Appendix 20C Ambient Air Quality and Health Risk Analysis Technical Report

20C.1 Introduction

20C.1.1. Objective

This appendix includes methods and results for the Ambient Air Quality Analysis (AAQA) and Health Risk Assessment (HRA) from the worst-case year of construction activities associated with the Sites Reservoir Project (Project).

The analysis is conducted consistent with guidance and methodologies from local, regional, state and federal agencies, including the California Air Pollution Control Officers Association (CAPCOA) (2009), the California Air Resources Board (CARB) (2021), the Office of Environmental Health Hazard Assessment (OEHHA) (2015), Sacramento Metropolitan Air Quality Management District (SMAQMD) Mobile Sources Air Toxics (MSAT) Protocol (Sacramento Metropolitan Air Quality Management District 2018), and the U.S. Environmental Protection Agency (USEPA) (2017) to support the Project's California Environmental Quality Act (CEQA) documentation.

Consistent with CEQA requirements and guidance provided by CAPCOA, the analysis evaluates:

1. *Health risk and hazard impacts of construction emissions* from the Project to the existing offsite sensitive receptors (residents and schools) located within 1,000 feet of Project locations.
2. *Health risk and hazard impacts of on-road project-related construction emissions* to existing offsite sensitive receptors located within 500 feet of Project construction routes.

20C.1.2. Project Sources Modeled

This AAQA and HRA evaluates the impact of Project-related emissions of criteria pollutants (carbon monoxide [CO], nitrogen dioxide [NO_2], sulfur dioxide [SO_2], particulate matter 10 microns in diameter or less [PM10], and particulate matter 2.5 microns in diameter or less [PM2.5]) and toxic air contaminants (TACs) (e.g., diesel particulate matter or DPM) along the ambient air boundary (defined as the edge of onsite construction area) and at existing nearby sensitive receptors within 1,000 feet of Project locations and 500 feet of Project construction routes to determine if sensitive receptors are exposed to substantial pollutant concentrations. Table 20C-1 provides the Project component areas that are selected for modeling.

There are seven Project components identified as having sensitive receptors located with 1,000 feet. At these seven Project components, both on- and offsite (i.e., on-road traffic sources) emissions are modeled at their respective component as aligned to the alternatives are summarized in Table 20C-1. These include:

1. Sites Dam and Stone Corral Creek Recreation Area
2. Terminal Regulating Reservoir (TRR) East/West Pumping Plant and Funks/TRR Pipelines
3. Glenn-Colusa Irrigation District (GCID) System Improvements
4. Funks Reservoir and Funks/TRR Pipelines
5. Dunnigan Pipeline extending to either the Colusa Basin Drain (CBD) (Alternatives 1 and 3) or the Sacramento River (Alternative 2)
6. Temporary Batch Plants
7. Golden Gate Dam (AAQA onsite and offsite, HRA offsite only)

Table 20C-1. Summary of Modeled Components and Alternatives

Component	Alternative 1	Alternative 2	Alternative 3
Sites Dam and Stone Corral Creek Recreation Area	X	X	X
TRR East PGP and Funks/TRR pipelines	X		X
TRR West PGP and Funks/TRR pipelines[1]		X	
Glenn-Colusa Irrigation District (GCID) System Improvements	X	X	X
Funks Reservoir/Funks/TRR pipelines	X	X	X
Dunnigan Pipeline (extending to CBD)	X		X
Dunnigan Pipeline (extending to Sacramento River)		X	
Temporary Batch Plants	X	X	X
Golden Gate Dam	X	X	X

CBD = Colusa Basin Drain; PGP = pumping gnerating plant; TRR = Terminal Regulating Reservoir
[1] Emissions associated with TRR West PGP were modeled using the TRR East PGP footprint site as this location is closer to sensitive receptors. TRR West PGP emissions are higher than TRR East PGP.

Note that GCID System Improvements involve five sub-groups for Altenatives 1, 2 or 3. These groups include: (1) GCID Headgate Structure, (2) GCID Willow and Walker Creek Siphons, (3) GCID Main Canal Improvement A and Railroad (RR) Siphon, (4) GCID Main Canal Improvement E, and (5) GCID Main Canal Improvements F through K.

For components of the Project that do not have any nearby sensitive receptors within 1,000 feet or have relatively small emissions in comparison to the sites listed above, only mobile on-road sources are modeled. The mobile-source-only components modeled include the following and are summarized in Table 20C-2 and include the following:

1. Peninsula Hills Recreation Area
2. Red Bluff Pumping Plant (RBPP)
3. Transmission Lines (extending north from TRR Pumping Plant and Funks/TRR Pipelines)
4. Transition Manifold
5. Inlet/Outlet Tower (located north of Sites Dam)
6. Saddle Dams
7. South Road Alignment and Huffmaster Road Realignment (Alternative 2)
8. Huffmaster Road Realignment (no South Road) (Alternatives 1 and 3)

Table 20C-2. Summary of Modeled Components and Alternatives

Component	Alternative 1	Alternative 2	Alternative 3
Peninsula Hills Recreation Area	X	X	X
Red Bluff Pumping Plant (RBPP)	X	X	X
Transmission Lines[1]	X		X
Transition Manifold[1]	X		X
Inlet/Outlet Tower[1]	X		X
Saddle Dams[1]	X		X
South Road Alignment and Huffmaster Road Realignment		X	
Huffmaster Road Realignment	X		X

[1] Project Alternative modeled based on maximum on-road mobile source daily/annual emissions. For these components, Alternatives 1 and 3 have higher on-road mobile emissions compared to Alternative 2.

The Project components that are not explicitly modeled include GCID Main Canal Improvements B, C, and D. There are no residential dwellings located within 1,000 feet of these

Project components and the construction traffic routes would be similar to those associated with GCID Main Canal Improvements A, E, and F through K.

There are three Project alternatives. As discussed in Chapter 3, *Environmental Analysis*, and Chapter 20, *Air Quality*, of the EIR/EIS, construction footprints are identical between Alternatives 1 and 3 and therefore the construction emissions would be the same. Construction emissions associated with Alternative 2 are less than Alternatives 1 and 3 as there is less overall construction activity. Alternative 2 does not include the construction of the Lodoga Road bridge and has fewer dams. In lieu of the Lodoga Road bridge, roadway construction would occur for the South Road and the realigned Huffmaster Road. The footprints of the TRR and TRR Pumping Plant vary between Alternatives 1 and 3 (TRR East) and Alternative 2 (TRR West). The closest sensitive receptor to TRR East is approximately 1,600 feet, compared to more than 1 mile for TRR West. With the closer proximity of sensitives receptors to TRR East, this footprint is used in the modeling. Table 20C-3 identifies the alternative associated with each Project component for modeling.

Table 20C-3. Project Components Modeled

Project Component Details	Alternative (1 or 3, 2, All)	District	Meteorological Station	Sources to Model
Red Bluff Pumping Plant	All	TCAPCD	Red Bluff AP	Offsite Traffic Only
GCID New Headgate Structure	All	GCAPCD	Chico	Onsite & Offsite Traffic
GCID Wilson Creek and Walker Creek Siphons	All	GCAPCD	Colusa	Onsite & Offsite Traffic
GCID System Upgrades Improvement A, GCID RR Siphon	All	GCAPCD	Colusa	Onsite & Offsite Traffic
GCID System Upgrades Improvement E	All	GCAPCD	Colusa	Onsite & Offsite Traffic
GCID System Upgrades Improvement F, G, H, I, J and K	All	GCAPCD	Colusa	Onsite & Offsite Traffic
Saddle Dams (1-3, 5-6, 8A-B), Topsoil Stockpiles, Crushing and Processing, Blasting, Concrete Batch Plant, ERS-1 and ERS-2 Facilities	All	GCAPCD /CCAPCD	Colusa	Offsite Traffic Only
Inlet/Outlet Tower and Transition Manifold, Blasting, and Concrete Batch Plant	All	CCAPCD	Colusa	Offsite Traffic Only
Golden Gate Dam, Topsoil Stockpile, Crushing and Processing, Blasting, and Batch Plant	All	CCAPCD	Colusa	Onsite & Offsite Traffic
Sites Dam, Sites Diversion Tunnel, Topsoil Stockpile, Crushing and Processing, Blasting, Concrete Batch Plant, and Stone Corral Creek Recreation Area	All	CCAPCD	Colusa	Onsite & Offsite Traffic
Sites Lodoga Road Bridge, Concrete Batch Plant	Alt 1 or 3	CCAPCD	Colusa	Offsite Traffic Only
Peninsula Hills Recreation Area	All	CCAPCD	Colusa	Offsite Traffic Only
South Road & Huffmaster Road Realignment (Earthwork, Rock Crushing and Processing)	All	CCAPCD	Colusa	Onsite & Offsite Traffic
Funks Reservoir, Funks Pumping Generating Plant, Substation, Concrete Batch Plant, Batch Slurry Plant, and Funks/TRR Pipelines	All	CCAPCD	Colusa	Onsite & Offsite Traffic
Terminal Regulating Reservoir (TRR) Pumping Generating Plant, Substation, TRR East/West, Topsoil Stockpiles, Batch Slurry and Soil Plants, and Funks/TRR Pipelines	All	CCAPCD	Colusa	Onsite & Offsite Traffic
Transmission Lines (extending north from TRR Pumping Plant and Funks/TRR Pipelines)	All	CCAPCD	Colusa	Offsite Traffic Only
Dunnigan Pipeline Section 2/Alt 2 and Batch Slurry Plant	Alt 2	YSAQMD	Sac Int'l	Onsite & Offsite Traffic

Notes: TCAPCD = Tehama County Air Pollution Control District; GCAPCD = Glenn County Air Pollution Control District; CCAPCD = Colusa County Air Pollution Control District; YSAQMD = Yolo Solano Air Quality Management District.
Alternatives 1 and 3 have the same construction footprint and means and methods.

20C.1.3. Thresholds for Determining Significance

Criteria pollutant modeling results are compared to the national ambient air quality standards (NAAQS) and California ambient air quality standards (CAAQS). These are summarized in Table 20C-4.

For the HRA (cancer and non-cancer chronic and acute risk), the modeling results are compared to CEQA health risk thresholds. Neither Colusa County nor Glenn County Air Pollution Control Districts have specific CEQA guidance, but rather default to the state thresholds. Table 20C-5 summarizes the CEQA thresholds of significance for TACs.

Table 20C-4. National and California Ambient Air Standards

Criteria Pollutant	Averaging Period	Rank	NAAQS[1] ($\mu g/m^3$)	CAAQS[2] ($\mu g/m^3$)
NO_2	1-hour	8th (NAAQS); 1st (CAAQS)	188.0	339.0
	Annual	1st	100.0	57.0
PM10	24-hour	2nd (NAAQS); 1st (CAAQS)	150.0	50.0
	Annual	1st (CAAQS)	---	20.0
PM2.5	24-hour	8th (NAAQS)	35.0	---
	Annual	1st	12.0	12.0
CO	1-hour	2nd (NAAQS); 1st (CAAQS)	40,000.0	23,000.0
	8-hour	2nd (NAAQS); 1st (CAAQS)	10,000.0	10,000.0
SO_2	1-hour	4th (NAAQS); 1st (CAAQS)	196.5	655.0
	3-hour	2nd (NAAQS)	1,300.0	---
	24-hour	2nd (NAAQS); 1st (CAAQS)	365.0	105.0
	Annual	1st (NAAQS)	80.0	---

Notes: NAAQS = national ambient air quality standard; CAAQS = California ambient air quality standard; $\mu g/m^3$ = microgram per cubic meter.
[1] U.S. Environmental Protection Agency 2021a
[2] California Air Resources Board 2016

Table 20C-5. CEQA Health Risk Assessment Thresholds

TACs	Threshold1
Maximum Incremental Cancer Risk	≤ 10 in 1 million
Chronic Non-Cancer, 8-hour Chronic Non-Cancer & Acute Hazard Index	≤ 1.0

Notes: TACs = Toxic Air Contaminants.
[1] Sacramento Metropolitan Air Quality Management District 2020

20C.2 Methodology

20C.2.1. Dispersion Model

The American Meteorological Society/USEPA Regulatory Model (AERMOD) dispersion model (Version 19191) (U.S. Environmental Protection Agency 2020a) was run with USEPA-regulatory, default options for both the AAQA and HRA.

For the larger construction component areas (i.e., Dams and Reservoirs and associated offsite traffic to and from the area), a 3-step alternative modeling technique, AERPOST, is implemented to streamline the process and reduce computational time. The AERPOST alternative modeling technique has been approved in other modeling demonstrations (U.S. Environmental Protection Agency 2018a).

Step 1 involves running the model with Project-specific emissions and generating a binary output file consisting of 1-hour averaging period and pollutant ID set to OTHER. Lakes Environmental (2012) provides an 8-core multi-processor version (AERMOD MPI) that uses AERMOD version 19191. To demonstrate that the AERMOD MPI version produces identical results to AERMOD, an equivalency test is conducted. Furthermore, a new version of AERMOD (version 21112) (U.S. Environmental Protection Agency 2021b) was released during the modeling. Based on the USEPA model change bulletin, only bug fixes and non-regulatory options are applied to this new release. To demonstrate that there are no changes to modeled concentrations between version 19191 and 21112, an equivalency test is performed. Details on these model equivalency tests are provided in Appendix 20C1, *AERMOD Equivalency Model Demonstration*.

Step 2 of the modeling for the Dams and Reservoir locations consists of merging the binary files for similar pollutants at the various locations to generate a single merged binary file per pollutant for both short-term and annual averaging periods. The final stage uses a modified version of AERMOD, called AERPOST (version 19191) that introduces a new keyword in the control pathway of the model, “HRBINARY”, that allows for the import of AERMOD unformatted 1-hour binary output from a separate model run. These input concentrations are added hour-by-hour to the current model run for generation of statistical averaging of ranked highs for all currently evaluated averaging periods.

20C.2.1.1. Modeling of NO_2

USEPA has developed a three tiered approach to handle the nitric oxide (NO) to NO_2 conversion in AERMOD (for combustion sources, most nitrogen oxide (NO_X) emissions are NO, which converts via ozone oxidation processes to NO_2 after being emitted). The three tiers for NO_2 modeling are as follows:

- **Tier 1:** assume immediate and full conversion of NO to NO_2. In other words, this tier assumes that all NO_X is emitted as NO_2.
- **Tier 2:** use the Ambient Ratio Method 2 (ARM2) method, which uses a semi-empirical, conservative NO_2/NO_X ratio that is a function of total predicted NO_X.
- **Tier 3:** use either the Ozone Limiting Method (OLM) or the Plume Volume Molar Ratio Method (PVMRM). Both the PVMRM and OLM options in AERMOD account for

ambient conversion of NO to NO_2, but are limited by the amount of available ozone. The conversion is based on ozone titration, which involves the interaction of NO with ambient ozone (O_3) to form NO_2 and molecular oxygen. OLM and PVMRM both assume that all O_3 measured at a representative ambient monitor will be available to oxidize NO to NO_2. The main distinction between PVMRM and OLM is the approach taken to estimate the ambient concentrations of NO and O_3 for which the ozone titration mechanism is applied. OLM applies the mechanism to the modeled ground-level concentration of NO and PVMRM applies the mechanism to the plume-average NO concentrations aloft.

The Tier 2 approach is used initially for all sites. The USEPA-default NO-to-NO_2 upper limit of 0.9 and lower limit of 0.5 are used. For model scenarios where the cumulative (Project plus ambient background) exceeded the NAAQS/CAAQS, a Tier 3 approached is applied.

Consistent with USEPA guidance (U.S. Environmental Protection Agency 2011, 2015), OLM is used as it is suggested as the best option for modeling near-surface releases (such as construction and roadway sources). OLM is used with the OLMGROUP ALL keyword, as recommended by USEPA.

Tier 3 NO_2 model approaches require user input for both NO_2/NO_x in-stack ratios (ISRs) and ambient ozone concentrations for use in the NO titration schemes. A review of past construction projects with similar on- and offsite construction activity as the Project indicated ISRs used in the model ranged from 0.05 to 0.10 (Applied Environmental Consultants 2011, U.S. Department of Agriculture 2021). An ISR of 0.10 is selected for the modeling of the Project using OLM. For ambient ozone, the Willows-Colusa Street monitor (ID 06-021-0003), operated by CARB, is selected. The monitor is approximately 14 miles (22 km) to the northeast of the Dams and Reservoir Project components. Additional details on the ambient ozone data are discussed in Section 20C.2.7, *Ambient Monitoring Data*.

20C.2.1.2. Rural/Urban Dispersion Environment

One of the factors affecting input parameters to dispersion models is the assessment of the mode application and the meteorological site's land use as either rural or urban. USEPA guidance suggests that application of a model's dispersion environment as either rural or urban should be based upon the land use characteristics within 3 km of the Project site(s) (USEPA Appendix W to 40 Code of Federal Regulations Part 51). Factors that affect the rural/urban choice, include the extent of vegetated surface area, the water surface area, types of industry and commerce, density of residential areas, and building types and heights within this area.

