7.10 Greenhouse Gas Emissions

This section describes the environmental setting, potential impacts, and mitigation measures for greenhouse gas (GHG) emissions impacts that may result from changes in hydrology or changes in water supply.

Changes in hydrology, including changes in the amount and timing of flows and changes in reservoir operations and levels could alter the production of hydropower generation. Increased power generation to balance any loss of hydropower production could generate increased GHG emissions.

Changes in water supply include actions in response to reductions in Sacramento/Delta supply, including groundwater pumping and other water management actions, such as groundwater storage and recovery, water transfers, and water recycling. These actions could result in increased operational energy consumption from groundwater pumping and GHG-emitting sources and equipment. Fallowing of agricultural land, replacement water that requires less treatment, and water conservation would decrease energy consumption and reduce GHG emissions.

Section 7.1, *Introduction, Project Description, and Approach to Environmental Analysis*, describes reasonably foreseeable methods of compliance and response actions, including actions that would require construction. These actions are analyzed for potential environmental effects in Section 7.21, *Habitat Restoration and Other Ecosystem Projects*, and Section 7.22, *New or Modified Facilities*.

7.10.1 Environmental Checklist

VII. Greenhouse Gas Emissions	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
Would the project:				
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 adopted for the purpose of reducing the emissions of greenhouse gases?	☒	☐	☐	☐

Sections 7.10.2, *Environmental Setting*, and 7.10.3, *Regulatory Setting*, describe background information on GHG emissions and the regulatory setting related to GHG emissions to inform the impact discussion presented in this section and in Section 7.21, *Habitat Restoration and Other Ecosystem Projects*; Section 7.22, *New or Modified Facilities*; and Chapter 9, *Proposed Voluntary Agreements*.

7.10.2 Environmental Setting

While there is some uncertainty in precise predictions, it is widely understood that climate change is expected because of past and future GHG emissions. Climate change refers to "any significant change in measures of climate, such as average temperature, precipitation, or wind patterns over time" (OPR 2008). Climate change is a complex phenomenon resulting from natural processes and human activities that has the potential to alter local climatic patterns and meteorology. Increases in anthropogenic (i.e., human-caused) GHG emissions have been unequivocally linked to recent warming and climate shifts (IPCC 2014). Although modeling by entities such as the Intergovernmental Panel on Climate Change indicate that climate change is occurring globally and regionally, there remains uncertainty with regard to characterizing the precise climate change characteristics at the local level and predicting precisely how various ecological and social systems will react to changes in the existing climate at the local level.

The most common GHGs resulting from human activity and contributing to climate change are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). State CEQA Guidelines section 15364.5 also defines GHGs to include perfluorocarbons, sulfur hexafluoride, and hydrofluorocarbons. The primary anthropogenic processes that release these gases consist of burning fossil fuels for transportation, heating, and electricity generation; agricultural practices that release CH_4 and N_2O, such as livestock grazing and crop residue decomposition; and industrial processes that release smaller amounts of GHGs, such as sulfur hexafluoride, perfluorocarbons, and hydrofluorocarbons (^DWR 2012). Deforestation and land cover conversion also have been identified as contributing to climate change by reducing the Earth's capacity to remove CO_2 from the air and altering the Earth's albedo, or surface reflectance, allowing more solar radiation to be absorbed (Longobardi et al. 2016).

Unlike criteria air pollutants, which occur locally and regionally, the long atmospheric lifetimes of GHGs allow them to be well mixed in the atmosphere and transported over distances. No single emitter of GHGs is large enough to trigger global climate change on its own. Rather, climate change is the result of the individual contributions of countless past, present, and future sources. Thus, GHG emissions impacts are inherently cumulative.

7.10.2.1 Greenhouse Gas Emissions Inventories

A GHG inventory is a quantification of GHG emissions and sinks within a selected physical or economic boundary over a specified time. GHG inventories can be performed on a large scale (e.g., for global and national entities) or on a small scale (e.g., for a particular building or person). According to California's statewide GHG emission inventory, which establishes historical emission trends and tracks California's progress in reducing GHGs, transportation is the largest source of 2020 GHG emissions (38 percent of emissions), followed by industrial sources (23 percent) and in-state electricity generation (11 percent) (CARB 2022a).

There is no regional GHG inventory for the study area. Activities known to produce GHG emissions currently take place throughout the study area. Activities producing the largest amounts of GHG emissions include mobile sources (e.g., vehicle trips) and electricity generation that utilizes fossil fuels (e.g., natural gas, digester gas). Power-generating facilities are located throughout the study area, with larger concentrations of facilities in urban areas (e.g., San Francisco Bay Area, Los Angeles, San Diego) (^CEC 2017a). Water transport of Delta exports to areas beyond the San Joaquin Valley (e.g., Southern California) also results in GHG emissions. Large amounts of electricity, the generation of which emits GHGs, are required to transport water exports over higher elevations for deliveries to the CVP and SWP water contractors in other parts of the state. Groundwater pumping for private, agricultural, or municipal consumption takes place throughout the study area, with increased groundwater pumping occurring in rural and agricultural areas (e.g., San Joaquin Valley). Groundwater pumping uses nonelectric and electric pumps and other stationary sources (e.g., generators) that generate GHG emissions. Other smaller sources of GHG emissions include facility operation and maintenance activities that involve equipment and vehicle use, worker commutes, and material delivery activities.

7.10.2.2 Climate Change Effects

Globally, average surface temperature during the last 100 years has not increased at a constant rate. Nevertheless, each of the last three decades (1983–2012) has been successively warmer than any preceding decade (going back to 1850) (IPCC 2014). During this same period, many other changes have occurred to natural systems, including the following.

- Sea levels rose on average 1.7 millimeters per year between 1901 and 2010.
- Precipitation patterns 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 and is now occurring earlier in the year (^DWR 2012; IPPC 2014).

In California, maximum (daytime) and minimum (nighttime) temperatures are increasing throughout the state, but at different rates depending on location (e.g., inland vs. coastal). The average annual statewide minimum temperature increased 0.33 degree Fahrenheit per decade from 1920 through 2003, while the average annual maximum temperature increased 0.1 degree Fahrenheit per decade (^DWR 2012). In addition to changes in temperatures, the following primary effects of climate change are anticipated in California over the next century (CNRA 2009).

- Reduced or slightly increased annual precipitation amounts.
- Change from snowfall (and spring snowmelt) to rainfall.
- Decreased Sierra snowpack (earlier runoff, reduced maximum storage).
- Increased evapotranspiration.
- Increased frequency and intensity of Pacific storms (flood events).
- Increased severity of droughts.
- Increased frequency and severity of extreme heat events.
- Increased frequency and severity of wildfire events.
- Sea level rise (with increased saltwater intrusion into the Delta).
- Changes in species distribution and ranges.
- Decreased number of species.
- Increased number of vector-borne diseases and pests (including impacts on agriculture).
- Altered timing of animal and plant lifecycles (phenology).

- Disruption of biotic interactions (e.g., predator-prey relationships and increased invasive species abundance).
- Changes in physiological performance, including reproductive success and survival of plants and animals.
- Increase in invasive species.
- Altered migration patterns of fishes, aquatic-breeding amphibians, birds, and mammals.
- Changes in food (forage) base.
- Changes in habitat, vegetation structure, and plant and animal communities.

The most significant impacts of climate change on California's water resources are 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 (^DWR 2012). Snowpack in the Sierra Nevada, which serves as an important natural reservoir, is also melting earlier in the spring (^DWR 2012) leading to reduced water availability later in the year when demand is high. 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 2012). These changes have significant adverse implications for state and local water supplies, flooding, aquatic ecosystems (e.g., cold water fish habitats), energy generation, and recreation. Similarly, sea level rise associated with increases in global temperatures will continue to threaten coastal lands and infrastructure, increase flooding at the mouths of rivers, place additional stress on levees in the Delta, cause saltwater intrusion into freshwater supplies, and intensify the difficulty of managing the Delta as a major hub of the state's water supply system (^DWR 2012).

