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GUIDANCE TO ADDRESS THE FRIANT RANCH RULING FOR CEQA PROJECTS IN THE SAC METRO AIR DISTRICT

SACRAMENTO METROPOLITAN
AIR QUALITY MANAGEMENT DISTRICT
SACRAMENTO, CALIFORNIA

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CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

AAQS:	Ambient Air Quality Standards
APCA:	Anthropogenic Precursor Culpability Assessment
AQMDs:	Air Quality Management Districts
AQTSD:	Air Quality Technical Support Document
ARB:	California Air Resources Board
BAAQMD:	Bay Area Air Quality Management District
BenMAP:	Benefits Mapping and Analysis Program
CAMx:	Comprehensive Air Quality Model with Extensions
CCOS:	Central California Ozone Study
CEQA:	California Environmental Quality Act
CMAQ:	Community Multiscale Air Quality
CO:	Carbon Monoxide
C-R:	Concentration-Response
CSAPR:	Cross-State Air Pollution Rule
DDM:	Decoupled Direct Method
DPM:	Diesel Particulate Matter
EC:	Elemental Carbon
EIR:	Environmental Impact Report
EMFAC:	Emissions Factor (ARB's on-road mobile source emissions model)
EPA:	United States Environmental Protection Agency
FF10:	Flat File 2010
FPRM:	Fine Particulate Matter
GHGs:	Greenhouse Gases
GIS:	Geographical Information System
HDDM:	Higher Order Decoupled Direct Method
ISAM:	Integrated Source Apportionment Method
ISORROPIA:	Aerosol Thermodynamic Module
MERPs:	Modeled Emission Rate Precursors
MRGUAM:	gridded merge program
NAAQS:	National Ambient Air Quality Standard
NH_4:	Ammonium

NH_4NO_3:	Ammonium Nitrate
NO_2:	Nitrogen Dioxide
NO_3:	Nitrate
NO_X:	Oxides of Nitrogen
O_3:	Ozone
OA:	Organic Aerosol
OC:	Organic Carbon
OSAT:	Ozone Source Apportionment Technology
PGM:	Photochemical Grid Model
PM:	Particulate Matter
$PM_{2.5}$:	Particulate Matter 2.5 micrometers or less in diameter
PM_{10}:	Particulate Matter 10 micrometers or less in diameter
POA:	Primary Organic Aerosol
Project:	CEQA project
PSAT:	Particulate Source Apportionment Technology
QA:	Quality Assurance
QC:	Quality Control
ROG:	Reactive Organic Gases
Sac Metro Air District:	Sacramento Metropolitan Air Quality Management District
SCC:	Source Classification Code
SFNA:	Sacramento Federal Ozone Nonattainment Area
SIPs:	State Implementation Plans
SMOKE:	Sparse Matrix Operator Kerner Emissions
SOx:	Oxides of Sulfur
SO_2:	Sulfur Dioxide
SO_4:	Sulfate
TOS:	Thresholds of Significance
USEPA:	United States Environmental Protection Agency
VOCs:	Volatile Organic Compounds

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1. INTRODUCTION

The California Environmental Quality Act (CEQA) is a state statute that requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. A public agency must comply with CEQA when it undertakes an activity defined by CEQA as a "Project." A Project is an activity undertaken by a public agency or a private activity which must receive some discretionary approval (meaning that the agency has the authority to deny the requested permit or approval) from a government agency which may cause either a direct physical change in the environment or a reasonably foreseeable indirect change in the environment. Air quality impacts of a proposed Project are one of the environmental factors that are required to be evaluated under CEQA, unless the impacts can be shown to be insignificant. Air quality impacts typically include criteria pollutants (e.g., ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO) and particulate matter (PM_{10} and $PM_{2.5}$), greenhouse gases (GHGs) and air toxics (e.g., diesel particulate matter, DPM) and resultant health effects of air toxics.

The California Supreme Court in the case of *Sierra Club v. County of Fresno* (2018) 6 Cal. 5th 502 regarding the proposed Friant Ranch Project determined the air quality analysis in the environmental impact report (EIR) prepared under CEQA was inadequate because it did not make "a reasonable effort to substantively connect the Project's air quality impacts to likely health consequences." The Court determined that "the EIR should be revised to relate the expected adverse air quality impacts to likely health consequences or explain in meaningful detail why it is not feasible at the time of drafting to provide such an analysis."

Lead agencies and practitioners preparing documents to comply with CEQA have requested guidance from the Sacramento Metropolitan Air Quality Management District (Sac Metro Air District) on implementing the Friant Ranch decision in the review and analysis of proposed projects in Sacramento County. On April 25, 2019, Sac Metro Air District published an Interim Recommendation for addressing the Friant Ranch decision. The Interim Recommendation stated that agencies should follow the Court's advice to explain in meaningful detail why an analysis of likely health consequences resulting from a development project is not yet feasible. This explanation should describe the background underlying air regulations, the regional nature of the regulatory approach, and why the approach is not amenable to project level assessments.

The Interim Recommendation stated that an expanded discussion of health impacts resulting from specific air pollutants may also be warranted for projects with emissions exceeding the Sac Metro Air District's thresholds of significance. The Interim Recommendation was put in place to assist lead agencies and practitioners with CEQA document preparation until Sac Metro Air District develops a methodology that provides a consistent, reliable and meaningful analysis to address the Court's direction on correlating health impacts to a project's emissions.

2. PURPOSE AND AUTHORITY

The Sac Metro Air District is one of 35 air districts in California responsible for local air quality planning, monitoring, and stationary source permitting. Sac Metro Air District covers Sacramento County, including the cities of Sacramento, Citrus Heights, Folsom, Rancho Cordova, Elk Grove, Galt, and Isleton.

Under the CEQA review process, Sac Metro Air District may serve as the lead agency, a responsible agency with limited discretionary authority, or a reviewing agency providing comment on the air quality impacts of a proposed project or plan. CEQA requires that lead agencies identify significant environmental impacts, and to avoid or mitigate those impacts, if feasible. Lead agencies in the Sacramento Federal Nonattainment Area (SFNA) often look to the Sac Metro Air District for guidance on CEQA related topics. In addition, the Sac Metro Air District partners on regional issues with nearby air districts including the following:

- Yolo-Solano Air Quality Management District;
- Placer County Air Pollution Control District;
- El Dorado County Air Quality Management District; and
- Feather River Air Quality Management District.

Sac Metro Air District staff has developed this guidance with input from the other SFNA air districts since they share air quality issues and use the same growth assumptions, mobile source emissions, and modeling efforts to support ozone and PM attainment plans.

This guidance is intended for use in the Sac Metro Air District, however it contains information that can be used by the partner agencies to set guidance.

This guidance document:

1. Replaces the Interim Recommendation.
2. Provides insight on the health effects that may result from a Project emitting at the maximum thresholds of significance (TOS) levels in the SFNA for oxides of nitrogen (NO_X), volatile organic compounds (VOCs), and PM, in addition to levels of CO and oxides of sulfur (SO_X) calculated proportional to NO_X (as described in **Section 4.1**). This information can be used in environmental documents to provide a conservative estimate the health effects of the emissions of criteria pollutants at levels at or below the significance thresholds;
3. Provides look-up tables to allow the estimation of health effects for strategic areas where growth exceeding thresholds of significance is anticipated; and
4. Provides modeling guidance for CEQA Projects that have emissions in excess of the significance thresholds and are located outside the strategic areas modeled.

