Bay Delta Conservation Plan
Health Risk Assessment for Construction Emissions

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Acronyms and Abbreviations

AERMOD	American Meteorological Society/United States Environmental Protection Agency Regulatory Improvement Committee (AERMIC) Model
BAAQMD	Bay Area Air Quality Management District
BDCP	Bay Delta Conservation Plan
CARB	California Air Resources Board
CEQA	California Environmental Quality Act
CRAF	cancer risk adjustment factor
CVP	Central Valley Project
Delta	Sacramento-San Joaquin River Delta
DEM	digital elevation model
DPM	diesel particulate matter
ED	exposure duration
EIR	environmental impact report
EIS	environmental impact statement
EPA	United States Environmental Protection Agency
GIS	geographic information system
HI	hazard index
HQ	hazard quotient
HRA	health risk assessment
MEI	maximally exposed individual
met	meteorological
OEHHA	Office of Environmental Health Hazard Assessment
PM10	particulate matter 10 microns or less in diameter
PM2.5	particulate matter 2.5 microns or less in diameter
PTO	Pipeline/Tunnel Option
REL	reference exposure level
SCO	Separate Corridors Option
SJVAPCD	San Joaquin Valley Air Pollution Control District

SMAQMD	Sacramento Metropolitan Air Quality Management District
SR	State Route
SWP	State Water Project
TAC	toxic air contaminant
URS	URS Corporation Americas, Inc. (Acquired by AECOM)
USGS	United States Geological Service
YSAQMD	Yolo-Solano Air Quality Management District
$\mu g/m^3$	micrograms per cubic meter

Introduction
This health risk assessment (HRA) was developed in support of Chapter 22, Air Quality and Greenhouse Gases, of the Bay Delta Conservation Plan (BDCP) Environmental Impact Report/Environmental Impact Statement (EIR/EIS). This HRA evaluates the human health risks resulting from construction emissions produced by each of 15 water conveyance alternatives proposed in the BDCP.

Study Area
Figure 1 shows the HRA project study area, which is bounded by the Sacramento River Deep Water Ship Channel and Sacramento River to the west, by Interstate 5 to the east, by the town of Clarksburg to the north, and by the Banks and Jones pumping plants to the south.

BDCP Corridors and Alternatives

Corridors
Four water conveyance corridors have been identified within the study area. Shown in Figure 1, these corridors include the Pipeline/Tunnel Option (PTO), the East Option, the West Option, and the Separate Corridors Option (SCO).

Alternatives
Each corridor option includes one or more alternatives. Many of the alternatives within each corridor differ only in the number and location of intakes, which are located at the northern end of the study area. Table 1 shows the 15 conveyance alternatives sorted by EIR/EIS alternative number. Table 2 shows the same 15 conveyance alternatives sorted by conveyance corridor.

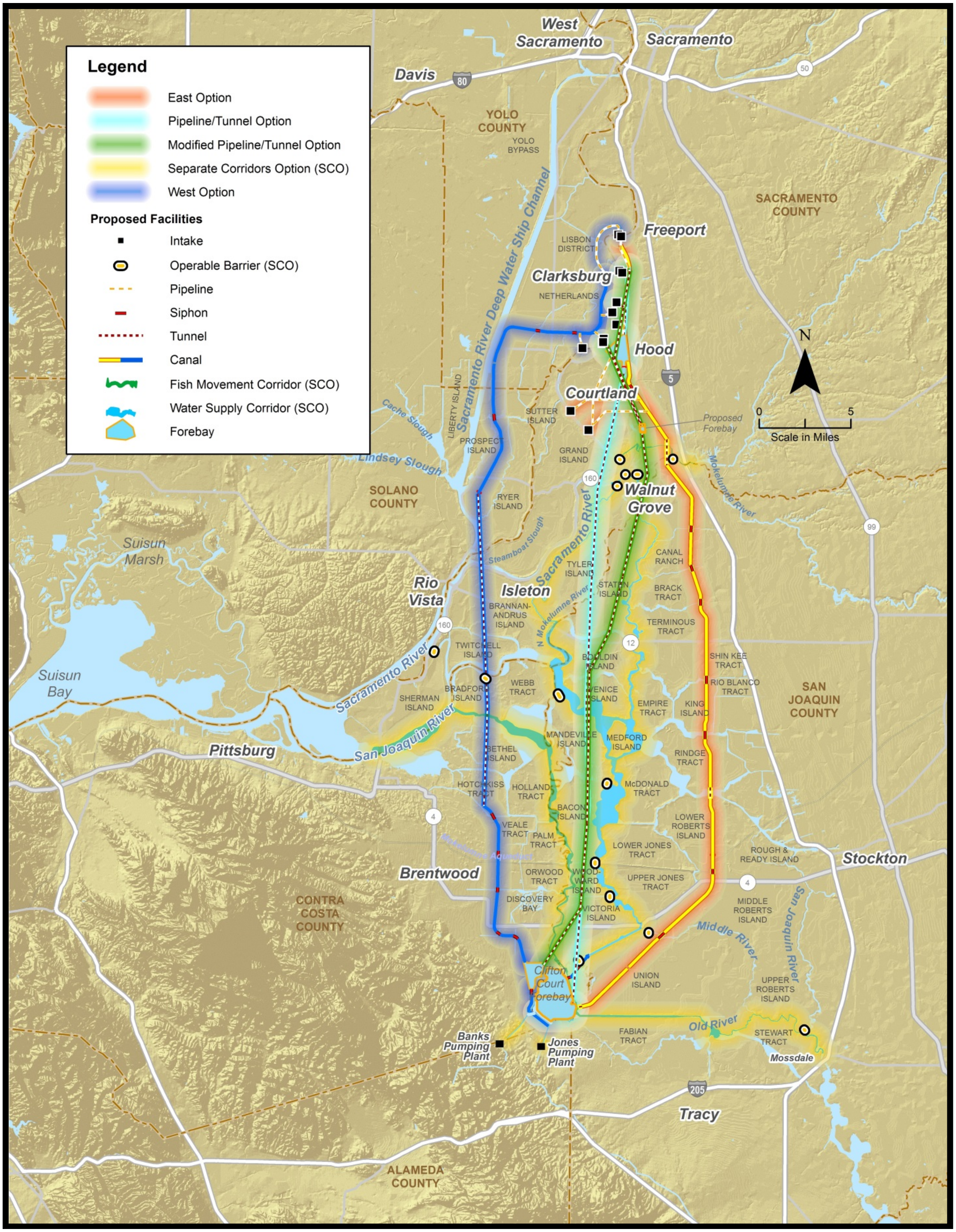

Figure 1. Project Study Area with Corridors

Table 1. Conveyance Alternatives by EIR/EIS Alternative Number

Alternative Number	Conveyance Corridor	Intake Number	North Delta Diversion Capacity (cfs)
1A	Pipeline/Tunnel	1,2,3,4,5	15,000
1B	East Option	1,2,3,4,5	15,000
1C	West Option	West side intakes (1,2,3,4,5)	15,000
2A	Pipeline/Tunnel	1,2,3,4,5 (or 1,2,3,6,7)	15,000
2B	East Option	1,2,3,4,5 (or 1,2,3,6,7)	15,000
2C	West Option	West side intakes (1,2,3,4,5)	15,000
3	Pipeline/Tunnel	1,2	6,000
4	Pipeline/Tunnel	2, 3, 5	9,000
5	Pipeline/Tunnel	1	3,000
6A	Pipeline/Tunnel	1,2,3,4,5	15,000
6B	East Option	1,2,3,4,5	15,000
6C	West Option	West side intakes (1,2,3,4,5)	15,000
7	Pipeline/Tunnel	2, 3, 5	9,000
8	Pipeline/Tunnel	2, 3, 5	9,000
9	Separate Corridors	No intakes, Diversions at Delta Cross Channel and Georgiana Slough	15,000

cfs = cubic feet per second
EIR = environmental impact report
EIS = environmental impact statement

Table 2. Conveyance Alternatives by Conveyance Corridor

Alternative Number	Conveyance Corridor	Intake Number	North Delta Diversion Capacity (cfs)
1A	Pipeline/Tunnel	1,2,3,4,5	15,000
2A	Pipeline/Tunnel	1,2,3,4,5 (or 1,2,3,6,7)	15,000
3	Pipeline/Tunnel	1,2	6,000
4	Pipeline/Tunnel	2, 3, 5	9,000
5	Pipeline/Tunnel	1	3,000
6A	Pipeline/Tunnel	1,2,3,4,5	15,000
7	Pipeline/Tunnel	2, 3, 5	9,000
8	Pipeline/Tunnel	2, 3, 5	9,000
1B	East Option	1,2,3,4,5	15,000
2B	East Option	1,2,3,4,5 (or 1,2,3,6,7)	15,000
6B	East Option	1,2,3,4,5	15,000
1C	West Option	West side intakes (1,2,3,4,5)	15,000
2C	West Option	West side intakes (1,2,3,4,5)	15,000
6C	West Option	West side intakes (1,2,3,4,5)	15,000
9	Separate Corridors	No intakes, Diversions at Delta Cross Channel and Georgiana Slough	15,000

cfs = cubic feet per second
EIR = environmental impact report
EIS = environmental impact statement

As listed in Tables 1 and 2, the alternatives differ in the number and location of intakes, the diversion capacity, and the conveyance corridor.

Intakes and Diversion Capacity

Except for Alternative 9 (SCO), all alternatives include from one to five intakes located at the northern end of the Sacramento-San Joaquin River Delta (Delta), as shown in Figure 2. The SCO option would not use intakes, but instead would use operable barriers to divert existing Delta flows toward the export facilities located at the southern end of the Delta.

Conveyance Corridor

The type of conveyance corridor has a direct relation to the amount of construction and resulting health risks. The PTO alternatives would transport water using two underground pipelines. Consequently, aboveground emissions associated with construction of the conveyance portion of this option would be limited primarily to underground emissions vented through tunnel air shafts and safe work areas. The East Option consists primarily of a canal that would convey water from the intakes south to the export facilities. The West Option would also consist primarily of canals to convey water, but would also include a tunnel for a portion of the route. The SCO would use existing channels to divert water from the Sacramento River through the Delta to the export facilities. The export facilities include the existing State Water Project (SWP) and federal Central Valley Project (CVP) pumping plants in the south Delta. These are shown in Figure 2 as the Banks Pumping Plant (SWP) and the Jones Pumping Plant (CVP).

Differences between Alternatives

As shown in Tables 1 and 2, there are eight PTO alternatives, three East Option alternatives, three West Option alternatives, and one SCO alternative. The primary construction-related differences between the alternatives within each corridor are the number and location of intakes. Consequently, the primary differences in the health risks within each corridor alternative are associated with these intakes.

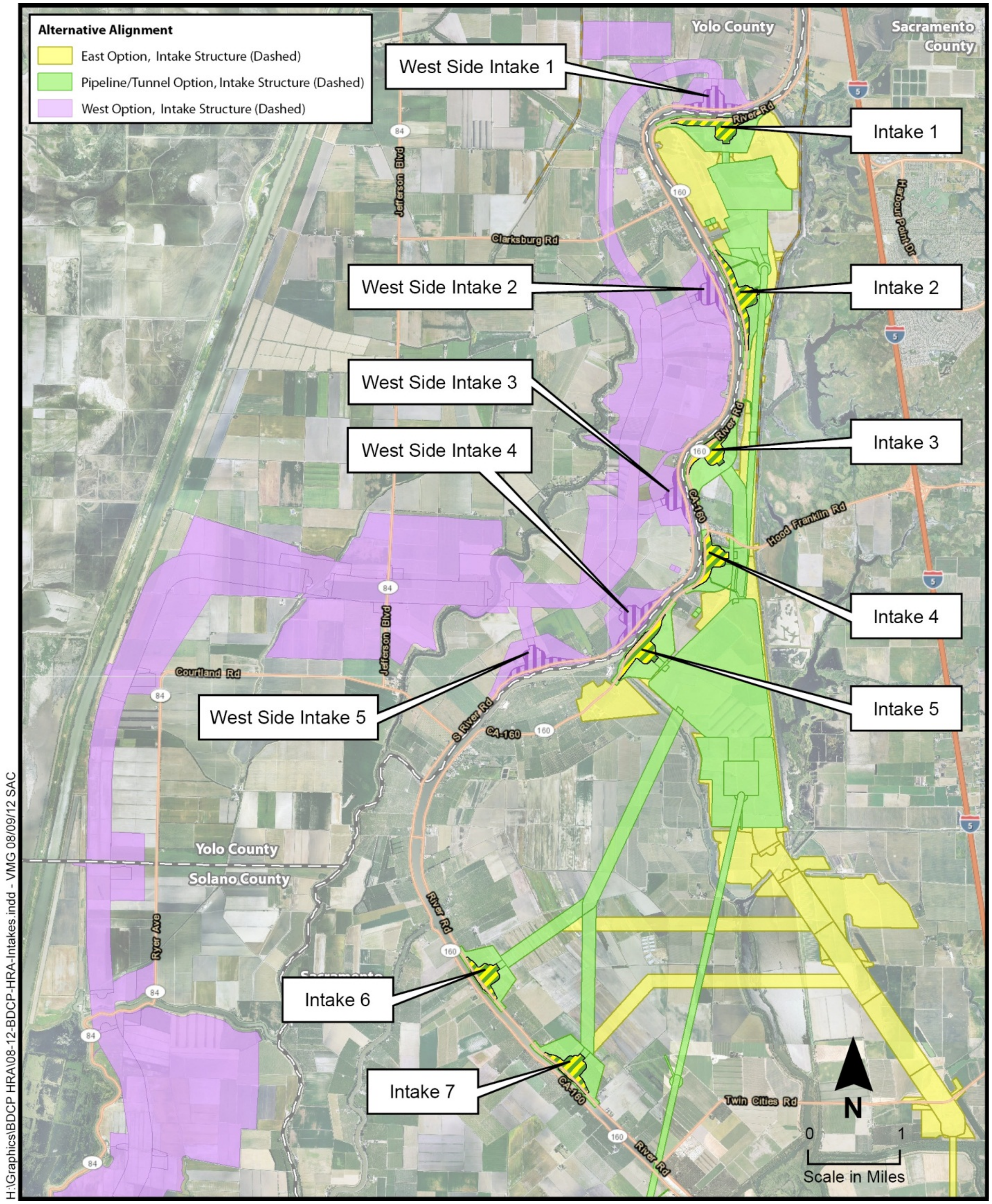

Figure 2. Intake Locations

Health Risk Assessment

This HRA evaluates potential human health risks from the emissions that would be produced by the construction of each alternative. The health risks are evaluated on a local scale at sensitive receptors located near each construction source.

The analysis of the proposed project's health risk impacts is consistent with the guidance and methodologies recommended by the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment's (OEHHA) Air Toxic Hot Spots Program Risk Assessment Guidelines (OEHHA, 2003; 2009; 2012). The OEHHA methodology used in this assessment uses a Dose-Response assessment to characterize risk from cancer due to inhaled diesel particulate matter (DPM) and the assessment of chronic non-cancer hazard from DPM. In addition, concentrations of PM10 and PM2.5 (particulate matter 10 and 2.5 microns or less in diameter) were assessed against significance thresholds established by air pollution control districts in which the proposed project would be located.

The evaluation of potential health risks used the standard four-step risk assessment process:

1) Hazard Identification
2) Exposure Assessment
3) Dose-Response Assessment
4) Risk Characterization

Each step is described in detail below.

Hazard Identification

This HRA evaluates the human health risks resulting from exposure to construction emission produced by each BDCP alternative. Construction activities generate toxic air contaminants (TACs) that include exhaust emissions from diesel and gasoline fuel combustion. In addition to TAC emissions, this analysis also evaluates PM10 and PM2.5 concentrations resulting from exhaust from both diesel and gasoline engine combustion and from fugitive dust generation.

Figure 1 shows the counties through which each corridor would run. The BDCP alternatives are located within three separate air basins that are under the jurisdiction of four air districts. Portions of the alternatives within Alameda County and Contra Costa County are within the San Francisco Bay Area Air Basin, and are under the jurisdiction of the Bay Area Air Quality Management District (BAAQMD). Portions of the BDCP alternatives within San Joaquin County are under the jurisdiction of the San Joaquin Valley Air Basin. Portions of the alternatives within Yolo County and Sacramento County are within the Sacramento Valley Air Basin. The Yolo-Solano Air Quality Management District (YSAQMD) has jurisdiction of projects within Yolo County and Solano County, while the Sacramento Metropolitan Air Quality Management District (SMAQMD) has jurisdiction of projects within Sacramento County.

An air quality modeling protocol was used to guide the HRA. To develop the protocol, a preliminary set of dispersion modeling and HRA questions was developed based on a review of existing HRA and modeling guidance issued by state and local agencies (BAAQMD, 2012; California Air Pollution Control Officers Association [CAPCOA], 2009; OEHHA, 2003; San

Joaquin Valley Air Pollution Control District [SJVAPCD], 2006; SJVAPCD, 2012; SMAQMD, 2009; SMAQMD, 2011; YSAQMD, 2007). Separate conference calls were held with each of the four air districts with jurisdiction over the project: BAAQMD; YSAQMD; SMAQMD; and the SJVAPCD.

