Prepared for

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San Diego, California

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Project Number
1690008171-001

Date
December 2019

SAN DIEGO STATE UNIVERSITY MISSION VALLEY CAMPUS MASTER PLAN EIR ADDITIONAL INFORMATION REGARDING POTENTIAL HEALTH EFFECTS OF AIR QUALITY IMPACTS

SAN DIEGO STATE UNIVERSITY
SAN DIEGO, 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 adoption and implementation of the San Diego State University (SDSU) Mission Valley Campus Master Plan Project (the proposed Project).[1] The proposed Project entails the acquisition, construction, and operation of a SDSU Mission Valley campus, stadium, parks, recreation, and innovation area to support SDSU's education, research, entrepreneurial, technology, and athletics programs. The new SDSU Mission Valley Campus Master Plan would accommodate up to 15,000 full-time-equivalent students (FTES) over time, resulting in a total student headcount of approximately 20,000 students.

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.)

Ramboll understands the Court's ruling to apply to both attainment and non-attainment areas, as there was no apparent distinction between the two in the Friant Ranch decision. Ramboll also understands the Friant Ranch decision to apply only when there is a significant impact resulting from a project's emission of criteria pollutants, as the decision focused on the informational value of correlating significant impacts to health effects.

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 California Supreme Court's decision. In this report, Ramboll presents one method that can be used to correlate

[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).

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 proposed 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. We 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 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 December 2018 California Supreme Court 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 $PM_{2.5}$.

The evaluation presented herein serves to describe the potential health effects of the criteria pollutant emissions already disclosed in the proposed Project's EIR. 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.

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

3 Reactive organic gas (ROG) emissions are quantified and modeled as VOCs in this assessment. ROG means total organic gases minus 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, and modeling performed by SCAQMD, was also relied on by San Diego Air Pollution Control District (SDAPCD) for their most recent ozone SIP modeling[5], and thus is suitable for Projects in the San Diego region. This PGM database is tailored for Southern California (including San Diego County) using California-specific input tools (e.g., the Emission FACtors (EMFAC)[6] 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[7]) and ozone and $PM_{2.5}$ modeling guidance[8] 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[9] and the Community Multiscale Air Quality (CMAQ[10]) PGMs have been used extensively in the past and would be acceptable PGMs. As such, the USEPA has prepared a memorandum[11] 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 proposed Project's emissions on ambient air concentrations, the Project's emissions were added to the CAMx 4-km annual PGM modeling database.[12] Operational and construction emissions from the Project were estimated as

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

5 https://www.sdapcd.org/content/dam/sdc/apcd/PDF/Air%20Quality%20Planning/8-Hr-O3%20Attain%20Plan-08%20Std.pdf.

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

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

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

9 http://www.camx.com/.

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

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

12 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.

described in the Air Quality Section of the Draft EIR.[13] For almost all pollutants, for any year, the maximum operational emissions at full buildout were greater than construction emissions. The exception is NOx from off-road equipment and implosion (if utilized) of the existing SDCCU Stadium, during one year of construction. In order to estimate the worst-case outcome, the emissions from the highest year of construction NOx were added to the full buildout emissions of all other pollutants. By doing this, the results below present a worst-case analysis for all construction and operational years.

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. The total unmitigated operational emission inventory[14] and NOx from the mitigated construction inventory for the Project were used in the analysis. This includes architectural coatings, VOCs in consumer products, natural gas combustion, landscaping, and emissions associated with motor vehicle use from operations, and off-road equipment and implosion emissions from construction. The emissions from architectural coatings, consumer products, natural gas combustion, landscaping, and construction are located onsite, and were therefore allocated to the grid cells representing the Project site (the University campus). The mobile source category includes both passenger vehicles and trucks. The mobile sources are also spatially distributed in both the site's grid cells, as well as the immediately adjacent grid cells. While it is expected that passenger vehicles and trucks may travel some distance outside of the Project site, they were conservatively distributed near the site's grid cells based on travel routes. 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 inventory, 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 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[15, 16] program to estimate the potential health effects of the Project's 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

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

14 Potential reductions from Project Design Features were conservatively not accounted for in this analysis.

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

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

wide history of applications by the USEPA and others, including for local-scale analysis[17] as needed for assessing the health effects of a project's emissions. We used the USEPA default BenMAP health effects C-R functions that are typically used in national rulemaking, such as the health effects assessment[18] for the 2012 $PM_{2.5}$ National Ambient Air Quality Standard (NAAQS). The health effects that we used 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 are mortality, emergency room visits (respiratory) and hospital admissions (respiratory). Details on the BenMAP inputs and outputs and definitions for the health effects are shown in **Appendix C.**

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

[18] 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 the proposed Project's EIR, 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:

- Use of unmitigated mobile emissions without project design features (i.e. Transportation Demand Management) (discussed further in Appendix A);
- Use of default emission factors for entrained roadway dust (discussed further in Appendix A);
- Use of maximum daily emissions (discussed further in Appendix A), with the exception of mortality health effects from $PM_{2.5}$, which uses average daily emissions;
- Assumption of concurrent maximum daily construction NOx emissions, including the assumption of NOx emissions from an implosion event (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 HEALTH EFFECTS

Overall, the estimated health effects from ozone and $PM_{2.5}$ are negligible in light of background incidences. Specifically, for all the health endpoints quantified, the number of estimated incidences is less than 0.004% of the background health incidence. The "background health incidence" is the actual incidence of health effects as measured in the local population in the absence of additional emissions from the Project. 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 negligible in a developed, urban environment.

$PM_{2.5}$-related health effects attributed to Project-related increases in ambient air concentrations included asthma-related emergency room visits (5.29 incidences per year), asthma-related hospital admissions (0.44 incidences per year), all cardiovascular-related hospital admissions (not including myocardial infarctions) (1.67 incidences per year), all respiratory-related hospital admissions (3.33 incidences per year), mortality

(8.97 incidences per year)[19], and nonfatal acute myocardial infarction (less than 0.70 incidences per year for all age groups) (discussed further in Appendix C).

Ozone-related health effects attributed to Project-related increases in ambient air concentrations included respiratory-related hospital admissions (0.45 incidences per year), mortality (0.21 incidences per year), and asthma-related emergency room visits for any age range (lower than 2.02 incidences per year for all age groups) (discussed further in Appendix C).

As noted above, health effects presented here conservatively utilize maximum daily emissions (with the exception of mortality health effects from $PM_{2.5}$), including NOx emissions from implosion[20], assumed to occur for an entire year. Should average daily emissions be used across all health endpoints, results would be even lower. Further, should potential reductions from Project Design Features be accounted for (e.g. a 14% reduction in $PM_{2.5}$ from Transportation Demand Management), or refinements to $PM_{2.5}$ emissions from entrained roadway dust (86% lower than maximum daily emissions if using County-level data provided by ARB), resulting $PM_{2.5}$ health effects, including the mortality incidence rate, would also be lower.