3. ORGANIZATION OF GUIDANCE

This guidance document provides an overview of the Friant Ranch screening analysis and results for Projects with emissions below the significance thresholds. **Section 4** describes the screening analysis approach and methods for Projects with emissions lower than the Thresholds of Significance. **Section 5** describes the screening methods for Projects located in strategic areas with emissions above the Thresholds of Significance. **Section 6** provides a general description of the methods used in the analysis recommended for Projects above the Thresholds of Significance suitable for planners and the public should the screening methods in **Section 4** and **Section 5** not be applicable. **Appendix A** provides recommended procedures for practitioners skilled in the art of photochemical grid modeling and health effects analyses for conducting a health effects analysis that would be expected for larger Projects, or for Projects that do not fit the requirements described for using the screening analyses. The procedures used in conducting the health effects screening analysis for small Projects are discussed in **Appendix B**. **Appendix C** discusses the screening analysis for strategic area Projects. The treatment of SO_2 and CO emissions that do not have any significant emissions levels in the screening analysis and procedures for speciating ROG and PM emissions is discussed in **Appendix D**. **Appendix E** provides a list of commonly used Source Classification Codes (SCC) for source types from typical CEQA Projects. **Appendices F and G** provide health effects output for the minor Project and strategic area Project screening modeling.

4. GUIDANCE FOR SCREENING HEALTH EFFECTS ANALYSIS

4.1 Thresholds of Significance

The Sac Metro Air District and nearby air districts have TOS for certain criteria air pollutants and their precursors. If a proposed Project has an emissions rate for a pollutant that exceeds one of the Thresholds of Significance, then the Project would be considered to have significant air quality impacts and the proponent must evaluate and implement mitigation where feasible. Table 1 displays the Thresholds of Significance for the Sac Metro Air District and neighboring air districts.

Table 1. Thresholds of significance for the Sac Metro Air District and neighboring Air Districts

Pollutants in lbs./day				
Air District	**NO_X**	**ROG**	**PM_{10}**	**$PM_{2.5}$**
Sacramento	65	65	80	**82**
Placer	55	55	**82**	Not established
El Dorado	**82**	**82**	Cause or contribute to an exceedance of Ambient Air Quality Standards (AAQS)	Cause or contribute to an exceedance of AAQS
Feather River	25	25	80	Not established
Yolo Solano	55[a]	55[a]	80	Not established

[a] 55 lbs./day is equivalent to the 10 tons/year adopted threshold.
Red indicates the highest emission rate among the five districts

Compared to the **Table 1** Thresholds, the construction Thresholds of Significance for the Sac Metro Air District are slightly higher for NO_X at 85 lbs./day, not applicable for ROG, and the same levels for PM_{10} and $PM_{2.5}$. Therefore, for a project in the Sac Metro Air Quality District area where construction emissions are being evaluated, the screening health effects analysis results may be applied to the construction emissions given how close the significance thresholds are to each other (the same or within 4%) and the conservative assumptions in the health effects screening analysis.

Ramboll conducted a screening analysis to estimate the level of health effects for a proposed CEQA Project that has emissions at the Thresholds of Significance levels. In addition to the pollutants with Thresholds, project emissions also include SO_2 and CO. SO_2 is a precursor to secondary $PM_{2.5}$ and CO plays a small role in the formation of ozone.

Lead agencies and CEQA practitioners can use this screening analysis to provide a conservative estimate of health effects for Projects with emissions at or below the Threshold of Significance.

4.2 Overview of Health Effects Analysis

This section presents a general overview of the procedures for conducting a health effects analysis of a Project that satisfies the requirements of the Friant Ranch court decision to

disclose adverse health effects resulting from a CEQA Project. The first step in the process is to run a Photochemical Grid Model (PGM) to assess the increases in ambient air concentrations of pollutants that the Project emissions may cause. PGMs require a database of information, including meteorology and the spatial and temporal allocation of emissions in the area to be modeled. This includes both existing emissions and emissions for the particular Project being evaluated. The next step is to put the increases in concentrations that result from the Project's emissions into the Benefits Mapping and Analysis Program (BenMAP), a U.S. Environmental Protection Agency (USEPA) tool that estimates health impacts from ozone and $PM_{2.5}$. More discussion of the procedures to conduct a health effects analysis are provided in **Section 6** of this guidance with technical details provided in **Appendix A**.

4.3 Screening Analysis for Projects at or Below Thresholds Levels

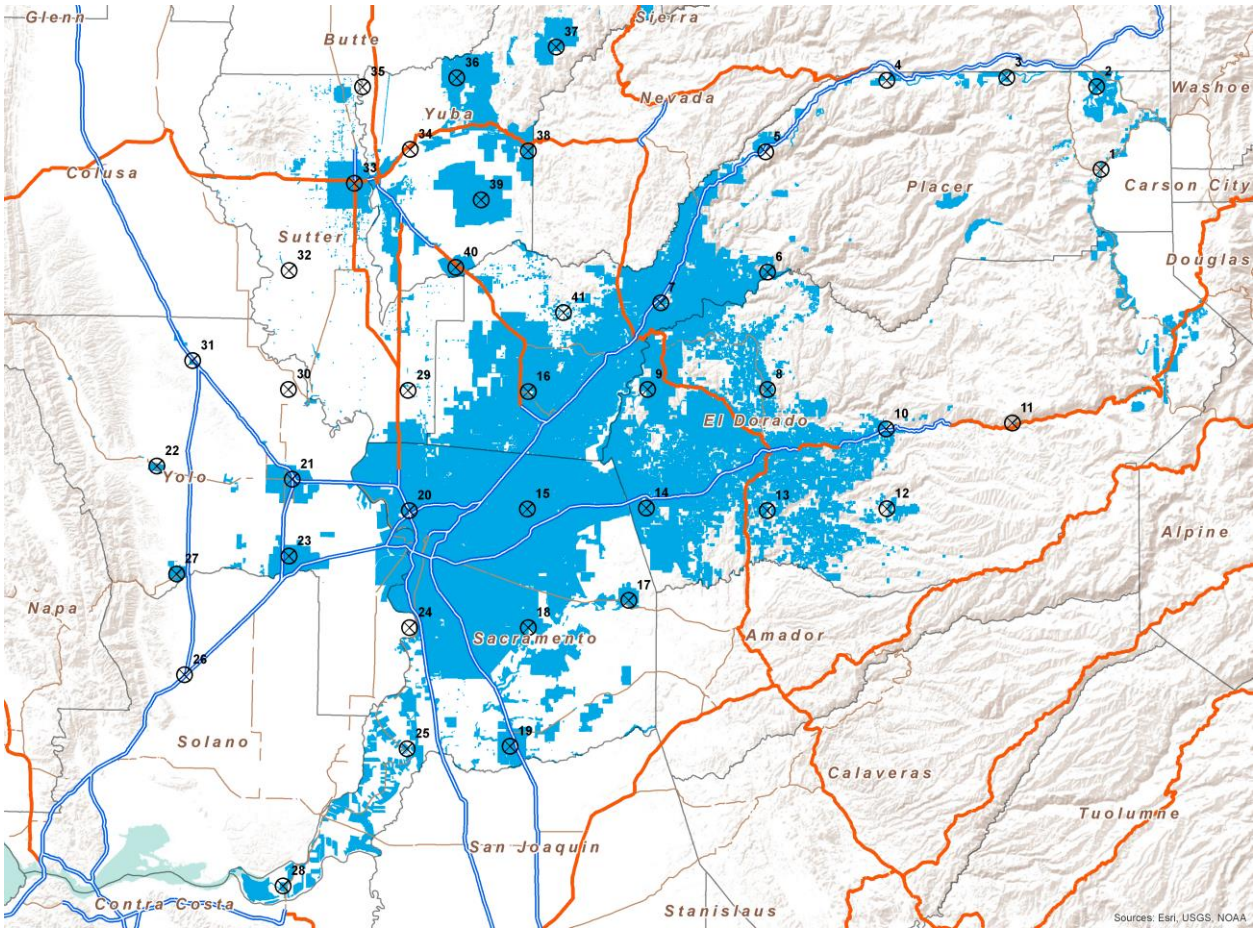
A health effects screening analysis was conducted for hypothetical sources within the Sac Metro Air District and adjacent air district regions using emission rates at the maximum Thresholds of Significance (**Table 1**). The hypothetical source locations were intended to be proxy locations for where real projects may be located.