During the conference calls with each air district, AECOM. posed several questions regarding the type of HRA preferred by the district, along with the pollutants of concern, and the best approaches and assumptions to be included in the modeling analysis and HRA (Jones, M., 2012; Huss, K. and R. Dubose, 2012; Martien, P., 2012; Martien, P. and V. Lau, 2012; Villalvazo, L., Siong, P., and D. Barber, 2012). Based on the air district responses, AECOM prepared a draft modeling protocol that described the assumptions to be incorporated into the HRA.

AECOM then distributed the draft modeling protocol to the four air districts for their respective reviews and comments. Based on the responses received, AECOM finalized the protocol. This final modeling protocol describes the assumptions to be used by AECOM in developing the HRA. The protocol is summarized as Appendix A of this report. The protocol includes a number of topics, described below, that cover assumptions associated with dispersion modeling and the HRA.

Emission Constituents of Concern

One issue addressed by the protocol is the air pollutant hazards of most concern. Based on discussions with the four air districts, the pollutants of most concern included DPM, PM10 and PM2.5. DPM was identified as the only TAC of significance from the proposed construction activities (Jones, M., 2012; Huss, K., and R. DuBose, 2012; Martien, P. 2012; Martien, P. and V. Lau; 2012; Villalvazo, L., Siong, P., and D. Barber, 2012). DPM toxicity far outweighs the risk associated with other TACs that would be produced during the construction phase of the project. Consequently, the HRA focuses on the health effects of DPM emissions. PM10 and PM2.5 concentrations produced from construction vehicle exhaust, concrete batch plant operations and soil disturbance during project construction are also analyzed to determine if the project would result in exceedances of significance thresholds established by the air districts.

Diesel Particulates

DPM historically has been used as a surrogate measure of exposure for whole diesel exhaust emissions. Diesel exhaust is a complex mixture of thousands of gases and fine particles (commonly known as soot). Diesel exhaust particles and gases are suspended in the air due to thermal buoyancy and the small size of the particles. The composition of diesel exhaust varies depending on engine type, operating conditions, fuel composition, lubricating oil, and presence of an emission control system. One of the main characteristics of diesel exhaust is the release of particles at a relative rate approximately 20 times greater than from gasoline-fueled vehicles, on an equivalent fuel basis. Diesel particulates are mainly aggregates of spherical carbon particles coated with inorganic and organic substances. The inorganic fraction primarily consists of small carbon (elemental carbon) particles ranging from 0.01 to 0.08 micron in diameter. The organic fraction consists of soluble organic compounds (soluble organic fraction) (California Air Resource Board [CARB] and OEHHA, 1998). OEHHA classifies DPM as a carcinogen.

DPM Inorganic Fraction

Association between particle size and health effects is of particular relevance to diesel particulates, most of which are smaller than 1 micron in diameter. Approximately 98 percent (by weight) of DPM are coarse particles (PM10), 94 percent are fine particles (PM2.5), and 92 percent are ultrafine particles (PM0.1). Because of their very small sizes, these particles can be inhaled into deep lung tissues and eventually trapped in the bronchial and alveolar regions of the lung (CARB and OEHHA, 1998).

DPM Organic Fraction

DPM has a large surface area that is attributed to the shape and quantity of particulates found in diesel exhaust, which makes DPM an excellent medium for absorbing organics. In 1998, OEHHA completed a comprehensive health assessment of diesel exhaust. The assessment concluded that diesel exhaust contains more than 40 toxic air contaminants (see Table 3). Based on the OEHHA study, in August 1998, CARB identified diesel exhaust as a TAC. In this OEHHA study, researchers identified a new class of potent mutagenic compounds in the organic extracts of DPM called nitrobenzanthrones. Mutagenic compounds cause genetic mutations and contribute to the cancer risk of DPM. The results showed that the mutagenicity of this new class of compounds, specifically 3-nitrobenzanthrone, compared similarly with that of 1,8-dinitropyrene, which is one of the strongest known direct-acting mutagens. Due to the similarities, this new class of compounds is also considered to be one of the strongest known mutagens. This compound and other TACs in DPM contributed to CARB's decision to identify DPM as a TAC. Studies have shown that, depending on the condition of the engine, emissions control equipment, and test cycle, the contribution of organics to the total diesel particulate matter mass could range from 10 to 90 percent, thereby increasing the mutagenic effects of diesel particulate matter (CARB and OEHHA, 1998).

Table 3. Substances in Diesel Exhaust Listed by the CARB as Toxic Air Contaminants

• Acetaldehyde • Acrolein • Aniline • Antimony compounds • Mercury compounds • Arsenic • Benzene • Beryllium compounds • Biphenyl • bis[2-ethylhexyl]phthalate • 1,3-butadiene • Cadmium • Chlorine • Chlorobenzene	• Chromium compounds • Cobalt compounds • Cresol isomers • Cyanide compounds • Dioxins and dibenzofurans • Dibutylphthalate • Ethyl benzene • Formaldehyde • Hexane • Inorganic lead • Manganese compounds • Methanol • Methyl ethyl ketone • Naphthalene	• Nickel • 4-nitrobiphenyl • Phenol • Phosphorus • Polycyclic organic matter, including polycyclic aromatic hydrocarbons and their derivatives • Propionaldehyde • Selenium compounds • Styrene • Toluene • Xylene isomers and mixtures • o-xylenes • m-xylenes • p-xylenes

Source: California Air Resource Board and Office of Environmental Health Hazard Assessment, 1998.

Fine and Coarse Particulate Matter

Fine and coarse particulate matter (PM2.5 and PM10, respectively) consists of finely divided solids or liquids such as soot, dust, aerosols, fumes, and mists. Fine particles are derived from a variety of sources, including windblown dust and construction activities. Fuel combustion and resultant exhaust from power plants and diesel buses and trucks are primarily responsible for fine particles (less than or equal to PM2.5). Fine particles can also be formed in the atmosphere through chemical reactions. Coarse particulate matter, particulate matter of 10 microns or smaller (PM10), pose a health concern because they can accumulate in the respiratory system and aggravate health problems, such as asthma. Particulates that are greater than 10 microns are removed from the human body through the mucocilliary system. The United States Environmental Protection Agency's (EPA's) scientific review concluded that PM2.5, which penetrates deeply into the lungs, is more likely than PM10 to contribute to health effects and at concentrations that extend well below those allowed by the current PM10 standards. These health effects include premature death and increased hospital admissions and emergency room visits (primarily the elderly and individuals with cardiopulmonary disease); increased respiratory symptoms and disease (children and individuals with cardiopulmonary disease, such as asthma); decreased lung functions (particularly in children and individuals with asthma); and alterations in lung tissue and structure and in respiratory tract defense mechanisms.

Exposure Assessment

The degree of public exposure to the pollutants of concern – DPM, PM10, and PM2.5 –was evaluated under the exposure assessment portion of the HRA. This portion of the analysis estimated the concentrations of DPM, PM10, and PM2.5 at sensitive receptors located near the BDCP construction areas. The analysis was conducted by estimating the emissions that would be generated by each alternative's construction areas, and estimating the resulting concentrations at sensitive receptors located near those areas.

Air dispersion models are often used to simulate atmospheric processes for situations where the spatial scale is in the tens of meters to tens of kilometers. Selection of air dispersion models depends on many factors, such as the characteristics of emission sources (point, area, volume, or line), the type of terrain (flat or complex) at the emission source locations, and source-receptor relationships. Air dispersion modeling was used to estimate DPM, PM10, and PM2.5 concentrations at sensitive receptors. The American Meteorological Society/EPA Regulatory Improvement Committee model (AERMOD) was used to conservatively estimate concentrations. The AERMOD model was used to conduct detailed modeling, as described below. The use of this model was agreed upon by the four governing air districts.

AERMOD is a steady-state[1], multiple-source, Gaussian dispersion model designed for use with emission sources situated in terrain where ground elevations can exceed the release heights of the emission sources (i.e., complex terrain). AERMOD has become a EPA regulatory dispersion model specified in the *EPA Guideline for Air Quality Methods* (Code of Federal Regulations, Title 40, Part 51, Appendix W) (EPA, 2005). AERMOD was used to evaluate the full length of each alternative.

The remaining portion of this section describes the assumptions used to conduct the AERMOD dispersion modeling analysis.

[1] Steady-state means that the model assumes no variability in meteorological parameters over a one-hour time period.

Emission Rates

The air pollutant dispersion modeling conducted as part of the exposure assessment includes project components that will be constructed throughout the entire construction time period and those that will involve a shortened construction duration. Emissions at the north and south ends of the PTO, East, and West corridor alternatives would include stationary construction activities that include intakes, forebays, and supporting activities that would be generally constructed for the entirety of the construction period. In addition, each of these corridors would include linear construction activities – canals and/or underground pipelines – allowing construction to move over time as construction occurs in a linear progression. The emissions produced from all project components along the entire extent of the BDCP were modeled to obtain the total cumulative exposure attributable to the proposed project.

Both daily and annual exposure durations for PM10 and PM2.5 concentrations were also modeled with AERMOD. Daily PM10 and PM2.5 concentrations were modeled for each project component based on the maximum yearly emissions estimated for the project's construction areas. Annual exposure of air pollutants were based on the average yearly emissions generated for each project component. Because both daily and annual air pollutant exposures had to be modeled, two sets of AERMOD modeling were conducted. The first set of AERMOD modeling addressed daily and annual exposure to PM10 and PM2.5 from diesel exhaust. The second set of AERMOD modeling involved assessing the daily and annual concentrations of PM10 and PM2.5 produced from fugitive dust.

The emissions used for the HRA were based on the emissions included in the air quality analysis. Emission sources included within the AERMOD modeling include off-road and on-road vehicles, as well as non-vehicular emission sources such as concrete batch plants and fugitive dust generated during grading/excavation activities. PM10 and PM2.5 emissions from exhaust and fugitive dust were included in the air dispersion modeling.

An emissions profile was developed for each alternative's construction components (e.g., intakes, forebay, bridges, screens, canals, tunnels, tunnel muck areas). Emissions for various sources were estimated to occur eight hours per day during work hours from Monday through Friday. The emission estimates included in the HRA modeling are consistent with the emission estimates for each alternative. Consequently, the HRA is based on emission estimates that account for the project's air quality-related environmental commitments. These environmental commitments are identified in the project's air quality study and include measures to reduce PM10 and PM2.5 exhaust and fugitive dust emissions.

This analysis characterizes health risks from PM10 diesel exhaust emissions (as a surrogate for DPM), as well as PM10 and PM2.5 concentrations from exhaust and fugitive dust emissions for evaluating against local PM thresholds. All dust and exhaust environmental commitments have been accounted for in the emission estimates.

Emissions at the north and south ends of the East, West, and PTO corridor alternatives would include stationary construction activities that involve intakes, forebays, and supporting activities. In addition, each of these corridors would include linear construction activities – canals, pipelines, and tunnels – for which construction would move over time.

Emissions from the various construction phases and components for each alignment were incorporated into the AERMOD model to estimate annual and maximum daily pollutant concentrations. To model annual average pollutant concentrations, the total emissions for each component were averaged over the duration of construction to obtain an average emission rate. To model maximum daily pollutant concentrations, the highest single year emissions for each component was used, and averaged over a single year to obtain a maximum case emission rate.

For area sources (construction area sources), a grams-per-second emission rate for each construction area, or source, divided by the area of the source, was calculated and inputted into AERMOD. For line sources (haul routes), a grams-per-second emission rate for each line source was calculated and inputted into AERMOD.

Emission Source Modeling

The emission rates described above are incorporated within the AERMOD model by assigning them to individual emission source areas. The location and size of the emission source areas are based on the proposed construction areas shown in the BDCP GIS database. The emission sources were modeled in three dimensions with each emission source having length, width, and elevation. Spatially modeling the emission sources is critical in air pollutant dispersion modeling because air pollutants disperse readily over distance to the analyzed receptor locations.

All proposed construction sources, with the exception of haul routes, were modeled as area sources. During consultations with the aforementioned air pollution control districts, the use of area sources to model the emission sources was determined to be an acceptable and conservative approach. Exhaust emissions from construction equipment were modeled using a release height of 5 meters with an initial vertical dispersion height of 1.4 meters, while fugitive dust emissions from construction areas were modeled using a surface release height and an initial vertical spread of 1 meter. The use of a 5-meter release height corresponds to a mid-range of expected plume rise from construction equipment during day-time atmospheric conditions. Dust emissions from concrete batch plant operations were modeled using a release height of 5 meters with no initial vertical dimension.

On-road DPM emissions were modeled as line sources near project features to account for the combined air pollutant concentrations from both of these sources. This modeling was achieved by individually modeling each of these on-road emissions in combination with the individual construction components. Haul routes within the vicinity of the proposed construction areas were included in the modeling as line sources. Exhaust emissions were modeled using a release height of 1.8 meters and no initial vertical dimension. Dust emissions were modeled using a ground level release height and an initial vertical dimension of 1 meter.

Meteorological Data

In order to run AERMOD, the following hourly surface meteorological data are required: wind speed, wind direction, ambient temperature, and opaque cloud cover. In addition, the daily upper air sounding data are required (EPA, 2004).

These meteorological variables are used to estimate air dispersion of pollutants in the atmosphere. Wind speed determines how rapidly pollutants are diluted and influences the rise of the emission plume in the air, thus affecting downwind pollutant concentrations. Wind direction determines where pollutants will be transported. The difference in ambient temperature and the emission releasing temperature from sources determines the initial buoyancy of emissions. In general, the greater the temperature difference, the higher the plume rise. The opaque cloud cover and upper air sounding data are used in calculations to determine other important dispersion parameters. These include atmospheric stability (a measure of turbulence and the rate at which pollutants disperse laterally and vertically) and mixing height (the vertical depth of the atmosphere within which dispersion occurs). The greater the mixing height is, the larger the volume of atmosphere is available to dilute the pollutant concentration (CARB, 2008).

Three different sets of meteorological data were used for the AERMOD modeling. These included meteorological data for the Sacramento Executive Airport in Sacramento, California, the Stockton Metropolitan Airport in Stockton, California, and the Contra Costa Power Plant in Antioch, California. The Sacramento Executive Airport data set included hourly data from 2001 through 2005 and was supplied by SMAQMD. The Stockton Metropolitan Airport meteorological data was provided by SJVAPCD and included hourly data from 2005 through 2009. The Contra Costa Power Plant meteorological data was provided by BAAQMD and included hourly data from 2007 through 2012.

The Sacramento meteorological data were used for modeling of receptors located within the jurisdictions of the YSAMQD and SMAQMD. The Stockton meteorological data was used for modeling for receptors located within the jurisdiction of the SJVAPCD. The Contra Costa meteorological data was used for receptors located within the jurisdiction of the BAAQMD (see Table 4).

Table 4. Meteorological Data Summary

Meteorological Data (Years)	Meteorological Data Collection Location	Use for Modeling Areas Located:
Sacramento (2001 – 2005)	Sacramento Executive Airport, Sacramento, CA	YSAQMD and SMAQMD
Stockton (2005 – 2009)	Stockton Metropolitan Airport, Stockton, CA	SJVAPCD
Contra Costa (2007 – 2012)	Contra Costa Power Plant Antioch, CA	BAAQMD

CA = California

Figures 3, 4, and 5 show wind rose for the Sacramento Executive Airport, Stockton Metropolitan Airport, and Contra Costa Power Plant met data, respectively. The Sacramento wind rose shows predominant winds from the southwest and south. Wind roses for both Stockton and Contra Costa show that winds from the west and northwest predominate.