Guidance documents have been drafted and published to discuss strategies to protect resources from climate change in California (e.g., the *State of California Sea-Level Rise Guidance Document*, developed by the Coastal and Ocean Working Group of the California Climate Action Team in 2010 and updated in 2013 and 2018). Many federal, state, and local agencies are incorporating adaptive strategies into their planning processes and planning documents to account for the potential changes in water resources and the effect on water supply reliability and other factors.

7.10.3 Regulatory Setting

7.10.3.1 Federal

Several federal executive orders (EO) have been signed by President Joe Biden related to GHG emissions and climate resiliency. EO 13990, signed in January 2021, set a national goal to achieve a 50 to 52 percent reduction from 2005 levels in economy-wide net GHG pollution in 2030. EO 14057, signed in December 2021, requires federal agencies to develop strategic processes for achieving, among other things, carbon-free electricity by 2030 and 100 percent zero-emission vehicle acquisitions by 2035. President Joe Biden has also signed two bills—Infrastructure Investment and Jobs Act (2021; H.R. 3684; Public Law 117-58) and Inflation Reduction Act (2022; H.R. 5376; Public Law 117-169)—that provide funding for infrastructure improvements that will reduce GHG emissions and bolster resilience to climate change.

Despite these actions, there is currently no federal law or legislatively mandated national GHG reduction target. However, the U.S. Environmental Protection Agency (USEPA) has adopted the Greenhouse Gas Reporting Rule (Reporting Rule). The Reporting Rule is a response to the fiscal year

2008 Consolidated Appropriations Act (H.R. 2764; Public Law 110-161), which required USEPA to develop "mandatory reporting of GHGs above appropriate thresholds in all sectors of the economy…." The Reporting Rule applies to most entities that emit 25,000 metric tons (MT) of carbon dioxide equivalent (CO_2e) or more per year. Starting in 2010, facility owners were required to submit an annual GHG emissions report with detailed calculations of facility GHG emissions. The Reporting Rule also mandates recordkeeping and administrative requirements for USEPA to verify annual GHG emissions reports. All electrical distribution utilities except investor-owned utilities must comply with the Reporting Rule.

7.10.3.2 State

Executive Orders and Legislation

California has adopted statewide legislation and other measures addressing various aspects of climate change and long-term GHG emissions reductions. Several EOs issued by the governor contain direction to state agencies to address the state's evolving climate change policy (e.g., EO S-3-05, EO S-13-08, EO B-30-15, and EO B-55-18), including establishing emissions reduction targets for 2020, 2030, 2045, and 2050. California also has established a Renewables Portfolio Standard (RPS), which obligates investor-owned utilities, energy service providers, and community choice aggregators to increase retail sales from eligible renewable sources each year. Specifically, California utilities are required to generate 44 percent of their electricity from renewables by 2024 (Senate Bill [SB] 100[1]), 50 percent by 2026 (SB 100), 52 percent by 2027 (SB 100), 60 percent by 2030 (SB 100), 90 percent by 2035 (SB 1020[2]), 95 percent by 2040 (SB 1020), and 100 percent by 2045 (SB 100/SB 1020). SB 1020 also requires state agencies to rely on 100 percent renewable energy and zero-carbon resources to serve their own facilities by 2035.

To attain these goals, energy sources that are not part of the RPS can be included as long as they do not emit carbon dioxide. For example, large hydropower and nuclear power could contribute to attainment of 100 percent carbon-free electricity. In addition, Assembly Bill (AB) 32, (Nunez), Statutes of 2006, added Division 25.5 (commencing with section 38500) to the Health and Safety Code that codified the state's GHG emissions reduction target by requiring that the state's GHG emissions be reduced to 1990 levels by 2020 (achieved). SB 32 (Pavley), Statutes of 2016, added section 38566 to the Health and Safety Code to legislate EO B-30-15, further requiring that statewide GHG emissions be reduced to at least 40 percent below the 1990 level by 2030. Finally, AB 1279 (Muratsuchi), Statutes of 2022, added section 38562.2 to the Health and Safety Code to legislate EO B-55-18, requiring California to achieve net zero GHG emissions (i.e., reach a balance between the GHGs emitted and removed from the atmosphere) no later than 2045 and to achieve and maintain net negative GHG emissions from then on. It also mandates an 85-percent reduction in statewide anthropogenic GHG emissions (from 1990 levels) by 2045.

California Air Resources Board Climate Change Scoping Plan

The California Air Resources Board (CARB), which is responsible for regulating the state's GHG emissions, is required by AB 32 to develop a Scoping Plan that describes the approach California will take to reduce GHGs. CARB adopted the first AB 32 Scoping Plan in 2008 and an update in 2014.

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[1] De León, Statutes of 2018, Public Utilities Code sections 399.11, 399.15, and 399.30.

[2] Clean Energy, Jobs, and Affordability Act of 2022, Statutes of 2022, Public Utilities Code sections 454.59 and 739.13.

With the passage of SB 32, CARB moved forward with a second update to the Scoping Plan to reflect the 2030 target. *California's 2017 Climate Change Scoping Plan* was built on the previous update and includes energy and water efficiency and renewable energy measures, targets for transportation-related GHG emissions, and targeted fees to reduce emissions (^CARB 2017). The scoping plans also identify cap-and-trade as a key component of the state's emission reduction strategy. CARB (2022b) released the *2022 Scoping Plan for Achieving Carbon Neutrality* in November 2022 to identify a technologically feasible, cost-effective, and equity-focused path to achieve carbon neutrality by 2045, pursuant to AB 1279.

California Cap-and-Trade Program

Cap-and-trade is a market-based regulation designed to reduce GHG emissions from multiple sources, including electricity generation. Under the cap-and-trade program, CARB issues a limited number of "allowances" (essentially, emission permits), which large GHG emitters can purchase at a state-run auction or on the private market. The program sets a firm limit, or cap, on GHG emissions, establishes a price for GHGs, and originally aimed to minimize the compliance costs of achieving AB 32 goals. Governor Brown signed into law AB 398 (Eduardo Garcia), Statutes of 2017, amended, repealed, and added sections 38501, 38562, and 38594 of the Health and Safety Code to extend the California cap-and-trade program through December 31, 2030, and ensure compliance with SB 32 targets. The program covers electricity generators emitting more than 25,000 $MTCO_2e$ per year. Power-generating facilities that have an electricity-generating capacity of 50 megawatts or larger are regulated by the California Energy Commission, and facilities that have electricity-generating capacity of less than 50 megawatts are regulated by local air districts through operating permits (CARB 2008).

Previous lawsuits have attempted to call into question whether the cap-and-trade program is outside CARB's authority or whether the auction of GHG allowances is a tax (which would have required legislative approval by a two-thirds vote in California). The California Court of Appeal, in *California Chamber of Commerce v. State Air Resources Board* (2017) 10 Cal.App.5th 604, ruled that the state legislature had given CARB "broad discretion" to design a system for reducing emissions and that the auction of emissions allowances did not exceed the scope of CARB's delegated authority. The court also held that auction sales of the emissions allowances were not a tax because purchase of the allowances was voluntary and because the allowances were "valuable, tradable commodities, conferring on the holder the privilege to pollute." The purchase of allowances, therefore, did not bear the hallmarks of a tax. The California Supreme Court subsequently declined to consider appeals from the plaintiffs/appellants. By declining to consider the appeal, the Supreme Court affirmed the Court of Appeal's decision and the essential legality of the program.

State Water Board Climate Change Resolution 2017-0012

The State Water Board has taken a variety of actions to respond to climate change, including the adoption of Resolution 2017-0012, which requires a proactive approach to climate change in all State Water Board actions. The resolution proposes actions to reduce energy requirements associated with providing reliable water supplies (water use efficiency, water recycling, and reuse of urban runoff), and reduce the amount of nonrenewable energy associated with conveying and treating water and providing adequate wastewater treatment (energy efficiency and increased renewable energy production). Since 2007, the State Water Board also has taken on additional responsibilities and functions, including the addition of the Division of Drinking Water to the State Water Board, implementation of the Sustainable Groundwater Management Act (Wat. Code, § 10720 et seq.), and adoption of statewide drought response and water conservation regulations. The State Water Board also has identified the human right to water as a top priority and core value across all programs and activities, and has taken multiple implementation actions to provide safe, accessible, and affordable drinking water for all Californians (^SWRCB 2017). In addition, the *Recommendations for an Effective Water Rights Response to Climate Change Staff Report* outlines recommendations to make the water availability analysis for permitting new water rights more robust and identifies actions to support an effective water rights response to climate change (SWRCB 2021).