4.3.1 Definition of Hypothetical Project Sources for Screening Analysis

Each hypothetical source had emission rates for each pollutant at the maximum Thresholds of Significance, which are indicated by the red numbers in **Table 1**. This results in an emission rate of 82 lbs./day for NO_X, ROG, $PM_{2.5}$ and PM_{10}. The hypothetical sources also included emissions for CO and SO_2 that were based on an analysis of the ratios of the emission rates of SO_2 to NO_X and CO to NO_X for six recent CEQA Projects in Sacramento County that is described in **Appendix D**.

Figure 1 shows the geographic areas where the Sac Metro Air District expects CEQA Projects to be located in Sacramento and adjacent counties (shaded blue) along with the locations of the 41 hypothetical Projects. The expected growth areas are consistent with the Sacramento Area Council of Government's 2050 Blueprint growth map. The 41 hypothetical Projects were distributed across the potential growth areas to capture the differing dispersion regimes of the mountain/valley flow systems, photochemical regimes, areas which include high emissions and low emissions, urban and rural atmosphere and population density of the urban to remote areas.

Figure 1. Locations of the 41 hypothetical project locations used in the health effects screening analysis.



4.3.2 Screening Analysis Health Effects Modeling

For the screening analysis, the Comprehensive Air Quality Model with Extensions (CAMx) PGM was used with a 2012 annual 4-km grid resolution meteorological and emissions database for a domain covering Sacramento and nearby counties. 2035 future year anthropogenic (i.e., human-made) emissions were used as the baseline emissions. The ozone and PM impacts were estimated from each of the 41 hypothetical sources whose emissions were set at the 82 lbs./day Threshold of Significance level for ROG, $PM_{2.5}$ and NO_X and corresponding levels of CO and SO_2. Health effects were estimated for each of the 41 hypothetical sources using a simulator of USEPA's BenMAP health effects model using the concentration-response (C-R) functions, 2035 population and procedures described in **Appendix A** (see **Tables A-1** and **A-2**). This guidance recommends assessing mortality (all causes), hospital admissions (respiratory, asthma, cardiovascular), emergency room visits (asthma), and acute myocardial infarction (non-fatal) health effects for $PM_{2.5}$ and assessing mortality, emergency room visits (respiratory) and hospital admissions (respiratory) health

effects for ozone, consistent with the USEPA's approach when establishing the National Ambient Air Quality Standards (NAAQS)[1].

As an example, **Table 2** displays the health effects for PM and ozone increases resulting from hypothetical source location number 20 (see **Figure 1** for location map). The analysis estimates that a Project at hypothetical source location number 20 emitting 82 lbs./day of NO_X, ROG and PM and corresponding levels of CO and SO_2, would have 2.3 premature deaths (mortality, all causes) per year due to its increases in PM concentrations. To put this health effect into context, **Table 2** also includes the increase over the background health incidence rate of each health effect endpoint. For hypothetical source location number 20, the 2.3 premature deaths per year due to the project's PM impacts would result in a very small (0.00124%) increase over the background incidence of pre-mature deaths due to PM concentrations.

The PM and ozone health effects resulting from emissions for each of the 41 hypothetical source locations are provided in **Appendix F**. A review of **Appendix F** results shows that the health effects from all of the hypothetical source locations in the screening analysis have very small increases over the background incident health effects.

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

Table 2. Health effects for hypothetical Project number 20 produced by EPA's BenMAP program (see Appendix F for health effects of all 41 hypothetical Projects).

BenMAP			
Run with PopGrid populations - Source 20			
$PM_{2.5}$ Health Endpoint	**Age Range***	**Incidences**	**Percent of Background Health Incidence****
		(Mean)	**(%)**
Emergency Room Visits, Asthma	0 - 99	1.4563	0.0018
Mortality, All Cause	30 - 99	2.2900	0.0012
Hospital Admissions, Asthma	0 - 64	0.0971	0.0011
Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	0.1857	0.0002
Hospital Admissions, All Respiratory	65 - 99	0.3370	0.0004
Acute Myocardial Infarction, Nonfatal	18 - 24	0.0001	0.0008
Acute Myocardial Infarction, Nonfatal	25 - 44	0.0123	0.0011
Acute Myocardial Infarction, Nonfatal	45 - 54	0.0249	0.0009
Acute Myocardial Infarction, Nonfatal	55 - 64	0.0398	0.0008
Acute Myocardial Infarction, Nonfatal	65 - 99	0.1192	0.0006
Ozone Health Endpoint	**Age Range**	**Incidences**	**Percent of Background Incidence**
		(Mean)	**(%)**
Hospital Admissions, All Respiratory	65 - 99	0.0852	0.0001
Mortality, Non-Accidental	0 - 99	0.0528	0.0000
Emergency Room Visits, Asthma	0 - 17	0.4607	0.0019
Emergency Room Visits, Asthma	18 - 99	0.7244	0.0013

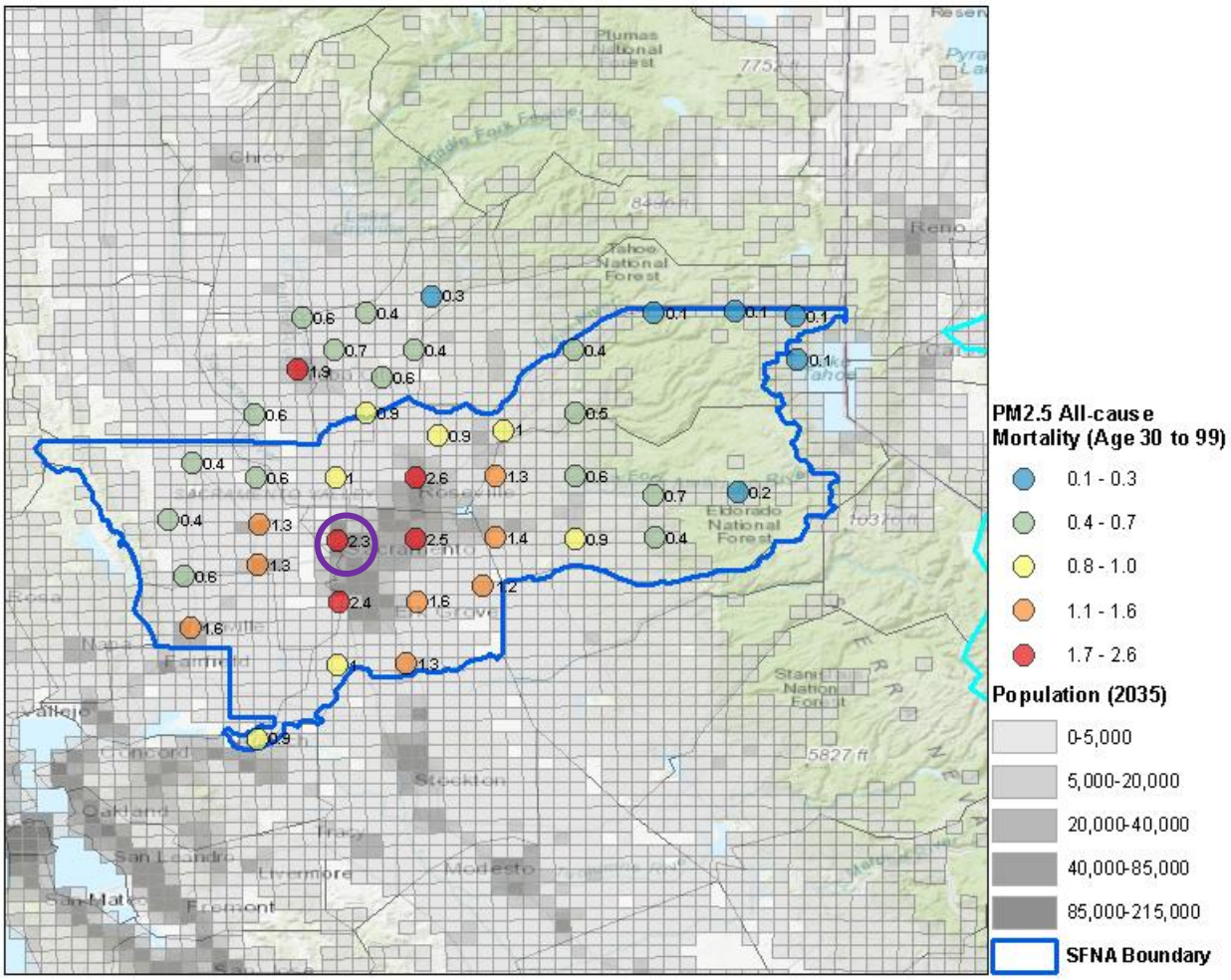
* Other age ranges are available, but the studies shown here are the ones used by the EPA in their health assessments. The age ranges are consistent with each epidemiological study conducted for each study.