Because the health effects from ozone and $PM_{2.5}$ are negligible 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.

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).

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[19] Since the mortality health endpoint uses an annual average concentration, results here reflect the use of average daily $PM_{2.5}$ emissions, instead of maximum daily $PM_{2.5}$ emissions. Resulting $PM_{2.5}$ concentrations are mostly from primary $PM_{2.5}$ emissions (see Appendix B), thus only average versus maximum primary $PM_{2.5}$ is used for this adjustment. Secondary $PM_{2.5}$ formation from NOx emissions may be reduced even further on an annual basis, which is not accounted for here.

[20] Should the Project choose to do mechanical dismemberment for demolition instead of implosion, NOx emissions, and associated health effects, would be lower than presented here.

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. 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 (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.

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 are conservatively estimated, and the actual effects may be zero.

4. REFERENCES

/1/ Kelly, F.J., J.C. Fussell, 2007. Particulate Toxicity Ranking Report. Report Number 2/07. Environmental Research Group, Kings College, London.

/2/ Lippmann, M., L.C. Chen, 2009. Health effects of concentrated ambient air particulate matter (CAPs) and its components. *Crit. Rev. Toxicol.*, 39, 865e913.

/3/ Rohr A.C., R.E. Wyzga, 2012. Attributing Health Effects to Individual Particulate Matter Constituents. *Atmos Environ*., 62, 130-152. doi:10.1016/j.atmosenv.07.036.

/4/ USEPA, 2009. Integrated Science Assessment (ISA) For Particulate Matter (Final Report, Dec 2009). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-08/139F, 2009. https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=216546

/5/ USEPA, 2010. Quantitative Health Risk Assessment for Particulate Matter. Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency. EPA-452/R-10-005. June 2010. Available: https://www3.epa.gov/ttn/naaqs/standards/pm/data/PM_RA_FINAL_June_2010.pdf.

/6/ USEPA, 2012. Regulatory Impact Analysis for the Final Revisions to the National Ambient Air Quality Standards for Particulate Matter. U.S. Environmental Protection Agency, Washington, DC, EPA-452/R-12-005. https://www3.epa.gov/ttn/ecas/docs/ria/naaqs-pm_ria_final_2012-12.pdf.

APPENDIX A

EMISSIONS INVENTORY, SPATIAL ALLOCATION, AND SMOKE SETUP
SAN DIEGO STATE UNIVERSITY MISSION VALLEY CAMPUS
MASTER PLAN EIR
SAN DIEGO STATE UNIVERSITY
SAN DIEGO, CALIFORNIA

1. INTRODUCTION

As set forth in the Project's Draft Environmental Impact Report (EIR), 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.

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

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 emission inventory for the Project is below in **Table 2-1a**. Mobile source emissions were split into categories based on the EMFAC2014 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.

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

Emission Category	ROG	NOx	PM_{10}	$PM_{2.5}$	SO_2	CO
	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day
Mobile	100.6	454.5	746.0	201.3	6.2	1364.4
Diurnal	4.1	0.0	0.0	0.0	0.0	0.0
Hotsoak	12.6	0.0	0.0	0.0	0.0	0.0
Idling Exhaust	0.3	2.7	0.0	0.0	0.0	4.0
Brakewear	0.0	0.0	2.4	2.3	0.0	0.0
Tirewear	0.0	0.0	0.5	0.3	0.0	0.0
Resting Loss	5.4	0.0	0.0	0.0	0.0	0.0
Road Dust	0.0	0.0	743.0	198.5	0.0	0.0
Running Exhaust	17.5	372.9	0.1	0.2	6.0	950.7
Running Loss	45.2	0.0	0.0	0.0	0.0	0.0
Starting Exhaust	15.3	78.9	0.0	0.0	0.3	409.7
Energy	3.0	26.8	2.1	2.1	0.2	19.0
Architectural Coatings	35.6	0.0	0.0	0.0	0.0	0.0

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

Table 2-1a. Maximum Daily Criteria Air Pollutant Emissions Estimates						
Emission Category	**ROG**	**NOx**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**CO**
	lbs/day	**lbs/day**	**lbs/day**	**lbs/day**	**lbs/day**	**lbs/day**
Consumer Products	162.5	0.0	0.0	0.0	0.0	0.0
Hearths	0.4	3.8	0.3	0.3	0.0	1.6
Landscaping	11.4	4.4	2.1	2.1	0.0	379.5
Generator	0.5	2.1	0.1	0.1	0.0	1.2
Construction Off-Road Equipment (2022), Mitigated		496.6				
Construction Implosion (2022), Mitigated		132.5				
Total	**314.1**	**1120.7**	**750.6**	**205.9**	**6.5**	**1765.8**

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

All emissions listed in **Table 2-1a** represent the maximum daily unmitigated operational emissions estimated for the proposed Project's 2037 buildout scenario, aside from the mitigated construction off-road equipment and implosion emissions (labeled as such). This analysis utilizes the 2037 operational emissions as they constitute the highest maximum daily emissions for the Project, with the exception of 2022 oxides of nitrogen (NOx) emissions from off-road equipment and implosion (if utilized) during construction. Those emissions were also included as a conservative approach. The analysis presented here conservatively assumes maximum daily emissions associated with a stadium event occur over an entire year, and does not account for potential reductions due to Project Design Features (e.g., Transportation Demand Management which would result in emissions reductions of about 14%). Further, road dust emissions presented above and utilized in the model use CalEEMod default emission factors. Should those be refined with County-level data, available from the California Air Resources Board (ARB), resulting road dust emissions would be 75% lower than maximum daily PM_{10} emissions and 86% lower than maximum daily $PM_{2.5}$ emissions. Should the Project choose to do mechanical dismemberment for demolition of the existing SDCCU Stadium instead of implosion, NOx emissions, and associated health effects, would be lower than presented here.

Table 2-1b below presents maximum versus average NOx (the largest precursor to secondary $PM_{2.5}$) and $PM_{2.5}$ emissions. Average daily emissions account for non-routine events (e.g. stadium events, implosion activity), averaged over a year.