According to Section 7.2.1.1 of USEPA's Appendix W, either a land use (Auer method) or a population density procedure should be used in determining if the model should be applied as if there is an urban vs. rural dispersion environment. For this application, the Auer method is used. This land-use approach classifies an area according to 12 land-use types. In this scheme, areas of industrial, commercial, and compact residential land use are designated urban. According to USEPA modeling guidelines, if more than 50% of an area within a 3-km radius of a site is classified as rural, and the AERMOD's urban source options would not be used. Based on visual inspection of recent satellite imagery (using Google Earth), all Project sites modeled have more than 50% of the surrounding 3-km land use as rural. Therefore, AERMOD is run in default mode without the consideration of any urban source options for all sources at all sites.

20C.2.2. Health Risk Analysis Model

For the HRA, AERMOD is run using unit emissions. Each source group is modeled assuming emissions of 1 gram per second (g/s) divided by the number of sources in a volume segment, or 1 g/s per stationary source. The unitized AERMOD results for each source or source group are then output for use in the CARB-developed Hot Spots Analysis and Reporting Program Version 2 (HARP2) software (California Air Resources Board 2021). HARP2 (version 21081) is designed to assist in the development of emissions inventories, air dispersion, and risk assessment. Maximum hourly and period-average files generated by AERMOD are input to HARP2 with corresponding TAC emission rates for each phase of construction to calculate Project concentration contributions. HARP2 is used solely to estimate cancer, non-cancer chronic, 8-hour non-cancer chronic, and acute risk consistent with the exposure factors and guidance from OEHHA (2015). Cancer and non-cancer chronic risks are calculated for all sensitive receptors. Eight-hour non-cancer chronic and acute risks are calculated for both receptors that reside on the ambient air boundary of each construction area and sensitive receptors. Risks to receptors were calculated assuming exposure during the entire construction period using the maximum year of construction emissions. Table 20C-6 summarizes the construction periods by modeled location.

Table 20C-6. Construction Periods

Project Component	Construction Period (Years)
Dams & Reservoirs[1]	5
Dunnigan Pipeline[2]	2
GCID A Improvements	3
GCID E Improvements	3
GCID F through K Improvements	3
GCID Headgate	3
GCID Wilson & Walker	2
Red Bluff	2
Saddle Dams	4
South Rd Alignment & Huffmaster Rd Realignment	4
Huffmaster Rd Realignment	4

[1] Includes Golden Gate and Sites Dams, Funks Reservoir, TRR pipelines and TRR Pumping Station, Sites Lodoga Road.
[2] Construction duration the same between Project alternatives.

Factors that affect the dose that a receptor would receive include but are not limited to age-specific daily breathing rates as well as exposure time, frequencies, and duration. The general formula for calculating residential inhalation risk is as follows:

$$\mathbf{RISK_{inh\text{-}res} = DOSE_{air} \times CPF \times ASF \times ED/AT \times FAH}$$

Where:

$RISK_{inh\text{-}res}$ = Residential inhalation cancer risk

$DOSE_{air}$	= Daily inhalation dose (milligrams per kilogram [mg/kg]-day)
CPF	= Inhalation cancer potency factor (mg/kg-day^{-1})
ASF	= Age sensitivity factor for a specified age group (unitless)
ED	= Exposure duration (in years) for a specified age group
AT	= Averaging time for lifetime cancer risk (years)
FAH	= Fraction of time spent at home (unitless)

The inhalation risk is calculated in HARP2 using the OEHHA 2015–recommended default values for these parameters:

CPF	= Substance-specific
ASF	= 10 for third trimester to age 2, 3 for ages 2–16, 1 for ages 16–30
ED	= 0.25 year for third trimester, 2 years for ages 0–2, 7 years for ages 2–9, 14 years for ages 2–16, 14 years for ages 16–30

For conservatism, FAH is turned off for this analysis.

The daily inhalation dose is defined as:

$$\mathbf{DOSE_{air} = C_{air} \times \{BR/BW\} \times A \times EF \times 10^{-6}}$$

Where:

$DOSE_{air}$	= Dose through inhalation (mg/kg-day)
C_{air}	= Concentration in air (µg/m^3)
{BR/BW}	= Daily breathing rate normalized to body weight (Liters per kilogram body weight - day)
A	= Inhalation absorption factor (unitless)
EF	= Exposure frequency (unitless), days/365 days
10^{-6}	= Micrograms to milligrams conversion, liters to cubic meters conversion

The daily inhalation dose is calculated in HARP2 using OEHHA 2015–recommended default values for these parameters:

C_{air}	= Concentration as calculated from AERMOD
{BR/BW}	= OEHHA-derived method (i.e., 95th-percentile) estimates (361 for third trimester, 1,090 for ages 0–2, 745 for ages 2–16, 335 for ages 16–30)
A	= 1
EF	= 0.96 (350 days/365 days in a year for a resident)

20C.2.3. Meteorological Data

The Project includes portions as far south as Dunnigan and as far north as Red Bluff, which is a 90-mile span (145 kilometers) within the Sacramento Valley Air Basin. Due to the various Project locations more than one meteorological dataset is used. Based on proximity and similar terrain features, Project sites are modeled with one of four meteorological datasets. These meteorological datasets include:

1. Sacramento International Airport
2. Chico Municipal Airport
3. Red Bluff Airport
4. Colusa California Irrigation Management Information System station

Locations of the meteorological stations are shown in Figure 20C-1. Wind roses for each meteorological station during their respective 5-year period are provided in Figure 20C-2.

The Sacramento International Airport meteorological data is available in pre-processed, AERMOD-ready format from the SMAQMD website (Sacramento Metropolitan Air Quality Management District 2019) for a 5-year period from 2014 through 2018. The Dunnigan Underground Pipeline Route is located approximately 36 kilometers from the site and is the only modeled site to use this meteorological dataset.

For the GCID Headgate construction activity, the Chico Municipal Airport, located approximately 16 km to the east is selected for the modeling at this site. Pre-processed AERMOD-ready meteorological files for Chico are available from CARB (2015) for a 5-year period from 2009 through 2013.

The Red Bluff Airport meteorological data from the HARP2 website (CARB 2015) consists of a 5-year period spanning 2009 through 2013. This meteorological dataset is selected for the modeling of the RBPP construction activities. The Red Bluff Airport is located 4.5 kilometers from the RBPP.

The Colusa California Irrigation Management Information System (CIMIS) station (California Department of Water Resources 2021) is selected for the majority of the Project sites modeled. These include: Golden Gate and Sites Dams, Funks Reservoir, TRR Pumping Station and TRR Pipelines, South Road and Huffmaster Road, Saddle Dams, and the GCID Improvements (A, E, and F through K). The Colusa CIMIS station collected data from 1983 through August 2016 and was located 29 kilometers from the town of Sites. A recent 5-year period (2010–2014) of hourly Colusa meteorological data are processed using AERMOD's meteorological pre-processor, AERMET. Additional details on the processing of the Colusa CIMIS station data are discussed below (Section 20C.2.3.1, *Processing of Colusa CIMIS Meteorological Data for AERMOD*).

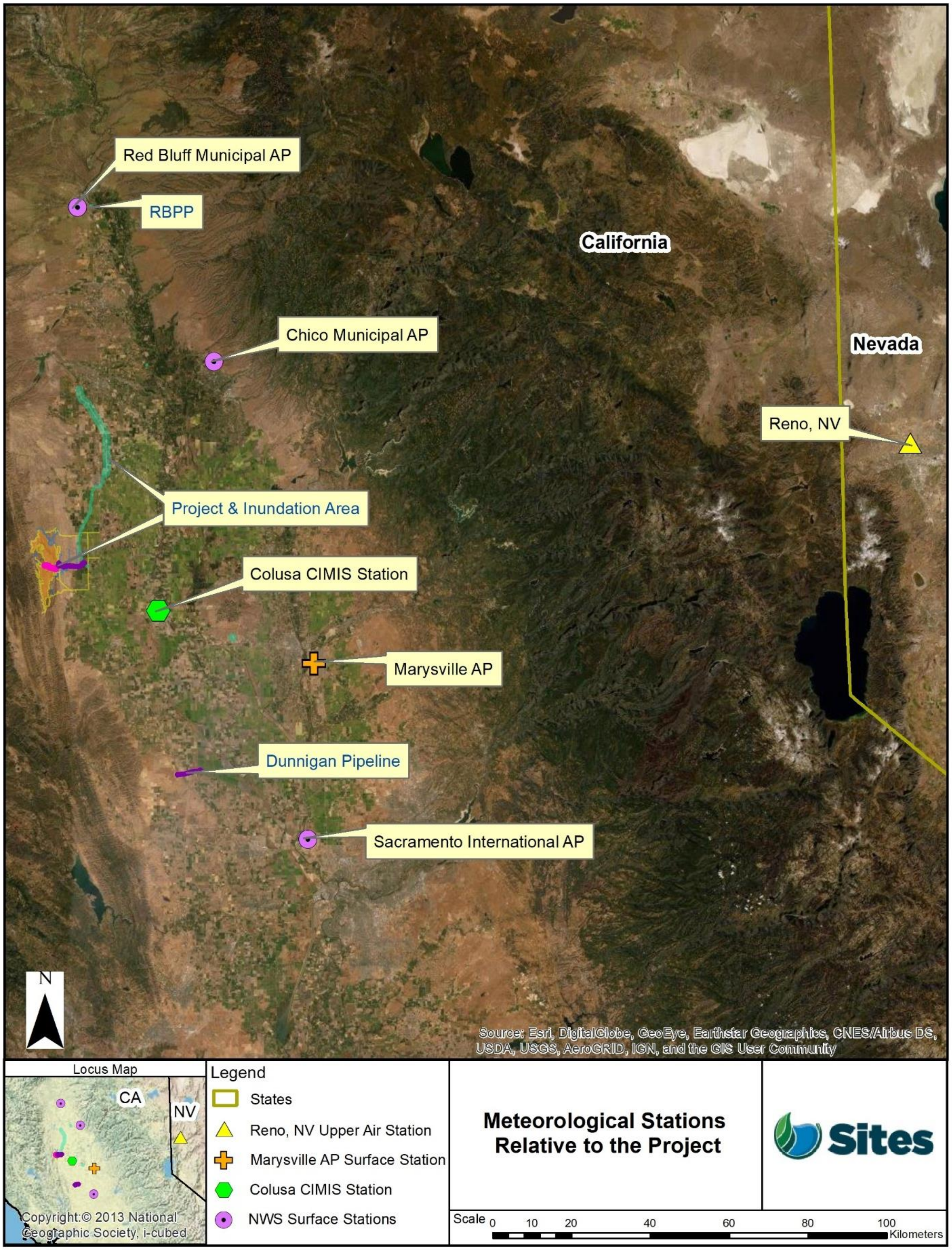

Figure 20C-1. Map of Meteorological Stations to be Used in Modeling

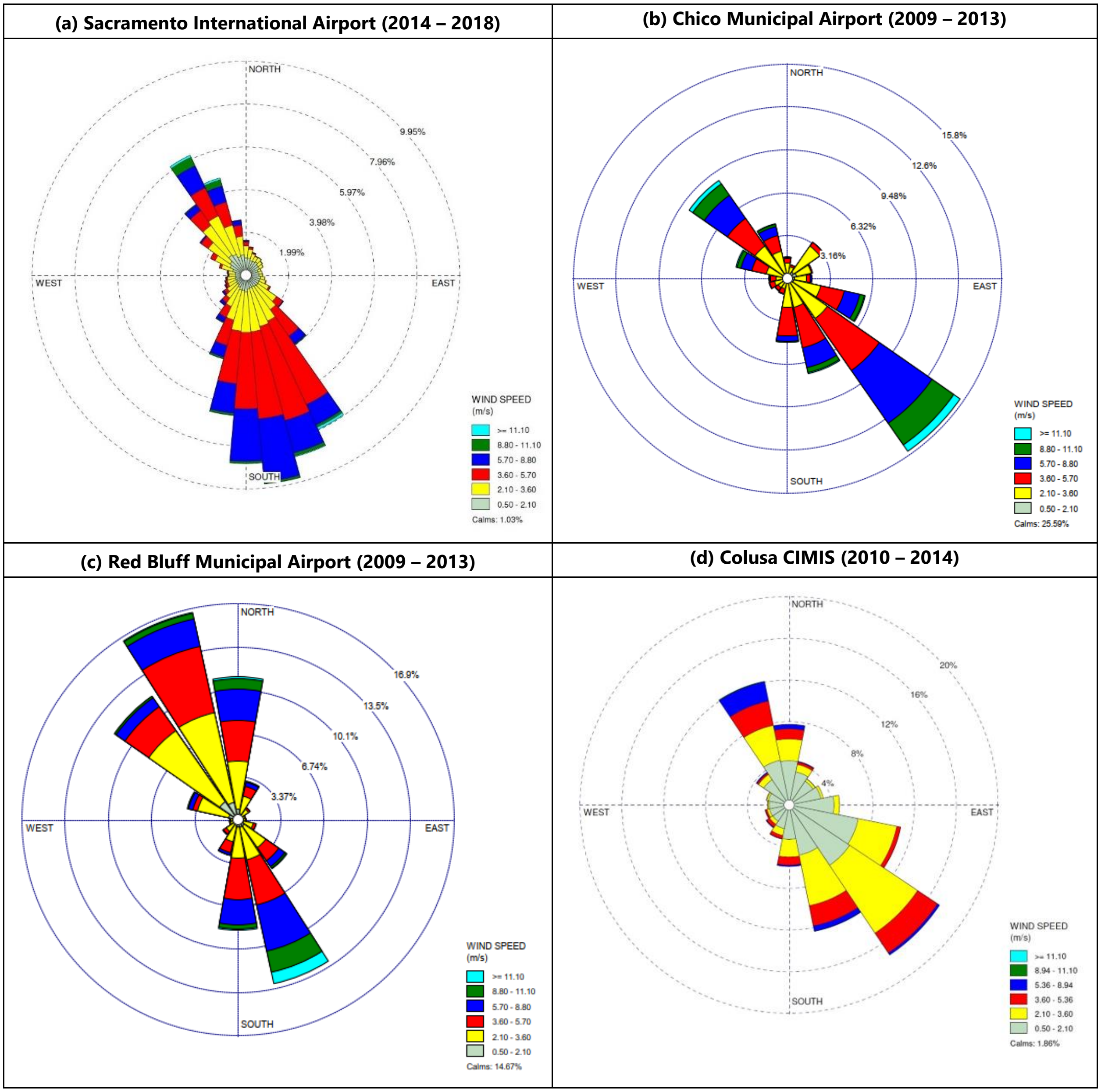

Figure 20C-2. Wind Roses at Meteorological Stations

20C.2.3.1. Processing of Colusa CIMIS Meteorological Data for AERMOD

The Colusa CIMIS meteorological station is located just outside the town of Colusa and is approximately 16 miles east-southeast of the Dams and Reservoirs (Golden Gate and Sites Dams, Funks Reservoir). The location of the anemometer in decimal degrees is 39.226861°N 122.024800°W. There is no significant terrain between the meteorological station and the Project sites that could potentially obstruct or dramatically change the wind flow.

A 5-year period (2010–2014) is selected from the Colusa CIMIS meteorological station. This 5-year period has high data capture rates, as shown in Table 20C-7. Calm winds are reported approximately 1.86% of the time over the 5-year period (as shown in Figure 20C-2(d)).

Table 20C-7. Colusa CIMIS Meteorological Station Data Capture Statistics

Year	Quarter	Precipitation	Temperature	Relative Humidity	Wind Speed	Wind Direction
2010	1	100.00%	100.00%	100.00%	100.00%	100.00%
	2	99.18%	99.18%	99.18%	99.18%	99.18%
	3	99.86%	99.86%	99.86%	99.86%	99.86%
	4	99.95%	99.95%	99.95%	99.95%	99.95%
2011	1	100.00%	100.00%	100.00%	100.00%	100.00%
	2	100.00%	100.00%	100.00%	100.00%	100.00%
	3	100.00%	100.00%	100.00%	100.00%	100.00%
	4	99.95%	100.00%	100.00%	100.00%	99.95%
2012	1	99.95%	99.95%	99.95%	99.95%	99.95%
	2	99.95%	100.00%	100.00%	100.00%	100.00%
	3	100.00%	100.00%	100.00%	100.00%	100.00%
	4	81.61%	81.61%	81.61%	81.61%	81.61%
2013	1	100.00%	100.00%	100.00%	100.00%	100.00%
	2	99.95%	99.95%	99.68%	99.95%	99.95%
	3	100.00%	100.00%	100.00%	100.00%	100.00%
	4	100.00%	100.00%	100.00%	100.00%	100.00%
2014	1	100.00%	100.00%	100.00%	100.00%	100.00%
	2	100.00%	100.00%	100.00%	100.00%	100.00%
	3	99.95%	99.95%	99.95%	99.95%	99.95%
	4	100.00%	100.00%	100.00%	100.00%	100.00%

Ambient temperature, dew point, relative humidity, precipitation, solar radiation, wind speed, and wind direction were measured at approximately 2.0 meters above ground level. The data capture for all parameters was at least 99% of the hours for this 5-year period except for the fourth quarter of 2012. The Colusa CIMIS meteorological data is missing for December 23, 2012 starting at hour 10 through December 31, 2012, hour 24. Meteorological data from a nearby National Weather Service station, Marysville Airport, CA Automated Surface Observing System (ASOS), is used to substitute for the missing onsite data.

Cloud cover data is also necessary for AERMOD. Since cloud cover was not recorded at the Colusa CIMIS meteorological station, a nearby National Weather Service station is used to obtain this meteorological variable. The closest station with cloud cover data is the Marysville Airport, CA ASOS. Concurrent 5-year cloud cover data from 2010–2014 are used from this site.