1. ** The percent of background health incidence uses the mean incidence. The background health incidence is an estimate of the average number of people that are affected by the health endpoint in a given population over a given period of time. In this case, these background incidence rates cover the modeled domain. Health incidence rates and other health data are typically collected by the government as well as the World Health Organization. The background incidence rates used here are obtained from BenMAP.

Figure 2 is a spatial map that displays the estimated number of premature deaths that may result from increases in PM concentrations from the NO_X and $PM_{2.5}$ emissions at each of the 41 hypothetical project locations. The estimated PM premature deaths range from 0.1 to 2.6. Also shown in **Figure 2** are the gridded population amounts in 2035 used in the health effect estimates. Premature death and other health effects are greatest for those sources located near high population areas. For example, there are three hypothetical sources in Sacramento County that have estimated PM premature deaths greater than 2, whereas all of the other hypothetical source estimated PM premature deaths are less than 2. The three Sacramento County hypothetical sources include source number 20 in the northwestern portion of Sacramento County (near Interstate 5 and Interstate 80) used for the example results shown in **Table 2**.

For a Project with emissions below the Thresholds of Significance, the health effects will be lower than presented here.

Figure 2. Premature Deaths Resulting from PM at 41 Hypothetical Project Locations on a Population Base Map with SFNA boundary outline. Location of hypothetical source number 20 whose results were presented in Table 2 is shown by the purple circle.



4.3.3 Minor Project Health Effects Screening Tool

The health effects of the 41 hypothetical sources were interpolated to the 4-km modeling domain and imported into an interactive spreadsheet where the user can input their Project location and obtain the estimated health effects information for a source with Thresholds of Significance emission rates at that location. Projects with emissions lower than the Thresholds of Significance would have lower estimated health effects.

The Minor Project Health Effects Screening Tool is available on the Sac Metro Air District's CEQA Guidance & Tools website.

5. TREATMENT OF PROJECTS THAT EXCEED THRESHOLDS IN STRATEGIC AREAS

To address health effects of potential Projects with emissions greater than the Thresholds of Significance emission rates and located in strategic areas, additional health effects screening modeling was conducted whose results were used to develop a Strategic Area Health Effects Screening Tool. The screening analysis is discussed briefly below, with details provided in **Appendix C**.

5.1 Strategic Area Project Screening Modeling

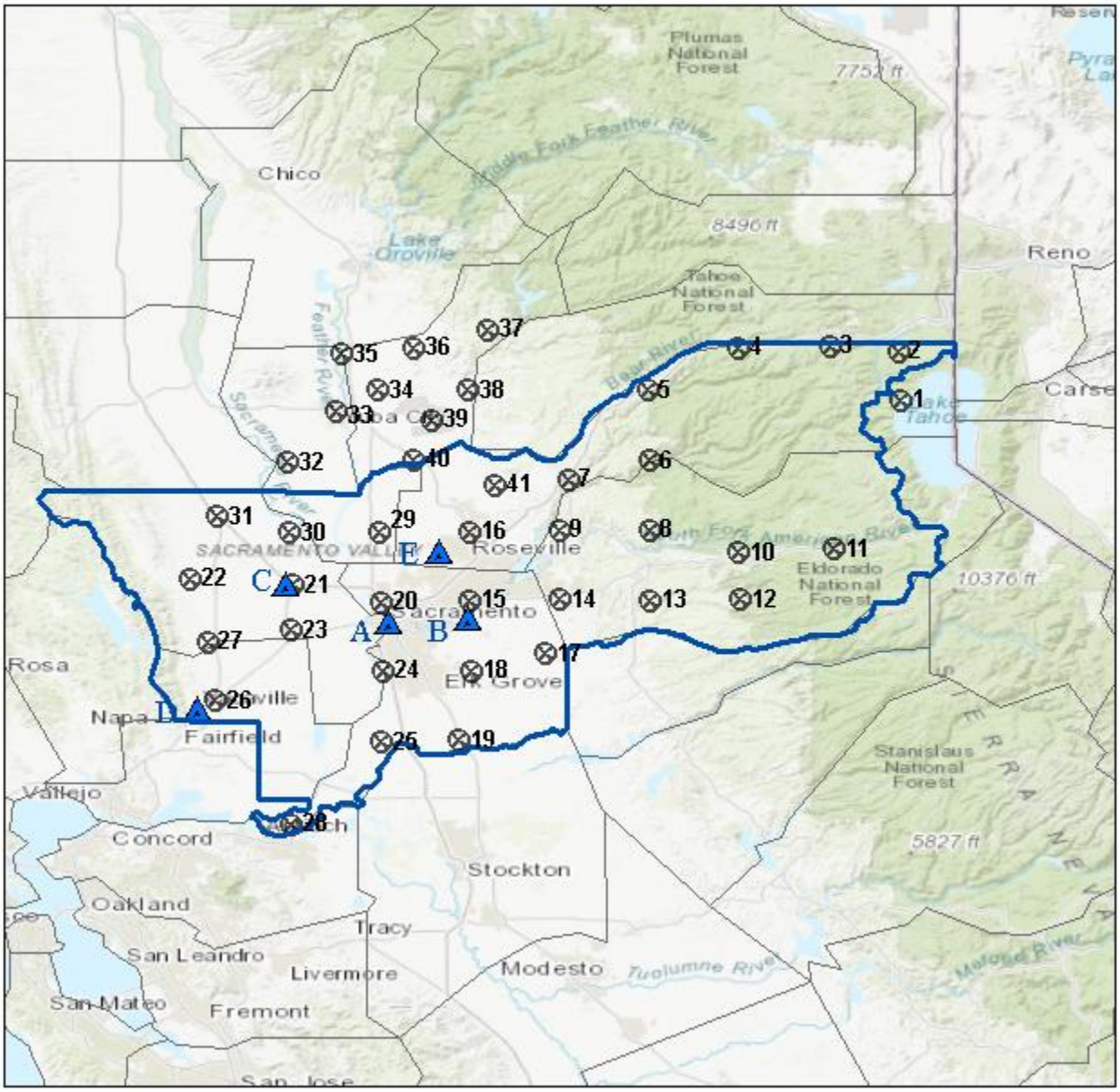
The Sac Metro Air District provided five potential Strategic Area Projects for use in the health effects screening modeling. These five locations are intended to be used as proxy locations for nearby projects exceeding the Thresholds of Significance. The five locations are listed in **Table 3** and shown in **Figure 3**.

Table 3. Coordinates for 5 hypothetical strategic area projects.