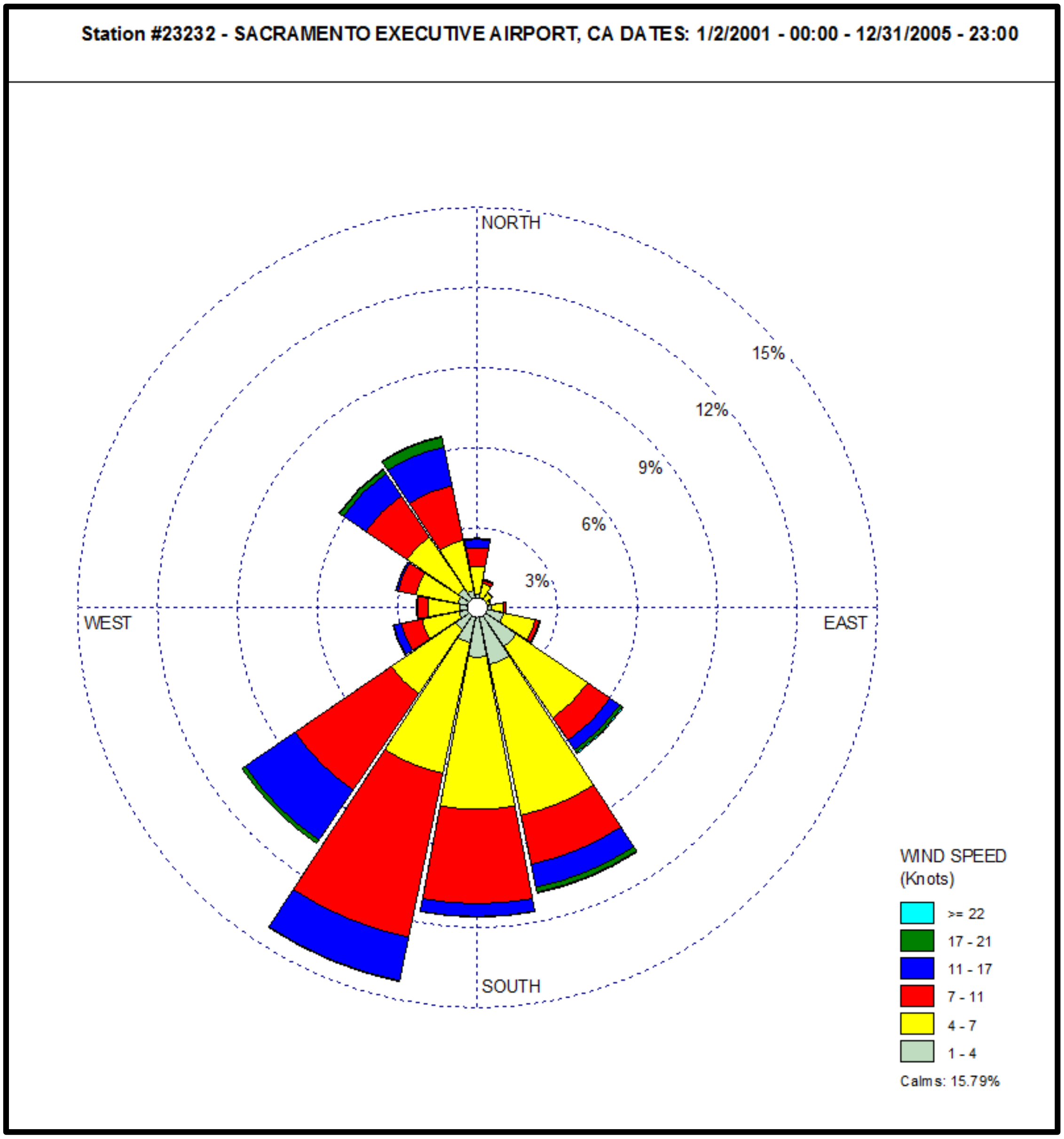

Figure 3. Wind Rose for Sacramento Executive Airport

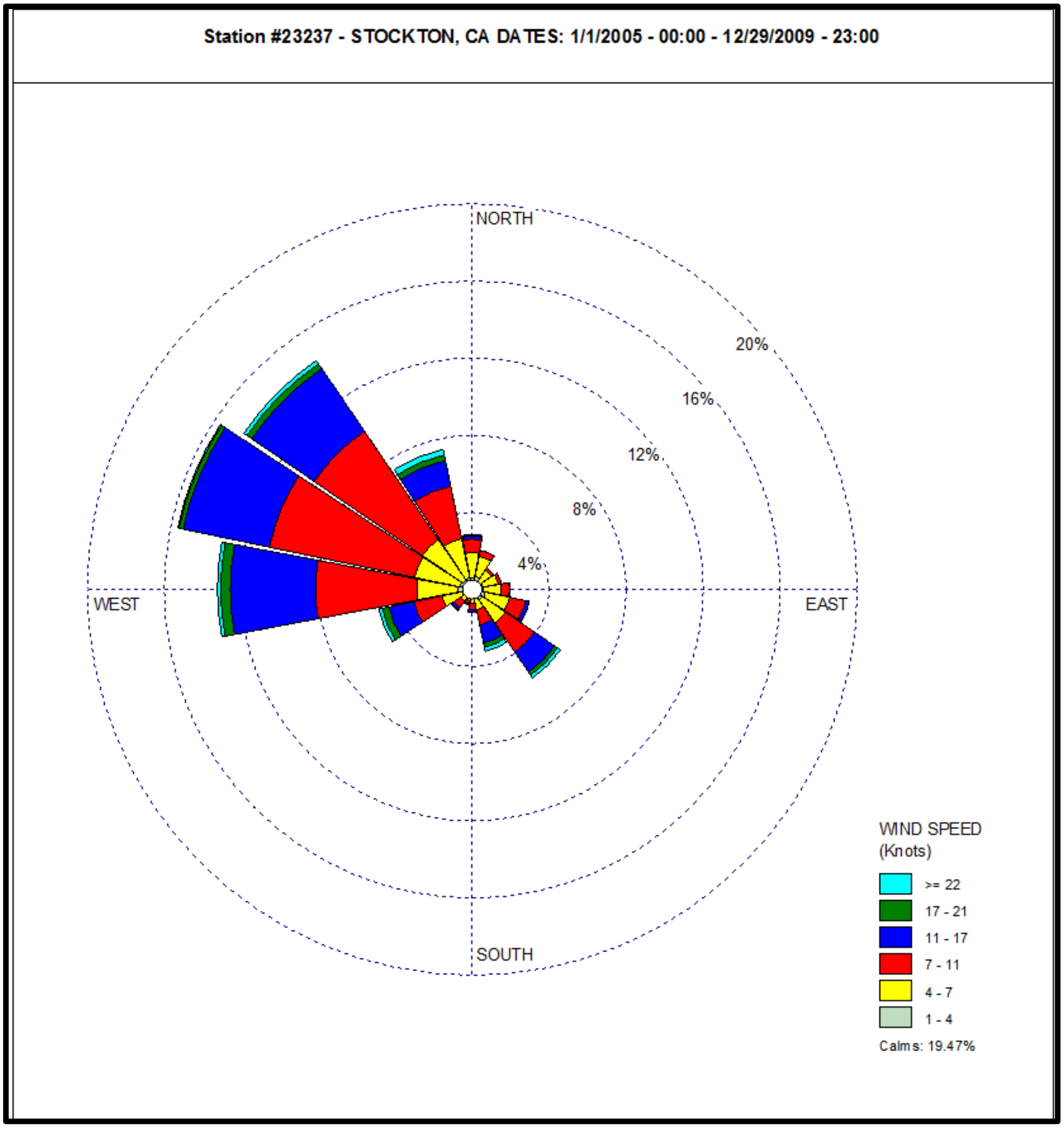

Figure 4. Wind Rose for Stockton Metropolitan Airport

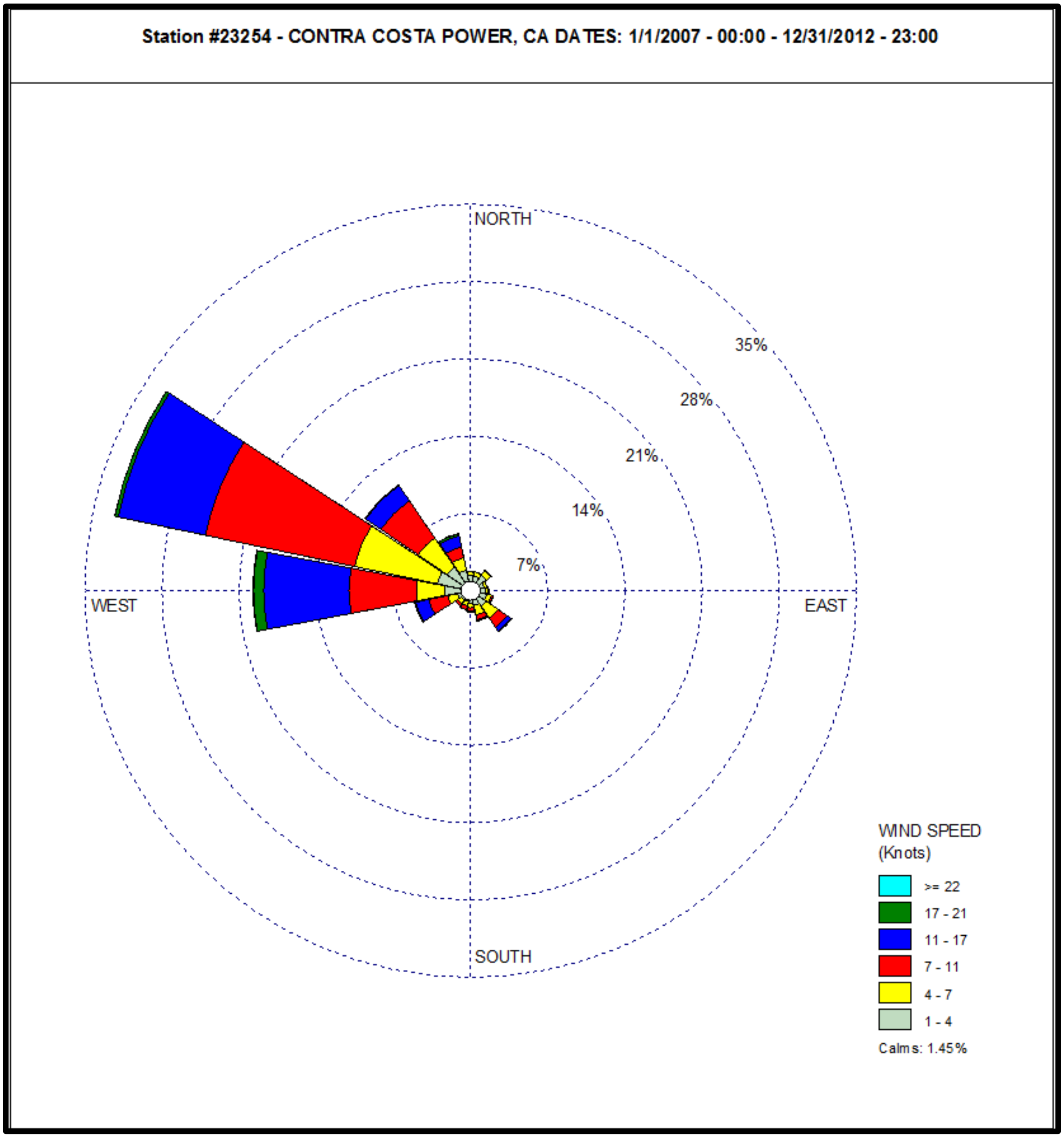

Figure 5. Wind Rose for Contra Costa Power Plant

Sensitive Receptors

AERMOD was used to estimate pollutant concentrations at sensitive receptors. Sensitive receptors include residences, schools, day care centers, parks, and medical facilities where the most susceptible individuals could be exposed to pollutant emissions generated by the construction of each BDCP alternative. The ultimate goal of the analysis was to find, for each alternative, the maximally exposed individual (MEI). The MEI refers to the sensitive receptor location that would be exposed to the highest pollutant concentrations and health risks from project construction.

For each alternative, the sensitive receptors evaluated using the AERMOD model was removed if located within an alternative's construction footprint. Modeled receptors were evaluated for their potential to exceed air district significance thresholds with receptor locations analyzed at a minimum of 3,000 feet from a project feature. Pollutant concentrations and health risks were estimated for each of these receptors.

Terrain Data

The United States Geological Service's (USGS's) 7.5-minute digital elevation model (DEM) files were imported into AERMOD. These files consist of terrain elevations for ground positions at regularly spaced horizontal intervals.

The 7.5-minute DEMs produced by USGS correspond in coverage to standard 1:24,000-scale 7.5- x 7.5-minute quadrangles and are based on 30-meter by 30-meter data spacing with the Universal Transverse Mercator projection.

Terrain elevations allow AERMOD to estimate concentrations at sensitive receptors located at or above the height of the emission source. This type of modeling scenario is known as complex terrain. For this analysis, AERMOD was run using the complex terrain assumption.

Other Modeling Parameters

Urban/Rural

The AERMOD model requires that the user specify whether a site should be modeled as either urban or rural. The urban option allows the user to incorporate the effects of increased surface heating from an urban area on pollutant dispersion under stable atmospheric conditions. This surface heating typically causes better dispersion, which results in lower pollutant concentrations. The classification of a site as urban or rural, and thus the selection of either urban or rural dispersion coefficients, is based upon either the land use procedure or population density procedure. Of the two methods, the land use procedure is considered a more definitive criterion and was used in this analysis.

The land use procedure requires that the following procedure be used:

- Circumscribe a 3 kilometer radius circle, A_o, about the source using the meteorological land use typing scheme -
  - If land use types I1 (Heavy Industrial), I2 (Light-moderate Industrial), C1 (Commercial), R2 (Compact single, some multi-family residential), and R3 (Compact Multi-Family Residential) account for 50 percent or more of A_o, select the Urban option,
  - Otherwise, use the Rural option.

Based on an evaluation of each alternative, all AERMOD modeling runs were conducted using the rural modeling option because more than 50 percent of the land uses surrounding each of the proposed corridor alternatives are rural, as defined by the standard land use classification system (Auer, Jr., A. H., 1977) referenced in the revisions to the guidelines on air quality models (EPA, 2005). This rural definition holds for the entire length of each corridor, including the northern end of the corridors containing the water intakes located near the towns of Clarksburg, Hood, and Courtland.

Dose Response Evaluation

This HRA considers the following three types of health hazards:

- Acute non-carcinogenic hazard (one-hour or other short-term averaging periods)
- Chronic non-carcinogenic hazard (averaging period equivalent to the exposure duration)
- Carcinogenic risk (70-year ["lifetime"] averaging period)

Acute Non-cancer Hazard

Toxicity from acute exposure to DPM has not been adequately characterized to allow evaluation in an HRA (OEHHA and CARB, 2012). Consequently, acute health risks were not evaluated in this HRA.

Chronic Non-cancer Hazard

DPM poses a potential chronic health risk, but this risk is limited to inhalation exposures and resultant effects on the respiratory system (OEHHA and CARB, 2012).

The potential for chronic non-cancer hazards is evaluated by comparing the long-term exposure level calculated by the AERMOD air pollutant dispersion modeling to a chronic reference exposure level (REL). A chronic REL is a concentration at or below which no adverse health effects are anticipated to occur under continuous exposure for up to a lifetime. RELs are designed to protect sensitive individuals within the population. Unlike cancer health effects, non-cancer health effects are generally assumed to have thresholds for adverse effects. In other words, injury from a pollutant will not occur until exposure to that pollutant has reached or exceeded a certain concentration (i.e., threshold).

Chronic non-cancer hazard quotients are calculated by dividing the exposure period's average concentration (as estimated using AERMOD) by the REL for that substance. The equation for estimating the dimensionless hazard quotient is:

$$\text{Chronic hazard quotient (HQ)} = \frac{C_i}{REL_i}$$

Where:

C_i = Concentration in the air of substance i (exposure period's average concentration in micrograms per cubic meter [$\mu g/m^3$])

REL_i = Chronic noncancer Reference Exposure Level for substance i ($\mu g/m^3$)

The hazard index (HI) is the sum of the individual HQs for TACs identified as affecting the same target organ or organ systems. In accordance with OEHHA's risk assessment guidelines, chronic non-cancer hazards should be assessed for inhalation and non-inhalation (e.g., ingestion and dermal contact) chronic exposures (OEHHA, 2003). However, for this HRA, DPM is the only substance of concern and DPM only affects the respiratory system.

Chronic hazard quotients exceeding 1 are considered significant. Exceeding either HQ or HI of 1 may indicate a potential for adverse chronic health impacts at this receptor location. Therefore, there is increased concern that exposed individuals may experience respiratory system irritation or injury, particularly among sensitive individuals.

For chronic health risks, the DPM chronic REL is 5 µg/m^3 (OEHHA and CARB, 2012). Consequently, any modeled DPM concentration exceeding 5 µg/m^3 would result in a chronic HQ exceeding 1, and would be considered a significant health hazard.

Cancer Risk

Cancer risk assessment involves estimating exposure to carcinogenic chemicals (for this HRA only DPM is evaluated), and multiplying the dose times the cancer potency factor. As agreed per agency consultation, a significant cancer risk is defined as a risk that exceeds 10 in one million.

DPM presents a cancer risk to the respiratory system (OEHHA and CARB, 2012). Consequently, the following procedure was used to assess inhalation cancer risk for BDCP construction activities.

1) DPM emissions were modeled using AERMOD to determine the average ground-level concentrations at each sensitive receptor location.

2) Ground level concentrations were converted to health risks using the following cancer risk equation (OEHHA, 2015):

RISKinh-res =		DOSEair x CPF x ASF x ED/AT x FAH
RISKinh-res	=	Residential inhalation cancer risk
DOSEair	=	Daily inhalation does
CPF	=	Inhalation cancer potency factor
ASF	=	Age sensitivity factor for a specified age group
ED	=	Exposure duration (in years) for a specified age group
AT	=	Averaging time for lifetime cancer risk
FAH	=	Fraction of time spent at home

For each receptor, the modeled concentration C_{air} was multiplied by the above inhalation factor and multiplied by one million to obtain the cancer risk in chances per million. The result was then adjusted by the number of years that construction would occur. For example, assuming that a construction project lasts 14 years, the ED factor would be reduced from 70 to 14 years, and the cancer risk would be reduced by a factor of 16/70.