Upper-air meteorological data is used from Reno, NV. This site is closest in proximity to the Project and would also not be heavily influenced by coast phenomenon, such as Oakland, CA. Upper-air data from Reno were obtained from 2010–2014.

AERMET creates two output files for input to AERMOD:

> SURFACE: a file with boundary layer parameters such as sensible heat flux, surface friction velocity, convective velocity scale, vertical potential temperature gradient in the 1,640 feet layer above the planetary boundary layer, and convective and mechanical mixing heights. Also provided are values of Monin-Obukhov length, surface roughness, albedo, Bowen ratio, wind speed, wind direction, temperature, and heights at which measurements were taken.

> PROFILE: a file containing multi-level meteorological data with wind speed, wind direction, temperature, sigma-theta (σq) and sigma-w (σw) when such data are available. For this application involving representative data from the Colusa CIMIS station, the profile file contains a single level of wind data and temperature data. Sigma-theta and sigma-w are not measured at this station.

AERMET requires specification of site characteristics including surface roughness (zo), albedo (r), and Bowen ratio (Bo). These parameters are developed according to the guidance provided by USEPA in the AERMOD Implementation Guide (U.S. Environmental Protection Agency 2021c). The AERMOD Implementation Guide provides the following recommendations for determining the site characteristics:

1. The determination of the surface roughness length should be based on an inverse distance weighted geometric mean for a default upwind distance of 1 kilometer relative to the measurement site. Surface roughness length may be varied by sector to account for variations in land cover near the measurement site; however, the sector widths should be no smaller than 30 degrees.
2. The determination of the Bowen ratio should be based on a simple un-weighted geometric mean (i.e., no direction or distance dependency) for a representative domain, with a default domain defined by a 0.6-mile by 0.6-mile region centered on the measurement site.
3. The determination of the albedo should be based on a simple un-weighted arithmetic mean (i.e., no direction or distance dependency) for the same representative domain as defined for Bowen ratio, with a default domain defined by a 0.6-mile by 0.6-mile region centered on the measurement site.

The AERMOD Implementation Guide recommends that the surface characteristics be determined based on digitized land cover data. USEPA has developed a tool called AERSURFACE that can be used to determine the site characteristics based on digitized land cover data in accordance with the recommendations from the implementation guide discussed above. AERSURFACE incorporates look-up tables of representative surface characteristic values by land cover category and seasonal category. AERSURFACE is applied with the instructions provided in the AERSURFACE User's Guide (U.S. Environmental Protection Agency 2020b).

The current version of AERSURFACE (Version 20060) supports the use of land cover data from the U.S. Geological Survey National Land Cover Data 2016 archives, which are the most up-to-date land cover data files available. The National Land Cover Data 2016 archive provides data at a spatial resolution of 30 x 30 meter grid cells upon a 16-category classification scheme applied over the continental U.S. AERSURFACE also requires percent impervious and percent tree canopy data files, for areas in the United States where they are available, to supplement the land cover data. The percent impervious and percent tree canopy data files for 2016 are available for the area around the meteorological site, and are used in conjunction with the land cover data file in processing AERSURFACE. The land cover, percent impervious, and percent tree canopy data files are available from the Multi-Resolution Land Characteristics Consortium Viewer (U.S. Geological Survey 2021).

As recommended in the AERMOD Implementation Guide for surface roughness, the 0.6-mile radius circular area centered at the meteorological station site can be divided into sectors for the analysis; 12 30-degree sectors were used for this analysis.

In AERSURFACE, the various land cover categories are linked to a set of seasonal surface characteristics. As such, AERSURFACE requires specification of the seasonal category for each month of the year. The following five seasonal categories are supported by AERSURFACE, with the applicable months of the year specified for this site.

1. Midsummer with lush vegetation (June–August).
2. Autumn with un-harvested cropland (September–November).
3. Late autumn after frost and harvest, or winter with no snow (December–February).
4. Winter with continuous snow on ground (none).
5. Transitional spring with partial green coverage or short annuals (March–May).

Snow cover data (National Weather Service 2021) for the nearest reporting station in the Sacramento Valley that had snow depth data is from the Red Bluff Municipal Airport, CA. Redding Airport, CA snow cover data is used to supplement several missing winter months in the Red Bluff data set. The snow cover data for the 2010-2014 period is analyzed to determine if any winter month had snow cover for more than half of the days in the month. Both Redding and Red Bluff reported less than 50% of any month over the 5-year period with a snow depth greater than 1 inch. As a result, no months are considered to be winter with continuous snow on the ground as part of the AERSURFACE processing.

For Bowen ratio, the land use values are linked to three categories of surface moisture corresponding to average, wet, and dry conditions. The surface moisture condition for the site may vary depending on the meteorological data period for which the surface characteristics were applied. AERSURFACE applies the surface moisture condition for the entire data period. Therefore, if the surface moisture condition varies significantly across the data period, then AERSURFACE can be applied multiple times to account for those variations.

As such, the surface moisture condition for each season are determined by comparing precipitation for the period of data to the 30-year climatological record, selecting “wet” conditions if precipitation is in the upper 30th-percentile, “dry” conditions if precipitation is in the lower 30th-percentile, and “average” conditions if precipitation is in the middle 40th-percentile. The 30-year (1985–2014) precipitation data set used in this modeling are taken from the National Weather Service station in Colusa, CA.

The monthly designations of surface moisture that are input to AERSURFACE are summarized in Table 20C-8.

Table 20C-8. AERSURFACE Bowen Ratio Condition Designations

Month	Bowen Ratio Category				
	2010	2011	2012	2013	2014
January	Wet	Dry	Avg	Dry	Dry
February	Avg	Avg	Dry	Dry	Avg
March	Dry	Wet	Avg	Dry	Avg
April	Wet	Dry	Wet	Avg	Wet
May	Avg	Wet	Dry	Avg	Avg
June	Avg	Wet	Avg	Avg	Avg
July	Avg	Avg	Avg	Avg	Avg
August	Avg	Avg	Avg	Avg	Wet
September	Avg	Avg	Avg	Wet	Avg
October	Wet	Avg	Avg	Dry	Dry
November	Avg	Avg	Wet	Dry	Wet
December	Wet	Dry	Avg	Dry	Wet

Notes: Avg = Average.

20C.2.4. Terrain and Receptor Data

Terrain elevations are obtained from commercially available digital terrain elevations developed by the U.S. Geological Survey by using its National Elevation Dataset (NED) (U.S. Geological Survey 2021). The NED data provide terrain elevations with 1-meter vertical resolution and 10-meter (1/3 arc-second) horizontal resolution based on a Universal Transverse Mercator (UTM) coordinate system. The U.S. Geological Survey specifies coordinates in North American Datum 83, UTM Zone 10. USEPA’s terrain pre-processor, AERMAP (Version 18081), is used to process the NED data and assign elevations to the receptor locations and sources within Lakes Environmental software’s user interface.

The AAQA and HRA evaluate the impact of project-related emissions of criteria pollutants and TACs along the ambient air boundary and at existing nearby sensitive receptors within 1,000 feet of Project locations and 500 feet of proposed construction routes to determine if sensitive receptors are exposed to substantial pollutant concentrations. The flagpole height for all receptors are set to 1.8 meters, consistent with SMAQMD modeling guidance.

Given the relatively extensive construction traffic routes and various roadway alignments associated with each Project site (along with portions of some routes overlapping for multiple Project phases), select portions of routes with similar orientation (i.e., west to east or north to south) are modeled once. For example, a 2,000-foot section of east to west is modeled, as well as 1,000 feet in each direction from intersections. Receptors are placed out to 500 feet on either side of the roadway at 50-foot intervals. This approach only applied to generally flat landscape, which includes construction traffic routes east of the Tehama-Colusa Canal. Roadways along construction routes that lie west of Tehama-Colusa Canal are modeled for all portions that were within 1,000 feet of a sensitive receptor. Figure 20C2-1, Figures 20C2-4 through 20C2-9, and Figures 20C2-11 and 20C2-13 (located in Appendix 20C2, *Model Construction Figures*) show the roadway segments that are modeled.

Minor changes to construction routes have been made since the modeling was conducted. These include changes to RBPP, GCID Headgate, and GCID A and Railroad Siphon. Since the changes involve roadways with similar orientation to those included in the modeling, the results included in this report are still representative.

As discussed previously, the AAQA and HRA also assesses impacts at receptors along the boundary between the Project site and ambient air. This is referred as the ambient air boundary. For areas considered within the Project site (i.e., not accessible by the public) and inside the ambient air boundary, receptors are not included. Figures 20C2-1 through 20C2-8 (located in Appendix 20C2) illustrate the ambient air boundaries for the seven Project site locations identified in Section 20C.1.2, *Project Sources Modeled*.

20C.2.5. Onsite Construction Sources

Construction of Project site locations (listed in Table 20C-9) are represented by adjacent volume sources in the model. These adjacent volume sources are placed over the Project site footprint (i.e., within the ambient air boundary) where construction activity is expected to occur. Guidance outlined by the SMAQMD (2013) on lateral dimensions and release height for adjacent volume sources are used for onsite construction activities. Consistent with this guidance, the release height of these sources are set to 16.4 feet (5 meters) and an initial vertical dimension (sigma-z) of 1 meter. The lateral dimension of each volume source is set to 30 meters, yielding a minimum of four volume sources per acre. PM fugitive dust emissions are modeled as volume sources at the same locations using a release height of zero meters and a sigma-z of 1 meter.

Construction activity at all sites are assumed to occur Monday through Friday. The construction hours during the day range between 8 and 12 hours, depending on the site and/or Project facility. Table 20C-9 lists the hours per day of construction by site. No night-time and weekend construction activities are anticipated, and therefore these days of the week and times, the model did not compute concentrations.

The Funks asphalt plant is the only onsite construction source that is represented in the model as a stationary point source. The asphalt plant is anticipated to be sited on the northwest side of Funks Reservoir. Release parameters for the point source include a 8.5 meter release height, 1.22 meter stack diameter, temperature of 402 K, and 17.65 meters/sec gas exit velocity. These values are based on a standard asphalt plant developed by the Department of Ecology State of Washington (2011).

Table 20C-9. Modeled Construction Activity Hours

Site	Hours (On/Off-Road)
Batch Plants - I/O, Golden Gate, Sites, Diversions, Saddle Dams, ERS-1, ERS-2	7 AM – 7 PM

Site	Hours (On/Off-Road)
Batch Plants – Funks, Funks/TRR, Dunnigan, TRR	7 AM – 7 PM
Sites Dam and Stone Corral Creek Recreation Area	7 AM – 5 PM
Terminal Regulating Reservoir (TRR) Pumping Plant and TRR Pipelines	8 AM – 4 PM
Glenn-Colusa Irrigation District (GCID) Main Canal	8 AM – 4 PM
Funks Reservoir and Funks/TRR Pipelines	8 AM – 4 PM
Dunnigan Pipeline	8 AM – 4 PM
Golden Gate Dam (AAQA only)	7 AM – 5 PM
Peninsula Hill Recreation Area (roads only)	7 AM – 7 PM
Red Bluff Pumping Plant (roads only)	7 AM – 7 PM
Transmission Lines (roads only)	7 AM – 7 PM
Transition Manifold (roads only)	7 AM – 7 PM

20C.2.6. On-Road Mobile Construction Traffic Sources

On-road traffic associated with construction activities are modeled as adjacent line volume sources along the routes between construction site and primary roadway (i.e., Interstate 5). Based on SMAQMD MSAT Protocol, a 4.57-meter and 0.6-meter release height is used for heavy-duty trucks and passenger vehicles, respectively. The lateral dimension of each volume source varies, as it is based upon the width of the roadway. Consistent with USEPA AERMOD guidance, a sigma-z of the release height divided by 4.3 is used.

It is anticipated that construction-related traffic will use designated routes. In general, access to the Project site during dam construction would come from the north using County Road 69 to the North Road (access road) and Saddle Dam Access Road as well as McDermott Road and Maxwell Sites Road. Sites Reservoir construction would require relocating county roads prior to inundation (Maxwell Sites Road, Sites Lodoga Road Bridge, and Huffmaster Road). Other new paved or unpaved roads would also be constructed to provide access to Project facilities from existing roads and to improve operation and maintenance access between the main dams and saddle dams.

Illustrations showing the construction traffic routes in the modeling domain are presented in Appendix 20C2.

20C.2.7. Ambient Monitoring Data

Ambient monitored concentrations represent air concentrations from existing sources not explicitly modeled in the analysis. Ambient monitoring stations within the Sacramento Valley are generally located within or very close to a densely-populated town or city. Due to the remote location of most Project components, adding the monitor concentrations to the modeled concentrations for each pollutant is conservative.

The ambient concentrations as applied to the NAAQS and CAAQS modeling for the most recent 3 years (2018 through 2020) are summarized in Tables 20C-10 and 20C-11, respectively. For the

CAAQS, the CO, 1-hour NO_2 and SO_2, 24-hour SO_2, annual NO_2 and SO_2, 24-hour and annual PM10 and annual PM2.5 values are the maximum concentration over the three-year period. For the NAAQS, the 1-hour NO_2 and 24-hour PM2.5 values are the 98th percentile (high-8th-high) for each year averaged over the 3-year period. The NAAQS for 1-hour SO_2 values are the 99th percentile (high-4th-high) for each year averaged over the 3-year period. The annual PM2.5 values are averaged over the 3 year period. The CO, 3-hour and 24-hour SO_2, and 24-hour PM10 are the maximum of the second-highest (high-2nd-high) over the 3-year period. The annual NO_2, SO_2 and PM10 values are the maximum over the 3-year period.

A refined, Tier 2 approach is used to determine ambient background concentrations for 1-hour NO_2 modeling at the Dams and Reservoir Project components. In a 2015 clarification memo, USEPA stated that a more refined temporal pairing of model and ambient concentrations is acceptable (USEPA 2015). The recommended Tier 2 approach uses multi-year averages of the 98th percentile background concentrations by season and hour of day. This season and hour of day approach is applied to the most recent 3-year period (2018–2020) for the Chico monitor located in Butte County. For the NAAQS modeling, the 3-year averaged 98th percentile season and hour of day ambient concentrations are incorporated into the model input file. The CAAQS modeling uses the 3-year average maximum (1st highest) season and hour of day values. Table 20C-12 lists the values derived from this Tier 2 method for the 98th percentile (NAAQS) and 1st highest (CAAQS). As a result, the concentrations produced by the model already include the ambient background concentration for the 1-hour NO_2 modeling of Dams and Reservoirs Project components.

Data from several monitoring stations are used based on the location of the Project sources. Figure 20C-3 illustrates the proximity to monitor locations to the Project. Tables 20C-10 and 20C-11 note what monitors are used for each modeled location. The ambient concentrations for 24-hour and annual PM10 and PM2.5 exceed the NAAQS and/or CAAQS at most monitor locations. For locations where the ambient concentrations exceeds the standard, the modeled concentration is compared to the USEPA Significant Impact Level (SIL).

20C.2.7.1. Ambient Ozone Data Used in Tier 3 NO_2 Modeling

The Willows-Colusa Street monitor (ID 06-021-0003), located in Willows, California is approximately 14 miles (22 km) northeast of the Dams and Reservoir Project components. The monitor is selected as the most representative of ozone for the Project area as it is the closest with no nearby large NO_2 sources impacting it. The monitor has been collecting hourly ozone measurements since 2006 to present day and is operated by CARB.

Hourly ozone data are obtained from the Willows-Colusa Street monitor for the period 2010 to 2014, which is concurrent with the meteorological period modeled for the Dams and Reservoir Project components. Annual data capture rates ranged between 91% to 96% for this 5-year period.

An hourly ozone file spanning January 1, 2010 through December 31, 2014 is generated for input in the Tier 3, OLM AERMOD run for NO_2. According to USEPA (2010), careful consideration should be taken in the methods used to substitute for periods of missing hourly data, specifically in the case of ozone for NO_2 modeling. A review of substitution methods revealed, a comprehensive technical guidance document produced by the Minnesota Pollution Control Agency outlining a “best practice” approach for substituing missing hourly ozone values (Minnesota Pollution Control Agency 2014). The method fills single missing hour data gaps through linear interpolation, where the average of the previous and next hour on either side of the missing hour is computed and used. For missing periods greater than 1-hour in duration, the data gaps are replaced with monthly/hourly maximums.