Table 2-1b. Maximum versus Average NOx and $PM_{2.5}$ Emissions

Emission Category	NOx		$PM_{2.5}$	
	Maximum	Average	Maximum	Average
	lbs/day	lbs/day	lbs/day	lbs/day
Mobile	454.5	272.4	201.3	103.7
Diurnal	0.0	0.0	0.0	0.0
Hotsoak	0.0	0.0	0.0	0.0
Brakewear	0.0	0.0	2.3	1.2
Tirewear	0.0	0.0	0.3	0.2
Resting Loss	0.0	0.0	0.0	0.0
Road Dust	0.0	0.0	198.5	102.2
Running Loss	0.0	0.0	0.0	0.0
Idling Exhaust	2.7	1.6	0.0	0.0
Running Exhaust	372.9	223.5	0.2	0.1
Starting Exhaust	78.9	47.3	0.0	0.0
Energy	26.8	26.8	2.1	2.1
Architectural Coatings	0.0	0.0	0.0	0.0
Consumer Products	0.0	0.0	0.0	0.0
Hearths	3.8	0.9	0.3	0.1
Landscaping	4.4	2.2	2.1	1.0
Generator	2.1	2.1	0.1	0.1
Construction Off-Road Equipment (2022), Mitigated	496.6	216.8		
Construction Implosion (2022), Mitigated	132.5	0.4		
Total	**1120.7**	**521.5**	**205.9**	**107.0**
% Reduction	**53%**		**48%**	

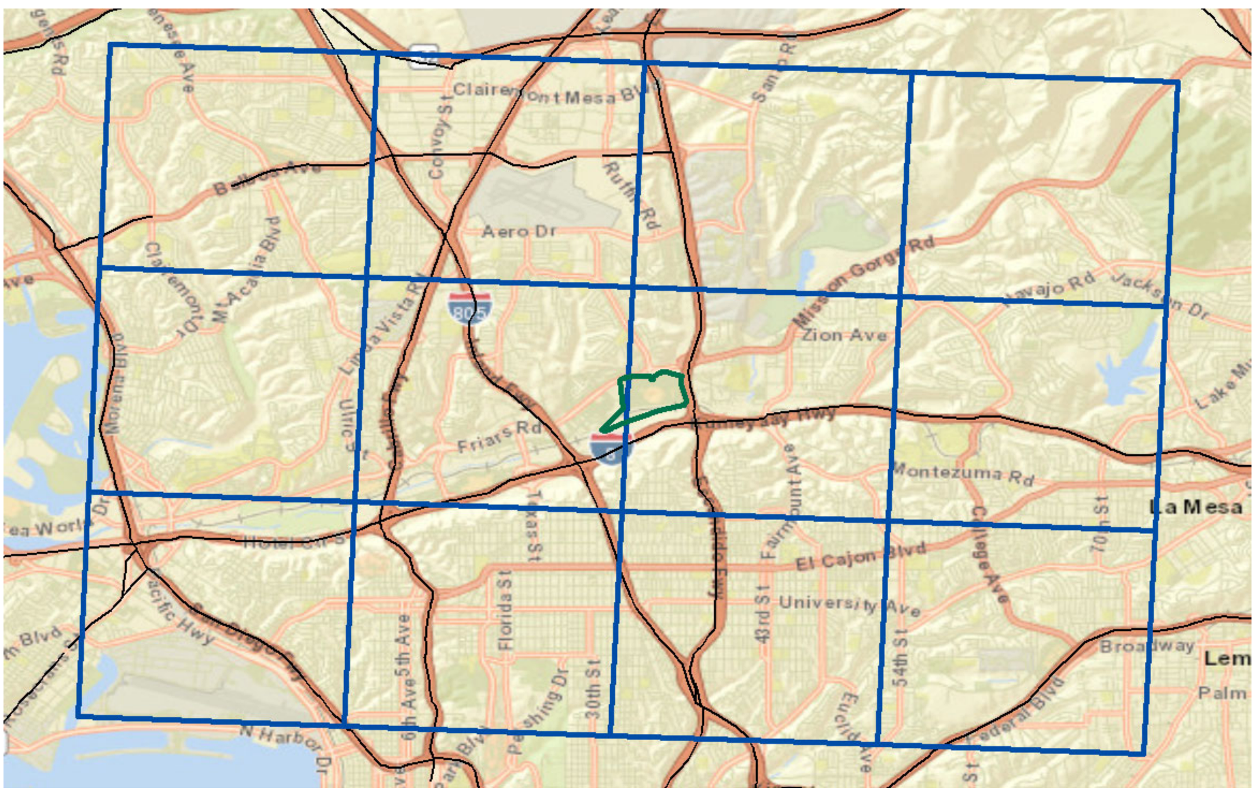
Mobile emissions include light, medium, and heavy-duty vehicles. **Table 2-2** below provides a summary of the spatial distribution of mobile emissions broken down by grid cell. The grid cells are numbered from left to right and then from top to bottom, as noted in the table. Distribution values in this table were calculated based on the distribution of project trips and stadium trips during the operational phase of the Project. The overall distribution percentages were weighted based on the stadium and non-stadium vehicle miles travelled (VMT). The trip distributions and VMT were calculated using data provided in the proposed Project's Transportation Impact Analysis[2] (Appendix 4.15-1 of the Draft EIR).

Table 2-2. Mobile Emission Distribution

Grid Cell	Distribution (%)	Grid Cell	Distribution (%)	Grid Cell	Distribution (%)	Grid Cell	Distribution (%)
1	0.1%	2	2.5%	3	10.9%	4	1.6%
5	0.0%	6	24.2%	7	38.6%	8	5.3%
9	3.7%	10	2.1%	11	11.1%	12	0.0%

Project emissions are allocated evenly across the Project site into 4 km x 4 km grid cells for the PGM. **Figure 2-1** below shows the Project boundary overlay with the 4-km grid. The Project site is shown in green. The 4x3 grid is presented on the figure with 12 blue grid cells.

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



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2 Appendix 4.15-1 of the Draft San Diego State University Mission Valley Campus Master Plan Environmental Impact Report. Available at: http://missionvalley.sdsu.edu/assets/pdfs/EIR/technical-appendices/Appendix-4-15-1-Traffic-Impact-Analysis.pdf. Accessed: August 2019.

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. We assigned appropriate Source Classification Codes (SCCs) 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
Construction Off-Road Equipment (2022)/Construction Implosion (2022)	2270002000	Mobile Sources; Off-highway Vehicle Diesel; Construction and Mining Equipment; Total
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
Energy	2102006000	Stationary Source Fuel Combustion; Industrial; Natural Gas; Total: Boilers and IC Engines
Generator	2265006005	Mobile Sources; Off-highway Vehicle Gasoline, 4-Stroke; Commercial Equipment; Generator Sets
Hearths	2104008000	Stationary Source Fuel Combustion; Residential; Wood; Total: Woodstoves and Fireplaces
Landscaping	2265004010	Mobile Sources; Off-highway Vehicle Gasoline, 4-Stroke; Lawn and Garden Equipment; Lawn Mowers (Residential)
Mobile	220100111B	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Vehicles (LDGV); Rural Interstate[3]: Brake Wear
Mobile	220100111R	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Vehicles (LDGV); Rural Interstate: Resting Loss

[3] Rural and Urban mobile designations provide equivalent chemical speciation and temporal distributions, as the EMFAC mobile emissions model does not distinguish between the two.