However, for exposure periods that include pre-natal and young ages (up through age 15), an age sensitivity factor (ASF) is also used to adjust cancer risk. This ASF is based on OEHHA guidance (OEHHA, 2015). OEHHA recommends weighting cancer risk by a factor of 10 for exposures that occur from the third trimester of pregnancy through 2 years of age, and by a factor of 3 for exposures that occur from 2 years through 15 years of age. According to OEHHA, these weighting factors should be applied to all carcinogens to reflect increased susceptibility when exposure occurs at early stages of development.

In addition, a factor for the fraction of time at home (FAH) during the day was also used to adjust cancer risk. The FAH is based on OEHHA guidance (OEHHA 2012). OEHHA recommends using an FAH of 0.85 for exposures that occur from the third trimester of pregnancy through 2 years of age, and an FAH of 0.72 for exposures that occur from 2 years through 15 years of age.

Construction of the proposed BDCP alternatives would take up to 14 years to complete. Table 5 shows the adjusted inhalation dose factors for each construction year.

Table 5. Adjusted Inhalation Dose Factor for Each Construction Year

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Adjusted Inhalation Dose Factor	1.16 E-04	1.40 E-04	5.59 E-05	2.80 E-05	2.80 E-05	2.80 E-05	2.80 E-05	2.80 E-05	2.80 E-05	2.80 E-05	2.80 E-05	2.52 E-05	2.42 E-05	2.42 E-05

This approach was used to calculate cancer risk for all sensitive receptor types included in the dispersion modeling analysis. The adjusted inhalation dose factors shown in Table 5 were used for all sensitive receptors because residences, schools, and health care facilities all have the potential to house pregnant females and young children who could be exposed to DPM emissions from construction.

Respirable Particulate Matter

Particulate matter is strongly associated with mortality, respiratory diseases, and impairment of lung development in children, and other endpoints such as hospitalization for cardiopulmonary disease. Therefore, estimates of PM2.5 emissions from a new source can be used to approximate broader potential adverse health effects.

Significance Criteria

In summary, potential health risks and hazards from new sources on existing or proposed sensitive receptors are considered significant if they exceed either of the following MEI thresholds shown in Table 6.

Table 6. Air District Thresholds of Significance[a]

Analysis	YSAQMD	SMAQMD[a]	BAAQMD[b]	SJVAPCD
Localized PM2.5	Violation of NAAQS (24-hour: 35 µg/m³) or CAAQS (annual: 12 µg/m³), and failure to implement dust BMPs	Increase greater than 0.6 µg/m³ annual for combined exhaust and dust concentration, or failure to implement dust emission control practices	Increase greater than annual 0.3 µg/m³ for total concentration (combined exhaust and dust) and failure to implement fugitive dust	Increase greater than 2.08 µg/m³ annual average or greater than 10.4 µg/m³ 24-hour average for total concentration (combined exhaust and dust), and failure to implement BMPs
Localized PM10	Violation of CAAQS for total (exhaust and dust) emissions (24-hour: 50 µg/m³; annual: 20 µg/m³)	Increase greater than 1 µg/m³ annual or greater than 2.5 µg/m³ 24-hour average[a] for total (exhaust and dust), or failure to implement emissions control practices	BAAQMD has not established an incremental increase threshold for localized PM_{10} concentrations.	Increase greater than 2.08 µg/m³ annual average or greater than 10.4 µg/m³ 24-hour average for total concentration (combined exhaust and dust), and failure to implement BMPs
Localized DPM	Increased cancer risk of 10 in 1 million or increased non-cancer hazard of greater than 1.0 (HI)	Increased cancer risk of 10 in 1 million or increased non-cancer hazard of greater than 1.0 (HI)	Increased cancer risk of 10 in 1 million; increased non-cancer hazard of greater than 1.0 (HI)	Increased cancer risk of 10 in 1 million or increased non-cancer hazard of greater than 1.0 (HI)

Sources: Yolo-Solano Air Quality Management District 2015; Sacramento Metropolitan Air Quality Management District 2014; Bay Area Air Quality Management District 2015; San Joaquin Valley Air Pollution Control District 2015; Siong pers. comm. 2011; Villalvazo pers. comm.

[a] Per the SMAQMD's CEQA guidelines (2014), a "project is considered significant if emissions exceed a CAAQS or contribute substantially to an existing or projected violation of a CAAQS. A substantial contribution is considered an emission that is equal to or greater than 5% of a CAAQS." Since PM10 background concentrations in the Plan Area currently exceed the CAAQS, it is necessary to evaluate if the project will contribute to existing violations of the CAAQS and result in an incremental increase of more than 5% of the PM10 CAAQS. This equates to an increase greater than 2.5 µg/m³ for the 24-hour state PM10 standard and 1 µg/m³ for the annual state PM10 standard.

[b] Note that a quantitative cumulative analysis was not conducted due to the rural nature of the project area (additional major sources are not anticipated in the vicinity of the project area). Consequently, the BAAQMD's quantitative cumulative thresholds of an increase greater than 0.8 µg/m³, increased cancer risk of 100 in 1 million, and increased non-cancer hazard of greater than 10 (HI) were not evaluated. However, cumulative health risks are considered in relation to ongoing and reasonably foreseeable future projects in the air basin. Please refer to Section 22.3.3.17.

Risk Characterization

The following sub-sections present the highest chronic and carcinogenic health risk results, by corridor and regulatory jurisdictional area.

Pipeline Tunnel Option (PTO) Corridor

The PTO corridor includes eight alternatives. From a construction standpoint, the primary difference among these alternatives is the number and location of the intakes, all of which are at the north end of the corridor (see Figure 2). The eight PTO alternatives include either one (Alternative 5), two (Alternative 3), three (Alternatives 4, 7, or 8), or five (1A, 2A, or 6A) intakes located at up to seven intake locations.

PTO - Alternative 1A, 2A, 3, 5, 6A, 7, and 8 Results

Chronic and Carcinogenic Health Risk Results

Yolo-Solano Air Quality Management District

Table 7 shows the 10 receptors with the highest chronic health risks for Alternatives 1A, 2A, 3, 5, 6A, 7, and 8 within YSAQMD. As Table 7 shows, none of the sensitive receptors would have a chronic HQ exceeding 1 (annual concentration divided by 5). Consequently, Alternatives 1A, 2A, 3, 5, 6A, 7, and 8 would not result in a chronic health risk to sensitive receptors.

Table 7. Alternative 1A, 2A, 3, 5, 6A, 7, and 8 Chronic and Carcinogenic Health Risk Results in YSAQMD

x	y	Chronic Hazard Quotient	Cancer Risks per Million
629514	4255184	0.002	5
629616	4255200	0.002	5
629419	4255213	0.001	4
629352	4255216	0.001	4
629281	4255212	0.001	4
629049	4255184	0.001	4
629569	4255241	0.001	4
629623	4255251	0.001	4
629886	4255284	0.001	4
629117	4255216	0.001	3

x, y = Universal Transverse Mercator coordinates

Table 7 also shows the carcinogenic health risk results for Alternatives 1A, 2A, 3, 5, 6A, 7, and 8. Of the 10 sensitive receptors with the highest cancer risk per million in YSAQMD, none show risks exceeding the 10 in one million threshold.

Sacramento Metropolitan Air Quality Management District

Table 8 shows the 10 receptors with the highest chronic health risks for Alternatives 1A, 2A, 3, 5, 6A, 7, and 8 within SMAQMD. As Table 8 shows, none of the sensitive receptors within SMAQMD would have a chronic non-cancer HQ exceeding 1. Consequently, Alternative 1A would not pose chronic non-cancer health hazards to sensitive receptors.

Table 8. Alternative 1A, 2A, 3, 5, 6A, 7, and 8 Chronic and Carcinogenic Health Risk Results in SMAQMD

x	y	Chronic Hazard Quotient	Cancer Risk per Million
629863	4249763	0.003	9
629430	4247578	0.003	9
630027	4250894	0.003	8
629447	4247594	0.002	7
630081	4255051	0.002	7
629387	4247730	0.002	7
629759	4247636	0.002	7
629507	4247556	0.002	7
629362	4247761	0.002	6
629433	4247663	0.002	6

x, y = Universal Transverse Mercator coordinates

Table 8 also shows the carcinogenic risk results for Alternatives 1A, 2A, 3, 5, 6A, 7, and 8 sensitive receptors within SMAQMD. Of the 10 sensitive receptors with the highest cancer risk per million in SMAQMD, none show risks exceeding the 10 in one million threshold.

San Joaquin Valley Air Pollution Control District

Table 9 shows the 10 receptors with the highest chronic health risks for Alternatives 1A, 2A, 3, 5, 6A, 7, and 8 within SJVAPCD. As Table 9 shows, none of the sensitive receptors would have a chronic non-cancer HQ exceeding 1. Consequently, Alternatives 1A, 2A, 3, 5, 6A, 7, and 8 would not pose chronic non-cancer health hazards to sensitive receptors within SJVAPCD.

Table 9. Alternative 1A, 2A, 3, 5, 6A, 7, and 8 Chronic and Carcinogenic Health Risk Results in SJVAPCD

x	y	Chronic Hazard Quotient	Cancer Risk per Million
627703	4219724	0.001	3
627714	4219684	0.001	3
627110	4186404	0.001	3
627603	4194572	0.001	2
627726	4219711	0.001	2
627233	4186358	0.001	2
627228	4186343	0.001	2
627175	4186316	0.001	2
627260	4186346	0.001	2
627206	4186307	0.001	2

x, y = universal transverse Mercator coordinates

Table 9 also shows the carcinogenic health risk results for Alternatives 1A, 2A, 3, 5, 6A, 7, and 8. Of the 10 sensitive receptors with the highest cancer risk in SJVAPCD, none show risks exceeding the 10 in one million threshold.

Bay Area Air Quality Management District

Table 10 shows the chronic health risk results for the 10 receptors with the highest cancer and chronic hazard exposures for Alternatives 1A, 2A, 3, 5, 6A, 7, and 8 within BAAQMD. As Table 10 shows, none of the six sensitive receptors would have a chronic non-cancer HQ exceeding 1. Consequently, Alternatives 1A, 2A, 3, 5, 6A, 7, and 8 would not pose chronic non-cancer health hazards to sensitive receptors within BAAQMD.

Table 10. Alternative 1A, 2A, 3, 5, 6A, 7, and 8 Chronic and Carcinogenic Health Risk Results in BAAQMD

x	u	Chronic Hazard Quotient	Cancer Risk per Million
624924	4185992	0.004	13.16
624946	4186023	0.004	12.79
626972	4186446	0.004	11.11
626993	4186446	0.004	10.88
626961	4186410	0.003	10.47
627002	4186425	0.003	10.37
626819	4186350	0.003	10.04
626675	4186290	0.003	10.03
626937	4186383	0.003	9.98
627013	4186407	0.003	9.83

x, y = universal transverse Mercator coordinates

Table 10 also shows the carcinogenic health risk results for Alternatives 1A, 2A, 3, 5, 6A, 7, and 8. Of the 10 sensitive receptors with highest cancer health risk in BAAQMD, 8 receptors show risks exceeding the 10 in one million threshold.

Fine Particulate Matter Less than 2.5 Microns (PM2.5) Results

Yolo-Solano Air Quality Management District

Table 11 shows the 10 highest 24-hour and annual concentrations of PM2.5 at sensitive receptors within YSAQMD's jurisdiction for Alternatives 1A, 2A, 3, 5, 6A, 7, and 8. All annual concentrations are less than YSAQMD's threshold of 12 µg/m^3 and all 24-hour concentrations are less than the 35 µg/m^3 threshold.

Table 11. Alternative 1A, 2A, 3, 5, 6A, 7, and 8 PM2.5 Concentration Results in YSAQMD

Annual (µg/m^3)			24-hour (µg/m^3)		
x	y	Concentration	x	y	Concentration
629514	4255184	0.04	628884	4248408	1.1
629616	4255200	0.04	628921	4248314	1.1
629419	4255213	0.03	628823	4248400	1.0
629352	4255216	0.03	628859	4248313	1.0
629281	4255212	0.03	629514	4255184	1.0
629569	4255241	0.03	629616	4255200	0.9
629049	4255184	0.03	629038	4247879	0.9
629623	4255251	0.03	629419	4255213	0.9
629886	4255284	0.03	629352	4255216	0.9
629217	4255230	0.03	628829	4248927	0.9

x, y = universal transverse Mercator coordinates
µg/m^3 = micrograms per cubic meter

Sacramento Metropolitan Air Quality Management District

Table 12 shows the 10 highest 24-hour and annual concentrations of PM2.5 at sensitive receptors within SMAQMD for Alternatives 1A, 2A, 3, 5, 6A, 7, and 8. All annual concentrations are less than SMAQMD's threshold of 0.6 µg/m^3. The SMAQMD has not established a 24-hour PM2.5 significance threshold.

Table 12. Alternative 1A, 2A, 3, 5, 6A, 7, and 8 PM2.5 Concentration Results in SMAQMD

Annual (µg/m^3)			24-hour (µg/m^3)		
x	y	Concentration	x	y	Concentration
629863	4249763	0.09	629681	4251776	1.7
629430	4247578	0.08	629863	4249763	1.6
630027	4250894	0.07	629848	4251234	1.5
629387	4247730	0.06	629188	4248305	1.4
630081	4255051	0.06	629676	4240293	1.4
629447	4247594	0.06	629624	4240067	1.3
629759	4247636	0.06	629387	4247730	1.3
629362	4247761	0.06	629865	4241011	1.3
629507	4247556	0.05	629430	4247578	1.3
629433	4247663	0.05	629635	4242120	1.3

x, y = universal transverse Mercator coordinates
µg/m^3 = micrograms per cubic meter

San Joaquin Valley Air Pollution Control District

Table 13 shows the 10 highest 24-hour and annual concentrations of PM2.5 at sensitive receptors within SJVAPCD for Alternatives 1A, 2A, 3, 5, 6A, 7, and 8. All annual concentrations are less than SJVAPCD's threshold of 2.08 μg/m^3 and all 24-hour concentrations are less than SJVAPCD's threshold of 10.4 μg/m^3.

Table 13. Alternative 1A, 2A, 3, 5, 6A, 7, and 8 PM2.5 Concentration Results in SJVAPCD

Annual (μg/m^3)			24-hour (μg/m^3)		
x	y	Concentration	x	y	Concentration
627703	4219724	0.02	628183	4205959	2.9
627714	4219684	0.02	628502	4203393	1.4
628183	4205959	0.02	627298	4208029	1.1
627726	4219711	0.02	627110	4186404	0.9
627603	4194572	0.01	627703	4219724	0.8
627110	4186404	0.01	628171	4207743	0.8
627233	4186358	0.01	627175	4186316	0.7
627228	4186343	0.01	627714	4219684	0.7
627175	4186316	0.01	627233	4186358	0.7
627260	4186346	0.01	627228	4186343	0.7

x, y = universal transverse Mercator coordinates
μg/m^3 = micrograms per cubic meter

Bay Area Air Quality Management District

Table 14 shows the highest 24-hour and annual concentrations of PM2.5 for the 10 receptors with the highest exposure to PM2.5 for Alternatives 1A, 2A, 3, 5, 6A, 7, within BAAQMD. All annual concentrations are less than BAAQMD's threshold of 0.3 μg/m^3. The BAAQMD has not established a 24-hour PM2.5 significance threshold.

Table 14. Alternative 1A, 2A, 3, 5, 6A, 7, and 8 PM2.5 Concentration Results in BAAQMD

Annual (μg/m^3)			24-hour (μg/m^3)		
x	y	Concentration	x	y	Concentration
624946	4186023	0.07	626972	4186446	6.1
624924	4185992	0.07	626993	4186446	6.1
626972	4186446	0.05	627002	4186425	5.9
626993	4186446	0.05	626961	4186410	5.7
626961	4186410	0.05	627013	4186407	5.5
627002	4186425	0.05	626937	4186383	5.3
626937	4186383	0.05	626986	4186384	5.2
626819	4186350	0.05	626970	4186376	5.2
627013	4186407	0.05	626675	4186290	5.2
626675	4186290	0.05	626925	4186370	5.1

x, y = universal transverse Mercator coordinates
μg/m^3 = micrograms per cubic meter

Respirable Particulate Matter Less than 10 Microns (PM10) Results

Yolo-Solano Air Quality Management District

Table 15 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within YSAQMD's jurisdiction for Alternatives 1A, 2A, 3, 5, 6A, 7, and 8. All annual concentrations are less than YSAQMD's threshold of 20 µg/m^3 and all 24-hour concentrations are less than the 50 µg/m^3 threshold.

Table 15. Alternative 1A, 2A, 3, 5, 6A, 7, and 8 PM10 Concentration Results in YSAQMD

Annual (µg/m^3)			24-hour (µg/m^3)		
x	**y**	**Concentration**	**x**	**y**	**Concentration**
629514	4255184	0.3	628884	4248408	7
629616	4255200	0.2	628921	4248314	7
629419	4255213	0.2	628823	4248400	6
629352	4255216	0.2	628859	4248313	6
629281	4255212	0.2	629514	4255184	6
629569	4255241	0.2	629616	4255200	6
629049	4255184	0.2	629419	4255213	6
629623	4255251	0.2	629038	4247879	6
629886	4255284	0.2	629352	4255216	6
629217	4255230	0.2	629281	4255212	6

x, y = universal transverse Mercator coordinates
µg/m^3 = micrograms per cubic meter

Sacramento Metropolitan Air Quality Management District

Table 16 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within SMAQMD for Alternatives 1A, 2A, 3, 5, 6A, 7, and 8. All annual concentrations are less than SMAQMD's threshold of 0.6 µg/m^3. The results show that there may be exceedances of SMAQMD's 24-hour threshold of 2.5 µg/m^3 at 225 receptor locations.

