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HIGHLAND FAIRVIEW WORLD LOGISTICS CENTER ADDITIONAL INFORMATION REGARDING POTENTIAL HEALTH EFFECTS OF AIR QUALITY IMPACTS

MORENO VALLEY, CALIFORNIA

RAMBOLL

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1. INTRODUCTION

This report presents an estimate of the potential health effects of the emissions of criteria pollutants that may result from the construction and operation of the Highland Fairview World Logistics Center Project (the Project).[1]

FRIANT RANCH DECISION

As background, Environmental Impact Reports (EIRs) prepared pursuant to the California Environmental Quality Act (CEQA) have long evaluated project-related health effects of toxic air contaminants, such as diesel particulate matter, through quantitative and/or qualitative means relative to air district-issued thresholds of significance. However, EIRs historically have not evaluated the specific health effects of project-related increases in criteria pollutants, other than to note and summarize scientific literature regarding the general effect of those pollutants on health. Instead, in accordance with air district-issued thresholds of significance and industry standard practice at the time, CEQA analysis historically and traditionally focused on estimating project-related mass emissions totals for criteria pollutants and, in certain cases, conducting dispersion modeling to assess impacts on local ambient air quality concentrations.

In December 2018, the California Supreme Court issued its decision in *Sierra Club v. County of Fresno* (2018) 6 Cal.5th 502 (hereinafter referred to as "the Friant Ranch decision"). The Court noted that the EIR at issue in the Friant Ranch decision disclosed the project's significant impacts attributable to the emissions of criteria pollutants, including oxides of nitrogen (NOx), and particulate matter (PM), but did not correlate the project's emissions to health effects. In finding the EIR inadequate in that respect, the Court held that the EIR should have "relate[d] the expected adverse air quality impacts to likely health consequences or explain[ed] in meaningful detail why it is not feasible at the time of drafting to provide such an analysis, so that the public may make informed decisions regarding the costs and benefits of" the project. (Id. at p. 510.)

CEQA practitioners and other expert agencies (like air districts) are still developing tools and methodologies to provide the type of CEQA analysis described in the Friant Ranch decision. In this report, Ramboll presents one method that can be used to correlate project-related mass emissions totals for criteria pollutants to estimated health effects. More specifically, in order to estimate the health effects of the increases of criteria pollutants for the Project, Ramboll applied a photochemical grid model (PGM), Comprehensive Air Quality Model with extensions (CAMx), to estimate the small increases in concentrations of ozone and $PM_{2.5}$ in the region as a result of the emissions of criteria and precursor pollutants from the Project. Ramboll then applied a U.S. Environmental Protection Agency (USEPA)-authored program, the Benefits Mapping and Analysis Program (BenMAP)[2], to estimate the resulting health effects from the small increases in concentration. Only the health effects of ozone and $PM_{2.5}$ are estimated, as those are the pollutants that USEPA uses in BenMAP to estimate the health

[1] Criteria pollutants are those pollutants with an air pollution standard or pollutants which are precursors to those with a standard. Pollutants with an air pollution standard include nitrogen dioxide, sulfur dioxide (SO_2), ozone, carbon monoxide (CO), particulate matter smaller than 2.5 microns in diameter and 10 microns in diameter, and ozone. Precursor pollutants to criteria pollutants include oxides of nitrogen (NOx), oxides of sulfur (SOx), carbon monoxide (CO), and volatile organic compounds (VOCs).

[2] https://www.epa.gov/benmap/benmap-ce-manual-and-appendices.

effects of emissions of NOx, VOCs, CO, SO_2, and $PM_{2.5}$. Ozone and $PM_{2.5}$ have the most critical health effects and thus are the emissions evaluated to determine the Project's health effects.

ADDITIONAL EVALUATION

In light of the Friant Ranch decision, this analysis estimates the health effects of criteria pollutants and their precursors, specifically those that are evaluated by the USEPA in rulemaking setting the national ambient air quality standards: NOx, VOC [also known as reactive organic gases, or ROG, which are virtually the same as VOC with some slight differences][3],CO, ozone, SO_2, and $PM_{2.5}$. USEPA's default health effect functions in BenMAP for PM use fine particulate matter ($PM_{2.5}$) as the causal PM agent, so the health effects of PM_{10} are represented using $PM_{2.5}$ as a surrogate. NOx and VOCs are not criteria air pollutants but, in the presence of sunlight, they form ozone and contribute to the formation of secondary $PM_{2.5}$ and thus are analyzed here. As a conservative measure, SO_2 and CO are evaluated due to their small contribution to the formation of secondary $PM_{2.5}$ and ozone. The health effects from ozone and $PM_{2.5}$ are examined for this Project because the USEPA has determined that these criteria pollutants would have the greatest effect on human health. The emissions of other criteria and precursor pollutants, including VOC, NOx, CO and SO_2, are analyzed in their contribution in the formation of ozone and secondary $PM_{2.5}$.

Additionally, NO_2 and CO concentration changes due to the Project are not evaluated here individually, as a localized significance threshold (LST) analysis has been performed as presented in Section 4.3 of the Draft Recirculated Revised Sections of the Final Environmental Report (Draft Recirculated RSFEIR), where Project plus background contributions are compared to the National Ambient Air Quality Standards (NAAQS). The NAAQS are health based thresholds and thus a direct comparison against such thresholds allows evaluation of potential health effects. Further, there are currently no NO_2 non-attainment areas in the United States, even after the 1-hour standard was implemented. Similarly, SO_2 concentration changes are also not individually evaluated here as there are no current SO_2 non-attainment areas in the state of California. Even so, as noted above, contributions of NOx, CO, and SO_2 are all still evaluated here in their contribution to the formation of ozone and secondary $PM_{2.5}$, the two criteria pollutants the USEPA has determined to have the greatest effect on human health.

The evaluation presented herein serves to describe the potential health effects of the criteria pollutant emissions disclosed in Section 4.3 of the Project's Draft Recirculated RSFEIR. This evaluation does not make a new significance determination, as the Project's air quality impacts were already found to be significant and unavoidable. Instead, this evaluation provides additional information regarding the potential health effects of the previously identified significant air quality impacts.

[3] Reactive organic gas (ROG) emissions are quantified and modeled as VOCs in this assessment. ROG means total organic gases minus the California Air Resources Board's (ARB's) "exempt" compounds (e.g., methane, ethane, CFCs, etc.). ROG is similar, but not identical, to USEPA's term "VOC", which is based on USEPA's exempt list, which is slightly different from ARB's list.

2. TECHNICAL APPROACH

The first step in the process is to run the PGM with appropriate information to assess the small increases in ambient air concentrations of pollutants that the Project emissions may cause. PGMs require a database of information, including the spatial allocation of emissions, in the area to be modeled. This includes both base (background/existing) emissions and Project emissions. The latest publicly available PGM database for Southern California, which contains base emissions, was developed by the South Coast Air Quality Management District (SCAQMD) in support of its adopted 2016 Air Quality Management Plan (AQMP)[4] and was adapted for use in this analysis. This PGM database is tailored for Southern California using California-specific input tools (e.g., the Emission FACtors (EMFAC)[5] mobile source emissions model) and uses a high-resolution 4- kilometer (km) horizontal grid to better simulate meteorology and air quality in the complex terrain and coastal environment of California.

Project emissions included NO_X, SO_2, CO, respirable (PM_{10}) and fine ($PM_{2.5}$) primary particulate matter (PM), and VOCs. As discussed above, NO_X and VOC are precursors to ozone and, along with SO_2, are also precursors to secondarily formed $PM_{2.5}$. CO also plays a smaller role in the formation of ozone and is thus conservatively evaluated here.

The USEPA's air quality modeling guidelines (Appendix W[6]) and ozone and $PM_{2.5}$ modeling guidance[7] recommend using a PGM to estimate ozone and secondary $PM_{2.5}$ concentrations. The USEPA's modeling guidance does not recommend specific PGMs but provides procedures for determining an appropriate PGM on a case-by-case basis. Both the modeling guidelines and guidance note that the CAMx[8] and the Community Multiscale Air Quality (CMAQ[9]) PGMs have been used extensively in the past and would be acceptable PGMs. As such, the USEPA has prepared a memorandum[10] documenting the suitability for using CAMx and CMAQ for ozone and secondary $PM_{2.5}$ modeling of single-sources or group of sources.

To estimate the potential outcome of the Project's emissions on ambient air concentrations, the Project's unmitigated and mitigated emissions were added to the CAMx 4-km annual PGM modeling database.[11] Operational and construction emissions from the Project were estimated as described in Section 4.3 of the Draft Recirculated RSFEIR.[12] For this analysis, both unmitigated and mitigated Project emissions were evaluated. In both cases, total emissions modeled reflect the maximum combined (operational + construction) emissions by

4 https://www.aqmd.gov/home/air-quality/clean-air-plans/air-quality-mgt-plan/final-2016-aqmp.

5 https://www.arb.ca.gov/emfac/.

6 https://www3.epa.gov/ttn/scram/appendix_w/2016/AppendixW_2017.pdf.

7 https://www3.epa.gov/ttn/scram/guidance/guide/O3-PM-RH-Modeling_Guidance-2018.pdf.

8 http://www.camx.com/.

9 https://www.epa.gov/cmaq.

10 https://www3.epa.gov/ttn/scram/guidance/clarification/20170804-Photochemical_Grid_Model_Clarification_Memo.pdf.

11 SCAQMD performed Weather Research and Forecasting (WRF) meteorological modeling for the 4-km domain and 2012 calendar year that has been processed by WRFCAMx to generate CAMx 2012 4-km meteorological inputs for the domain. The CMAQ 2012 emissions have been converted to the format used by CAMx using the CMAQ2CAMx processor.

12 To the extent that the Draft Recirculated RSFEIR used conservative inputs to estimate Project-related criteria pollutants and precursors, the analysis provided herein also is conservatively influenced by those inputs.

pollutant. These maxima may occur in different years for different pollutants, though each pollutant's maximum year is conservatively analyzed collectively in a single year assessment. Full operational emissions (at Project buildout) were modeled for all pollutants, and the balance of emissions were allocated to construction sources, with the distribution of emissions types representative of the maximum construction years. This allows for analysis of the worst-case emissions scenario over a single construction or operational year. Full operational emissions (at Project buildout) are expected to have the greatest contribution to health effects due to the proximity of the mobile source emissions to dense population centers, and thus were modeled in full. Additional construction emissions were evaluated to conservatively represent a potential year where construction and operation may coincide, though in reality the situation of full operations plus construction is hypothetical, and conservative for the purposes of this analysis.

For use in PGMs, each Project emissions source must be spatially distributed across the modeling grid cells so that they can be incorporated into the gridded emission inventory. Operational emissions include area sources (architectural coatings, VOCs in consumer products, and landscaping equipment), emergency generators, off-road equipment, and emissions associated with motor vehicle use. Construction emissions include off-road equipment, paving, architectural coatings, fugitive dust, and emissions associated with hauling, vendor, and worker activity. Operational area sources and off-road equipment emissions were evenly distributed within the Project site. Emergency generator emissions were evenly distributed across all emergency generator point source locations. The operational mobile source category includes both passenger vehicles and trucks. The operational mobile sources are also spatially distributed in both the site's grid cells, as well as the grid cells for the local and regional roadways with Project travel. Non-road construction emissions (off-road equipment, paving, architectural coating, and fugitive dust) were allocated to specific plots within the Project area. On-road mobile construction emissions were spatially distributed to the Project site and nearby roadways. Annual emission estimates from the Project were spatially gridded, temporally allocated, and chemically speciated to be used for photochemical grid modelling using the Sparse Matrix Operator Kerner Emissions (SMOKE) emissions modelling system supported by the USEPA. The emissions inventories, spatial allocation, and SMOKE inputs and outputs are shown in **Appendix A.**

As discussed above, the SCAQMD's Southern California 2016 AQMP modeling database was used for this Project. The Southern California 4-km CAMx modeling database is based on a 2012 base meteorological year and includes future year emission scenarios. The 2031 future year projections were used for this analysis, as that is the nearest future year to full operational buildout with base emissions available as of the date of this report. The Project's emissions were tagged for treatment by the source apportionment tools in CAMx to obtain the incremental ozone and $PM_{2.5}$ concentration changes due to the Project's emissions. More details and inputs for the PGM modeling are included in **Appendix B.**

Following completion of the CAMx source apportionment modeling, Ramboll used the USEPA's BenMAP[13, 14] program to estimate the potential health effects of the Project's

[13] https://www.epa.gov/benmap/how-benmap-ce-estimates-health-and-economic-effects-air-pollution.

[14] https://www.epa.gov/sites/production/files/2015-04/documents/benmap-ce_user_manual_march_2015.pdf.

contribution to ozone and $PM_{2.5}$ concentration. BenMAP uses the concentration estimates produced by CAMx, along with population and health effect concentration-response (C-R) functions, to estimate various health effects of the concentration increases. BenMAP has a wide history of applications by the USEPA and others, including for local-scale analysis[15] as needed for assessing the health effects of a project's emissions. Ramboll used the USEPA default BenMAP health effects C-R functions that are typically used in national rulemaking, such as the health effects assessment[16] for the 2012 $PM_{2.5}$ National Ambient Air Quality Standard (NAAQS). The health effects estimated for $PM_{2.5}$ include mortality (all causes), hospital admissions (respiratory, asthma, cardiovascular), emergency room visits (asthma), and acute myocardial infarction (non-fatal). For ozone, the endpoints estimated include mortality, emergency room visits (respiratory) and hospital admissions (respiratory). BenMAP applies "effect functions" to calculate incremental health effects from incremental changes in PM and ozone, and an underlying assumption is that there is a causal link between PM and ozone exposures and health effects. The effect functions are derived from statistical correlations reported in epidemiologic studies that compare fluctuations in air pollutant levels measured at central monitors against small fluctuations in population-wide health effects. These are statistical correlations and do not establish a cause-and-effect relationship between small fluctuations in the level of one (or many) ambient air pollutants and health effects, particularly mortality. For example, there is no toxicological or experimental study that has demonstrated or supported that small incremental changes in PM concentrations as a whole, or major PM components, at ambient levels can cause any serious health effects, let alone death (USEPA, 2009). That being said, in an overabundance of caution, and as an expression of the precautionary principal, BenMAP uses these studies to characterize the potential human health effect of small changes in PM and ozone concentrations. Details on the BenMAP inputs and outputs and definitions for the health effects are shown in **Appendix C.**

[15] https://www.epa.gov/benmap/benmap-ce-applications-articles-and-presentations#local.

[16] https://www3.epa.gov/ttn/naaqs/standards/pm/data/PM_RA_FINAL_June_2010.pdf.

3. RESULTS

This section presents the results of the health effects analysis for the incremental increases in $PM_{2.5}$ and ozone resulting from primary and precursor emissions for these constituents. The results presented here describe the potential health effects of the criteria pollutant emissions already disclosed in Section 4.3 of the Draft Recirculated RSFEIR, and the results themselves do not constitute a new significance determination, as the Project's air quality impacts were already found to be significant and unavoidable.

It is important to note there are a number of conservative assumptions built into this evaluation, beginning with the quantification of emissions themselves. These conservative assumptions include, but are not limited to, the following:

- Potential reductions due to mitigation measure 4.3.6.2A(d) which restricts idling of all diesel powered construction equipment, delivery vehicles, and delivery trucks to three minutes has conservatively not been accounted for (discussed further in Appendix A).
- Evaluation of full operational emissions at Project buildout, plus additional construction emissions to reflect the potential maximum combined year (discussed further in Appendix A);
- Assumption that health effects occur at any concentration, including small incremental concentrations (discussed further in Appendix C);
- Assumption that all $PM_{2.5}$ is of equal toxicity (discussed further in Appendix C);

As such, results presented below are meant to represent an upper bound of potential health effects, and actual effects may be zero.

POTENTIAL PROJECT HEALTH EFFECTS

Overall, the estimated health effects from ozone and $PM_{2.5}$ are minimal in light of background incidences. **Tables 3-1 through 3-4** below show the annual percent of background health incidence for $PM_{2.5}$ and Ozone health effects associated with the Unmitigated and Mitigated Project, respectively. The "background health incidence" is the actual incidence of health effects (based on available data) as estimated in the local population in the absence of additional emissions from the Project.[17] When taken into context, the small increase in incidences and the very small percent of the number of background incidences indicate that these health effects are minimal in a developed, urban environment.

[17] Background health statistics were obtained from data included in the BenMAP model, and the sources are referenced in the BenMAP manual (USEPA, 2018). For example, EPA obtained mortality rates from the Centers for Disease Control (CDC) WONDER database, and hospital admissions rates from the Healthcare Cost and Utilization Project (HCUP).

Unmitigated Project Health Effects

Table 3-1. BenMAP-Estimated Annual Mean $PM_{2.5}$ Health Effects of the Unmitigated Project Emissions Across the Southern California Model Domain [1]

Health Endpoint[2]	Annual Percent of Background Health Incidence (%)	Background Health Incidence (Annual)
Emergency Room Visits, Asthma [0-99]	0.0051%	130,805
Mortality, All Cause [30-99]	0.0047%	325,048
Hospital Admissions, Asthma [0-64]	0.0029%	17,730
Hospital Admissions, All Cardiovascular (less Myocardial Infarctions) [65-99]	0.00063%	224,047
Hospital Admissions, All Respiratory [65-99]	0.0016%	193,354
Acute Myocardial Infarction, Nonfatal [18-24]	0.0020%	36
Acute Myocardial Infarction, Nonfatal [25-44]	0.0021%	1,904
Acute Myocardial Infarction, Nonfatal [45-54]	0.0020%	5,241
Acute Myocardial Infarction, Nonfatal [55-64]	0.0020%	9,226
Acute Myocardial Infarction, Nonfatal [65-99]	0.0019%	40,966

[1] Health effects are shown terms of incidences of each health endpoint and how it compares to the base values (2035 base year health effect incidences or "background health incidence"). Health effects and background health incidences are across the Southern California model domain.
[2] Affected age ranges are shown in square brackets.

Potential $PM_{2.5}$-related health effects associated with unmitigated Project-related increases in ambient air concentrations include asthma-related emergency room visits (6.63 incidences per year), asthma-related hospital admissions (0.52 incidences per year), all cardiovascular-related hospital admissions (not including myocardial infarctions) (1.42 incidences per year), all respiratory-related hospital admissions (3.17 incidences per year), mortality (15.19 incidences per year), and nonfatal acute myocardial infarction (less than 0.78 incidences per year for all age groups) (discussed further in Appendix C).

Table 3-2. BenMAP-Estimated Annual Mean Ozone Health Effects of the Unmitigated Project Emissions Across the Southern California Model Domain[1]

Health Endpoint[2]	Annual Percent of Background Health Incidence (%)	Background Health Incidence (Annual)
Hospital Admissions, All Respiratory [65-99]	0.00075%	193,354
Mortality, Non-Accidental [0-99]	0.00033%	210,692
Emergency Room Visits, Asthma [0-17]	0.014%	50,722
Emergency Room Visits, Asthma [18-99]	0.010%	80,084

[1] Health effects are shown terms of incidences of each health endpoint and how it compares to the base values (2035 base year health effect incidences, or "background health incidence"). Health effects and background health incidences are across the Southern California model domain.
[2] Affected age ranges are shown in square brackets.

Potential ozone-related health effects associated with unmitigated Project-related increases in ambient air concentrations include respiratory-related hospital admissions (1.46 incidences per year), mortality (0.69 incidences per year), and asthma-related emergency room visits for any age range (lower than 8.20 incidences per year for all age groups) (discussed further in Appendix C).

Mitigated Project Health Effects

Table 3-3. BenMAP-Estimated Annual Mean $PM_{2.5}$ Health Effects of the Mitigated Project Emissions Across the Southern California Model Domain [1]

Health Endpoint[2]	Annual Percent of Background Health Incidence (%)	Background Health Incidence (Annual)
Emergency Room Visits, Asthma [0-99]	0.0047%	130,805
Mortality, All Cause [30-99]	0.0044%	325,048
Hospital Admissions, Asthma [0-64]	0.0028%	17,730
Hospital Admissions, All Cardiovascular (less Myocardial Infarctions) [65-99]	0.00059%	224,047
Hospital Admissions, All Respiratory [65-99]	0.0015%	193,354
Acute Myocardial Infarction, Nonfatal [18-24]	0.0019%	36
Acute Myocardial Infarction, Nonfatal [25-44]	0.0020%	1,904
Acute Myocardial Infarction, Nonfatal [45-54]	0.0019%	5,241
Acute Myocardial Infarction, Nonfatal [55-64]	0.0019%	9,226
Acute Myocardial Infarction, Nonfatal [65-99]	0.0018%	40,966

[1] Health effects are shown terms of incidences of each health endpoint and how it compares to the base (2035 base year health effect incidences, or "background health incidence"). Health effects and background health incidences are across the Southern California model domain.
[2] Affected age ranges are shown in square brackets.

Potential $PM_{2.5}$-related health effects associated with mitigated Project-related increases in ambient air concentrations include asthma-related emergency room visits (6.2 incidences per year), asthma-related hospital admissions (0.49 incidences per year), all cardiovascular-related hospital admissions (not including myocardial infarctions) (1.33 incidences per year), all respiratory-related hospital admissions (2.98 incidences per year), mortality (14.17 incidences per year), and nonfatal acute myocardial infarction (less than 0.724 incidences per year for all age groups) (discussed further in Appendix C).

Table 3-4. BenMAP-Estimated Annual Mean Ozone Health Effects of the Mitigated Project Emissions Across the Southern California Model Domain[1]

Health Endpoint[2]	Annual Percent of Background Health Incidence (%)	Background Health Incidence (Annual)
Hospital Admissions, All Respiratory [65-99]	0.00062%	193,354
Mortality, Non-Accidental [0-99]	0.00027%	210,692
Emergency Room Visits, Asthma [0-17]	0.011%	50,722
Emergency Room Visits, Asthma [18-99]	0.0085%	80,084

[1] Health effects are shown terms of incidences of each health endpoint and how it compares to the base (2035 base year health effect incidences, or "background health incidence"). Health effects and background health incidences are across the Southern California model domain.
[2] Affected age ranges are shown in square brackets.

Potential ozone-related health effects associated with mitigated Project-related increases in ambient air concentrations include respiratory-related hospital admissions (1.20 incidences per year), mortality (0.56 incidences per year), and asthma-related emergency room visits for any age range (lower than 6.84 incidences per year for all age groups) (discussed further in Appendix C).

Because the health effects from ozone and $PM_{2.5}$ are minimal in light of background incidences, and health effects from other criteria pollutants would be even smaller, the health effects of those other criteria pollutants were not quantified.

POTENTIAL CUMULATIVE HEALTH EFFECTS

Maximum daily operational and construction emissions were estimated for 354 projects (herein referred to as "cumulative projects") in the region surrounding the Project, as described further in Section 4.3 of the Draft Recirculated RSFEIR. Maximum daily operational emissions for all cumulative projects are reflective of year 2035, consistent with the full buildout year for the Project. Construction emissions vary by project but occur within years 2020 through year 2035. To capture both potential operational and construction emissions from the cumulative projects in a single year, either maximum daily operational or construction emissions were used for each project, evaluated on a pollutant basis (shown in Appendix A).

