Chapter 21 Greenhouse Gas Emissions

21.1 Introduction

This chapter describes the environmental setting, methods of analysis, and impact analysis for greenhouse gas (GHG) emissions due to construction and operation of the Project. GHG emissions are defined as gaseous compounds that limit the transmission of Earth's radiated heat out to space. The study area for GHG emissions consists of the entire state and global atmosphere because climate change is the result of the individual contributions of countless past, present, and future sources throughout the world. The Project area generally consists of locations where Project facilities would be constructed or operated and areas of supporting activities (e.g., haul trips).

Tables 21-1a and 21-1b summarize the CEQA determinations and NEPA conclusions for construction and operations impacts, respectively, between alternatives that are described in the impact analysis.

Table 21-1a. Summary of Construction Impacts between Alternatives

Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Impact GHG-1: Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment or conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases			
No Project	NI/NE	-	NI/NE
Alternative 1	S/SA	**Mitigation Measure GHG-1.1**: Achieve Net-Zero Emissions Through a GHG Reduction Plan	LTSM/NE
Alternative 2	S/SA	**Mitigation Measure GHG-1.1**: Achieve Net-Zero Emissions Through a GHG Reduction Plan	LTSM/NE
Alternative 3	S/SA	**Mitigation Measure GHG-1.1**: Achieve Net-Zero Emissions Through a GHG Reduction Plan	LTSM/NE

Notes:
GHG = greenhouse gas.
NI = CEQA no impact.
LTSM = CEQA less than significant with mitigation.
S = CEQA significant impact.
NE = NEPA no effect or no adverse effect.
SA = NEPA substantial adverse effect.

Table 21-1b. Summary of Operations Impacts between Alternatives

Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Impact GHG-1: Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment or conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases			
No Project	NI/NE	-	NI/NE
Alternative 1	S/SA	**Mitigation Measure GHG-1.1**: Achieve Net-Zero Emissions Through a GHG Reduction Plan	LTSM/NE
Alternative 2	S/SA	**Mitigation Measure GHG-1.1**: Achieve Net-Zero Emissions Through a GHG Reduction Plan	LTSM/NE
Alternative 3	S/SA	**Mitigation Measure GHG-1.1**: Achieve Net-Zero Emissions Through a GHG Reduction Plan	LTSM/NE

Notes:
GHG = greenhouse gas.
NI = CEQA no impact.
LTSM = CEQA less than significant with mitigation.
S = CEQA significant impact.
NE = NEPA no effect or no adverse effect.
SA = NEPA substantial adverse effect.

21.2 Environmental Setting

21.2.1. Global Climate Change

The process known as the *greenhouse effect* keeps the atmosphere near Earth's surface warm enough for the successful habitation of humans and other life forms. The greenhouse effect is created by sunlight that passes through the atmosphere. Some of the sunlight striking Earth is absorbed and converted to heat, which warms the surface. The surface emits a portion of this heat as infrared radiation, some of which is re-emitted back toward the surface by GHGs in the atmosphere, and some of which results in warming of the atmosphere. Human activities that generate GHGs increase the amount of infrared radiation absorbed by the atmosphere, thus enhancing the greenhouse effect and amplifying the warming of Earth.

Increases in fossil fuel combustion and deforestation have exponentially increased concentrations of GHGs in the atmosphere since the Industrial Revolution (Intergovernmental Panel on Climate Change 2018a). Rising atmospheric concentrations of GHGs in excess of natural levels result in increasing global surface temperatures—a process commonly referred to as *global warming*. Higher global surface temperatures, in turn, result in changes to Earth's climate system, including increased ocean temperature and acidity, reduced sea ice, variable precipitation, and increased frequency and intensity of extreme weather events (Intergovernmental Panel on

Climate Change 2018a). Large-scale changes to Earth's system are collectively referred to as *climate change.*

The Intergovernmental Panel on Climate Change (IPCC) was established by the World Meteorological Organization and United Nations Environment Programme to assess scientific, technical, and socioeconomic information relevant to the understanding of climate change, its potential impacts, and options for adaptation and mitigation. The IPCC estimates that human-induced warming reached approximately 1°C above pre-industrial levels in 2017, increasing at 0.2°C per decade. Under the current nationally determined contributions of mitigation from each country until 2030, global warming is expected to rise to 3°C by 2100, with warming to continue afterward (Intergovernmental Panel on Climate Change 2018a). Large increases in global temperatures could have substantial adverse effects on the natural and human environments worldwide and in California.

As discussed above, this chapter addresses the potential GHG emissions generated as a result of construction and operation of the Project. A more extensive discussion of climate change and how the alternatives affect the study area's resiliency to expected changes in climate can be found in Chapter 28, *Climate Change*.

21.2.1.1. Pollutants of Concern

The principal anthropogenic (human-made) GHGs contributing to global warming are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated compounds, including sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). Water vapor, the most abundant GHG, is not included in this list because its natural concentrations and fluctuations far outweigh its anthropogenic sources.

The primary GHGs of concern associated with the Project are CO_2, CH_4, N_2O, HFCs, and SF_6. Principal characteristics of these pollutants are discussed in the following sections. Note that PFCs are not discussed because these gases are primarily generated by industrial and manufacturing processes, which are not anticipated as part of the Project.

Methods have been set forth to describe emissions of GHGs in terms of a single gas to simplify reporting and analysis. The most accepted method to compare GHG emissions is the global warming potential (GWP) methodology defined in IPCC reference documents. IPCC defines the GWP of various GHG emissions on a normalized scale that recasts all GHG emissions in terms of carbon dioxide equivalent (CO_2e), which compares the gas in question to that of the same mass of CO_2 (CO_2 has a GWP of 1 by definition).

Table 21-2 lists the GWP of CO_2, CH_4, N_2O, SF_6, and HFCs and their lifetimes in the atmosphere. The GWPs are from the IPCC's fourth assessment report, consistent with statewide GHG emissions reporting protocol (California Air Resource Board No Date A).

Table 21-2. Lifetimes and Global Warming Potentials of Key Greenhouse Gases

Greenhouse Gas	Global Warming Potential (100 years)	Lifetime (years)
CO_2	1	–
CH_4	25	12

Greenhouse Gas	Global Warming Potential (100 years)	Lifetime (years)
N_2O	298	114
SF_6	22,800	3,200
HFCs	124 to 14,800	1 to 270

Source: California Air Resources Board No Date A.
Notes: CH_4 = methane; CO_2 = carbon dioxide; HFC = hydrofluorocarbon; N_2O = nitrous oxide; SF_6 = sulfur hexafluoride.

All GWPs used for California Air Resources Board's (CARB) GHG inventory and to assess attainment of the State's GHG reduction targets are considered over a 100-year timeframe (as shown in Table 21-2). However, CARB recognizes the importance of short-lived climate pollutants (SLCPs) and reducing these emissions to achieve the State's overall climate change goals. SLCPs have atmospheric lifetimes on the order of a few days to a few decades, and their relative climate-forcing impacts, when measured in terms of how they heat the atmosphere, can be tens, hundreds, or even thousands of times greater than that of CO_2 (California Air Resources Board 2017:36). Recognizing their short-term lifespan and warming impact, SLCPs are measured in terms of metric tons (MT) CO_2e using a 20-year time period. The use of GWPs with a time horizon of 20 years better captures the importance of the SLCPs and gives a better perspective on the speed at which SLCP emission controls will affect the atmosphere relative to CO_2 emission controls. The SLCP Reduction Strategy addresses the three primary SLCPs—CH_4, HFC gases, and anthropogenic black carbon (California Air Resources Board 2017:1). CH_4 has a lifetime of 12 years and a 20-year GWP of 72. HFC gases have lifetimes of 1.4 to 52 years and a 20-year GWP of 437 to 6,350. Anthropogenic black carbon has a lifetime of a few days to weeks and a 20-year GWP of 3,200 (California Air Resources Board 2017:40).

Carbon Dioxide

CO_2 accounts for more than 80% of all GHG emissions emitted in California (California Air Resources Board No Date B). CO_2 enters the atmosphere through fossil fuel (oil, natural gas, and coal) combustion, solid waste decomposition, plant and animal respiration, and chemical reactions (e.g., manufacture of cement). CO_2 is also removed from the atmosphere (or *sequestered*) when it is absorbed by plants as part of the biological carbon cycle.

Methane

CH_4, the main component of natural gas, is the second most abundant GHG and has a GWP of 25 (California Air Resources Board No Date B). Sources of anthropogenic emissions of CH_4 include growing rice, raising cattle, using natural gas, landfill outgassing, and mining coal. Certain land uses also function as both a source and sink for CH_4. For example, wetlands are a terrestrial source of CH_4, whereas undisturbed, aerobic soils act as a CH_4 sink (i.e., they remove CH_4 from the atmosphere).

Nitrous Oxide

Anthropogenic sources of N_2O include agricultural processes (e.g., fertilizer application), nylon production, fuel-fired power plants, nitric acid production, and vehicle emissions. N_2O also is used in rocket engines, race cars, and as an aerosol spray propellant. Natural processes, such as nitrification and denitrification, can also produce N_2O, which can be released to the atmosphere by diffusion.