Table 2-3. Assigned SCC to Project Emission Sources		
Emission Source	**SCC**	**SCC Description**
Mobile	220100111S	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Vehicles (LDGV); Rural Interstate: Start
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: Evap (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 Loss
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: Evap (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 - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 2B; Rural Interstate: Idling
Mobile	220107011R	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV); Rural Interstate: Resting Loss
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: Evap (except Refueling)
Mobile	220107011X	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV); Rural Interstate: Exhaust

Table 2-3. Assigned SCC to Project Emission Sources		
Emission Source	**SCC**	**SCC Description**
Mobile	220107013B	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV); Rural Other Principal Arterial: Brake Wear
Mobile	220107013I	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV); Rural Other Principal Arterial: Idling
Mobile	220107013R	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV); Rural Other Principal Arterial: Resting Loss
Mobile	220107013S	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV); Rural Other Principal Arterial: Start
Mobile	220107013T	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV); Rural Other Principal Arterial: Tire Wear
Mobile	220107013V	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV); Rural Other Principal Arterial: Evap (except Refueling)
Mobile	220107013X	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV); Rural Other Principal Arterial: Exhaust
Mobile	220108011B	Mobile Sources; Highway Vehicles - Gasoline; Motorcycles (MC); Rural Interstate: Brake Wear
Mobile	220108011R	Mobile Sources; Highway Vehicles - Gasoline; Motorcycles (MC); Rural Interstate: Resting Loss
Mobile	220108011S	Mobile Sources; Highway Vehicles - Gasoline; Motorcycles (MC); Rural Interstate: Start
Mobile	220108011T	Mobile Sources; Highway Vehicles - Gasoline; Motorcycles (MC); Rural Interstate: Tire Wear
Mobile	220108011V	Mobile Sources; Highway Vehicles - Gasoline; Motorcycles (MC); Rural Interstate: Evap (except Refueling)
Mobile	220108011X	Mobile Sources; Highway Vehicles - Gasoline; Motorcycles (MC); Rural Interstate: 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

Table 2-3. Assigned SCC to Project Emission Sources		
Emission Source	**SCC**	**SCC Description**
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: Idling
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: Idling
Mobile	223007211T	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Vehicles (HDDV) Class 3, 4, & 5; Rural Interstate: Tire Wear
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: Idling
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	223007513B	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Buses (School & Transit); Rural Other Principal Arterial: Brake Wear
Mobile	223007513I	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Buses (School & Transit); Rural Other Principal Arterial: Idling
Mobile	223007513S	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Buses (School & Transit); Rural Other Principal Arterial: Start

Table 2-3. Assigned SCC to Project Emission Sources		
Emission Source	**SCC**	**SCC Description**
Mobile	223007513T	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Buses (School & Transit); Rural Other Principal Arterial: Tire Wear
Mobile	223007513X	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Buses (School & Transit); Rural Other Principal Arterial: Exhaust
Mobile	2294000000	Mobile Sources; Paved Roads; All Paved Roads; Total: Fugitives
Operational Architectural Coatings	2401001000	Solvent Utilization; Surface Coating; Architectural Coatings; Total: All Solvent Types

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,[4] 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 Project emissions were distributed in the modeling grid cells where the Project is located as shown in **Figure 2-1**. 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 **Figure 2-1**. 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. We used speciation profiles compatible with the SAPRC07 AERO6 mechanism from the South Coast Air Quality Management District's (SCAQMD) modeling system (which includes the San Diego County area) to be consistent with the regional modeling emissions. We then converted those emissions 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.

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

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. We 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. We 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.

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. We merged the daily emissions in the time format required by CAMx.

2.2.5 Emissions Summary

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

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

Type	CO	NO_X	VOC	SO_2	PM_{10}	$PM_{2.5}$
Mobile	1,364.43	454.48	100.60	6.25	746.03	201.31
Energy	18.98	26.85	3.01	0.16	2.08	2.08
Operational Architectural Coatings	-	-	35.61	-	-	-
Consumer Products	-	-	162.55	-	-	-
Hearths	1.62	3.82	0.45	0.02	0.31	0.31
Landscaping	379.54	4.38	11.43	0.02	2.11	2.11
Generator	1.20	2.10	0.47	0.00	0.07	0.07
Construction Off-Road Equipment (2022)	-	496.57	-	-	-	-

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

Type	CO	NO_X	VOC	SO_2	PM_{10}	$PM_{2.5}$
Construction Implosion (2022)	-	132.49	-	-	-	-
Total	**1,765.8**	**1,120.7**	**314.1**	**6.5**	**750.6**	**205.9**

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 2-5. Project Emission Inventory Data Output from SMOKE by Project Region (lbs/day)

Type	CO	NO_X	VOC	SO_2	PM_{10}	$PM_{2.5}$
Onsite	692.8	740.4	256.6	0.9	71.0	22.5
Offsite	1,073.0	380.3	57.5	5.6	679.6	183.4
Total	**1,765.8**	**1,120.7**	**314.1**	**6.5**	**750.6**	**205.9**

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. We 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 Project inventory in the 4-km modeling grid.

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

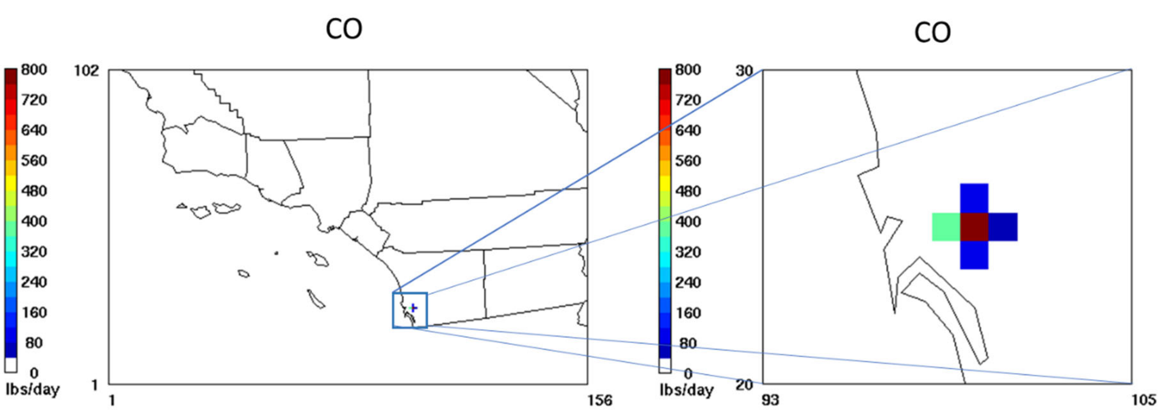


Figure 2-3. Spatial Distribution of NO_x Emissions (in lbs/day) for the Project in the Southern California 4-km Domain