Potential health effects from the cumulative project emissions can be generally characterized using the Project level modeling results and a comparison of overall emissions. Emissions from cumulative projects would be subject to the similar meteorological and photochemical reaction conditions as the Project assessment. The application of an overall scaling factor based on emissions, as presented here, is likely conservative since the cumulative projects are unlikely to have the same distribution of mobile emissions to the Los Angeles area as the Project.

Tables 3-5 and 3-6 below show the estimated annual percent of background health incidence for $PM_{2.5}$ and Ozone health effects associated with cumulative projects (including the unmitigated Project). When taken into context, the small percent of the number of background incidences indicate that these health effects are minimal in a developed, urban environment.

Table 3-5. Estimated Annual $PM_{2.5}$ Health Effects of Cumulative Project Emissions

Health Endpoint[2]	Annual Percent of Background Health Incidence (%)	Background Health Incidence (Annual)
Emergency Room Visits, Asthma [0-99]	0.16%	130,805
Mortality, All Cause [30-99]	0.14%	325,048
Hospital Admissions, Asthma [0-64]	0.09%	17,730
Hospital Admissions, All Cardiovascular (less Myocardial Infarctions) [65-99]	0.02%	224,047
Hospital Admissions, All Respiratory [65-99]	0.05%	193,354
Acute Myocardial Infarction, Nonfatal [18-24]	0.06%	36
Acute Myocardial Infarction, Nonfatal [25-44]	0.07%	1,904
Acute Myocardial Infarction, Nonfatal [45-54]	0.06%	5,241
Acute Myocardial Infarction, Nonfatal [55-64]	0.06%	9,226
Acute Myocardial Infarction, Nonfatal [65-99]	0.06%	40,966

[1] Estimated health effects are compared to the base (2035 base year health effect incidences) values across the Southern California model domain.

[2] Affected age ranges are shown in square brackets.

Potential $PM_{2.5}$-related health effects associated with increases in ambient air concentrations estimated from cumulative Projects (including the unmitigated Project) include asthma-related emergency room visits (204 incidences per year), asthma-related hospital admissions (16 incidences per year), all cardiovascular-related hospital admissions (not including myocardial infarctions) (44 incidences per year), all respiratory-related hospital admissions (98 incidences per year), mortality (467 incidences per year), and nonfatal acute myocardial infarction (less than 24 incidences per year for all age groups) (discussed further in Appendix C).

Table 3-6. Estimated Annual Ozone Health Effects of Cumulative Project Emissions

Health Endpoint[2]	Annual Percent of Background Health Incidence (%)	Background Health Incidence (Annual)
Hospital Admissions, All Respiratory [65-99]	0.02%	193,354
Mortality, Non-Accidental [0-99]	0.01%	210,692
Emergency Room Visits, Asthma [0-17]	0.31%	50,722
Emergency Room Visits, Asthma [18-99]	0.23%	80,084

[1] Estimated health effects are compared to the base (2035 base year health effect incidences) values across the Southern California model domain.

[2] Affected age ranges are shown in square brackets.

Potential ozone-related health effects associated with increases in ambient air concentrations estimated from cumulative Projects (including the unmitigated Project) include respiratory-related hospital admissions (33 incidences per year), mortality (16 incidences per year), and asthma-related emergency room visits for any age range (lower than 188 incidences per year for all age groups) (discussed further in Appendix C).

UNCERTAINTY

Analyses that evaluate the increases in concentrations resulting from individual sources, and the health effects of increases or decreases in pollutants as a result of regulation on a localized basis, are routinely done. This analysis does not tie the increase in concentration to a specific health effect in an individual; however, it does use scientific correlations of certain types of health effects from pollution to estimate increases in effects to the population at large.

There is a degree of uncertainty in these results from a combination of the uncertainty in the emissions themselves, the increase in concentration resulting from the PGM and the uncertainty of the application of the C-R increase. All simulations of physical processes, whether ambient air concentrations, or health effects from air pollution, have a level of uncertainty associated with them, due to simplifying assumptions. The overall uncertainty is a combination of the uncertainty associated with each piece of the modeling study, in this case, the emissions quantification, the emissions model, the PGM, and BenMAP. While these results reflect a level of uncertainty, regulatory agencies, including the USEPA have judged that, even with the uncertainty in the results, the results provide sufficient information to the public to allow them to understand the potential health effects of increases or decreases in air pollution (USEPA 2012).

The approach and methodology of this analysis ensures that the uncertainty is of a conservative nature. In addition to the conservative assumptions built into the emissions noted above, there are a number of assumptions built into the application of C-R functions in BenMAP that may lead to an overestimation of health effects. For example, for all-cause mortality health effects from $PM_{2.5}$, these estimates are based on a single epidemiological

study that found an association between $PM_{2.5}$ concentrations and mortality.[18] While similar studies suggest that such an association exists, there remains uncertainty regarding a clear causal link. This uncertainty stems from the limitations of epidemiological studies, such as inadequate exposure estimates and the inability to control for many factors that could explain the association between $PM_{2.5}$and mortality such as lifestyle factors like smoking. Several reviews have evaluated the scientific evidence of health effects from specific particulate components (e.g., Rohr and Wyzga 2012; Lippmann and Chen, 2009; Kelly and Fussell, 2007). These reviews indicate that the evidence is strongest for combustion-derived components of PM including elemental carbon (EC), organic carbon (OC) and various metals (e.g., nickel and vanadium); however, there is still no definitive data that points to any particular component of PM as being more toxic than other components. The USEPA has also stated that results from various studies have shown the importance of considering particle size, composition, and particle source in determining the health effects of PM (USEPA, 2009). Further, the USEPA (2009) found that studies have reported that particles from industrial sources and from coal combustion appear to be the most significant contributors to PM-related mortality, consistent with the findings by Rohr and Wyzga (2012) and others. This is particularly important to note here, as the majority of PM emissions generated from the Project are from entrained roadway dust, brakewear, and tirewear (see Appendix A), and not from combustion. Therefore, because they do not consider the relative toxicity of PM components, the results presented here are conservative.

Air pollution epidemiology studies are ecological studies. This means that they are population-based, observational epidemiological studies that look for patterns between population exposure and population disease rates. They do not use data at the individual level (e.g., correlations between regional mortality rates and community air pollution levels). Epidemiologists generally consider relative risks (RRs, a measure of the association between exposures and health effects) from these types of studies that are greater than 3 to 4 to reflect strong associations and to be supportive of a causal link, while smaller RRs (1.5 to 3) are considered to be weak, and require other lines of evidence (e.g., toxicological evidence, plausible biological mechanism) to demonstrate causality (Taubes 1995). For example, the RR of lung cancer for heavy smokers is in the range of 10 to 20, whereas PM associations with mortality yield RRs in the range of 1.01 to 1.05, i.e., very close to the RR = 1.0, which indicates little to no association.

Aside from the uncertainty as to the causal basis of the statistical associations in air pollution epidemiology studies of PM and mortality, some epidemiological studies have found no correlation between mortality and increased PM (Enstrom, 2005; 2017; Lipfert et al., 2000; Murray and Nelson, 2000; Greven et al., 2011; You et al.,2018; Zhou et al.,2015). Although there are a greater number of publications reporting a positive PM association for mortality compared to those reporting no association.

Another uncertainty highlighted by the USEPA (2012) that applies to potential health effects from both $PM_{2.5}$ and ozone, is the assumption of a log-linear response between exposure and health effects, without consideration for a threshold below which effects may not be

[18] For $PM_{2.5}$ mortality estimates, BenMAP relies on the study by Krewski et al. (2009). This study conducted multiple sensitivity analyses using different statistical model specifications. For all-cause mortality, the authors reported positive associations between exposures to $PM_{2.5}$ and all-cause mortality that ranged from a 3% to a 6% increase in mortality per increase in 10 ug/m^3 of $PM_{2.5}$, depending on the model used and the exposure data considered. The default USEPA value in BenMAP is the 6% increase, or double the low end of the range.

measurable. The issue of a threshold for $PM_{2.5}$ and ozone is highly debatable and can have significant implications for health effects analyses as it requires consideration of current air pollution levels and calculating effects only for areas that exceed threshold levels. Without consideration of a threshold, any incremental contribution to existing ambient air pollution levels, whether below or above the applicable threshold for a given criteria pollutant, is assumed to adversely affect health. Although the USEPA traditionally does not consider thresholds in its cost-benefit analyses, the NAAQS itself is a health-based threshold level that the USEPA has developed based on evaluating the most current evidence of health effects.

As noted above, the health effects estimation using this method presumes that effects seen at large concentration differences can be linearly scaled down to (i.e., correspond to) small increases in concentration, with no consideration of potential thresholds below which health effects may not occur. This methodology of linearly scaling health effects is broadly accepted for use in regulatory evaluations and is considered as being health protective (USEPA, 2010), but potentially overstates the potential effects. In summary, health effects presented are conservatively estimated, and the actual effects may be zero.

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APPENDIX A
EMISSIONS INVENTORY, SPATIAL ALLOCATION, AND SMOKE SETUP HIGHLAND FAIRVIEW WORLD LOGISTICS CENTER MORENO VALLEY, CALIFORNIA

1. INTRODUCTION

As set forth in Section 4.3 of the Project's Draft Recirculated Revised Sections of the Final Environmental Impact Report (Draft Recirculated RSFEIR), construction and operational emissions from the Project were estimated using methodologies consistent with the California Emissions Estimator Model (CalEEMod®) and Project-specific data, where available. The model employs widely accepted calculation methodologies for emission estimates combined with appropriate default data if site-specific information is not available. In order to allow for a more accurate representation of mobile source operational emissions associated with the Project, mobile source emission factors were estimated using EMFAC2017. These emission factors were then used to estimate mobile source operational emissions using Project-specific traffic data.

Annual emission estimates from the Project need to be spatially gridded, temporally allocated, and chemically speciated to be used for photochemical grid modeling. The Sparse Matrix Operator Kerner Emissions (SMOKE) emissions modeling system (Coats, 1996; Coats and Houyoux, 1996)[1] is used for this process.

Section 2 of this Appendix describes in detail the development of the gridded Project emissions.

2. PROJECT EMISSIONS AND SPATIAL ALLOCATION

Both unmitigated and mitigated emissions were estimated for the Project to support the photochemical grid model (PGM) and are allocated into 4 kilometer (km) x 4 km grid cells. This section describes those emissions and how they were spatially allocated.

2.1 Project Emissions and Spatial Allocation

For use in PGMs, emissions must be spatially allocated over the area so that they can be incorporated into the gridded emission inventory. The total unmitigated emission inventory for the Project is below in **Table 2-1a** and the total mitigated emission inventory for the Project is below in **Table 2-1b**. Mobile source emissions were split into sub-categories based on Project-specific data and EMFAC2017 emission rates. For particulate matter, less than 2.5 microns in diameter ($PM_{2.5}$) emissions are used in the modelling; less than 10 microns in diameter (PM_{10}) emissions are presented for information below.

All emissions listed in **Table 2-1a** represent the sum of the maximum daily unmitigated emissions for the maximum operational and maximum construction emission years. Total emissions modeled reflect the maximum combined (operational + construction) emissions by pollutant. These maxima may occur in different years for different pollutants, though each pollutant's maximum year is conservatively analyzed collectively in a single year assessment. Full operational emissions (at Project buildout) were modeled for all pollutants, and the balance of emissions were allocated to construction sources, with the distribution of emissions types representative of the maximum construction years. This allows for analysis of the worst-case emissions scenario over a single construction or operational year. Full operational emissions (at Project buildout) are expected to have the greatest contribution to health effects due to the proximity of the mobile source emissions to dense population centers, and thus were modeled in full. Additional construction emissions were evaluated to conservatively represent a potential year where construction and operation may coincide, though in reality the situation of full operations plus construction is hypothetical, and conservative for the purposes of this analysis.

[1] https://www.cmascenter.org/smoke/.

Table 2-1a. Maximum Daily Unmitigated Criteria Air Pollutant Emissions Estimates

Emission Category	ROG lbs/day	NOx lbs/day	PM_{10} lbs/day	$PM_{2.5}$ lbs/day	SO_2 lbs/day	CO lbs/day
Operational Emissions						
On-Road Mobile	45	1,361	388	125	9.63	867
Diurnal	1.96	0	0	0	0	0
Hotsoak	1.50	0	0	0	0	0
Idling Exhaust	5.7	35	0.18	0.18	0.07	80
Brakewear	0	0	113	48	0	0
Tirewear	0	0	29	7.4	0	0
Resting Loss	2.0	0	0	0	0	0
Road Dust	0	0	232	57	0	0
Running Exhaust	20	1,288	13	12	9.55	746
Running Loss	10.71	0	0	0	0	0
Starting Exhaust	2.51	38	0.02	0.02	0.01	41
Emergency Generators	2.06	62	1.88	1.86	0.00	11
Architectural Coatings	103	0	0	0	0	0
Consumer Products	207	0	0	0	0	0
Landscaping	0.38	0.04	0.01	0.01	0.0003	4.12
Off-Road Mobile	7.18	183	0.50	0.50	0	78
Total Operational	**364**	**1,606**	**390**	**127**	**9.63**	**961**
Construction Emissions						
Fugitive Dust	0	0	29.95	4.91	0	0
Off-Road Equipment	75	204	2.16	2.15	0.38	184
Paving	50	0	0	0	0	0
Architectural Coating	111	0	0	0	0	0
On-Road Mobile	3.37	7.4	50.5	2.22	0.06	5.04
Diurnal	0.13	0	0	0	0	0
Hotsoak	0.26	0	0	0	0	0
Idling Exhaust	0.80	0.98	0.00001	0.00004	0.003	0.88
Brakewear	0	0	0.00830	0.01085	0	0
Tirewear	0	0	0.00337	0.00244	0	0
Resting Loss	0.13	0	0	0	0	0
Road Dust	0	0	50.50	2.21	0	0
Running Exhaust	0.59	5.58	0.00170	0.00478	0.06	2.88
Running Loss	0.97	0	0	0	0	0
Starting Exhaust	0.49	0.80	0.00001	0.00001	0.0003	1.27
Total Construction	**239**	**212**	**82.6**	**9.3**	**0.45**	**189**
Total Combined	**603**	**1,818**	**473**	**137**	**10.07**	**1,150**

Table 2-1a. Maximum Daily Unmitigated Criteria Air Pollutant Emissions Estimates

Emission Category	ROG lbs/day	NOx lbs/day	PM_{10} lbs/day	$PM_{2.5}$ lbs/day	SO_2 lbs/day	CO lbs/day

Abbreviations:
CO - Carbon Monoxide
lbs – Pounds
NOx - Nitrogen Oxides
$PM_{2.5.}$ - Particulate Matter less than 2.5 microns in diameter
$PM_{10.}$ - Particulate Matter less than 10 microns in diameter
ROG - Reactive Organic Gas
SO_2 - Sulfur Dioxide

The emissions listed in **Table 2-1b** represent the sum of the maximum daily mitigated emissions for the maximum operational and maximum construction emission years. Mitigated construction emissions were scaled using the approach described for unmitigated emissions. The mitigated emission inventory includes mitigation measures 4.3.6.2A through E, 4.3.6.3A through F, 4.3.6.4A, and 4.3.6.5A, as listed in Section 4.3 of the Draft Recirculated RSFEIR. Potential reductions due to mitigation measure 4.3.6.2A(d) which restricts idling of all diesel powered construction equipment, delivery vehicles, and delivery trucks to three minutes has conservatively not been accounted for (the emissions presented here assume five minutes of idling per vehicle).

Table 2-1b. Maximum Daily Mitigated Criteria Air Pollutant Emissions Estimates

Emission Category	ROG lbs/day	NOx lbs/day	PM_{10} lbs/day	$PM_{2.5}$ lbs/day	SO_2 lbs/day	CO lbs/day
Operational Emissions						
On-Road Mobile	45	1,341	387	125	9.60	867
Diurnal	1.96	0	0	0	0	0
Hotsoak	1.50	0	0	0	0	0
Idling Exhaust	5.7	35	0.18	0.17	0.07	80
Brakewear	0	0	113	48	0	0
Tirewear	0	0	29	7.4	0	0
Resting Loss	2.0	0	0	0	0	0
Road Dust	0	0	232	57	0	0
Running Exhaust	20	1,269	13	12	9.53	746
Running Loss	10.71	0	0	0	0	0
Starting Exhaust	2.51	38	0.02	0.02	0.01	41
Emergency Generators	0.56	0	0.00	0.00	0.00	28
Architectural Coatings	103	0	0	0	0	0
Consumer Products	207	0	0	0	0	0
Landscaping	0.38	0.04	0.01	0.01	0.0003	4.12
Off-Road Mobile	7.18	91	0.50	0.50	0	78
Total Operational	**363**	**1,432**	**388**	**125**	**9.60**	**978**

Table 2-1b. Maximum Daily Mitigated Criteria Air Pollutant Emissions Estimates

Emission Category	ROG lbs/day	NOx lbs/day	PM_{10} lbs/day	$PM_{2.5}$ lbs/day	SO_2 lbs/day	CO lbs/day
Construction Emissions						
Fugitive Dust	0	0	29.95	4.92	0	0
Off-Road Equipment	23	23	0.57	0.57	0.41	255
Paving	55	0	0	0	0	0
Architectural Coating	50	0	0	0	0	0
On-Road Mobile	3.45	4.1	50.5	2.23	0.07	5.31
Diurnal	0.13	0	0	0	0	0
Hotsoak	0.29	0	0	0	0	0
Idling Exhaust	0.71	0.51	0.00004	0.00008	0.003	0.68
Brakewear	0	0	0.02370	0.02075	0	0
Tirewear	0	0	0.00960	0.00491	0	0
Resting Loss	0.13	0	0	0	0	0
Road Dust	0	0	50.50	2.20	0	0
Running Exhaust	0.58	3.09	0.00483	0.00938	0.06	3.19
Running Loss	1.07	0	0	0	0	0
Starting Exhaust	0.55	0.51	0.00002	0.00003	0.0003	1.44
Total Construction	**132**	**27**	**81.1**	**7.7**	**0.47**	**260**
Total	**495**	**1,459**	**469**	**133**	**10.07**	**1,238**

Abbreviations:
CO - Carbon Monoxide
lbs – Pounds
NOx - Nitrogen Oxides
$PM_{2.5.}$ - Particulate Matter less than 2.5 microns in diameter
$PM_{10.}$ - Particulate Matter less than 10 microns in diameter
ROG - Reactive Organic Gas
SO_2 - Sulfur Dioxide

Mobile emissions include light, medium, and heavy-duty vehicles. **Table 2-2** below provides a summary of the spatial distribution of operational mobile emissions broken down by roadway for the regional freeway segments. For roadways within the Project vicinity, emissions were distributed using the VMT modeled for the Project Operational HRA. The overall distribution percentages were weighted based on the vehicle miles travelled (VMT). This breakdown was applied to both unmitigated and mitigated mobile emissions.

Table 2-2. Operational Mobile Emission Distribution

Location	Roadway	Overall Project Distribution			
		Cars	Light Trucks	Medium Trucks	Heavy Trucks
Project Vicinity		26%	33%	42%	29%
Regional Segments	I-10	11%	5%	5%	4%
	I-110	5%	5%	4%	6%
	SR-215 (North of SR-60)	3%	2%	1%	1%
	SR-215 (South of SR-60)	4%	2%	2%	1%
	SR-60 (between I-215 and SR-71/Gary Ave)	20%	21%	18%	21%
	SR-60 - (between SR-71/Gary Ave and I-110/SR-91)	10%	12%	9%	17%
	SR-91 (between Spruce St/SR-60 and I-15)	6%	6%	6%	6%
	SR-91 (between I-15 and I-110)	14%	14%	14%	15%

Project emissions are allocated according to their expected location into 4 km x 4 km grid cells for the PGM. **Figure 2-1a** below shows a close-up of the Project boundary overlay with the 4-km grid. Operational area sources and off-road equipment emissions were evenly distributed within the Project site. Emergency generator emissions were evenly distributed across all emergency generator point source locations as shown in Figure 2-1a.

Figure 2-1a. Overlap of Model Grid Cells on Project Site

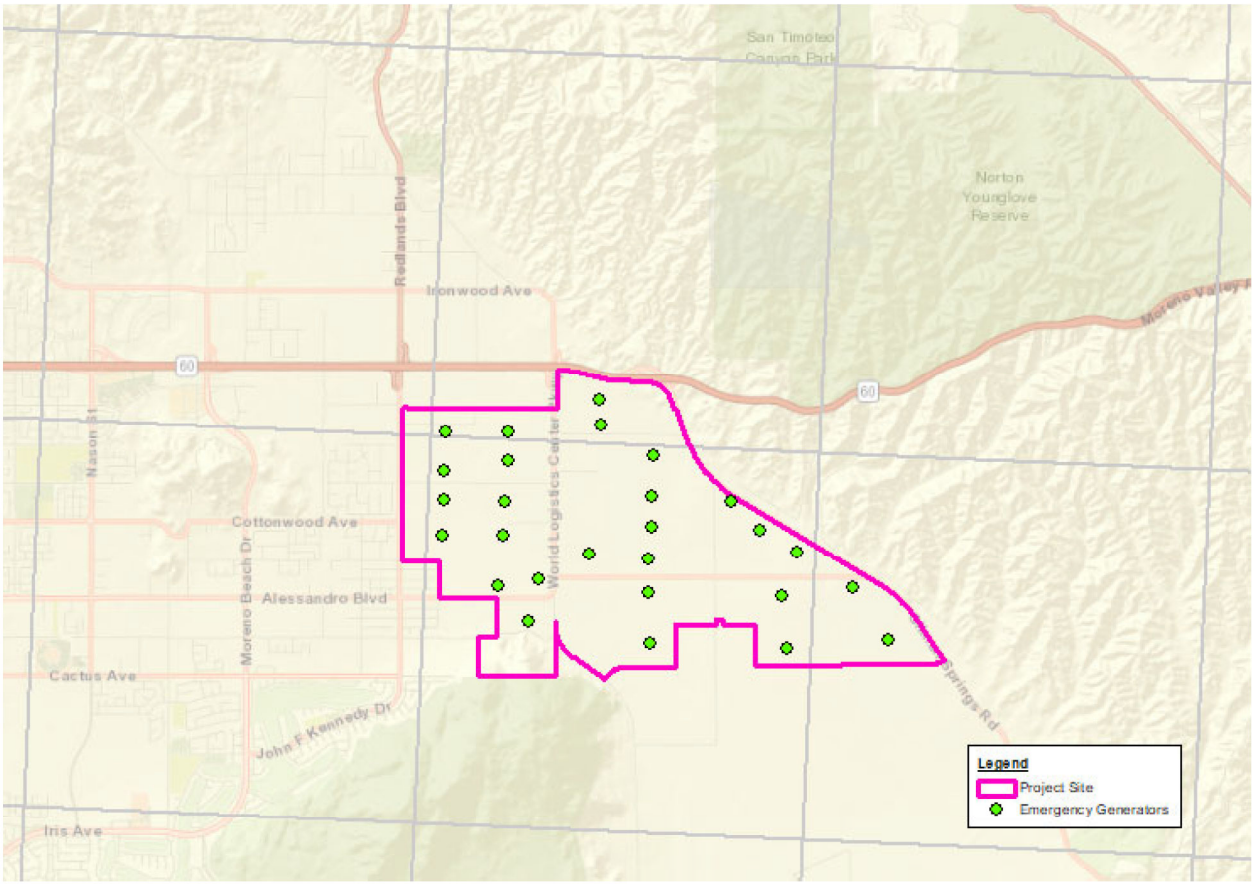
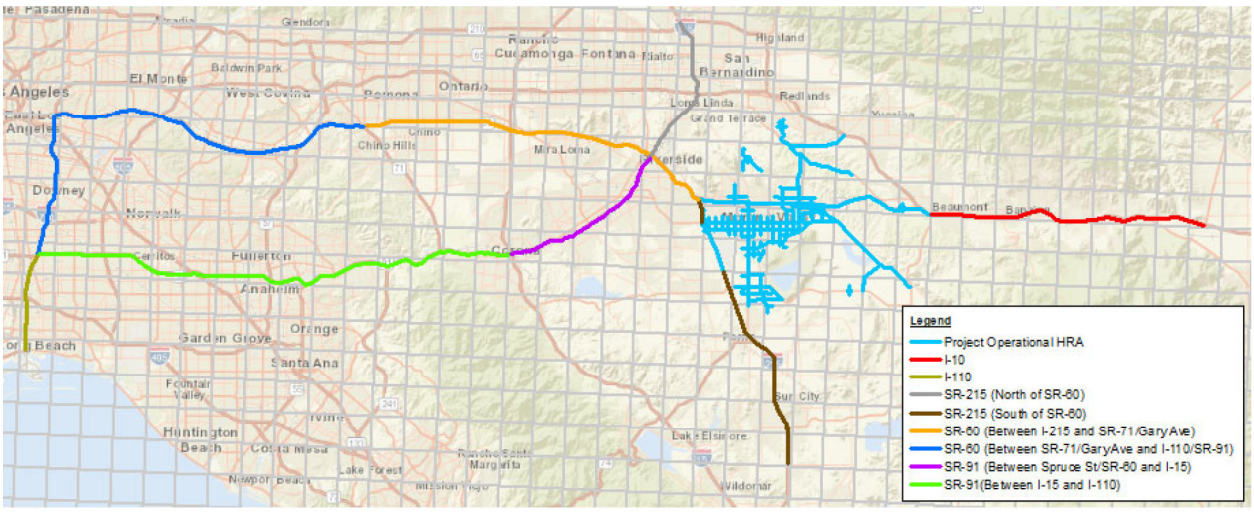