Sulfur Hexafluoride

SF_6, a human-made chemical, is used as an electrical insulating fluid for power distribution equipment, in the magnesium industry, in semiconductor manufacturing, and as a tracer chemical for the study of oceanic and atmospheric processes. SF_6 is a powerful GHG with a GWP of 22,800 (California Air Resources Board No Date A). Because SF_6 is a human-made chemical, it did not exist in the atmosphere before the twentieth century.

Hydrofluorocarbons

HFCs are human-made chemicals used in commercial, industrial, and consumer products and have high GWPs. HFCs are generally used as substitutes for ozone-depleting substances in automobile air conditioners and refrigerants.

21.2.1.2. Greenhouse Gas Inventories

A GHG inventory is a quantification of all GHG emissions and sinks within a selected physical and/or economic boundary. GHG inventories can be performed on a large scale (i.e., for global and national entities) or on a small scale (i.e., for a building or person). Although many processes are difficult to evaluate, several agencies have developed tools to quantify emissions from certain sources. Table 21-3 outlines the most recent global, national, statewide, and local GHG inventories to help contextualize the magnitude of potential Project-related emissions.

Table 21-3. Global, National, State, and Local Greenhouse Gas Emissions Inventories

Year and Area [a]	CO_2e (metric tons)
2017 Global	53,500,000,000
2019 United States	6,558,300,000
2018 California	425,300,000
2008 Tehama County	821,570
2008 Unincorporated Yolo County	651,740

Sources: Intergovernmental Panel on Climate Change 2018b; U.S. Environmental Protection Agency 2021a; California Air Resources Board 2020a; Tehama County No Date; AECOM and Ascent 2011.
Notes:
CO_2e = carbon dioxide equivalent.
[a] GHG emissions inventories for Colusa and Glenn Counties are currently unavailable.

21.3 Methods of Analysis

21.3.1. Construction

Construction of the Project would generate emissions of GHGs, including CO_2, CH_4, N_2O, and SF_6. Emissions would originate from off-road equipment exhaust, helicopter exhaust, employee and haul truck vehicle exhaust, electricity consumption, and concrete and asphalt batch plants. These emissions would be limited to the construction period and would cease when construction activities are completed.

The combustion exhaust GHG emissions are based on Project-specific construction data (e.g., schedule, construction equipment and truck inventory) provided by the Project engineering team and a combination of emission factors and methodologies from the California Emissions Estimator Model (CalEEMod), version 2016.3.2; CARB's Emissions Factors (EMFAC) model (EMFAC2017)[1]; the U.S. Environmental Protection Agency's (USEPA) *AP-42 Compilation of Air Pollutant Emission Factors* (AP-42); and other relevant agency guidance and published literature (U.S. Environmental Protection Agency 2021b). Annual GHG emissions were quantified based on concurrent construction activity.

Refer to Appendix 20A, *Methodology for Air Quality and GHG Emissions Calculations*, for a detailed description of the analysis method. Modeling assumptions are provided in Appendix 20B, *Air Quality and GHG Analysis Data*.

21.3.1.1. Concrete Emissions

Construction of the Project would require concrete from both onsite and offsite batch plants. "Lifecycle" emissions for cement and aggregate manufacturing, which are the processes that are upstream of the concrete batching process, are not included in the analysis. The California Natural Resources Agency expressly declined to include requirements for "lifecycle" analysis in CEQA Guidelines Section 15064.4. See Statement of Reasons for Regulatory Action, California Natural Resources Agency, December 2009 (California Natural Resources Agency 2009). Although this Final EIR/EIS does not include concrete lifecycle emissions as part of its CEQA analysis, Appendix 2D, *Best Management Practices, Management Plans, and Technical Studies*, includes BMP-29, Minimization of Asphalt and Concrete Batching Odors and GHG Emission, to encourage reduction in upstream GHG emissions from concrete used for the Project.

21.3.1.2. Land Use Change

Surfaces of some reservoirs may emit or absorb GHG emissions at material rates depending on several complex and dynamic factors. For example, GHG emissions rates vary depending on the depth of reservoir, the amount of organic material/plant material decaying under anaerobic conditions, the underlying climatic conditions (e.g., tropical vs. temperate zones), and if turbines are present, the water source to the turbines.

The World Bank GHG guidelines recognize the importance of existing emission sources when analyzing changes in GHG emissions from open water sources, noting "the need to estimate pre-impoundment emissions to enable the calculation of the net GHG emissions that are 'visible' to the atmosphere." The guidelines go on further to state that "what matters to the atmosphere from the introduction of a reservoir is, therefore, limited to the processes where the changes create a net increase in CO_2 equivalent fluxes" (World Bank 2017:13). Such a comparison requires a detailed accounting of local and site-specific variables, including salinity, pH (i.e., level of acidity or basicity), type of grass, carbon content of soils, and other chemical and biological characteristics. Additionally, post-impoundment studies and sampling would be required. These types of site-specific data are not available, and, as such, a quantitative analysis of potential

[1] CARB released EMFAC2021 on January 15, 2021, but this version has not yet been approved by USEPA. Accordingly, this analysis uses EMFAC2017, which was available at the time of notice of preparation and is the current USEPA-approved version of EMFAC.

GHG emissions from conversion of existing cattle grazing land to a surface storage reservoir using site-specific data is not possible and would be speculative. When the Authority takes ownership of the land in the inundation area, it may be possible to quantify GHG emissions from land conversion using actual site-specific data (Chapter 3, *Environmental Analysis*, describes lack of access). It is anticipated that, at that time, the necessary data and studies would be attainable. The Authority and Reclamation have evaluated estimated potential emissions from land use conversion using high-level methods and non–site-specific information, which are included in the analysis of impacts below and in full detail in Appendix 21A, *Greenhouse Gas Support Appendix*. The GHG emissions presented in Appendix 21A do not account for activities that would potentially sequester carbon, such as activities associated with Project implementation, or implementation of Project mitigation measures. The analysis represents a conservative assessment of emissions because it does not currently account for potential carbon sequestration activities that would result from implementation of the Project, such as offsite Project activities and Project features, or mitigation measures identified for other resource areas that may affect land use changes. Additionally, readers should note the discussion in Appendix 21A of calculation uncertainties inherent to the methods used to calculate emissions. Given the uncertainties described and the lack of available site-specific data, the emissions estimates in Appendix 21A should be viewed as rough approximations.

21.3.2. Operations

21.3.2.1. Maintenance Activities

Maintenance of the Project would generate emissions of GHGs (CO_2, CH_4, N_2O, and SF_6) that could result in long-term and recurring GHG impacts. Similar to construction activities, emissions would originate from the exhaust of on-road vehicles, off-road equipment, and helicopters associated with checking and maintaining transmission lines. Emissions were quantified using Project-specific activity data for maintenance activities, emission factors and methodologies from the CalEEMod and EMFAC models, the USEPA’s AP-42, and other relevant agency guidance and published literature. Refer to Appendix 20A, *Methodology for Air Quality and GHG Emissions Calculations*, for a detailed description of the analysis method.

21.3.2.2. Water Conveyance Energy

Operation of the Project would require the use of electricity for pumping, which would result in GHG emissions[2] from the generation, distribution, and transmission of this electricity. Annual electricity consumption values required for Alternatives 1, 2, and 3 are presented in Chapter 17, *Energy*, Tables 17-9 through 17-11.

Hydropower generation would be an incidental benefit of conveying water through specific Project facilities and would be influenced by the timing of releases, movement of water, and seasonal operational decisions. The Project would ultimately be a net user of electricity rather than a net generator of electricity and would reduce the hydroelectric power generated elsewhere in the existing system, as described in Chapter 17. Because the specific sources of electricity

[2] Fossil fuel–powered electrical-generating facilities also emit criteria pollutants. Criteria pollutants emitted by these facilities are regulated by the California Energy Commission and California Public Utilities Commission. Accordingly, criteria pollutants from offsite generation of electricity are excluded from project-level environmental analysis.

(e.g., natural gas, solar, wind) are unknown, indirect GHG emissions from water conveyance electricity were quantified using statewide grid average emission factors from the USEPA for the "CAMx" region (U.S. Environmental Protection Agency 2021c). The USEPA factors for CO_2, CH_4, and N_2O for 2019 were used and were scaled to future years 2030–2040 based on an extrapolation of the renewable portfolio goals of the State (i.e., 33% renewable in 2020, 60% in 2030, and 100% in 2045). As such, the emission factors for electricity decrease in magnitude for each future year. To quantify SF_6 emissions from losses in the electric grid, the emission factor was developed based on the CARB GHG inventory of high-GWP gases for the current inventory year (2018) and statewide electricity consumption (California Air Resources Board 2020b; California Energy Commission 2019).

21.3.2.3. Recreational Areas

Recreational Vehicles Trips

The Project would result in a change in the number of vehicle trips and thus vehicle miles traveled (VMT) associated with recreational areas throughout the state. People are currently using existing reservoirs for recreational purposes, and, with the construction of Sites Reservoir, some recreationists would travel to and use Sites Reservoir instead. As noted in Chapter 18, *Navigation, Transportation, and Traffic*, the Project would result in a net decrease in VMT when considering regional population centers in northern California.