This page intentionally left blank

Table 20C-10. Ambient Background Concentrations (NAAQS)

Monitor			Pollutant	Averaging Period	Rank	Concentration			Maximum or 3-year Avg.	Background Concentration Added to Modeling Results (μg/m³)	Modeled Location
ID	County	Address				2018	2019	2020			
60070008	Butte	984 East Avenue, Chico	CO (ppm)	1-hr	H2H	19.30(1)	1.50	7.20	7.20	8,275.9	All
				8-hr		6.40(1)	1.00	3.60	3.60	4,137.9	
60070008	Butte	984 East Avenue, Chico	NO_2 (ppb)	1-hr	98th	36.00	35.00	27.00	32.67	see season hour-by-day Table 20C-12.	All except Dunnigan
				Annual	H1H	6.78	7.08	5.50	7.08	13.32	
61010003	Sutter	773 Almond St, Yuba City		1-hr	98th	41.00	40.00	38.00	39.67	74.61	Dunnigan
				Annual	H1H	7.47	6.50	6.20	7.47	14.05	
60670006	Sacramento	Del Paso-2701 Avalon Dr, Sacramento	SO_2 (ppb)	1-hr	99th	2.00	3.00	3.00	2.67	6.99	All
				3-hr	H2H	2.00	2.30	3.40	3.40	8.91	
				24-hr	H2H	1.10	1.10	1.30	1.30	3.41	
				Annual	H1H	0.37	0.38	0.46	0.46	1.21	
60070008	Butte	984 East Avenue, Chico	PM10 (μg/m³)	24-hr	H2H	81.00	53.00	325.00	325.00	**325.00**	GCID A and RR, E, F – K, Walker and Wilson Siphons
60111002	Colusa	100 Sunrise Blvd., Colusa		24-hr		166.00	110.00	210.00	210.00	**210.00**	Dunnigan
60210003	Glenn	720 N Colusa Street, Willows		24-hr		121.00	115.00	152.00	152.00	**152.00**	GCID Headgate, Dam and Reservoir Areas
61030007	Tehama	1834 Walnut Street, Red Bluff		24-hr		100.00	33.00	151.00	151.00	**151.00**	Red Bluff
60070008	Butte	984 East Avenue, Chico	PM2.5 (μg/m³)	24-hr	98th	61.00	24.00	92.00	59.00	**59.00**	All GCID Sites
				Annual	H1H	13.70	7.9(2)	16.00	14.85	**14.85**	
60111002	Colusa	100 Sunrise Blvd., Colusa		24-hr	98th	60.00	24.00	59.00	47.67	**47.67**	Dunnigan, Dam and Reservoir Areas
				Annual	H1H	11.3(2)	7.00	13.2(2)	10.50	10.50	
61030007	Tehama	1834 Walnut Street, Red Bluff		24-hr	98th	63.00	15.00	87.00	55.00	**55.00**	Red Bluff
				Annual	H1H	10.50	5.40	13.20	9.70	9.70	

(1). Removed due to exceptional event (Camp Fire).
(2). Indicates the annual average does not satisfy minimum data completeness criteria. If value is higher than those that meet the criteria, it is included in the average.
Bolded values exceed standard.
U.S. Environmental Protection Agency 2021d, 2022

Table 20C-11. Ambient Background Concentrations (CAAQS)

Monitor			Pollutant	Averaging Period	Rank	Concentration			Maximum or 3-year Avg.	Background Concentration Added to Modeling Results (ug/m^3)
ID	County	Address				2018	2019	2020		
60070008	Butte	984 East Avenue, Chico	CO (ppm)	1hr	H1H	20.70[1]	1.60	7.40	7.40	8,505.7
				8hr		12.80[1]	1.30	4.90	4.90	5,632.2
60070008	Butte	984 East Avenue, Chico	NO_2 (ppb)	1hr		52.00	42.00	33.00	52.00	see season hour-by-day Table 20C-12.
				Annual		6.78	7.08	5.50	7.08	13.32
61010003	Sutter	773 Almond St, Yuba City		1hr		51.00	45.00	46.00	51.00	95.93
				Annual		7.47	6.50	6.20	7.47	14.05
60670006	Sacramento	Del Paso-2701 Avalon Dr, Sacramento	SO_2 (ppb)	1hr		3.60	4.00	8.60	8.60	22.53
				24hr		1.10	1.10	1.70	1.70	4.45
60070008	Butte	984 East Avenue, Chico	PM10 (ug/m^3)	24hr		91.00	53.00	390.00	390.00	390.00
				Annual		31.04	19.91	35.64	35.64	35.64
60111002	Colusa	100 Sunrise Blvd., Colusa		24hr		257.00	117.00	304.00	304.00	304.00
				Annual		32.99	28.03	36.30	36.30	36.30
60210003	Glenn	720 N Colusa Street, Willows		24hr		215.00	125.00	182.00	215.00	215.00
				Annual		29.42	19.86	28.41	29.42	29.42
61030007	Tehama	1834 Walnut Street, Red Bluff		24hr		102.00	43.00	172.00	172.00	172.00
				Annual		23.90	14.15	23.71	23.90	23.90
60070008	Butte	984 East Avenue, Chico	PM2.5 (ug/m^3)	Annual		13.70	7.9(2)	16.00	16.00	16.00
60111002	Colusa	100 Sunrise Blvd., Colusa		Annual		11.3(2)	7.00	13.2(2)	13.20	13.20
61030007	Tehama	1834 Walnut Street, Red Bluff		Annual		10.50	5.40	13.20	13.20	13.20

Removed due to exceptional event (Camp Fire).
Indicates the annual average does not satisfy minimum data completeness criteria. If value is higher than those that meet the criteria, it is included in the average.
Bolded values exceed standard.
U.S. Environmental Protection Agency 2021d, 2022

Table 20C-12. Hour Varying by Season Ambient Background Concentrations for NO_2 Modeling Dams and Reservoir Project Component[1]

Ending Hour	3-Year (2018–2020) Averaged Seasonal Values (µg/m³)							
	Winter (Jan, Feb, Dec)		Spring (Mar–May)		Summer (Jun–Aug)		Fall (Sep–Nov)	
	Maximum (1st high)	98th Percentile	Maximum (1st high)	98th Percentile	Maximum (1st high)	98th Percentile	Maximum (1st high)	98th Percentile
01:00	37.04	32.09	48.88	26.63	20.49	12.97	51.14	38.92
02:00	45.68	32.96	48.50	23.63	19.18	13.66	44.93	35.22
03:00	44.56	29.58	43.99	26.26	23.31	14.66	44.74	33.15
04:00	44.74	32.65	41.55	23.63	21.24	16.67	41.36	31.15
05:00	46.06	34.34	39.57	27.13	28.76	22.75	40.70	32.68
06:00	47.38	36.03	37.60	30.64	37.22	28.83	42.11	34.22
07:00	43.99	40.04	41.17	34.91	54.33	30.96	49.44	40.29
08:00	56.02	46.19	44.56	33.28	50.95	31.52	49.63	44.62
09:00	54.14	41.86	40.04	28.76	43.62	25.32	56.21	45.12
10:00	44.18	34.97	41.74	25.32	33.09	15.10	60.54	44.18
11:00	35.72	27.39	43.43	20.99	21.81	12.35	85.73	33.34
12:00	38.54	22.69	45.12	21.37	15.42	11.22	95.88	27.45
13:00	28.76	18.24	52.26	22.50	17.11	10.59	97.57	24.50
14:00	25.94	18.55	55.27	23.56	16.73	10.97	68.24	24.44
15:00	22.75	16.86	58.66	23.00	15.98	10.65	57.53	24.63
16:00	32.34	21.62	62.23	23.19	19.55	9.59	66.74	29.70
17:00	40.04	26.82	65.05	24.25	18.05	10.65	90.05	43.55
18:00	60.54	43.74	66.55	27.01	18.80	12.35	96.07	66.36
19:00	55.65	47.81	66.93	30.83	27.26	16.61	83.47	64.36
20:00	52.08	45.93	63.54	33.53	35.53	24.50	76.89	56.71
21:00	51.51	44.62	59.41	30.27	32.90	25.25	72.19	52.20
22:00	47.75	41.92	56.40	32.34	42.11	16.73	64.67	48.07
23:00	45.50	40.61	52.83	31.83	36.10	15.04	56.78	43.99
24:00	41.74	37.16	50.76	29.45	30.64	14.23	54.52	41.99

[1] 3-year average (2018–2020) at Chico, CA monitor (ID 06-007-0008).

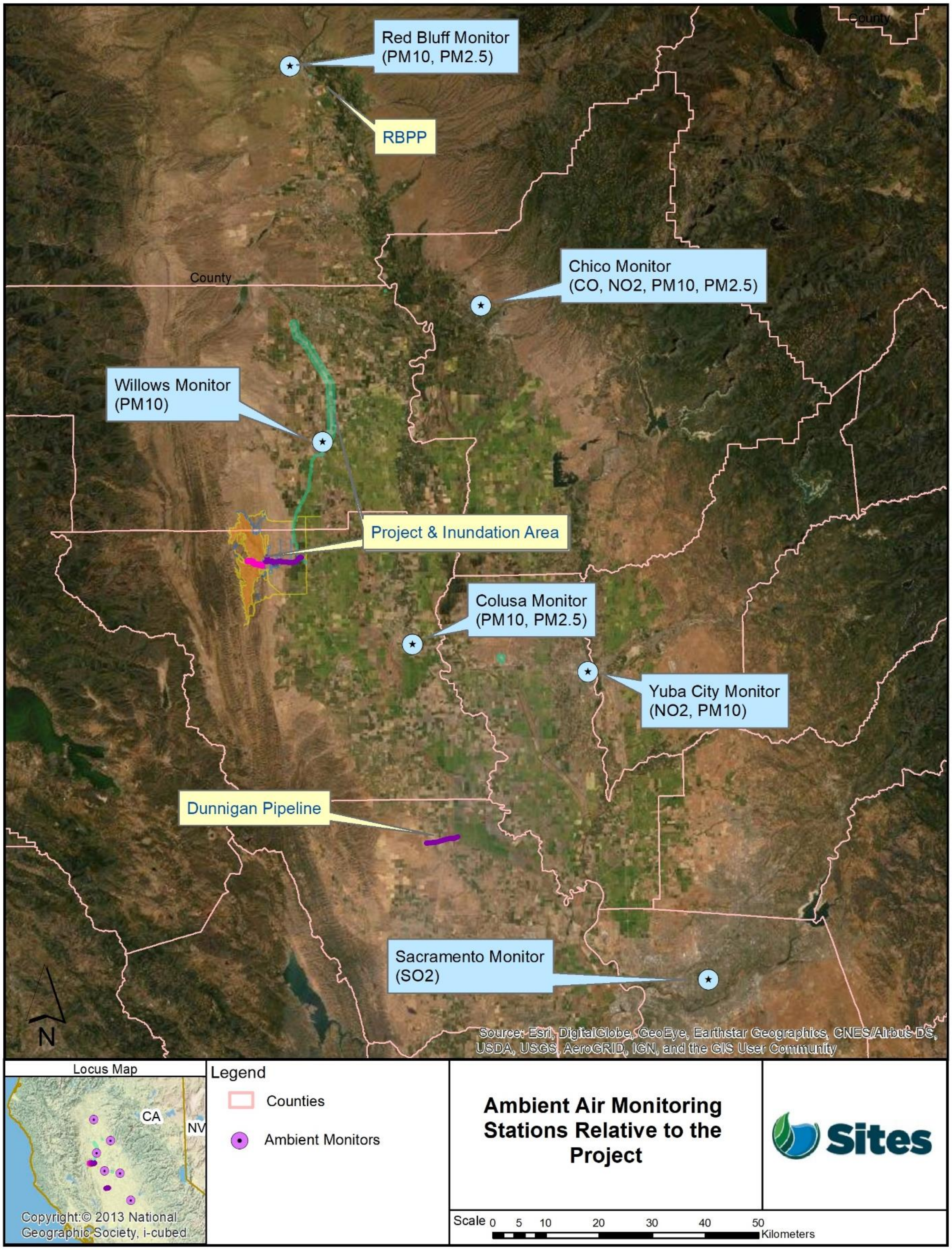

Figure 20C-3. Ambient Monitor Locations

20C.3 Emission Estimates

Emissions of criteria pollutants and DPM would originate from off-road equipment exhaust, helicopter exhaust, employee and haul truck vehicle exhaust, and concrete and asphalt batch plants during construction of the Project. Fugitive dust emissions would occur from paved and unpaved road travel, earthmoving activities (i.e., grading, soil and rock loading/unloading), wind-blown dust from soil stockpiles, onsite crushing and processing of rock, and the use of explosives at the dam features. These emissions would be limited to the construction period and would cease when construction activities are completed. TACs would also originate from the batch plants including: arsenic, beryllium, cadmium, lead, manganese, nickel, and selenium compounds. Appendix 20A, *Methodology for Air Quality and GHG Emissions Calculations*, provides a detailed description of the analysis method. For this analysis, emissions have been quantified and are presented without implementation of best management practices (BMPs) and with implementation of BMPs (ICF 2021).

For the purpose of the AAQA and HRA modeling, the only Project Alternative emissions assessed are Alternatives 1 and 2, as Alternatives 1 and 3 are similar.

Daily maximum and annual mass emissions are used as inputs to the modeling. The maximum daily emissions (between alternatives) associated for each modeled Project site that are used for short-term averaging periods (24-hours or less) are summarized in Appendix 20C3, *Modeled Emissions*. At each Project site, onsite activities and offsite mobile emissions are summed to generate the maximum daily emission for model input. The daily maximum pound per hour (lb/hr) emissions are converted to 1-hour rates in model units of g/s and factor in hours per day of construction activities.

For annual emissions, the maximum annual emission rate (between Project Alternatives) during construction for each pollutant are used. For example, if PM10 is highest in 2025 and NO_2 is highest in 2026, the PM10 emission rate in 2025 and NO_2 emission rate in 2026 are used to ensure the maximum annual emission rate by pollutant is modeled. Similar to the daily maximum emissions, the maximum ton per year emissions are converted to 1-hour rates in model units of g/s and factor in hours per day and 5 days a week of construction activities.

The offsite vehicle emissions associated with hauling trucks and personal worker vehicles are based on trip distances that extend well beyond the modeling domain. Therefore, these emissions were scaled based upon the ratio of the road segment length in the model to the average 1-way trip distance.

Emissions that are used in the HRA modeling are based upon the PM2.5 exhaust (DPM) maximum annual emissions and maximum daily emissions for the TACs emitted from the batch plants. Appendix 20C3 provides the emission rates used in the HRA modeling for PM2.5 exhaust and TACs.

20C.4 Results

The HRA and AAQA modeling are based on the worst-case emissions (daily/annual) for a given Project component location. As previously discussed, there are some Project component locations where the footprint and/or emissions are significantly different between Project Alternatives. These include: Dunnigan Pipeline, Huffmaster Realignment/Sites Lodoga Bridge versus South and Huffmaster Realignment, and TRR East versus TRR West (included in the Dams and Reserviours component). The results of these are provided separately in this section. For all remaining Project components they are modeled only using the worst-case emissions, the impacts from the lower emission case would yield impacts lower than the worst-case.

20C.4.1. Health Risk Analysis

The greatest potential for TAC emissions during construction would be related to DPM emissions associated with the operations of heavy-duty equipment. According to OEHHA methodology, health effects from carcinogenic TACs are usually described in terms of individual cancer risk, which is based on a 30-year exposure duration (or residency time) to TACs as the basis for public notification and risk reduction audits and plans. However, the construction activities for the Project are anticipated to last between 2 and 5 years (depending on Project site) and would cease following completion. Therefore, the total exposure period for construction activities would range from 7% to 17% of the total exposure period used for typical health risk calculations (i.e., 30 years). With the exception of offsite mobile vehicles, sensitive receptors are generally located beyond 1,000 feet from onsite Project component footprints. Thus, construction activities would not occur in the immediate vicinity of sensitive receptors for an extended period of time.

Concentrations of mobile source DPM emissions are typically reduced by 70% at a distance of approximately 500 feet from freeways, which are continuous emission sources (California Air Resources Board 2005). Studies also indicate that DPM emissions and the relative health risk can decrease substantially within 300 feet (California Air Resources Board 2005; Zhu et al. 2002). Further, CARB has adopted the In-Use Off-Road Diesel-Fueled Fleets Regulation and Airborne Toxic Control Measures (ATCMs) applicable to off-road diesel equipment and portable diesel engines. The In-Use Off-Road Diesel-Fueled Fleets Regulation require diesel engines to comply with emission limits on a fleet-average basis. The purpose of ATCMs is to reduce emissions of TAC emissions, including DPM, from engines subject to the rule. CARB has also adopted an ATCM that limits diesel-fueled commercial motor vehicles idling. The rule restricts vehicles from idling for more than 5 minutes at any location with exceptions for idling that may be necessary in the operation of the vehicle. All off-road diesel equipment, on-road heavy-duty diesel trucks, and portable diesel equipment used for the Project would be subject to CARB's regulations and ATCMs. Thus, given the short-term construction activities, substantial buffer distances to the nearest sensitive receptors, and the highly dispersive nature of DPM emissions, construction of the Project would not expose sensitive receptors to substantial pollutant concentrations.

Health risks are provided in terms of cancer and non-cancer risks, where the non-cancer risks are further divided into chronic (long-term and 8-hour) and acute (short-term) risks.

20C.4.1.1. Cancer Risk

The maximum individual excess cancer risk is an estimate of the highest increased cancer risk an offsite individual can expect from a multi-year exposure to emissions of toxic substances from Project construction activities. Table 20C-13 presents the maximum exposed individual resident (MEIR) and maximum exposed individual worker (MEIW) at each of the modeled site locations. The MEIR is assessed at sensitive receptors, while the MEIW accounts for both sensitive receptors and ambient air boundary receptors.

At all of the modeled locations, both the MEIR and MEIW are well below the 10-in-a-million significance level for excess cancer risk during construction for the sensitive receptors located within 1,000 feet of the Project component. Since the locations of the maximum sensitive receptors vary by Project component each is assessed separately. There may be some overlap with sensitive receptors for Project components located near each other, such as Dams and Reservoirs and Traffic Along Roadways, or GCID A and GCID Wilson and Walker, and GCID E and F through K Improvements. Even so, the sum of the maximum sensitive receptor from both Dams and Reservoirs and Traffic Along Roadways is still below 2.0 for both MEIR and MEIW.