ID	Name	Latitude	Longitude	Location
A	Sacramento	38.579336	-121.494119	10th Street & K Street
B	Rancho Cordova	38.588080	-121.286765	Zinfandel Drive & White Rock Road
C	Woodland	38.677388	-121.765759	Main Street & East Street
D	Vacaville	38.347954	-121.998058	Merchant Street & Lincoln Highway
E	West Roseville	38.765833	-121.359299	Fiddyment Road & Pleasant Grove Boulevard

IMPORTANT NOTE: Project proponents should confirm with Sac Metro Air District staff if one of the strategic area project locations are appropriate for use as a proxy prior to using the Strategic Area Project Health Screening Tool.

Figure 3. Locations of five strategic area Projects A-E used in the screening modeling, along with the 41 hypothetical Projects used in the minor Project analysis with outline of the SFNA boundary.



The screening modeling addressed hypothetical sources at each of the five Strategic Area Project locations at emission levels that were two times (2x) and 8 times (8x) the maximum Threshold of Significance (TOS) level (see **Table 1**). The Strategic Area Projects also included CO and SO_2 emissions and speciated ROG and PM emissions using the same approach as used in the 41 hypothetical minor Project analysis (see **Appendix D**). The Strategic Area Project screening modeling emissions rates used are shown in **Table 4**.

Table 4. Levels of emissions proposed for evaluating strategic area projects that are 2 and 8 times the maximum Threshold of Significance (TOS).

Pollutant	Emissions (lbs./day)	
	2xTOS	8xTOS
NO_X	164	656
$PM_{2.5}$	164	656
ROG	164	656
SO_2	1.96	7.84
CO	524	2096

Two annual CAMx ozone and PM source apportionment model simulations were conducted for the 2012 calendar year; 2035 future year anthropogenic (i.e., human-made) emissions were used as the baseline emissions. The following future year anthropogenic emissions were used: (1) five Projects at 2xTOS emissions; and (2) five Projects at 8xTOS emissions. Emissions from each of the five Projects were tagged for treatment by the CAMx ozone and PM source apportionment tool. The incremental ozone and $PM_{2.5}$ contributions of each of the five Projects at the two levels of emissions were used with the BenMAP tool to estimate health effects, whose results are shown in **Appendix G**. BenMAP was run to obtain ozone and $PM_{2.5}$ health effects from each of the precursor emissions (i.e., NO_X, ROG and PM) separately; this allows the user to obtain only the health results associated with the pollutant with emissions above the threshold.

5.2 Strategic Area Project Health Effects Screening Tool

The Strategic Area Project screening modeling health effects were used to develop a Strategic Area Projects Health Effects Screening Tool spreadsheet that can be used to estimate health effects for potential Projects with emissions below the 8xTOS level. The Strategic Area Project Health Effects Screening Tool (obtained on the Sac Metro Air District's CEQA Guidance & Tools website) has two interactive components that need to be specified by the user:

1. Project Location: The user selects one of the 5 strategic area project locations (see **Table 3** and **Figure 3**) from a dropdown menu and the spreadsheet will use the Strategic Area Project health effects screening modeling results for that location.
2. Project Emissions: The user inputs the NO_X, ROG and $PM_{2.5}$ emissions in pounds/day for their potential Project and the tool will linearly interpolate the ozone and PM health effects for the selected Project location from the 2xTOS and 8xTOS CAMx/BenMAP modeling.

If the user inputs any one of the NO_X, ROG or PM emissions below the 2xTOS emissions rate, then the health effects for the 2xTOS emissions level for that precursor is used to provide a conservative estimate of health effects. If the user inputs one or more emission rates above the 8xTOS level, the tool will output an error message that one or more of the emission rates provided is too high to use the tool.

6. ANALYSIS OF INDIVIDUAL PROJECTS

Appendix A provides detailed guidance on how to conduct a health effects analysis for an individual Project in the Sacramento Federal Nonattainment Area (SFNA) for a practitioner skilled in the art of detailed photochemical grid modeling and health effects analysis**.** A layperson's description of this approach is found in this section. While the approach outlined in this section can be used for any Project, this guidance document allows a screening approach for projects within the SFNA where emissions of VOC, NO_X and particulate matter (PM) are below or equal to the applicable Thresholds of Significance and provides look-up tables for larger commercial and residential projects in designated strategic areas. Therefore, this individual project modeling guidance will only be used for larger projects outside the designated strategic areas to prepare a site-specific health effects analysis.

In order to estimate the health effects of the increases of criteria pollutants for a proposed Project, practitioners should apply a photochemical grid model (PGM) to estimate the increases in concentrations of ozone and $PM_{2.5}$ in the region as a result of the emissions of criteria and precursor pollutants from a Project. Next apply the U.S. Environmental Protection Agency (USEPA)-authored program, the Benefits Mapping and Analysis Program (BenMAP[2]), to estimate the resulting health effects from the increases in concentration. This is described further below.

6.1 Pollutants Evaluated

This analysis estimates the health effects of criteria pollutants and their precursors, specifically those health effects that are evaluated by the USEPA in rulemaking setting the NAAQS: NO_X, 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, $PM_{2.5}$ and PM_{10}. USEPA's default health effect functions in BenMAP for PM use $PM_{2.5}$ as the causal PM agent, so the health effects of PM_{10} are represented using $PM_{2.5}$ as a surrogate. NO_X and VOC 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, respectively.

This guidance recommends that the health effects from ozone and $PM_{2.5}$ are evaluated, because the USEPA has determined that these criteria pollutants would have the greatest effect on human health. While ozone is not commonly directly emitted, some $PM_{2.5}$ is emitted directly. Ozone and secondary $PM_{2.5}$ are formed by the emissions of other pollutants to the atmosphere, including VOC, NO_X, CO and SO_2.

Additionally, SO_2, NO_2 and CO concentration changes due to a Project are not evaluated individually. Each of these pollutants have NAAQS against which the presence or absence of health effects can be measured, and none of these pollutants are typically considered to be formed in the atmosphere as secondary pollutants, like ozone and $PM_{2.5}$. NAAQS are health-based thresholds and thus a direct comparison against such thresholds allows evaluation of potential health effects. NO_2 concentration changes are not individually evaluated as there

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

[3] 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.

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 as there are no current SO_2 non-attainment areas in the state of California. Sac Metro Air District has been in attainment of the NAAQS and State CO standards since the early 1990s. Even so, as noted above, contributions of NO_X, CO, and SO_2 are all still evaluated for 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.

6.2 Technical Analysis

The first step in the technical analysis is to run the PGM with appropriate information to assess the increases in ambient air concentrations of pollutants that the Project's emissions may cause. PGMs require a database of information, including meteorological fields and how emissions are distributed in the area to be modeled. This includes both existing emissions and Project emissions. The latest publicly available PGM database for Northern California should be used in this analysis

The USEPA's air quality modeling guidelines (Appendix W[4]) and ozone and $PM_{2.5}$ modeling guidance[5] 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[6] and the Community Multiscale Air Quality (CMAQ)[7] PGMs have been used extensively in the past and would be acceptable PGMs. The USEPA has prepared a memorandum[8] 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 a proposed Project's emissions on ambient air concentrations, the Project's mitigated emissions are added to the existing emissions in the PGM database. Ensure that the Project emissions that are analyzed present a maximum year when considering both operation and construction. These maxima may occur in different years but may be conservatively analyzed in a single year assessment. Consideration of whether the maximum emissions year will have the greatest impact should be taken into consideration. It is recommended that maximum 24-hour emission rates be used as some of the C-R health effects functions use daily concentration estimates. Accounting for seasonal changes in maximum 24-hour emissions should be accounted for when appropriate, such as when wood stoves or fireplaces are used for home heating in the cold months.

Each Project emissions should be spatially distributed across the modeling area in a manner that reflects the actual distribution, with consideration taken for where mobile source emissions may occur. Operational emissions may 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

[4] https://www3.epa.gov/ttn/scram/appendix_w/2016/AppendixW_2017.pdf.

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

[6] http://www.camx.com/.

[7] https://www.epa.gov/cmaq.