The activity at other existing reservoirs would likely decrease, which would result in a reduction in vehicle trips and emissions and boating activity and emissions near those reservoirs but an increase near Sites Reservoir. In Chapter 20, *Air Quality*, it is noted that there would be an increase in criteria pollutant emissions in Colusa and Glenn Counties. For GHGs, emissions are global pollutants and do not ascribe to air district or county boundaries. Consequently, the analysis of GHG emissions relies on the VMT assessment at the scale of the multi-region population centers from Chapter 18, Tables 18-18 and 18-19. The overall effect of the Project would be a net decrease in VMT, which is what is relevant to GHG emissions.

The change in recreational vehicle emissions resulting from the Project was quantified using the VMT data Tables 18-18 and 18-19 and the EMFAC model.

Recreational Boating

Recreational boating would result in an increase in emissions at Sites Reservoir. Recreationists are currently using existing reservoirs for recreational purposes, and, with the construction of the Project, some recreationists would use Sites Reservoir instead. Thus, the boating activity at other existing reservoirs would likely decrease, which would result in a reduction in boating activity and emissions near those reservoirs. Consequently, the Project would likely result in GHG decreases in some areas and an increase at Sites Reservoir. The decrease in boating activity at other reservoirs cannot be quantified, however, because the change in boating activity at the affected reservoirs cannot be accurately predicted at this time. It is assumed some visitors who use existing reservoirs would go to Sites Reservoir instead, but it is unknown, and cannot be identified, which of those displaced visitors previously used existing reservoirs for boating purposes. An attempt to quantify the number of displaced visitors using boats, in particular, would be speculative. As such, this analysis is conservative in that it assumes there would be no reduction in boating activity at other reservoirs.

Emissions from recreational boating activity were estimated based on the anticipated number of visitor days that would involve the use of boats from the Project's application for the WSIP, Table 1. The number of annual visitor days for boating purposes was translated into an estimate of annual boating hours using the U.S. Coast Guard's recreational survey data (U.S. Coast Guard 2012), using assumptions for the number of visitors per boat (2.4) and the number of hours per visit (4.9 or 5.1, depending on boat type). Emission factors for the GHGs are from CARB's PC2014 Model, which an emissions inventory database for recreational watercraft (California Air Resources Board 2014). The PC2014 Model contains pollutant data in units of tons and boating activity data in units of hours for the air basins in the state. Thus, emission factors can be developed for boats by dividing these data points and converting units, to yield grams of GHG emissions per hour of boat activity. The emission factors were applied to the estimated amount of boating activity at Sites Reservoir to quantify GHG emissions. The PC2014 Model assumes that average horsepower values for various boat types increase over time, which increases fuel consumption on a per-hour basis. Because CO_2 emissions are correlated to fuel consumption, CO_2 emissions rates increase over time due solely to CARB's horsepower assumptions. CARB is currently working on a new regulation that would include potential requirements for electrification of outboard engines, with adoption expected by 2027 (California Air Resources Board 2021). Consequently, this analysis is conservative, because there are likely to be more electric (i.e., non-emitting) boats operating in 2030 than what is assumed in the PC2014 Model.

21.3.2.4. Public Services and Utilities

Emissions from public services and utilities would result from the use of water and from the generation of waste and wastewater. At the publicly accessible recreational areas and at the administrative and operations building, visitors and staff would use water and generate waste; as such, these sources of emissions were calculated using the water consumption, waste quantity, and wastewater quantity estimates from Chapter 26, *Public Services and Utilities*, and the CalEEMod model.

21.3.3. Thresholds of Significance

An impact on GHG emissions would be considered significant if the Project would:

- 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.

These thresholds of significance are evaluated within the same impact discussion (Impact GHG-1) because the method of evaluation, as discussed in *Additional CEQA Considerations* addresses both. Impacts related to GHG emissions are evaluated based on consistency with established statewide GHG reduction goals, including Senate Bill (SB) 32, Executive Order (EO) S-3-05, and EO B-55-18. The GHG reduction goals are based on scientific consensus on the GHG emissions reduction needed to avert the worst effects of climate change. The CEQA Guidelines provide that a lead agency may consider a project's consistency with the State's long-term climate goals or strategies in determining the significance of impacts (CEQA Guidelines § 15064.4[b][3]).

21.3.3.1. Additional CEQA Considerations

The CEQA Guidelines Section 15064.4 provides guidance to lead agencies for determining the significance of environmental impacts pertaining to GHG emissions. Section 15064.4(a) states that a lead agency should make a good-faith effort that is based, to the extent possible, on scientific and factual data to describe, calculate, or estimate the amount of GHG emissions that would result from implementation of a project. Section 15064.4(b) also states that, when assessing the significance of impacts from GHG emissions, a lead agency should consider (1) the extent to which the project may increase or reduce GHG emissions compared with existing environmental setting, (2) whether the project's GHG emissions would exceed a threshold of significance that the lead agency has determined to be applicable to the project, and (3) the extent to which the project would comply with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of GHG emissions.

The CEQA Guidelines allow lead agencies to consider GHG thresholds of significance adopted or recommended by other public agencies or recommended by experts, provided that the thresholds are supported by substantial evidence, and/or to develop their own significance threshold. The air quality management districts in the Project area do not yet recommend GHG significance thresholds that are consistent with the State's next milestone reduction goal in 2030 (i.e., SB 32) or applicable to water infrastructure projects for either construction or operations-related activities. Additionally, there is no applicable climate action plan that the Project could use.

By enacting SB 32, the State Legislature has established statewide GHG reduction targets extending through 2030 (a 40% reduction below 1990 levels by 2030). Scientific studies (as best represented by the IPCC's periodic reports) demonstrate that climate change is already occurring due to past GHG emissions, and evidence concludes that carbon neutrality must be achieved by midcentury to avoid the most severe climate change impacts.

For the Project, construction would begin in 2024 and end in 2029 (i.e., before the milestone year of 2030), and operations-related activities would begin in 2030 and occur indefinitely for the lifetime of the Project. Although construction emissions could be evaluated with respect to the 2030 reduction goal, operations emissions are long term and would extend beyond the 2030 timeframe. Additionally, the Project is a large water infrastructure project and has the potential to generate relatively high emissions, and, for these reasons, it is appropriate to look beyond the SB 32 milestone year of 2030 and the corresponding reduction goal.

Because of the need for carbon neutrality and in the absence of an established quantitative GHG emissions threshold or climate action plan that is applicable to Alternatives 1, 2, and 3, the impact analysis bases its determinations of significance upon a net-zero threshold and consistency with EO B-55-18. A net-zero threshold is not required, but the Authority has conservatively elected to define a significant GHG impact as any increase in emissions above the No Project Alternative for the reasons described above.

Previous EOs and legislation (EO S-3-05, EO B-30-15, and SB 32) have had reduction trajectories that are consistent with an 80% reduction in emissions below 1990 levels by 2050, so a net-zero threshold would be more climate protective. *Net zero* means that there is no net increase in GHG emissions from a project, which is achieved through reductions in emissions either onsite (e.g., at an equipment exhaust pipe), offsite (e.g., at a power plant that provides energy), or through carbon offset credits. Because attainment of net-zero emissions would avoid conflicts with any plans or policies adopted for the purposes of reducing GHG emissions, this section discusses the Project's GHG emissions and consistency with plans and policies within the same impact discussion.

For construction, a net-zero threshold thus represents a conservative assessment of construction emissions, considering that the generation of construction-related GHG emissions is generally short term in duration compared to the Project's overall lifetime. Operations emissions from the Project would also be generated on an annual basis for the entire lifetime of the Project. Environmental impacts associated with GHG emissions are exclusively cumulative in nature in accordance with the contemporary scientific knowledge of their effects on climate change. It is infeasible to determine the extent to which an individual project would cause changes in climate.

21.3.3.2. NEPA

There have been several recent changes in Council on Environmental Quality (CEQ) guidance with respect to GHG emissions (Appendix 4A, *Regulatory Requirements*, Section 4A.17.1.5). The final CEQ guidance on GHG emissions from 2016 was rescinded in 2017 by the Trump administration and replaced, in 2019, with updated guidance that required federal agencies to analyze the direct, indirect, and cumulative impacts of a proposed action's GHG emissions. In February 2021, the 2019 guidance was rescinded by the Biden administration, in conjunction with the announcement that the original 2016 guidance is currently being reviewed for potential updates (86 *Federal Register* 10252 [February 19, 2021]). Because there is no finalized guidance from CEQ at this time, NEPA impacts from GHG emissions are evaluated with respect to a net-zero threshold, as outlined above for CEQA. The net-zero threshold approach is conservative and is in line with current scientific evidence that points to the need to achieve carbon neutrality by midcentury to avoid the most severe climate change impacts.

21.4 Impact Analysis and Mitigation Measures

Impact GHG-1: Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment or conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases

No Project

The No Project Alternative would not generate either construction or operations GHG emissions, because no Project facilities would be constructed or operated. Construction and operation of other unrelated projects and other existing sources in the Project region, including those associated with existing facilities (e.g., RBPP), would still occur. Emissions would be generated from sources such as vehicle traffic, construction and agricultural equipment, and operation of various facilities, but these are baseline sources of emissions.

<u>*Significance Determination*</u>

The No Project Alternative would not cause a change in GHG emissions relative to the baseline that would have a significant impact on the environment. There would be no impact/no effect.