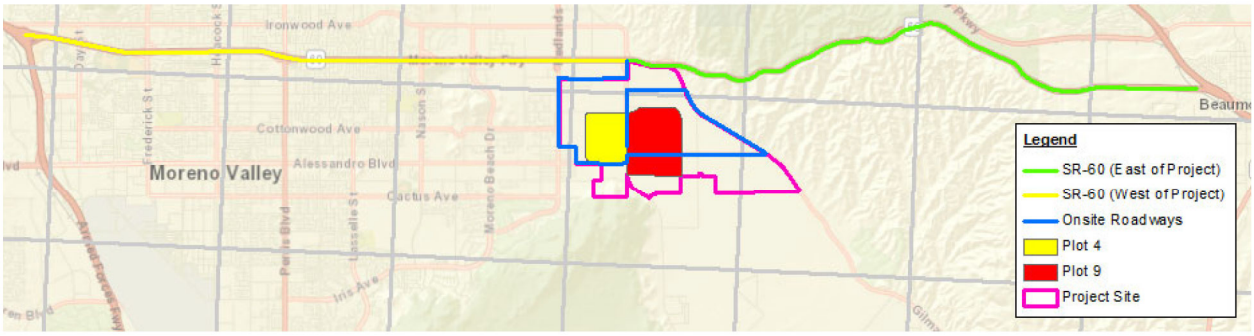
Figure 2-1b shows the full extent of operational roadways modeled. Emissions on links in the Project Vicinity were allocated using VMT modeled in the Project Operational HRA. VMT that was not modeled in the Operational HRA was allocated to regional freeway links. This includes the portions of the I-10, SR-60, SR-91, I-110 and SR-215 shown on the figure, with overall project distributions as assigned in **Table 2-2**. For major roadways that cross into multiple cells, emissions were allocated proportionally based on the length of roadway within each cell.

Figure 2-1b. Roadways Modeled



Construction emissions were allocated to sources modeled in the Project Construction HRA. Off-road equipment activity was allocated to Plots 4 and 9 based on the location of activity in the maximum construction year. As these plots are located within the same grid cell as the majority of the Project site, they were determined to be a reasonable representation of construction off-road equipment activity. On-site on-road emissions were evenly distributed within the Project Site. Off-site on-road emissions were evenly distributed to the road segments modeled in the Project Construction HRA (see green, yellow, and blue links in the figure below). The location of the Project construction sources are shown in **Figure 2-1c**.

Figure 2-1c. Modeled Construction Sources



2.2 Convert Project Inventories to SMOKE Input Format

The first step in the emissions processing was to convert the Project emission inventory into the Flat File 2010 (FF10) format for input to SMOKE. Appropriate Source Classification Codes (SCCs) were then assigned to the Project emissions sources. **Table 2-3** provides the SCC assigned to each Project source.

Table 2-3. Assigned SCC to Project Emission Sources

Emission Source	SCC	SCC Description
Architectural Coatings	2401001000	Solvent Utilization; Surface Coating; Architectural Coatings; Total: All Solvent Types
Consumer Products	2460000000	Solvent Utilization; Miscellaneous Non-industrial: Consumer and Commercial; All Processes; Total: All Solvent Types
Consumer Products	2460100000	Solvent Utilization; Miscellaneous Non-industrial: Consumer and Commercial; All Personal Care Products; Total: All Solvent Types
Consumer Products	2460200000	Solvent Utilization; Miscellaneous Non-industrial: Consumer and Commercial; All Household Products; Total: All Solvent Types
Consumer Products	2460400000	Solvent Utilization; Miscellaneous Non-industrial: Consumer and Commercial; All Automotive Aftermarket Products; Total: All Solvent Types
Consumer Products	2460500000	Solvent Utilization; Miscellaneous Non-industrial: Consumer and Commercial; All Coatings and Related Products; Total: All Solvent Types
Consumer Products	2460600000	Solvent Utilization; Miscellaneous Non-industrial: Consumer and Commercial; All Adhesives and Sealants; Total: All Solvent Types
Consumer Products	2460800000	Solvent Utilization; Miscellaneous Non-industrial: Consumer and Commercial; All FIFRA Related Products; Total: All Solvent Types
Consumer Products	2460900000	Solvent Utilization; Miscellaneous Non-industrial: Consumer and Commercial; Miscellaneous Products (Not Otherwise Covered);Total: All Solvent Types
Consumer Products	2461021000	Solvent Utilization; Miscellaneous Non-industrial: Commercial; Cutback Asphalt; Total: All Solvent Types
Energy	20200202	Internal Combustion Engines; Industrial; Natural Gas; Reciprocating
Energy	20200102	Internal Combustion Engines; Industrial; Distillate Oil (Diesel); Reciprocating
Construction Dust	2311020000	Industrial Processes; Construction: SIC 15 - 17;Industrial/Commercial/Institutional; Total
Off-road equipment	2265004010	Mobile Sources; Off-highway Vehicle Gasoline, 4-Stroke;Lawn and Garden Equipment; Lawn Mowers (Residential)
Off-road equipment	2267003070	Mobile Sources; LPG; Industrial Equipment; Terminal Tractors
Off-road equipment	2268003020	Mobile Sources; CNG; Industrial Equipment; Forklifts
Mobile	220100111B	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Vehicles (LDGV);Rural Interstate: Brake Wear
Mobile	220100111R	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Vehicles (LDGV);Rural Interstate: Resting
Mobile	220100111S	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Vehicles (LDGV);Rural Interstate: Start

Table 2-3. Assigned SCC to Project Emission Sources

Emission Source	SCC	SCC Description
Mobile	220100111T	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Vehicles (LDGV);Rural Interstate: Tire Wear
Mobile	220100111V	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Vehicles (LDGV);Rural Interstate: Eva (except Refueling)
Mobile	220100111X	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Vehicles (LDGV);Rural Interstate: Exhaust
Mobile	220102011B	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5);Rural Interstate: Brake Wear
Mobile	220102011R	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5);Rural Interstate: Resting
Mobile	220102011S	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5);Rural Interstate: Start
Mobile	220102011T	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5);Rural Interstate: Tire Wear
Mobile	220102011V	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5);Rural Interstate: Eva (except Refueling)
Mobile	220102011X	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5);Rural Interstate: Exhaust
Mobile	220107011B	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV);Rural Interstate: Brake Wear
Mobile	220107011I	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV);Rural Interstate: Idle
Mobile	220107011R	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV);Rural Interstate: Resting
Mobile	220107011S	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV);Rural Interstate: Start
Mobile	220107011T	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV);Rural Interstate: Tire Wear
Mobile	220107011V	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV);Rural Interstate: Eva (except Refueling)
Mobile	220107011X	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV);Rural Interstate: Exhaust
Mobile	220361008B	Mobile Sources; Highway Vehicles - Compressed Natural Gas (CNG);Combination Short-haul Truck; All on and off-network processes except refueling: Brake Wear

Table 2-3. Assigned SCC to Project Emission Sources

Emission Source	SCC	SCC Description
Mobile	220361008I	Mobile Sources; Highway Vehicles - Compressed Natural Gas (CNG);Combination Short-haul Truck; All on and off-network processes except refueling: Idle
Mobile	220361008T	Mobile Sources; Highway Vehicles - Compressed Natural Gas (CNG);Combination Short-haul Truck; All on and off-network processes except refueling: Tire Wear
Mobile	220361008X	Mobile Sources; Highway Vehicles - Compressed Natural Gas (CNG);Combination Short-haul Truck; All on and off-network processes except refueling: Exhaust
Mobile	223000111B	Mobile Sources; Highway Vehicles - Diesel; Light Duty Diesel Vehicles (LDDV);Rural Interstate: Brake Wear
Mobile	223000111T	Mobile Sources; Highway Vehicles - Diesel; Light Duty Diesel Vehicles (LDDV);Rural Interstate: Tire Wear
Mobile	223000111X	Mobile Sources; Highway Vehicles - Diesel; Light Duty Diesel Vehicles (LDDV);Rural Interstate: Exhaust
Mobile	223006011B	Mobile Sources; Highway Vehicles - Diesel; Light Duty Diesel Trucks 1 thru 4 (M6) (LDDT);Rural Interstate: Brake Wear
Mobile	223006011T	Mobile Sources; Highway Vehicles - Diesel; Light Duty Diesel Trucks 1 thru 4 (M6) (LDDT);Rural Interstate: Tire Wear
Mobile	223006011X	Mobile Sources; Highway Vehicles - Diesel; Light Duty Diesel Trucks 1 thru 4 (M6) (LDDT);Rural Interstate: Exhaust
Mobile	223007111B	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 2B;Rural Interstate: Brake Wear
Mobile	223007111I	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 2B;Rural Interstate: Idle
Mobile	223007111T	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 2B;Rural Interstate: Tire Wear
Mobile	223007111X	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 2B;Rural Interstate: Exhaust
Mobile	2230072110	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 3, 4, & 5;Rural Interstate: Total
Mobile	223007211B	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 3, 4, & 5;Rural Interstate: Brake Wear
Mobile	223007211I	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 3, 4, & 5;Rural Interstate: Idle
Mobile	223007211T	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 3, 4, & 5;Rural Interstate: Tire Wear

Table 2-3. Assigned SCC to Project Emission Sources

Emission Source	SCC	SCC Description
Mobile	223007211X	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 3, 4, & 5;Rural Interstate: Exhaust
Mobile	223007311B	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 6 & 7;Rural Interstate: Brake Wear
Mobile	223007311I	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 6 & 7;Rural Interstate: Idle
Mobile	223007311S	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 6 & 7;Rural Interstate: Start
Mobile	223007311T	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 6 & 7;Rural Interstate: Tire Wear
Mobile	223007311X	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 6 & 7;Rural Interstate: Exhaust
Mobile	2270000000	Mobile Sources; Off-highway Vehicle Diesel; Compression Ignition Equipment except Rail and Marine; Total
Mobile	22940000H1	Mobile Sources; Paved Roads; All Paved Roads; Total: Fugitives - Light-Heavy-Duty Trucks (8501-10000 lbs)
Mobile	22940000H2	Mobile Sources; Paved Roads; All Paved Roads; Total: Fugitives - Light-Heavy-Duty Trucks (10000-14000 lbs)
Mobile	22940000HT	Mobile Sources; Paved Roads; All Paved Roads; Total: Fugitives - Heavy-Heavy Duty Trucks
Mobile	22940000LD	Mobile Sources; Paved Roads; All Paved Roads; Total: Fugitives - Passenger Cars
Mobile	22940000MD	Mobile Sources; Paved Roads; All Paved Roads; Total: Fugitives - Medium-Duty Trucks (6000-8500 lbs)
Mobile	22940000MT	Mobile Sources; Paved Roads; All Paved Roads; Total: Fugitives - Medium-Heavy Duty Trucks
Mobile	22940000T1	Mobile Sources; Paved Roads; All Paved Roads; Total: Fugitives - Light-Duty Trucks (0-3750 lbs)
Mobile	22940000T2	Mobile Sources; Paved Roads; All Paved Roads; Total: Fugitives - Light-Duty Trucks (3751-5750 lbs)
Mobile	22960000HT	Mobile Sources; Unpaved Roads; All Unpaved Roads; Total: Fugitives - Heavy-Heavy Duty Trucks
Mobile	22960000LD	Mobile Sources; Unpaved Roads; All Unpaved Roads; Total: Fugitives - Passenger Cars
Mobile	22960000MT	Mobile Sources; Unpaved Roads; All Unpaved Roads; Total: Fugitives - Medium-Heavy Duty Trucks
Mobile	22960000T1	Mobile Sources; Unpaved Roads; All Unpaved Roads; Total: Fugitives - Light-Duty Trucks (0-3750 lbs)
Mobile	22960000T2	Mobile Sources; Unpaved Roads; All Unpaved Roads; Total: Fugitives - Light-Duty Trucks (3751-5750 lbs)

2.2.1 Generate Spatial Surrogates for 4-km Domains

As part of the analysis, the Project source emissions need to be spatially allocated to appropriate geographic locations. The emissions can be allocated to modeling grid cells using gridding surrogates. To process the Project emissions, a Project area-based spatial surrogate was developed. The surrogate was developed using the US Environmental Protection Agency (USEPA's) Spatial Allocation Tool,[2] which combines geographical information system (GIS)-based data (shapefiles) and modeling domain definitions to generate the appropriate gridded surrogate data set. The Project sources were then assigned specific surrogates for gridding by cross-referencing the SCCs. As mentioned above, all unmitigated and mitigated Project emissions were distributed in the modeling grid cells where the Project is located as shown in **Figures 2-1a and 2-1b**. The mobile sources are spatially distributed in the site's grid cells and surrounding grid cells, as outlined in **Table 2-2**.

2.2.2 SMOKE 4 km Processing of Project Emissions

SMOKE system was used to process emissions for the Southern California 4-km modeling grid shown in **Figures 2-1a and 2-1b**. A representative week from each month (seven days a month) was used to represent the entire month's emissions. Holidays were modeled separately as if they were a Sunday. SMOKE was applied to perform following tasks:

1. Chemical Speciation: Emission estimates of criteria pollutants were speciated for the SAPRC07 AERO6 chemical mechanism employed in Community Multiscale Air Quality (CMAQ) in SMOKE processing. Speciation profiles compatible with the SAPRC07 AERO6 mechanism from the South Coast Air Quality Management District's (SCAQMD) modeling system were used to be consistent with the regional modeling emissions. Those emissions were then converted into Comprehensive Air Quality Model with extensions (CAMx)-ready formats using CMAQ2CAMx conversion program and species mapping.
2. Temporal Allocation: Annual emission estimates were resolved on an hourly timescale for CAMx modeling. These allocations were determined from the particular source category, specified by the SCC. Monthly, weekly, and diurnal profiles were cross-referenced to the SCCs to provide the appropriate temporal resolution. The temporal profiles were also obtained from the Bay Area Air Quality Management District's (BAAQMD) emissions modeling system, as they were unavailable from SCAQMD.
3. Spatial Allocation: The Project emission estimates were spatially resolved to the grid cells for modeling using spatial surrogates as described above.

2.2.3 QA/QC of Emissions Modeling

Standard quality assurance/quality control (QA/QC) was conducted during all aspects of the SMOKE emissions processing. These steps followed the approach recommended in the USEPA modeling guidance (USEPA, 2007). SMOKE includes quality assurance (QA) and reporting features to keep track of the adjustments at each processing stage and ensure that data integrity is not compromised. Ramboll carefully reviewed the SMOKE log files for error messages and ensured that appropriate source profiles were used. All error records reported during processing were reviewed and resolved. This is important to ensure that source categories are correctly characterized. Ramboll also compared SMOKE input and output emissions: summary tables were generated to compare input inventory totals against model-ready output totals to confirm consistency. Spatial plots were generated to visually verify correct spatial allocation of the emissions.

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[2] https://www.cmascenter.org/sa-tools/documentation/4.2/html/srgtool/SurrogateToolUserGuide_4_2.pdf.

2.2.4 Merge SMOKE Pre-merged Emissions to Generate CAMx-ready Emission Inputs

The final step in the emissions processing is to merge the Project gridded emissions with other regional components through the gridded merge program (MRGUAM) for CAMx. The daily emissions were merged in the time format required by CAMx.

2.2.5 Emissions Summary

Summaries of the unmitigated and mitigated Project gridded CAMx model-ready emissions data are provided in this section. **Tables 2-4 and 2-5** summarize the unmitigated and mitigated Project emission inventory data input to SMOKE from the FF10 data files in pounds per day by source type. **Tables 2-6 and 2-7** present the emissions data after SMOKE processing for unmitigated and mitigated, respectively. The consistency in data in Tables 2-4 and 2-6 and in Tables 2-5 and 2-7 offer confidence in the correct operation of the SMOKE emissions processing for CAMx.

Table 2-4. Unmitigated Project Emission Inventory Data Input to SMOKE by Source Type (lbs/day)

Emission Category	ROG lbs/day	NOx lbs/day	PM_{10} lbs/day	$PM_{2.5}$ lbs/day	SO_2 lbs/day	CO lbs/day
Operational Emissions						
On-Road Mobile	45	1,361	388	125	9.6	867
Emergency Generators	2.06	62.1	2	2	0	11
Architectural Coatings	103	0	0	0	0	0
Consumer Products	207	0	0	0	0	0
Landscaping	0.38	0	0.01	0.01	0	4
Off-Road Mobile	7.18	183	0.50	0.50	0	78
Total Operational	**364**	**1,606**	**390**	**127**	**9.6**	**961**
Construction Emissions						
Fugitive Dust	0	0	29.95	4.91	0	0
Off-Road Equipment	75	204	2.16	2.15	0.38	184
Paving	50	0	0	0	0	0
Architectural Coating	111	0	0	0	0	0
On-Road Mobile	3.4	7.4	51	2.2	0.06	5.0
Total Construction	**239**	**212**	**82.6**	**9.3**	**0.45**	**189**
Total	**603**	**1,818**	**473**	**137**	**10**	**1,150**

Abbreviations:
CO - Carbon Monoxide
lbs – Pounds
NOx - Nitrogen Oxides
$PM_{2.5.}$ - Particulate Matter less than 2.5 microns in diameter
$PM_{10.}$ - Particulate Matter less than 10 microns in diameter
ROG - Reactive Organic Gas
SO_2 - Sulfur Dioxide

Table 2-5. Mitigated Project Emission Inventory Data Input to SMOKE by Source Type (lbs/day)

Emission Category	ROG lbs/day	NOx lbs/day	PM_{10} lbs/day	$PM_{2.5}$ lbs/day	SO_2 lbs/day	CO lbs/day
Operational Emissions						
On-Road Mobile	45	1,341	387	125	9.6	868
Emergency Generators	0.56	0.4	0	0	0	28
Architectural Coatings	103	0	0	0	0	0
Consumer Products	207	0	0	0	0	0
Landscaping	0.38	0	0.01	0.01	0	4
Off-Road Mobile	7.18	91	0.50	0.50	0	78
Total Operational	**363**	**1,432**	**388**	**125**	**10**	**978**
Construction Emissions						
Fugitive Dust	0	0	29.95	4.92	0	0
Off-Road Equipment	23	23	0.57	0.57	0.41	255
Paving	55	0	0	0	0	0
Architectural Coating	50	0	0	0	0	0
On-Road Mobile	3.4	4.1	51	2.2	0.07	5.3
Total Construction	**132**	**27**	**81.1**	**7.7**	**0.47**	**260**
Total	**495**	**1,459**	**469**	**133**	**10**	**1,238**

Abbreviations:
CO - Carbon Monoxide
lbs – Pounds
NOx - Nitrogen Oxides
$PM_{2.5.}$ - Particulate Matter less than 2.5 microns in diameter
$PM_{10.}$ - Particulate Matter less than 10 microns in diameter
ROG - Reactive Organic Gas
SO_2 - Sulfur Dioxide

Table 2-6. Unmitigated Project Emission Inventory Data Output from SMOKE by Project Region (lbs/day)

Type	ROG	NOx	PM_{10}	$PM_{2.5}$	SO_2	CO
Onsite	573.4	608.4	183.5	38.0	1.1	459.7
Offsite	29.7	1,209.3	289.1	98.6	9.0	690.4
Total	**603**	**1,818**	**473**	**137**	**10**	**1,150**

Abbreviations:
CO - Carbon Monoxide
NOx - Nitrogen Oxides
$PM_{2.5}$ - Particulate Matter less than 2.5 microns in diameter
PM_{10} - Particulate Matter less than 10 microns in diameter
SO_2 - Sulfur Dioxide
VOC - Volatile Organic Compounds

Table 2-7. Mitigated Project Emission Inventory Data Output from SMOKE by Project Region (lbs/day)

Type	ROG	NOx	PM_{10}	$PM_{2.5}$	SO_2	CO
Onsite	465.4	271.1	180.0	34.6	1.1	547.8
Offsite	29.3	1,187.9	289.1	98.6	9.0	690.5
Total	**495**	**1,459**	**469**	**133**	**10**	**1,238**

Abbreviations:
CO - Carbon Monoxide
NOx - Nitrogen Oxides
$PM_{2.5}$ - Particulate Matter less than 2.5 microns in diameter
PM_{10} - Particulate Matter less than 10 microns in diameter
SO_2 - Sulfur Dioxide
VOC - Volatile Organic Compounds

Spatial displays of the gridded emissions data are presented below. Ramboll examined the gridded emissions in 4-km grid to verify accurate spatial allocation by SMOKE. **Figures 2-2 through 2-7** displays gridded emissions for the unmitigated Project inventory in the 4-km modeling grid and **Figures 2-8 through 2-13** displays gridded emissions for the mitigated Project inventory in the 4-km modelling grid.