[8] https://www3.epa.gov/ttn/scram/guidance/clarification/20170804-Photochemical_Grid_Model_Clarification_Memo.pdf.

emissions may include off-road equipment, paving, architectural coatings, fugitive dust, and emissions associated with hauling, vendor, and worker activity.

Following completion of the PGM modeling, use USEPA's BenMAP[9, 10] program to estimate the potential health effects of the Project's contribution to ozone and $PM_{2.5}$ concentrations. BenMAP uses the concentration estimates produced by the PGM along with population and health effect 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[11] as needed for assessing the health effects of a project's emissions. Use the USEPA default BenMAP health effects C-R functions that are typically used in national rulemaking, such as the health effects assessment[12] for the 2012 $PM_{2.5}$ NAAQS. The guidance recommends assessing the following health effects for $PM_{2.5:}$ mortality (all causes), hospital admissions (respiratory, asthma, cardiovascular), emergency room visits (asthma), and acute myocardial infarction (non-fatal). For ozone the guidance recommends the following endpoints: mortality, emergency room visits (respiratory) and hospital admissions (respiratory).

The procedures outlined in **Appendix A** are designed to provide guidance to a practitioner with experience in PGM modeling to conduct a health effects analysis that satisfies the requirements of the Friant Ranch court decision. Consequently, the guidance assumes a level of knowledge related to PGM and health effects modeling and is not designed for those not familiar with PGM and health effects modeling.

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

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

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

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

APPENDIX A
GUIDANCE FOR CONDUCTING A SITE-SPECIFIC HEALTH EFFECTS ANALYSIS

This Appendix provides documentation on how to conduct a site-specific health effects analysis for a Project in the Sacramento Federal Nonattainment Area (SFNA) that does not qualify to use the minor project screening approach, or the larger project strategic area approach provided in this guidance.

The procedures outlined in this Appendix are designed to provide guidance to a practitioner with experience in PGM modeling to conduct a health effects analysis that satisfies the requirements of the Friant Ranch court decision. Consequently, the guidance assumes a level of knowledge related to PGM modeling and is not designed for those not familiar with PGM modeling.

A.1 OVERVIEW OF TECHNICAL APPROACH

The first step in this process is to run a Photochemical Grid Model (PGM) with appropriate information to assess the increases in ambient air concentrations of pollutants that the Project emissions may cause. PGMs require a database of information, including meteorological fields and the spatial allocation of emissions, in the area to be modeled. This includes both base (background/existing) emissions and emissions for the Project being evaluated. A recommended modeling plan for conducting such a photochemical modeling study is provided in **Section A.2.**

Project emissions include oxides of nitrogen (NO_X), respirable (PM_{10}) and fine ($PM_{2.5}$) primary particulate matter (PM), sulfur dioxide (SO_2), carbon monoxide (CO) and volatile organic compounds (VOC, also called ROG). NO_X and VOC are precursors to ozone and, along with SO_2, are also precursors to secondary $PM_{2.5}$. CO also plays a smaller role in the formation of ozone and should be considered for evaluation if emissions information is available.

To estimate the potential outcome of a proposed Project's emissions on ambient air concentrations, a Project's emissions are added to the 4-km annual PGM modeling database.[13] 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. For projects with on-road mobile source emissions, the emissions will need to be spread across the roadway network.

Once Project emissions are allocated to grid cells, annual emission estimates from the Project are spatially gridded, temporally allocated (e.g., adjustments to account for season/month, day-of-week and hour-of-day), and chemically speciated to be used for the PGM using the Sparse Matrix Operator Kerner Emissions (SMOKE[14]) emissions modeling system supported by the USEPA. More details on how to work with the emissions inventory, spatial allocation, and SMOKE inputs and outputs are described in **Section A.3.**

In order to be conservative, we recommend that future years be used for the modeling database. Population increases with future years, and background emissions are lower, which usually results in higher ozone and secondary PM from the incremental project emissions. Accordingly, the future year database provides the most conservative estimate of health effects. More details on preparing inputs for the PGM modeling are included in **Section A.3.**

Following completion of the PGM modeling, the USEPA's BenMAP[15, 16] program is used to estimate the potential health effects of the Project's contribution to ozone and $PM_{2.5}$ concentrations. USEPA's default health effect functions in BenMAP for PM use fine particulate ($PM_{2.5}$) as the causal PM agent, so the health effects of PM_{10} are represented using $PM_{2.5}$ as a surrogate. BenMAP uses the concentration

[13] In this guidance we recommend that the currently available BAAQMD 2012 PGM modeling database be used for the CCOS Northern California domain or a reduced size domain that is focused on the SFNA. BAAQMD performed Weather Research and Forecasting (WRF) meteorological modeling for the 4-km domain and 2012 calendar year that has been processed by MCIP and WRFCAMx to generate CMAQ and CAMx 2012 4-km meteorological inputs for the domain. BAAQMD prepared 2012 emissions for the CMAQ model that have been converted to the format used by CAMx using the CMAQ2CAMx processor.

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

[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.

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[17] as needed for assessing the health effects of a project's emissions. This guidance recommends using 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 $PM_{2.5}$ NAAQS. The health effects 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 **Section A.4.**

[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.

A.2 MODELING PLAN

To estimate the potential health impacts of criteria pollutants due to emissions from a proposed CEQA Project involves the following activities:

- Selection of an air quality model and air quality modeling database for use in the analysis.
- Estimating the ozone and PM precursor emissions for the proposed CEQA Project.
- Processing of the CEQA Project emissions for use in the selected air quality model.
- Air quality modeling of the proposed CEQA Project emissions to obtain the incremental ozone and PM concentrations due to the Project's emissions.
- Processing of the incremental ozone and PM concentrations due to the Project's emissions by a health effects model to estimate the mortality, morbidity and other health effects.
- Documenting the health effects modeling and results with enough detail that the results could be duplicated.

A.2.1 Selection of an Air Quality Model

Proposed CEQA Project emissions typically include, but are not limited to NO_X, PM_{10}, $PM_{2.5}$, SO_2, CO and VOC. NO_X and VOCs are not criteria air pollutants[19] but, in the presence of sunlight, they form ozone and contribute to the formation of secondary $PM_{2.5}$ and thus are analyzed here. If SO_2 and CO emissions are otherwise quantified in the EIR, these can be conservatively included as they have contributions to the formation of secondary $PM_{2.5}$ and/or ozone.

EPA's air quality modeling guidelines (Appendix W[20]) and ozone and $PM_{2.5}$ modeling guidance[21] recommends using a photochemical model to estimate ozone and secondary $PM_{2.5}$ concentrations. Most photochemical models for modeling ozone and secondary PM are Photochemical Grid Models (PGMs). EPA's modeling guidance does not recommend specific PGMs but provides procedures for determining an appropriate PGM on a case-by-case basis. EPA's air quality modeling guidelines and guidance does note that both the Comprehensive Air-quality Model with extensions (CAMx[22]) and the Community Multiscale Air Quality (CMAQ[23]) PGMs have been used extensively in the past and if applied correctly would be acceptable PGMs. In fact, EPA has prepared a Memorandum[24] documenting the suitability for using CAMx and CMAQ for ozone and secondary $PM_{2.5}$ modeling of single-sources or group of sources.

Thus, for the Sac Metro Air District Friant Ranch analysis of the health effects of criteria pollutants from a proposed CEQA Project, either the CAMx or CMAQ PGMs would be acceptable.

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[19] The six criteria air pollutants are ozone (O_3), particulate matter (PM), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO) and lead (Pb).

[20] https://www3.epa.gov/ttn/scram/appendix_w/2016/AppendixW_2017.pdf.

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

[22] http://www.camx.com/.

[23] https://www.epa.gov/cmaq.

[24] https://www3.epa.gov/ttn/scram/guidance/clarification/20170804-Photochemical_Grid_Model_Clarification_Memo.pdf.