Alternative 1

<u>*Construction*</u>

Construction of Alternative 1 would generate GHG emissions during the construction period through the use of heavy-duty construction equipment, construction worker vehicles, haul trucks, and electricity consumption and associated equipment. Table 21-4 summarizes annual and total estimated GHG emissions associated with construction of Alternatives 1, 2, and 3. Because GHG emissions are global pollutants and do not ascribe to air district boundaries, only the annual totals by alternative and variant are presented in Table 21-4 (as opposed to emissions by air district, as is presented for criteria pollutant and ozone precursors).

Table 21-4. Greenhouse Gas Emissions from Construction Alternatives 1, 2 and 3[a] (metric tons CO_2e)

Year	Alternatives 1 and 3		Alternative 2	
	Variant 1[b]	Variant 2[c]	Variant 1	Variant 2
2024	18,190	18,190	18,900	18,900
2025	51,941	51,941	64,594	64,594
2026	94,462	94,508	111,426	111,442
2027	89,927	90,020	90,167	90,196
2028	72,180	72,188	55,979	55,979
2029	21,948	21,948	10,252	10,252
Total	348,648	348,796	351,317	351,362
Amortized Emissions [d]	11,622	11,627	11,711	11,712

Notes:

CO_2e = carbon dioxide equivalent.

[a] The emissions results account for all emissions directly and indirectly generated by construction activities over which the Authority and Reclamation have control. Emissions generated upstream (e.g., material manufacturing) and downstream (e.g., recycling) of construction, otherwise known as *lifecycle emissions*, are not included in the analysis, consistent with guidance from the California Natural Resources Agency (California Natural Resources Agency 2018).

[b] Variant 1 assumes the Project would connect to existing Western Area Power Administration utility infrastructure.

[c] Variant 2 assumes the Project would connect to existing Pacific Gas and Electric utility infrastructure.

[d] Total emissions have been amortized over a 30-year Project life.

Table 21-4 indicates total GHG construction emissions for Alternative 1 are estimated to be between 348,648 and 348,796 CO_2e, depending on the variant that is constructed. The Western Area Power Administration (WAPA) variant (Variant 1) would result in slightly less emissions than the Pacific Gas and Electric Company (PG&E) variant (Variant 2), because the activity required to construct the transmission lines and substation for WAPA would be less than the activity required to construct the transmission lines and substation for PG&E. The greatest annual construction emissions occur between 2026 and 2027, mainly because these years are when most construction activities would occur across the entire Project area. Amortized emissions would be about 11,620 MT CO_2e per year.

Operations

Operations emissions for Alternatives 1A and 1B are shown in Table 21-5. The only differences in emissions between these two alternatives would be for water conveyance energy consumption and land use change–related emissions.

As shown in the table, maintenance activities and public services and utilities would result in relatively minor contributions to the total emissions. Maintenance activities would consist of inspections and other required activities to maintain the facilities. The number of activities would be variable by year and would gradually decrease, though certain future years would require more activity.[3] Emissions from public services and utilities are those that are generated from the use of water, such as in restrooms, and the generation of wastewater and waste at the recreational areas and at the administration and maintenance building.

Emissions from recreational boats would be generated at Sites Reservoir. Per CARB's PC2014 Model (California Air Resources Board 2014), the boating emissions would gradually increase each year, which is the result of projected increases in boat horsepower values in the future. However, the PC2014 Model does not include future regulatory action that would reduce emissions from boats. As noted above, a potential new regulation may require electrification of outboard engines in 2027 (California Air Resources Board 2021). Consequently, the emissions shown in this analysis are conservative.

Recreational vehicle trips would be a net negative source of emissions, because Alternative 1 would result in a net decrease in VMT in California. Visitor trips to Sites Reservoir would, overall, be shorter than to the reservoirs visitors are currently using. The difference in emissions would gradually shrink each year (i.e., move closer to zero), because the vehicle fleet becomes progressively lower emitting each year due to technological improvements and turnover of older vehicles. Excluding water conveyance emissions, Alternative 1 would result in net negative emissions annually, because the emissions decrease from vehicle trips is greater than the emissions increase from all other non-water-conveyance sources combined.

For water conveyance, Alternative 1A would result in higher energy consumption than Alternative 1B in long-term average water years and in Dry and Critically Dry Water Years. Annual emissions from water conveyance are a dominant source of emissions from operations, and these emissions would be highest in 2030 and decrease each year, because electricity providers in the state will be complying with the renewable energy goals under SB 100. As such, the electricity purchased for the Project's needs would become progressively lower in carbon intensity.

Land use change emissions are the result of converting the inundation area to flooded land. The difference in land use change emissions between Alternatives 1A and 1B would be minor, with Alternative 1A resulting in slightly more emissions than Alternative 1B. These emissions would

[3] Certain activities, such as instrumentation and equipment repair, would be required approximately 25 years after operations begins. Because no projections are currently available for years beyond 2040, these activities were conservatively assumed to occur in 2040, when equipment would be less clean that it would be 25 years from the start of operations. Over time, vehicles and equipment tend to become lower emitting due to technological advancements and turnover of older, higher-emitting vehicles and equipment.

occur within the first 20 years of the land being converted to a reservoir. Twenty years after inundation, the annual emissions would decrease as the reservoir approaches a steady state. The land use change emissions represent the maximum (i.e., upper-end) annual emissions from the land conversion; the full range of values, including the average and lower-end values, are presented in Appendix 21A. As such, the land use emissions values in this table are conservative because the upper-end estimates are included here.

The maximum net increase in GHG emissions during long-term average water years would be 60,610 MT CO_2e for Alternative 1A and 59,573 MT CO_2e for Alternative 1B. In Dry and Critically Dry Water Years, the maximum annual increase would be 72,736 MT CO_2e for Alternative 1A and 72,070 MT CO_2e for Alternative 1B. Accordingly, Alternative 1 would generate both direct and indirect emissions that would constitute a significant net increase in GHG emissions to the atmosphere.

Table 21-5. Annual Greenhouse Gas Emissions from Alternative 1 Operations (metric tons CO_2e)

Year	Maintenance	Recreational Vehicle Trips [a]	Recreational Boating	Public Services and Utilities [b]	Water Conveyance – Long-Term Average [c]	Water Conveyance – Dry and Critically Dry [c]	Land Use Change Emissions – Maximum [d]	Total – Long Term	Total – Dry and Critically Dry
Alternative 1A									
2030	262	(5,696)	2,360	24	19,595	31,722	44,065	60,610	72,736
2031	270	(5,648)	2,387	24	18,297	29,621	44,065	59,395	70,719
2032	260	(5,600)	2,409	24	17,000	27,520	44,065	58,157	68,677
2033	256	(5,552)	2,431	24	15,702	25,419	44,065	56,924	66,642
2034	257	(5,505)	2,452	24	14,404	23,319	44,065	55,698	64,612
2035	118	(5,457)	2,485	24	13,107	21,218	44,065	54,341	62,452
2036	115	(5,409)	2,496	24	11,809	19,117	44,065	53,100	60,408
2037	124	(5,361)	2,518	24	10,511	17,016	44,065	51,881	58,386
2038	118	(5,313)	2,540	24	9,214	14,916	44,065	50,647	56,349
2039	117	(5,265)	2,562	24	7,916	12,815	44,065	49,419	54,317
2040	346	(5,218)	2,579	24	6,618	10,714	44,065	48,414	52,510
Maximum Annual								**60,610**	**72,736**
Alternative 1B									
2030	262	(5,696)	2,360	24	18,560	31,056	44,064	59,573	72,070
2031	270	(5,648)	2,387	24	17,331	28,999	44,064	58,427	70,096
2032	260	(5,600)	2,409	24	16,102	26,943	44,064	57,258	68,099
2033	256	(5,552)	2,431	24	14,872	24,886	44,064	56,094	66,107
2034	257	(5,505)	2,452	24	13,643	22,829	44,064	54,936	64,122
2035	118	(5,457)	2,485	24	12,414	20,773	44,064	53,647	62,006
2036	115	(5,409)	2,496	24	11,185	18,716	44,064	52,475	60,006
2037	124	(5,361)	2,518	24	9,956	16,659	44,064	51,325	58,028
2038	118	(5,313)	2,540	24	8,727	14,603	44,064	50,160	56,035
2039	117	(5,265)	2,562	24	7,498	12,546	44,064	48,999	54,048
2040	346	(5,218)	2,579	24	6,269	10,489	44,064	48,064	52,284
Maximum Annual								**59,573**	**72,070**

Notes:

CO_2e = carbon dioxide equivalent.

[a] Negative values are indicated by parentheses. Alternative 1 would result in a net decrease in vehicle miles traveled in California, because visitor trips to Sites Reservoir would, overall, be shorter than to the reservoirs where visitors are currently traveling to.

[b] Public services and utilities include the GHG emissions from the use of water and the generation of waste and wastewater at the recreational areas.

[c] Refer to Chapter 17, *Energy*, for further discussion of the long-term average and Dry and Critically Dry scenarios.

[d] The land use change emissions shown in this table are the result of converting the inundation area to flooded land. The emissions are comprised of CO_2 and CH_4 and represent the emissions that would occur within the first 20 years of the land being converted to a reservoir. Twenty years after inundation, the annual emissions would decrease as the reservoir approaches a steady state. The emissions values in this table represent the maximum annual emissions from land use change; the average values and lower-end values are presented in Appendix 21A. As such, the land use emissions values in this table are conservative because the upper-end estimates are included here. Appendix 21A also presents the methodology used to quantify these emissions.

