APPENDIX 3.3-A, APPENDIX E: LOCALIZED IMPACTS FROM CONSTRUCTION

APPENDIX E: LOCALIZED IMPACTS FROM CONSTRUCTION

1 INTRODUCTION

The California high-speed rail (HSR) program would include a wide variety of construction activities in numerous locations, extending from Scott Boulevard in Santa Clara through downtown San Jose and south to Gilroy across Pacheco Pass to Carlucci Road in Merced County (San Jose to Central Valley Wye Project Extent [project extent or project]). Because the total construction area would include laying of nearly 90 miles of track and three major tunnels with numerous portions built with various techniques (e.g., at grade, viaduct, berm, cut and fill, and possibly three concrete batch plants), analyzing the project as a whole is not practical. In general, analysts modeled representative sections of track for each construction activity within each subsection for long-term and short-term (less than 24-hour) air quality effects. Where feasible, the entire length of the subsection was modeled for all construction techniques. In addition, for short-term emissions, one construction activity may occur adjacent to another construction source type, and combined emissions would potentially be greater than either part alone. Based on the construction activities and engineering design, the following construction source types were evaluated for the potential to cause localized air quality effects:

- Berm
- At grade
- Aerial
- Trench
- Tunnel
- Cut and fill
- Operation of concrete batch plants to support construction

For each of these types of construction activities, maximum activities were determined, and air quality effects were evaluated. This appendix provides additional detail regarding the methods described in the *San Jose to Merced Project Section Air Quality and Greenhouse Gases Technical Report* (Air Quality and Greenhouse Gases Technical Report) to which this appendix is attached. This detail includes identification of the pollutants of concern, air quality modeling of the construction sites, determination of the modeled emission rates for the air dispersion modeling, and development of air quality modeling inputs and model output. Air dispersion modeling results were used to predict the ambient effects of criteria pollutant emissions and evaluate these effects with respect to the national ambient air quality standards (NAAQS) and California ambient air quality standards (CAAQS). Health risk calculations were also performed to evaluate the incremental cancer risks and acute and chronic noncancer health effects on residential receptors located near the construction work areas.

2 POLLUTANTS OF CONCERN

Criteria pollutants and toxic air contaminants (TAC)[1] were assessed for localized effects. The following criteria pollutants were considered in this analysis of potential localized effects:[2]

- Carbon monoxide
- Nitrogen dioxide (NO_2)
- Particulate matter (PM) smaller than or equal to 2.5 microns
- PM smaller than or equal to 10 microns
- Sulfur dioxide (SO_2)

TACs were analyzed for potential localized effects in terms of health risk. Sources of TACs include construction equipment exhaust and fugitive dust from concrete batch plant processes. The California Air Resources Board (CARB) and the California Office of Environmental Health Hazard Assessment (OEHHA) have identified TACs that may be emitted from these sources. Construction equipment exhaust may contain diesel particulate matter (DPM), and fugitive dust emissions from concrete batch plants may contain a number of toxic pollutants (in particular, heavy metals and sulfates). DPM has been identified by CARB as a TAC based on its potential to cause cancer and other adverse health problems, including respiratory illnesses and increased risk of heart disease. Heavy metals and sulfate associated with concrete batch plant emissions present potential carcinogenic and noncarcinogenic health risks.[3] Finally, some criteria pollutants pose acute and chronic health risks (such as NO_2 and SO_2). These pollutants are analyzed for both health effects and their effects relative to air quality standards.

Analyses were conducted that considered chronic (long-term) carcinogenic, chronic noncarcinogenic, and acute (short-term) health risks. These analyses were conducted following San Joaquin Valley Air Pollution Control District (SJVAPCD) guidance in the San Joaquin Valley and Bay Area Air Quality Management District (BAAQMD) guidance in the San Francisco Bay Area. OEHHA modeling guidance was followed for the health risk assessment. Further details on the cancer risk from DPM are discussed in Section 6.4.8, Construction Health Risk Assessment, of the Air Quality and Greenhouse Gases Technical Report.

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[1] TACs (sometimes referred to as hazardous air pollutants) are noncriteria pollutants that pose health risk.