Table 20C-13. Summary of Cancer Risks

Location	Exposure Period	MEIR[2]	MEIW[3]	Significance Level	Exceeds Threshold?
		(in-a-million)			
Dams & Reservoirs[1]	5 Years	0.828	1.789	10	No
Traffic Along Roadways	5-Years	0.936	0.119	10	No
Dunnigan Pipeline to CBD (Alt 1 and 3)	2 Years	0.057	0.062	10	No
Dunnigan Pipeline to Sacramento River (Alt 2)	2 Years	0.098	0.088	10	No
GCID A Improvements	3 Years	0.101	0.009	10	No
GCID E Improvements	3 Years	0.352	0.017	10	No
GCID F – K Improvements	3 Years	0.004	0.011	10	No
GCID Headgate	3 Years	0.009	0.005	10	No
GCID Wilson & Walker	2 Years	0.044	0.046	10	No

Location	Exposure Period	MEIR[2]	MEIW[3]	Significance Level	Exceeds Threshold?
		(in-a-million)			
Red Bluff	2 Years	0.000	0.000	10	No
Saddle Dams	4 Years	0.664	0.072	10	No
South Rd Alignment & Huffmaster Rd Realignment (Alt 2)	4 Years	0.984	0.107	10	No
Huffmaster Rd Realignment (Alt 1 and 3)	4 Years	0.598	0.065	10	No

Notes: MEIR = Maximum Exposed Individual Resident; MEIW = Maximum Exposed Individual Worker; MEIR and MEIW are assessed at sensitive receptors (i.e., not at any ambient air boundary receptors).

[1] Includes Golden Gate and Sites Dams, Funks Reservoir, TRR pipelines and TRR East Pumping Station location with the higher TRR West emissions, Sites Lodoga Road.

[2] At sensitive receptors only.

[3] At both sensitive and ambient air boundary receptors.

20C.4.1.2. Chronic Non-Cancer Risks

Table 20C-14 presents the chronic non-cancer hazard index (HI) for the point of maximum impact (PMI) for residences and workers at each modeled construction location during construction. The His are well below the significant level of 1.0 for all locations.

Table 20C-14. Summary of Non-Cancer Chronic Risks

Location	Exposure Period	PMI HI Resident[2]	PMI HI Worker[3]	Significance Level	Exceeds Threshold?
Dams & Reservoirs[1]	5 Years	3.75E-03	6.42E-01	1.0	No
Traffic Along Roadways	5 Years	4.38E-04	4.38E-04	1.0	No
Dunnigan Pipeline to CBD (Alt 1 and 3)	2 Years	3.23E-05	7.15E-02	1.0	No
Dunnigan Pipeline to Sacramento River (Alt 2)	2 Years	4.53E-04	1.79E-01	1.0	No
GCID A Improvements	3 Years	5.43E-05	5.43E-05	1.0	No
GCID E Improvements	3 Years	1.90E-04	4.36E-04	1.0	No

Location	Exposure Period	PMI HI Resident[2]	PMI HI Worker[3]	Significance Level	Exceeds Threshold?
GCID F – K Improvements	3 Years	1.91E-06	6.69E-05	1.0	No
GCID Headgate	3 Years	4.84E-06	3.15E-05	1.0	No
GCID Wilson & Walker	2 Years	2.57E-05	4.23E-04	1.0	No
Red Bluff	2 Years	3.57E-08	3.57E-08	1.0	No
Saddle Dams	4 Years	3.33E-04	3.33E-04	1.0	No
South Rd Alignment & Huffmaster Rd Realignment (Alt 2)	4 Years	4.93E-04	4.93E-04	1.0	No
Huffmaster Rd Realignment (Alt 1 and 3)	4 Years	2.99E-04	2.99E-04	1.0	No

Notes: PMI = Point of Maximum Impact; HI = Hazard Index; PMI HIs are assessed at all sensitive receptors and at the ambient air boundary receptors.
[1] Includes Golden Gate and Sites Dams, Funks Reservoir, TRR pipelines and TRR Pumping Station, Sites Lodoga Road.
[2] At sensitive receptors only.
[3] At both sensitive and ambient air boundary receptors.

20C.4.1.3. 8-hour Chronic Non-Cancer Risks

An 8-hour chronic risk is assessed for certain TACs, some of which are emitted by the batch plants. Therefore, the only Project locations where 8-hour chronic risk are assessed include the Dams/Reservoirs and Dunnigan Pipeline. Table 20C-15 presents the chronic non-cancer HI for the PMI for residences and workers at these locations during construction. The HIs are well below the significant level of 1.0 for both locations.

Table 20C-15. Summary of 8-hour Non-Cancer Chronic Risks

Location	Exposure Period	PMI HI Resident[2]	PMI HI Worker[2]	Significance Level	Exceeds Threshold?
Dams & Reservoirs[1]	8-hour	2.89E-02	1.21E-01	1.0	No
Dunnigan Pipeline to CBD (Alt 1 and 3)	8-hour	1.35E-02	1.35E-02	1.0	No
Dunnigan Pipeline to Sacramento River (Alt 2)	8-hour	3.38E-02	3.38E-02	1.0	No

Notes: PMI = Point of Maximum Impact; PMI HIs are assessed at all sensitive receptors and at the ambient air boundary receptors.
[1] Includes Golden Gate and Sites Dams, Funks Reservoir, TRR pipelines and TRR Pumping Station, Sites Lodoga Road.
[2] At both sensitive and ambient air boundary receptors.

20C.4.1.4. Acute Non-Cancer Risks

Similar to the 8-hour chronic risk, 1-hour (acute) non-cancer risk are assessed at only the Dams/Reservoirs and Dunnigan Pipeline locations. Table 20C-16 presents the chronic non-cancer HI for the PMI for residences and workers at these locations during construction. The HIs are well below the significant level of 1.0 for both locations.

Table 20C-16. Summary of Acute Risks

Location	Exposure Period	PMI HI[2]	Significance Level	Exceeds Threshold?
Dams & Reservoirs[1]	1-hour	5.61E-01	1.0	No
Dunnigan Pipeline to CBD (Alt 1 and 3)	1-hour	9.24E-02	1.0	No
Dunnigan Pipeline to Sacramento River (Alt 2)	1-hour	2.31E-01	1.0	No

Notes: PMI = Point of Maximum Impact; PMI HIs are assessed at all sensitive receptors and at the ambient air boundary receptors.
[1] Includes Golden Gate and Sites Dams, Funks Reservoir, TRR pipelines and TRR Pumping Station, Sites Lodoga Road.
[2] At both sensitive and ambient air boundary receptors.

20C.4.2. Ambient Air Quality Analysis

Criteria pollutants (CO, NO_2, PM10, PM2.5, and SO_2) are modeled using AERMOD, as discussed in Section 20C.2, *Methodology*. Project modeled concentrations associated with construction activities are generated for each pollutant and averaging period and compared against the NAAQS and CAAQS for each of the following 12 modeled locations.

1. Dams & Reservoirs
2. Receptors Along Road Associated with Dams & Reservoirs
3. Dunnigan Pipeline to CBD and Sacramento River
4. GCID A Improvements
5. GCID E Improvements
6. GCID F through K Improvements
7. GCID Headgate
8. GCID Wilson & Walker
9. RBPP

10. Saddle Dams
11. South Rd Alignment & Huffmaster Rd Realignment
12. Huffmaster Rd Realignment

Finally, the Project modeled concentrations are added to the ambient background concentrations. The total (Project plus background) are then compared against the NAAQS and CAAQS, or against the USEPA SILs for pollutants and averaging periods where the ambient background concentration exceeds the NAAQS and/or CAAQS.

20C.4.2.1. Project-Only Results Compared to NAAQS and CAAQS

Tables 20C-17 and 20C-18 summarize the criteria pollutant Project-only modeled concentrations for the modeled areas along with a percent of the standard for the NAAQS and CAAQS, respectively. Out of the 11 sites modeled, there are only 2 that yield Project-only concentrations above one or more of the pollutants and averaging periods. These 2 sites include: South Road Alignment and Huffmaster Road Realignment, and the ambient air boundary around the Dam and Reservoir areas. The exceedances occur for all Project Alternatives (Alternatives 1 and 3 and Alternative 2).

The 24-hour PM10 modeled concentrations exceed CAAQS for Huffmaster Road Realignment (Alternative 1) and South Road Alignment and Huffmaster Road Realignment (Alternative 2). These high modeled concentrations occur at the nearby sensitive receptors located toward the connection between South Road and Huffmaster Road.

The modeling for the Dams and Reservoirs also show NAAQS and CAAQS exceedance for 24-hour PM10 and annual PM10 (CAAQS only). For 24-hour PM10, the majority of receptors on the ambient air boundaries for Sites Dam, Stone Corral Creek Recreation Area, and Golden Gate Dam are found to exceed the NAAQS. The only other group of receptors to exceed the 24-hour PM10 NAAQS is along the southwest corner of Funks Reservoir construction area. As for receptors exceeding the CAAQS for 24-hour PM10, these include nearly all of the receptors along the Dams and Reservoir boundaries. Nearly all ambient air boundary receptors along Sites Dam, Stone Corral Creek Recreation Area, and Golden Gate Dam exceed the CAAQS for annual PM10.

20C.4.2.2. Project and Background Cumulative Results Compared to NAAQS and CAAQS

Tables 20C-19 and 20C-20 present the modeled concentrations from the Project, ambient background, and the total concentration (Project plus background) for the modeled areas along with the percent of the standard for the NAAQS and CAAQS, respectively. At all Project component locations modeled, NAAQS and CAAQS are exceeded for 24-hour and annual PM10 (CAAQS only), as well as 24-hour PM2.5 (CAAQS only). These results are primarily driven by existing ambient monitor concentrations already above these standards. Annual PM2.5 exceeds the NAAQS at six Project component locations, all of which are due to existing ambient monitor concentrations above the NAAQS.

Since all Project component locations exceed the NAAQS and CAAQS for PM10 and PM2.5 due primarily to the ambient background values already over the standards, the contribution of the Project is compared against the USEPA SILs for these pollutants. Table 20C-21 summarizes the SILs for PM10 and PM2.5. The only Project components that are found to exceed the SILs for 24-hour and annual PM10 and PM2.5 are for the Dunnigan Pipeline (all alternatives), South Road alignment and Huffmaster Road realignment (Alternatives 1 and 3), Huffmaster Road realignment (Alternative 2), traffic to/from the Dams and Reservoir construction areas (all Alternatives), and the Dams and Reservoirs ambient air boundaries (all Alternatives). All other Project component locations that show violations of the NAAQS and CAAQS for PM10 and PM2.5 are below the USEPA SILs.

Table 20C-17a. Summary of Project-Only Model Concentrations Compared to NAAQS

Pollutant	Avg. Period	Rank	NAAQS (ug/m^3)	Red Bluff		Dunnigan Alt 1&3		Dunnigan Alt 2		GCID Headgate		GCID A and RR		GCID E	
				NAAQS Conc. (µg/m^3)	PCT. of NAAQS	NAAQS Conc. (µg/m^3)	PCT. of NAAQS	NAAQS Conc. (µg/m^3)	PCT. of NAAQS	NAAQS Conc. (µg/m^3)	PCT. of NAAQS	NAAQS Conc. (µg/m^3)	PCT. of NAAQS	NAAQS Conc. (µg/m^3)	PCT. of NAAQS
SO_2	1-hour	H4H	196.5	7.00E-05	0.0%	9.99E-02	0.1%	8.73E-02	0.0%	5.17E-03	0.0%	4.24E-02	0.0%	5.19E-03	0.0%
	3-hour	H2H	1300	4.00E-05	0.0%	8.66E-02	0.0%	8.70E-02	0.0%	6.45E-03	0.0%	2.86E-02	0.0%	3.69E-03	0.0%
	24-hour	H2H	356	1.00E-05	0.0%	2.31E-02	0.0%	1.95E-02	0.0%	2.46E-03	0.0%	7.41E-03	0.0%	9.00E-04	0.0%
	Annual	H1H	80	0.00E+00	0.0%	3.16E-03	0.0%	2.50E-03	0.0%	6.90E-04	0.0%	1.66E-03	0.0%	1.60E-04	0.0%
CO	1-hour	H2H	40000	2.39E-02	0.0%	1.04E+02	0.3%	1.04E+02	0.3%	5.98E+00	0.0%	2.50E+01	0.1%	3.75E+00	0.0%
	8-hour	H2H	10000	4.54E-03	0.0%	2.78E+01	0.3%	2.31E+01	0.2%	2.87E+00	0.0%	8.90E+00	0.1%	8.60E-01	0.0%
NO_2	1-hour	H8H	188	1.91E-03	0.0%	1.24E+01	6.6%	9.24E+00	4.9%	1.21E+00	0.6%	6.37E+00	3.4%	1.27E+00	0.7%
	Annual	H1H	100	4.00E-05	0.0%	5.37E-01	0.5%	4.05E-01	0.4%	1.56E-01	0.2%	2.70E-01	0.3%	4.43E-02	0.0%
PM10	24-hour	H2H	150	1.16E-02	0.0%	1.79E+01	11.9%	4.26E+01	28.4%	2.18E-01	0.1%	2.96E-01	0.2%	2.31E+00	1.5%
PM2.5	24-hour	H8H	35	7.30E-04	0.0%	1.54E+00	4.4%	3.63E+00	10.4%	2.04E-02	0.1%	9.17E-02	0.3%	2.79E-01	0.8%
	Annual	H1H	12	1.30E-04	0.0%	6.70E-02	0.6%	8.78E-02	0.7%	6.92E-03	0.1%	2.33E-02	0.2%	6.52E-02	0.5%

Notes: µg/m^3 = micrograms per cubic meter; PCT = percent.

Table 20C-17b. Summary of Project-Only Model Concentrations Compared to NAAQS

Pollutant	Avg. Period	Rank	NAAQS (µg/m³)	GCID F to K		GCID Willows & Walker Siphons		Saddle Dams		Huffmaster Rd Alt 1 & 3		South & Huffmaster Alt 2		Traffic Along Roads Supporting Dams & Reservoirs	
				NAAQS Conc. (µg/m³)	PCT. of NAAQS	NAAQS Conc. (µg/m³)	PCT. of NAAQS	NAAQS Conc. (µg/m³)	PCT. of NAAQS	NAAQS Conc. (µg/m³)	PCT. of NAAQS	NAAQS Conc. (µg/m³)	PCT. of NAAQS	NAAQS Conc. (µg/m³)	PCT. of NAAQS
SO_2	1-hour	H4H	196.5	2.86E-03	0.0%	5.46E-02	0.0%	3.38E-01	0.2%	4.92E-01	0.3%	4.00E-01	0.2%	9.21E-01	0.5%
	3-hour	H2H	1300	1.73E-03	0.0%	5.11E-02	0.0%	1.60E-01	0.0%	2.45E-01	0.0%	2.00E-01	0.0%	4.75E-01	0.0%
	24-hour	H2H	356	3.60E-04	0.0%	8.39E-03	0.0%	4.02E-02	0.0%	4.10E-02	0.0%	4.13E-02	0.0%	9.67E-02	0.0%
	Annual	H1H	80	9.00E-05	0.0%	1.43E-03	0.0%	1.15E-03	0.0%	8.80E-04	0.0%	4.60E-04	0.0%	1.02E-02	0.0%
CO	1-hour	H2H	40000	1.67E+00	0.0%	9.30E+01	0.2%	8.13E+01	0.2%	2.19E+02	0.5%	1.84E+02	0.5%	2.98E+02	0.7%
	8-hour	H2H	10000	3.81E-01	0.0%	3.36E+01	0.3%	1.40E+01	0.1%	4.02E+01	0.4%	3.36E+01	0.3%	4.34E+01	0.4%
NO_2	1-hour	H8H	188	6.14E-01	0.3%	8.33E+00	4.4%	2.38E+01	12.7%	3.90E+01	20.7%	2.97E+01	15.8%	4.69E+01	24.9%
	Annual	H1H	100	2.52E-02	0.0%	2.56E-01	0.3%	1.16E-01	0.1%	5.49E-02	0.1%	2.84E-02	0.0%	8.50E-01	0.9%
PM10	24-hour	H2H	150	1.48E+00	1.0%	1.50E+00	1.0%	3.42E+00	2.3%	6.63E+01	44.2%	6.14E+01	40.9%	3.27E+01	21.8%
PM2.5	24-hour	H8H	35	1.12E-01	0.3%	9.80E-02	0.3%	4.15E-01	1.2%	4.35E+00	12.4%	3.44E+00	9.8%	4.78E+00	13.7%
	Annual	H1H	12	3.12E-02	0.3%	2.52E-02	0.2%	2.29E-02	0.2%	1.02E-01	0.8%	4.02E-02	0.3%	4.20E-01	3.5%

Notes: µg/m³ = micrograms per cubic meter; PCT = percent. **Bold** value indicate exceedance of NAAQS.