CEQA Significance Determination and Mitigation Measures

The impact would be significant for Alternative 1, because construction and operations emissions would generate substantial emissions of GHGs that constitute a net increase in emissions and thus do not meet the carbon-neutral threshold. The net increase in emissions could also conflict with the State's plans to reduce GHG emissions, resulting in a potentially significant impact with respect to the Project conflicting with plans or policies adopted for the purpose of reducing GHG emissions. Implementation of Mitigation Measure GHG-1.1 would reduce or offset these emissions to net zero through a GHG Reduction Plan.

Per Mitigation Measure GHG-1.1, the Authority would develop and implement a GHG Reduction Plan that would reduce the Project's GHG emissions to net zero. First, the Authority would implement these strategies to reduce GHG emissions, which would reduce emissions by utilizing electric power instead of generators; developing a Project-specific ride share program for employees; and using electric or alternatively fueled equipment instead of diesel equipment. For emissions that would not be reduced through these strategies, Mitigation Measure GHG-1.1 provides additional methods for achieving the net-zero goal.

For emissions that cannot otherwise be reduced, the Authority would offset those emissions so that there is no net increase in GHG emissions from construction or operations activities of Alternative 1. Mitigation Measure GHG-1.1 specifies the requirements for using GHG credits for CEQA purposes.

This measure ensures Alternative 1 GHG emissions would not result in a significant GHG impact, because there would be no net increase in emissions. Further, with implementation of Mitigation Measure GHG-1.1, Alternative 1 would not conflict with any plans adopted for the purpose of reducing GHG emissions, because there would be no net increase in emissions. Accordingly, this impact would be less than significant with mitigation.

Mitigation Measure GHG-1.1: Achieve Net-Zero Emissions Through a GHG Reduction Plan

To achieve net-zero emissions, the Authority will develop a GHG Reduction Plan to reduce Project emissions from onsite and offsite sources. The Authority will retain a qualified consultant to develop a GHG Reduction Plan to reduce GHG emissions resulting from construction and operational activities to net zero. Net additional GHG emissions from the construction period and annual emissions from operations have been quantified as part of this analysis. Construction emissions total to 348,648 to 351,362 metric tons of CO_2e depending on the alternative and variant of the Project. Annual operational emissions could be a maximum of 72,736 metric tons CO_2e, which corresponds to Alternative 1A, but are expected to continually decrease in future years as the electric power sector transitions to more renewable sources of energy. This yields a reduction commitment of up to 351,362 metric tons CO_2e total for construction and up to 72,736 metric tons of CO_2e annually needed to meet the net-zero performance standard. These maximum values of 72,736 metric tons CO_2e and 351,362 metric tons CO_2e correspond to Alternatives 1A and 2, respectively. Table 21-6 summarizes the reduction by alternative.

Table 21-6 Summary of Metric Ton Reduction (metric tons CO2e)

Year	Alternatives 1A		Alternative 1B		Alternative 2		Alternative 3	
	Variant 1[a]	Variant 2[b]	Variant 1	Variant 2	Variant 1	Variant 2	Variant 1	Variant 2
Total Construction Emissions Commitment	348,648	348,796	348,648	348,796	351,317	351,362	348,648	348,796
Maximum Annual Operational Emissions Commitment (Long-Term Average)	60,610	60,610	59,573	59,573	59,003	59,003	56,613	56,613
Maximum Annual Operational Emissions Commitment (Dry and Critically Dry)	72,736	72,736	72,070	72,070	71,056	71,056	67,778	67,778

Notes:
CO_2e = carbon dioxide equivalent.
[a] Variant 1 assumes the Project would connect to existing Western Area Power Administration utility infrastructure.
[b] Variant 2 assumes the Project would connect to existing Pacific Gas and Electric utility infrastructure.

As noted in the text of this measure, below, the net-zero performance standard may be achieved based on actual emission calculations, and thus the Authority's reduction commitment may differ from the values included in this analysis.

The GHG Reduction Plan will include the following content and adhere to the following requirements.

1) *Emissions Quantities and Reduction Commitments*: GHG emissions from construction and operations must be reduced to net zero on a continual basis throughout construction and operations. Advanced planning for GHG reductions will be necessary to ensure that the net effect of Project emissions and this mitigation is that the Project will not result in any increase in GHG emissions relative to the No Project Alternative throughout the construction and operational period. The Authority will thus need to proactively assess upcoming construction activity and implement early investment in GHG reduction efforts prior to construction (to ensure that the emissions that are being mitigated through other measures are only those that are unavoidable).

   Since some of the planning will be reliant on the estimated GHG reduction value of future actions during construction and operation (as discussed below) there may be an emissions credit debt if emissions are higher than expected or if certain measures do not achieve the reductions that were anticipated. Conversely, if emissions are lower than expected or measures achieve higher reductions than expected, the Authority may bank credits for the next year of construction and/or operations.

2) *Plan Development:* The GHG Reduction Plan will identify the amount of GHG emissions anticipated during each construction phase. Amendments to the GHG Reduction Plan may be made during the construction period for the purpose of giving the Authority flexibility to adapt to changing technologies that have increasing effectiveness at reducing emissions and/or changes in expected construction emissions or available mitigation approaches. For operations, the GHG Reduction Plan may be developed and implemented in 5-year increments and can be amended to include more cost effective or environmentally beneficial technologies. This analysis presents an estimate of annual GHG emissions generated by Project construction and operations. Although the emissions provided in this analysis could be used to inform the required mitigation commitment, the methods used to quantify emissions are conservative. This analysis does not account for any GHG reduction measures that may be implemented by the Authority pursuant to this measure. Accordingly, this EIR likely overestimates actual GHG emissions that would be generated by the Project. The Authority may therefore reanalyze GHG emissions for construction and/or operation of the Project to update the required reduction commitment to achieve net zero.

   Updated emissions analysis conducted for the GHG Reduction Plan will be performed using approved emissions models and methods available at the time of that analysis. Updated emissions analysis conducted for the GHG Reduction Plan will, at a minimum, consider the categories and types of emission sources included in this Final EIR/EIS; additional categories and types of emission sources should be considered for inclusion based on then-available scientific information. The analysis must use the latest available engineering data for the Project, inclusive of any required BMPs or GHG emissions reduction measures. Consistent with the methodology used in this analysis, emission factors may account for enacted regulations that will influence future year emissions intensities (e.g., fuel efficiency standards for on-road vehicles). Net emissions from changes in operations emissions will be quantified using approved methods at the time of analysis and applicable activity data for each component of operations (such as maintenance activities, recreational vehicle trips, recreational boating, public services and utilities, water conveyance, and land use, including water storage).

3) *GHG Reduction Strategies*: The construction component and each operational increment in the GHG Reduction Plan will identify the GHG reduction measures that will be implemented during that period to achieve the net-zero performance standard. GHG reduction measures must be verifiable and feasible to implement. The GHG Reduction Plan will identify the entity responsible for implementing each measure and the estimated GHG reduction that will be achieved by implementation of the measure. If the selected measures are shown to result in reductions that exceed total

net emissions of that period, the estimated surplus can be applied as a credit for future periods.

The constituent measures in the GHG Reduction Plan are summarized in this section. Implementation of BMP-29 is a required Project design feature that must be incorporated into the GHG Reduction Plan. The Authority will prioritize strategies to reduce emissions in the following order (1) onsite measures for construction or operations that are not already part of BMP-29, (2) offsite measures, and (3) carbon credits. The order of priority for the location of selected measures will be (1) within the Project footprint, (2) within communities in the vicinity of the Project site, (3) in the Sacramento Valley Air Basin, (4) in the State of California, and (5) in the United States. If the GHG Reduction Plan proposes GHG reduction strategies that do not conform to the priorities outlined above, it must present substantial evidence to justify the deviation or explain why higher priority locations were deemed infeasible as defined under CEQA. In addition, the Authority will seek opportunities to implement GHG reduction measures in environmental justice communities (as defined in this Final EIR/EIS) in and near the Project site and report on the effort and outcomes in the annual reporting required in this measure.

The Authority will be responsible for determining the measures necessary to ensure the performance standard to mitigate the significant GHG impact is met.

The list of measures presented in this section is not exclusive. The Authority may include additional measures to reduce GHG emissions to the extent that the measures become commercially available, have documented reliability in real-world conditions and become cost effective. This may include new equipment and vehicle systems (e.g., autonomous construction equipment, fuel-cells), new energy systems (e.g., battery storage), or other technologies (e.g., carbon capture and storage).

a. Construction Best Management Practices and Other Onsite Measures. The Authority will reduce onsite GHG emissions as much as feasible through implementation of the measures identified below. These measures include a list of strategies to reduce GHG emissions from construction. Two measures that have a higher potential to reduce emissions include the use of electric equipment and vehicles instead of diesel-powered vehicles and the use of vehicles that use alternative fuels, such as compressed natural gas, liquified natural gas, propane, or biodiesel. These measures are not reflected in the emissions modeling results, because the future availability of electric-powered construction equipment and vehicles and alternative fuels in the California market is uncertain. As such, a mandate to use all-electric equipment and vehicles and alternative fuels cannot be made at this time. The Authority and its construction contractors will prioritize the use of electric or hybrid-electric off-road construction equipment and vehicles over diesel equipment. These measures, or other equivalent measures, will be implemented by the Authority and their construction contractors prior to or during construction. The Authority would review all designs and plans to ensure incorporation of these measures or the equivalent. In addition, the Authority will deploy a construction monitor during construction to monitor implementation of the required measures. Construction monitors will report regularly (at least quarterly) to the Authority on contractor compliance and will record inspection records in the Project file.

i. Preconstruction and Final Design Considerations: Preconstruction and final design considerations would be designed to ensure unique characteristics of facility construction are taken into consideration when determining if specific equipment, procedures, or material requirements are feasible and efficacious for reducing GHG emissions. Examples of requirements and considerations are identified below.