California Water Plan

The California Water Plan is the long-term strategic plan for guiding the management and development of water resources in the state. Since its first publication in 1957, the California Department of Water Resources (DWR) has prepared numerous plan updates. The Water Code requires that the California Water Plan be updated every 5 years.

The *California Water Plan Update 2013* incorporated a comprehensive suite of actions, including strengthening integrated regional water management, using and reusing water more efficiently, and expanding conjunctive management of multiple water supply sources. The update also examined future water demands, resource management strategies, and climate change adaptation (^2013 Water Plan Highlights). *California Water Plan Update 2018* presents a vision for greater collaboration and alignment among water sectors and institutions, sound strategies, and long-term investments needed for the sustainable management of California's water supply. *California Water Plan Update 2018* recommends 19 priority actions to improve integrated watershed management; strengthen infrastructure resiliency; restore ecosystem functions; empower under-represented communities; improve inter-agency alignment; address regulatory challenges; and support decision-making, adaptive management, and long-term planning (DWR 2019).

DWR is currently working on the *California Water Plan Update 2023*. Update 2023 will promote climate change adaptation, support California's regions, and strengthen water equity (^DWR 2022).

California Water Action Plan

The *California Water Action Plan* is a suite of actions developed by the California Natural Resources Agency (CNRA), California Department of Food and Agriculture, and California Environmental Protection Agency to build resiliency into California water management and the ecosystems it supports. The Water Action Plan directives include conservation, integrated management, ecosystem protection, drought planning, expanded water storage, recycled water use, and sustainable and integrated financing. The Water Action Plan also emphasizes diversified regional supply portfolios that provide resiliency in response to drought, flood, population growth and climate change, and multiple-benefits projects, which are integral to climate mitigation and adaptation (CNRA et al. 2016).

California Climate Adaptation Strategy 2009, 2018, and 2021 Updates

In 2009, California adopted a statewide *California Climate Adaptation Strategy* (CAS). The CAS summarizes climate change impacts and recommends adaptation strategies for seven sectors—public health, biodiversity and habitat, oceans and coastal resources, water, agriculture, forestry, and transportation and energy (CNRA 2009). In 2018, the CAS was updated to provide the next steps to respond to climate change in 11 sectors, including the water sector. The update includes overarching strategies recommended by CNRA and ongoing actions and cost-effective and achievable next steps to make California more resilient to climate change (CNRA 2018). The CAS was updated again in 2021 to organize the state's climate adaptation efforts around six outcome-based resilience priorities and increase the state's ability to measure progress. The 2021 CAS also unifies collective climate adaptation efforts across all sectors and regions (CNRA 2022).

Department of Water Resources Climate Action Plan

In 2012, DWR adopted the first phase of its *Climate Action Plan* (CAP). The CAP is DWR's guide to addressing climate change in the programs, projects, and activities over which it has authority and establishes DWR's GHG emissions reduction goals and strategies for 2020 and 2050. The CAP details DWR's progress and future plans for reducing GHG emissions consistent with GHG emissions reduction targets established by AB 32 and EO S-3-05 and outlines the steps DWR will take to reduce and monitor its emissions, including energy efficiency improvements, construction best management practices, and procurement of renewable energy (^DWR 2012). In July 2020, DWR updated its CAP based on a review of GHG reductions since 2012. The update establishes DWR's GHG emissions reduction goals and strategies for 2030 and 2040 and expands strategies, such as those relating to maintenance and business practices, to achieve further reductions consistent with EOs B-30-15 and B-55-18 and SB 32 (^DWR 2020).

In addition, DWR has devoted considerable attention to analyzing, planning, and implementing strategies that minimize energy use, maximize hydroelectric energy generation, increase the use of clean and renewable energy supplies, and increase the use of SWP lands for building renewable energy projects. These strategies include the termination of power supply agreements from high–GHG-intensity supplies, procurement of high-efficiency energy sources, and replacement and refurbishment of generating and pumping equipment to increase energy efficiencies. These strategies are included in DWR's CAP (DWR 2020).

Progress on Incorporating Climate Change into Management of California's Water Resources (Technical Memorandum Report)

In response to EO S-3-05, DWR developed a report describing progress made toward incorporating climate change into existing water resources planning and management tools and methodologies to guide future climate change analysis. This report focuses on assessment methodologies and preliminary study results and is primarily focused on the potential effects of climate change on the Central Valley and associated water resource systems (DWR 2006).

State Water Board Strategic Plan and Regional Water Quality Control Plans

The State Water Board and regional water boards regularly review and update as appropriate water quality control plans. This planning process provides an opportunity to consider information related to water quality, such as developing information about climate change. The *2010 Update to Strategic Plan 2008–2012* calls for the continued consideration of climate change in several areas, including the planning process for water quality control plans. Under climate change scenarios, it is likely that increased flow variability and shifts in timing of high flows would occur (SWRCB 2010).

California Water Resilience Portfolio

In April 2019, Governor Newsom issued EO N-10-19, directing three state agencies, CNRA, the California Environmental Protection Agency, and the California Department of Food and Agriculture to develop recommendations to meet California water security challenges. In response to this order and in collaboration with the identified agencies, DWR published the *2020 Water Resilience Portfolio* in July 2020 (CNRA et al. 2020). The portfolio builds on previous work created by the state under the California Water Action Plan. The portfolio establishes four broad approaches to prepare California's water systems for a warmer and more variable climate: (1) maintain and diversify water supplies; (2) protect and enhance natural systems; (3) build connections; and (4) to be prepared. From these broad approaches, the portfolio includes more than 100 detailed actions that can be applied at local, regional, and tribal levels to ensure California water systems work for communities, the economy, and the environment. In January 2022, DWR (2022b) published a progress report documenting its efforts to implement the portfolio over the previous 18 months.

7.10.3.3 Local

Air District Rules, Regulations, and Guidance

As discussed in Section 7.5, *Air Quality*, California air districts have developed guidance and established thresholds to evaluate activities for air quality impacts. To evaluate activities for GHG emissions impacts, several air districts (e.g., Sacramento Metropolitan Air Quality Management District) have adopted a stationary source threshold of 10,000 $MTCO_2e$. This threshold captures a substantial fraction (typically 90 to 95 percent, depending on the regional inventory) of emissions from new stationary source projects. New projects with emissions of more than 10,000 $MTCO_2e$ typically account for less than 10 percent of new permit applications but represent 90 to 95 percent of stationary source GHG emissions. Accordingly, this threshold applies to large, significant projects that emit most of the new GHGs without overburdening smaller developments. Several air districts throughout the study area also have identified numeric thresholds to evaluate GHG emissions from new land use development projects (e.g., residential developments).

City and County Climate Action Plans

Several cities and counties have prepared and adopted CAPs that outline a variety of strategies to reduce GHG emissions generated by community and municipal activities. These strategies include actions to reduce operational emissions sources and promote sustainable land use to meet GHG emissions reduction targets.

Integrated Regional Water Management Plans

Several entities have adopted integrated regional water management plans (e.g., San Francisco Bay Area, San Joaquin Valley). The integrated regional water management plans coordinate with local planning efforts by using local water plans as a basis for developing a regional view of water supply, water quality, wastewater, recycled water, flood protection, stormwater management, watershed management, habitat protection and restoration, and climate change mitigation and adaptation strategies (Kennedy/Jenks Consultants 2013; ESJCGBA 2014).

Local Water Management Plans

Irrigation districts within the study area have adopted agricultural water management plans and provided them to DWR. These plans generally have sections that discuss the expected effects of climate change on agriculture within their districts and on water supply used within the districts. In addition, all municipal water providers that receive surface water from the irrigation districts have prepared urban water management plans for their respective service areas as required. Some urban water management plans have sections that discuss the expected effects of climate change on water demand and water supply used within their service areas.

7.10.4 Impact Analysis

This section identifies potential GHG emissions resulting from the changes in hydrology and changes in water supply that could significantly affect the environment or conflict with an applicable plan, policy, or regulation adopted to reduce GHG emissions.