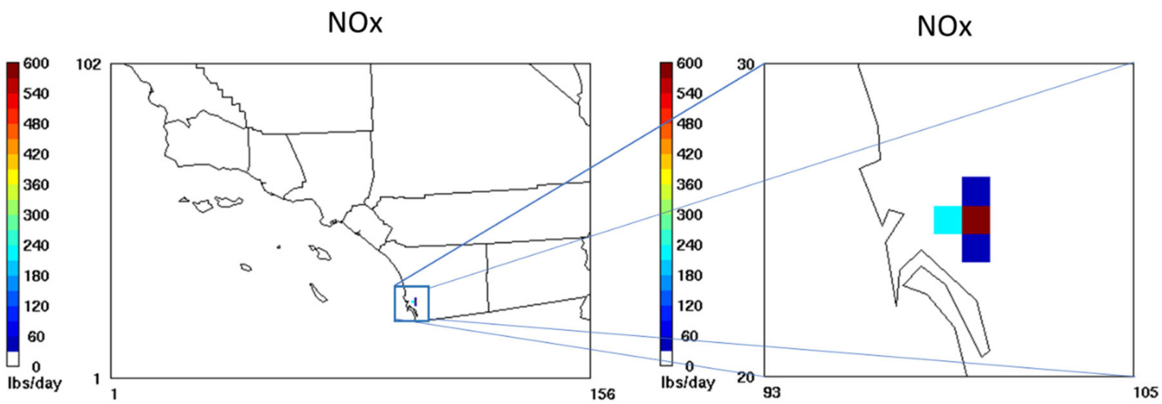


Figure 2-4. Spatial Distribution of VOC Emissions (in lbs/day) for the Project in the Southern California 4-km Domain

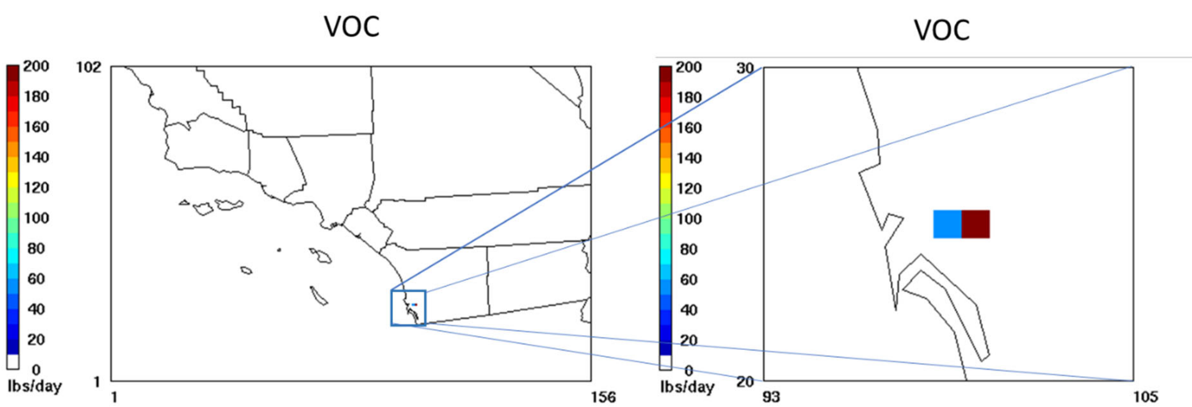


Figure 2-5. Spatial Distribution of SO_2 Emissions (in lbs/day) for the Project in the Southern California 4-km Domain

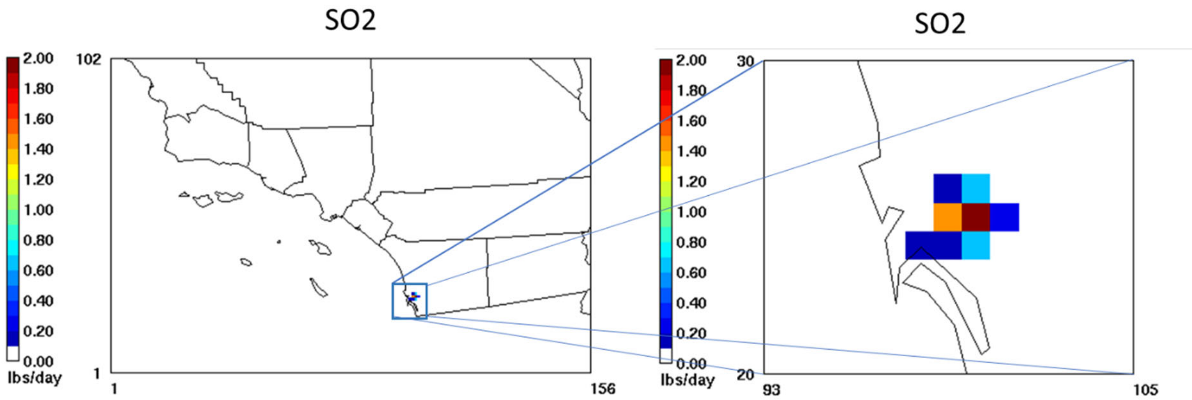


Figure 2-6. Spatial Distribution of PM_{10} Emissions (in lbs/day) for the Project in the Southern California 4-km Domain

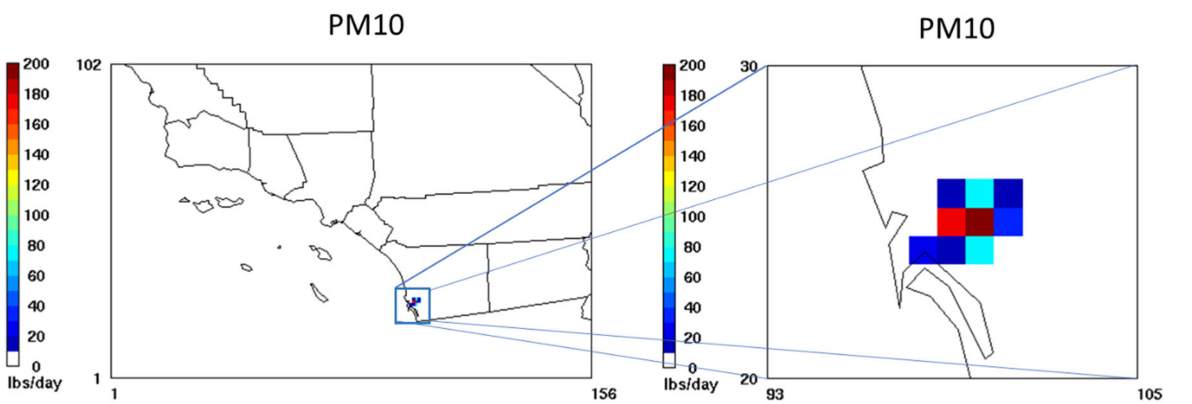
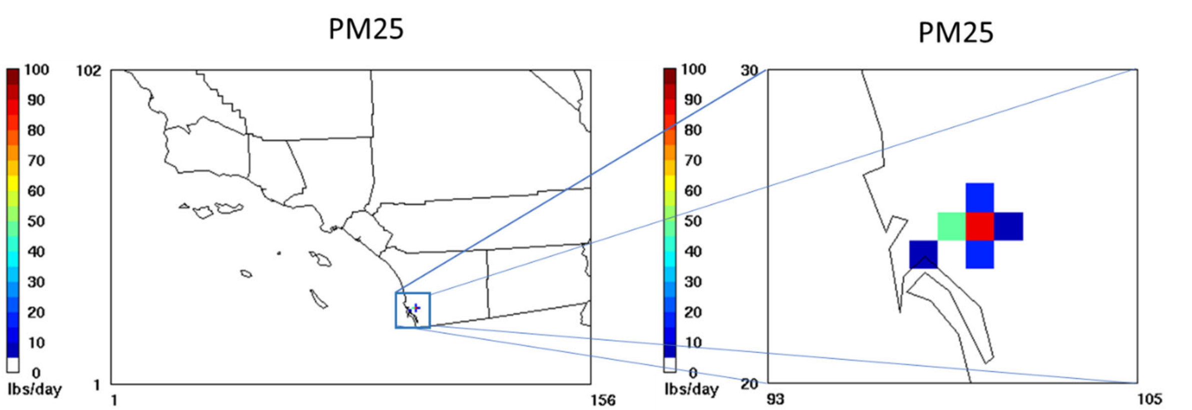