[2] Ozone and its precursors (reactive organic gases or volatile organic compounds) are classified as regional effects due to the atmospheric transport and chemical conversions that take place over long distances and time scales. Therefore, they were not analyzed in terms of localized effects. Lead emissions were not considered because the mass emissions are negligible and thus unlikely to exceed the ambient air quality standards. Lead was quantified as part of the TACs because it has health toxicity factors.

[3] Current analyses do not associate any combustion emissions, including DPM, with the concrete batch plants as combustion activities would not occur with batching activities.

3 MODELED CONSTRUCTION SITES

As described in Section 6.4.8 of the Air Quality and Greenhouse Gases Technical Report, the following construction source types were evaluated for the potential to cause localized air quality effects:

- Berm construction of the rail segment
- Aerial construction for an elevated rail segment
- At-grade construction for development of the rail segment
- Trench construction for a below-grade rail segment
- Tunnel construction and ventilation shafts for the rail segment
- Cut and fill for the rail segment
- Concrete batch plants to support construction

Not all subsections include all construction source types, but in each subsection, at least one modeling analysis was performed for at least one construction activity. A brief description of the approach and study area for each construction source type is provided in this section. More detailed modeling source parameters are provided in Section 6.4.8 of the Air Quality and Greenhouse Gases Technical Report. In addition to analysis of each of these seven construction source types, an analysis was conducted for potential effects from those short-term activities that could be co-located and occur simultaneously in each subsection. This approach assured that the maximum effect would be found, given the likelihood that construction activities could occur simultaneously at the same location.

Berm construction of the rail segment—The construction emissions associated with berm construction include phases such as utility relocation, earth excavation, concrete work preparation, retaining wall construction, form work, and track bed construction. Long-term emissions associated with berm construction were analyzed for the entire 90-mile project extent; however, for short-term emissions (maximum daily emissions) modeling over the entire 90-mile project extent would not be realistic because many combinations of adjacent construction activity types do not occur over the length of each subsection. Therefore, localized effects for short-term emissions in each subsection were evaluated for potential construction of 1,000-foot sections of track where concurrent construction activity types could take place. Anywhere from one to three track orientations were modeled depending on the alignment, with receptors located either adjacent or close to the rail line right-of-way.

Aerial construction for an elevated rail segment—The construction emissions associated with aerial (viaduct) construction include phases such as utility relocation; earth excavation; cast-in-place drilled pier construction; formwork for concrete work preparation, including aerial bridges; and concrete pouring. As in the case for berm construction, aerial construction was modeled for the entire 90-mile project extent for long-term activity; however, for short-term emissions (maximum daily emissions), modeling over the entire 90-mile project extent would not be practical because many combinations of adjacent construction activity types would occur over the length of each subsection. Therefore, localized effects for short-term emissions in each subsection were evaluated for potential construction of 1,000-foot sections of track where concurrent construction activity types could take place. Anywhere from one to three track orientations were modeled depending on alignment, with receptors located either adjacent or close to the rail line right-of-way.

At-grade construction of the rail segment—The construction emissions associated with at-grade construction include phases such as utility relocation, demolition, cast-in-place drilled pier construction, excavation for slurry wall, base slab formwork, and pouring of concrete slab and walls. As in the case for berm construction, the at-grade construction was modeled for the entire 90-mile project extent for long-term activity; however for short-term emissions (maximum daily emissions) modeling over the entire 90-mile project extent would not be practical because many combinations of adjacent construction activity types would occur over the length of each subsection. Therefore, localized effects for short-term emissions in each subsection were evaluated for potential construction of 1,000-foot sections of track where concurrent construction activity types could take place. Anywhere from one to three track orientations were modeled depending on alignment, with receptors located either adjacent or close to the rail line right-of-way.

Trench construction of the below-grade rail segment—The construction emissions associated with trench construction include phases such as demolition, cast-in-place drilled pier construction, excavation for slurry wall and trench, base slab formwork, concrete slab and walls pouring. The locations for trench construction are well defined and limited to the Morgan Hill and Gilroy Subsection for Alternative 2. Therefore, localized effects for this subsection were evaluated for potential construction of the entire trench rail segment, with receptors located either adjacent or close to the rail line right-of-way.