Changes in hydrology include changes in the amount and timing of flows in the Sacramento River watershed and Delta eastside tributaries, Delta outflow, and changes in reservoir operations and levels. These changes could alter the production of hydropower generation and result in the need to offset reductions with power generated at fossil-fuel facilities. Reasonable assumptions have been made to analyze and quantify potential GHG emissions associated with these changes.

Changes in water supply include reduced Sacramento/Delta supply for agricultural use that could decrease long-term GHG emissions due to fallowing of agricultural land. Changes in water supply also include actions in response to reductions in Sacramento/Delta supply, including groundwater pumping and other water management actions such as groundwater storage and recovery, water transfers, and water recycling. Increased groundwater pumping using diesel-powered pumps could generate GHG emissions exceeding the 10,000 $MTCO_2e$ threshold and conflict with plans and policies to reduce GHG emissions. Other actions could result in increased operational energy consumption at fossil-fuel facilities from groundwater pumping using electric-powered pumps and from other GHG-emitting sources and equipment to utilize groundwater storage and recovery, water transfers, and water recycling. A qualitative and quantitative discussion is provided for increased emissions associated with changes in water supply because the specific type and magnitude of actions taken in response to the proposed Plan amendments cannot be precisely predicted. While reduction in supply could affect operations at existing wastewater treatment plants, transitions to cleaner energy sources by utilities could offset these increases. Further, water conservation measures may reduce the energy required for drinking water treatment, wastewater treatment, and water heating.

The proposed Plan amendments generally support and are consistent with several GHG reduction measures recommended by CARB (e.g., water use efficiency, water recycling, reuse of urban runoff), which would be beneficial in meeting any other state and local goals outlined in the water and climate change plans. However, changes in water supply also could result in increased GHG-emitting sources and equipment, which may conflict with applicable plans.

Section 7.21, *Habitat Restoration and Other Ecosystem Projects*, and Section 7.22, *New or Modified Facilities,* describe and analyze potential GHG emissions impacts from various actions that involve construction.

Impact GHG-a: Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment

Changes in Hydrology

Reduced Hydropower Generation in the Sacramento River Watershed and Delta Eastside Tributaries Regions

Numerous hydropower generation facilities are in the Sacramento River watershed and Delta eastside tributaries regions and would be affected by the proposed Plan amendments (see Section 7.8, *Energy*). Changes in hydrology include changes in the amount and timing of flows in the Sacramento River watershed and Delta eastside tributaries regions, and changes in reservoir operations and levels. These changes could alter the production of hydropower generation, which in turn could result in additional energy generation at fossil-fuel facilities.[3]

As described in Section 7.8.3, *Impact Analysis*, Impact EN-a under *Evaluation of Hydropower Generation in the Sacramento River Watershed and Delta Eastside Tributaries Regions* in Section 7.8, *Energy*, hydropower generation would increase during the spring and be reduced during the summer. To compensate for any reduced hydropower electricity generation, other facilities may need to increase electricity production to meet electricity demands from end-users. Hydropower serves a somewhat unique function in that it can be turned on and off, an ability that helps compensate for fluctuations in solar and wind power and helps to meet peak daily demand. While additional energy may be produced by renewable energy facilities (e.g., solar and wind facilities), it is more likely that fossil-fuel facilities, specifically existing natural-gas facilities, would be required to offset reductions in hydropower generation. Therefore, this analysis conservatively assumes that natural-gas facilities would be used to compensate for the estimated reductions in hydropower generation.

Emission factors from USEPA's Emissions and Generation Revenue Integrated Database for natural-gas facilities were used to determine GHG emissions associated with displaced hydropower production (USEPA 2022). Table 7.10-1 lists the GHG emission factors for CO_2, CH_4, and N_2O for natural-gas facilities used in the analysis.

Table 7.10-1. Greenhouse Gas Emission Factors for Natural-Gas Facilities (pounds per megawatt hour)

Area	CO_2	CH_4	N_2O
California	895.9	0.016	0.002

Source: USEPA 2022, page ref. n/a.
CH_4 = methane; CO_2 = carbon dioxide; N_2O = nitrous oxide

[3] While the analysis of GHG emissions impacts focuses on indirect emissions from reduced quantities of hydropower supplied to the California grid, some research suggests that operation of hydroelectric turbines may release dissolved CH_4. Changes in flow rates and water conveyance may also affect GHG flux rates in adjacent canals and rivers. However, the GHG flux rate and amount of released CH_4 is highly variable and depends on a number of site-specific factors, including the reservoir depth, the amount of organic material/plant material, the flow rate, and the reservoir/river location (Teodoru et al. 2012). Moreover, while turbines may hasten the release of excess CH_4, those emissions likely would be released downstream regardless of whether the water runs through a turbine (Teodoru et al. 2012). Accordingly, this analysis does not include evaluations of CH_4 emissions during turbine operation or of changes in GHG flux rates in upstream and downstream tributaries because they would be speculative, and the net systematic effect likely would be immaterial.

As discussed in Chapter 5, *Proposed Changes to the Bay-Delta Plan for the Sacramento/Delta*, the proposed program of implementation for the Plan amendments provides for a range of flow scenarios from 45 to 65, with default implementation starting at the 55 scenario. Changes in annual average hydropower generation for the flow scenarios are compared with the baseline. The 35 and 75 flow scenario results are also presented in tables to inform the analyses of low and high flow alternatives in Section 7.24, *Alternatives Analysis*.

Table 7.10-2 presents the GHG emissions estimates associated with replacement power due to reductions in hydropower generation. Emission factors are multiplied by the change in hydropower generation for baseline and the flow scenarios to determine the change in GHG emissions. Annual average hydropower generation could decrease by approximately -27 to -99 gigawatt hours (GWh) (45 to 65 scenarios), resulting in an increase of 10,983 to 40,271 MTCO_2e per year from replacement power supply from existing natural-gas facilities.

Table 7.10-2. Greenhouse Gas Emissions Associated with Replacement Power due to Reductions in Hydropower Generation

Changes in Annual Average Hydropower Generation from Baseline (flow scenario)	Greenhouse Gas Emissions (metric tons/year)			
	CO_2	N_2O	CH_4	CO_2e
Baseline	0	0	0	0
-10 GWh (35)	4,064	<1	<1	4,068
-27 GWh (45)	10,972	<1	<1	10,983
-56 GWh (55)	22,757	<1	<1	22,780
-99 GWh (65)	40,231	1	<1	40,271
-153 GWh (75)	62,176	1	<1	62,237

Sources: Appendix A5, *Hydropower, Energy Grid, and Export Energy Analyses* (Table A5-8); USEPA 2022, page ref. n/a. See also Section 7.8, *Energy*.
CH_4 = methane; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GWh = gigawatt hour; N_2O = nitrous oxide

Changes in hydrology under the proposed Plan amendments (45 to 65 scenarios) could result in GHG emissions at natural-gas facilities to compensate for the estimated reductions in hydropower, as identified in Table 7.10-2. The proposed Plan amendments also could result in less exported water through the SWP and CVP from the Delta to other regions, including Southern California, which would result in corresponding energy reductions. Reduced Delta exports could more than compensate for these emissions (see discussion in Section 7.8.3, *Impact Analysis*, Impact EN-a under *Evaluation of Change in Energy to Export Sacramento/Delta Water Supply* in Section 7.8, *Energy*), but precise emission benefits cannot be quantified. A portion of these emissions savings from reduced Delta exports also may be offset by energy needed to secure replacement water supply (as described under *Changes in Water Supply*), depending on how water users respond to reductions in Sacramento/Delta supply. Replacement methods that could result in increased emissions include groundwater pumping and other water management actions such as groundwater storage and recovery, water transfers, and water recycling (as described under *Other Water Management Actions*). If response actions include north to south water transfers, exports could increase beyond what was modeled by the Sacramento Water Allocation Model (SacWAM) and offset energy and emissions reductions associated with reduced Delta exports.