Figure 2-2. Spatial Distribution of Unmitigated CO Emissions (in lbs/day) for the Project in the Southern California 4-km Domain

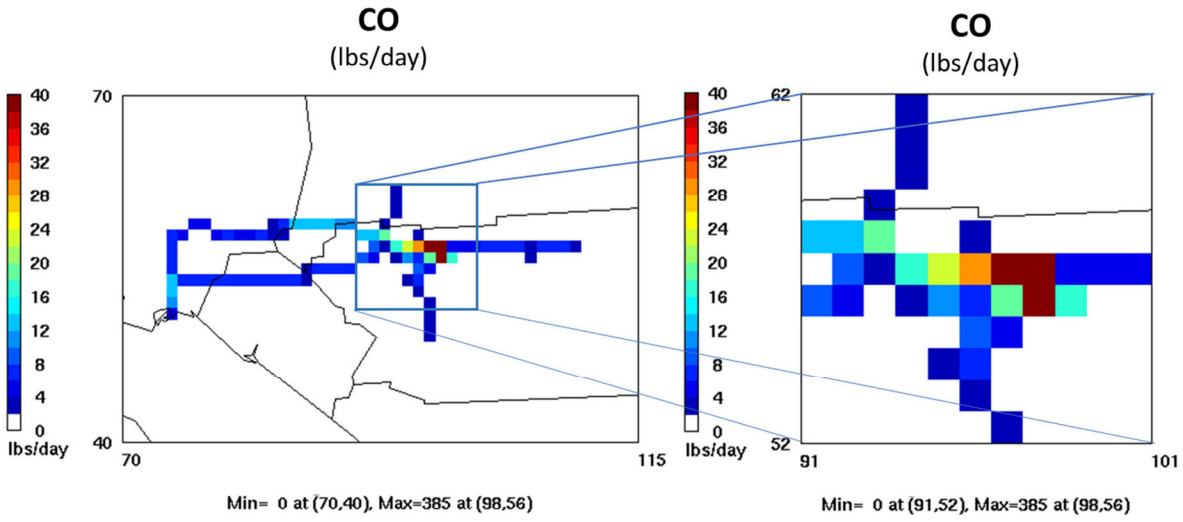


Figure 2-3. Spatial Distribution of Unmitigated NO_x Emissions (in lbs/day) for the Project in the Southern California 4-km Domain

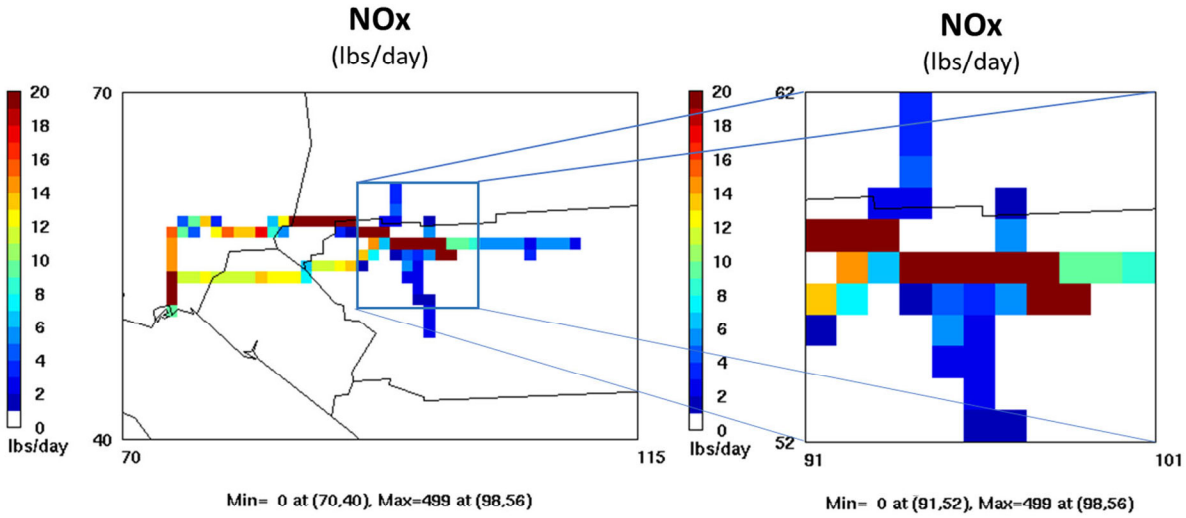


Figure 2-4. Spatial Distribution of Unmitigated VOC Emissions (in lbs/day) for the Project in the Southern California 4-km Domain

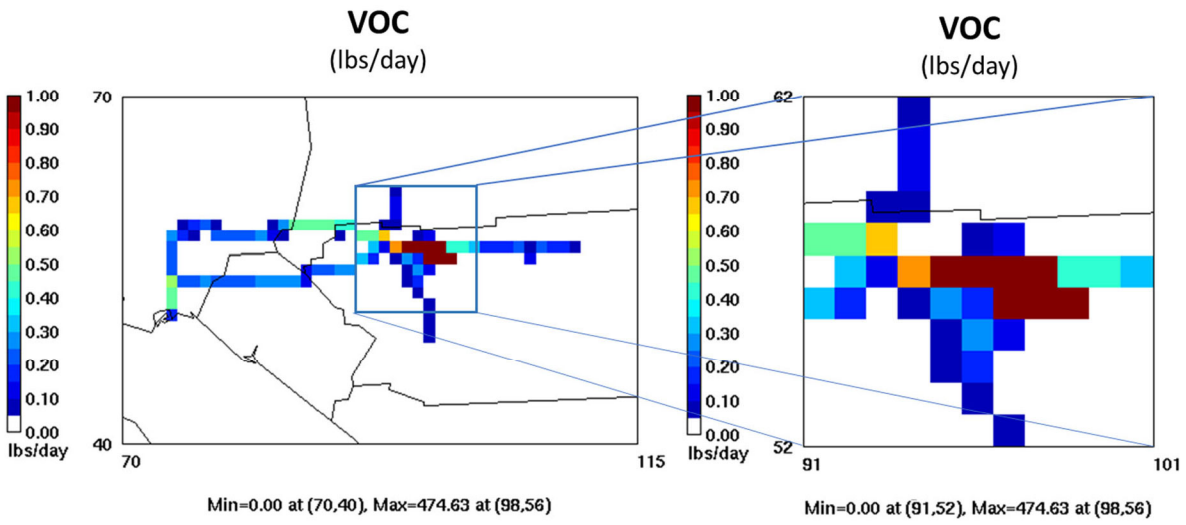


Figure 2-5. Spatial Distribution of Unmitigated SO2 Emissions (in lbs/day) for the Project in the Southern California 4-km Domain

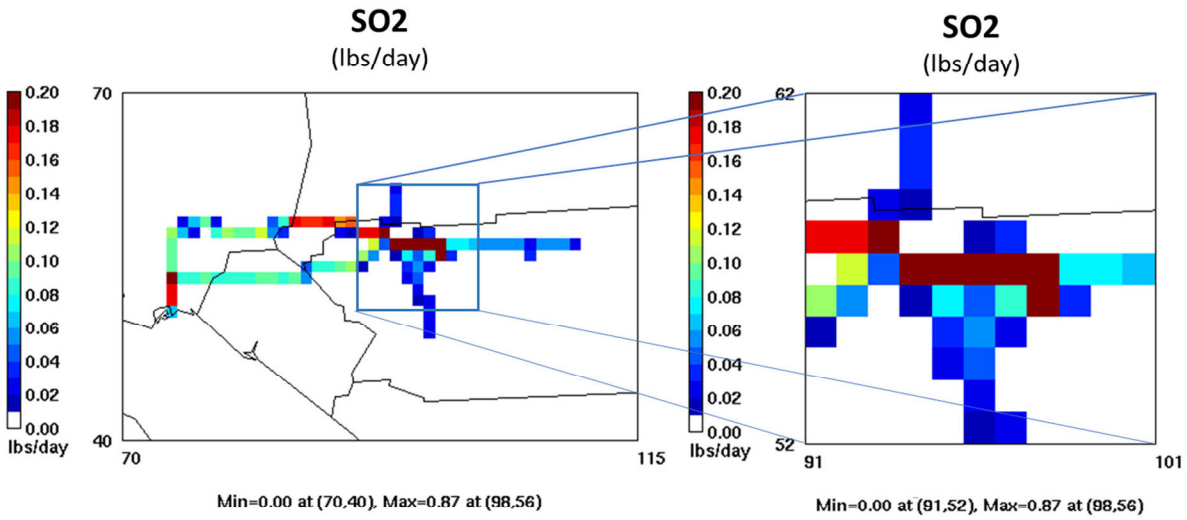


Figure 2-6. Spatial Distribution of Unmitigated PM10 Emissions (in lbs/day) for the Project in the Southern California 4-km Domain

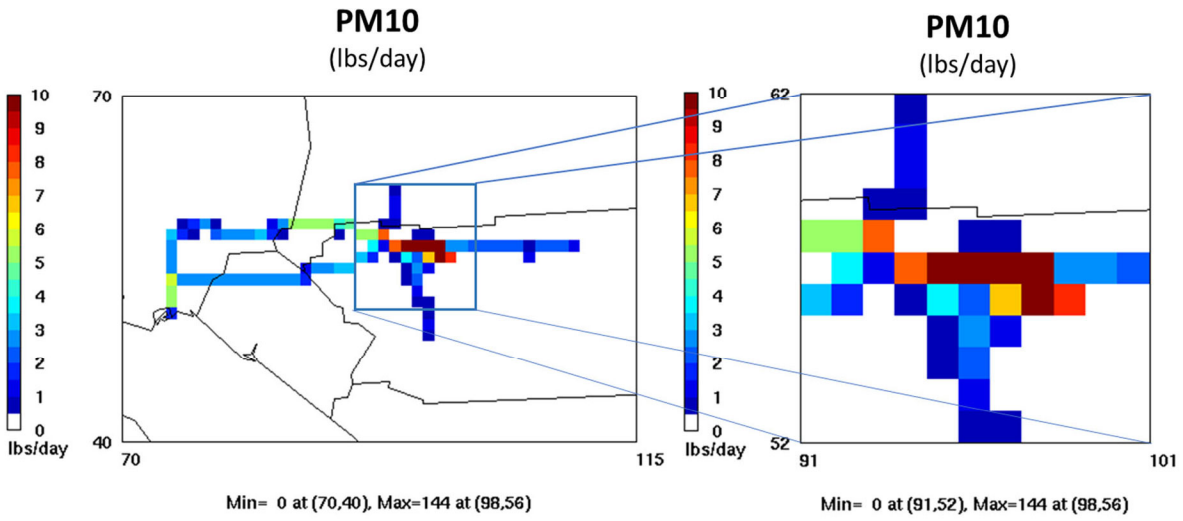


Figure 2-7. Spatial Distribution of Unmitigated PM2.5 Emissions (in lbs/day) for the Project in the Southern California 4-km Domain

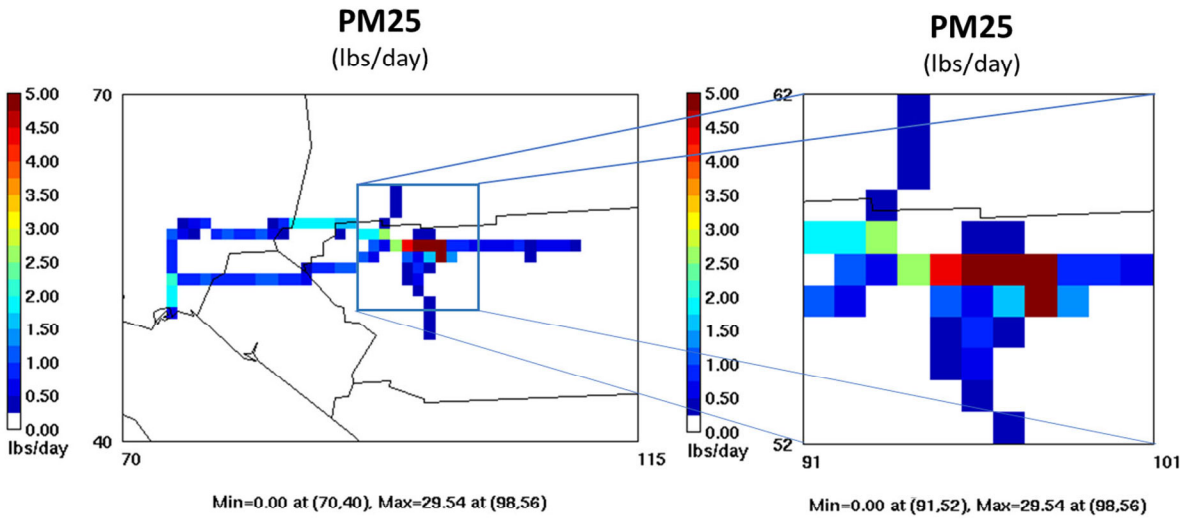


Figure 2-8. Spatial Distribution of Mitigated CO Emissions (in lbs/day) for the Project in the Southern California 4-km Domain

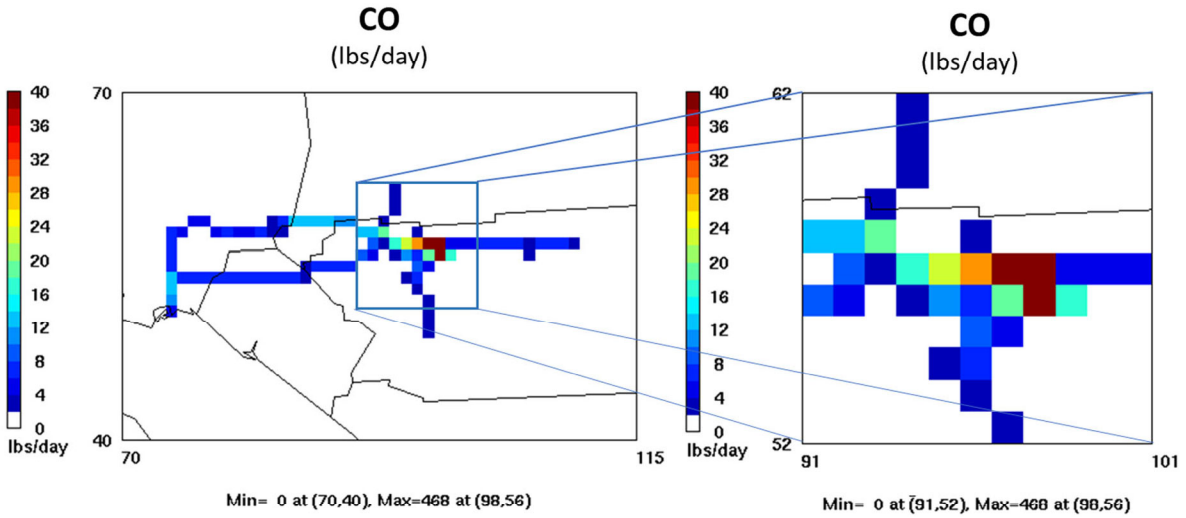


Figure 2-9. Spatial Distribution of Mitigated NO_x Emissions (in lbs/day) for the Project in the Southern California 4-km Domain

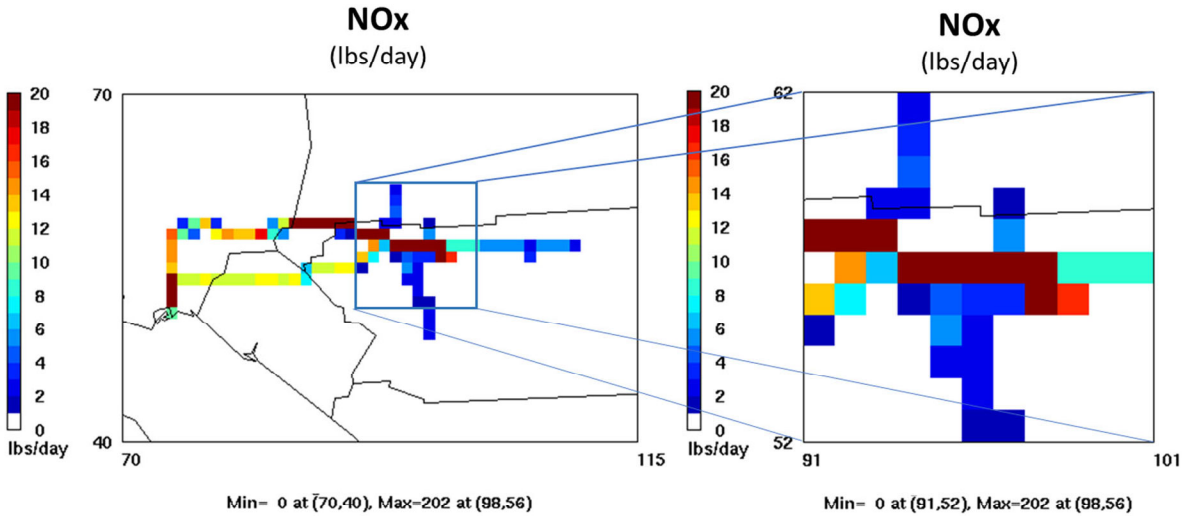


Figure 2-10. Spatial Distribution of Mitigated VOC Emissions (in lbs/day) for the Project in the Southern California 4-km Domain

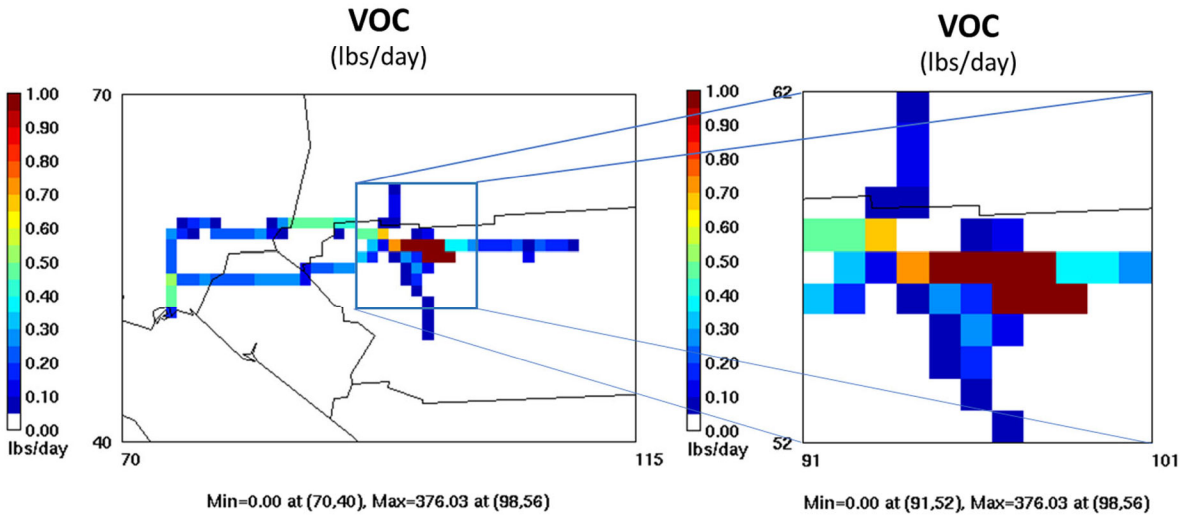


Figure 2-11. Spatial Distribution of Mitigated SO_2 Emissions (in lbs/day) for the Project in the Southern California 4-km Domain

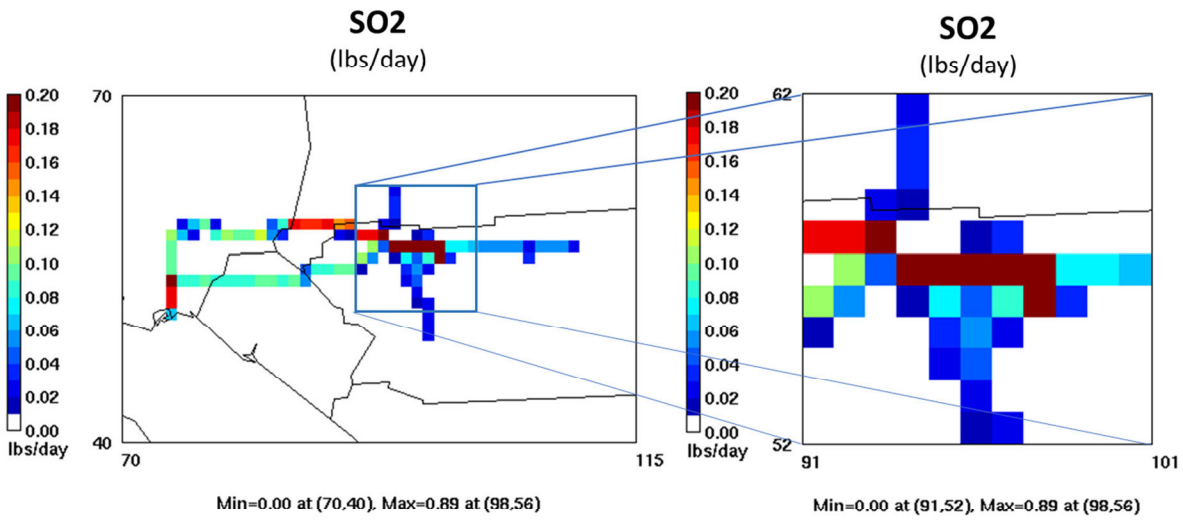


Figure 2-12. Spatial Distribution of Mitigated PM_{10} Emissions (in lbs/day) for the Project in the Southern California 4-km Domain

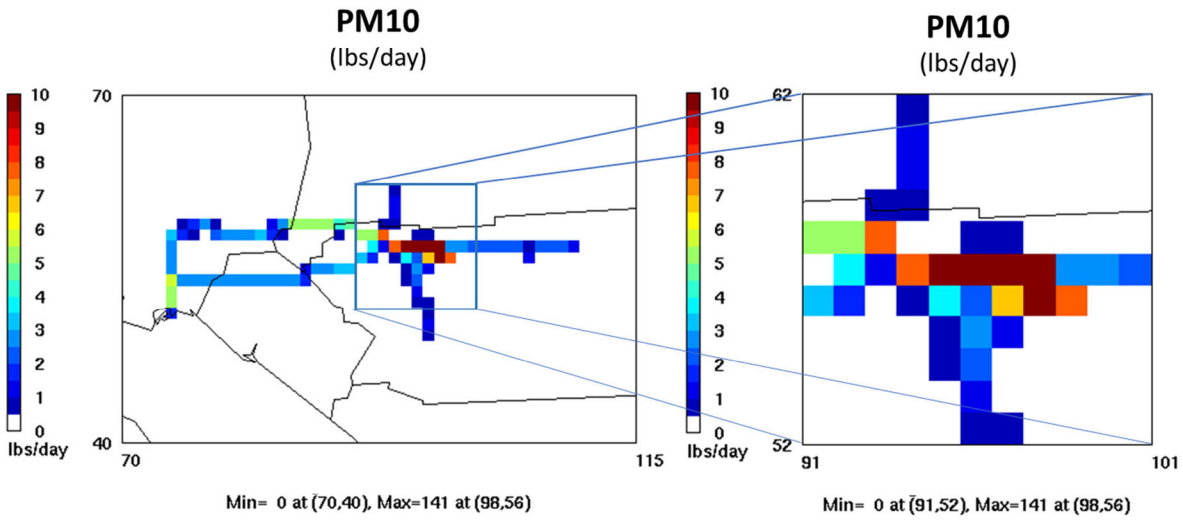
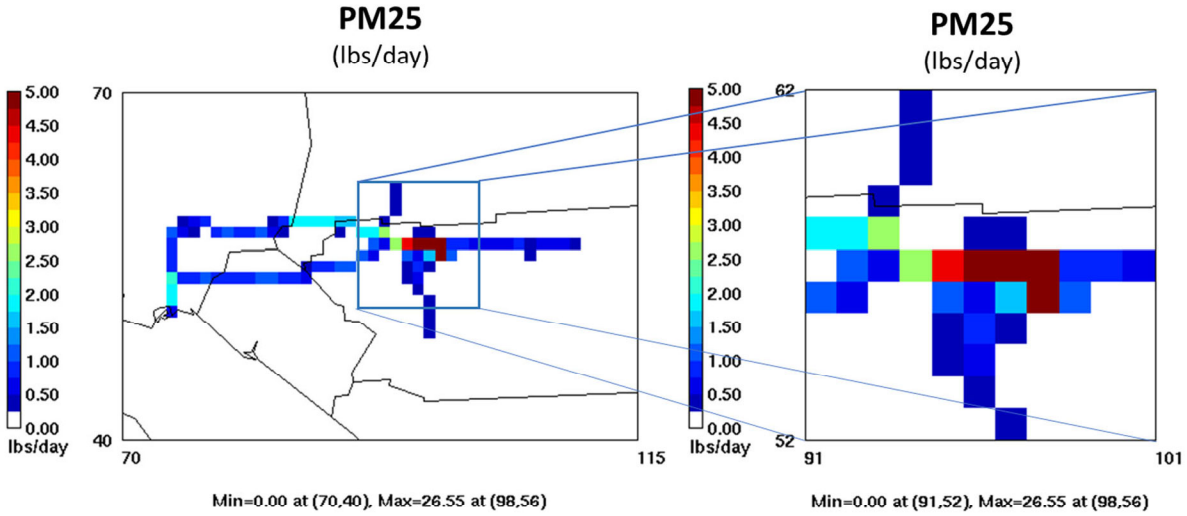


Figure 2-13. Spatial Distribution of Mitigated $PM_{2.5}$ Emissions (in lbs/day) for the Project in the Southern California 4-km Domain



3. CUMULATIVE EMISSIONS

Maximum daily operational and construction emissions were estimated for 349 projects (herein referred to as "cumulative projects") in the region surrounding the Project, as described further in Section 6.3 of the Draft Recirculated RSFEIR. Maximum daily operational emissions for all cumulative projects are reflective of year 2035, consistent with the full buildout year for the Project. Construction emissions vary by project but occur within years 2020 through year 2035. To capture both potential operational and construction emissions from the cumulative projects in a single year, either maximum daily operational or construction emissions were used for each project, evaluated on a pollutant basis. Resulting maximum daily emissions for each of the cumulative projects are shown in **Table 3-1** below.