- Consider Project characteristics, including location, Project workflow, site conditions, 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.
- Ensure that all economically feasible avenues have been explored for providing an electrical service drop to the construction site for temporary construction power. When generators must be used, consider use of alternative fuels, such as propane or solar, to power generators to the maximum extent feasible, as specified in construction contracts.
- Minimize idling time by requiring that equipment be shut down after 3 minutes when not in use (5 minutes 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.
- Maintain all construction equipment in proper working condition and perform all preventive 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.
- Implement a tire inflation program on each jobsite to ensure that equipment tires are correctly inflated. Check tire inflation when equipment arrives onsite and every 2 weeks for equipment that remains onsite. Check vehicles used for hauling materials offsite 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.
- Develop a Project-specific ride share program to encourage carpools and shuttle vans.

- 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 implement procedures for turning off computers, lights, air conditioners, heaters, and other equipment each day at close of business, wherever feasible.
- For material 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 SmartWay26 certified truck will be used to the maximum extent feasible.
- Develop a Project-specific construction debris recycling and diversion program to achieve a documented 50% diversion of construction waste.
- During all activities, diesel-fueled portable equipment with maximum power greater than 25 horsepower shall be registered under the CARB's Statewide Portable Equipment Registration Program.

b. Offsite Measures. For GHG emissions that cannot be reduced through the construction BMPs and other onsite measures discussed above, the Authority will reduce emissions as much as feasible through offsite measures. The GHG Reduction Plan will identify offsite measures that are suitable to reduce emissions. Offsite strategies include those that reduce emissions from an emissions source(s) that is not located in the Project area and may or may not be associated with the Project.

i. For construction electricity and water conveyance–related energy, the Authority will increase the proportion of renewable energy purchases for the Project's electricity needs to the highest amount that is feasible. The Authority is planning on purchasing 60% of the Project's power needs from renewable, carbon-free sources starting in 2030. To fully reduce the emissions from construction electricity and water conveyance electricity, the Authority would need to purchase 100% of energy needs from carbon-free sources. If the Authority determines that it is infeasible to purchase 100% carbon-free energy for construction and/or operations, carbon credits would be required to reduce the remaining emissions.

ii. The GHG Reduction Plan may identify other strategies that reduce emissions from sources that are not affiliated with the Project. The Authority can take credit for reductions that result from projects it sponsors, to achieve the net-zero goal. For example, the Authority could directly sponsor emissions-reducing projects, such as the following.

- replacing diesel school buses with electric buses.
- planting trees in local communities.
- providing support to local businesses or homeowners to install solar photovoltaic systems, other renewable energy projects, or energy

efficiency improvements. Energy efficient improvements could include installing energy efficient appliances and cool roofs on buildings.

- working with local communities to implement transportation-related emissions-reducing projects. These may include sponsoring bike- or car-share programs, providing support to public transit systems, or contributing to infrastructure and streetscape improvements for pedestrians and bicycles.

c. Carbon Credits. For all emissions that cannot otherwise be reduced through onsite or offsite measures, the purchase and retirement of carbon credits would be required. A carbon credit enables development projects to compensate for their GHG emissions and associated environmental impacts by financing reductions in GHG emissions elsewhere. GHG credits derived from completed prior actions are referred to as "GHG offsets" or "carbon offsets." GHG credits derived from future contracted actions are referred to as "GHG future credits" or GHG (future mitigation units [FMUs]). Carbon credits are classified as either compliance or voluntary. Compliance credits can be purchased by covered entities subject to the cap-and-trade regulation to meet predetermined regulatory targets. Voluntary credits are not associated with the cap-and-trade regulation and are purchased with the intent to voluntarily meet carbon-neutral or other environmental obligations.

The Authority may purchase carbon credits from a voluntary GHG credit provider that has an established protocol that requires projects generating GHG credits to demonstrate that the reduction of GHG emissions is real, permanent, quantifiable, verified, enforceable, and additional (per the definition in California Health & Saf. Code §§ 38562(d)(1) and (2)). Definitions for these terms are as follows.

i. **Real**. Estimated GHG reductions should not be an artifact of incomplete or inaccurate emissions accounting. Methods for quantifying emission reductions should be conservative to avoid overstating a project's effects. The effects of a project on GHG emissions must be comprehensively accounted for, including unintended effects (often referred to as "leakage").[4]

ii. **Additional**. GHG reductions must be additional to any that would have occurred in the absence of the Climate Action Reserve or of a market for GHG reductions generally. "Business as usual" reductions (i.e., those that would occur in the absence of a GHG reduction market) should not be eligible for registration.

iii. **Permanent**. To function as GHG credits, GHG reductions must effectively be "permanent." This means, in general, that any net reversal in GHG reductions

[4] To ensure that GHG reductions are real, CARB requires the reduction be "a direct reduction within a confined project boundary."

must be fully accounted for and compensated through the achievement of additional reductions.

iv. **Quantifiable**. The ability to accurately measure and calculate GHG reductions or GHG removal enhancements relative to a project baseline in a reliable and replicable manner for all GHG emission sources, GHG sinks, or GHG reservoirs included within the credit project boundary, while accounting for uncertainty, activity-shifting leakage, and market-shifting leakage.

v. **Verified**. GHG reductions must result from activities that have been verified. Verification requires third-party review of monitoring data for a project to ensure the data are complete and accurate.

vi. **Enforceable.** The emission reductions from credits must be backed by a legal instrument or contract that defines exclusive ownership, and the legal instrument can be enforced within the legal system in the country in which the credit project occurs or through other compulsory means. Please note that per this mitigation measure, only credits originating within the United States are allowed.

Carbon credits must also meet the following requirements:

i. Carbon credits may be in the form of GHG offsets for prior reductions of GHG emissions verified through protocols or forecasted mitigation units for future committed GHG emissions meeting protocols.

ii. All credits will be documented per protocols functionally equivalent in terms of stringency to CARB's protocol for offsets in the cap-and-trade program. If using credits not from CARB protocols, the Authority must provide the protocols from the credit provider and must document why the protocols are functionally equivalent in terms of stringency to CARB protocols.

iii. The Authority will identify carbon credits in geographies closest to the Project first and only go to larger geographies (i.e., California, United States) if adequate credits cannot be found in closer geographies or the procurement of such credits would create an undue financial burden. The Authority will provide the following justification for not using credits in closer geographies in terms of either availability or cost prohibition.

- Lack of enough credits available in closer geographies (e.g., Northern Sacramento Valley).
- Prohibitively costly credits in closer geographies defined as credits costing more than 300% the amount of the current costs of credits in the regulated CARB offset market or of the current costs of credits in the Compliance Offset Program, which is part of CARB's broader cap-and-trade program.

iv. Documentation submitted supporting carbon credit proposals will be prepared by individuals qualified in GHG credit development and verification, and such individuals will certify the following:

- Proposed credits meet the criteria in California Health and Safety Code Sections 38562(d)(1) and (d)(2).
- Proposed credits meet the definitions for the criteria provided in this measure.
- The protocols used for the credits meet or exceed the standards for stringency used in CARB protocols for offsets under the California cap-and-trade system.

Monitoring, reporting, and enforcement requirements for implementation of the GHG Reduction Plan will include the following components.

1) *Phased Analysis and Plan Amendments:* As described above, the GHG Reduction Plan may be developed and implemented over five-year increments for Project operations. Prior to the start of each five-year increment, the Authority will update the GHG Reduction Plan to calculate the amount of GHG emissions anticipated in the upcoming five-year period, as well as emissions from prior periods (if needed to cover any deficits) and the projected total net emissions of the Project. The GHG Reduction Plan will identify the specific GHG reduction measures that will be implemented to meet the net-zero performance standard for the upcoming five-year period and include quantification of the expected reductions that will be achieved by each measure. All emissions and reductions will be quantified in accordance with the requirements outlined in *Plan Development* above.

   The Authority will retain a third-party expert to assist with the review and approval of the GHG Reduction Plan. Subsequent amendments to the GHG Reduction Plan will identify reductions that have been achieved during prior phases and determine if those reductions exceed emissions generated by the Project. If the GHG reduction measures implemented by the Authority result in a surplus of reductions above the net-zero performance standard, the balance of those reductions may be credited to subsequent phases.

2) *Timing and Execution:* The Authority will prepare the GHG Reduction Plan prior to issuance of the first construction or grading permit for the Project. For Project operations, the GHG Reduction Plan will be prepared prior to the end of construction and prior to the start of the next five-year phase of operations. The Authority Board of Directors will formally adopt the completed GHG Reduction Plan and make it publicly available on its website prior to its adoption.