California's continued climate change efforts, which include expanding power procured from renewable resources, would reduce emissions as the GHG intensity of the state energy supply declines as a function of time. Accordingly, the net change in annual energy-related GHG emissions from implementation of the proposed Plan amendments over time is unknown and cannot be quantified with certainty. However, it is known that, pursuant to SB 100 and SB 1020, indirect emissions from displaced purchases of hydropower within the state's electric grid would achieve carbon neutrality by 2045.

California's 2017 Climate Change Scoping Plan and the *2022 Scoping Plan for Achieving Carbon Neutrality* include measures that will provide necessary emissions reductions from the electric power sector to achieve the state's 2030 and 2045 GHG reduction goals. For example, under the cap-and-trade program, CARB issues a limited number of allowances (i.e., emission permits) that large GHG emitters can purchase at a state-run auction or on the private market. The regulation places strict compliance obligations on entities covered by the program, including electric power–generating facilities. Penalties may be assessed pursuant to Health and Safety Code section 38580 (e.g., misdemeanor, fines, and possibly imprisonment). There are separate and substantial penalties for misreporting or non-reporting under the Mandatory GHG Reporting Regulation in California Code of Regulations, title 17, sections 95100 to 95163.

Reductions in hydropower generation could increase electricity generation demand at existing natural-gas facilities. Under the California cap-and-trade program, fossil-fueled electric generating facilities that increase production to replace lost hydropower would be required to purchase emissions allowances for any increase in emissions above their designated cap. With passage of AB 398, purchased allowances would decrease GHG emissions consistent with SB 32, thereby ensuring that emissions from reduced hydropower generation would comply with the state's 2030 GHG reduction goal of reducing statewide emissions to 40 percent below 1990 levels. By 2045, all retail sales of electricity to California end-users would be provided by zero-carbon resources under the state's RPS (SB 100/1020). SB 1020 also requires state agencies to rely on 100 percent renewable energy and zero-carbon resources to serve their own facilities by 2030. Although replacement of hydropower could result in increased emissions in the near-term, emissions would decline consistent with the state's GHG reduction trajectory to reach carbon neutrality by 2045. Accordingly, the reduced hydropower generation would not result in greenhouse gas emissions, either directly or indirectly, that would have a significant impact. This impact would be less than significant.

Changes in Water Supply

Groundwater Pumping

Reduced Sacramento/Delta water supply for agriculture could result in fallowing of agricultural land and a subsequent reduction in emissions from conveying irrigation water to those lands. A reduction in Sacramento/Delta surface water supply to municipal users could lead to replacement with groundwater supply. Groundwater supply often receives less treatment for drinking water purposes than surface water, which could reduce the amount of emissions associated with treatment. However, these emissions savings could be counteracted by the emissions resulting from groundwater pumping to replace reduced surface water supplies.

It is currently unknown what types of pumps (electric, diesel, gas, other fuel) would be used to pump groundwater because it is not known at this time which wells (existing and/or new) would increase pumping. However, based on the U.S. Department of Agriculture (USDA) 2013 Farm and Irrigation Survey, it is anticipated that most deep wells are and would be powered by electric pumps, while a smaller portion would be powered by diesel, gasoline, and other fuels (USDA 2014).

Electric pumps produce fewer GHG emissions per unit of power than fossil-fuel–powered pumps. For example, an electric pump would generate about 30 percent less emissions per horsepower-hour than an equivalently sized diesel pump (based on emission factors from USEPA [2022] and Trinity Consultants [^2017]). More than 85 percent of irrigation wells in California are powered by electric pumps (USDA 2014).

According to USDA, use of renewable energy (e.g., solar) to power groundwater pumps has been steadily increasing in the agricultural sector. Between 2003 and 2008, use of renewable-based pumps increased fivefold in California. This trend is anticipated to continue because costs associated with renewable-based pumps have dramatically declined (USDA 2011). Therefore, energy consumption from electric and nonelectric groundwater pumping is anticipated to decline over time as renewable-based pump use increases.

Emissions from Electric Pumps

The total extent of electric groundwater pumping that may result from changes in supply under the proposed Plan amendments is unknown. The California Energy Commission estimates that water supplied from groundwater requires approximately 400 to 1,200 kilowatt hours of energy per acre-foot (AF) (see Section 7.8, *Energy*). Based on emission factors from USEPA's Emissions and Generation Revenue Integrated Database for the California grid average, pumping 1 AF of water would result in 206 to 619 pounds of CO_2e emissions.[4] Emissions from electric-powered pumps would occur at existing electric generating facilities throughout the state. Similar to emissions from increased power generation to balance the loss of hydropower production, the cap-and-trade program outlined in *California's 2017 Climate Change Scoping Plan* will provide necessary emission reductions (i.e., emission allowances) for fossil-fueled electric generation facilities to offset any increase in emissions associated with electric groundwater pumping above each facility's designated cap. In addition, with the passage of AB 398, purchased allowances would decrease GHG emissions consistent with SB 32, thereby ensuring that indirect emissions associated with responses to the proposed Plan amendments would not conflict with the state's 2030 GHG reduction goal of reducing statewide emissions to 40 percent below 1990 levels. As noted previously, all retail sales of electricity to California end-users also will be provided by zero-carbon resources by 2045 under the state's RPS (SB 100/1020). Therefore, impacts resulting from replacement groundwater pumping with electric fuel pumps would be less than significant.

Emissions from Nonelectric Fuel Pumps

The study area spans multiple air basins and air districts, each with different local conditions, such as climate, and many with different local regulations, thereby resulting in varied levels of GHG emissions depending on the location of activities taken in response to changes in water supply. Several local air pollution control districts (e.g., Sacramento Metropolitan Air Quality Management District) have established a threshold of 10,000 $MTCO_2e$ per year to evaluate emissions from individual industrial and stationary source projects, such as diesel-powered pumps. This analysis uses a threshold of 10,000 $MTCO_2e$ per year for the combined emissions of diesel, gasoline, or other nonelectric groundwater pumping. Use of the 10,000 $MTCO_2e$ threshold is conservative because it was developed to analyze emissions generated by a single stationary source, as opposed to

[4] The energy source for the electric pumps is currently unknown. Potential energy sources include renewable and fossil-fuel facilities. Therefore, the California grid average, which assumes a mix of energy sources, is used in this analysis.

emissions from a plan that is composed of numerous individual emission sources. The use of a stationary source threshold would, therefore, conservatively apply to emissions generated by multiple emission sources from increased groundwater pumping from diesel pumps in response to the proposed Plan amendments. Analyses completed by air districts that have adopted this threshold indicate that projects that could exceed the 10,000 $MTCO_2e$ per year threshold usually involve use of large permitted equipment, such as production flares, steam generators, thermal oxidizers, and furnaces, with an individual or combined project power rating of 20 million British thermal units per hour or greater (SBCAPCD n.d.). Stationary source emissions in excess of the 10,000 $MTCO_2e$ threshold may have a significant impact on the environment.

The extent of groundwater pumping in response to reduced Sacramento/Delta supply is unknown. Depending on the type of fuel used, emissions could vary, though diesel pumps are typically more polluting than pumps powered by other fuels. Therefore, this analysis conservatively assumes that diesel pumps would be used for groundwater pumping. Based on emission factors from the California Emissions Estimator Model (^Trinity Consultants 2017), using a diesel pump to pump 1 AF of water, which requires 400 to 1,200 kilowatt hours of energy, would generate CO_2e emissions of 227 to 682 pounds.

Emissions from diesel-powered pumps would occur locally at the pump source. Depending on the extent of groundwater pumping, the combined emissions level of all other groundwater pumping in the study area could exceed the 10,000 $MTCO_2e$ threshold. This would be a potentially significant impact. Implementation of Mitigation Measure MM-GHG-a will reduce potential GHG emissions through implementation of water use efficiency, water conservation, energy efficiency, and irrigation system management strategies. Implementation of Mitigation Measure MM-GHG-b requires compliance with applicable air quality plans, programs, rules, and regulations and promotes use of renewable energy sources to minimize GHG emissions. These measures were adapted from agency best practice and mitigation designed to avoid or minimize GHG emissions effects, including: California Air Pollution Control Officers Association's *Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity: Designed for Local Governments, Communities, and Project Developers* (2021), DWR's CAP (2012; 2020a), State Water Board's *Resolution No. 2017-0012: Comprehensive Response to Climate Change* (^2017) and USEPA's *Water Conservation Plan Guidelines* (1998) and *Energy Efficiency in Water and Wastewater Facilities* (2013). Many of these measures are project-level measures appropriate for project-specific development. Individual projects by other public agencies would be subject to the appropriate level of environmental review at the time they are proposed, and site-specific, project-specific mitigation would be identified to avoid or reduce significant effects prior to any project-level action. However, some actions may not require approvals and may not be subject to project-level CEQA review. Unless and until the mitigation is fully implemented, this impact remains potentially significant.