Figure 2-7. Spatial Distribution of $PM_{2.5}$ Emissions (in lbs/day) for the Project in the Southern California 4-km Domain



3. REFERENCES

/1/ Coats Jr., C.J., 1996. High-performance algorithms in the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system. Proc. Ninth AMS Joint Conference on Applications of Air Pollution Meteorology with AWMA. Amer. Meteor. Soc., Atlanta, GA, 584-588.

/2/ Coats Jr., C.J., Houyoux, M.R., 1996. Fast Emissions Modeling with the Sparse Matrix Operator Kernel Emissions (SMOKE) Modeling System. The Emission Inventory: Key to Planning, Permits, Compliance, and Reporting, Air & Waste Management Association. New Orleans, Louisiana.

/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
SAN DIEGO STATE UNIVERSITY MISSION VALLEY CAMPUS
MASTER PLAN EIR
SAN DIEGO STATE UNIVERSITY
SAN DIEGO, CALIFORNIA

1. REGIONAL AIR QUALITY MODELING PLATFORM

The Southern California 2012 4- kilometer (km) Comprehensive Air Quality Model with extensions (CAMx) 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[1]. This PGM database, and modeling performed by SCAQMD, was also relied on by San Diego Air Pollution Control District (SDAPCD) for their most recent ozone SIP modeling[2], and thus is suitable for Projects in the San Diego region. This PGM database is tailored for Southern California (including San Diego County) 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.

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

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

[2] https://www.sdapcd.org/content/dam/sdc/apcd/PDF/Air%20Quality%20Planning/8-Hr-O3%20Attain%20Plan-08%20Std.pdf.

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

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

Figure 1-1. Air Quality Modeling Domain for Southern California[5]

2. REGIONAL GRID MODELING

In this section, we describe the regional PGM modeling setup to assess the outcome of the 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

5 https://ww3.arb.ca.gov/research/cabots/docs/9a-cabots-baaqmd-20170419.pdf.

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 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[6]. 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[7] 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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6 http://www.camx.com/download/support-software.aspx.

7 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[8]. 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 ftp://toms.gsfc.nasa.gov/pub/omi/data/.

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 emissions are derived from a single simulation 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.

The metrics relevant to the $PM_{2.5}$ health effects selected in this study are 24-hour annual average concentrations (see **Appendix C**). **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. In the 2031 base case scenario, the Los Angeles County is the region most affected along with the southern portion of Imperial County. Annual $PM_{2.5}$ concentrations in these counties 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 Project emissions to annual average $PM_{2.5}$ are about 0.53 $\mu g/m^3$ at the most affected areas and contributions to the maximum 24-hour average are as large as 1.69 $\mu g/m^3$ at the most affected areas. The largest change for the maximum 24-hour average episode represents only 5.6 percent of the total $PM_{2.5}$ at that location. **Figure 2-2** presents increases in annual average and maximum 24-hour average $PM_{2.5}$ due to the Project by $PM_{2.5}$ component at the grid cell of maximum concentration change. It confirms that the $PM_{2.5}$ increases due to the Project are mostly due to primary PM components, although nitrate is the second most important contributor to the total $PM_{2.5}$.

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 Project (center and right panels);
Annual Averages (top panels);
Maximum 24-hour Averages (bottom panels)