Table 16. Alternative 1A, 2A, 3, 5, 6A, 7, and 8 PM10 Concentration Results in SMAQMD

Annual (µg/m^3)			24-hour (µg/m^3)		
x	**y**	**Concentration**	**x**	**y**	**Concentration**
629863	4249763	0.5	629681	4251776	11
629430	4247578	0.5	629863	4249763	10
630027	4250894	0.4	629848	4251234	9
630081	4255051	0.4	629676	4240293	9
629447	4247594	0.4	629188	4248305	8
629387	4247730	0.4	629624	4240067	8
629759	4247636	0.4	629865	4241011	8
629507	4247556	0.3	629635	4242120	8
629362	4247761	0.3	629747	4239326	8
629433	4247663	0.3	629430	4247578	8

x, y = universal transverse Mercator coordinates
µg/m^3 = micrograms per cubic meter

San Joaquin Valley Air Pollution Control District

Table 17 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within SJVAPCD for Alternatives 1A, 2A, 3, 5, 6A, 7, and 8. All annual concentrations are less than SJVAPCD's threshold of 2.08 $\mu g/m^3$, and 24-hour concentrations would exceed SJVAPCD's threshold of 10.4 $\mu g/m^3$ at four receptor locations.

Table 17. Alternative 1A, 2A, 3, 5, 6A, 7, and 8 PM10 Concentration Results in SJVAPCD

Annual ($\mu g/m^3$)			24-hour ($\mu g/m^3$)		
x	y	Concentration	x	y	Concentration
627703	4219724	0.1	628183	4205959	37.1
627714	4219684	0.1	628502	4203393	17.9
628183	4205959	0.1	627298	4208029	14.3
627726	4219711	0.1	627703	4219724	10.4
627603	4194572	0.1	628171	4207743	10.2
627110	4186404	0.1	628514	4207688	9.1
627233	4186358	0.0	627714	4219684	8.8
627228	4186343	0.0	628676	4200962	8.8
627175	4186316	0.0	628689	4200931	8.6
627260	4186346	0.0	627110	4186404	8.6

x, y = universal transverse Mercator coordinates
$\mu g/m^3$ = micrograms per cubic meter

Bay Area Air Quality Management District

Table 18 shows the 10 highest 24-hour and annual concentrations of PM10 for the six receptors for Alternatives 1A, 2A, 3, 5, 6A, 7, and 8 within BAAQMD. BAAQMD has not developed thresholds for annual or 24-hour PM10 concentrations.

Table 18. Alternative 1A, 2A, 3, 5, 6A, 7, and 8 PM10 Concentration Results in BAAQMD

Annual ($\mu g/m^3$)			24-hour ($\mu g/m^3$)		
x	y	Concentration	x	y	Concentration
624946	4186023	0.3	626972	4186446	31
624924	4185992	0.3	626993	4186446	30
626972	4186446	0.3	627002	4186425	29
626993	4186446	0.3	626961	4186410	28
626961	4186410	0.2	627013	4186407	27
627002	4186425	0.2	626937	4186383	25
626937	4186383	0.2	626986	4186384	25
627013	4186407	0.2	626675	4186290	25
626819	4186350	0.2	626970	4186376	25
626675	4186290	0.2	624924	4185992	25

x, y = universal transverse Mercator coordinates
$\mu g/m^3$ = micrograms per cubic meter

PTO - Alternative 4 Results

Chronic and Carcinogenic Health Risk Results

Yolo-Solano Air Quality Management District

Table 19 shows the 10 receptors with the highest chronic health risks for Alternative 4 within YSAQMD. As Table 19 shows, none of the sensitive receptors would have a chronic HQ exceeding 1. Consequently, Alternative 4 would not result in a chronic health risk to sensitive receptors.

Table 19. Alternative 4 Chronic and Carcinogenic Health Risk Results in YSAQMD

x	Y	Chronic Hazard Quotient	Cancer Risks per Million
629061	4249357	0.0004	1
629071	4249386	0.0003	1
629031	4249336	0.0003	1
628150	4246056	0.0003	1
629001	4249318	0.0003	1
628862	4249014	0.0003	1
628568	4246553	0.0002	1
628829	4248927	0.0002	1
627888	4245752	0.0002	1
628816	4248877	0.0002	1

x, y = universal transverse Mercator coordinates

Table 19 also shows the carcinogenic health risk results for Alternatives 4. Of the 10 sensitive receptors with the highest cancer risk per million in YSAQMD, none show risks exceeding the 10 in one million threshold.

Sacramento Metropolitan Air Quality Management District

Table 20 shows the 10 receptors with the highest chronic health risks for Alternative 4 within SMAQMD. As Table 20 shows, none of the sensitive receptors within SMAQMD would have a chronic HQ exceeding 1. Consequently, Alternative 4 would not result in a chronic health risk to sensitive receptors.

Table 20. Alternative 4 Chronic and Carcinogenic Health Risk Results in SMAQMD

x	y	Chronic Hazard Quotient	Cancer Risks per Million
628739	4246274	0.0016	5
629575	4247537	0.0012	4
629788	4249623	0.0011	3
630475	4242655	0.0011	3
630076	4252566	0.0010	3
629559	4247789	0.0010	3
630027	4250894	0.0010	3
629598	4247531	0.0010	3
629994	4247594	0.0010	3
629354	4247779	0.0009	3

x, y = universal transverse Mercator coordinates

Table 20 also shows the carcinogenic health risk results for Alternative 4 sensitive receptors within SMAQMD. Of the 10 sensitive receptors with the highest cancer risk per million in SMAQMD, none show risks exceeding the 10 in one million threshold.

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Table 21 shows the 10 receptors with the highest chronic health risks for Alternative 4 within SJVAPCD. As Table 21 shows, none of the sensitive receptors would have a chronic HQ exceeding 1. Consequently, Alternative 4 would not result in a chronic health risk to sensitive receptors within SJVAPCD.

Table 21. Alternative 4 Chronic and Carcinogenic Health Risk Results in SJVAPCD

x	y	Chronic Hazard Quotient	Cancer Risks per Million
628411	4219855	0.0008	2
628396	4219891	0.0006	2
627980	4216034	0.0006	2
631537	4216916	0.0004	1
627603	4194572	0.0004	1
632090	4232214	0.0004	1
632081	4232147	0.0004	1
628935	4220140	0.0004	1
632067	4232056	0.0004	1
628183	4205959	0.0004	1

x, y = universal transverse Mercator coordinates

Table 21 also shows the carcinogenic health risk results for Alternative 4. Of the 10 sensitive receptors with the highest cancer risk per million in SJVAPCD, none show risks exceeding the 10 in one million threshold.

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Table 22 shows the 10 receptors with the highest chronic health risks for Alternative 4 within BAAQMD. As Table 22 shows, none of the sensitive receptors would have a chronic HQ exceeding 1. Consequently, Alternatives 4 would not result in a chronic health risk to sensitive receptors within BAAQMD.

Table 22. Alternative 4 Chronic and Carcinogenic Health Risk Results in BAAQMD

x	y	Chronic Hazard Quotient	Cancer Risks per Million
623495	4187453	0.0017	5
624946	4186023	0.0013	4
626972	4186446	0.0013	4
626993	4186446	0.0013	4
626961	4186410	0.0012	4
627002	4186425	0.0012	4
623149	4188720	0.0012	4
626819	4186350	0.0012	4
626937	4186383	0.0012	4
627013	4186407	0.0012	4

x, y = universal transverse Mercator coordinates

Table 22 also shows the carcinogenic health risk results for Alternative 4. Of the 10 sensitive receptors with the highest cancer risk per million in BAAQMD, none show risks exceeding the 10 in one million threshold.

Fine Particulate Matter Less than 2.5 Microns (PM2.5) Results

Yolo-Solano Air Quality Management District

Table 23 shows the 10 highest 24-hour and annual concentrations of PM2.5 at sensitive receptors within YSAQMD's jurisdiction for Alternative 4. All annual concentrations are less than YSAQMD's threshold of 12 µg/m^3 and all 24-hour concentrations are less than the 35 µg/m^3 threshold.

Table 23. Alternative 4 PM2.5 Concentration Results in YSAQMD

Annual (µg/m^3)			24-hour (µg/m^3)		
x	**y**	**Concentration**	**x**	**y**	**Concentration**
629061	4249357	0.010	628884	4248408	0.4
629071	4249386	0.009	628859	4248313	0.4
629031	4249336	0.009	628823	4248400	0.4
628150	4246056	0.009	628808	4248836	0.3
629001	4249318	0.008	628816	4248877	0.3
628862	4249014	0.007	628829	4248927	0.3
628568	4246553	0.007	628765	4248838	0.3
628829	4248927	0.006	628862	4249014	0.3
627888	4245752	0.006	629654	4251428	0.3
628816	4248877	0.006	629665	4251386	0.3

x, y = universal transverse Mercator coordinates
µg/m^3 = micrograms per cubic meter

Sacramento Metropolitan Air Quality Management District

Table 24 shows the 10 highest 24-hour and annual concentrations of PM2.5 at sensitive receptors within SMAQMD for Alternative 4. All annual concentrations are less than SMAQMD's threshold of 0.6 µg/m^3. The SMAQMD has not developed significance thresholds for 24-hour PM2.5.

Table 24. Alternative 4 PM2.5 Concentration Results in SMAQMD

Annual (µg/m^3)			24-hour (µg/m^3)		
x	**y**	**Concentration**	**x**	**y**	**Concentration**
628739	4246274	0.055	629788	4249623	0.5
629788	4249623	0.038	628739	4246274	0.5
629575	4247537	0.031	629526	4247760	0.5
630027	4250894	0.029	629304	4246850	0.4
630076	4252566	0.028	629526	4247649	0.4
629863	4249763	0.025	629510	4247797	0.4
629559	4247789	0.024	629242	4247944	0.4
629598	4247531	0.023	629532	4247586	0.4
629532	4247586	0.023	629559	4247789	0.4
629574	4247689	0.023	629374	4247689	0.4

x, y = universal transverse Mercator coordinates
µg/m^3 = micrograms per cubic meter

San Joaquin Valley Air Pollution Control District

Table 25 shows the 10 highest 24-hour and annual concentrations of PM2.5 at sensitive receptors within SJVAPCD for Alternative 4. All annual concentrations are less than SJVAPCD's threshold of 2.08 $\mu g/m^3$ and all 24-hour concentrations are less than SJVAPCD's threshold of 10.4 $\mu g/m^3$.

Table 25. Alternative 4 PM2.5 Concentration Results in SJVAPCD

Annual ($\mu g/m^3$)			24-hour ($\mu g/m^3$)		
x	y	Concentration	x	y	Concentration
628411	4219855	0.016	625829	4190985	1.1
628396	4219891	0.012	625845	4190980	1.1
627980	4216034	0.012	625859	4190975	1.1
631537	4216916	0.011	628411	4219855	1.1
632090	4232214	0.010	625890	4191102	1.1
632081	4232147	0.010	625883	4190968	1.1
628935	4220140	0.010	625881	4191090	1.1
632067	4232056	0.010	625921	4191108	1.0
626050	4191029	0.010	625817	4191006	1.0
626036	4191012	0.010	625878	4190987	1.0

x, y = universal transverse Mercator coordinates
$\mu g/m^3$ = micrograms per cubic meter

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Table 26 shows the 10 highest 24-hour and annual concentrations of PM2.5 at sensitive receptors within BAAQMD for Alternative 4. All annual concentrations are less than BAAQMD's threshold of 0.3 $\mu g/m^3$. The BAAQMD has not developed significance thresholds for 24-hour PM2.5.

Table 26. Alternative 4 PM2.5 Concentration Results in BAAQMD

Annual ($\mu g/m^3$)			24-hour ($\mu g/m^3$)		
x	y	Concentration	x	y	Concentration
623149	4188720	0.036	625797	4191023	5.9
624946	4186023	0.030	622773	4188736	5.4
622773	4188736	0.028	622770	4188667	4.9
625797	4191023	0.028	622693	4188552	4.8
623495	4187453	0.028	621353	4189620	4.7
626972	4186446	0.026	626972	4186446	4.2
624924	4185992	0.026	626993	4186446	4.2
626993	4186446	0.026	627002	4186425	4.2
626961	4186410	0.025	627013	4186407	4.2
627002	4186425	0.025	626961	4186410	4.2

x, y = universal transverse Mercator coordinates
$\mu g/m^3$ = micrograms per cubic meter

Respirable Particulate Matter Less than 10 Microns (PM10) Results

Yolo-Solano Air Quality Management District

Table 27 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within YSAQMD's jurisdiction for Alternative 4. All annual concentrations are less than YSAQMD's threshold of 20 μg/m^3 and all 24-hour concentrations are less than the 50 μg/m^3 threshold.

Table 27. Alternative 4 PM10 Concentration Results in YSAQMD

Annual (μg/m^3)			24-hour (μg/m^3)		
x	**y**	**Concentration**	**x**	**y**	**Concentration**
629061	4249357	0.059	628884	4248408	2.5
629071	4249386	0.057	628859	4248313	2.2
629031	4249336	0.056	628823	4248400	2.2
628150	4246056	0.054	628808	4248836	2.1
629001	4249318	0.052	628816	4248877	2.0
628862	4249014	0.045	628829	4248927	1.9
628568	4246553	0.041	628765	4248838	1.9
628829	4248927	0.040	628862	4249014	1.8
627888	4245752	0.038	629487	4251687	1.8
628816	4248877	0.037	629665	4251386	1.8

x, y = universal transverse Mercator coordinates
μg/m^3 = micrograms per cubic meter

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Table 28 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within SMAQMD for Alternative 4. All annual concentrations are less than SMAQMD's threshold of 1.0 μg/m^3. The results show that there may be exceedances of SMAQMD's 24-hour threshold of 2.5 μg/m^3 at 10 receptor locations.

Table 28. Alternative 4 PM10 Concentration Results in SMAQMD

Annual (μg/m^3)			24-hour (μg/m^3)		
x	**y**	**Concentration**	**x**	**y**	**Concentration**
628739	4246274	0.402	629788	4249623	3.1
629788	4249623	0.269	628739	4246274	3.0
629575	4247537	0.212	629526	4247760	2.7
630076	4252566	0.199	629532	4247586	2.6
630027	4250894	0.199	629575	4247537	2.6
630076	4252566	0.171	629524	4247743	2.5
629863	4249763	0.158	629304	4246850	2.5
629532	4247586	0.157	629242	4247944	2.5
629559	4247789	0.155	629526	4247649	2.5
629598	4247531	0.146	629290	4247958	2.4

x, y = universal transverse Mercator coordinates
μg/m^3 = micrograms per cubic meter

Additional quantification was conducted to incorporate Mitigation Measure AQ-9 to reduce fugitive dust from roadways through the application of chemical suppressants and pave portions of work sites. The reductions in PM10 emissions associated with Mitigation Measure AQ-9 were not quantified for the other alignments due to the improbability of this measure reducing the impacts of the other alignments to below the respective significance thresholds.

Table 29 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within SMAQMD for Alternative 4 with the implementation of Mitigation Measure AQ-9. All annual concentrations are less than SMAQMD's threshold of 1.0 $\mu g/m^3$ and 24-hour threshold of 2.5 $\mu g/m^3$.

Table 29. Alternative 4 Mitigated PM10 Concentration Results in SMAQMD

Annual ($\mu g/m^3$)			24-hour ($\mu g/m^3$)		
x	y	Concentration	x	y	Concentration
629575	4247537	0.138	630393	4252680	2.06
629559	4247789	0.122	629532	4247586	1.96
628739	4246274	0.118	629526	4247760	1.86
630393	4252680	0.112	630550	4252689	1.81
629574	4247689	0.104	632084	4236261	1.81
629532	4247586	0.099	629526	4247649	1.75
629568	4247751	0.096	629575	4247537	1.73
629526	4247760	0.093	629524	4247743	1.72
629570	4247738	0.093	630076	4252566	1.72
630076	4252566	0.092	629522	4247700	1.63

x, y = universal transverse Mercator coordinates
$\mu g/m^3$ = micrograms per cubic meter

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Table 30 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within SJVAPCD for Alternative 4. All annual concentrations are less than SJVAPCD's threshold of 2.08 $\mu g/m^3$, and all 24-hour concentrations are less than SJVAPCD's threshold of 10.4 $\mu g/m^3$.