Tunnel construction and ventilation shafts for the rail segment—The construction emissions associated with tunnel construction include phases such as tunnel boring,[4] muck handling (earth removal), forming and pouring of interior and upper walls and floors, and track bed construction. The locations for tunnel construction are well defined and limited to the Pacheco Pass Subsection and the Morgan Hill and Gilroy Subsection. Therefore, localized effects for these subsections were evaluated for potential construction of the entire tunnel rail segment. For the longest tunnel over the Pacheco Pass (13.6 miles), effects were evaluated at tunnel openings and for three ventilation shaft locations. The shorter tunnel as part of the Morgan Hill and Gilroy Subsection was evaluated for air quality effects at the tunnel openings.

Cut and fill for the rail segment—The construction emissions associated with cut-and-fill construction include phases such as land clearing, excavation, compact filling and slope finishing, and track bed construction. As in the case for berm construction, the cut-and-fill construction long-term activities were modeled for the entire 90-mile project extent; however, for short-term emissions (maximum daily emissions) modeling over the entire 90-mile project extent would not be practical because many combinations of adjacent construction activity types would occur over the length of each subsection. Therefore, localized effects for short-term emissions in each subsection were evaluated for potential construction of 1,000-foot sections of track where concurrent activity types could take place. Anywhere from one to three track orientations were modeled depending on alignment, with residential receptors located either adjacent or close to the rail line right-of-way.

Operation of concrete batch plants to support construction—Concrete batch plants and storage areas would be located near the west portal of the shorter tunnel and at the east and west portal of the longer tunnel that traverses the Pacheco Pass. The emissions from these plants were modeled at the proposed locations for these facilities. To capture the maximum effects, modeling results from the concrete batch plant were coupled with the maximum rail segment construction.

[4] The tunnel-boring machine would be electrically powered so there would be no direct on-site emissions.

4 CONSTRUCTION EMISSIONS AND EMISSION RATES

Air quality analyses were performed for two types of construction emission scenarios: (1) long-term (annual) mitigated emissions that characterized maximum annual average activity for each construction year (2022–2028) and source type of construction by subsection and (2) short-term mitigated emissions that characterized the maximum daily emissions for each subsection and source type of construction. The methods for modeling of each source type and determination of the maximum emission rate addressed both long-term and short-term emissions.

4.1 Long-Term

Long-term construction emissions were modeled as follows.

- Identify source type(s): embankment, aerial, tunnel, cut and fill, and trench
  - Embankment, aerial, and cut and fill were best characterized as area sources.
  - Tunneling activity was characterized as a horizontal point source at portal openings and a capped point source at ventilation shafts.
  - Trenching activity was modeled as an open-pit source.
- Determine the annual emissions for each source type and calculate the maximum annual criteria pollutant emissions for each of the 7 years (2022–2028).
- Use the information from the engineering construction analysis for the linear distance of construction for each source type and calculate the source-type emissions for the particular linear length for the AERMOD-modeled subsection.
- Express the emissions in units of grams per second (g/s) using an activity level of 250 days a year and 8 hours a day (except 365 days a year and 24 hours a day for the tunnel construction).
- Determine the maximum on-site emission density for each pollutant using the maximum year emission rate.
- Include the off-site activity (e.g., haul trucks) and include adjacent emission density for each modeled area source using a width of 12 feet. Maximum ballast emissions are included in the off-site modeling.

4.2 Short-Term

Short-term construction emissions were modeled as follows:

- Determine the maximum daily emissions for each construction activity subsection (e.g., berm activity concrete work and retaining walls may be done concurrently, as well as formwork and earthwork).
- For each subsection, determine the maximum daily emissions from among the 7 years (2022–2028)
- Each construction subsection is resolved to 1,000 linear feet within the engineering construction analysis. To determine the emissions density for the AERMOD air dispersion modeling (Section 5, Dispersion Modeling), divide the maximum daily emissions for each subsection by the total number of 1,000-foot segments.
- Express the emissions from pounds per day to g/s assuming 8 hours a day (except 24 hours a day for tunnel construction).
- Determine the emission density for each modeled subsection, model the subsection, and combine concentration results for activities that may occur in parallel.