Table 20C-17c. Summary of Project-Only Model Concentrations Compared to NAAQS

Pollutant	Avg. Period	Rank	NAAQS (µg/m³)	Dams Reservoirs Alt 1 & 3		Dams Reservoirs Alt 2	
				NAAQS Conc. (µg/m³)	PCT. of NAAQS	NAAQS Conc. (µg/m³)	PCT. of NAAQS
SO_2	1-hour	H4H	196.5	3.23E+01	16.5%	3.23E+01	16.5%
	3-hour	H2H	1300	2.42E+01	1.9%	2.42E+01	1.9%
	24-hour	H2H	356	3.27E+00	0.9%	3.27E+00	0.9%
	Annual	H1H	80	1.10E-01	0.1%	1.10E-01	0.1%
CO	1-hour	H2H	40000	2.31E+03	5.8%	2.31E+03	5.8%
	8-hour	H2H	10000	3.58E+02	3.6%	3.58E+02	3.6%
NO_2	1-hour	H8H	188	1.64E+02	87.4%	1.64E+02	87.4%
	Annual	H1H	100	4.64E+00	4.6%	4.64E+00	4.6%
PM10	24-hour	H2H	150	5.54E+02	**369.1%**	5.54E+02	**369.1%**
PM2.5	24-hour	H8H	35	3.30E+01	94.4%	3.23E+01	92.2%
	Annual	H1H	12	5.77E+00	48.1%	5.77E+00	48.1%

Notes: µg/m³ = micrograms per cubic meter; PCT = percent . **Bold** value indicate exceedance of NAAQS.

Table 20C-18a. Summary of Project-Only Model Concentrations Compared to CAAQS

Pollutant	Avg. Period	Rank	CAAQS (ug/m^3)	Red Bluff		Dunnigan Alt 1& 3		Dunnigan Alt 2		GCID Headgate		GCID A and RR		GCID E	
				CAAQS Conc. (μg/m^3)	PCT. of CAAQS	CAAQS Conc. (μg/m^3)	PCT. of CAAQS	CAAQS Conc. (μg/m^3)	PCT. of CAAQS	CAAQS Conc. (μg/m^3)	PCT. of CAAQS	CAAQS Conc. (μg/m^3)	PCT. of CAAQS	CAAQS Conc. (μg/m^3)	PCT. of CAAQS
SO_2	1-hour	H1H	655	1.20E-04	0.0%	3.27E-01	0.0%	3.36E-01	0.1%	1.56E-02	0.0%	7.15E-02	0.0%	1.23E-02	0.0%
	24-hour		105	1.00E-05	0.0%	2.73E-02	0.0%	2.37E-02	0.0%	2.55E-03	0.0%	8.62E-03	0.0%	1.03E-03	0.0%
CO	1-hour		23,000	2.57E-02	0.0%	1.47E+02	0.6%	1.34E+02	0.6%	7.20E+00	0.0%	3.04E+01	0.1%	4.37E+00	0.0%
	8-hour		10,000	6.46E-03	0.0%	3.28E+01	0.3%	2.83E+01	0.3%	3.37E+00	0.0%	1.10E+01	0.1%	1.10E+00	0.0%
NO_2	1-hour		339	3.89E-03	0.0%	6.69E+01	19.7%	5.47E+01	16.1%	4.14E+00	1.2%	1.41E+01	4.2%	3.99E+00	1.2%
	Annual		57	4.00E-05	0.0%	5.37E-01	0.9%	4.05E-01	0.7%	1.56E-01	0.3%	2.70E-01	0.5%	4.43E-02	0.1%
PM10	24-hour		50	1.29E-02	0.0%	1.98E+01	39.7%	4.75E+01	95.0%	2.94E-01	0.6%	3.23E-01	0.6%	3.31E+00	6.6%
	Annual		20	1.09E-03	0.0%	5.13E-01	2.6%	1.33E+00	6.6%	4.38E-02	0.2%	5.91E-02	0.3%	2.91E-01	1.5%
PM2.5	Annual		12	1.30E-04	0.0%	7.15E-02	0.6%	9.13E-02	0.8%	1.29E-02	0.1%	2.54E-02	0.2%	7.54E-02	0.6%

Notes: μg/m^3 = micrograms per cubic meter; PCT = percent.

Table 20C-18b. Summary of Project-Only Model Concentrations Compared to CAAQS

Pollutant	Avg. Period	Rank	CAAQS (μg/m^3)	GCID F to K		GCID Willows & Walker Siphons		Saddle Dams		Huffmaster Rd Alt 1 & 3		South & Huffmaster Alt 2	
				CAAQS Conc. (μg/m^3)	PCT. of CAAQS	CAAQS Conc. (μg/m^3)	PCT. of CAAQS	CAAQS Conc. (μg/m^3)	PCT. of CAAQS	CAAQS Conc. (μg/m^3)	PCT. of CAAQS	CAAQS Conc. (μg/m^3)	PCT. of CAAQS
SO_2	1-hour	H1H	655	6.70E-03	0.0%	2.18E-01	0.0%	4.73E-01	0.1%	6.39E-01	0.1%	5.19E-01	0.1%
	24-hour		105	4.60E-04	0.0%	1.13E-02	0.0%	4.97E-02	0.0%	4.97E-02	0.0%	4.74E-02	0.0%
CO	1-hour		23,000	2.39E+00	0.0%	9.85E+01	0.4%	9.97E+01	0.4%	2.36E+02	1.0%	1.96E+02	0.9%
	8-hour		10,000	4.90E-01	0.0%	3.69E+01	0.4%	1.86E+01	0.2%	4.75E+01	0.5%	3.95E+01	0.4%
NO_2	1-hour		339	2.21E+00	0.7%	4.72E+01	13.9%	3.08E+01	9.1%	6.33E+01	18.7%	4.81E+01	14.2%
	Annual		57	2.52E-02	0.0%	2.56E-01	0.4%	1.16E-01	0.2%	5.49E-02	0.1%	2.84E-02	0.0%
PM10	24-hour		50	1.87E+00	3.7%	1.64E+00	3.3%	4.25E+00	8.5%	7.00E+01	**140.1%**	6.58E+01	**131.5%**
	Annual		20	1.34E-01	0.7%	2.16E-01	1.1%	8.39E-02	0.4%	9.90E-01	5.0%	3.90E-01	1.9%
PM2.5	Annual		12	3.64E-02	0.3%	2.85E-02	0.2%	2.65E-02	0.2%	1.20E-01	1.0%	4.78E-02	0.4%

Notes: micrograms per cubic meter = μg/m^3, percent = PCT. **Bold** value indicate exceedance of CAAQS.

Table 20C-18c. Summary of Project-Only Model Concentrations Compared to CAAQS

Pollutant	Avg. Period	Rank	CAAQS (μg/m³)	Traffic Along Roads Supporting Dams & Reservoirs		Dams Reservoirs Alt 1 & 3		Dams Reservoirs Alt 2	
				CAAQS Conc. (μg/m³)	PCT. of CAAQS	CAAQS Conc. (μg/m³)	PCT. of CAAQS	CAAQS Conc. (μg/m³)	PCT. of CAAQS
SO_2	1-hour	H1H	655	1.47E+00	0.2%	7.29E+01	11.1%	7.29E+01	11.1%
	24-hour		105	1.13E-01	0.1%	3.81E+00	3.6%	3.81E+00	3.6%
CO	1-hour		23,000	3.16E+02	1.4%	2.54E+03	11.0%	2.54E+03	11.0%
	8-hour		10,000	5.07E+01	0.5%	3.98E+02	4.0%	3.98E+02	4.0%
NO_2	1-hour		339	8.55E+01	25.2%	2.32E+02	68.4%	2.32E+02	68.4%
	Annual		57	8.50E-01	1.5%	4.64E+00	8.1%	4.64E+00	8.1%
PM10	24-hour		50	3.76E+01	75.3%	7.57E+02	**1513.5%**	**7.57E+02**	**1513.5%**
	Annual		20	3.59E+00	17.9%	5.65E+01	**282.5%**	**5.65E+01**	**282.6%**
PM2.5	Annual		12	4.52E-01	3.8%	6.66E+00	55.5%	6.66E+00	55.5%

Notes: μg/m³ = micrograms per cubic meter; PCT = percent. **Bold** value indicate exceedance of CAAQS.

Table 20C-19a. Summary of Cumulative (Project Plus Background) Model Concentrations Compared to NAAQS

Pollutant	Avg. Period	Rank	NAAQS (ug/m^3)	Red Bluff				Dunnigan Alt 1 & 3				GCID Headgate			
				Project NAAQS Conc. (ug/m^3)	BKGD NAAQS Conc. (ug/m^3)	Total NAAQS Conc. (ug/m^3)	PCT. of NAAQS	Project NAAQS Conc. (ug/m^3)	BKGD NAAQS Conc. (ug/m^3)	Total NAAQS Conc. (ug/m^3)	PCT. of NAAQS	Project NAAQS Conc. (ug/m^3)	BKGD NAAQS Conc. (ug/m^3)	Total NAAQS Conc. (ug/m^3)	PCT. of NAAQS
SO_2	1-hour	H4H	196.5	7.00E-05	6.99E+00	6.99E+00	3.6%	9.99E-02	6.99E+00	7.09E+00	3.6%	5.17E-03	6.99E+00	6.99E+00	3.6%
	3-hour	H2H	1300	4.00E-05	8.91E+00	8.91E+00	0.7%	8.66E-02	8.91E+00	8.99E+00	0.7%	6.45E-03	8.91E+00	8.91E+00	0.7%
	24-hour	H2H	356	1.00E-05	3.41E+00	3.41E+00	1.0%	2.31E-02	3.41E+00	3.43E+00	1.0%	2.46E-03	3.41E+00	3.41E+00	1.0%
	Annual	H1H	80	0.00E+00	1.21E+00	1.21E+00	1.5%	3.16E-03	1.21E+00	1.21E+00	1.5%	6.90E-04	1.21E+00	1.21E+00	1.5%
CO	1-hour	H2H	40000	2.39E-02	8.28E+03	8.28E+03	20.7%	1.04E+02	8.28E+03	8.38E+03	20.9%	5.98E+00	8.28E+03	8.28E+03	20.7%
	8-hour	H2H	10000	4.54E-03	4.14E+03	4.14E+03	41.4%	2.78E+01	4.14E+03	4.17E+03	41.7%	2.87E+00	4.14E+03	4.14E+03	41.4%
NO_2	1-hour	H8H	188	1.91E-03	6.14E+01	6.14E+01	32.7%	1.24E+01	6.14E+01	7.39E+01	39.3%	1.21E+00	6.14E+01	6.27E+01	33.3%
	Annual	H1H	100	4.00E-05	1.33E+01	1.33E+01	13.3%	5.37E-01	1.41E+01	1.46E+01	14.6%	1.56E-01	1.33E+01	1.35E+01	13.5%
PM10	24-hour	H2H	150	1.16E-02	1.51E+02	1.51E+02	**100.7%**	1.79E+01	2.10E+02	2.28E+02	**151.9%**	2.18E-01	1.52E+02	1.52E+02	**101.5%**
PM2.5	24-hour	H8H	35	7.30E-04	5.50E+01	5.50E+01	**157.1%**	1.54E+00	4.77E+01	4.92E+01	**140.6%**	2.04E-02	5.90E+01	5.90E+01	**168.6%**
	Annual	H1H	12	1.30E-04	9.70E+00	9.70E+00	80.8%	6.70E-02	7.00E+00	7.07E+00	58.9%	6.92E-03	1.49E+01	1.49E+01	**123.8%**

Notes: $\mu g/m^3$ = micrograms per cubic meter; BKGD = background; PCT = percent.

Table 20C-19b. Summary of Cumulative (Project Plus Background) Model Concentrations Compared to NAAQS

Pollutant	Avg. Period	Rank	NAAQS (ug/m³)	GCID A and RR				GCID E				GCID F to K			
				Project NAAQS Conc. (ug/m³)	BKGD NAAQS Conc. (ug/m³)	Total NAAQS Conc. (ug/m³)	PCT. of NAAQS	Project NAAQS Conc. (ug/m³)	BKGD NAAQS Conc. (ug/m³)	Total NAAQS Conc. (ug/m³)	PCT. of NAAQS	Project NAAQS Conc. (ug/m³)	BKGD NAAQS Conc. (ug/m³)	Total NAAQS Conc. (ug/m³)	PCT. of NAAQS
SO_2	1-hour	H4H	196.5	4.24E-02	6.99E+00	7.03E+00	3.6%	5.19E-03	6.99E+00	6.99E+00	3.6%	2.86E-03	6.99E+00	6.99E+00	3.6%
	3-hour	H2H	1300	2.86E-02	8.91E+00	8.94E+00	0.7%	3.69E-03	8.91E+00	8.91E+00	0.7%	1.73E-03	8.91E+00	8.91E+00	0.7%
	24-hour	H2H	356	7.41E-03	3.41E+00	3.41E+00	1.0%	9.00E-04	3.41E+00	3.41E+00	1.0%	3.60E-04	3.41E+00	3.41E+00	1.0%
	Annual	H1H	80	1.66E-03	1.21E+00	1.21E+00	1.5%	1.60E-04	1.21E+00	1.21E+00	1.5%	9.00E-05	1.21E+00	1.21E+00	1.5%
CO	1-hour	H2H	40000	2.50E+01	8.28E+03	8.30E+03	20.8%	3.75E+00	8.28E+03	8.28E+03	20.7%	1.67E+00	8.28E+03	8.28E+03	20.7%
	8-hour	H2H	10000	8.90E+00	4.14E+03	4.15E+03	41.5%	8.60E-01	4.14E+03	4.14E+03	41.4%	3.81E-01	4.14E+03	4.14E+03	41.4%
NO_2	1-hour	H8H	188	6.37E+00	6.14E+01	6.78E+01	36.1%	1.27E+00	6.14E+01	6.27E+01	33.4%	6.14E-01	6.14E+01	6.21E+01	33.0%
	Annual	H1H	100	2.70E-01	1.33E+01	1.36E+01	13.6%	4.43E-02	1.33E+01	1.34E+01	13.4%	2.52E-02	1.33E+01	1.33E+01	13.3%
PM10	24-hour	H2H	150	2.96E-01	3.25E+02	3.25E+02	**216.9%**	2.31E+00	3.25E+02	3.27E+02	**218.2%**	1.48E+00	3.25E+02	3.26E+02	**217.7%**
PM2.5	24-hour	H8H	35	9.17E-02	5.90E+01	5.91E+01	**168.8%**	2.79E-01	5.90E+01	5.93E+01	**169.4%**	1.12E-01	5.90E+01	5.91E+01	**168.9%**
	Annual	H1H	12	2.33E-02	1.49E+01	1.49E+01	**123.9%**	6.52E-02	1.49E+01	1.49E+01	**124.3%**	3.12E-02	1.49E+01	1.49E+01	**124.0%**

Notes: μg/m³ = micrograms per cubic meter; BKGD = background; PCT = percent.

Table 20C-19c. Summary of Cumulative (Project Plus Background) Model Concentrations Compared to NAAQS

Pollutant	Avg. Period	Rank	NAAQS (ug/m³)	GCID Willows & Walker Siphons				Saddle Dams				South & Huffmaster Alt 2			
				Project NAAQS Conc. (ug/m³)	BKGD NAAQS Conc. (ug/m³)	Total NAAQS Conc. (ug/m³)	PCT. of NAAQS	Project NAAQS Conc. (ug/m³)	BKGD NAAQS Conc. (ug/m³)	Total NAAQS Conc. (ug/m³)	PCT. of NAAQS	Project NAAQS Conc. (ug/m³)	BKGD NAAQS Conc. (ug/m³)	Total NAAQS Conc. (ug/m³)	PCT. of NAAQS
SO_2	1-hour	H4H	196.5	5.46E-02	6.99E+00	7.04E+00	3.6%	3.38E-01	6.99E+00	7.32E+00	3.7%	4.00E-01	6.99E+00	7.39E+00	3.8%
	3-hour	H2H	1300	5.11E-02	8.91E+00	8.96E+00	0.7%	1.60E-01	8.91E+00	9.07E+00	0.7%	2.00E-01	8.91E+00	9.11E+00	0.7%
	24-hour	H2H	356	8.39E-03	3.41E+00	3.41E+00	1.0%	4.02E-02	3.41E+00	3.45E+00	1.0%	4.13E-02	3.41E+00	3.45E+00	1.0%
	Annual	H1H	80	1.43E-03	1.21E+00	1.21E+00	1.5%	1.15E-03	1.21E+00	1.21E+00	1.5%	4.60E-04	1.21E+00	1.21E+00	1.5%
CO	1-hour	H2H	40000	9.30E+01	8.28E+03	8.37E+03	20.9%	8.13E+01	8.28E+03	8.36E+03	20.9%	1.84E+02	8.28E+03	8.46E+03	21.1%
	8-hour	H2H	10000	3.36E+01	4.14E+03	4.17E+03	41.7%	1.40E+01	4.14E+03	4.15E+03	41.5%	3.36E+01	4.14E+03	4.17E+03	41.7%
NO_2	1-hour	H8H	188	8.33E+00	6.14E+01	6.98E+01	37.1%	2.38E+01	6.14E+01	8.53E+01	45.4%	2.97E+01	6.14E+01	9.11E+01	48.5%
	Annual	H1H	100	2.56E-01	1.33E+01	1.36E+01	13.6%	1.16E-01	1.33E+01	1.34E+01	13.4%	2.84E-02	1.33E+01	1.33E+01	13.3%
PM10	24-hour	H2H	150	1.50E+00	3.25E+02	3.26E+02	**217.7%**	3.42E+00	1.52E+02	1.55E+02	**103.6%**	6.14E+01	1.52E+02	2.13E+02	**142.3%**
PM2.5	24-hour	H8H	35	9.80E-02	5.90E+01	5.91E+01	**168.9%**	4.15E-01	4.77E+01	4.81E+01	**137.4%**	3.44E+00	4.77E+01	5.11E+01	**146.0%**
	Annual	H1H	12	2.52E-02	1.49E+01	1.49E+01	**124.0%**	2.29E-02	7.00E+00	7.02E+00	58.5%	4.02E-02	7.00E+00	7.04E+00	58.7%

Notes: µg/m³ = micrograms per cubic meter; BKGD = background; PCT = percent.