Table 30. Alternative 4 PM10 Concentration Results in SJVAPCD

Annual ($\mu g/m^3$)			24-hour ($\mu g/m^3$)		
x	y	Concentration	x	y	Concentration
628411	4219855	0.093	628411	4219855	6.9
628396	4219891	0.074	625829	4190985	6.6
631537	4216916	0.074	625845	4190980	6.6
627980	4216034	0.073	625859	4190975	6.5
632090	4232214	0.071	625890	4191102	6.5
632081	4232147	0.068	625883	4190968	6.5
632067	4232056	0.066	625881	4191090	6.5
628935	4220140	0.066	625921	4191108	6.4
626050	4191029	0.060	625902	4191122	6.4
626036	4191012	0.059	625910	4191094	6.4

x, y = universal transverse Mercator coordinates
$\mu g/m^3$ = micrograms per cubic meter

Bay Area Air Quality Management District

Table 31 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within BAAQMD for Alternative 4. BAAQMD has not developed thresholds for annual or 24-hour PM10 concentrations.

Table 31. Alternative 4 PM10 Concentration Results in BAAQMD

Annual (μg/m^3)			24-hour (μg/m^3)		
x	y	Concentration	x	y	Concentration
623149	4188720	0.158	625797	4191023	36.5
625797	4191023	0.157	622773	4188736	34.7
626972	4186446	0.157	622770	4188667	31.3
622773	4188736	0.155	622693	4188552	30.2
626993	4186446	0.149	621353	4189620	29.4
626961	4186410	0.148	623149	4188720	23.8
627002	4186425	0.144	621220	4189634	22.7
626937	4186383	0.143	626972	4186446	22.6
626819	4186350	0.143	626993	4186446	22.5
627013	4186407	0.141	627002	4186425	22.4

x, y = universal transverse Mercator coordinates
μg/m^3 = micrograms per cubic meter

East Corridor

East Corridor - Alternative 1B and 6B Results

Chronic and Carcinogenic Health Risk Results

Yolo-Solano Air Quality Management District

Table 32 shows the 10 receptors with the highest chronic health risks for Alternatives 1B and 6B within YSAQMD. As Table 32 shows, none of the sensitive receptors would have a chronic HQ exceeding 1. Consequently, Alternatives 1B and 6B would not result in a chronic health risk to sensitive receptors.

Table 32. Alternatives 1B and 6B Chronic and Carcinogenic Health Risk Results in YSAQMD

x	y	Chronic Hazard Quotient	Cancer Risks per Million
629616	4255200	0.001	4
629419	4255213	0.001	4
629352	4255216	0.001	4
629281	4255212	0.001	4
629569	4255241	0.001	4
629623	4255251	0.001	3
629886	4255284	0.001	3
629117	4255216	0.001	3
629217	4255230	0.001	3
629292	4255244	0.001	3

x, y = Universal Transverse Mercator coordinates

Table 32 also shows the carcinogenic health risk results for Alternatives 1B and 6B. Of the 10 sensitive receptors with the highest cancer risk per million in YSAQMD, none show risks exceeding the 10 in one million threshold.

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Table 33 shows the 10 receptors with the highest chronic health risks for Alternatives 1B and 6B within SMAQMD. As Table 33 shows, none of the sensitive receptors within SMAQMD would have a chronic non-cancer HQ exceeding 1. Consequently, Alternative 1B and 6B would not pose a chronic non-cancer health hazard to sensitive receptors.

Table 33. Alternatives 1B and 6B Chronic and Carcinogenic Health Risk Results in SMAQMD

x	y	Chronic Hazard Quotient	Cancer Risk per Million
629808	4247639	0.003	9
629863	4249763	0.003	9
629751	4247660	0.003	8
630550	4252689	0.003	8
629430	4247578	0.003	8
629363	4247745	0.002	7
629387	4247730	0.002	6
629447	4247594	0.002	6
629749	4247680	0.002	6
629188	4248305	0.002	6

x, y = universal transverse Mercator coordinates

Table 33 also shows the carcinogenic health risk results for Alternatives 1B and 6B sensitive receptors within SMAQMD. Of the 10 sensitive receptors with the highest cancer risk per million in SMAQMD, none show risks exceeding the 10 in one million threshold.

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Table 34 shows the 10 receptors with the highest chronic health risks for Alternatives 1B and 6B within SJVAPCD. As Table 34 shows, none of the sensitive receptors would have a chronic non-cancer HQ exceeding 1. Consequently, Alternatives 1B and 6B would not result in a chronic non-cancer health risk to sensitive receptors within SJVAPCD.

Table 34. Alternatives 1B and 6B Chronic and Carcinogenic Health Risk Results in SJVAPCD

x	y	Chronic Hazard Quotient	Cancer Risk per Million
639240	4200920	0.005	15
639365	4200938	0.004	13
630792	4189393	0.003	8
630847	4189469	0.002	8
636070	4231917	0.002	7
636543	4232128	0.002	6
638564	4202004	0.002	6
636627	4232113	0.002	6
636013	4231912	0.002	5
636719	4232102	0.002	5

x, y = universal transverse Mercator coordinates

Table 34 also shows the carcinogenic health risk results for Alternative 1B and 6B. Of the 10 sensitive receptors with the highest cancer risk per million in SJVAPCD, two exceed the 10 in one million risk threshold.

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Table 35 shows the 10 receptors with the highest chronic health risk results for Alternatives 1B and 6B within BAAQMD. As Table 35 shows, none of the sensitive receptors would have a chronic non-cancer HQ exceeding 1. Consequently, Alternatives 1B and 6B would not pose chronic non-cancer health hazards to sensitive receptors within BAAQMD.

Table 35. Alternatives 1B and 6B Chronic and Carcinogenic Health Risk Results in BAAQMD

x	y	Chronic Hazard Quotient	Cancer Risk per Million
626675	4186290	0.002	5
626784	4186218	0.002	5
626972	4186446	0.002	5
626993	4186446	0.001	5
627002	4186425	0.001	4
627013	4186407	0.001	4
626986	4186384	0.001	4
626937	4186383	0.001	4
626957	4186355	0.001	4
626925	4186370	0.001	4

x, y = universal transverse Mercator coordinates

Table 35 also shows the carcinogenic health risk results for Alternatives 1B and 6B. Of the 10 sensitive receptors with the highest cancer risk per million in BAAQMD, none show risks exceeding the 10 in one million threshold.

Fine Particulate Matter Less than 2.5 Microns (PM2.5) Results

Yolo-Solano Air Quality Management District

Table 36 shows the 10 highest 24-hour and annual concentrations of PM2.5 at sensitive receptors within YSAQMD's jurisdiction for Alternatives 1B and 6B. All annual concentrations are less than YSAQMD's threshold of 12 $\mu g/m^3$ and all 24-hour concentrations are less than the 35 $\mu g/m^3$ threshold.

Table 36. Alternative 1B and 6B PM2.5 Concentration Results in YSAQMD

Annual (µg/m³)			24-hour (µg/m³)		
x	y	Concentration	x	y	Concentration
629616	4255200	0.03	628884	4248408	1.1
629419	4255213	0.03	628150	4246056	1.0
629352	4255216	0.03	627888	4245752	1.0
629281	4255212	0.03	628859	4248313	1.0
629569	4255241	0.03	628823	4248400	1.0
629623	4255251	0.03	629665	4251386	0.9
629886	4255284	0.03	629654	4251428	0.9
629117	4255216	0.03	629616	4255200	0.8
629217	4255230	0.03	629419	4255213	0.8
629292	4255244	0.03	629352	4255216	0.8

x, y = universal transverse Mercator coordinates
µg/m³ = micrograms per cubic meter

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Table 37 shows the 10 highest 24-hour and annual concentrations of PM2.5 at sensitive receptors within SMAQMD for Alternatives 1B and 6B. All annual concentrations are less than SMAQMD's threshold of 0.6 µg/m³. The SMAQMD has not developed significance thresholds for 24-hour PM2.5.

Table 37. Alternative 1B and 6B PM2.5 Concentration Results in SMAQMD

Annual (µg/m³)			24-hour (µg/m³)		
x	y	Concentration	x	y	Concentration
630550	4252689	0.09	630550	4252689	3.5
629808	4247639	0.08	629808	4247639	3.3
629863	4249763	0.08	629751	4247660	2.8
629751	4247660	0.07	629685	4247675	2.5
629430	4247578	0.06	629176	4253098	2.4
629363	4247745	0.06	633233	4234637	2.1
629685	4247675	0.05	629749	4247680	2.0
629387	4247730	0.05	629664	4247572	1.7
629188	4248305	0.05	629683	4247693	1.7
629749	4247680	0.05	629807	4247682	1.7

x, y = universal transverse Mercator coordinates
µg/m³ = micrograms per cubic meter

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Table 38 shows the 10 highest 24-hour and annual concentrations of PM2.5 at sensitive receptors within SJVAPCD for Alternatives 1B and 6B. All annual concentrations are less than SJVAPCD's threshold of 2.08 µg/m^3, and 24-hour concentrations at two receptor locations would exceed SJVAPCD's threshold of 10.4 µg/m^3.

Table 38. Alternative 1B and 6B PM2.5 Concentration Results in SJVAPCD

Annual (µg/m^3)			24-hour (µg/m^3)		
x	Y	Concentration	x	y	Concentration
639240	4200920	0.12	633277	4234487	13.4
639365	4200938	0.11	633499	4235497	12.7
636070	4231917	0.06	633615	4235546	7.2
630792	4189393	0.06	638346	4198894	7.0
630847	4189469	0.06	639240	4200920	6.7
636627	4232113	0.05	630792	4189393	6.5
638564	4202004	0.05	630847	4189469	6.5
636543	4232128	0.05	636543	4232128	6.4
635948	4232022	0.05	636070	4231917	6.3
636013	4231912	0.05	635891	4231934	6.2

x, y = universal transverse Mercator coordinates
µg/m^3 = micrograms per cubic meter

Bay Area Air Quality Management District

Table 39 shows the highest 24-hour and annual concentrations of PM2.5 at sensitive receptors within BAAQMD for Alternatives 1B and 6B. All annual concentrations are less than the BAAQMD's threshold of 0.3 µg/m^3. The BAAQMD has not developed significance thresholds for 24-hour PM2.5.

Table 39. Alternative 1B and 6B PM2.5 Concentration Results in BAAQMD

Annual (µg/m^3)			24-hour (µg/m^3)		
x	y	Concentration	x	y	Concentration
624946	4186023	0.04	624946	4186023	9.1
624924	4185992	0.03	624924	4185992	7.1
626675	4186290	0.03	628549	4189426	5.5
626972	4186446	0.03	626972	4186446	4.8
626993	4186446	0.03	626993	4186446	4.8
626784	4186218	0.03	623537	4185713	4.8
627002	4186425	0.03	627013	4186407	4.8
627013	4186407	0.03	627002	4186425	4.8
626961	4186410	0.03	626957	4186355	4.7
626937	4186383	0.03	626986	4186384	4.7

x, y = universal transverse Mercator coordinates
µg/m^3 = micrograms per cubic meter

Respirable Particulate Matter Less than 10 Microns (PM10) Results

Yolo-Solano Air Quality Management District

Table 40 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within YSAQMD's jurisdiction for Alternatives 1B and 6B. All annual concentrations are less than YSAQMD's threshold of 20 μg/m^3 and all 24-hour concentrations are less than the 50 μg/m^3 threshold.

Table 40. Alternative 1B and 6B PM10 Concentration Results in YSAQMD

Annual (μg/m^3)			24-hour (μg/m^3)		
x	**y**	**Concentration**	**x**	**y**	**Concentration**
629616	4255200	0.21	628884	4248408	6.6
629419	4255213	0.19	628150	4246056	6.5
629352	4255216	0.19	627888	4245752	6.2
629281	4255212	0.18	628823	4248400	6.0
629569	4255241	0.18	628859	4248313	5.9
629623	4255251	0.17	629665	4251386	5.4
629886	4255284	0.17	629654	4251428	5.3
629117	4255216	0.16	629616	4255200	5.2
629217	4255230	0.16	629419	4255213	5.2
629292	4255244	0.16	629352	4255216	5.1

x, y = universal transverse Mercator coordinates
μg/m^3 = micrograms per cubic meter

Sacramento Metropolitan Air Quality Management District

Table 41 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within SMAQMD for Alternatives 1B and 6B. All annual concentrations are less than SMAQMD's threshold of 1.0 μg/m^3. The results show that there may be exceedances of SMAQMD's 24-hour threshold of 2.5 μg/m^3 at 186 receptor locations.

Table 41. Alternative 1B and 6B PM10 Concentration Results in SMAQMD

Annual (μg/m^3)			24-hour (μg/m^3)		
x	**y**	**Concentration**	**x**	**y**	**Concentration**
630550	4252689	0.53	630550	4252689	21.1
629808	4247639	0.50	629808	4247639	20.1
629863	4249763	0.50	629751	4247660	16.4
629751	4247660	0.41	629176	4253098	15.5
629363	4247745	0.39	629685	4247675	14.7
629430	4247578	0.39	633233	4234637	13.8
629387	4247730	0.32	629749	4247680	11.8
629188	4248305	0.32	629807	4247682	10.3
629685	4247675	0.32	629683	4247693	10.3
629447	4247594	0.31	629664	4247572	10.2

x, y = universal transverse Mercator coordinates
μg/m^3 = micrograms per cubic meter

San Joaquin Valley Air Pollution Control District

Table 42 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within SJVAPCD for Alternatives 1B and 6B. All annual concentrations are less than SJVAPCD's threshold of 2.08 μg/m^3, and there may be exceedances of SJVAPCD's 24-hour concentration threshold of 10.4 μg/m^3 at 108 receptor locations

Table 42. Alternative 1B and 6B PM10 Concentration Results in SJVAPCD

Annual (μg/m^3)			24-hour (μg/m^3)		
x	y	Concentration	x	y	Concentration
639240	4200920	0.70	633277	4234487	88.4
639365	4200938	0.68	633499	4235497	83.7
636070	4231917	0.38	633615	4235546	46.2
630792	4189393	0.36	638346	4198894	43.2
630847	4189469	0.35	636543	4232128	40.0
638564	4202004	0.31	630792	4189393	39.1
636627	4232113	0.31	635891	4231934	38.8
635948	4232022	0.29	630847	4189469	38.1
636013	4231912	0.28	636070	4231917	37.8
636719	4232102	0.28	639240	4200920	36.9

x, y = universal transverse Mercator coordinates
μg/m^3 = micrograms per cubic meter

Bay Area Air Quality Management District

Table 43 shows the 10 highest 24-hour and annual concentrations of PM10 at the six sensitive receptors within BAAQMD for Alternatives 1B and 6B. BAAQMD has not developed thresholds for annual or 24-hour PM10 concentrations.

Table 43. Alternative 1B and 6B PM10 Concentration Results in BAAQMD

Annual (μg/m^3)			24-hour (μg/m^3)		
x	y	Concentration	x	y	Concentration
624946	4186023	0.21	624946	4186023	52.5
624924	4185992	0.21	624924	4185992	39.5
626675	4186290	0.19	628549	4189426	29.7
626972	4186446	0.17	623537	4185713	27.9
626993	4186446	0.17	626805	4185794	24.2
626784	4186218	0.16	626801	4185775	24.1
627002	4186425	0.16	626972	4186446	23.6
627013	4186407	0.16	626993	4186446	23.5
626961	4186410	0.16	626848	4185775	23.4
626937	4186383	0.16	627002	4186425	23.1

x, y = universal transverse Mercator coordinates
μg/m^3 = micrograms per cubic meter

West Corridor

West Corridor - Alternative 1C, 2C, and 6C Results

Chronic and Carcinogenic Health Risk Results

Yolo-Solano Air Quality Management District

Table 44 shows the 10 receptors with the highest chronic health risks for Alternatives 1C, 2C, and 6C within YSAQMD. These receptors are all located in Yolo County near the intakes in areas near the towns of Clarksburg and Hood. As Table 44 shows, none of the sensitive receptors would have a chronic HQ exceeding 1. Consequently, Alternatives 1C, 2C, and 6B would not result in a chronic health risk to sensitive receptors.

Table 44. Alternatives 1C, 2C, and 6C Chronic and Carcinogenic Health Risk Results in YSAQMD

x	y	Chronic Hazard Quotient	Cancer Risks per Million
629840	4255395	0.003	9
628700	4246675	0.003	9
628765	4248838	0.003	8
628808	4248836	0.002	7
628754	4248892	0.002	5
628816	4248877	0.002	5
629951	4255379	0.002	5
629006	4252595	0.002	5
619071	4244365	0.002	5
628784	4248943	0.001	4

x, y = Universal Transverse Mercator coordinates

Table 44 also shows the carcinogenic health risk results for Alternatives 1C, 2C, and 6C. Of the 10 sensitive receptors with the highest cancer risk per million in YSAQMD, none of the receptor locations show risks exceeding the 10 in one million threshold.

Sacramento Metropolitan Air Quality Management District

Table 45 shows the 10 receptors with the highest chronic health risks for Alternatives 1C, 2C, and 6C within SMAQMD. As Table 45 shows, none of the sensitive receptors within SMAQMD would have a chronic non-cancer HQ exceeding 1. Consequently, Alternatives 1C, 2C, and 6C would not pose chronic non-cancer health hazards to sensitive receptors.