   BMPs and selected onsite construction measures will be included in construction-permits and contractor bid packages and/or agreements. Offsite measures that the Authority chooses to implement will be completed or in progress before completion of construction or before the end of the calendar year (for Project operations) in which the measure(s) are intended to reduce emissions. If GHG credits are purchased, the Authority will enter the necessary contract(s) to purchase credits prior to the start of construction or prior to the start of the calendar year (for Project operations). All credits must be retired before completion of construction or the calendar year (for Project operations).

3) *Monitoring and Reporting:* The Authority will retain a third-party expert to assist with review and approval of annual reports. Through the third-party expert, the Authority will conduct annual monitoring and reporting to ensure that the reduction measures included in the plan achieve sufficient emission reductions to reduce Project emissions to net zero. Each annual report should describe the GHG reduction strategies that were implemented over the prior year; summarize past, current, and anticipated Project phasing; document compliance with GHG Reduction Plan requirements; and identify corrective actions needed to ensure that the GHG Reduction Plan achieves the net-zero performance standard. If GHG credits have been purchased to reduce emissions for the reporting year, the annual report must include copies of the credit retirement verification.

   The reports will be finalized and posted in a publicly accessible location online by December 31st of the following year.

NEPA Conclusion

Construction and operations effects would be the same as described above for CEQA. Construction and operations of Alternative 1 would generate substantial emissions of GHGs that constitute a net increase in emissions and could conflict with State plans adopted to reduce GHG emissions as compared to the No Project Alternative. With Mitigation Measure GHG-1.1, construction and operation of Alternative 1 would be consistent with a net-zero threshold and thus have no adverse effect.

Alternative 2

Construction

As shown in Table 21-4, total construction emissions for Alternative 2 would be greater than Alternatives 1 and 3. Although Alternative 2 has fewer dams, and does not include the reservoir bridge roadway, Alternative 2 would require construction of the South Road. Emissions from construction of the South Road result in Alternative 2 having greater emissions than Alternative 1. In some years, Alternative 2 GHG emissions may be lower than Alternative 1, but the total and amortized emissions for Alternative 2 are greater than Alternative 1.

Similar to Alternatives 1 and 3, the greatest annual emissions for Alternative 2 occur in 2026 and 2027, mainly because these years are when the majority of construction activities will occur across the entire Project area. Amortized emissions for Alternative 2 would be around 11,700 MT CO_2e.

Operations

Operations emissions for Alternative 2 are shown in Table 21-7. The emissions for recreational boating and public services and utilities would be the same as for Alternative 1, because there would be no expected differences in the amount of recreational boating activity or public services and utilities between the alternatives.

There would be minor differences in maintenance activities, and Alternative 2 would result in slightly lower emissions annually than Alternative 1. Alternative 2 would require less inspections and maintenance, because it has fewer dams and does not include the bridge.

Overall, the profile of emissions for Alternative 2 is similar to Alternative 1, because water conveyance and land use change emissions are the dominant sources of emissions. Recreational vehicle trips would be a net negative source of emissions, but the emissions would be less negative than for Alternative 1 because visitors would need to travel a greater distance to Sites Reservoir in the absence of the bridge under Alternative 2, which would result in greater VMT.

For water conveyance, Alternative 2 would result in lower energy consumption than Alternative 1 but more consumption than Alternative 3, for all water year types. As with Alternative 1, emissions would be highest in 2030 and decrease each year from the continual decrease in carbon intensity of the electricity supply.

For land use change, Alternative 2 would result in the lowest emissions of all the alternatives because this emissions source is determined by the reservoir's surface area, and Alternative 2 would have the smallest surface area. As noted previously, the emissions shown are conservative because the upper-end values of the emissions range are presented here. The full range of values, including the lower-end and average values, are included in Appendix 21A. Additionally, 20 years after inundation, the annual emissions would decrease as the reservoir approaches a steady state.

The maximum net increase in GHG emissions during long-term average water years would be 59,003 MT CO_2e. In Dry and Critically Dry Water Years, the increase would be a maximum of 71,056 MT CO_2e. Alternative 2 would generate emissions annually that constitute a net increase in emissions.

Table 21-7. Annual Greenhouse Gas Emissions from Alternative 2 Operations (metric tons CO_2e)

Year	Maintenance	Recreational Vehicle Trips [a]	Recreational Boating	Public Services and Utilities [b]	Water Conveyance – Long-Term Average [c]	Water Conveyance- Dry and Critically Dry [c]	Land Use Change Emissions – Maximum [d]	Total – Long Term	Total – Dry and Critically Dry
2030	249	(3,306)	2,360	24	18,412	30,465	41,264	59,003	71,056
2031	269	(3,278)	2,387	24	17,193	28,447	41,264	57,858	69,112
2032	254	(3,250)	2,409	24	15,973	26,430	41,264	56,673	67,130
2033	249	(3,222)	2,431	24	14,754	24,412	41,264	55,499	65,157
2034	256	(3,195)	2,452	24	13,535	22,395	41,264	54,336	63,196
2035	113	(3,167)	2,485	24	12,315	20,377	41,264	53,033	61,095
2036	112	(3,139)	2,496	24	11,096	18,360	41,264	51,852	59,116
2037	126	(3,111)	2,518	24	9,877	16,342	41,264	50,697	57,162
2038	115	(3,084)	2,540	24	8,657	14,325	41,264	49,516	55,183
2039	114	(3,056)	2,562	24	7,438	12,307	41,264	48,346	53,215
2040	320	(3,028)	2,579	24	6,219	10,290	41,264	47,377	51,448
Maximum Annual								**59,003**	**71,056**

Notes:

CO_2e = carbon dioxide equivalent.

[a] Negative values are indicated by parentheses. Alternative 2 would result in a net decrease in vehicle miles traveled in California, because visitor trips to Sites Reservoir would, overall, be shorter than to the reservoirs where visitors are currently traveling to.

[b] Public services and utilities include the GHG emissions from the use of water and the generation of waste and wastewater at the recreational areas.

[c] Refer to Chapter 17, *Energy*, for further discussion of the long-term average and Dry and Critically Dry scenarios.

[d] The land use change emissions shown in this table are the result of converting the inundation area to flooded land. The emissions are comprised of CO_2 and CH_4 and represent the emissions that would occur within the first 20 years of the land being converted to a reservoir. Twenty years after inundation, the annual emissions would decrease as the reservoir approaches a steady state. The emissions values in this table represent the maximum annual emissions from land use change; the average values and lower-end values are presented in Appendix 21A. As such, the land use emissions values in this table are conservative because the upper-end estimates are included here. Appendix 21A also presents the methodology used to quantify these emissions.

CEQA Significance Determination and Mitigation Measures

Alternative 2 would result in greater construction GHG emissions than Alternative 1, because of South Road construction. For operations, Alternative 2 would result in less emissions than Alternative 1A and Alternative 1B for all water year types. The water conveyance and land use change emissions are the dominant sources of emissions for operations, so the relative level of emissions between alternatives is primarily governed by the amount of energy consumed for water conveyance and the difference in land use change emissions, which are based on the alternatives' surface areas. Because Alternative 2 would have a smaller surface area than Alternative 1, it would result in less land use change emissions and thus less emissions overall. Construction and operation of Alternative 2 would result in both direct and indirect GHG emissions that would be a potentially substantial net increase in emissions to the atmosphere, and this impact would be potentially significant. The net increase in emissions could also conflict with the State's plans to reduce GHG emissions, resulting in a potentially significant impact with respect to the Project conflicting with plans or policies adopted for the purpose of reducing GHG emissions.

Mitigation Measure GHG-1.1 would ensure that Alternative 2 GHG emissions would not result in a significant GHG impact, because there would be no net increase in emissions. Further, Alternative 2 would not conflict with any plans adopted for the purpose of reducing GHG emissions, because there would be no net increase in emissions. Accordingly, this impact would be less than significant with mitigation.

NEPA Conclusion

Construction and operations effects would be the same as described above for CEQA. Construction and operations of Alternative 2 would generate substantial emissions of GHGs that constitute a net increase in emissions and could conflict with State plans adopted to reduce GHG emissions as compared to the No Project Alternative. With Mitigation Measure GHG-1.1, construction and operation of Alternative 2 would be consistent with a net-zero threshold and thus have no adverse effect.

Alternative 3

Construction

Alternative 3 would result in the same quantity of emissions as Alternative 1, as shown in Table 21-4. The footprints for these alternatives would be identical and thus construction emissions would be the same.

Operation

Operations emissions for Alternative 3 are shown in Table 21-8. The emissions for maintenance activities, recreational vehicle trips, recreational boating, and public services and utilities would be the same as for Alternative 1, because the footprint would be the same. There would therefore be no expected differences in the maintenance activities or amount of recreational activity, and thus emissions would be the same for these sources.

Overall, the profile of emissions for Alternative 3 is similar to Alternatives 1 and 2, because water conveyance and land use change are the dominant source of emissions. Recreational vehicle trips would be a net negative source of emissions.

For water conveyance, Alternative 3 would result in the lowest energy consumption relative to Alternatives 1 and 2. Alternative 3 would result in more land use change emissions than Alternative 2, but less than Alternative 1. Because it would result in the lowest energy consumption, which more than compensates for its larger land use emissions relative to Alternative 2, Alternative 3 results in the lowest overall emissions. As with Alternatives 1 and 2, emissions would be highest in 2030 and decrease each year from the continual decrease in carbon intensity of the electricity supply.