Table 20C-19d. Summary of Cumulative (Project Plus Background) Model Concentrations Compared to NAAQS

Pollutant	Avg. Period	Rank	NAAQS (ug/m^3)	Huffmaster Rd Alt 1				Dunnigan Alt 2				Traffic Along Roads Supporting Dams & Reservoirs			
				Project NAAQS Conc. (ug/m^3)	BKGD NAAQS Conc. (ug/m^3)	Total NAAQS Conc. (ug/m^3)	PCT. of NAAQS	Project NAAQS Conc. (ug/m^3)	BKGD NAAQS Conc. (ug/m^3)	Total NAAQS Conc. (ug/m^3)	PCT. of NAAQS	Project NAAQS Conc. (ug/m^3)	BKGD NAAQS Conc. (ug/m^3)	Total NAAQS Conc. (ug/m^3)	PCT. of NAAQS
SO_2	1-hour	H4H	196.5	4.92E-01	6.99E+00	7.48E+00	3.8%	8.73E-02	6.99E+00	7.07E+00	3.6%	9.21E-01	6.99E+00	7.91E+00	4.0%
	3-hour	H2H	1300	2.45E-01	8.91E+00	9.15E+00	0.7%	8.70E-02	8.91E+00	8.99E+00	0.7%	4.75E-01	8.91E+00	9.38E+00	0.7%
	24-hour	H2H	356	4.10E-02	3.41E+00	3.45E+00	1.0%	1.95E-02	3.41E+00	3.43E+00	1.0%	9.67E-02	3.41E+00	3.50E+00	1.0%
	Annual	H1H	80	8.80E-04	1.21E+00	1.21E+00	1.5%	2.50E-03	1.21E+00	1.21E+00	1.5%	1.02E-02	1.21E+00	1.22E+00	1.5%
CO	1-hour	H2H	40000	2.19E+02	8.28E+03	8.49E+03	21.2%	1.04E+02	8.28E+03	8.38E+03	20.9%	2.98E+02	8.28E+03	8.57E+03	21.4%
	8-hour	H2H	10000	4.02E+01	4.14E+03	4.18E+03	41.8%	2.31E+01	4.14E+03	4.16E+03	41.6%	4.34E+01	4.14E+03	4.18E+03	41.8%
NO_2	1-hour	H8H	188	3.90E+01	6.14E+01	1.00E+02	53.4%	9.24E+00	6.14E+01	7.07E+01	37.6%	4.69E+01	6.14E+01	1.08E+02	57.6%
	Annual	H1H	100	5.49E-02	1.33E+01	1.34E+01	13.4%	4.05E-01	1.41E+01	1.45E+01	14.5%	8.50E-01	1.33E+01	1.42E+01	14.2%
PM10	24-hour	H2H	150	6.63E+01	1.52E+02	2.18E+02	**145.5%**	4.26E+01	2.10E+02	2.53E+02	**168.4%**	3.27E+01	1.52E+02	1.85E+02	**123.2%**
PM2.5	24-hour	H8H	35	4.35E+00	4.77E+01	5.20E+01	**148.6%**	3.63E+00	4.77E+01	5.13E+01	**146.6%**	4.78E+00	4.77E+01	5.24E+01	**149.8%**
	Annual	H1H	12	1.02E-01	7.00E+00	7.10E+00	59.2%	8.78E-02	7.00E+00	7.09E+00	59.1%	4.20E-01	7.00E+00	7.42E+00	61.8%

Notes: µg/m^3 = micrograms per cubic meter; BKGD = background; PCT = percent.

Table 20C-19e. Summary of Cumulative (Project Plus Background) Model Concentrations Compared to NAAQS

Pollutant	Avg. Period	Rank	NAAQS (ug/m^3)	Dams Reservoirs Alt 1 & 3				Dams Reservoirs Alt 2			
				Project NAAQS Conc. (ug/m^3)	BKGD NAAQS Conc. (ug/m^3)	Total NAAQS Conc. (ug/m^3)	PCT. of NAAQS	Project NAAQS Conc. (ug/m^3)	BKGD NAAQS Conc. (ug/m^3)	Total NAAQS Conc. (ug/m^3)	PCT. of NAAQS
SO_2	1-hour	H4H	196.5	3.23E+01	6.99E+00	3.93E+01	20.0%	3.23E+01	6.99E+00	3.93E+01	20.0%
	3-hour	H2H	1300	2.42E+01	8.91E+00	3.31E+01	2.5%	2.42E+01	8.91E+00	3.31E+01	2.5%
	24-hour	H2H	356	3.27E+00	3.41E+00	6.67E+00	1.9%	3.27E+00	3.41E+00	6.67E+00	1.9%
	Annual	H1H	80	1.10E-01	1.21E+00	1.32E+00	1.6%	1.10E-01	1.21E+00	1.32E+00	1.6%
CO	1-hour	H2H	40000	2.31E+03	8.28E+03	1.06E+04	26.5%	2.31E+03	8.28E+03	1.06E+04	26.5%
	8-hour	H2H	10000	3.58E+02	4.14E+03	4.50E+03	45.0%	3.58E+02	4.14E+03	4.50E+03	45.0%
NO_2	1-hour	H8H	188	1.64E+02	Included in model[1]	1.64E+02	87.4%	1.64E+02	Included in model[1]	1.64E+02	87.4%
	Annual	H1H	100	4.64E+00	1.33E+01	1.80E+01	18.0%	4.64E+00	1.33E+01	1.80E+01	18.0%
PM10	24-hour	H2H	150	5.54E+02	1.52E+02	7.06E+02	**470.4%**	5.54E+02	1.52E+02	7.06E+02	**470.4%**
PM2.5	24-hour	H8H	35	3.30E+01	4.77E+01	8.07E+01	**230.6%**	3.23E+01	4.77E+01	8.00E+01	**228.4%**
	Annual	H1H	12	5.77E+00	7.00E+00	1.28E+01	**106.4%**	5.77E+00	7.00E+00	1.28E+01	**106.4%**

Notes: µg/m^3 = micrograms per cubic meter; BKGD = background; PCT = percent.
[1] Season and hour-by-day 3-year average maximum background concentrations included in model concentrations.

Table 20C-20a. Summary of Cumulative (Project Plus Background) Model Concentrations Compared to CAAQS

Pollutant	Avg. Period	Rank	CAAQS (ug/m³)	Red Bluff				Dunnigan Alt 1 & 3				GCID Headgate			
				Project CAAQS Conc. (ug/m³)	BKGD CAAQS Conc. (ug/m³)	Total CAAQS Conc. (ug/m³)	PCT. of CAAQS	Project CAAQS Conc. (ug/m³)	BKGD CAAQS Conc. (ug/m³)	Total CAAQS Conc. (ug/m³)	PCT. of CAAQS	Project CAAQS Conc. (ug/m³)	BKGD CAAQS Conc. (ug/m³)	Total CAAQS Conc. (ug/m³)	PCT. of CAAQS
SO_2	1-hour	H1H	655	1.20E-04	2.25E+01	2.25E+01	3.4%	3.27E-01	2.25E+01	2.29E+01	3.5%	1.56E-02	2.25E+01	2.25E+01	3.4%
	24-hour		105	1.00E-05	4.45E+00	4.45E+00	4.2%	2.73E-02	4.45E+00	4.48E+00	4.3%	2.55E-03	4.45E+00	4.46E+00	4.2%
CO	1-hour		23,000	2.57E-02	8.51E+03	8.51E+03	37.0%	1.47E+02	8.51E+03	8.65E+03	37.6%	7.20E+00	8.51E+03	8.51E+03	37.0%
	8-hour		10,000	6.46E-03	5.63E+03	5.63E+03	56.3%	3.28E+01	5.63E+03	5.66E+03	56.6%	3.37E+00	5.63E+03	5.64E+03	56.4%
NO_2	1-hour		339	3.89E-03	9.78E+01	9.78E+01	28.9%	6.69E+01	9.59E+01	1.63E+02	48.0%	4.14E+00	9.78E+01	1.02E+02	30.1%
	Annual		57	4.00E-05	1.33E+01	1.33E+01	23.4%	5.37E-01	1.41E+01	1.46E+01	25.6%	1.56E-01	1.33E+01	1.35E+01	23.6%
PM10	24-hour		50	1.29E-02	1.72E+02	1.72E+02	**344.0%**	1.98E+01	3.04E+02	3.24E+02	**647.7%**	2.94E-01	2.15E+02	2.15E+02	**430.6%**
	Annual		20	1.09E-03	2.39E+01	2.39E+01	**119.5%**	5.13E-01	3.63E+01	3.68E+01	**184.0%**	4.38E-02	2.94E+01	2.95E+01	**147.3%**
PM2.5	Annual		12	1.30E-04	1.32E+01	1.32E+01	**110.0%**	7.15E-02	1.32E+01	1.33E+01	**110.6%**	1.29E-02	1.60E+01	1.60E+01	**133.4%**

Notes: μg/m³ = micrograms per cubic meter; BKGD = background; PCT = percent.

Table 20C-20b. Summary of Cumulative (Project Plus Background) Model Concentrations Compared to CAAQS

Pollutant	Avg. Period	Rank	CAAQS (ug/m³)	GCID A and RR				GCID E				GCID F to K			
				Project CAAQS Conc. (ug/m³)	BKGD CAAQS Conc. (ug/m³)	Total CAAQS Conc. (ug/m³)	PCT. of NAAQS	Project CAAQS Conc. (ug/m³)	BKGD CAAQS Conc. (ug/m³)	Total CAAQS Conc. (ug/m³)	PCT. of NAAQS	Project CAAQS Conc. (ug/m³)	BKGD CAAQS Conc. (ug/m³)	Total CAAQS Conc. (ug/m³)	PCT. of NAAQS
SO_2	1-hour	H1H	655	7.15E-02	2.25E+01	2.26E+01	3.5%	1.23E-02	2.25E+01	2.25E+01	3.4%	6.70E-03	2.25E+01	2.25E+01	3.4%
	24-hour		105	8.62E-03	4.45E+00	4.46E+00	4.3%	1.03E-03	4.45E+00	4.46E+00	4.2%	4.60E-04	4.45E+00	4.45E+00	4.2%
CO	1-hour		23,000	3.04E+01	8.51E+03	8.54E+03	37.1%	4.37E+00	8.51E+03	8.51E+03	37.0%	2.39E+00	8.51E+03	8.51E+03	37.0%
	8-hour		10,000	1.10E+01	5.63E+03	5.64E+03	56.4%	1.10E+00	5.63E+03	5.63E+03	56.3%	4.90E-01	5.63E+03	5.63E+03	56.3%
NO_2	1-hour		339	1.41E+01	9.78E+01	1.12E+02	33.0%	3.99E+00	9.78E+01	1.02E+02	30.0%	2.21E+00	9.78E+01	1.00E+02	29.5%
	Annual		57	2.70E-01	1.33E+01	1.36E+01	23.8%	4.43E-02	1.33E+01	1.34E+01	23.4%	2.52E-02	1.33E+01	1.33E+01	23.4%
PM10	24-hour		50	3.23E-01	3.90E+02	3.90E+02	**780.6%**	3.31E+00	3.90E+02	3.93E+02	**786.6%**	1.87E+00	3.90E+02	3.92E+02	**783.7%**
	Annual		20	5.91E-02	2.94E+01	2.95E+01	**147.4%**	2.91E-01	2.94E+01	2.97E+01	**148.6%**	1.34E-01	2.94E+01	2.96E+01	**147.8%**
PM2.5	Annual		12	2.54E-02	1.60E+01	1.60E+01	**133.5%**	7.54E-02	1.60E+01	1.61E+01	**134.0%**	3.64E-02	1.60E+01	1.60E+01	**133.6%**

Notes: μg/m³ = micrograms per cubic meter; BKGD = background; PCT = percent.

Table 20C-20c. Summary of Cumulative (Project Plus Background) Model Concentrations Compared to CAAQS

Pollutant	Avg. Period	Rank	CAAQS (ug/m^3)	GCID Willows & Walker Siphons				Saddle Dams				South & Huffmaster Alt 2			
				Project CAAQS Conc. (ug/m^3)	BKGD CAAQS Conc. (ug/m^3)	Total CAAQS Conc. (ug/m^3)	PCT. of NAAQS	Project CAAQS Conc. (ug/m^3)	BKGD CAAQS Conc. (ug/m^3)	Total CAAQS Conc. (ug/m^3)	PCT. of NAAQS	Project CAAQS Conc. (ug/m^3)	BKGD CAAQS Conc. (ug/m^3)	Total CAAQS Conc. (ug/m^3)	PCT. of NAAQS
SO_2	1-hour		655	2.18E-01	2.25E+01	2.28E+01	3.5%	4.73E-01	2.25E+01	2.30E+01	3.5%	5.19E-01	2.25E+01	2.31E+01	3.5%
	24-hour		105	1.13E-02	4.45E+00	4.47E+00	4.3%	4.97E-02	4.45E+00	4.50E+00	4.3%	4.74E-02	4.45E+00	4.50E+00	4.3%
CO	1-hour		23,000	9.85E+01	8.51E+03	8.60E+03	37.4%	9.97E+01	8.51E+03	8.61E+03	37.4%	1.96E+02	8.51E+03	8.70E+03	37.8%
	8-hour		10,000	3.69E+01	5.63E+03	5.67E+03	56.7%	1.86E+01	5.63E+03	5.65E+03	56.5%	3.95E+01	5.63E+03	5.67E+03	56.7%
NO_2	1-hour	H1H	339	4.72E+01	9.78E+01	1.45E+02	42.8%	3.08E+01	9.78E+01	1.29E+02	37.9%	4.81E+01	9.78E+01	1.46E+02	43.0%
	Annual		57	2.56E-01	1.33E+01	1.36E+01	23.8%	1.16E-01	1.33E+01	1.34E+01	23.6%	2.84E-02	1.33E+01	1.33E+01	23.4%
PM10	24-hour		50	1.64E+00	3.90E+02	3.92E+02	**783.3%**	4.25E+00	2.15E+02	2.19E+02	**438.5%**	6.58E+01	2.15E+02	2.81E+02	**561.5%**
	Annual		20	2.16E-01	2.94E+01	2.96E+01	**148.2%**	8.39E-02	2.94E+01	2.95E+01	**147.5%**	3.90E-01	2.94E+01	2.98E+01	**149.1%**
PM2.5	Annual		12	2.85E-02	1.60E+01	1.60E+01	**133.6%**	2.65E-02	1.32E+01	1.32E+01	**110.2%**	4.78E-02	1.32E+01	1.32E+01	**110.4%**

Notes: $\mu g/m^3$ = micrograms per cubic meter; BKGD = background; PCT = percent.

Table 20C-20d. Summary of Cumulative (Project Plus Background) Model Concentrations Compared to CAAQS

Pollutant	Avg. Period	Rank	CAAQS (ug/m³)	Huffmaster Rd Alt 1				Dunnigan Alt 2				Traffic Along Roads Supporting Dams & Reservoirs			
				Project CAAQS Conc. (ug/m³)	BKGD CAAQS Conc. (ug/m³)	Total CAAQS Conc. (ug/m³)	PCT. of NAAQS	Project CAAQS Conc. (ug/m³)	BKGD CAAQS Conc. (ug/m³)	Total CAAQS Conc. (ug/m³)	PCT. of NAAQS	Project CAAQS Conc. (ug/m³)	BKGD CAAQS Conc. (ug/m³)	Total CAAQS Conc. (ug/m³)	PCT. of NAAQS
SO_2	1-hour	H1H	655	6.39E-01	2.25E+01	2.32E+01	3.5%	3.36E-01	2.25E+01	2.29E+01	3.5%	1.47E+00	2.25E+01	2.40E+01	3.7%
	24-hour		105	4.97E-02	4.45E+00	4.50E+00	4.3%	2.37E-02	4.45E+00	4.48E+00	4.3%	1.13E-01	4.45E+00	4.57E+00	4.3%
CO	1-hour		23,000	2.36E+02	8.51E+03	8.74E+03	38.0%	1.34E+02	8.51E+03	8.64E+03	37.6%	3.16E+02	8.51E+03	8.82E+03	38.4%
	8-hour		10,000	4.75E+01	5.63E+03	5.68E+03	56.8%	2.83E+01	5.63E+03	5.66E+03	56.6%	5.07E+01	5.63E+03	5.68E+03	56.8%
NO_2	1-hour		339	6.33E+01	9.78E+01	1.61E+02	47.5%	5.47E+01	9.59E+01	1.51E+02	44.4%	8.55E+01	9.78E+01	1.83E+02	54.1%
	Annual		57	5.49E-02	1.33E+01	1.34E+01	23.5%	4.05E-01	1.41E+01	1.45E+01	25.4%	8.50E-01	1.33E+01	1.42E+01	24.9%
PM10	24-hour		50	7.00E+01	2.15E+02	2.85E+02	**570.1%**	4.75E+01	3.04E+02	3.52E+02	**703.0%**	3.76E+01	2.15E+02	2.53E+02	**505.3%**
	Annual		20	9.90E-01	2.94E+01	3.04E+01	**152.1%**	1.33E+00	3.63E+01	3.76E+01	**188.1%**	3.59E+00	2.94E+01	3.30E+01	**165.1%**
PM2.5	Annual		12	1.20E-01	1.32E+01	1.33E+01	**111.0%**	9.13E-02	1.32E+01	1.33E+01	**110.8%**	4.52E-01	1.32E+01	1.37E+01	**113.8%**

Notes: μg/m³ = micrograms per cubic meter; BKGD = background; PCT = percent.