Table 45. Alternative 1C, 2C, and 6C Chronic and Carcinogenic Health Risk Results in SMAQMD

x	y	Chronic Hazard Quotient	Cancer Risk per Million
629188	4248305	0.001	3
629476	4252488	0.001	3
629242	4247944	0.001	3
629239	4247763	0.001	2
629807	4251753	0.001	2
628503	4245954	0.001	2
629271	4254969	0.001	2
626518	4244939	0.001	2
626345	4244891	0.001	2
629580	4254965	0.001	2

x, y = universal transverse Mercator coordinates

Table 45 also shows the carcinogenic risk results for Alternatives 1C, 2C, and 6C sensitive receptors within SMAQMD. Of the 10 sensitive receptors with the highest cancer risk per million in SMAQMD, none show risks exceeding the 10 in one million risk threshold.

San Joaquin Valley Air Pollution Control District

Table 46 shows the 10 receptors with the highest chronic health risks for Alternatives 1C, 2C, and 6C within SJVAPCD. As Table 46 shows, none of the sensitive receptors would have a chronic non-cancer HQ exceeding 1. Consequently, Alternatives 1C, 2C, and 6C would not pose chronic non-cancer health hazards to sensitive receptors within SJVAPCD.

Table 46. Alternative 1C, 2C, and 6C Chronic and Carcinogenic Health Risk Results in SJVAPCD

x	y	Chronic Hazard Quotient	Cancer Risk per Million
625817	4191006	0.000	1
625853	4191056	0.000	1
625839	4191047	0.000	1
625834	4191033	0.000	1
625829	4190985	0.000	1
625845	4190980	0.000	1
625881	4191090	0.000	1
625873	4191079	0.000	1
625880	4191057	0.000	1
625864	4191035	0.000	1

x, y = universal transverse Mercator coordinates

Table 46 also shows the carcinogenic risk results for Alternatives 1C, 2C, and 6C sensitive receptors within SJVAPCD. Of the 10 sensitive receptors with the highest cancer risk per million in SJVAPCD, none show risks exceeding the 10 in one million risk threshold.

Bay Area Air Quality Management District

Table 47 shows the 10 receptors with the highest chronic health risks for Alternatives 1C, 2C, and 6C within BAAQMD. As Table 47 shows, none of the sensitive receptors would have a chronic non-cancer HQ exceeding 1. Consequently, Alternatives 1C, 2C, and 6C would not pose chronic non-cancer health hazards to sensitive receptors within BAAQMD.

Table 47. Alternative 1C, 2C, and 6C Chronic and Carcinogenic Health Risk Results in BAAQMD

x	y	Chronic Hazard Quotient	Cancer Risk per Million
619931	4201595	0.006	18
620287	4194440	0.006	18
620354	4195129	0.006	17
620286	4194466	0.005	16
620281	4194867	0.005	16
620743	4198374	0.005	16
620329	4194438	0.005	16
620284	4194843	0.005	16
620323	4195661	0.005	16
620605	4196781	0.005	16

x, y = universal transverse Mercator coordinates

Table 47 also shows the highest carcinogenic health risk results for Alternatives 1C, 2C, and 6C. All 10 sensitive receptors provided in the table and a total of 186 modeled sensitive receptors along the pipeline corridor and within the jurisdiction of BAAQMD show results greater than the 10 in one million threshold.

Fine Particulate Matter Less than 2.5 Microns (PM2.5) Results

Yolo-Solano Air Quality Management District

Table 48 shows the 10 highest 24-hour and annual concentrations of PM2.5 at sensitive receptors within YSAQMD's jurisdiction for Alternatives 1C, 2C, and 6C. All annual concentrations are less than YSAQMD's threshold of 12 $\mu g/m^3$ and all 24-hour concentrations are less than the 35 $\mu g/m^3$ threshold.

Table 48. Alternatives 1C, 2C, and 6C PM2.5 Concentration Results in YSAQMD

Annual ($\mu g/m^3$)			24-hour ($\mu g/m^3$)		
x	y	Concentration	x	y	Concentration
628700	4246675	0.084	628765	4248838	1.4
629840	4255395	0.079	618973	4236541	1.4
628765	4248838	0.062	628700	4246675	1.3
628808	4248836	0.054	629840	4255395	1.3
629006	4252595	0.040	628808	4248836	1.3
628754	4248892	0.040	629006	4252595	1.2
629951	4255379	0.040	618991	4236436	1.2
628816	4248877	0.037	628754	4248892	1.0
627501	4254071	0.035	625403	4244478	1.0
628784	4248943	0.029	627474	4248741	1.0

x, y = universal transverse Mercator coordinates
$\mu g/m^3$ = micrograms per cubic meter

Sacramento Metropolitan Air Quality Management District

Table 49 shows the 10 highest 24-hour and annual concentrations of PM2.5 at sensitive receptors within SMAQMD for Alternatives 1C, 2C, and 6C. All annual concentrations are less than SMAQMD's threshold of 0.6 μg/m^3. The results show that there will not be exceedances of SMAQMD's 24-hour threshold of 2.5 μg/m^3.

Table 49. Alternatives 1C, 2C, and 6C PM2.5 Concentration Results in SMAQMD

Annual (μg/m^3)			24-hour (μg/m^3)		
x	y	Concentration	x	y	Concentration
629188	4248305	0.021	627684	4245223	1.1
629476	4252488	0.019	628189	4245468	1.0
629242	4247944	0.019	628380	4245780	0.9
629239	4247763	0.019	626345	4244891	0.9
629271	4254969	0.017	628023	4245146	0.9
629580	4254965	0.017	626518	4244939	0.9
626518	4244939	0.016	629271	4254969	0.8
629807	4251753	0.016	628739	4246274	0.8
628503	4245954	0.016	628503	4245954	0.8
626345	4244891	0.016	628853	4246303	0.8

x, y = universal transverse Mercator coordinates
μg/m^3 = micrograms per cubic meter

San Joaquin Valley Air Pollution Control District

Table 50 shows the highest 24-hour and annual concentrations of PM2.5 at ten sensitive receptors within SJVACPD for Alternatives 1C, 2C, and 6C. All annual concentrations are less than SJVACPD's threshold of 2.08 μg/m^3 and the 24-hour threshold of 10.4 μg/m^3.

Table 50. Alternatives 1C, 2C, and 6C PM2.5 Concentration Results in SJVAPCD

Annual (μg/m^3)			24-hour (μg/m^3)		
x	y	Concentration	x	y	Concentration
625817	4191006	0.00	625902	4191122	0.7
625829	4190985	0.00	625890	4191102	0.7
625839	4191047	0.00	625881	4191090	0.7
625834	4191033	0.00	625912	4191131	0.7
625853	4191056	0.00	625873	4191079	0.7
625845	4190980	0.00	625917	4191145	0.7
625864	4191035	0.00	625910	4191094	0.7
625871	4190991	0.00	625921	4191108	0.7
625859	4190975	0.00	625920	4191159	0.7
625881	4191090	0.00	625927	4191119	0.7

x, y = universal transverse Mercator coordinates
μg/m^3 = micrograms per cubic meter

Bay Area Air Quality Management District

Table 51 shows the highest 24-hour and annual concentrations of PM2.5 at ten sensitive receptors within BAAQMD for Alternatives 1C, 2C, and 6C. All annual concentrations are less than BAAQMD's threshold of 0.3 μg/m^3. The BAAQMD has not developed significance thresholds for 24-hour PM2.5.

Table 51. Alternatives 1C, 2C and 6C PM2.5 Concentration Results in BAAQMD

Annual (µg/m³)			24-hour (µg/m³)		
x	y	Concentration	x	y	Concentration
619931	4201595	0.19	621178	4192916	18.7
620287	4194440	0.13	619931	4201595	17.7
619741	4203197	0.13	620399	4194439	16.2
620354	4195129	0.11	620428	4194440	16.0
620743	4198374	0.11	620743	4198374	15.7
622827	4187324	0.11	620401	4194459	15.2
620329	4194438	0.11	619168	4194835	15.2
620605	4196781	0.11	620544	4195160	15.0
620544	4195160	0.10	620497	4194454	15.0
620286	4194466	0.10	620425	4194459	14.8

x, y = universal transverse Mercator coordinates
µg/m³ = micrograms per cubic meter

Respirable Particulate Matter Less than 10 Microns (PM10) Results

Yolo-Solano Air Quality Management District

Table 52 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within YSAQMD's jurisdiction for Alternatives 1C, 2C, and 6C. All annual concentrations are less than YSAQMD's threshold of 20 µg/m³ and all 24-hour concentrations are less than the 50 µg/m³ threshold.

Table 52. Alternatives 1C, 2C, and 6C PM10 Concentration Results in YSAQMD

Annual (µg/m³)			24-hour (µg/m³)		
x	y	Concentration	x	y	Concentration
628700	4246675	0.55	628765	4248838	8.7
629840	4255395	0.51	628700	4246675	8.3
628765	4248838	0.39	629840	4255395	8.1
628808	4248836	0.34	628808	4248836	7.8
629006	4252595	0.26	618973	4236541	7.7
629951	4255379	0.25	629006	4252595	7.6
628754	4248892	0.25	618991	4236436	6.6
627501	4254071	0.24	628754	4248892	6.3
628816	4248877	0.23	625403	4244478	6.2
628784	4248943	0.18	628816	4248877	6.0

x, y = universal transverse Mercator coordinates
µg/m³ = micrograms per cubic meter

Sacramento Metropolitan Air Quality Management District

Table 53 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within SMAQMD for Alternatives 1C, 2C, and 6C. All annual concentrations are less than SMAQMD's threshold of 1.0 µg/m³. The results show that there may be exceedances of SMAQMD's 24-hour threshold of 2.5 µg/m³ at 287 receptor locations.

Table 53. Alternatives 1C, 2C, and 6C PM10 Concentration Results in SMAQMD

Annual (µg/m^3)			24-hour (µg/m^3)		
x	y	Concentration	x	y	Concentration
629188	4248305	0.13	627684	4245223	6.7
629476	4252488	0.12	628189	4245468	6.0
629242	4247944	0.12	628380	4245780	5.6
629239	4247763	0.12	626345	4244891	5.5
629271	4254969	0.11	628023	4245146	5.4
629580	4254965	0.10	629271	4254969	5.3
626518	4244939	0.10	626518	4244939	5.2
629830	4255041	0.10	628739	4246274	5.1
629807	4251753	0.10	628503	4245954	5.0
628503	4245954	0.10	628853	4246303	5.0

x, y = universal transverse Mercator coordinates
µg/m^3 = micrograms per cubic meter

San Joaquin Valley Air Pollution Control District

Table 54 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within SJVAPCD for Alternatives 1C, 2C, and 6C. All annual concentrations are less than SJVAPCD's threshold of 2.08 µg/m^3. The results show that there would not be exceedances of SJVAPCD's 24-hour threshold of 10.4 µg/m^3

Table 54. Alternatives 1C, 2C and 6C PM10 Concentration Results in SJVAPCD

Annual (µg/m^3)			24-hour (µg/m^3)		
x	y	Concentration	x	y	Concentration
625817	4191006	0.01	625920	4191159	3.8
625829	4190985	0.01	625917	4191145	3.8
625834	4191033	0.01	625912	4191131	3.8
625839	4191047	0.01	625902	4191122	3.8
625845	4190980	0.01	625924	4191182	3.8
625853	4191056	0.01	625922	4191202	3.8
625859	4190975	0.01	625927	4191119	3.8
625864	4191035	0.01	625890	4191102	3.8
625871	4190991	0.01	625936	4191127	3.8
625873	4191079	0.01	625921	4191108	3.8

x, y = universal transverse Mercator coordinates
µg/m^3 = micrograms per cubic meter

Bay Area Air Quality Management District

Table 55 shows the 10 highest 24-hour and annual concentrations of PM10 at the six sensitive receptors within BAAQMD for Alternatives 1C, 2C, and 6C. BAAQMD has not developed thresholds for annual or 24-hour PM10 concentrations.

Table 55. Alternatives 1C, 2C and 6C PM10 Concentration Results in BAAQMD

Annual (µg/m³)			24-hour (µg/m³)		
x	y	Concentration	x	y	Concentration
619931	4201595	1.14	621178	4192916	107.6
619741	4203197	0.79	619931	4201595	99.8
620287	4194440	0.73	620399	4194439	93.3
622827	4187324	0.64	620428	4194440	91.5
620743	4198374	0.63	620743	4198374	90.9
620354	4195129	0.61	619168	4194835	88.2
620605	4196781	0.58	620401	4194459	86.5
620544	4195160	0.57	620497	4194454	86.3
620329	4194438	0.57	620544	4195160	86.1
620357	4194438	0.54	620425	4194459	83.9

x, y = universal transverse Mercator coordinates
µg/m³ = micrograms per cubic meter

Separate Corridors Option (SCO)

SCO - Alternative 9 Results

The SCO option consisted of only one alternative. The modeling analysis for Alternative 9 included sensitive receptors located in close proximity to proposed construction activities.

DPM Chronic Non-cancer Hazard and Cancer Risk Results

Yolo-Solano Air Quality Management District

The Separate Corridors Option does not travel through or near receptors within the jurisdiction of the YSAQMD. Consequently, no exceedance of YSAQMD thresholds at receptors within the YSAQMD would occur.

Sacramento Metropolitan Air Quality Management District

Table 56 shows the 10 receptors with the highest chronic health risks for Alternative 9 within SMAQMD. As Table 56 shows none of the sensitive receptors would have a chronic non-cancer HQ exceeding 1. Consequently, the Alternative 9 would not result in a chronic non-cancer health hazards to sensitive receptors.

Table 56. Alternative 9 Chronic and Carcinogenic Health Risk Results in SMAQMD

x	y	Chronic Hazard Quotient	Cancer Risk per Million
630499	4234465	0.019	57
629772	4233285	0.018	55
630470	4234482	0.013	40
629804	4233348	0.012	35
630534	4234655	0.009	29
630457	4234587	0.009	26
630441	4234585	0.008	24
630485	4234660	0.008	23
630453	4234627	0.007	23
629853	4233358	0.007	22

x, y = universal transverse Mercator coordinates

Table 56 also shows the highest carcinogenic risk results for Alternative 9. All 10 sensitive receptors provided in the table and a total of 52 modeled sensitive receptors along the pipeline corridor and within the jurisdiction of SMAQMD show results greater than the 10 in one million threshold. This risk is associated with construction of the SCO's fish screens and operable barriers in this area.

San Joaquin Valley Air Pollution Control District

Table 57 shows the 10 receptors with the highest chronic health risks for San Joaquin County. As Table 57 shows, none of the sensitive receptors would have a chronic non-cancer HQ exceeding 1. Consequently, Alternative 9 would not result in a chronic non-cancer health hazards to sensitive receptors.

Table 57. Alternative 9 Chronic and Carcinogenic Health Risk Results in SJVAPCD

x	y	Chronic Hazard Quotient	Cancer Risk per Million
627228.4	4186343	0.001	4
627260.2	4186346	0.001	4
627206.3	4186307	0.001	4
627261.8	4186297	0.001	3
627315.8	4186309	0.001	3
627293.4	4186287	0.001	3
627341.0	4186261	0.001	2
633160.1	4194033	0.001	2
633153.6	4194031	0.001	2
627551.7	4186132	0.000	1

x, y = universal transverse Mercator coordinates

Table 57 also shows the carcinogenic risk results. Of the 10 sensitive receptors with the highest cancer risk within SJVAPCD, none show risks exceeding the 10 in one million threshold.

Bay Area Air Quality Management District

Table 58 shows the 10 receptors with the highest chronic non-cancer HQs and carcinogenic health risks within BAAQMD. As Table 58 shows, none of the sensitive receptors would have a chronic non-cancer HQ exceeding 1. Consequently, Alternative 9 would not result in a chronic non-cancer health hazards to sensitive receptors.

Table 58. Alternative 9 Chronic and Carcinogenic Health Risk Results in BAAQMD

x	y	Chronic Hazard Quotient	Cancer Risk per Million
627275	4187011	0.003	8
627271	4187085	0.002	8
626819	4186350	0.002	5
628279	4190037	0.001	4
626784	4186218	0.001	4
628549	4189426	0.001	3
626675	4186290	0.001	3
626839	4186003	0.001	2
626841	4185989	0.001	2
628550	4189157	0.001	2

x, y = universal transverse Mercator coordinates

Table 58 also shows the carcinogenic risk results. Of the 10 sensitive receptors with the highest cancer risk in BAAQMD, none were found to exceed the 10 in one million risk threshold.

Fine Particulate Matter Less than 2.5 Microns (PM2.5) Results

Yolo-Solano Air Quality Management District

The Separate Corridors Option does not travel through or near receptors within the jurisdiction of the YSAQMD. Consequently, no exceedances of thresholds at receptors within the YSAQMD would occur.

Sacramento Metropolitan Air Quality Management District

Table 59 shows the 10 highest 24-hour and annual concentrations of PM2.5 at sensitive receptors within SMAQMD for Alternative 9. All annual concentrations are less than SMAQMD's threshold of 0.6 μg/m^3. The SMAQMD does not have a 24-hour PM2.5 significance threshold.