Finally, the concrete batch plant fugitive dust contains several metals and sulfates that have chronic and acute health effects. These metals include arsenic, beryllium, cadmium, nickel, manganese, selenium, and lead. The emissions of these air contaminates from the concrete batch plants were based on the PM emissions and a speciation factor for each pollutant appropriate for concrete batching. The speciation factors were determined as the portion of the PM emissions composed of these pollutants based on the BAAQMD Permit Handbook on emission factors concrete batch plants (BAAQMD 2016).

5 DISPERSION MODELING

Because the project construction activities have the potential to cause adverse health effects, detailed dispersion modeling analyses were conducted to determine whether these effects would be significant. The U.S. Environmental Protection Agency's (USEPA) AERMOD atmospheric dispersion model was used to simulate physical conditions and predict pollutant concentrations near the construction work areas using historical meteorological data. This allowed for an assessment of the local air quality effects from the construction emissions.

AERMOD is the USEPA's recommended air dispersion model for near-field modeling from vented and unvented (fugitive) sources. The model uses hourly meteorological observations and emission rates to determine hourly average concentrations from which other averaging periods (3-hour, 24-hour, annual averages) are determined. The detailed information on the methods and data used to conduct the air dispersion modeling is summarized here and in Sections 6.4.8 and 6.4.9, Other Localized Construction Effects, of the Air Quality and Greenhouse Gases Technical Report.

5.1 Inputs

5.1.1 Model and Inputs

AERMOD (version 18081) was used to conduct the modeling analysis. All calculation inputs are identical between the simulations used in the health risk assessments and for air quality (those used for comparison of the NAAQS and CAAQS), except for site-specific health risk receptor placement, which was located at the nearest residential locations. The modeling used terrain height information in the analysis. No removal through deposition of air contaminants was considered, and the FASTAREA computation method was used for all area sources. AERMOD's urban dispersion option was used in the analysis for locations between San Jose and Gilroy. The rural dispersion algorithm was used in the analysis for locations south and east of Gilroy and into the San Joaquin Valley.

5.1.2 Meteorological Data

AERMOD requires meteorological data as input into the model. These data are typically processed using AERMET and AERSURFACE, preprocessors to AERMOD. AERMET requires surface meteorological data, upper air meteorological data, and surface parameter data (supplied from AERSURFACE).

The SJVAPCD has meteorological datasets developed for use in air quality modeling within its boundaries. The dataset used in this analysis was based on data derived from a mesoscale meteorological model (MM5) that uses historical meteorological data to develop meteorological data where there are no airports (in this case, Los Banos). Five years of hourly meteorological data (2004–2008) were used in the Merced County portion of the analysis.

The BAAQMD has meteorological preprocessed data based on observations from San Jose International Airport for surface observations and Oakland International Airport for upper air data. Five years of meteorological data (2009–2013) were used in the analyses for the San Jose Diridon Station Approach and Monterey Corridor Subsections.

The BAAQMD had meteorological data available from an instrumented tower located in San Martin for the period 2010–2014. Use of this data required AERMET processing for use in the AERMOD model.

Meteorological data used in the creation of the San Martin AERMET data for input to AERMOD are shown in Table 1.

Table 1 Meteorological Data for AERMET Processing at the San Martin Site

Site ID	Site Name	Latitude	Longitude	Elevation	Source of Data
7901	San Martin	37.086	121.601	85.3	BAAQMD
23293/KSJC	San Jose Intl.	37.359	112.924	15.5	ftp://ftp.ncdc.noaa.gov/pub/data/noaa/
23230/OAK	Oakland Intl.	37.750	122.220	6	http://esrl.noaa.gov/raobs/
047821	San Jose Climate Station	37.333	121.900	19.5	http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7821

Source: BAAQMD 2017; NOAA 2017a, b; WRCC 2017
deg N = degrees north
deg W = degrees west
m = meters
BAAQMD = Bay Area Air Quality Management District

The surface data for the San Martin site was available in the ONSITE format required by AERMET for the period 2010–2014. Upon the suggestion of the BAAQMD (Cordova pers. comm.; BAAQMD 2016), data from San Jose International Airport were used for cloud cover when processing the ONSITE data, precipitation data from the San Jose Climate Station were used to determine surface moisture conditions for use in AERSURFACE, and data from the Oakland upper-air site at Oakland International Airport were used to represent conditions aloft.