Other Water Management Actions

In response to reduced Sacramento/Delta water supplies, water users may switch to or increase the use of other water management actions such as groundwater storage and recovery, water transfers, water recycling, or water conservation measures to meet water demand.

The degree to which other water management actions are utilized in response to reduced Sacramento/Delta supply is uncertain. However, some of these actions could increase GHG emissions from increased energy consumption. The net change in energy use and any associated GHG emissions would depend on the response actions that are chosen.

Energy requirements for storing groundwater as part of a groundwater storage and recovery operation may include energy use by injection wells. Other types of groundwater storage may require less energy. For example, passive water recharge requires minimal additional energy once the infrastructure is in place and during stormwater capture (e.g., directing runoff to open spaces and other unpaved areas and harvesting rainwater for non-drinking uses) (NRDC 2016). Energy use and emissions associated with groundwater pumping to extract stored water are similar to what is described in the *Groundwater Pumping* subsection. Water transfers from groundwater substitution also could increase emissions associated with groundwater pumping.

Water recycling facilities require substantial amounts of energy during operations (e.g., for processing, treatment, and discharge). However, wastewater that is not recycled also typically requires treatment before any water can be discharged into the environment. Therefore, use of recycled water, depending on the conveyance needs and discharge destination, is not anticipated to substantially increase energy requirements or GHG emissions when compared with standard water treatment practices.

Reduced surface water supply or increased water conservation could affect operations at existing municipal wastewater treatment plants, at water recycling facilities, and throughout the wastewater conveyance system. As discussed in Section 7.12.1, *Surface Water*, reductions in overall wastewater flow rates could result in lower pipe velocities and longer detention times in sewer collection systems. Anaerobic decomposition may also increase, resulting in the potential generation of CH_4 within the conveyance system (^DeZellar and Maier 1980). While declining flows could exacerbate blockages, facilities have preventive measures to mitigate blockages and reduce corrosion.

For the purposes of this analysis, implementation of other water management actions would occur through use of existing infrastructure (i.e., existing conveyance facilities, groundwater wells, or recycling facilities) that may require additional operational energy for pumping, treatment, processing, and transport. (Construction-related impacts from building new or modified facilities is evaluated in Section 7.22, *New or Modified Facilities*.) Table 7.8-5 in Section 7.8.3, *Impact Analysis*, Impact EN-e under *Evaluation of Energy Costs of Actions to Replace Reduction in Water Supply from the Sacramento/Delta* in Section 7.8, *Energy*, summarized the average reduction in Sacramento/Delta water supply for the 55 scenario in thousand acre-feet (TAF)/year. Table 7.8-5 also summarizes the existing energy costs of pumping CVP and SWP export water and the energy costs associated with possible response actions that may be taken to replace reductions of Sacramento/Delta water supply. Under the 55 scenario, the average reduction in Sacramento/Delta supply ranged among the regions from 19 TAF to 606 TAF. These reductions likely would be replaced by one or more of the other water management actions, and the per unit cost of each action varies by region. For example, the kilowatt-hour/AF for water transfers ranges from 0 to 240 in the Sacramento River watershed to 2,580 to 3,240 in the Southern California region. The discussion that follows Table 7.8-5 in Section 7.8, *Energy*, describes the other water management actions and conditions that lead to the variations in per unit cost of each action between regions.

To illustrate the least and greatest potential energy costs and associated GHG emissions, Table 7.10-3 presents the low in the lowest region and the high in the highest region to replace 1 AF of water. Emission factors from USEPA's Emissions and Generation Revenue Integrated Database for the statewide electric grid were used to determine GHG emission rates associated with other water management actions (USEPA 2022). The emission results, which are expressed in terms of pounds of CO_2e per AF, are presented in Table 7.10-3.

Table 7.10-3. Summary of Potential Energy and Greenhouse Gas Emissions Costs of Other Water Management Actions

Replacement Water	Unit Energy Cost for Replacement Water (kWh/AF)		Unit GHG Emissions for Replacement Water (lbs CO_2e/AF)	
	Low	High	Low	High
Groundwater Storage and Recovery	0	650	0	355
Water Recycling for Nonpotable Reuse	0	540	0	278
Water Transfers	0	3,240	0	1,670
Agricultural Water Conservation	-80	200	-41	103
Municipal Water Conservation	-290	-8,850	-149	-4,562

Sources: Section 7.8, *Energy*, Table 7.8-5; USEPA 2022.
AF = acre-foot; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; kWh = kilowatt-hour; lbs = pounds

Water transfers would be the most energy-intensive mechanism with a high-end value of 3,240 kWh/AF with associated GHG emissions of 1,670 lbs CO_2e/AF. Municipal water conservation would be the least energy-intensive with -290 to -8,850 kWh/AF, with an estimated reduction in GHG emissions of -149 to -4,562 lbs CO_2e/AF.

As shown in Table 7.10-3, other water management actions could result in approximately -4,562 to 1,670 pounds CO_2e per AF. This is equivalent to about -2 $MTCO_2e$ per AF to just under 1 $MTCO_2e$ per AF. Table 7.10-3 presents those values in 1 $MTCO_2e$ per AF.

Table 7.10-4 presents the lowest and highest range of GHG emissions that could result from water transfers and municipal water conservation under the 55 scenario. The range is conservative because (1) it assumes the TAF of replacement water resulting from the 55 scenario; (2) the energy cost estimates do not subtract the amount of energy currently expended to pump and deliver water; and (3) it does not include the likelihood that water users would use a combination of these actions in response to reductions in Sacramento/Delta water supply.

Table 7.10-4. Range of Possible Greenhouse Gas Emissions from Water Transfers and Municipal Water Conservation under the 55 Scenario

Replacement Water	Unit Energy Cost for Replacement Water (kWh/TAF)		Unit GHG Emissions for Replacement Water (lbs CO_2e/TAF)	
	Low	High	Low	High
Water Transfers	0	3,240,000	0	1,670,220
Municipal Water Conservation	-290,000	-8,850,000	-149,495	-4,562,175

Sources: Section 7.8, *Energy*, Table 7.8-5; USEPA 2022 .
CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; kWh = kilowatt-hour; lbs = pounds; TAF = thousand acre-feet

In general, all the other water management actions under the 55 scenario would be expected to result in GHG emissions within the range presented in Table 7.10-4.

Water conservation measures may reduce the energy required for drinking water treatment, wastewater treatment, and water heating. These conservation measures include energy-efficient residential retrofits (e.g., showerheads, clothes washers, toilets) and commercial and industrial retrofits (e.g., water loss control and efficient equipment) that reduce overall energy and water consumption and GHG emissions (Pacific Institute 2016) (see Table 7.10-3).

In addition, because revenue sources are available to utilities (e.g., selling excess renewable electricity and cap-and-trade proceeds), utilities may be able to transition to cleaner energy sources by increased investing in renewable energy sources, such as solar, hydropower, and wind, to further reduce energy consumption and GHG emissions (Union of Concerned Scientists 2015). Other efforts, such as conservation, recycling, and powering facilities with renewable energy, could further achieve energy, water, and climate objectives. The cap-and-trade program will provide necessary emissions reductions for fossil-fueled electric generation facilities to accommodate any increase in emissions associated with these activities above their designated cap to ensure that these activities do not generate GHG emissions and have a significant impact on the environment. As noted previously, all electricity sold in California also will be provided by zero-carbon resources by 2045 under the state's RPS (SB 100/1020).