Table 3-1. Cumulative Emissions Inventory

Project ID	Maximum Daily Emissions (lb/day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
B-001	159.63	376.90	682.82	1.90	230.13	64.81
B-002	17.12	15.71	101.66	0.25	30.84	8.66
B-003	44.60	125.63	190.78	0.53	64.30	18.11
B-004	292.73	62.82	146.98	0.71	82.18	23.03
B-005	63.58	60.33	176.22	0.86	96.70	27.35
B-006	312.85	72.13	295.58	1.28	165.89	44.92
B-007	20.93	62.82	83.39	0.23	28.10	7.91

Table 3-1. Cumulative Emissions Inventory

Project ID	Maximum Daily Emissions (lb/day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
B-008	31.35	125.63	134.08	0.37	45.19	13.09
B-009	215.26	546.63	920.77	2.56	310.33	87.39
B-010	30.79	73.66	43.56	0.11	10.53	6.54
B-011	104.50	98.54	140.66	0.27	34.90	12.01
B-012	8.37	7.67	49.67	0.12	15.07	4.23
B-013	91.43	251.27	391.07	1.09	131.80	37.12
B-014	33.86	125.63	144.84	0.40	48.82	13.75
C-001	103.21	87.59	125.03	0.24	31.02	8.71
C-002	319.38	499.42	877.00	2.29	296.44	81.82
C-003	67.60	31.84	45.45	0.09	11.28	3.17
H-001	30.44	62.82	121.67	0.34	41.01	11.55
H-002	22.83	62.82	91.04	0.25	30.68	8.64
H-003	45.04	125.63	192.64	0.54	64.93	18.28
H-004	292.08	62.82	221.02	0.99	123.91	33.88
H-005	38.99	9.21	13.07	0.03	3.24	0.91
H-006	315.70	298.17	425.61	0.81	105.59	29.65
H-007	30.23	62.82	48.10	0.08	10.53	6.55
H-008	20.38	62.82	89.12	0.19	22.30	6.55
H-009	15.95	11.89	80.48	0.14	16.60	4.83
M-001	333.75	106.20	69.14	0.30	36.23	10.03
M-002	126.64	303.00	298.23	2.27	198.18	56.08
M-003	359.18	176.72	128.30	1.17	92.10	26.35
M-004	101.14	47.70	68.08	0.13	16.89	4.74
M-005	184.81	222.58	253.57	1.79	163.11	46.13
M-006	101.90	42.48	34.98	0.15	20.47	12.01
M-007	313.29	73.66	43.56	0.27	21.45	6.54
M-008	300.51	532.68	1,476.21	5.11	660.05	179.57

Table 3-1. Cumulative Emissions Inventory

Project ID	Maximum Daily Emissions (lb/day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
M-009	27.88	62.82	40.79	0.08	10.53	6.55
M-010	259.30	68.24	42.18	0.23	17.75	6.54
M-011	62.32	29.34	41.89	0.08	10.39	2.92
MV-001	141.34	133.36	190.36	0.36	47.23	13.26
MV-002	39.47	62.82	92.67	0.24	29.94	8.42
MV-003	280.95	125.91	115.21	0.92	77.77	22.15
MV-004	24.22	25.70	79.45	0.38	44.42	12.45
MV-005	108.06	50.96	72.74	0.14	18.05	5.07
MV-006	347.82	73.66	43.56	0.30	23.82	6.81
MV-007	17.70	42.48	22.27	0.05	20.47	12.01
MV-008	32.90	68.24	42.18	0.10	10.53	6.54
MV-009	7.12	42.48	22.27	0.04	10.53	6.54
MV-010	26.70	68.24	42.18	0.10	10.53	6.54
MV-011	13.75	42.48	22.27	0.05	20.47	12.01
MV-012	4.28	7.07	29.64	0.12	15.38	4.16
MV-013	55.83	9.32	8.06	0.02	2.01	0.66
MV-014	22.14	73.66	43.56	0.11	10.53	6.55
MV-015	35.69	73.66	43.56	0.11	10.53	6.54
MV-016	18.26	68.24	42.18	0.10	10.53	6.54
MV-017	31.11	73.66	43.56	0.11	10.53	6.54
MV-018	0.44	2.41	3.44	0.01	0.85	0.24
MV-019	3.70	2.76	18.68	0.03	3.85	1.12
MV-020	7.49	41.08	58.63	0.11	14.55	4.08
MV-021	74.37	26.80	29.64	0.12	15.38	4.16
MV-022	1.93	1.51	8.28	0.02	2.79	0.79
MV-023	74.90	73.66	74.24	0.18	22.52	6.54
MV-024	24.12	62.82	40.79	0.09	11.09	6.55

Table 3-1. Cumulative Emissions Inventory

Project ID	Maximum Daily Emissions (lb/day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
MV-025	26.27	73.66	43.56	0.11	10.53	6.54
MV-026	32.40	73.66	43.56	0.11	10.53	6.54
MV-027	19.03	42.48	22.27	0.04	10.53	6.54
MV-028	28.42	42.48	22.27	0.05	20.47	12.01
MV-029	28.42	62.82	56.90	0.16	19.18	6.55
MV-030	26.91	73.66	43.56	0.11	10.53	6.54
MV-031	30.08	68.24	42.18	0.10	10.53	6.54
MV-032	23.78	73.66	43.56	0.11	10.53	6.55
MV-033	30.64	68.24	42.18	0.10	10.53	6.54
MV-034	29.52	68.24	42.18	0.10	10.53	6.54
MV-035	14.32	42.48	22.27	0.05	20.47	12.01
MV-036	1.68	1.54	9.97	0.02	3.02	0.85
MV-037	40.05	38.00	111.00	0.54	60.91	17.23
MV-038	11.21	11.90	36.79	0.18	20.57	5.77
MV-039	41.34	43.88	135.62	0.65	75.83	21.25
MV-040	91.42	21.38	17.08	0.04	4.05	2.46
MV-041	384.38	88.36	64.15	0.59	46.05	13.17
MV-042	207.10	68.24	42.18	0.18	14.18	6.54
MV-043	13.77	13.07	38.17	0.19	20.94	5.92
MV-044	294.12	73.66	49.08	0.45	35.23	10.08
MV-045	80.96	38.16	54.46	0.10	13.51	3.79
MV-046	8.47	23.30	16.91	0.15	12.14	3.47
MV-047	9.25	42.48	22.27	0.05	20.47	12.01
MV-048	47.85	57.78	236.77	1.03	132.88	35.98
MV-049	50.28	60.72	248.81	1.08	139.64	37.81
MV-050	9.17	9.73	30.08	0.14	16.82	4.71
MV-051	19.88	21.10	65.21	0.31	36.46	10.22

Table 3-1. Cumulative Emissions Inventory

Project ID	Maximum Daily Emissions (lb/day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
MV-052	22.71	24.10	74.51	0.36	41.66	11.68
MV-053	27.68	76.17	55.30	0.50	39.70	11.36
MV-054	293.41	105.91	76.89	0.70	55.20	15.79
MV-056	9.25	42.48	22.27	0.05	20.47	12.01
MV-057	21.07	68.24	42.18	0.10	10.53	6.54
MV-058	0.39	0.30	1.66	0.005	0.56	0.16
MV-059	35.69	73.66	43.56	0.11	10.53	6.54
MV-060	29.81	73.66	43.56	0.11	10.53	6.54
MV-061	92.91	78.83	112.53	0.22	27.92	7.84
MV-062	28.13	62.82	112.36	0.31	37.87	10.66
MV-063	33.43	62.82	45.73	0.13	15.41	6.55
MV-064	28.20	73.66	43.56	0.11	10.53	6.54
MV-065	18.33	42.48	22.27	0.04	10.53	6.54
MV-066	78.83	68.24	44.69	0.11	13.56	6.54
MV-067	24.42	62.82	40.79	0.09	11.23	6.55
MV-068	106.87	42.48	22.27	0.07	10.53	6.54
MV-069	10.15	9.63	28.13	0.14	15.44	4.37
MV-070	75.70	68.24	42.91	0.10	13.02	6.54
MV-071	17.29	42.48	22.27	0.04	10.53	6.54
MV-072	15.26	21.38	15.73	0.03	4.05	2.46
MV-073	30.30	42.48	22.27	0.05	20.47	12.01
MV-074	21.80	62.82	40.79	0.08	10.53	6.55
MV-075	38.91	125.63	196.29	0.35	40.48	13.09
MV-076	144.64	136.49	194.82	0.37	48.33	13.57
MV-077	247.25	73.66	45.18	0.22	25.26	7.08
MV-078	13.44	14.26	44.08	0.21	24.65	6.91
MV-079	170.32	42.48	24.86	0.15	20.47	12.01

Table 3-1. Cumulative Emissions Inventory

Project ID	Maximum Daily Emissions (lb/day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
MV-080	41.29	21.38	27.69	0.05	6.87	2.46
MV-081	15.50	42.66	30.97	0.28	22.23	6.36
MV-082	11.07	30.47	22.12	0.20	15.88	4.54
MV-083	9.20	9.76	30.18	0.15	16.87	4.73
MV-084	2.58	2.74	8.47	0.04	4.74	1.33
MV-085	72.32	61.32	87.52	0.17	21.71	6.54
MV-086	3.43	2.69	14.69	0.04	4.95	1.39
MV-087	21.11	42.48	22.27	0.04	10.53	6.54
MV-088	15.26	9.05	8.05	0.01	0.92	0.66
MV-089	15.26	9.05	8.05	0.01	0.92	0.66
MV-090	13.79	9.03	8.05	0.01	1.13	0.66
MV-091	28.20	73.66	43.56	0.11	10.53	6.54
MV-093	3.36	3.08	19.94	0.05	6.05	1.70
MV-094	83.53	73.66	47.36	0.12	14.37	6.54
MV-095	90.34	76.64	109.40	0.21	27.14	7.62
MV-096	44.13	73.66	43.56	0.11	10.53	6.54
MV-097	32.38	62.82	44.28	0.12	14.92	6.55
MV-098	9.25	42.48	22.27	0.05	20.47	12.01
MV-099	30.30	42.48	22.27	0.05	20.47	12.01
MV-100	60.98	68.24	42.18	0.10	10.53	6.54
MV-101	16.92	9.03	8.05	0.01	1.40	0.66
MV-102	78.08	26.80	16.75	0.04	5.61	2.64
MV-103	94.99	42.48	22.27	0.08	10.53	6.54
MV-104	173.12	42.48	24.97	0.15	20.47	12.01
MV-105	15.26	9.05	8.05	0.01	0.92	0.66
MV-106	15.26	9.05	8.05	0.01	0.92	0.66
MV-107	10.37	21.38	15.09	0.03	4.05	2.46

Table 3-1. Cumulative Emissions Inventory

Project ID	Maximum Daily Emissions (lb/day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
MV-108	5.75	8.94	8.05	0.01	0.92	0.66
MV-109	53.45	125.63	228.64	0.64	77.06	21.70
MV-110	21.11	42.48	22.27	0.04	10.53	6.54
MV-111	10.26	21.38	15.45	0.03	4.05	2.46
MV-112	19.01	9.06	8.05	0.01	0.92	0.66
MV-113	29.72	62.82	40.79	0.08	10.53	6.55
MV-114	10.81	8.94	8.05	0.01	0.92	0.66
MV-115	0.90	8.94	8.05	0.01	0.92	0.66
MV-116	14.32	42.48	22.27	0.05	20.47	12.01
MV-117	48.43	21.38	16.04	0.03	4.05	2.46
MV-118	10.37	21.38	15.09	0.03	4.05	2.46
MV-119	19.95	68.24	42.18	0.10	10.53	6.54
MV-120	97.82	83.00	118.48	0.23	29.39	8.25
MV-121	8.31	8.94	8.05	0.01	0.92	0.66
MV-123	26.18	9.12	8.75	0.02	2.17	0.66
MV-124	72.32	61.32	87.52	0.17	21.71	6.54
MV-125	15.26	21.38	15.73	0.03	4.05	2.46
MV-126	24.32	62.82	48.63	0.14	16.39	6.55
P-001	6.63	5.19	28.35	0.08	9.55	2.69
P-002	13.29	36.56	26.54	0.24	19.06	5.45
P-003	10.24	28.17	20.45	0.19	14.68	4.20
P-004	88.81	42.48	22.27	0.07	10.53	6.54
P-005	213.42	68.24	42.18	0.19	14.61	6.54
P-006	278.31	73.66	50.86	0.24	28.44	7.97
P-007	315.44	62.82	100.86	0.49	56.39	15.81
P-008	111.93	42.48	22.27	0.10	20.47	12.01
P-009	297.77	73.66	44.09	0.21	24.20	6.84

Table 3-1. Cumulative Emissions Inventory

Project ID	Maximum Daily Emissions (lb/day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
P-010	37.65	103.60	75.21	0.69	53.99	15.45
P-011	30.36	28.80	84.14	0.41	46.17	13.06
P-012	210.69	68.24	42.18	0.19	21.52	6.54
P-014	318.13	73.66	53.09	0.48	38.11	10.90
P-015	17.29	47.58	34.54	0.32	24.80	7.09
P-016	29.01	79.83	57.96	0.53	41.61	11.90
P-017	12.84	35.34	25.66	0.23	18.42	5.27
P-018	34.26	94.27	68.44	0.62	49.13	14.06
P-019	15.45	42.51	30.86	0.28	22.16	6.34
P-020	19.30	53.11	38.56	0.35	27.68	7.92
P-021	3.76	10.36	7.52	0.07	5.40	1.54
P-022	176.35	42.48	25.12	0.15	20.47	12.01
P-023	92.93	42.48	22.27	0.07	10.53	6.54
P-024	388.08	89.21	64.77	0.59	46.50	13.30
P-025	481.27	73.66	45.92	0.42	32.97	9.43
P-026	376.38	73.66	68.80	0.33	38.47	10.78
P-027	19.13	52.65	38.22	0.35	27.44	7.85
P-028	310.75	73.66	56.79	0.27	31.76	8.90
P-030	25.50	62.82	101.80	0.28	34.31	9.66
P-031	26.33	42.48	22.27	0.05	10.53	6.54
P-032	298.19	281.62	401.98	0.77	99.73	28.00
P-033	89.97	188.45	384.86	1.07	129.71	36.53
P-034	392.21	192.98	140.11	1.28	100.58	28.77
P-035	25.27	21.38	16.24	0.03	4.05	2.46
P-036	295.79	232.06	183.83	1.45	117.29	33.51
P-037	8.85	6.93	37.87	0.11	12.76	3.59
P-038	10.79	8.44	46.14	0.13	15.55	4.38

Table 3-1. Cumulative Emissions Inventory

Project ID	Maximum Daily Emissions (lb/day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
P-039	363.44	73.66	43.56	0.32	24.89	7.12
P-040	25.21	73.66	43.56	0.11	10.53	6.55
P-041	77.34	42.48	22.27	0.06	10.53	6.54
P-042	34.59	68.24	42.18	0.10	10.53	6.54
P-043	32.33	68.24	42.18	0.10	10.53	6.54
P-044	29.67	42.48	22.27	0.05	20.47	12.01
P-045	26.33	42.48	22.27	0.05	10.53	6.54
P-046	24.80	62.82	57.64	0.10	11.89	6.55
P-047	26.99	62.82	107.80	0.30	36.33	10.23
P-048	42.44	73.66	43.56	0.11	10.53	6.54
P-049	23.58	73.66	43.56	0.11	10.53	6.55
P-050	74.37	35.04	50.01	0.10	12.41	3.48
P-051	19.95	68.24	42.18	0.10	10.53	6.54
P-052	26.59	73.66	43.56	0.11	10.53	6.54
P-053	24.42	62.82	40.79	0.09	11.23	6.55
P-054	24.63	62.82	49.25	0.14	16.60	6.55
P-055	208.76	197.09	281.32	0.54	69.80	19.60
P-056	18.50	9.04	8.05	0.01	0.92	0.66
P-057	77.42	9.50	8.32	0.02	1.32	0.66
P-058	175.42	42.48	25.96	0.13	20.47	12.01
P-059	25.14	62.82	50.28	0.14	16.95	6.55
P-060	8.58	8.94	8.05	0.01	0.92	0.66
P-061	7.75	21.33	15.48	0.14	11.12	3.18
R-001	44.32	53.52	219.33	0.95	123.10	33.33
R-002	12.90	35.51	25.78	0.24	18.51	5.29
R-003	16.85	17.88	55.27	0.27	30.90	8.66
R-004	67.87	68.24	42.18	0.10	11.67	6.54

Table 3-1. Cumulative Emissions Inventory

Project ID	Maximum Daily Emissions (lb/day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
R-005	231.96	73.66	185.24	0.74	96.09	26.00
R-006	27.03	42.48	22.27	0.05	10.53	6.54
R-007	52.22	24.57	35.07	0.07	8.70	2.46
R-008	11.83	42.48	22.27	0.05	20.47	12.01
R-009	701.42	3,844.34	5,487.47	10.50	1,361.41	382.27
R-010	43.91	10.32	14.73	0.03	3.65	1.03
R-011	158.12	42.48	54.33	0.24	30.49	12.01
R-012	57.11	26.88	38.37	0.07	9.52	2.67
R-013	7.00	8.94	8.05	0.01	0.92	0.66
R-014	7.39	8.94	8.05	0.01	0.92	0.66
R-015	26.03	62.82	40.79	0.10	11.97	6.55
R-016	3.68	8.94	8.05	0.01	0.92	0.66
R-017	86.35	73.66	48.96	0.12	14.85	6.54
R-018	233.52	320.38	766.09	3.69	428.35	120.05
R-019	19.37	42.48	22.27	0.04	10.53	6.54
R-020	387.41	89.06	64.66	0.59	46.42	13.28
R-021	9.63	42.48	22.27	0.04	10.53	6.54
R-022	10.37	21.38	15.09	0.03	4.05	2.46
R-023	15.14	9.03	8.05	0.01	1.25	0.66
R-024	241.87	591.67	1,034.58	2.88	348.69	98.19
R-025	65.37	68.24	42.18	0.10	11.23	6.54
R-026	268.27	169.90	321.69	0.98	122.05	33.93
R-027	6.95	8.94	8.05	0.01	0.92	0.66
R-028	24.21	73.66	43.56	0.11	10.53	6.54
R-029	7.28	8.94	8.05	0.01	0.92	0.66
R-030	107.62	91.35	130.39	0.25	32.35	9.08
R-031	22.77	21.38	16.09	0.03	4.05	2.46

Table 3-1. Cumulative Emissions Inventory

Project ID	Maximum Daily Emissions (lb/day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
R-032	41.51	9.75	13.92	0.03	3.45	0.97
R-033	19.02	21.38	15.92	0.03	4.05	2.46
R-034	22.79	9.04	8.05	0.01	0.92	0.66
R-035	32.18	42.48	22.27	0.05	20.47	12.01
R-036	21.81	42.48	22.27	0.04	10.53	6.54
R-037	11.36	8.94	8.05	0.01	0.93	0.66
R-038	6.73	8.94	8.05	0.01	0.92	0.66
R-039	20.88	62.82	83.18	0.23	28.03	7.89
R-040	4.69	8.94	8.05	0.01	0.92	0.66
R-041	43.09	9.22	8.05	0.01	1.55	0.66
R-042	30.95	62.82	123.74	0.34	41.70	11.74
R-043	28.39	68.24	42.18	0.10	10.53	6.54
R-044	7.66	8.94	8.05	0.01	0.92	0.66
R-045	70.54	9.49	8.23	0.02	2.54	0.69
R-046	20.42	68.24	42.18	0.10	10.53	6.54
R-047	100.07	21.38	17.27	0.04	4.05	2.46
R-048	70.01	32.98	47.07	0.09	11.68	3.28
R-049	26.21	62.82	41.65	0.08	10.53	6.55
R-050	4.56	21.38	15.01	0.03	4.05	2.46
R-051	4.62	8.94	8.05	0.01	0.92	0.66
R-052	18.26	68.24	42.18	0.10	10.53	6.54
R-053	16.57	42.48	22.27	0.05	20.47	12.01
R-054	14.32	42.48	22.27	0.05	20.47	12.01
R-055	11.50	42.48	22.27	0.05	20.47	12.01
R-056	67.70	42.48	22.27	0.07	10.53	6.54
R-057	88.61	42.48	22.27	0.07	10.53	6.54
R-058	5.33	8.94	8.05	0.01	0.92	0.66