5.1.2.1 AERSURFACE Processing

The National Land Cover Dataset 1992 (NLCD92) (Vogelmann et al. 2001) was downloaded[5] and used with AERSURFACE (version 13016) to provide the surface parameters for the third stage of AERMET. The coordinates of the San Martin BAAQMD meteorological site were used to determine surface characteristics in AERSURFACE. AERSURFACE was run with specifications that the area was not arid and that the site was not at an airport. Per the BAAQMD's recommendation (Cordova pers. comm; BAAQMD 2016), five sectors were used for San Martin processing to account for variations in land cover near the measurement site:

- SECTOR 1: 48–186 degrees
- SECTOR 2: 186–237 degrees
- SECTOR 3: 237–284 degrees
- SECTOR 4: 284–342 degrees
- SECTOR 5: 342–48 degrees

The study radius for surface roughness was set at 1 kilometer. The monthly seasonal profile used is shown in Table 2.

Table 2 Monthly Seasonal Profile at the San Martin Site

Months	Season
November, December, January	Late autumn after frost and harvest or winter with no snow
February, March	Transitional spring with partial green coverage or short annuals
April, May, June, July	Midsummer with lush vegetation
August, September, October	Autumn with unharvested cropland

[5] http://landcover.usgs.gov/natllandcover.php

AERSURFACE was run separately specifying dry, average, and wet surface moisture, and the results were later used to create composite surface characteristics for the third stage of AERMET.

5.1.2.2 Determination of Dry, Average, and Wet Months

Based on recommendations from BAAQMD (Cordova pers. comm.; BAAQMD 2016) and information provided in the AERSURFACE users' guide, each month in the modeling period was classified as either dry, average, or wet, and this information was later used in Stage 3 of AERMET. The rainfall data for the San Jose Climate Station for the 30-year period ending 2015 were gathered, and 30-year monthly averages were computed for each month. The monthly statistics for a given month were not used in the average if more than 5 days of data were missing in a given month. The next step was to compute the ratio of the monthly precipitation total for a given month during the modeling period and the corresponding 30-year monthly average. If the ratio was less than 0.5, the month was designated as dry. If the ratio was greater than or equal to 0.5 but less than 2, the month was designated as average. If the ratio was greater than or equal to 2, the month was designated as wet. Table 3 provides the information for the moisture classification of the region.

Table 3 Precipitation at the San Jose Climate Site

YEAR	Precipitation (in)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2010	4.58	2.12	2.05	2.99	0.35	0	0	0	0	0.25	1.76	3.05
2011	0.96	3.15	4.32	0.2	0.4	1.51	0	0	0	0.77	0.7	0.08
2012	0.9	0.67	1.98	1.88	0	0.15	0	0	0.01	0.35	2.58	4.24
2013	0.69	0.37	0.87	0.26	0.01	0.04	0	0	0.66	0	0.77	0.13
2014	0.12	2.65	1.35	0.64	0	0.01	0	0	0.36	0.62	1.57	7.74
30 year mean (1986–2015)	2.56	3.04	2.20	1.07	0.53	0.15	0.01	0.02	0.15	0.66	1.30	22.73
Ratio to 30-Year Mean												
2010	1.79	0.70	0.93	2.79	0.66	0.00	0.00	0.00	0.00	0.38	1.35	1.12
2011	0.38	1.04	1.96	0.19	0.76	10.04	0.00	0.00	0.00	1.16	0.54	0.03
2012	0.35	0.22	0.90	1.75	0.00	1.00	0.00	0.00	0.07	0.53	1.99	1.55
2013	0.27	0.12	0.40	0.24	0.02	0.27	0.00	0.00	4.44	0.00	0.59	0.05
2014	0.05	0.87	0.61	0.60	0.00	0.07	0.00	0.00	2.42	0.94	1.21	2.84

YEAR	Precipitation (in)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Moisture Classification												
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2010	avg	avg	avg	wet	avg	dry	dry	dry	dry	dry	avg	avg
2011	dry	avg	avg	dry	avg	wet	dry	dry	dry	avg	avg	dry
2012	dry	dry	avg	avg	dry	avg	dry	dry	dry	avg	avg	avg
2013	dry	dry	dry	dry	dry	dry	dry	dry	wet	dry	avg	dry
2014	dry	avg	avg	avg	dry	dry	dry	dry	wet	avg	avg	wet

Source: WRCC 2014
in = inches
avg = average

5.1.2.3 AERMET

Version 15181 of AERMET was used to process the meteorological data. The first step used data from the Oakland upper-air soundings with the MODIFY option turned on. San Jose International Airport data were used for the SURFACE portion of the processing, and San Martin on-site data were used for the ONSITE portion. The missing flags were set per BAAQMD recommendations (Cordova pers. comm.; BAAQMD 2016) and are shown in Tables 4 and 5.