Table 20C-20e. Summary of Cumulative (Project Plus Background) Model Concentrations Compared to CAAQS

Pollutant	Avg. Period	Rank	CAAQS (ug/m^3)	Dams Reservoirs Alt 1 & 3				Dams Reservoirs Alt 2			
				Project CAAQS Conc. (ug/m^3)	BKGD CAAQS Conc. (ug/m^3)	Total NAAQS Conc. (ug/m^3)	PCT. of CAAQS)	Project CAAQS Conc. (ug/m^3)	BKGD NAAQS Conc. (ug/m^3)	Total CAAQS Conc. (ug/m^3)	PCT. of CAAQS
SO_2	1-hour	H1H	655	7.29E+01	2.25E+01	9.55E+01	14.6%	7.29E+01	2.25E+01	9.55E+01	14.6%
	24-hour		105	3.81E+00	4.45E+00	8.26E+00	7.9%	3.81E+00	4.45E+00	8.26E+00	7.9%
CO	1-hour		23,000	2.54E+03	8.51E+03	1.10E+04	48.0%	2.54E+03	8.51E+03	1.10E+04	48.0%
	8-hour		10,000	3.98E+02	5.63E+03	6.03E+03	60.3%	3.98E+02	5.63E+03	6.03E+03	60.3%
NO_2	1-hour		339	2.32E+02	Included in model[1]	2.32E+02	68.4%	2.32E+02	Included in model[1]	2.32E+02	68.4%
	Annual		57	4.64E+00	1.33E+01	1.80E+01	31.5%	4.64E+00	1.33E+01	1.80E+01	31.5%
PM10	24-hour		50	7.57E+02	2.15E+02	9.72E+02	**1943.5%**	7.57E+02	2.15E+02	9.72E+02	**1943.5%**
	Annual		20	5.65E+01	2.94E+01	8.59E+01	**429.6%**	5.65E+01	2.94E+01	8.59E+01	**429.7%**
PM2.5	Annual		12	6.66E+00	1.32E+01	1.99E+01	**165.5%**	6.66E+00	1.32E+01	1.99E+01	**165.5%**

Notes: µg/m^3 = micrograms per cubic meter; BKGD = background, PCT = percent.

[1] Season and hour-by-day 3-year average maximum background concentrations included in model concentrations.

Table 20C-21. USEPA Significant Impact Levels for PM10 and PM2.5

Pollutant	Avg. Period	SIL ($\mu g/m^3$)
PM10	24-hour	5.0(1)
	Annual	1.0(1)
PM2.5	24-hour	1.2(2)
	Annual	0.2(2)

Notes: $\mu g/m^3$ = micrograms per cubic meter; PM10 = particulates 10 microns in diameter or less; PM2.5 = particulates 2.5 microns in diameter or less
(1) San Joaquin Valley Air Pollution Control District 2014
(2) U.S. Environmental Protection Agency 2018b

20C.4.3. Qualitative Assessment of Operational Impacts

Upon completion of the Project, sources of emissions from day-to-day activities would involve public vehicles traveling to and from the reservoir along with on-water sources, such as water vessels. Both source types would be mobile in nature. The pollutant with the highest operational emissions is CO with annual emissions that could approach 315 tons. For perspective, the highest annual emission rate of CO during construction is approximately 340 tons. Given that for construction, the cumulative impacts for 1-hour and 8-hour CO were both less than 50% of the NAAQS and less than 61% of the CAAQS, impacts from operational activities are expected to be lower than those modeled during construction.

20C.5 Summary

The AAQA and HRA are conducted based upon the worst-case year of construction activities associated with the Project. The HRA evaluated:

1. *Health risk and hazard impacts of construction emissions* from the Project to the existing offsite sensitive receptors (residents and schools) located within 1,000 feet of Project locations.
2. *Health risk and hazard impacts of on-road project-related construction emissions* to existing offsite sensitive receptors located within 500 feet of Project construction routes.

Health risks associated with the HRA are provided in terms of cancer and non-cancer risks, where the non-cancer risks are further divided into chronic (long-term and 8-hour) and acute (short-term) risks. At all 11 Project component locations, cancer and non-cancer risk associated with Project construction are below their respective thresholds.

The AAQA evaluated concentrations of criteria pollutants (CO, NO_2, PM10, PM2.5, and SO_2) for both the Project only and total concentration (Project plus background) and compared them to the NAAQS and CAAQS. Background concentrations measured at ambient monitors already show values of PM10 and PM2.5 over the standards.

For the Project alone, only the Dams and Reservoir Project component for Alternatives 1, 2, and 3 show modeled concentrations in excess of the NAAQS. The CAAQS are exceeded by the Project at two of the 11 Project component locations (Huffmaster/South and Huffmaster and Dams and Reservoirs) for Alternatives 1, 2, and 3. The exceedances from construction activities along South Road and Huffmaster Road is the only location to exceed the CAAQS at nearby sensitive receptors. All other exceedances occur along the ambient air boundary bordering the construction areas.

20C.6 Uncertainties

The following discussion summarizes the main uncertainties associated with the air dispersion modeling and risk estimation components of the AAQA and HRA.

20C.6.1. Emission Estimates

Uncertainties exist in estimating emissions from construction equipment. Since the maximum daily or maximum annual emissions at a given Project site are modeled concurrently with the maximum emissions for the other sites, emission estimates are likely conservative. Furthermore, the equipment estimated for use during construction is estimated to operate more hours than it will actually occur.

20C.6.2. Air Dispersion Modeling

In addition to the uncertainty associated with emission estimates, uncertainty exists regarding the pollutant concentrations estimated by the air dispersion model. The limitations of the air dispersion model provide a source of uncertainty in the estimation of exposure concentrations. According to USEPA Appendix W, errors attributable to the limitation of the algorithms implemented in the air dispersion model in the highest estimated concentrations of +/- 10% to 40% are typical. The AAQA and HRA methodologies use conservative assumptions and techniques to produce conservative results; thus, predicted exposure concentrations are likely to be at or above actual exposure concentrations.

The source parameters used to model emission sources add uncertainty. For all emission sources, source parameters are used that are either recommended as defaults or expected to produce more conservative (worst-case) results. Discrepancies might exist between the actual emissions characteristics of a source and its representation in the model; exposure concentrations used in this assessment represent approximate exposure concentrations.

20C.6.3. Ambient Air Quality and Health Risk Analysis

Numerous assumptions must be made to estimate human exposure to pollutants. These assumptions include parameters such as breathing rates, exposure time and frequency, exposure duration, and human activity patterns. The NAAQS and CAAQS are standards designed to protect human health. While a mean value derived from scientifically defensible studies is the best estimate of central tendency, most exposure variables used in this AAQA and HRA are high-end estimates. For example, it is assumed that residential receptors would be exposed to Project emissions during the entire construction duration. This assumption is highly conservative because most residents do not remain in their homes for this period of time. The combination of several high-end estimates used as exposure parameters may substantially overestimate chemical intake. The excess lifetime cancer risks calculated in this assessment are therefore likely to be higher than may be required to be protective of public health. Generally, the concentrations and health risk decrease substantially as the distance between the source and receptor increases.

The OEHHA Cancer Potency Factor (CPF) for DPM is used to estimate cancer risks associated with exposure to DPM from the Project and off-site emissions. However, the CPF derived by OEHHA for DPM is highly uncertain in the estimation of both response and dose. In the past, because of inadequate animal test data and epidemiology data on diesel exhaust, the International Agency for Research on Cancer, a branch of the World Health Organization, had classified DPM as Probably Carcinogenic to Humans (Group 2); USEPA had also concluded that the existing data did not provide an adequate basis for quantitative risk assessment (U.S. Environmental Protection Agency 2012). However, based on two recent scientific studies (Attfield at al. 2012, Benbrahim-Tallaa et al. 2012) International Agency for Research on Cancer recently reclassified DPM as Carcinogenic to Humans (Group 1) (International Agency for Research on Cancer 2012), which means that the agency has determined that there is "sufficient evidence of carcinogenicity" of a substance in humans and represents the strongest weight-of-evidence rating in International Agency for Research on Cancer's carcinogen classification scheme. This determination by International Agency for Research on Cancer may provide additional impetus for the USEPA to identify a quantitative dose/response relationship between exposure to DPM and cancer.

OEHHA 2015 notes that the conservative assumptions used in a risk assessment are intended to avoid underestimation of actual risks posed by a site, and are designed to err on the side of health protection. The estimated risks in this HRA are based primarily on a series of conservative assumptions related to predicted environmental concentrations, exposure, and chemical toxicity. The use of conservative assumptions tends to produce upper-bound estimates of risk. Although it is difficult to quantify the uncertainties associated with all the assumptions made in this risk assessment, the use of conservative assumptions is likely to result in substantial overestimates of exposure and, hence, risk.

20C.7 References Cited

Applied Environmental Consultants. 2011. *Revised AERMOD Modeling Report to Assess Ambient Air Quality Impacts*. Accessed July 2021. https://www.rosemonteis.us/sites/default/files/technical-reports/jbr-revised-aermod-modeling-report-2011.pdf.

Attfield MD, Schleiff PL, Lubin JH, Blair A, Stewart PA, Vermeulen R, Coble JB, Silverman DT. 2012. The Diesel Exhaust in Miners Study: A Nested Case-Control Study of Lung Cancer and Diesel Exhaust. *J Natl Cancer Inst*.

Benbrahim-Tallaa, L., R. Baan, Y. Grosse, B. Lauby-Secretan, F. E. Ghissassi, V. Bouvard, N. Guha, D. Loomis, and K. Straif. 2012. *Carcinogenicity of Diesel-engine and Gasoline-engine Exhausts and Some Nitroarenes, Lancet Oncology*. July 2012.

California Air Pollution Control Officers Association. 2009. *Health Risk Assessments for Proposed Land Use Projects*. Available: http://www.capcoa.org/wp-content/uploads/2010/05/2010_CAPCOA_HRA_Land_Use_Workshop.pdf. Accessed: June 2021.

California Air Resources Board. 2021. Hotspots Analysis Reporting Program 2 Air Dispersion Modeling and Risk Tool (Version 21081). Accessed June 2021. https://ww3.arb.ca.gov/toxics/harp/harp.htm.

———. 2016. California Ambient Air Quality Standards (CAAQS). Accessed June 2021. https://ww2.arb.ca.gov/resources/california-ambient-air-quality-standards.

———. 2015. Meteorological data for AERMOD. Accessed June 2021. https://www.arb.ca.gov/toxics/harp/metfiles2.htm.

———. 2005. *Air Quality and Land Use Handbook: A Community Health Perspective*. Available: https://ww3.arb.ca.gov/ch/handbook.pdf. Accessed: October 2022.

California Department of Water Resources. 2021. California Irrigation Management Information System. Accessed June 2021. https://cimis.water.ca.gov/Stations.aspx.

Department of Ecology State of Washington. 2011. Technical Support Document for The Asphalt Plant (Portable and Stationary) General Order. Accessed July 2021. https://ecology.wa.gov/DOE/files/bd/bd447e53-476e-48e8-9e20-550ecbe54c6e.pdf.

ICF. 2021. Construction Modeling Output Files. July 2021.

International Agency for Research on Cancer. 2012 (June). Press Release No. 213. IARC: Diesel Engine Exhaust Carcinogenic.

Lakes Environmental. 2012. AERMOD MPI. Accessed June 2021. https://www.weblakes.com/products/aermod/resources/Lakes_AERMOD_MPI_Getting_Started_V.8.0.pdf.

Minnesota Pollution Control Agency. 2014. *Technical Guidance: Filling Missing Ozone Data for OLM and PVMRM Applications*. Available: https://www.pca.state.mn.us/sites/default/files/aq2-69.pdf. Accessed: June 2021.

National Weather Service. 2021. Sacramento Weather Forecast Office. NOWData. Available: https://www.weather.gov/wrh/climate?wfo=sto. Accessed: June 2021.

Office of Environmental Health Hazard Assessment. 2015 (February). *Air Toxics Hot Spots Program Guidance Manual*. Accessed June 2021. https://oehha.ca.gov/air/crnr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0.

Sacramento Metropolitan Air Quality Management District. 2020. Mobile Sources Air Toxics Protocol Guidance Document. 2020. V1.3. Accessed June 2021.

http://www.airquality.org/LandUseTransportation/Documents/FinalMSATProtocolGuidancev1.3Sept2020.pdf.

———. 2019. AERMOD Meteorological Data Files. Sacramento International Airport. Available: http://www.airquality.org/Residents/CEQA-Land-Use-Planning/CEQA-Guidance-Tools. Accessed: June 2021.

———. 2018. Board-Adopted Methodology (Technical Appendix) for the Mobile Sources Air Toxics Protocol. V1.1. Accessed June 2021. http://www.airquality.org/LandUseTransportation/Documents/V1.1MSATProtocolMethodologyAppendixJuly2018.pdf.

———. 2013. CEQA Guide. Dispersion Modeling of Construction-Generated PM10 Emissions. Revised July 2013. Accessed June 2021. http://airquality.org/LandUseTransportation/Documents/Ch3PMDispersionModelingGuidanceFINAL7-2013.pdf.

San Joaquin Valley Air Pollution Control District. 2014. Policy for District Rule 2201 AAQA Modeling. Accessed June 2021. http://www.valleyair.org/policies_per/Policies/APR-1925.pdf.

U.S. Environmental Protection Agency. 2022 (May). Air Quality Monitor Data. Accessed June 2021. https://www.epa.gov/outdoor-air-quality-data/interactive-map-air-quality-monitors.

———. 2021a. National Ambient Air Quality Standards (NAAQS) Table. Accessed June 2021. https://www.epa.gov/criteria-air-pollutants/NAAQS-table.

———. 2021b. AERMOD Modeling System. Accessed June 2021. https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models.

———. 2021c (April). AERMOD Implementation Guide. Accessed June 2021. https://gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/aermod_implementation_guide.pdf.

———. 2021d (May). Air Quality Design Values. Accessed June 2021. https://www.epa.gov/air-trends/air-quality-design-values.

———. 2020a. AERMOD Modeling System. Accessed June 2021. https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models#aermod

———. 2020b (February). User's Guide for AERSURFACE Tool. Accessed June 2021. https://gaftp.epa.gov/Air/aqmg/SCRAM/models/related/aersurface/aersurface_ug_v20060.pdf.

———. 2018a. *Alternative Model Techniques to Address Two Issues with Modeling Buoyant Line Sources in AERMOD*. Available:

https://cfpub.epa.gov/oarweb/MCHISRS/index.cfm?fuseaction=main.resultdetails&recnum=18-IV-01. Accessed: June 2021.

———. 2018b. Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program. Accessed. June 2021. https://www.epa.gov/sites/production/files/2018-04/documents/sils_guidance_2018.pdf.

———. 2017. Guideline on Air Quality Models (Revised). 40 Code of Federal Regulations, Part 51, Appendix W. Office of Air Quality Planning and Standards. January 2017. Accessed June 2021. https://www.epa.gov/scram/2017-appendix-w-final-rule.

———. 2015. Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with NO_2 National Ambient Air Quality Standard. Accessed July 2021. https://www.epa.gov/sites/production/files/2020-10/documents/no2_clarification_memo-20140930.pdf.

———. 2011. Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard. Accessed July 2021. https://www.epa.gov/sites/production/files/2020-10/documents/additional_clarifications_appendixw_hourly-no2-naaqs_final_03-01-2011.pdf.

———. 2010. *Applicability of Appendix W Modeling Guidance for the 1-hour NO2 National Ambient Air Quality Standard*. Available: https://www.epa.gov/sites/default/files/2020-10/documents/clarificationmemo_appendixw_hourly-no2-naaqs_final_06-28-2010.pdf. Accessed: June 2021.

U.S. Department of Agriculture. 2021. Pinto Valley Mine Final Environmental Impacts Statement. Accessed July 2021. http://www.pintovalleymineeis.us/documents.html.

U.S. Geological Society. 2021. Multi-Resolution Land Characteristics Consortium. Accessed June 2021. https://www.mrlc.gov/viewer/.

Zhu, Y., W. C. Hinds, S. Kim, and C. Sioutas. 2002. Study of Ultra-Fine Particles Near a Major Highway with Heavy-Duty Diesel Traffic. *Atmospheric Environment* 36:4323–4335. Available: https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NCER&dirEntryId=83813. Accessed: October 20, 2022.