Table 3-1. Cumulative Emissions Inventory

Project ID	Maximum Daily Emissions (lb/day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
R-059	7.75	8.94	8.05	0.01	0.92	0.66
R-060	94.37	26.80	17.12	0.07	9.09	2.64
R-061	197.38	186.33	265.97	0.51	65.99	18.53
R-062	3.64	8.94	8.05	0.01	0.92	0.66
R-063	13.39	21.38	15.65	0.03	4.05	2.46
R-064	5.87	21.38	15.01	0.03	4.05	2.46
R-065	35.15	68.24	42.18	0.10	10.53	6.54
R-066	11.64	9.03	8.05	0.01	0.95	0.66
RC-001	60.52	188.45	258.85	0.72	87.24	24.57
RC-002	96.75	251.27	413.83	1.15	139.48	39.28
RC-003	165.05	376.90	706.00	1.96	237.95	67.01
RC-005	36.28	125.63	155.19	0.43	52.30	14.73
RC-006	278.31	62.82	95.70	0.41	53.71	14.54
RC-007	267.88	96.69	70.19	0.64	50.39	14.42
RC-009	319.91	62.82	84.66	0.41	46.47	13.12
RC-010	262.94	170.02	525.55	2.53	293.85	82.36
RC-011	377.48	73.66	43.56	0.33	25.85	7.40
RC-012	196.58	42.48	35.91	0.17	20.47	12.01
RC-013	25.76	62.82	102.84	0.29	34.66	9.76
RC-014	100.41	73.66	56.97	0.14	17.28	6.54
RC-015	29.31	62.82	40.79	0.08	10.53	6.55
RC-017	17.44	9.03	8.05	0.01	1.44	0.66
RC-018	9.63	42.48	22.27	0.04	10.53	6.54
RC-019	49.16	23.12	33.01	0.06	8.19	2.46
RC-020	5.43	8.94	8.05	0.01	0.92	0.66
RC-021	15.07	9.03	8.05	0.01	0.92	0.66
RC-022	27.06	62.82	40.79	0.08	10.53	6.55

Table 3-1. Cumulative Emissions Inventory

Project ID	Maximum Daily Emissions (lb/day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
RC-023	48.84	21.38	16.08	0.03	4.05	2.46
RC-024	98.49	42.48	22.27	0.08	10.53	6.54
RC-025	79.01	21.38	16.75	0.03	4.05	2.46
RC-026	4.75	8.94	8.05	0.01	0.92	0.66
RC-027	97.40	42.48	22.27	0.08	10.53	6.54
RC-028	10.62	8.94	8.05	0.01	0.92	0.66
RC-029	15.33	9.03	8.05	0.01	1.26	0.66
RC-030	333.77	76.73	55.70	0.51	39.99	11.44
RC-031	93.24	42.48	22.27	0.07	10.53	6.54
RC-032	35.12	125.63	150.22	0.42	50.63	14.26
RC-033	19.95	62.82	79.46	0.22	26.78	7.54
RC-034	22.42	62.82	89.39	0.25	30.13	8.48
RC-035	139.65	314.09	602.02	1.68	204.38	57.49
RC-036	24.27	62.82	96.84	0.27	32.64	9.19
RC-037	29.10	62.82	116.29	0.32	39.19	11.04
RC-038	307.88	111.14	80.69	0.74	57.92	16.57
RC-039	22.20	68.24	42.18	0.10	10.53	6.54
RD-001	3.97	3.10	16.97	0.05	5.72	1.61
RD-002	2.66	2.08	11.38	0.03	3.84	1.08
RD-003	33.37	73.66	43.56	0.11	10.53	6.54
RD-004	37.94	73.66	43.56	0.11	10.53	6.54
RD-005	11.09	30.51	22.15	0.20	15.90	4.55
RD-006	44.93	21.38	30.15	0.06	7.48	2.46
RD-007	118.61	55.95	79.86	0.15	19.81	5.56
RD-008	25.29	42.48	22.27	0.05	20.47	12.01
RD-009	40.83	21.38	27.38	0.05	6.79	2.46
RD-010	75.04	42.48	22.27	0.06	10.53	6.54

Table 3-1. Cumulative Emissions Inventory

Project ID	Maximum Daily Emissions (lb/day)					
	ROG	NO_X	CO	SO_2	PM_{10}	$PM_{2.5}$
RD-011	51.63	24.29	34.67	0.07	8.60	2.46
RD-012	13.31	36.64	26.60	0.24	19.10	5.46
RD-013	22.43	61.73	44.82	0.41	32.17	9.20
RD-014	17.10	47.04	34.15	0.31	24.52	7.01
RD-015	9.37	25.78	18.71	0.17	13.43	3.84
RD-016	15.83	43.56	31.62	0.29	22.70	6.49
SB-001	13.60	37.44	27.18	0.25	19.51	5.58
SB-002	6.94	19.10	13.87	0.13	9.96	2.85
SB-003	13.14	36.17	26.26	0.24	18.85	5.39
SB-004	17.22	47.39	34.40	0.31	24.70	7.07
SB-005	6.24	17.18	12.48	0.11	8.96	2.56
SB-006	12.02	33.09	24.02	0.22	17.24	4.93
SB-007	19.39	68.24	42.18	0.10	10.53	6.54
SB-008	22.76	68.24	42.18	0.10	10.53	6.54
SJ-001	283.22	735.02	1,049.18	2.01	260.30	73.09
SJ-002	16.72	62.82	66.42	0.18	22.39	6.55
SJ-003	30.03	62.82	120.01	0.33	40.45	11.39
SJ-004	31.72	62.82	126.84	0.35	42.75	12.04
Total	**26,381**	**26,742**	**33,893**	**109**	**12,738**	**4,076**

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/3/ USEPA, 2007. Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 and Regional Haze. Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC. EPA-454/B-07-002.

APPENDIX B
PGM INPUTS, OUTPUTS, AND ASSUMPTIONS HIGHLAND FAIRVIEW WORLD LOGISTICS CENTER MORENO VALLEY, CALIFORNIA

1. REGIONAL AIR QUALITY MODELING PLATFORM

The Southern California 2012 4- kilometer (km) Comprehensive Air Quality Model with extensions (CAMx)[1] modeling database along with a 2031 emissions database were used in this assessment. The 2012 base case is based on a Photochemical Grid Model (PGM) database developed by the South Coast Air Quality Management District (SCAQMD) as part of the modeling and attainment demonstration for their 2016 Air Quality Management Plan[2]. This PGM database is tailored for Southern California and reflects updated emissions estimates, new technical information and enhanced air quality modeling techniques. The database uses a high-resolution 4-km horizontal grid to better simulate meteorology and air quality in the complex terrain and coastal environment of California. This contrasts with the United States Environmental Protection Agency's (USEPA's) national modeling platforms[3] used for national rulemakings (e.g., transport rules such as CSAPR[4] or defining new National Ambient Air Quality Standards [NAAQS]) that use a coarser 12-km horizontal grid resolution. The model domain is shown in **Figure 1-1**.

Details of the model inputs, configuration, and results are presented in Section 2 of this Appendix.

Figure 1-1. Air Quality Modeling Domain for Southern California



1 http://www.camx.com.

2 http://www.aqmd.gov/home/air-quality/clean-air-plans/air-quality-mgt-plan/final-2016-aqmp.

3 https://www.epa.gov/air-emissions-modeling/2014-2016-version-7-air-emissions-modeling-platforms.

4 https://www.epa.gov/csapr.

2. REGIONAL GRID MODELING

This section describes the regional PGM modeling setup to assess the outcome of the unmitigated and mitigated Project emissions on the ambient Particulate Matter less than 2.5 microns in diameter ($PM_{2.5}$) levels in the region. The 2012 base case modeling databases were developed by the SCAQMD for the Community Multiscale Air Quality (CMAQ) PGM. The CMAQ annual 2012 4-km modeling database and annual 2012 4-km Weather Research and Forecasting (WRF) meteorological model output files were obtained from the SCAQMD. The SCAQMD CMAQ and WRF 2012 4-km data were then processed to generate a 2012 4-km annual PGM modeling database suitable for the CAMx. The following paragraphs describe how Ramboll developed the CAMx 2012 4-km annual database used in this study, starting with the SCAQMD CMAQ and WRF 2012 4-km data. Preparation of the Project unmitigated and mitigated emissions inputs for CAMx is discussed in **Appendix A**.

2.1 Model Inputs and Configuration

The SCAQMD emissions database has both 2012 and 2031 future year projections for CMAQ area and in-line point emissions. Ramboll converted both years' emissions to corresponding CAMx area and point-source emissions files using the CMAQ2CAMx interface program[5]. Sea salt emissions were developed using an emissions processor that integrates published sea spray flux algorithms to estimate sea salt PM emissions for input to CAMx. The CAMx sea salt emissions were then merged with area emissions files.

The most commonly used prognostic meteorological models to provide meteorological fields for air quality modeling are the Weather Research and Forecasting (WRF) model (Skamarock et al., 2005) and the Fifth-Generation Mesoscale Model (MM5; Grell et al, 1994). MM5 is a nonhydrostatic, prognostic meteorological model developed in the 1970s by Pennsylvania State University and the National Center for Atmospheric Research (NCAR) and has been widely used for urban- and regional-scale photochemical, fine particulate, and regional haze regulatory modeling studies. However, development of MM5 ceased in 2006, and WRF has become the new standard model used in place of the older MM5 for regulatory air quality applications in the US. Developed jointly by NCAR and the National Center for Environmental Prediction in late 1990s, WRF has been under continuous development, improvement, testing and open peer-review for more than 10 years and used world-wide by hundreds of researchers and practitioners around the globe for a variety of mesoscale studies. SCAQMD adopted WRF version 3.6 for the 2012 simulations. For the current application, the meteorology remains unchanged for the future year simulation and SCAQMD WRF 2012 4-km model outputs were processed using the WRFCAMx[6] processor to generate the meteorological fields ready for CAMx. The WRF model employs a terrain-following coordinate system defined by pressure, using multiple layers that extend from the surface to 50 millibars (approximately 19 kilometers above ground level [AGL]). A layer averaging scheme is adopted for CAMx simulations to reduce the computational burden. **Table 2-1** presents the mapping from the WRF vertical layer structure to the CAMx vertical layers.

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5 http://www.camx.com/download/support-software.aspx.

6 WRFCAMx is available on the CAMx website (http://www.camx.com/download/support-software.aspx).

Table 2-1. Vertical Layer Structure for WRF and CAMx Modeling

WRF		CAMx			
Layer	**Height (m)**	**Layer**	**Height (m)**	**Thickness (m)**	**Sigma**
30	19260	18	19260	4769	0.0000
29	17456				
28	15900				
27	14492	17	14492	6027	0.0788
26	13185				
25	11945				
24	10755				
23	9597				
22	8465	16	8465	4906	0.2930
21	7345				
20	6237				
19	5177				
18	4295				
17	3559	15	3559	1560	0.6254
16	2944				
15	2430				
14	1999	14	1999	358	0.7733
13	1641	13	1641	300	0.8107
12	1341	12	1341	251	0.8431
11	1090	11	1090	209	0.8709
10	881	10	881	175	0.8946
9	706	9	706	146	0.9148
8	561	8	561	121	0.9319
7	439	7	439	101	0.9463
6	338	6	338	85	0.9585
5	253	5	253	70	0.9688
4	183	4	183	59	0.9774
3	124	3	124	49	0.9846
2	75	2	75	41	0.9907
1	34	1	34	34	0.9958
0	0		0	0	1

The SCAQMD data set provided the lateral boundary conditions (BCs) for the 4-km state-wide modeling grid. The SCAQMD simulated a 12-km domain whose boundary concentrations were extracted from a global model simulation for the year 2012. The Model for Ozone and Related Chemical Tracers Version 4 (MOZART-4; Emmons et al., 2010) is a global chemical transport model

developed jointly by NCAR, the Geophysical Fluid Dynamics Laboratory, and the Max Planck Institute for Meteorology, and simulates chemistry and transport of tropospheric gases and bulk aerosols. The 12-km outputs were saved and used to derive the boundary conditions for the 4-km domain. The CMAQ2CAMX processor was used to convert the CMAQ 4-km boundary conditions to suitable CAMx BCs. The model was initialized from clean initial concentrations and five days of spin-up period were used for the 4-km grids to minimize their influence.

Additional data used in the air quality modeling include ozone column data from the Ozone Monitoring Instrument (OMI), which continues the Total Ozone Mapping Spectrometer (TOMS) record for total ozone and other atmospheric parameters related to ozone chemistry (OMI officially replaced the TOMS ozone column satellite data on January 1, 2006). OMI data are available every 24-hours and are obtained from the TOMS ftp site[7]. The CAMx O3MAP program reads the OMI ozone column txt file data and interpolates to fill gaps and generated gridded daily ozone column input data. The OMI data is used in the CAMx (TUV) radiation models, which is a radiative transfer model that develops clear-sky photolysis rate inputs for CAMx. The land use file was generated with the WRFCAMx processor and modified to remove lakes and set coastal waters with a surf zone width of 50 m; this file was used to update the emissions database and provide more realistic representation of sea salt emissions.

Table 2-2 presents the CAMx configuration used for the modeling in this Project analysis. In the past, the Carbon-Bond IV (CB4) chemical mechanism (Gery et al., 1989) has been predominantly used for the California State Implementation Plan (SIP) modeling. In 1999, however, the California Air Resources Board's (CARB's) Reactivity Scientific Advisory Committee recommended switching to the 1999 State-wide Air Pollution Research Center (SAPRC99) chemical mechanism (Carter, 2000) based on a comprehensive review by Stockwell (1999), and SAPRC99 has since been the mechanism of choice for the California SIPs. The 2007 update to the SAPRC chemistry mechanism, called SAPRC07 (Carter, 2010), replaced the dated SAPRC99 mechanism. The version implemented in CAMx is SAPRC07TC, which includes additional model species to explicitly represent selected toxics and reactive organic compounds and uses numerical expressions of rate constants that are compatible with the current chemistry mechanism solver. The partitioning of inorganic aerosol constituents (sulfate, nitrate, ammonium and chloride) between gas and aerosol phases is performed using the ISORROPIA module. The Secondary Organic Aerosol Processor (SOAP) is a semi-volatile equilibrium scheme used to perform the organic aerosol-gas partitioning. These processes are described in more detailed in the CAMx user guide.[8]

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7 ftp://toms.gsfc.nasa.gov/pub/omi/data/.

8 http://www.camx.com/files/camxusersguide_v6-50.pdf

Table 2-2. CAMx Modeling Configuration

Science Option	Configuration	Notes
Model Code	CAMx v6.5	Released April 2018
Horizontal Grid	4-km 1-way nesting	
O3 and PM 4-km	156 x 102 grid cells	
Vertical Grid	18 vertical layers extending up to ~19 km AGL	Collapsed from 30 WRF layers (see Table 3-1)
Initial Conditions	Clean initial conditions	5-day spin-up for 4-km domain
Boundary Conditions	CMAQ 4km lateral concentrations converted to CAMx	
Photolysis Rate	Photolysis rates lookup table	Derived from satellite measurements and TUV processor
Gas-phase Chemistry	SAPRC07TC	Solved by the Euler Backward Iterative (EBI) solver
Aerosol-phase Chemistry	ISORROPIA (inorganic aerosol) SOAP v2.1 (organic aerosol)	
Meteorological Input Pre-processor	WRFCAMx v4.7	
Advection	Piecewise Parabolic Method (PPM)	
Diffusion	Eddy diffusion algorithm	

2.2 Model Results

The future modeling scenario was simulated using the CAMx source apportionment technology. Both cumulative concentrations from all the sources and the concentrations from Project-specific unmitigated and mitigated emissions are derived from separate simulations following the model configuration discussed in the previous section. The model results of hourly $PM_{2.5}$ concentrations were processed into aggregated metrics that are relevant to health effects.

$PM_{2.5}$ Model Results

The metrics relevant to the $PM_{2.5}$ health effects selected in this study are 24-hour annual average concentrations (see **Appendix C**).

Unmitigated Project

Figure 2-1 shows spatial plots of annual average and a single day episode maximum 24-hour average $PM_{2.5}$ concentrations from the base case and the unmitigated Project emissions. In the 2031 base case scenario, the highest concentrations occur in Los Angeles County and the central portion of Imperial County. Annual $PM_{2.5}$ concentrations in these counties generally range between 10 and 20 micrograms per cubic meter ($\mu g/m^3$) with isolated regions that could be higher than 25 $\mu g/m^3$.

Contributions of the unmitigated Project emissions to annual average $PM_{2.5}$ are 0.266 $\mu g/m^3$ at the most impacted area and represent a 3.2 percent increase over the base case concentrations at that location. Contributions to the maximum 24-hour average $PM_{2.5}$ are 0.781 $\mu g/m^3$ at the most impacted area and represent a 2.4 percent increase over the base case concentrations at that location. **Figure 2-2** presents increases in annual average and maximum 24-hour average $PM_{2.5}$ due to the unmitigated Project emissions by $PM_{2.5}$ chemical component at the grid cell of maximum concentration change. The figure shows that on average, the primary concentrations of crustal material (labeled other), elemental carbon and primary organic aerosol account for about 86 percent of the contributions at the location of maximum impact, while the other 14 percent is due to secondary PM (sulfate, ammonium and nitrate). The maximum 24-hr impacts show a larger impact from secondary PM, in particular nitrate alone represents 41 percent of the Project unmitigated scenario contributions.

Figure 2-1. Results of the 4 km $PM_{2.5}$ Modeling Domain
$PM_{2.5}$ Concentrations from the Base Case Scenario (left panels);
Increases in $PM_{2.5}$ due to the Unmitigated Project (center and right panels);
Annual Averages (top panels); Maximum 24-hour Averages (bottom panels)

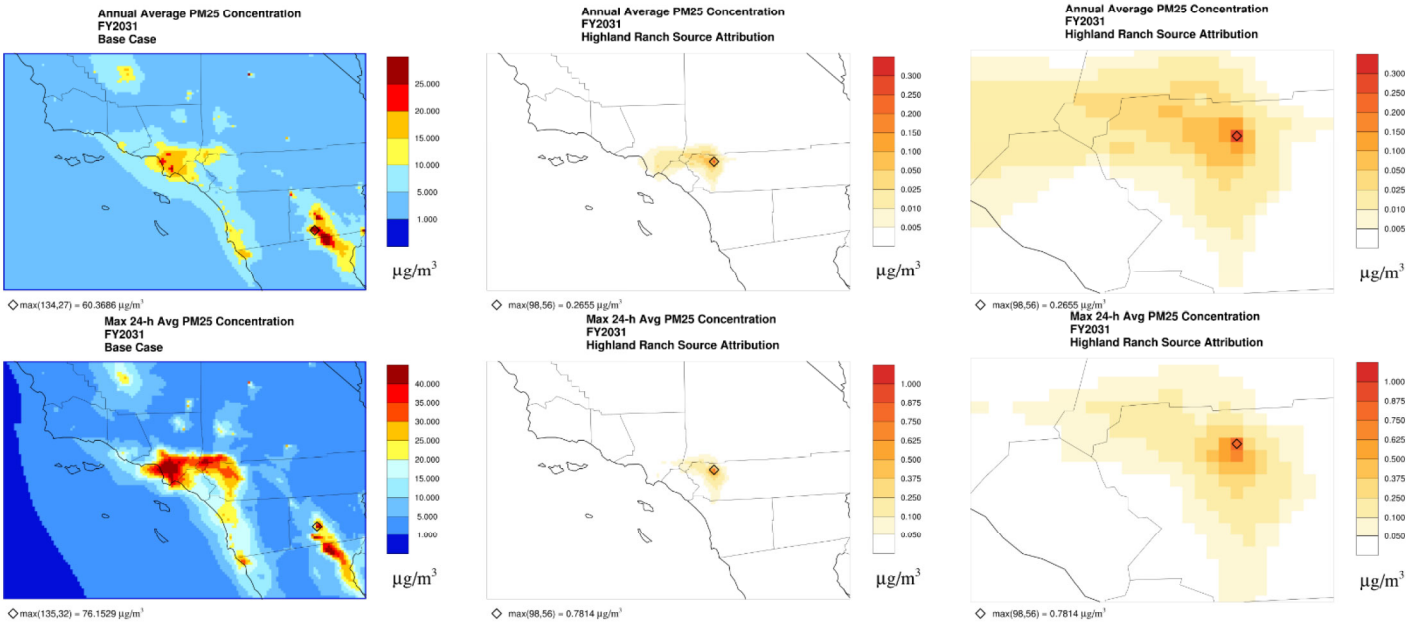
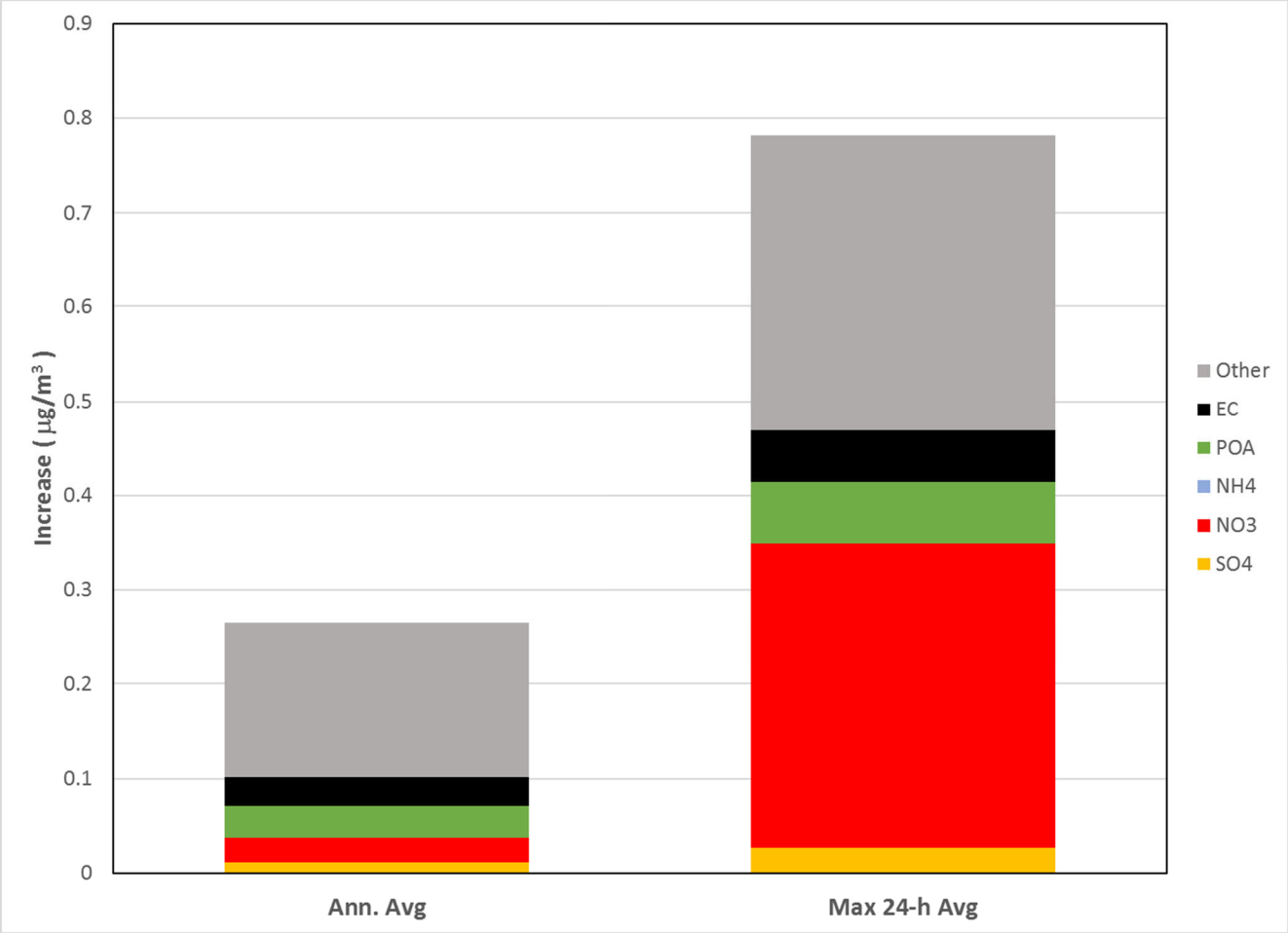


Figure 2-2. Increases in Annual Average and Episode Maximum 24-hour Average $PM_{2.5}$ Concentrations due to the Unmitigated Project by $PM_{2.5}$ Component: fine particulate sulfate (SO_4), nitrate (NO_3), ammonium (NH_4), primary organic aerosol (POA), elemental carbon (EC), and other primary PM (Other); Where the Maximum Change due to Project Emissions Occurred



Mitigated Project

Figure 2-3 shows spatial plots of annual average and a single day episode maximum 24-hour average $PM_{2.5}$ concentrations from the base case and the mitigated Project emissions. Contributions of the mitigated Project emissions to annual average $PM_{2.5}$ are 0.233 $\mu g/m^3$ at the most impacted area and represent a 2.8 percent increase over the base case concentrations at that location. Contributions to the maximum 24-hour average $PM_{2.5}$ are 0.607 $\mu g/m^3$ at the most impacted area and represent a 1.9 percent increase over the base case concentrations at that location. **Figure 2-4** presents increases in annual average and maximum 24-hour average $PM_{2.5}$ due to the mitigated Project emissions by $PM_{2.5}$ chemical component at the grid cell of maximum concentration change. The figure shows that on average, the primary concentrations of crustal material (labeled other), elemental carbon and primary organic aerosol account for about 89 percent of the contributions at the location of maximum impact, while the other 11 percent is due to secondary PM (sulfate, ammonium and

nitrate). The maximum 24-hr impacts show a larger impact from secondary PM, in particular nitrate alone represents 31 percent of the Project mitigated scenario contributions.