A.2.2 Selection of an Air Quality Modeling Platform

Because some of the health effect Concentration-Response (C-R) functions require annual PM concentrations, an annual PGM modeling platform is required. The development of an all new annual PGM modeling platform from scratch is quite resource extensive. Thus, it is more cost-effective to use an appropriate existing PGM modeling platform. The California Air Resources Board (ARB) and several air districts in California routinely develop PGM modeling databases to address ozone and $PM_{2.5}$ attainment as part of State Implementation Plans (SIPs). We propose to use the latest publicly available PGM database for Northern California developed by the Bay Area Air Quality Management District (BAAQMD) and adapt it for this analysis. The BAAQMD PGM database is tailored for California using California-specific input tools [e.g., the Emissions Factor (EMFAC[25]) mobile source emissions model] and use a high-resolution 4-km horizontal grid resolution to better simulate meteorology and air quality in the complex terrain and coastal environment of California. This contrasts with EPA's national modeling platforms[26] used for national rulemakings [e.g., transport rules such as Cross-State Air Pollution Rule (CSAPR[27])or defining new NAAQS] that use a coarser 12-km horizontal grid resolution. The BAAQMD 2012 annual PGM modeling database that uses the Central California Ozone Study (CCOS) modeling domain depicted in **Figure A-1** would be appropriate for this analysis. For the hypothetical Project screening analysis discussed in **Appendix B** the BAAQMD 2012 annual CCOS domain PGM database was adapted for a reduced 4-km grid resolution domain covering the Sacramento and neighboring counties shown in **Figure B-2** that would also be appropriate for this analysis. The CCOS and reduced 4-km PGM modeling domains use a lambert Conformal Conic (LCC) projection with the domain definitions given in **Table A-1**. BAAQMD performed WRF meteorological and SMOKE emissions modeling for the CCOS 4-km domain and 2012 calendar year in generating the 2012 CCOS domain PGM modeling database. The 2012 CCOS PGM modeling database was originally developed for the CMAQ PGM but has been extended for the CAMx PGM as well. Descriptions of the WRF meteorological, SMOKE emissions and CMAQ and CAMx PGM models are available on the BAAQMD's Research and Modeling website.[28]

Table A-1. Definitions of the Northern California CCOS (Figure A-1) and reduced Sacramento (Figure B-2) 4-km grid resolution PGM modeling domains.

Parameter	**Value**			
Projection	Lambert-Conformal Conic			
1st True Latitude	30 degrees N			
2nd True Latitude	60 degrees N			
Central Longitude	-120.5 degrees W			
Central Latitude	37 degrees N			
Domain	**NX**	**NY**	**X-Offset Origin (km)**	**Y-Offset Origin (km)**
CCOS (NCA)	185	185	-376	-292
Reduced (Sacramento)	78	106	-224	8

[25] https://www.arb.ca.gov/emfac/

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

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

[28] http://www.baaqmd.gov/about-air-quality/research-and-data/research-and-modeling

Future year emission scenarios can be developed as far out as the 2035 year using ARB's county level emissions by species and source category that are available on the ARB CEPAM webpage[29] that can be used to project the 2012 emissions to a future year. A Project's contribution to ozone and PM concentrations should be evaluated for the most appropriate future year(s) based on the characteristics of the Project.

[29] https://www.arb.ca.gov/app/emsinv/fcemssumcat/fcemssumcat2016.php

Figure A-1. CCOS 4 km Modeling domain for Northern California PGM modeling

A.2.3 Approaches for Estimating Incremental Project Contributions

PGMs simulate concentrations due to all sources, including all anthropogenic and natural emissions and transport from all upwind sources. There are several techniques that can be used to isolate the incremental contributions of emissions from a proposed CEQA Project to ozone and PM concentrations:

1. Brute Force Method: In the Brute Force Method, the PGM is applied for a base case and a case where the Project's emissions are added to the base case and the Project's ozone and PM incremental impacts are obtained from the differences in the two simulations.
2. Source Apportionment Tools: Some PGMs (including CAMx and CMAQ) come instrumented with a source apportionment tool that uses tagged species (reactive tracers) that run in parallel to the

host model and keeps track of the ozone and PM contributions due to user selected source groups (e.g., emission from a CEQA Project).

3. Sensitivity Tools: Some PGMs also come with sensitivity tools that can track the sensitivity of ozone and PM to user selected source groups that can be post-processed to get the source contributions.

The Brute Force Method can be used with any air quality model and could be a viable method for obtaining the ozone and PM contributions from a proposed CEQA Project. However, because the Projects incremental concentrations are obtained by taking the difference in two PGM simulations there is the potential to introduce model noise. Model noise in this case are changes in the two PGM simulations concentration estimates due to numerical artifacts that are not associated with the Project's emissions. The aerosol thermodynamic module (ISORROPIA) used in CAMx and CMAQ is particularly prone to producing model noise in particle ammonium nitrate (NH_4NO_3) concentrations due to its complicated parameterization that includes branching. Given the small concentrations expected from CEQA Projects, model noise could be a significant issue.

Source Apportionment methods alleviate the problem of model noise because only one simulation is performed. The CAMx Ozone and Particulate Source Apportionment Technology (OSAT/PSAT) tools have been used extensively by EPA and others, including in EPA's CSAPR (CSAPR Update[30]) that estimated upwind state contributions to downwind state nonattainment with details on the CSAPR CAMx source apportionment modeling contained in the CSAPR Air Quality Technical Support Document (AQTSD).[31] CAMx was also used by EPA to develop single-source or facility level ozone and secondary $PM_{2.5}$ Modeled Emission Rate Precursors (MERPs[32]) significance threshold emission rates, a use similar to modeling a CEQA Project's emissions ozone and $PM_{2.5}$ impacts. The CMAQ has the Integrated Source Apportionment Method (ISAM[33]) source apportionment tool for ozone and PM.

Both CAMx and CMAQ have the Decoupled Direct Method (DDM) and the Higher-Order DDM (HDDM) sensitivity tools. DDM/HDDM operates similarly to the source apportionment tools only providing sensitivity coefficients for user-selected source groups. However, DDM is much more expensive than source apportionment. And for a single Project, the Brute Force Method, which is another sensitivity method, is also more efficient. Thus, we do not recommend using it for this analysis.

Either the Brute Force or Source Apportionment methods are viable tools for estimating the incremental ozone and PM impacts due to emissions of a proposed CEQA Project's emissions. Given that it is difficult to determine whether model noise will be a problem, the Source Apportionment method is a safer pathway so is recommended in this guidance.

[30] https://www.govinfo.gov/content/pkg/FR-2016-10-26/pdf/2016-22240.pdf.

[31] https://www.epa.gov/sites/production/files/2017-05/documents/aq_modeling_tsd_final_csapr_update.pdf.

[32] https://www3.epa.gov/ttn/scram/appendix_w/2016/MERPs_WebinarPresentation_01192017.pdf.

[33] https://github.com/USEPA/CMAQ/blob/master/DOCS/Users_Guide/CMAQ_UG_ch11_ISAM.md

A.3 EMISSIONS AND AIR QUALITY MODELING

The following sections describe how the CEQA Project emissions are processed and the air quality modeling conducted using either the BAAQMD Northern California CCOS 4-km modeling domain or Sacramento reduced 4-km modeling domain 2012 PGM modeling database.

A.3.1 Project Emissions

For most Projects, the maximum daily emissions of criteria pollutants and their precursors from operation and construction should be used. In cases where there are Projects with large seasonal variations in maximum daily emissions (e.g., wood stoves or fireplace use), the seasonal variation in the maximum daily emissions should be accounted for. If maximum daily emissions are not otherwise quantified in the EIR, average daily emissions should be provided. At a minimum, emissions of NO_X, VOC, and $PM_{2.5}$ are required, unless one or more of these did not increase due to the Project. If quantified and available, Project emissions for CO and SO_2 should be provided as well. The development of detailed emissions inventories is an important component of any CEQA Project analysis. However, for PGM modeling the Project emission inventories need to be converted into the hourly gridded speciated emission inputs in the format used by the PGM. This is typically accomplished using the Sparse Matrix Kernel Emissions (SMOKE[34]) modeling system.