For further discussion on the energy requirements related to each of the other water management actions and based on the conditions within each region, see Section 7.8, *Energy.*

Due to uncertainty in the actions that would be taken to replace reduced Sacramento/Delta water supply in each region, it is difficult to know whether the total energy required for these actions would be greater than the total energy savings associated with reduced conveyance and water conservation. There could be a net energy cost that would result in GHG emissions. The impact of this net energy cost combined with reductions in hydropower generation could exceed the energy savings associated with reduced exports and water conservation, resulting in GHG emissions. This impact would be potentially significant.

Implementation of Mitigation Measures MM-GHG-a and MM-GHG-b will reduce potential GHG emissions through implementation of efficiency, conservation, and irrigation system management strategies, as well as compliance with applicable air quality plans, programs, rules, or regulations, and will promote use of renewable energy sources to minimize GHG emissions. Unless and until the mitigation is fully implemented, this impact remains potentially significant.

Impact GHG-b: Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases

The proposed Plan amendments are a part of the state's larger water strategy and are consistent and coordinated with larger state efforts related to GHG emissions and climate change. The State Water Board intends to follow the direction provided in its Resolution 2017-0012 to ensure that criteria (e.g., whether a project is consistent with plans or state goals to reduce or mitigate GHGs, including consistency with CARB's *California's 2017 Climate Change Scoping Plan*, regulations, or requirements adopted by CARB; or whether a proposed project is part of a plan that includes overall reductions in GHG emissions) are met. The proposed Plan amendments support several GHG reduction measures recommended by CARB (e.g., water use efficiency, water recycling, reuse of urban runoff), which also would be beneficial in meeting any other state and local goals outlined in the water and climate change plans discussed in this section.

Clean Air Act

Clean Air Act requirements for GHGs are the GHG emissions standards for vehicles and do not apply to projects that do not generate GHG emissions from vehicles. GHG emissions from the largest stationary sources (e.g., electricity utilities, refineries) are typically covered by the Clean Air Act Prevention of Significant Deterioration and Title V Operating Permit Programs. These regulations require permitting for facilities in excess of 100,000 $MTCO_2e$ per year. The electric utilities that could be affected by the proposed Plan amendments as a result of reduced hydropower, increased groundwater pumping, or other water management actions would be subject to these permitting requirements regardless of the project, and the proposed Plan amendments would not alter or modify these permit requirements. Therefore, the proposed Plan amendments would not conflict with the requirements of the Clean Air Act.

Senate Bill 32

The generation of replacement power due to reductions in hydropower generation, increased energy consumption from electric pumps for groundwater pumping, and increased energy consumption for water acquisition would result in an increase in GHG emissions from fossil-fueled electric generating facilities. However, the state's cap-and-trade program sets a limit on GHG emissions at these facilities and allows sources to trade emissions or purchase allowances to meet the emissions limit. These emissions limits would ensure that any added emissions generated to meet increased electricity demand from the proposed Plan amendments would not obstruct compliance with SB 32.

Increases in use of diesel pumps for groundwater pumping could result in emissions in excess of the 10,000 $MTCO_2e$ threshold. Many air districts throughout the state established this threshold using the state's 2020 planning horizon as the basis for development. Most local air districts have not proposed or adopted quantitative thresholds for evaluating emissions beyond 2020.[5] Air districts will likely develop 2030 thresholds based on CARB's *California's 2017 Climate Change Scoping Plan*. Potential 2030 GHG thresholds derived from the updated 2017 Scoping Plan would presumably be lower than the 10,000 $MTCO_2e$ GHG threshold, although neither the Placer County Air Pollution Control District nor the Sacramento Metropolitan Air Quality Management District revised their stationary source threshold as part of their 2030 threshold update. Nonetheless, because SB 32 requires a reduction in California GHG emissions to 40 percent below the 1990 levels by 2030, it is reasonable to conclude that the 10,000 $MTCO_2e$ stationary source threshold or other adopted thresholds based on the 2020 planning horizon would be lowered to facilitate greater reductions needed to meet the state's 2030 GHG goal. Because emissions from diesel pumping activities could exceed current thresholds, and it was assumed that the thresholds would be lowered to address future Scoping Plan objectives, the proposed Plan amendments could hinder the state's ability to meet the SB 32 GHG reduction goal.

[5] The Placer County Air Pollution Control District has developed post-2020 efficiency thresholds for land use development projects. The Sacramento Metropolitan Air Quality Management District has adopted best performance standards for evaluating GHG emissions generated by land use development projects through 2030. The Bay Area Air Quality Management District has proposed draft thresholds for land use development projects through 2045.

Executive Orders S-3-05, B-55-18, and B-30-15 and Assembly Bill 1279

EO S-3-05 establishes GHG emissions reduction targets for the state of California, including reducing GHG emissions to 80 percent below 1990 levels by 2050. EO B-55-18 strengthens the state's reduction commitment to achieve carbon neutrality by 2045. This target was codified by AB 1279, which also mandates an 85-percent reduction in statewide anthropogenic GHG emissions (from 1990 levels) by 2045. EO B-30-15 requires all state agencies to implement measures pursuant to statutory authority to reduce GHG emissions in order to meet the state's reduction targets.

Although it has not yet been extended by the legislature to 2050, the cap-and-trade program, as amended by AB 398, includes an approach for setting the annual cap through 2050, indicating that cap-and-trade is likely to continue as part of the state's long-term strategy for addressing GHG emissions. The *2022 Scoping Plan for Achieving Carbon Neutrality* also identifies evaluating and strengthening the cap-and-trade program as a potential strategy for achieving the state's 2045 carbon neutrality goal (CARB 2022b). Therefore, generation of replacement power due to reductions in hydropower generation, increased energy consumption from electric pumps for groundwater pumping, and increased energy consumption for water acquisition would likely result in an increase in GHG emissions from fossil-fueled electric generating facilities that meet future emissions limits. Future emissions limits would ensure that any added emissions generated to meet increased electricity demand from responses to the proposed Plan amendments would not obstruct compliance with the EOs or AB 1279. The state's RPS also requires electric utilities to achieve sales of renewably generated electricity of 44 percent by 2024, 52 percent by 2027, 60 percent by 2030, 90 percent by 2035, 95 percent by 2040, and 100 percent by 2045. GHG emissions from electricity generation will, therefore, decrease over time, eventually achieving carbon neutrality in 2045.

While generation of replacement power due to reductions in hydropower generation, increased energy consumption from electric pumps for groundwater pumping, and increased energy consumption for water acquisition would not conflict with EO targets or AB 1279, increases in use of diesel pumps for groundwater pumping could result in emissions in excess of the 10,000 $MTCO_2e$ threshold. Exceedance of a threshold could affect the state's ability to meet future GHG reduction goals. Accordingly, it is conservatively concluded that the proposed Plan amendments could conflict with EO S-3-05, EO B-55-18, AB 1279, and EO B-30-15 beyond 2030.

Renewables Portfolio Standard

The proposed Plan amendments are unlikely to hinder attainment of the state's RPS. As described in more detail in Section 7.8, *Energy*, energy generation from small hydropower facilities could range from a decrease of about 30 GWh for the 45 scenario to a decrease of about 100 GWh for the 65 scenario. The estimated average annual reduction in small hydropower generation from facilities in the Sacramento/Delta is about 56 GWh per year for the 55 scenario. Increases in wind and solar energy generation are helping attain the RPS objectives. RPS energy procurement is currently in excess of the obligation under the state's RPS. The change in small hydropower generation is not significant when compared with the available renewable energy bank and considering the expected future growth of wind and solar energy.

Climate Resiliency and Adaptation

Many California agencies have articulated climate resiliency goals in various reports and policies, as described in Section 7.10.3, *Regulatory Setting*. In general, these goals can be grouped into three categories: (1) restoring ecosystems and habitat, (2) water supply, and (3) adaptive management.