Figure 2-3. Results of the 4 km $PM_{2.5}$ Modeling Domain
$PM_{2.5}$ Concentrations from the Base Case Scenario (left panels);
Increases in $PM_{2.5}$ due to the Mitigated Project (center and right panels);
Annual Averages (top panels);
Maximum 24-hour Averages (bottom panels)

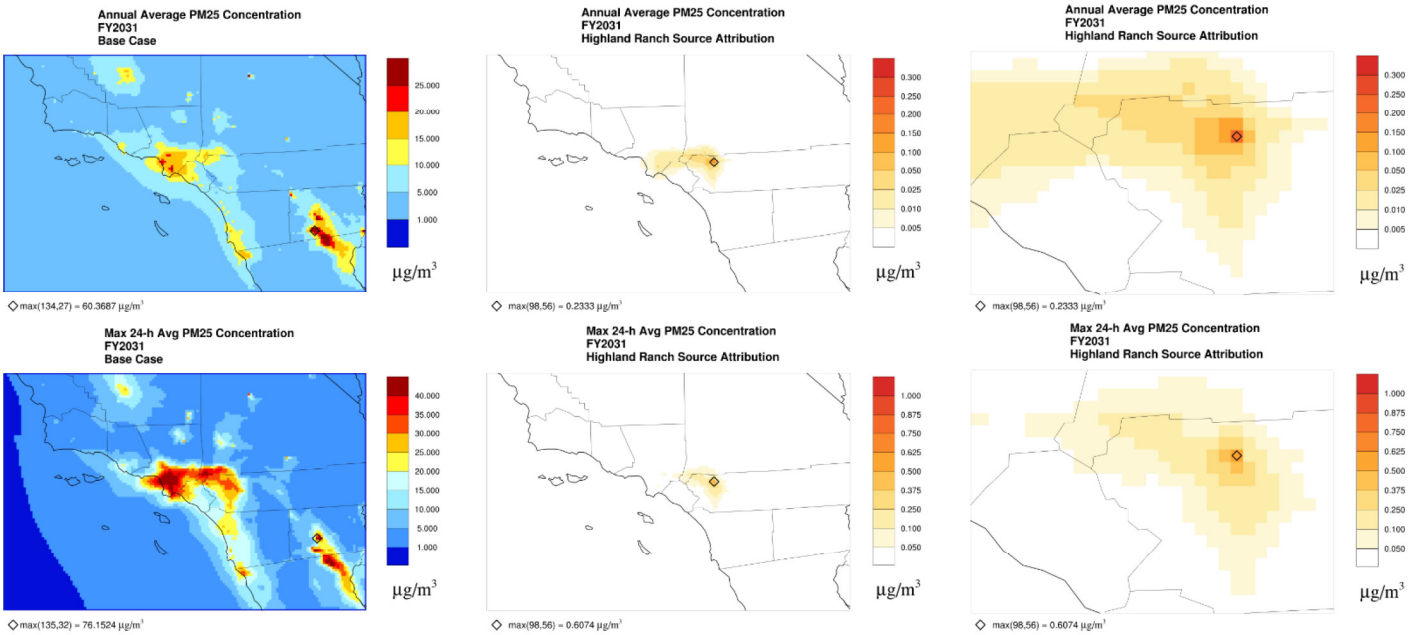
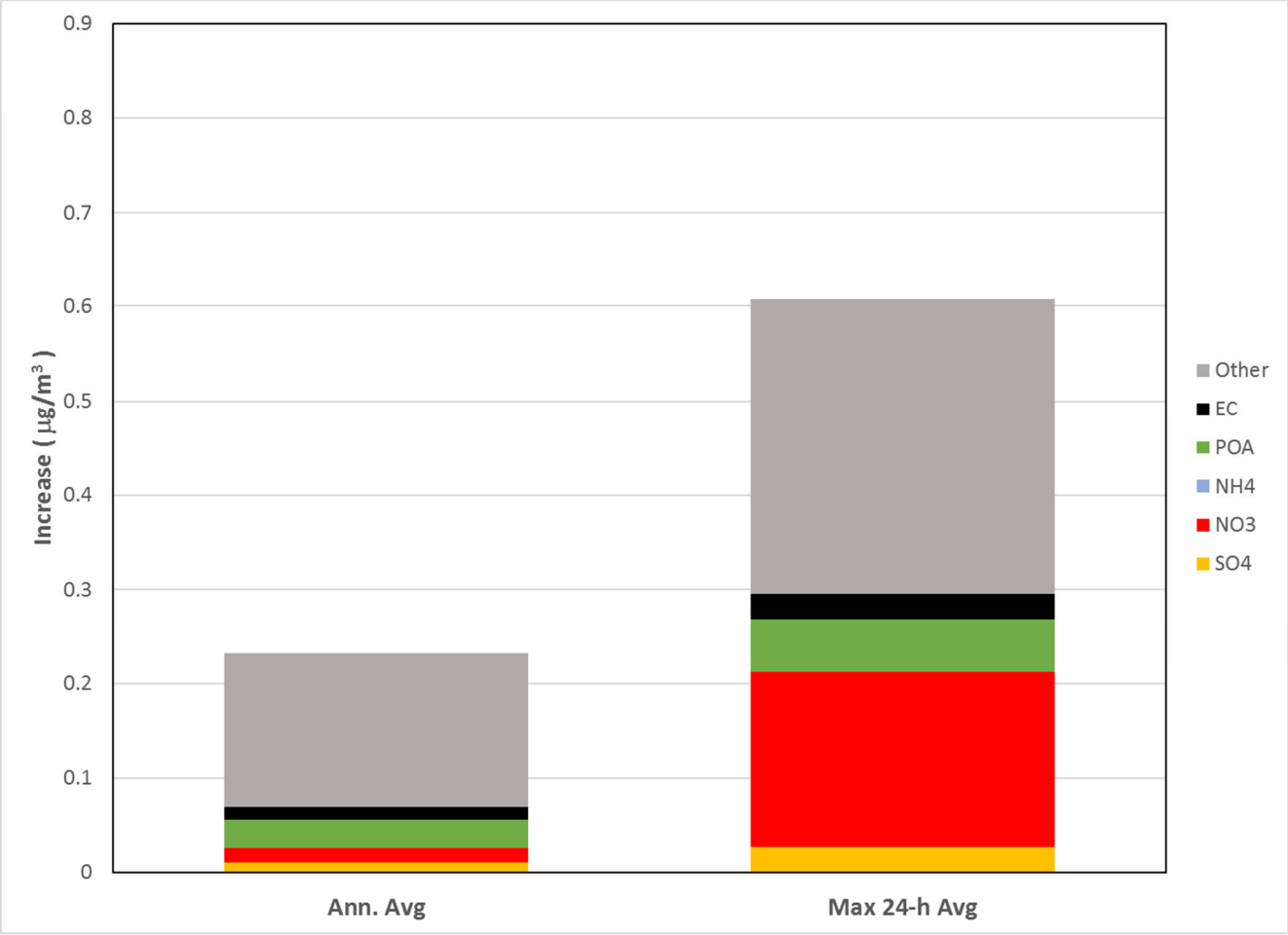


Figure 2-4. Increases in Annual Average and Episode Maximum 24-hour Average $PM_{2.5}$ Concentrations due to the Mitigated Project by $PM_{2.5}$ Component: fine particulate sulfate (SO_4), nitrate (NO_3), ammonium (NH_4), primary organic aerosol (POA), elemental carbon (EC), and other primary PM (Other); Where the Maximum Change due to Project Emissions Occurred



Ozone Model Results

The metrics relevant to the ozone health effects selected in this study are consistent with the ozone NAAQS (see **Appendix C**). The model provides hourly concentrations that are further post-processed to produce maximum daily average 8-hour (MDA8) ozone concentrations for each day.

Unmitigated Project

Figure 2-5 displays spatial plots of the annual average MDA8 ozone for the 2031 emissions scenario and the corresponding annual average MDA8 increases due to the unmitigated Project emissions. In the 2031 base case emissions scenario, the eastern portion of Los Angeles County, the western portions of San Bernardino and Riverside counties and the northern portion of Orange County show the largest concentrations ranging between 50 and 56 ppb. The maximum impact to the annual average MDA8 ozone concentrations due to the unmitigated Project is 0.213 ppb and occurs in northern Riverside County where it represents a 0.41 percent increase over the base case concentrations. **Figure 2-6** displays MDA8 ozone for the base case and increases in MDA8 ozone due to the unmitigated Project on July 10, the day that the unmitigated Project has the highest ozone

contribution for the entire modeling year. The highest MDA8 ozone contribution due to the unmitigated Project is 1.44 ppb (Figure 2-4, right) that occurs in northern Riverside County where total MDA8 ozone concentrations are 79.9 ppb.

Figure 2-5. Annual Average MDA8 Ozone Concentrations from the Base Case Scenario (left) and Increases in Annual Average MDA8 Ozone Concentrations due to the Unmitigated Project (right) for the Annual Modeling of the 2031 Emissions Scenario

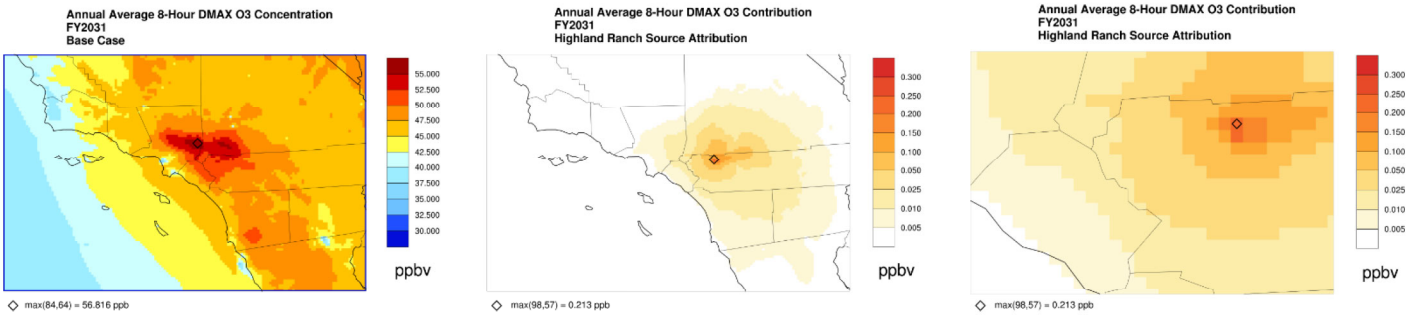
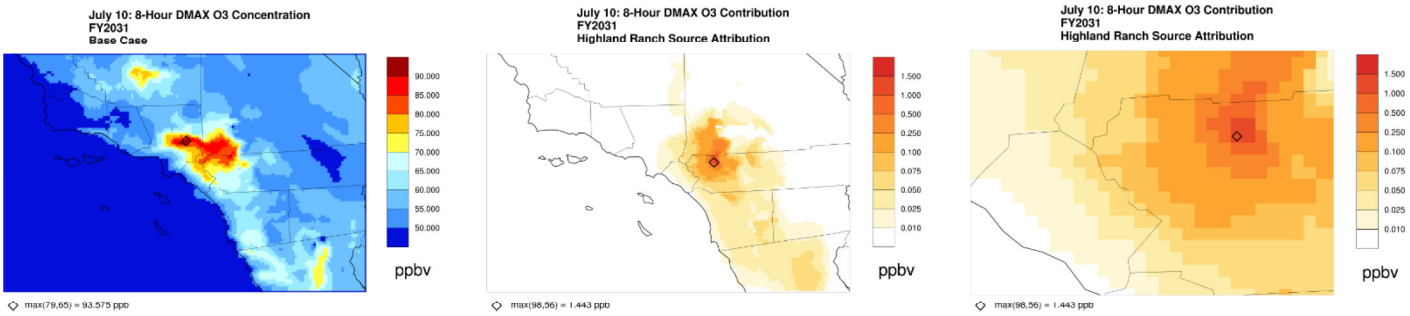


Figure 2-6. MDA8 Ozone Concentrations from the Base Case Scenario (left) and Increases in MDA8 Ozone Concentrations due to the Unmitigated Project (right) on July 10, the Day with the Highest Unmitigated Project Ozone Contributions for the Annual Modeling of the 2031 Emissions Scenario



Mitigated Project

Figure 2-7 displays spatial plots of the annual average MDA8 ozone for the 2031 emissions scenario and the corresponding annual average MDA8 increases due to the mitigated Project emissions. The maximum impact to the annual average MDA8 ozone concentrations due to the mitigated Project is 0.165 ppb and occurs in northern Riverside County where it represents a 0.31 percent increase over the base case concentrations. **Figure 2-8** displays MDA8 ozone for the base case and increases in MDA8 ozone due to the mitigated Project on July 10, the day that the mitigated Project has the highest ozone contribution for the entire modeling year. The highest MDA8 ozone contribution due to the mitigated Project is 0.924 ppb (Figure 2-4, right) that occurs in northern Riverside County where total MDA8 ozone concentrations are 84.8 ppb.

Figure 2-7. Annual Average MDA8 Ozone Concentrations from the Base Case Scenario (left) and Increases in Annual Average MDA8 Ozone Concentrations due to the Mitigated Project (right) for the Annual Modeling of the 2031 Emissions Scenario

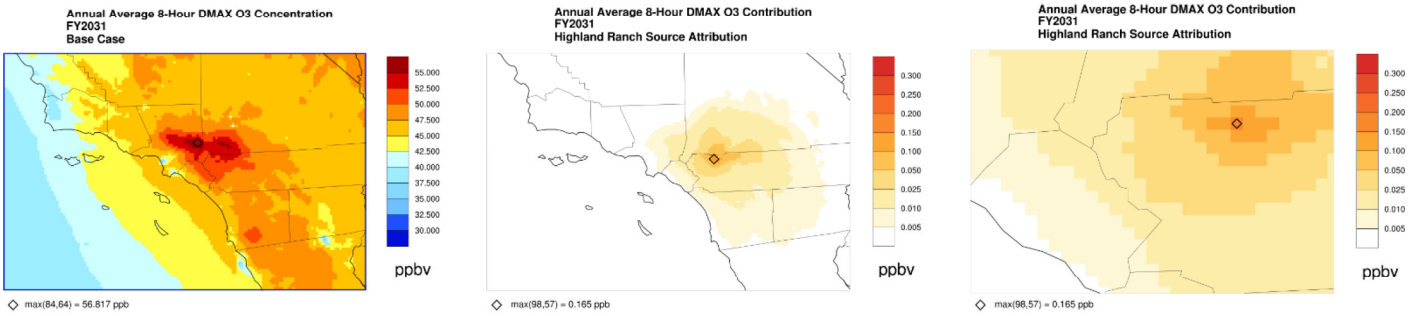
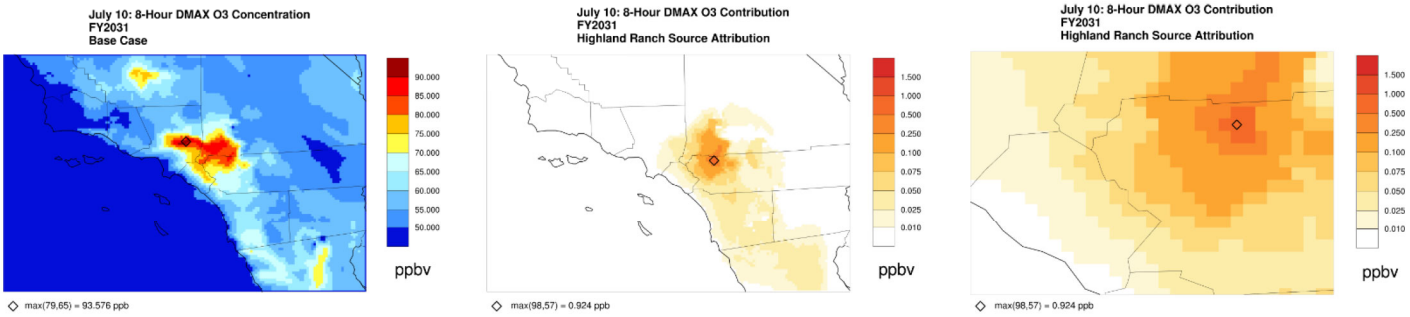


Figure 2-8. MDA8 Ozone Concentrations from the Base Case Scenario (left) and Increases in MDA8 Ozone Concentrations due to the Mitigated Project (right) on July 10, the Day with the Highest Mitigated Project Ozone Contributions for the Annual Modeling of the 2031 Emissions Scenario



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APPENDIX C
BENMAP AND POTENTIAL HEALTH EFFECTS HIGHLAND FAIRVIEW WORLD LOGISTICS CENTER MORENO VALLEY, CALIFORNIA

1. HEALTH EFFECTS ANALYSIS

The potential health effects of ozone and Particulate Matter less than 2.5 microns in diameter ($PM_{2.5}$) concentrations associated with the Project's emissions were estimated using the Environmental Benefits Mapping and Analysis Program (BenMAP), Community Edition v1.5 (March 2019).[1] BenMAP, originally developed by the United States Environmental Protection Agency (USEPA), is a powerful and flexible tool that helps users estimate human health effects and economic value resulting from changes in air quality. BenMAP outputs include PM- and ozone-related health endpoints such as premature mortality, hospital admissions, and emergency room visits. BenMAP uses the following simplified formula to relate changes in ambient air pollution to certain health endpoints (USEPA, 2018)[2]:

$$\text{Health Effect} = \text{Air Quality Change} \times \text{Health Effect Estimate} \times \text{Exposed Population} \times \text{Background Health Incidence}$$

- Air Quality Change - The difference between the starting air pollution level (the base) and the air pollution level after some change, such as a new source.
- Health Effect Estimate - An estimate of the percentage change in an adverse health effect due to a one unit change in ambient air pollution. Effect estimates, also referred to as concentration-response (C-R) functions, are obtained from epidemiological studies.
- Exposed Population - The number of people affected by the air quality change. The government census office is a good source for this information. This analysis uses data from PopGrid, which is an add-on program to BenMAP that allocates the block-level U.S. Census population to a user-defined grid.[3]
- Background Health Incidence - An estimate of the average number of people that die (or suffer from some adverse health effect) in a given population over a given period of time. For example, the health incidence rate might be the probability that a person will die in a given year. Health incidence rates and other health data are typically collected by the government as well as the World Health Organization.[4]

BenMAP applies "effect functions" to calculate incremental health effects from incremental changes in PM and ozone, and an underlying assumption is that there is a causal link between PM and ozone exposures and health effects. The effect functions are derived from statistical correlations reported in epidemiologic studies that compare fluctuations in air pollutant levels measured at central monitors against small fluctuations in population-wide health effects. These are statistical correlations and do not establish a cause-and-effect relationship between small fluctuations in the level of one (or many) ambient air pollutants and health effects, particularly mortality. For example, there is no toxicological or experimental study that has demonstrated or supported that small incremental changes in PM concentrations as a whole, or major PM components, at ambient levels can cause any serious health

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1 http://www.epa.gov/air/benmap/.

2 The common function used for calculating health effects is the following log-linear function: Health Effect = Background Health Incidence x [1 – exponential (Health Effect Estimate * Air Quality Change)] x Exposed Population.

3 https://www.epa.gov/benmap/benmap-community-edition.

4 Background health statistics were obtained from data included in the BenMAP model, and the sources are referenced in the BenMAP manual (AAI, 2018). For example, EPA obtained mortality rates from the Centers for Disease Control (CDC) WONDER database, and hospital admissions rates from the Healthcare Cost and Utilization Project (HCUP).

effects, let alone death (USEPA, 2009). That being said, in an overabundance of caution, and as an expression of the precautionary principal, BenMAP uses these studies to characterize the potential human health effect of small changes in PM and ozone concentrations.

The health endpoints analyzed in this study and the BenMAP results are presented in Section 2 of this appendix.

2. PROJECT HEALTH EFFECTS ANALYSIS RESULTS

This section presents the health effects of the unmitigated and mitigated Project emissions on the population in the Southern California model domain, estimated by the BenMAP model.

The Comprehensive Air Quality Model with extensions (CAMx) modeling results (**Appendix B**) are processed to generate aggregated daily averages $PM_{2.5}$ and maximum daily 8-hour ozone appropriate for various health endpoints. The CAMx simulation results from the full year (January to December) are used to estimate the health effects of $PM_{2.5}$ and ozone. BenMAP translates increases in the pollutant concentration associated with the Project emissions to changes in the incidence rate for each health effect using a C-R function derived from previously published epidemiological studies. BenMAP often provides multiple C-R functions based on different epidemiological studies for a given health endpoint. The USEPA default C-R functions were used when evaluating health effects, except for more refined population data. This analysis uses population data from PopGrid, which allocates the census population to each modeled 4x4 kilometer (km) grid cell.

The population used for both the quantified health effects and the calculation of background health incidence presented here is for the future year 2035[5], for consistency with the Project buildout year. This is conservative compared to utilizing a 2031 population that would have been consistent with the CAMx model year.

2.1 $PM_{2.5}$ Health Effects

Although there are a large number of potential health endpoints that could be included in the analysis as described above, Ramboll selected the key health endpoints that have been the focus of recent United States Environmental Protection Agency (USEPA) risk assessments (e.g., USEPA, 2010; USEPA, 2014). For example, the USEPA notes that health endpoints were selected based on consideration of at-risk populations (e.g. asthmatics), endpoints that have public health significance, and endpoints for which information is sufficient to support a quantitative concentration-response relationship (USEPA, 2014).

The health endpoints and associated C-R functions examined in this study are presented in **Table** . Each C-R function is based on a certain age range for the given health endpoint depending on the underlying epidemiological study on which it is based.