The maximum net increase in GHG emissions during long-term average water years would be 56,613 MT CO_2e. In Dry and Critically Dry Water Years, the increase would be a maximum of 67,778 MT CO_2e. Because Alternative 3 would generate emissions annually that constitute a net increase in emissions, this impact would be potentially significant.

Table 21-8. Annual Greenhouse Gas Emissions from Alternative 3 Operations (metric tons CO_2e)

Year	Maintenance	Recreational Vehicle Trips [a]	Recreational Boating	Public Services and Utilities [b]	Water Conveyance – Long-Term Average [c]	Water Conveyance- Dry and Critically Dry [c]	Land Use Change Emissions – Maximum [d]	Total – Long Term	Total – Dry and Critically Dry
2030	262	(5,696)	2,360	24	15,602	26,767	44,061	56,613	67,778
2031	270	(5,648)	2,387	24	14,569	24,995	44,061	55,662	66,088
2032	260	(5,600)	2,409	24	13,536	23,222	44,061	54,689	64,375
2033	256	(5,552)	2,431	24	12,502	21,449	44,061	53,721	62,668
2034	257	(5,505)	2,452	24	11,469	19,677	44,061	52,758	60,966
2035	118	(5,457)	2,485	24	10,436	17,904	44,061	51,666	59,134
2036	115	(5,409)	2,496	24	9,403	16,131	44,061	50,690	57,419
2037	124	(5,361)	2,518	24	8,369	14,359	44,061	49,735	55,725
2038	118	(5,313)	2,540	24	7,336	12,586	44,061	48,766	54,016
2039	117	(5,265)	2,562	24	6,303	10,813	44,061	47,801	52,312
2040	346	(5,218)	2,579	24	5,270	9,041	44,061	47,062	50,833
Maximum Annual								**56,613**	**67,778**

Notes:

CO_2e = carbon dioxide equivalent.

[a] Negative values are indicated by parentheses. Alternative 3 would result in a net decrease in vehicle miles traveled in California, because visitor trips to Sites Reservoir would, overall, be shorter than to the reservoirs where visitors are currently traveling to.

[b] Public services and utilities include the GHG emissions from the use of water and the generation of waste and wastewater at the recreational areas.

[c] Refer to Chapter 17, *Energy*, for further discussion of the long-term average and Dry and Critically Dry scenarios.

[d] The land use change emissions shown in this table are the result of converting the inundation area to flooded land. The emissions are comprised of CO_2 and CH_4 and represent the emissions that would occur within the first 20 years of the land being converted to a reservoir. Twenty years after inundation, the annual emissions would decrease as the reservoir approaches a steady state. The emissions values in this table represent the maximum annual emissions from land use change; the average values and lower-end values are presented in Appendix 21A. As such, the land use emissions values in this table are conservative because the upper-end estimates are included here. Appendix 21A also presents the methodology used to quantify these emissions.

CEQA Significance Determination and Mitigation Measures

Alternative 3 would result in the same construction GHG emissions as Alternative 1, because the construction footprint would be the same. For operations, Alternative 3 would result in the lowest emissions of all alternatives, because the water conveyance emissions, a dominant source of emissions, would be the lowest. Therefore, construction GHG impacts for Alternative 3 would be the same as those for Alternative 1 and less than those for Alternative 2. Alternative 3 would result in operations GHG emissions lower than Alternative 1 or 2. Construction and operation of the Alternative 3 would result in both direct and indirect GHG emissions that would be a potentially substantial net increase in emissions to the atmosphere, and this impact would be potentially significant. The net increase in emissions could also conflict with the State's plans to reduce GHG emissions, resulting in a significant impact with respect to conflicting with plans or policies adopted for the purpose of reducing GHG emissions.

Mitigation Measure GHG-1.1 would ensure Alternative 3 GHG emissions would not result in a significant GHG impact, because there would be no net increase in emissions. Further, the Alternative 3 would not conflict with any plans adopted for the purpose of reducing GHG emissions, because there would be no net increase in emissions. Accordingly, this impact would be less than significant with mitigation.

NEPA Conclusion

Construction and operations effects would be the same as described above for CEQA. Construction and operations of Alternative 3 would generate substantial emissions of GHGs that constitute a net increase in emissions and could conflict with State plans adopted to reduce GHG emissions as compared to the No Project Alternative. With Mitigation Measure GHG-1.1, construction and operation of Alternative 3 would be consistent with a net-zero threshold and thus have no adverse effect.

21.5 References

21.5.1. Printed References

AECOM and Ascent. 2011. *Yolo County Climate Action Plan: A Strategy for Smart Growth Implementation, Greenhouse Gas Reduction, and Adaptation to Global Climate Change.* Last revised: March 15, 2011. Available: https://www.yolocounty.org/home/showpublisheddocument/18005/635289380535200000. Accessed: April 20, 2021.

California Air Resources Board. 2014. *Appendix J: Recreational Watercraft Emissions Inventory Methodology*. November. Available: https://ww3.arb.ca.gov/msei/pc2014_technical_document.pdf. Accessed: April 22, 2021.

California Air Resources Board. 2017. *Short-Lived Climate Pollutant Reduction Strategy*. March. Available: https://ww2.arb.ca.gov/sites/default/files/2020-07/final_SLCP_strategy.pdf. Accessed: April 20, 2021.

California Air Resources Board. 2020a. *California Greenhouse Gas Inventory for 2000-2018 – by Category as Defined in the 2008 Scoping Plan.* Last revised: October 15, 2020. Available: https://ww3.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_sum_2000-18.pdf. Accessed: April 20, 2021.

California Air Resources Board. 2020b. *California High GWP Gases Inventory for 2000-2018 – by Category as Defined in the 2008 Scoping Plan.* Last revised: October 15, 2020. Available: https://ww3.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_2000-18hgwp.pdf. Accessed: April 22, 2021.

California Air Resources Board. 2021. *Development of Recreational Marine Vessel Emissions Inventory Model.* March 30. Available: https://ww2.arb.ca.gov/sites/default/files/2021-03/rmv2022_workshop_presentation_dw_032721_ada.pdf. Accessed: June 30, 2021.

California Air Resources Board. No date A. *GHG Global Warming Potentials*. Available: https://ww2.arb.ca.gov/ghg-gwps. Accessed: April 20, 2021.

California Air Resources Board. No date B. *GHGs Descriptions & Sources in California*. Available: https://ww2.arb.ca.gov/ghg-descriptions-sources. Accessed: April 20, 2021.

California Energy Commission. 2019. *2018 Total System Electric Generation*. Available: https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2019-total-system-electric-generation/2018. Accessed: April 22, 2021.

California Natural Resources Agency. 2009. *Final Statement of Reasons for Regulatory Actions*. December. Available: https://resources.ca.gov/CNRALegacyFiles/ceqa/docs/Final_Statement_of_Reasons.pdf. Accessed: July 19, 2021.

California Natural Resources Agency. 2018. *Final Statement of Reasons for Regulatory Action Amendments to the State CEQA Guidelines*. November. Available: https://resources.ca.gov/CNRALegacyFiles/ceqa/docs/2018_CEQA_Final_Statement_of%20Reasons_111218.pdf. Accessed: May 13, 2021.

Intergovernmental Panel on Climate Change. 2018a. *Global Warming of 1.5°C – An IPCC Special Report on the Impacts of Global Warming of 1.5°C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*. Available: https://www.ipcc.ch/site/assets/uploads/sites/2/2018/07/SR15_SPM_version_stand_alone_LR.pdf. Accessed: April 20, 2021.

Intergovernmental Panel on Climate Change. 2018b. *Emissions Gap Report - 2018*. Available: https://www.ipcc.ch/site/assets/uploads/2018/12/UNEP-1.pdf. Accessed: April 20, 2021.

Tehama County. No date. *Tehama County GHG Inventory and Forecast Summary*. Available: https://www.tehcoapcd.net/PDF/Tehama%20County%20GHG%20Inventory.pdf. Accessed: April 20, 2021.

U.S. Coast Guard. 2012. *National Recreational Boating Survey*. Last revised: April 12, 2021. Available: https://cdn.ymaws.com/aca.site-ym.com/resource/resmgr/SPP-documents/Boating_Survey-USCG_2012.pdf. Accessed: April 22, 2021.

U.S. Environmental Protection Agency. 2021a. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019*. Last revised: April 14, 2021. Available: https://www.epa.gov/sites/production/files/2021-04/documents/us-ghg-inventory-2021-main-text.pdf. Accessed: April 20, 2021.

U.S. Environmental Protection Agency. 2021b. *AP-42: Compilation of Air Emissions Factors*. Last revised: January 20, 2021. Available: https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors. Accessed: May 13, 2021.

U.S. Environmental Protection Agency. 2021c. *eGRID Data Explorer–Output Emission Rates for CO_2, CH_4, and N_2O for All Fuels at the eGrid Subregion Level for 2019*. Last revised: April 12, 2021. Available: https://www.epa.gov/egrid/data-explorer. Accessed: April 22, 2021.

World Bank. 2017. *Greenhouse Gases from Reservoirs Caused by Biogeochemical Processes*. December. Available: http://documents1.worldbank.org/curated/en/739881515751628436/pdf/Greenhouse-gases-from-reservoirs-caused-by-biogeochemical-processes.pdf. Accessed: May 20, 2021.