The current Bay-Delta Plan requirements are largely rigid and unadaptable, requiring a lengthy process to adjust. The proposed flow objectives represent a major shift in regulatory philosophy and methods that are better equipped to accommodate the effects of climate change and other needs for adaptive management to respond to new and changing information and conditions. For example, the proposed inflow and outflow objectives automatically scale to water availability in a watershed that may change because of climate change. Incorporating a range, rather than a discrete number, allows for adjustment that may be needed to provide more protection for the environment or additional water for consumptive use due to drought. Sculpting and shaping of flows is also allowed in recognition that runoff patterns will change and that consideration of and adaptation to these changes are needed to protect native fish and wildlife. In addition, cold water habitat requirements are proposed and emphasized in response to these same issues. Different tools may be needed to address climate change, including passage projects, riparian reforestation, and other measures. The proposed program of implementation encourages voluntary implementation plans that can help advance habitat restoration and other physical improvements that make the ecosystem and the State's water infrastructure more resilient to the effects of climate change. In addition, the proposed Plan amendments would advance Climate Resiliency and Adaptation goals, as discussed in the following subsections.

Restoring Ecosystems and Habitat

Ecosystem and habitat restoration is identified by several state agencies as a fundamental goal for improving climate resilience. Specifically, many state policies and programs target restoring Delta flows, improving water quality, restoring natural processes, improving the health of wetlands and rivers, and rehabilitating water resource management systems (CNRA 2018; CNRA et. al 2016; DSC 2018; DWR 2019; PPIC 2018; ^SWRCB 2017).

The proposed Plan amendments are expected to contribute to ecosystem and habitat restoration and, therefore, align with the state's climate resiliency and adaptation strategy. Specifically, the proposed Plan amendments would lead to changes in hydrology that are expected to result in streamflows that more closely resemble the natural flow regime (e.g., magnitude, frequency, timing, duration, rate of change of flow conditions) to which native aquatic and aquatic-dependent species have evolved. The proposed Plan amendments are also expected to improve water quality conditions over a large geographic area. These changes are expected to improve the health of rivers, estuaries, and watersheds and to benefit native fish and wildlife populations. Also see Sections 7.6.1, *Terrestrial Biological Resources*, and 7.6.2, *Aquatic Biological Resources.*

Water Supply

Given the expected variability in local precipitation patterns, increasing the quantity, accessibility, and quality of available water supplies is critical to enhancing the resiliency of the water sector to future climate change effects. CNRA, DWR, and the State Water Board have all developed targeted programs to improve water supply by enhancing the use of recycled water, improving water conservation and efficiency, and diversifying water supplies (CNRA 2018; DWR 2017 ; ^SWRCB 2017). In response to reduced Sacramento/Delta surface water supplies, water users would likely modify their water portfolios by increasing the use of other water management actions to replace reductions in surface water supplies. These actions include increased use of groundwater storage and recovery, water recycling, and water conservation. While many of these actions are already being pursued, these efforts would likely be accelerated as a result of the proposed Plan amendments. Water management actions to integrate other water supplies into local and regional water portfolios to improve water supply reliability are consistent with the California Water Action Plan and the Delta Plan.

Adaptive Management

Future shifts in California's climate are inevitable and, as such, adaptive management is a fundamental component of the state's climate change strategy. The proposed Plan amendments include a monitoring and evaluation program to inform adaptive management of water flows, biological resources, and ecosystems (see Chapter 5, Section 5.6.1, *Accounting, Monitoring, Reporting, Assessment, and Adaptive Management*).

The proposed Plan amendments support the state's climate resiliency goals. Changes in hydrology and water supply would not conflict with the Clean Air Act; however, increases in use of diesel pumps for groundwater pumping could result in emissions in excess of the 10,000 $MTCO_2e$ per year threshold that could affect the state's ability to meet the SB 32 (2030) and AB 1279 (2045) GHG reduction goals. This impact would be potentially significant. Implementation of Mitigation Measures MM-GHG-a and MM-GHG-b can reduce potential GHG emissions and conflicts with the state's GHG reduction plans from increased groundwater pumping if adopted by local water districts and suppliers, regional groundwater agencies, irrigation districts, local utilities, and local agencies and governments. Unless and until the mitigation is fully implemented, this impact remains potentially significant.

7.10.5 Mitigation Measures

MM-GHG-a: Mitigate impacts from greenhouse gas emissions

1. **Water Use Efficiency:**
   i. Increase water use efficiency to reduce water demand related to agricultural uses.
   ii. Create water-efficient landscapes (e.g., by reducing lawn sizes; planting vegetation with minimal water needs, such as California native species; choosing vegetation appropriate for the climate of the project site; and choosing complementary plants with similar water needs or the ability to provide each other with shade and/or water).
   iii. Install water-efficient irrigation systems and devices, such as soil moisture–based irrigation controls.
2. **Water Conservation:**
   i. Devise a comprehensive water conservation strategy appropriate for the project and location. The strategy may include the water use efficiency practices listed in Mitigation Measure MM-GHG-a: 1, plus other innovative measures that are appropriate to the specific project.
   ii. Provide education about water conservation, such as through an "informative" water bill that goes beyond basic information used to calculate the bill based on usage and rates. Comparisons to previous bills and topics on water conservation would be incorporated.
   iii. Implement integrated resource management on both the supply side (e.g., source-water protection strategies to conserve water resources and avoid costly new supplies) and the demand side (e.g., comprehensive end-use audits).

   iv. Use graywater for non-potable uses instead of new potable water supplies.
   v. Use reclaimed water instead of new potable water supplies.

3. **Energy Efficiency:**
   i. Increase energy efficiency of pumps (e.g., solar) and turbines throughout the SWP system through design, construction, and refurbishment methods.
   ii. Increase water system energy efficiency to reduce energy consumption related to irrigation deliveries.
   iii. Improve efficiency of water system operations, such as by installing supervisory control and data acquisition software, which can increase the efficiency of process monitoring and operating control.
   iv. Increase efficiency of existing hydropower facilities and operations.
   v. Increase the proportion of energy used to run the SWP with energy supplies from renewable sources.
   vi. Use locally sourced water supplies or water from less energy-intensive sources instead of imported water or other sources of water that have high energy intensities.

4. **Irrigation Systems:**
   i. Increase the use of irrigation management services to better determine how much water is needed by crops and when to apply it.
   ii. Convert current inefficient irrigation systems (e.g., surface irrigation) to more efficient ones (e.g., use of micro-irrigation).
   iii. Increase the capability of irrigation water suppliers to provide delivery flexibility, such as the use of regulating reservoirs to allow flexible delivery durations, scheduling, and flow rates.
   iv. Reduce turf in landscapes and lawns.

5. **Restoration, Pricing Strategies, and Mitigation Credits:**
   i. Implement environmental restoration activities that have the potential to improve sequestration of carbon by natural processes.
   ii. Implement water pricing, such as metered rates, non-promotional rates, block rates, time-of-day pricing, water surcharges, and seasonal rates.
   iii. Purchase mitigation credits or offsets.

6. **Implement Energy Mitigation:** Implementation of Mitigation Measure MM-EN-a–e: 1–6 (see Section 7.8, *Energy*) will reduce energy impacts of other water management actions, including any associated GHG emissions.

7. Implement Mitigation Measure MM-GHG-b, Comply with applicable greenhouse gas emissions reduction plans, policies, or regulations, to minimize GHG emissions from groundwater pumping and other water management actions.

MM-GHG-b: Comply with applicable greenhouse gas emissions reduction plans, policies, or regulations

1. **Implement Air Quality Plans and Programs:** All power facilities and infrastructure required to increase production of energy due to reductions in hydropower production, or associated with other water management actions in response to reduced Sacramento/Delta supply, must comply with all applicable plans, programs, rules, and regulations, including but not limited to, emissions standards and targets in CARB's most recent *California's 2017 Climate Change Scoping Plan*, EOs, and emissions standards adopted by air quality management and air pollution control districts for the reduction of GHG emissions.
2. **Renewable Energy:**
   i. DWR will continue to implement its Renewable Energy Procurement Plan to meet EO S-3-05 per DWR's CAP.
   ii. Any reduction in hydropower production that requires increased power from other sources will acquire and/or use power from renewable energy sources, including but not limited to, solar and wind power, as defined in CARB's *California's 2017 Climate Change Scoping Plan*.
3. Implement Mitigation Measure MM-GHG-a, Mitigate impacts from greenhouse gas emissions, to ensure increased use of diesel groundwater pumps complies with SB 32 and AB 1279 GHG reduction goals.

7.10.6 References Cited

7.10.6.1 Common References

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