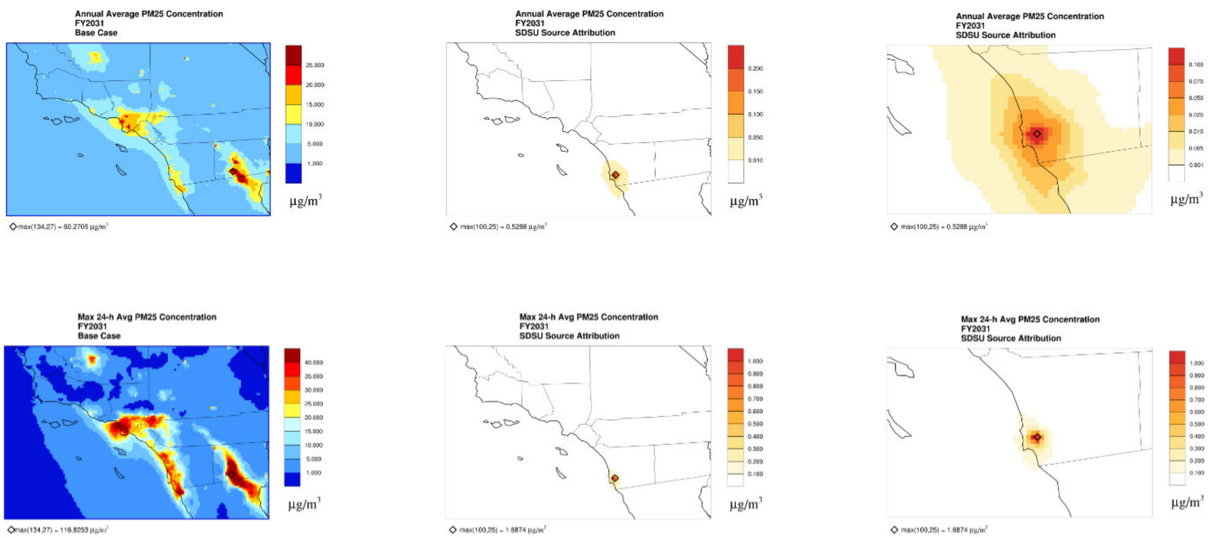
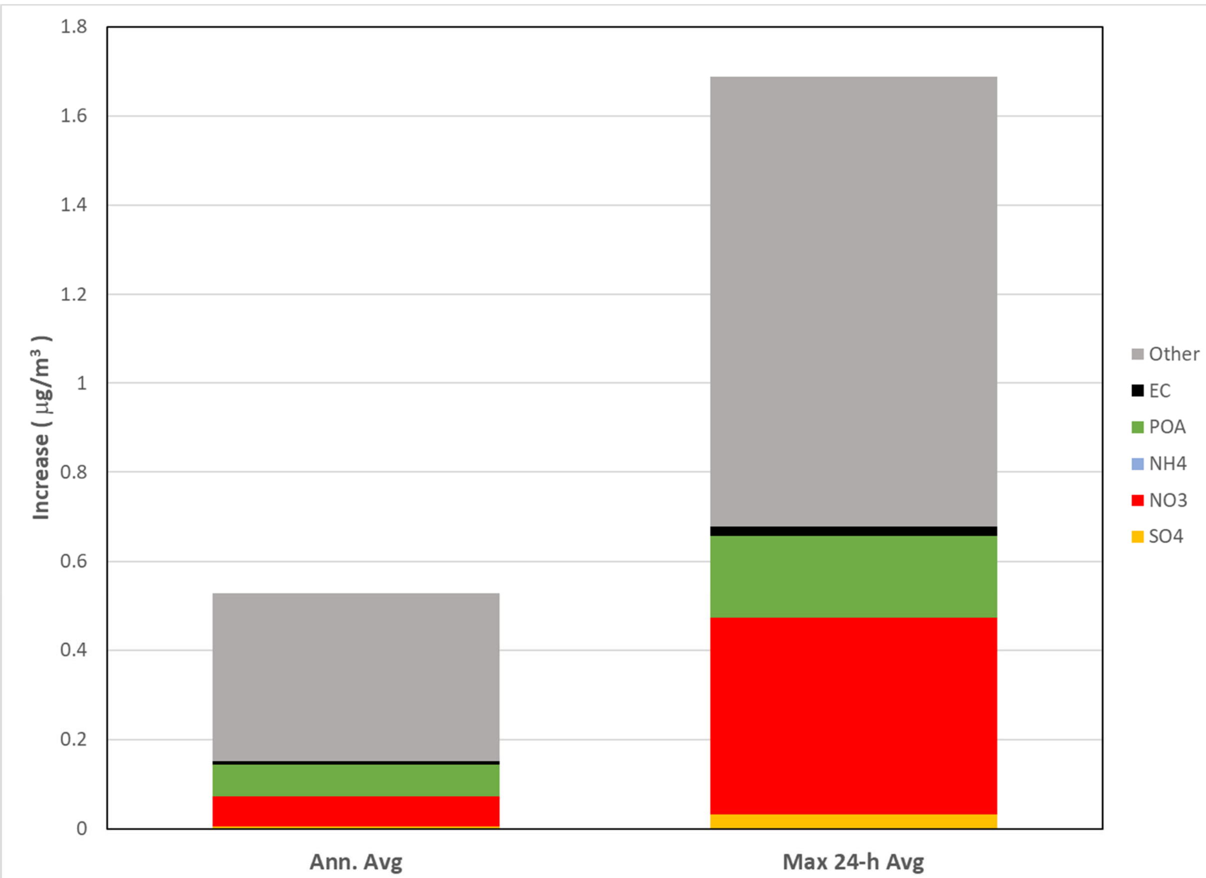


Figure 2-2. Increases in Annual Average and Episode Maximum 24-hour Average $PM_{2.5}$ Concentrations due to the Project by $PM_{2.5}$ Component: fine particulate sulfate (SO4), nitrate (NO3), ammonium (NH4), primary organic aerosol (POA), elemental carbon (EC), and other primary PM (Other); Where the Maximum Change due to Project Emissions Occurred



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. **Figure 2-3** displays spatial plots of the annual highest MDA8 ozone for the 2031 emissions scenario and the increases in highest MDA8 ozone concentrations due to the Projects emissions. In the 2031 base case emissions scenario, the western Los Angeles, northern Orange, southern San Bernardino and eastern Riverside counties show the highest MDA8 ozone concentration between 90 and 100 ppb. The maximum increase in the highest MDA8 ozone concentrations due to the Project is 0.424 ppb in southern San Diego County.

Figure 2-4 displays MDA8 ozone for the base case and increases in MDA8 ozone due to the project on August 14, the day that the Project has the highest ozone contribution. The highest MDA8 ozone contribution due to the Project is 0.552 ppb (Figure 2-4, right) that occurs in southern San Diego County where total MDA8 ozone concentrations are 69.9 ppb.

Figure 2-3. Highest MDA8 Ozone Concentrations from the Base Case Scenario (left) and Increases in Highest MDA8 Ozone Concentrations due to the Project (right) for the Annual Modeling of the 2031 Emissions Scenario

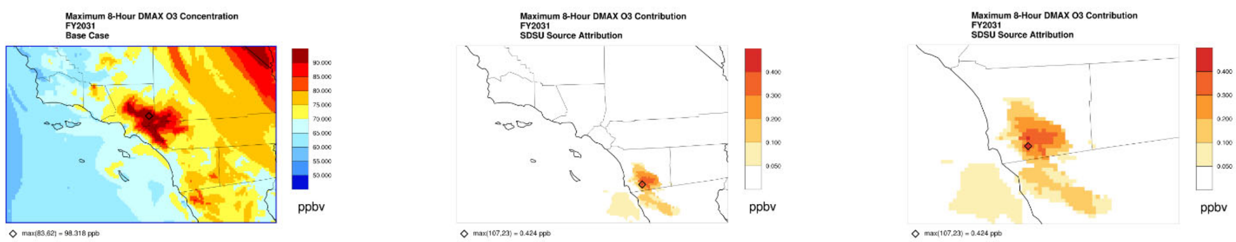
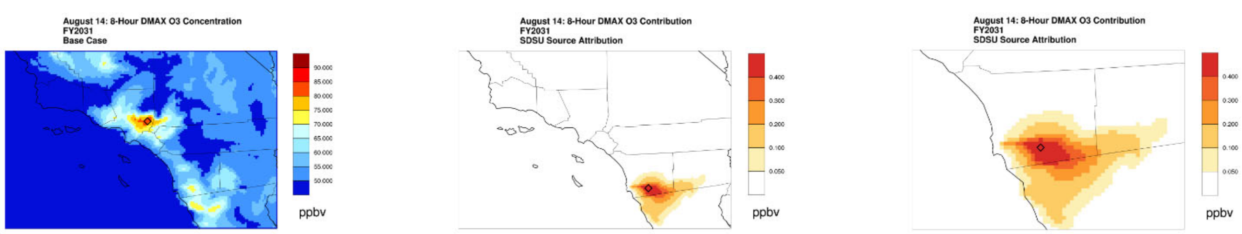


