation strategies, see Section 3.1.2, "Analysis Methodology."

Specific mitigation measures identified above in the NTMA and LTMA impact/mitigation pairings are not identified again in the mitigation strategies. It is assumed that mitigation measures described in the impact/mitigation pairings above would already be required, as applicable, as part of the project-level evaluation of specific LTMAs. Not all mitigation measures listed below will apply to all LTMAs; the applicability of mitigation measures will vary based on the location, timing, and nature of each management action. In addition, some mitigation strategies on their own may not constitute sufficient mitigation under CEQA but must be coupled with other mitigation strategies to fully address the impacts of LTMAs.

The following potential mitigation strategies have been identified for GHG emissions:

- Incorporate into conservation actions a program to document and monitor carbon sequestration. Utilize earned "carbon credits" to compensate for program emissions.
- Develop carbon sequestration projects by planting riparian forest, coniferous forest, and other forest/woodland types.
- Purchase carbon credits to compensate for GHG emissions generated by the proposed program.
- Design and locate new facilities to minimize the use of energy and fuel required for operations and maintenance.

Consider the organic and nutrient content of soils and amount of submerged vegetation when evaluating potential locations for floodway expansions. Favor sites with low organic and nutrient content, and manage inundation regimes to minimize anaerobic, microbial GHG emissions.