Table 4 AERMET Single-Value and Date/Time Variable Descriptions and QA Values

AERMET Name	Description	Units	Missing Indicator	Lower Bound	Type	Upper Bound
OSDY	Day		-9	1	<=	31
OSMP	Month		-9	1	<=	12
OSYR	Year		-9	0	<=	99
OSHR	Hour		-9	0	<=	24
PAMT	Precipitation	cm	999	0	<=	100
INSO	Insulation	watts/square meter	9999	0	<	1250

Sources: Cordova pers. comm.; BAAQMD 2016; USEPA 2016
cm = centimeter

Table 5 AERMET Multi-value Variable Descriptions and Quality Assurance Values

AERMET Name	Description	Units	Missing Indicator	Lower Bound	Type	Upper Bound
TT01	Temperature	degrees Centigrade	99	-30	<	46
WS01	Wind speed	meters / second	999	0	<	50
WD01	Wind direction	degrees from north	999	0	<=	360
RH01	Relative humidity	percent	999	0	<=	100
DP01	Dew-point temperature	degrees Centigrade	99	-65	<	35
SA01	Standard deviation, horizontal wind	degrees	999	0	<	104

Sources: Cordova pers. comm.; BAAQD 2016; USEPA 2016

The second step was a simple merging of the quality assurance files produced from step one. The third step was to set the following options per BAAQMD suggestion (Cordova pers. comm.; BAAQMD 2016):

- SUBNWS option was turned off. REFLEV SUBNWS was not turned on, so entire substitution of all meteorological parameters was not used.
- METHOD CCVR SUB_CC was turned on; therefore, cloud cover substitution from the NWS site was performed.
- METHOD TEMP SUB_TT was turned on; therefore, temperature substitution from the NWS site was performed.

This final step was repeated separately for each of the 5 years. The surface characteristics portions of the input files were created by using the AERSURFACE output corresponding to the moisture characteristics of each month and year. The output message and report files were checked for error messages. The error messages were examined and the errors were corrected when possible. Warning messages were also reviewed. In some cases, changes in inputs were made based on warnings (e.g., discrepancies in elevations provided in site list files and in the actual data). In other cases, they were left unchanged (e.g., variations in elevations throughout the data files). Other warnings regarding missing data and substituted data were noted, but no changes were made to the data.

- **Terrain—**Terrain information for modeling used terrain data available from the National Elevation Dataset at 1/3 arc-second database.
- **Receptors—**Receptors were modeled using a network of discrete receptors. Details on the spacing, height, and layout are provided in Sections 6.4.8 and 6.4.9 of the Air Quality and Greenhouse Gases Technical Report.
- **Source parameters—**Details on the source type configurations, release height, and spatial dimensions are provided in Section 6.4.8 (Tables 6-6 and 6-7) of the Air Quality and Greenhouse Gases Technical Report. Construction is modeled as occurring 5 days per week with 8-hour days (250 days per year), except for construction of the tunnels, which occurs 7 days per week, 24 hours per day. For the non-tunnel emissions, AERMOD's HRDOW7 option was used to have emissions occur from 8:00 a.m. to 4:00 p.m., Monday through Friday.

5.2 Output Options

The dispersion model outputs hourly concentrations and these can be expressed in terms of different averaging periods, such as hourly, daily, and annual, in the same form as the air quality standard. The averaging times used for the ambient air quality standards and concentration thresholds are different for each pollutant. To compare the model results to the applicable ambient air quality standards and thresholds, criteria pollutant concentrations were calculated relative to the form of the air quality standard for the CAAQS and the NAAQS.

AERMOD output files and Hotspots Analysis and Reporting Program (HARP) Risk Assessment Standalone Tool (RAST) summary output files for the simulations are available upon request.

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