Figure 2-4. MDA8 Ozone Concentrations from the Base Case Scenario (left) and Increases in MDA8 Ozone Concentrations due to the Project (right) on August 14, the Day with the Highest Project Ozone Contributions for the Annual Modeling of the 2031 Emissions Scenario



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APPENDIX C

BENMAP AND HEALTH EFFECTS
SAN DIEGO STATE UNIVERSITY MISSION VALLEY CAMPUS
MASTER PLAN EIR
SAN DIEGO STATE UNIVERSITY
SAN DIEGO, 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 due to 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 benefits 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 (AAI, 2018)[2]:

Health Effect = Air Quality Change × Health Effect Estimate × Exposed Population × 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.

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

2. HEALTH EFFECTS ANALYSIS RESULTS

This section presents the health effects of the 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 due to 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

[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.

different epidemiological studies for a given health endpoint. We used the USEPA default C-R functions 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 2037[4], for consistency with the Proposed 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, we 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 2-1**. 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. Increases in the BenMAP-estimated health effect incidences and percent of background health incidence due to the Project emissions are presented in **Table 2-2.** These values reflect the total health effects across the Southern California model domain.

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	-	-	

[4] 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
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 (AAI, 2018)

The results show that the highest health effect is for all-cause mortality, with an estimated mean increased incidence of 8.97 deaths per year due to the project emissions. Smaller mean increased incidences were estimated for other relevant $PM_{2.5}$-related health effects: 5.29 increase in incidence of asthma related emergency room visits, 3.33 increase in incidence of respiratory hospital admissions, and 1.67 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 8.97 deaths per year due to project emissions represents 0.0026% of the total all-cause mortality for people ages 30 to 99.

Table 2-2. BenMAP-Estimated Mean $PM_{2.5}$ Health Effects of the Project Emissions Across the Southern California Model Domain[1]

Health Endpoint[2]	Incidences (Mean)	Percent of Background Health Incidence (%)
Emergency Room Visits, Asthma [0-99]	5.29	0.0040%
Mortality, All Cause [30-99] [3]	8.97	0.0026%
Hospital Admissions, Asthma [0-64]	0.44	0.0025%
Hospital Admissions, All Cardiovascular (less Myocardial Infarctions) [65-99]	1.67	0.00071%
Hospital Admissions, All Respiratory [65-99]	3.33	0.00164%
Acute Myocardial Infarction, Nonfatal [18-24]	0.00083	0.00223%
Acute Myocardial Infarction, Nonfatal [25-44]	0.031	0.00167%
Acute Myocardial Infarction, Nonfatal [45-54]	0.097	0.00178%

Table 2-2. BenMAP-Estimated Mean $PM_{2.5}$ Health Effects of the Project Emissions Across the Southern California Model Domain[1]

Health Endpoint[2]	Incidences (Mean)	Percent of Background Health Incidence (%)
Acute Myocardial Infarction, Nonfatal [55-64]	0.153	0.00163%
Acute Myocardial Infarction, Nonfatal [65-99]	0.70	0.00164%

[1] Health effects are shown in terms of incidences of each health endpoint and how it compares to the base (2037 base year health effect incidences) values.

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

[3] Since the mortality health endpoint uses an annual average concentration, results here reflect the use of average daily $PM_{2.5}$ emissions, instead of maximum daily $PM_{2.5}$ emissions. Resulting $PM_{2.5}$ concentrations are mostly from primary $PM_{2.5}$ emissions (see Appendix B), thus only average versus maximum primary $PM_{2.5}$ is used for this adjustment. Secondary $PM_{2.5}$ formation from NOx emissions may be reduced even further on an annual basis, which is not accounted for here.

2.2 Ozone Health Effects

As noted above, although a larger number of health endpoints could be evaluated, we 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 2-3.** 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. Increases in the BenMAP-estimated health effect incidences and percent of background health incidence due to the Project emissions are presented in **Table 2-4.** These values reflect the total health effects across the Southern California model domain.

Table 2-3. 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 (AAI, 2018).

For this project, asthma related emergency room visits are associated with the highest health effects due to the project emissions in the Southern California domain (2.02 increase for adults ages 18 to 99 and 1.73 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 (0.45 and 0.21 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 2-4** as Percent of Background

Health Incidence). For example, the increase in asthma emergency room visits represents 0.003% of the total asthma-related emergency room visits for children.

Table 2-4. BenMAP-Estimated Mean Ozone Health Effects of the Project Emissions Across the Southern California Model Domain[1]

Health Endpoint[2]	Incidences (Mean)	Percent of Background Health Incidence (%)
Hospital Admissions, All Respiratory [65-99]	0.45	0.0002%
Mortality, Non-Accidental [0-99]	0.21	0.00010%
Emergency Room Visits, Asthma [0-17]	1.73	0.003%
Emergency Room Visits, Asthma [18-99]	2.02	0.002%

[1] Health effects are shown in terms of incidences of each health endpoint and how it compares to the base (2037 base year health effect incidences) values.

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

2.3 Conclusion

The $PM_{2.5}$ and ozone concentration changes modeled by CAMx 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 (all-cause mortality) representing only 0.0026% of the total of all deaths, and the largest health effect for ozone (asthma related emergency room visits by adults) representing 0.002% of all emergency room visits. For the $PM_{2.5}$-related health endpoints, the health effect on mortality is the highest (Incidence = 8.97). For ozone-related health endpoints, asthma related emergency room visits are most affected (Incidence = 2.02 for adults ages 18 to 99 and Incidence = 1.73 for children ages 0 to 17). Other health effect incidences are lower. 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 negligible in a developed, urban environment.

Health effects presented above conservatively utilize maximum daily emissions (with the exception of mortality health effects from $PM_{2.5}$), including NOx emissions from implosion[5], assumed to occur for an entire year. Should average daily emissions be used across all health endpoints, results would be even lower. Further, should potential reductions from Project Design Features be accounted for (e.g., a 14% reduction in $PM_{2.5}$ from Transportation Demand Management), or refinements to $PM_{2.5}$ emissions from entrained roadway dust (86% lower than maximum daily emissions if using County-level data provided by ARB), resulting $PM_{2.5}$ health effects, including the mortality incidence rate, would also be lower.

[5] Should the Project choose to do mechanical dismemberment for demolition of the existing SDCCU Stadium instead of implosion, NOx emissions, and associated health effects, would be lower than presented here.

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. 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 (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.

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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