Table 59. Alternative 9 PM2.5 Concentration Results in SMAQMD

Annual (μg/m^3)			24-hour (μg/m^3)		
x	y	Concentration	x	y	Concentration
630499	4234465	0.45	630499	4234465	20.7
629772	4233285	0.42	630470	4234482	16.2
630470	4234482	0.32	629344	4233195	14.2
629804	4233348	0.27	630410	4234078	13.5
630534	4234655	0.23	629337	4233221	13.4
630457	4234587	0.21	630489	4233997	12.5
630441	4234585	0.20	630388	4234038	12.2
630485	4234660	0.19	629354	4233265	12.0
630453	4234627	0.18	629307	4233201	12.0
630452	4234636	0.18	630457	4234587	11.9

x, y = universal transverse Mercator coordinates
μg/m^3 = micrograms per cubic meter

San Joaquin Valley Air Pollution Control District

Table 60 shows the 10 highest 24-hour and annual concentrations of PM2.5 at sensitive receptors within SJVAPCD for Alternative 9. All annual concentrations are less than SJVAPCD's threshold of 2.08 μg/m^3, and 24-hour concentrations at six receptor locations would exceed SJVAPCD's threshold of 10.4 μg/m^3.

Table 60. Alternative 9 PM2.5 Concentration Results in SJVAPCD

Annual (µg/m³)			24-hour (µg/m³)		
x	y	Concentration	x	y	Concentration
627228	4186343	0.02	633615	4235546	18.3
627206	4186307	0.02	633574	4235545	17.0
627260	4186346	0.02	633499	4235497	16.9
633160	4194033	0.02	633744	4235357	16.8
633154	4194031	0.02	634092	4234779	13.7
627262	4186297	0.01	635957	4234360	10.6
627316	4186309	0.01	636005	4234298	10.0
627293	4186287	0.01	634689	4234302	7.0
627341	4186261	0.01	635960	4234509	6.9
632880	4195153	0.01	633160	4194033	3.9

x, y = universal transverse Mercator coordinates
µg/m³ = micrograms per cubic meter

Bay Area Air Quality Management District

Table 61 shows the highest 24-hour and annual concentrations of PM2.5 at the six sensitive receptors within BAAQMD for Alternative 9. All annual concentrations are less than BAAQMD's threshold of 0.3 µg/m³. The BAAQMD has not developed significance thresholds for 24-hour PM2.5.

Table 61. Alternative 9 PM2.5 Concentration Results in BAAQMD

Annual (µg/m³)			24-hour (µg/m³)		
x	y	Concentration	x	y	Concentration
627275	4187011	0.05	627275	4187011	3.5
627271	4187085	0.04	628279	4190037	3.5
626819	4186350	0.03	627271	4187085	3.5
628279	4190037	0.02	626819	4186350	3.1
626784	4186218	0.02	626960	4185693	2.8
626675	4186290	0.01	626841	4185989	2.8
626839	4186003	0.01	626839	4186003	2.8
628549	4189426	0.01	626840	4185974	2.8
626841	4185989	0.01	626841	4185966	2.8
626819	4185993	0.01	626840	4185959	2.7

x, y = universal transverse Mercator coordinates
µg/m³ = micrograms per cubic meter

Respirable Particulate Matter Less than 10 Microns (PM10) Results

Yolo-Solano Air Quality Management District

The Separate Corridors Option does not travel through or near receptors within the jurisdiction of the YSAQMD. Consequently, no exceedances of thresholds at receptors within the YSAQMD would occur.

Sacramento Metropolitan Air Quality Management District

Table 62 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within SMAQMD for Alternative 9. SMAQMD's annual threshold of 1.0 µg/m³ is exceeded at 17 receptor locations. The results also show that there may be exceedances of SMAQMD's 24-

hour threshold of 2.5 µg/m^3 at the 10 highest receptor concentrations shown in Table 62 and at 435 total receptor locations.

Table 62. Alternative 9 PM10 Concentration Results in SMAQMD

Annual (µg/m^3)			24-hour (µg/m^3)		
x	y	Concentration	x	y	Concentration
6304989	4234465	2.9	630498.7	4234465	131.4
629772	4233285	2.6	630470.4	4234482	102.5
630470	4234482	2.0	629343.9	4233195	90.8
629804	4233348	1.7	630409.8	4234078	85.8
630534	4234655	1.5	629337.3	4233221	85.7
630457	4234587	1.3	630488.6	4233997	78.1
630441	4234585	1.2	630387.9	4234038	77.6
630485	4234660	1.2	629307.3	4233201	76.9
630453	4234627	1.2	629353.9	4233265	76.3
630452	4234636	1.1	630456.9	4234587	76.1

x, y = universal transverse Mercator coordinates
µg/m^3 = micrograms per cubic meter

San Joaquin Valley Air Pollution Control District

Table 63 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within SJVAPCD for Alternative 9. All annual concentrations are less than SJVAPCD's threshold of 2.08 µg/m^3, and there may be exceedances of SJVAPCD's 24-hour concentration threshold of 10.4 µg/m^3 at 24 locations.

Table 63. Alternative 9 PM10 Concentration Results in SJVAPCD

Annual (µg/m^3)			24-hour (µg/m^3)		
x	y	Concentration	x	y	Concentration
633160	4194033	0.1	633614.9	4235546	114.0
633154	4194031	0.1	633573.9	4235545	105.6
627228	4186343	0.1	633499.2	4235497	105.5
627206	4186307	0.1	633744.0	4235357	103.1
627260	4186346	0.1	634092.2	4234779	83.7
627262	4186297	0.1	635957.3	4234360	66.5
627316	4186309	0.1	636005.1	4234298	62.5
627293	4186287	0.1	634689.1	4234302	43.3
627341	4186261	0.0	635960.4	4234509	42.7
632880	4195153	0.0	633160.1	4194033	25.8

x, y = universal transverse Mercator coordinates
µg/m^3 = micrograms per cubic meter

Bay Area Air Quality Management District

Table 64 shows the 10 highest 24-hour and annual concentrations of PM10 at sensitive receptors within BAAQMD for Alternative 9. BAAQMD has not developed thresholds for annual or 24-hour PM10 concentrations.

Table 64. Alternative 9 PM10 Concentration Results in BAAQMD

Annual (μg/m³)			24-hour (μg/m³)		
x	**y**	**Concentration**	**x**	**y**	**Concentration**
627275	4187011	0.2	627275.1	4187011	18.0
627271	4187085	0.2	627271.4	4187085	17.7
626819	4186350	0.1	628278.9	4190037	16.9
628279	4190037	0.1	626819.2	4186350	14.5
626784	4186218	0.1	626960.4	4185693	12.1
626675	4186290	0.1	626841.0	4185989	12.0
626839	4186003	0.1	626839.0	4186003	11.9
626841	4185989	0.1	626839.8	4185974	11.8
628549	4189426	0.1	626841.3	4185966	11.7
626819	4185993	0.1	626840.2	4185959	11.6

x, y = universal transverse Mercator coordinates
μg/m³ = micrograms per cubic meter

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Appendix A. Modeling Protocol

Health Risk Protocol Parameters

Contacts	
BAAQMD	Virginia Lau/Phil Martin
SMAQMD	Karen Huss/Rachel Dubose
YSAQMD	Matt Jones
SJVAPCD	Leland Villalvazo/Patia Siong/Dan Barber
URS	Tim Rimpo, Tin Cheung, Avanti Tamhane, Jon Tamimi, Megan Giglini
AERMOD Modeling Parameters	
Screening Tables	Are screening tables used?
BAAQMD	Yes, but cannot be used for linear construction projects.
SMAQMD	No.
YSAQMD	No.
SJVAPCD	Yes. Tools are available for highway truck travel; diesel internal combustion engines; truck idling; truck travel (50-meter segments).
URS' Anticipated Approach	No screening tables will be used. Screening level analyses will be based on AERSCREEN modeling.
Source Representation – Area, volume, open pit, other	What type of AERMOD source should be used to characterize PM2.5 fugitive dust and vehicle exhaust?
BAAQMD	Multiple area sources. Could also justify the use of a volume source, but would have to look at equipment information to figure out appropriate release height.
SMAQMD	PM10 dispersion modeling guidance parameters are appropriate to use for Health Risk Assessment Multiple volume sources with a release height of 5 meters. Each acre of project site should have at least four volume sources.
YSAQMD	If over a large area, use area sources. If over a small concentrated area, use volume sources with a release height of 3 meters.
SJVAPCD	SJVAPCD will allow the use of area or volume source. Whichever option is picked, URS must provide justification.
URS' Anticipated Approach	Multiple area sources based on changes in the magnitude of emission sources. Initial vertical release for dust emissions is 1 meter and 5 meters for vehicle exhaust.[2]
Use on-road emission sources?	Should on-road emission sources be included outside of the project site?
BAAQMD	Consider on-road vehicles within 1,000 feet of receptors. Would need to justify the criteria.
SMAQMD	Recommend evaluating on-road truck emissions that occur only on the project site, but also suggest including all on-road emissions from the project segment being modeled that is occurring within the borders of Sacramento County, or suggest a radius and justify it.

2 Based on South Coast Air Quality Management District (SCAQMD) final Localized Significance Threshold Methodology (July 2008), which states that for exhaust from construction equipment "The release height is assumed to be 5 meters. This represents the mid-range of the expected plume rise from frequently used construction equipment during daytime atmospheric conditions."

Contacts	
YSAQMD	Only concerned with the travel on local/arterial roads and roads with receptors within 500 feet. Suggested plotting out routes and determining where receptors are 500 feet from the road.
SJVAPCD	SJVAPCD recommends only evaluating on-site TAC emissions and impacts.
URS' Anticipated Approach	URS determined that all the on-road DPM emissions would contribute to 0.4% of total DPM emissions. Within 1 mile, the on-road DPM emissions would only contribute to 0.04% of the total DPM emissions. Therefore, URS proposes focusing on on-site emissions only.
Meteorological Data	How many years of meteorological data should be used?
BAAQMD	Met data provided for Contra Costa Power. Can use one year for construction modeling. If you have five years of data, look at the worst case year.
SMAQMD	SMAQMD suggested using AERMOD processed met data for Executive Airport. SMAQMD provided that met data to URS.
YSAQMD	Suggested using the met data from SMAQMD.
SJVAPCD	Pre-processed format available on SJVAPCD's website. SJVAPCD recommends using the Stockton met data.
URS' Anticipated Approach	Five years of met data from Sacramento Executive Airport for locations with the SMAQMD and YSAQMD district boundaries. Five years of met data from Stockton (supplied by SJVAPCD) for locations within the SJVAPCD district boundary. Five years of met data from Contra Costa power tower for locations within the BAAQMD district boundary. However, to reduce processing time, URS will only run AERMOD for the worst-case scenario met year to estimate annual concentrations (2002 for Sacramento Executive Airport, 2009 for Stockton, and 2004 for Contra Costa. All five model years run to estimate 24-hour concentrations.
Default regulatory options	Is the use of default regulatory options acceptable?
BAAQMD	
SMAQMD	
YSAQMD	
SJVAPCD	Use regulatory default options for dispersion modeling.
URS' Anticipated Approach	Use regulatory default options for dispersion modeling.
Urban Options	Should the Rural or Urban be used?
BAAQMD	
SMAQMD	
YSAQMD	Rural.
SJVAPCD	Rural.
URS' Anticipated Approach	Use of Rural Area option. Land use sector analysis showed that the majority of the project area is rural.
Health Risk Assessment Methods	
Significance Thresholds	What significance thresholds are being used by each District?
BAAQMD	Increased Cancer Risk > 10 in one million. Increased Chronic and Acute Hazard Index > 1.0. PM2.5 concentration increase > 0.3 µg/m^3 (for exhaust emissions only) [3]

3 The BAAQMD's Air Quality CEQA Thresholds of Significance were challenged by an order issued March 5, 2012, in *California Building Industry Association v. BAAQMD,* Alameda Superior Court Case No. RGI0548693. The order requires the BAAQMD thresholds to be subject to further environmental review. The claims made in the case concerned the CEQA impacts of adopting the thresholds (i.e., how the thresholds would affect land use development patterns), and petitioners argued that the thresholds for Health Risk Assessments encompassed issues not addressed by CEQA. URS proposes using the 2011 thresholds

Contacts	
SMAQMD	No quantitative thresholds for construction projects, but can use thresholds for stationary sources. For stationary sources: significant cancer risk equals risk > 10 in one million at any off-site receptor. Ground-level concentration of TACs that would result in a Hazard Index > 1 at any off-site receptor.
YSAQMD	No quantitative thresholds for mobile sources, but can use thresholds for stationary source. Increase in cancer risk > 10 in one million at any off-site receptor. Ground-level concentration that would result in a Hazard Index > 1 for MEI.
SJVAPCD	No quantitative thresholds for mobile sources. Can use the TAC thresholds for stationary sources: Increase in cancer risk > 10 in one million at any off-site receptor. Ground-level concentration that would result in a Hazard Index > 1 for MEI. Does not apply to intermittent sources (less than 200 hours/year).
URS' Anticipated Approach	Cancer risk > 10 in one million. Hazard Index > 1 (Chronic only, because DPM does not pose an acute risk). $PM_{2.5}$ concentration increase > 0.3 µg/m[3.]
Specific TACs to be modeled	What TACs should be included within the HRA for construction activities?
BAAQMD	DPM only. Would not recommend looking at gaseous components of diesel fuel, because DPM factor already accounts for them. Could potentially look at gaseous components from gasoline equipment, if BAAQMD believes there will be a large number. BAAQMD no longer recommends looking at acrolein.
SMAQMD	DPM. Discuss other TACs qualitatively.
YSAQMD	DPM. YSAQMD is not concerned with other TACs.
SJVAPCD	DPM.
URS' Anticipated Approach	DPM only due to recommendations of air districts, and the low level of risk from other toxics.
Use of exposure durations of less than 9 years	Should an exposure of less than nine years be used?
BAAQMD	Yes, can use exact timeframe of the project. Must use age sensitivity factor for short-term projects.
SMAQMD	Based on OEHAA guidance.
YSAQMD	Based on OEHAA guidance.
SJVAPCD	SJVAPCD guidance states the use of 70-year time frame, but this guidance may apply to longer-term sources (results in the application factor of 4.1453E-04).
URS' Anticipated Approach	URS proposes calculating a 70-year cancer risk, but multiplying it by the exact number of years (7-9 years), and an age sensitivity factor.
Adult or child breathing rates	Should adult or child breathing rates be used?
BAAQMD	Child breathing rate for construction projects.
SMAQMD	Based on OEHAA guidance.
YSAQMD	Based on OEHAA guidance.
SJVAPCD	Use of 393 liters per kilogram, which leads to an adjustment factor of 4.1453E-04 (multiply DPM ground concentration for each source by adjustment factor).

for impact analysis, given the OEHAA guidance for cancer risk thresholds, and the EPA significant impact levels for PM2.5 concentrations (BAAMQD, 2010)

Contacts	
URS' Anticipated Approach	URS proposes using the child breathing rate of 581 liters per kilogram, since the construction timeframe is 9 years or less. OEHHA guidance (OEHHA, 2003) states that for periods between 2-9 years, the child breathing rate should be used.
Receptor grid	What is the District's expectation for spacing of receptor grids?
BAAQMD	For cases with emissions from short stacks or vents and a close property line, a receptor spacing of 10 meters may be sufficient.
SMAQMD	SMAQMD recommends that the spacing of a receptor grid be 10 meters. Discrete receptors shall be added to ensure that specific nearby sensitive receptors are represented in the model.
YSAQMD	If receptors are greater than 500 feet from the site, YSAQMD is not too concerned with modeling. For less than 500 feet, setup receptor grids with 10-meter spacing.
SJVAPCD	For Cartesian receptor grid: 25-meter spacing on the facility boundary: • 25-meter spacing from Facility Boundary to 100 • 50-meter spacing from 100 to 250 meters • 100-meter spacing from 250 to 500 meters • 250-meter spacing from 500 to 1000 meters • 500-meter spacing from 1000 to 2000 meters Leland Villalvazo (SJVAPCD) also suggested looking at receptors up to 2 kilometers.
URS' Anticipated Approach	In lieu of Cartesian receptor grids, URS proposes to use the 12,874 discrete Cartesian receptors as included within the BDCP GIS. This includes receptors within the 2 kilometer buffer area of construction emission sources, but outside of the construction footprint.

AERMOD	an atmospheric dispersion modeling system
BAAQMD	Bay Area Air Quality Management District
CEQA	California Environmental Quality Act
DPM	diesel particulate mater
EPA	United States Environmental Protection Agency
HRA	health risk assessment
OEHHA	Office of Environmental Health Hazard Assessment
SJVAPCD	San Joaquin Valley Air Pollution Control District
SMAQMD	Sacramento Metropolitan Air Quality Management District
MEI	maximally exposed individual
TAC	toxic air contaminant
URS	URS Corporation Americas, Inc.
YSAQMD	Yolo-Solano Air Quality Management District
µg/m3	micrograms per cubic meter