[5] For background incidence rates, BenMAP projects likely mortality rates for future years, but for other health effects, incidence rates are based on population changes only and may not reflect rates for future years.

Table 2-1. Summary of $PM_{2.5}$ Health Endpoints Used in this Study

Health Endpoint	Age Range	Daily Metric	Seasonal Metric	Annual Metric	C-R Function Selected
Emergency Room Visits, Asthma	0-99	24-hr mean			Mar et al., 2010[1]
Mortality, All Cause	30-99	24-hr mean	Quarterly mean	Mean	Krewski et al., 2009[1]
Hospital Admissions, Asthma	0-64	24-hr mean	-	-	Sheppard, 2003[1]
Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65-99	24-hr mean	-	-	Bell, 2012[1]
Hospital Admissions, All Respiratory	65-99	24-hr mean	-	-	Zanobetti et al., 2009[1]
Acute Myocardial Infarction, Nonfatal	18-24	24-hr mean	-	-	Zanobetti et al., 2009[1]
Acute Myocardial Infarction, Nonfatal	25-44	24-hr mean	-	-	
Acute Myocardial Infarction, Nonfatal	45-54	24-hr mean	-	-	
Acute Myocardial Infarction, Nonfatal	55-64	24-hr mean	-	-	
Acute Myocardial Infarction, Nonfatal	65-99	24-hr mean	-	-	

[1] C-R functions available in BenMAP (USEPA, 2018).

Unmitigated Project $PM_{2.5}$ Health Effects

Increases in the BenMAP-estimated annual health effect incidences and percent of background health incidence associated with the unmitigated Project emissions are presented in **Table 2-2.** These values reflect the total health effects across the Southern California model domain.

The results show that the highest health effect is for all-cause mortality, with an estimated mean increased incidence of 15.19 deaths per year associated with the Project mitigated emissions. Smaller mean increased incidences were estimated for other relevant $PM_{2.5}$-related health effects: 6.63 increase in incidence of asthma related emergency room visits, 3.17 increase in incidence of respiratory hospital admissions, and 1.42 increase in incidence of cardiovascular hospital admissions.

It should be noted, however, that the estimated increased incidence in those health effects are quite minor compared to the background health incidence values (shown in Table 2-2 as percent of Background Health Incidence). For example, for mortality, the increase of 15.19 deaths per year associated with project emissions represents 0.0047% of the total all-cause mortality for people ages 30 to 99.

Table 2-2. BenMAP-Estimated Annual Mean PM2.5 Health Effects of the Unmitigated Project Emissions Across the Southern California Model Domain[1]

Health Endpoint[2]	Annual Percent of Background Health Incidence (%)	Potential Incidences (Annual, Mean)	Background Health Incidence (Annual)
Emergency Room Visits, Asthma [0-99]	0.0051%	6.63	130,805
Mortality, All Cause [30-99]	0.0047%	15.19	325,048
Hospital Admissions, Asthma [0-64]	0.0029%	0.523	17,730
Hospital Admissions, All Cardiovascular (less Myocardial Infarctions) [65-99]	0.00063%	1.42	224,047
Hospital Admissions, All Respiratory [65-99]	0.0016%	3.17	193,354
Acute Myocardial Infarction, Nonfatal [18-24]	0.0020%	0.00072	36
Acute Myocardial Infarction, Nonfatal [25-44]	0.0021%	0.041	1,904
Acute Myocardial Infarction, Nonfatal [45-54]	0.0020%	0.105	5,241
Acute Myocardial Infarction, Nonfatal [55-64]	0.0020%	0.188	9,226
Acute Myocardial Infarction, Nonfatal [65-99]	0.0019%	0.776	40,966

[1] Health effects are shown in terms of incidences of each health endpoint and how it compares to the base (2035 base year health effect incidences, or "background health incidence") values. Health effects and background health incidences are across the Southern California model domain.

[2] Affected age ranges are shown in square brackets.

Mitigated Project $PM_{2.5}$ Health Effects

Increases in the BenMAP-estimated annual health effect incidences and percent of background health incidence associated with the mitigated Project emissions are presented in **Table 2-3**. These values reflect the total health effects across the Southern California model domain.

The results show that the highest health effect is for all-cause mortality, with an estimated mean increased incidence of 14.17 deaths per year associated with the Project mitigated emissions. Smaller mean increased incidences were estimated for other relevant $PM_{2.5}$-related health effects: 6.20 increase in incidence of asthma related emergency room visits, 2.98 increase in incidence of respiratory hospital admissions, and 1.33 increase in incidence of cardiovascular hospital admissions.

It should be noted, however, that the estimated increased incidence in those health effects are quite minor compared to the background health incidence values (shown in Table 2-3 as percent of Background Health Incidence). For example, for mortality, the increase of 14.17 deaths per year associated with project emissions represents 0.0044% of the total all-cause mortality for people ages 30 to 99.

Table 2-3. BenMAP-Estimated Annual Mean PM2.5 Health Effects of the Mitigated Project Emissions Across the Southern California Model Domain[1]

Health Endpoint[2]	Annual Percent of Background Health Incidence (%)	Potential Incidences (Annual, Mean)	Background Health Incidence (Annual)
Emergency Room Visits, Asthma [0-99]	0.0047%	6.20	130,805
Mortality, All Cause [30-99]	0.0044%	14.17	325,048
Hospital Admissions, Asthma [0-64]	0.0028%	0.490	17,730
Hospital Admissions, All Cardiovascular (less Myocardial Infarctions) [65-99]	0.00059%	1.33	224,047
Hospital Admissions, All Respiratory [65-99]	0.0015%	2.98	193,354
Acute Myocardial Infarction, Nonfatal [18-24]	0.0019%	0.00067	36
Acute Myocardial Infarction, Nonfatal [25-44]	0.0020%	0.038	1,904
Acute Myocardial Infarction, Nonfatal [45-54]	0.0019%	0.098	5,241
Acute Myocardial Infarction, Nonfatal [55-64]	0.0019%	0.176	9,226
Acute Myocardial Infarction, Nonfatal [65-99]	0.0018%	0.724	40,966

[1] Health effects are shown in terms of incidences of each health endpoint and how it compares to the base (2035 base year health effect incidences, or "background health incidence") values. Health effects and background health incidences are across the Southern California model domain.

[2] Affected age ranges are shown in square brackets.

2.2 Ozone Health Effects

As noted above, although a larger number of health endpoints could be evaluated, Ramboll selected the health endpoints based on recent USEPA risk assessments (USEPA, 2010; USEPA, 2014). The health endpoints and associated C-R functions examined in this study are presented in **Table 2-4.** Each C-R function is associated with a certain age range for the given health endpoint depending on the epidemiological study on which it is based.

Table 2-4. Summary of Ozone Health Endpoints Used in this Study.

Health Endpoint	Age Range	Daily Metric	Seasonal Metric	Annual Metric	C-R Function Selected
Hospital Admissions, All Respiratory	65 - 99	MDA8	-	-	Katsouyanni et al., 2009[1]
Mortality, Non-Accidental	0 - 99	MDA8	-	-	Smith et al., 2009[1]
Emergency Room Visits, Asthma	0 - 17	MDA8	-	-	Mar and Koenig, 2009[1]
Emergency Room Visits, Asthma	18 - 99	MDA8	-	-	Mar and Koenig, 2009[1]

[1] C-R function available in BenMAP (USEPA, 2018).

Unmitigated Project Ozone Health Effects

Increases in the BenMAP-estimated annual health effect incidences and percent of background health incidence associated with the unmitigated Project emissions are presented in **Table 2-5.** These values reflect the total health effects across the Southern California model domain.

For this project, asthma related emergency room visits are associated with the highest health effects associated with the unmitigated project emissions in the Southern California domain (8.20 increase for adults ages 18 to 99 and 6.93 increase for children ages 0 to 17). Hospital admissions due to respiratory issues for adults age 65-99 and non-accidental mortality have lower incidence increases (1.46 and 0.69 respectively).

It should be noted, however, that the estimated increases in those health effect incidences are quite minor compared to the background health incidence (shown in Table 2-5 as Percent of Background Health Incidence). For example, the increase in asthma emergency room visits represents 0.014% of the total asthma-related emergency room visits for children.

Table 2-5. BenMAP-Estimated Annual Mean Ozone Health Effects of the Unmitigated Project Emissions Across the Southern California Model Domain[1]

Health Endpoint[2]	Annual Percent of Background Health Incidence (%)	Potential Incidences (Annual, Mean)	Background Health Incidence (Annual)
Hospital Admissions, All Respiratory [65-99]	0.00075%	1.46	193,354
Mortality, Non-Accidental [0-99]	0.00033%	0.69	210,692
Emergency Room Visits, Asthma [0-17]	0.014%	6.93	50,722
Emergency Room Visits, Asthma [18-99]	0.010%	8.20	80,084

[1] Health effects are shown in terms of incidences of each health endpoint and how it compares to the base (2035 base year health effect incidences, or "background health incidence") values. Health effects and background health incidences are across the Southern California model domain.

[2] Affected age ranges are shown in square brackets.

Mitigated Project Ozone Health Effects

Increases in the BenMAP-estimated annual health effect incidences and percent of background health incidence associated with the mitigated Project emissions are presented in **Table 2-6**. These values reflect the total health effects across the Southern California model domain.

For this project, asthma related emergency room visits are associated with the highest health effects associated with the mitigated project emissions in the Southern California domain (6.84 increase for adults ages 18 to 99 and 5.80 increase for children ages 0 to 17). Hospital admissions due to respiratory issues for adults age 65-99 and non-accidental mortality have lower incidence increases (1.20 and 0.56 respectively).

It should be noted, however, that the estimated increases in those health effect incidences are quite minor compared to the background health incidence (shown in Table 2-6 as Percent of Background Health Incidence). For example, the increase in asthma emergency room visits represents 0.011% of the total asthma-related emergency room visits for children.

Table 2-6. BenMAP-Estimated Annual Mean Ozone Health Effects of the Mitigated Project Emissions Across the Southern California Model Domain[1]

Health Endpoint[2]	Annual Percent of Background Health Incidence (%)	Potential Incidences (Annual, Mean)	Background Health Incidence (Annual)
Hospital Admissions, All Respiratory [65-99]	0.00062%	1.20	193,354
Mortality, Non-Accidental [0-99]	0.00027%	0.56	210,692
Emergency Room Visits, Asthma [0-17]	0.011%	5.80	50,722
Emergency Room Visits, Asthma [18-99]	0.009%	6.84	80,084

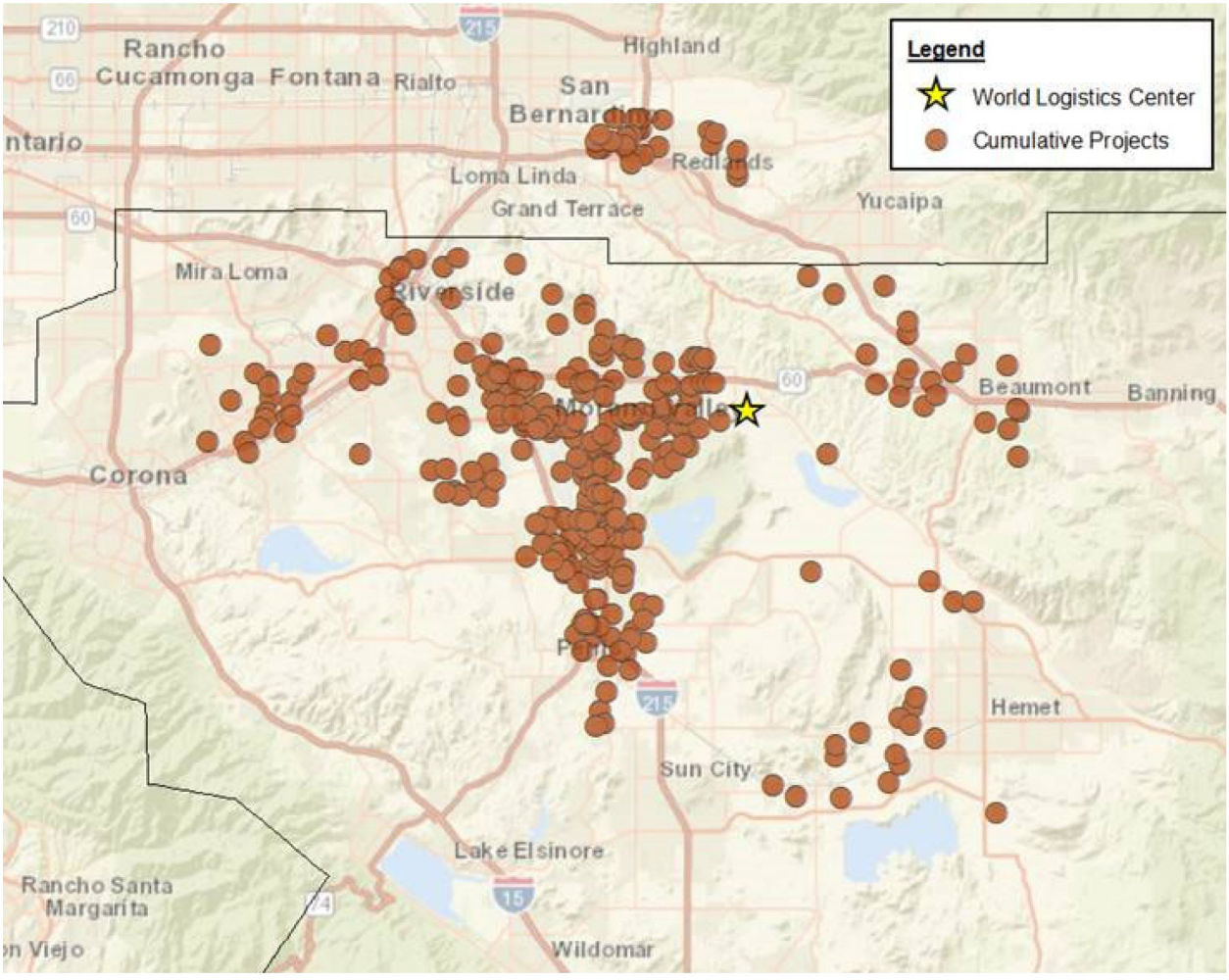
[1] Health effects are shown in terms of incidences of each health endpoint and how it compares to the base (2035 base year health effect incidences, or "background health incidence") values. Health effects and background health incidences are across the Southern California model domain.

[2] Affected age ranges are shown in square brackets.

3. CUMULATIVE HEALTH EFFECTS

Potential health effects from the cumulative project emissions can be generally characterized using the Project level modeling results and a comparison of overall emissions. Cumulative project locations are shown in **Figure 3-1** below and would be subject to the similar meteorological and photochemical reaction conditions as the Project assessment. The application of an overall scaling factor based on emissions, as presented here, is likely conservative since the cumulative projects are unlikely to have the same distribution of mobile emissions to the Los Angeles area as the Project.

Figure 3-1. Cumulative Project Locations



Concentrations changes, and thus health effects, from $PM_{2.5}$ are driven by primary $PM_{2.5}$ components (see Appendix B), with smaller contributions from NOx, VOC, and SO_2 on secondary $PM_{2.5}$ formation. Based on a ratio of total $PM_{2.5}$ emissions from the cumulative projects to the unmitigated Project $PM_{2.5}$ emissions, approximate health effect results from $PM_{2.5}$ were calculated. Combined estimated health effects from the cumulative projects and from the modeled unmitigated Project are shown in **Table 3-1** below.

Table 3-1. Estimated Annual $PM_{2.5}$ Health Effects of Cumulative Project Emissions

Health Endpoint[2]	Annual Percent of Background Health Incidence (%)	Potential Incidences (Annual, Estimated)	Background Health Incidence (Annual)
Emergency Room Visits, Asthma [0-99]	0.16%	204	130,805
Mortality, All Cause [30-99]	0.14%	467	325,048
Hospital Admissions, Asthma [0-64]	0.09%	16	17,730
Hospital Admissions, All Cardiovascular (less Myocardial Infarctions) [65-99]	0.02%	44	224,047
Hospital Admissions, All Respiratory [65-99]	0.05%	98	193,354
Acute Myocardial Infarction, Nonfatal [18-24]	0.06%	0.02	36
Acute Myocardial Infarction, Nonfatal [25-44]	0.07%	1	1,904
Acute Myocardial Infarction, Nonfatal [45-54]	0.06%	3	5,241
Acute Myocardial Infarction, Nonfatal [55-64]	0.06%	6	9,226
Acute Myocardial Infarction, Nonfatal [65-99]	0.06%	24	40,966

[1] Estimated health effects are compared to the base (2035 base year health effect incidences) values across the Southern California model domain.

[2] Affected age ranges are shown in square brackets.

Concentration changes, and thus health effects, from ozone are driven primarily by emissions of VOC and NOx, with some contribution from CO. Based on a ratio of total VOC and NOx emissions from the cumulative projects to the unmitigated Project VOC and NOx emissions, approximate health effect results from ozone were calculated. Combined estimated health effects from the cumulative projects and from the modeled unmitigated Project are shown in **Table 3-2** below.

Table 3-2. Estimated Annual Ozone Health Effects of Cumulative Project Emissions

Health Endpoint[2]	Annual Percent of Background Health Incidence (%)	Potential Incidences (Annual, Estimated)	Background Health Incidence (Annual)
Hospital Admissions, All Respiratory [65-99]	0.02%	33	193,354
Mortality, Non-Accidental [0-99]	0.01%	16	210,692
Emergency Room Visits, Asthma [0-17]	0.31%	159	50,722
Emergency Room Visits, Asthma [18-99]	0.23%	188	80,084

Table 3-2. Estimated Annual Ozone Health Effects of Cumulative Project Emissions

Health Endpoint[2]	Annual Percent of Background Health Incidence (%)	Potential Incidences (Annual, Estimated)	Background Health Incidence (Annual)

[1] Estimated health effects are compared to the base (2035 base year health effect incidences) values across the Southern California model domain.

[2] Affected age ranges are shown in square brackets.

4. CONCLUSION

The $PM_{2.5}$ and ozone concentration changes modeled by CAMx for unmitigated and mitigated Project emissions were converted to health effects on various health endpoints including premature mortality, hospitalizations, and emergency room visits, using the BenMAP health effects assessment model and USEPA defaults for health endpoints. Estimated changes in the health effect incidences are presented across the grids in the Southern California model domain. Across the board, the estimated increases in those health effect incidences are quite minor compared to the background health incidence values, with the largest $PM_{2.5}$ health effect from unmitigated Project emissions (all-cause mortality) representing only 0.0047% of the background health incidence across the Southern California model domain. When taken into context, the small increase in incidences and the very small percent of the number of background incidences indicate that these health effects are minimal in a developed, urban environment.

Similarly, for estimated cumulative health effects, the estimated increases in those health effect incidences are quite minor compared to the background health incidence values, with the largest $PM_{2.5}$ health effect from all-cause mortality representing only 0.14% of the background health incidence across the Southern California model domain.

Uncertainty

The approach and methodology of this analysis ensures that the uncertainty is of a conservative nature. In addition to the conservative assumptions built into the emissions noted above, there are a number of assumptions built into the application of C-R functions in BenMAP that may lead to an overestimation of health effects. For example, for all-cause mortality health effects from $PM_{2.5}$, these estimates are based on a single epidemiological study that found an association between $PM_{2.5}$ concentrations and mortality.[6] While similar studies suggest that such an association exists, there remains uncertainty regarding a clear causal link. This uncertainty stems from the limitations of epidemiological studies, such as inadequate exposure estimates and the inability to control for many factors that could explain the association between $PM_{2.5}$ and mortality such as lifestyle factors like smoking. Several reviews have evaluated the scientific evidence of health effects from specific particulate components (e.g., Rohr and Wyzga 2012; Lippmann and Chen, 2009; Kelly and Fussell, 2007). These reviews indicate that the evidence is strongest for combustion-derived components of PM including elemental carbon (EC), organic carbon (OC) and various metals (e.g., nickel and vanadium), however, there is still no definitive data that points to any particular component of PM as being more toxic than other components. The USEPA has also stated that results from various studies have shown the importance of considering particle size, composition, and particle source in determining the health effects of PM (USEPA, 2009). Further, the USEPA (2009) found that studies have reported that particles from industrial sources and from coal combustion appear to be the most significant contributors to PM-related mortality, consistent with the findings by Rohr and Wyzga (2012) and others. This is particularly important to note here, as the majority of PM emissions generated from the Project are from entrained roadway dust, breakwear, and tirewear (see Appendix A), and not from combustion. Therefore, because they do not consider the relative toxicity of PM components, the results presented here are conservative.

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[6] For $PM_{2.5}$ mortality estimates, BenMAP relies on the study by Krewski et al. (2009). This study conducted multiple sensitivity analyses using different statistical model specifications. For all-cause mortality, the authors reported positive associations between exposures to $PM_{2.5}$ and all-cause mortality that ranged from a 3% to a 6% increase in mortality per increase in 10 ug/m^3 of $PM_{2.5}$, depending on the model used and the exposure data considered. The default USEPA value in BenMAP is the 6% increase, or double the low end of the range.

Air pollution epidemiology studies are ecological studies. This means that they are population-based, observational epidemiological studies that look for patterns between population exposure and population disease rates. They do not use data at the individual level (e.g., correlations between regional mortality rates and community air pollution levels). Epidemiologists generally consider relative risks (RRs, a measure of the association between exposures and health effects) from these types of studies that are greater than 3 to 4 to reflect strong associations and to be supportive of a causal link, while smaller RRs (1.5 to 3) are considered to be weak, and require other lines of evidence (e.g., toxicological evidence, plausible biological mechanism) to demonstrate causality (Taubes 1995). For example, the RR of lung cancer for heavy smokers is in the range of 10 to 20, whereas PM associations with mortality yield RRs in the range of 1.01 to 1.05, i.e., very close to the RR = 1.0, which indicates little to no association.

Aside from the uncertainty as to the causal basis of the statistical associations in air pollution epidemiology studies of PM and mortality, some epidemiological studies have found no correlation between mortality and increased PM (Enstrom, 2005; 2017; Lipfert et al., 2000; Murray and Nelson, 2000; Greven et al., 2011; You et al.,2018; Zhou et al.,2015). Although there are a greater number of publications reporting a positive PM association for mortality compared to those reporting no association.

Another uncertainty highlighted by the USEPA (2012) that applies to potential health effects from both $PM_{2.5}$ and ozone, is the assumption of a log-linear response between exposure and health effects, without consideration for a threshold below which effects may not be measurable. The issue of a threshold for $PM_{2.5}$ and ozone is highly debatable and can have significant implications for health effects analyses as it requires consideration of current air pollution levels and calculating effects only for areas that exceed threshold levels. Without consideration of a threshold, any incremental contribution to existing ambient air pollution levels, whether below or above the applicable threshold for a given criteria pollutant, is assumed to adversely affect health. Although the USEPA traditionally does not consider thresholds in its cost-benefit analyses, the NAAQS itself is a health-based threshold level that the USEPA has developed based on evaluating the most current evidence of health effects.

As noted above, the health effects estimation using this method presumes that effects seen at large concentration differences can be linearly scaled down to (i.e., correspond to) small increases in concentration, with no consideration of potential thresholds below which health effects may not occur. This methodology of linearly scaling health effects is broadly accepted for use in regulatory evaluations and is considered as being health protective (USEPA, 2010), but potentially overstates the potential effects. In summary, health effects presented in this report are conservatively estimated, and the actual effects may be zero.

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