A.3.2 SMOKE Emissions Modeling of Project Emissions

The first step in the SMOKE emissions processing is to convert the Project emission inventory into the Flat File 2010 (FF10) format for input to SMOKE. The emissions for each process of the Project's emissions need to be assigned an appropriate Source Classification Code (SCC[35]) that are used to cross-reference to that particular source sector's typical chemical speciation and temporal allocation profile. SCCs are a 10-digit numerical code that represents a hierarchical classification of the source sectors emissions type. In this case, chemical speciation is performed for the SAPRC07 chemical mechanism used in the 2012 4-km PGM modeling database. Temporal allocation takes annual emissions or maximum daily emissions and distributes them to month of year, day-of-week and hour of day using typical temporal profiles for each source sector as defined by the SCC. In some cases, there are source sectors that only operate during part of a year (e.g., residential wood combustion, home heating using wood stoves and fireplaces). In this case, separate SMOKE modeling using the maximum daily emissions for the different seasons is appropriate. EPA has a detailed website describing SCC[36], although not all possible SCC have a cross-reference to chemical speciation and temporal profiles in SMOKE. **Appendix E** presents several SCCs that are typically used to characterize source types in CEQA Project emissions that are included in SMOKE's cross-reference file and can be used in populating the FF10 SMOKE input files.

As part of the analysis, the Project source emissions need to be spatially allocated to appropriate geographic locations (i.e., 4-km grid cells). The emissions can be allocated to modeling grid cells using gridding surrogates. To process the Project emissions, a Project area-based spatial surrogate needs to be developed. For many Project sources the emission sources (e.g., construction) will be allocated to

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

[35] https://ofmpub.epa.gov/sccwebservices/sccsearch/docs/SCC-IntroToSCCs.pdf

[36] https://ofmpub.epa.gov/sccwebservices/sccsearch/

the grid cell(s) containing the Project. For more geographically complex Project emission source categories (e.g., mobile source emissions associated with the Project), the surrogate distributions can be developed using the USEPA's Spatial Allocation Tool,[37] which combines geographical information system (GIS)-based data (shapefiles) and modeling domain definitions to generate the appropriate gridded surrogate data set. In SMOKE, the Project sources are assigned specific surrogates for gridding by cross-referencing the SCCs. All onsite Project emissions are distributed in the modeling grid cell(s) where the Project is located. On-road mobile sources are typically spatially distributed in the site's grid cells and surrounding grid cells based on roadway locations that can be defined using GIS shapefiles and the EPA surrogate tool. In some cases, CEQA Projects have used transportation models to characterize the Project's effects on mobile sources whose data can also be used to define the extent of the mobile source emissions spatial distribution.

The SMOKE system is then used to process emissions for the modeling domain, for example the CCOS 4-km modeling grid shown in **Figure A-1**. A representative week from each month (seven days a week for each month) is typically used to represent the entire month's emissions and obtain the correct day-of-week emissions. Holidays are typically modeled separately as if they were a Sunday. SMOKE should be applied to perform the following tasks:

1. Chemical Speciation: Emission estimates of criteria pollutant precursors should be speciated for the SAPRC07 photochemical and AERO6 aerosol chemical mechanisms employed by the PGM in SMOKE processing. The speciation profiles compatible with the SAPRC07-AERO6 mechanism for $PM_{2.5}$ should be used to be consistent with the emissions used in the BAAQMD's modeling system used in this analysis. SMOKE outputs PGM emission inputs in the CMAQ PGM format that can be converted into CAMx-ready formats using CMAQ2CAMx conversion program and species mapping if CAMx is the PGM used.
2. Temporal Allocation: SMOKE resolves the annual emissions to a monthly, day-of-week and hour-of-day timescale for PGM modeling. These allocations are determined from the particular source category, specified by the SCC. Monthly, weekly, and diurnal profiles are cross-referenced to SCC in the SMOKE processing to provide the appropriate temporal resolution.
3. Spatial Allocation: The Project emission estimates should be spatially resolved to the grid cells for modeling using spatial surrogates as described above.

Standard quality assurance/quality control (QA/QC) of the emissions developed and SMOKE processing needs to be conducted during all aspects of the SMOKE emissions processing. These steps should follow 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. The SMOKE log files should be carefully reviewed for error messages and ensured that appropriate source profiles were used. All error records reported during processing should be reviewed and any discrepancies resolved. This is important to ensure that source categories are correctly characterized. A key step in the QA/QC of the SMOKE emissions modeling is to compare SMOKE input and output emissions to make sure no emissions are dropped or added in the processing. As part of the documentation, summary tables of emissions should be generated to compare input inventory totals against model-ready output totals to confirm

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

consistency. Spatial plots should be generated to visually verify correct spatial allocation of the emissions.

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 for CAMx should be merged in the time format required by CAMx. If CAMx v7.0 or newer is used, then the individual "pre-merged" emission inputs can be provided separately in the CAMx inputs, so the final merge is not necessary. CMAQ can also take separate emission file inputs so also does not need a final merged step.

A.3.3 PGM Modeling of Project Emissions

PGM modeling is conducted for a future year emissions scenario to isolate the contributions of the Project's emissions to ozone and PM concentrations. As noted above, either the CAMx or CMAQ PGM models would be acceptable and the Project's contributions could be obtained in either model using either the Brute Force or Source Apportionment approaches, but this guidance recommends that source apportionment approach be used to isolate the Project's ozone and PM2.5 contributions as the Brute Force method can be susceptible to model noise.

At this time, we are only recommending that the CAMx source apportionment tool be used in this analysis as we have not tested the new ISAM Source Apportionment tool in CMAQ. With CAMx the Anthropogenic Precursor Culpability Assessment (APCA) ozone and PSAT PM source apportionment tools should be used. The Project emissions need to be separately tagged for tracking by the APCA/PSAT source apportionment tools. The CAMx user's guide[38] describes how to tag sources for treatment by and how to invoke the APCA/PSAT source apportionment tools. A CAMx APCA/PSAT source apportionment simulation will generate two hourly average concentration files: (1) the standard model output of hourly gridded total surface layer concentrations; and (2) an hourly output file of surface layer gridded concentrations for each APCA/PSAT source group. The standard output file with elimination (subtraction) of the APCA/PSAT concentration contributions from the Project source group is defined as the Base Case and the standard output that includes the contributions of the Project's emissions is defined as the Project Case.

The PGM Base Case and Project Case gridded hourly concentration output are processed to generate annual (365 days) gridded files for the following two species and averaging times:

- Daily average total $PM_{2.5}$ concentrations; and
- Maximum Daily Average 8-Hour (MDA8) ozone concentrations.

The PGM gridded daily $PM_{2.5}$ and MDA8 ozone concentrations are used as input to BenMAP to obtain the incremental health effects due to the emissions of the Project as described in the next section.

[38] http://www.camx.com/files/camxusersguide_v6-50.pdf

A.4 ESTIMATION OF HEALTH EFFECT IMPACTS

The potential health effects of ozone and $PM_{2.5}$ concentrations due to the Project's emissions should be estimated using the Environmental Benefits Mapping and Analysis Program (BenMAP), Community Edition v1.5 (March 2019).[39] BenMAP, originally developed by the 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)[40]:

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

- Air Quality Change: The difference between the starting air pollution concentration level (the Base Case) and the air pollution concentration level after some change, such as a new source (e.g., emissions from a proposed CEQA Project in the Project Case).
- 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. As noted below, we recommend the use of 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.[41] As new census data is collected USEPA updates the BenMAP tool.
- 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 background incidence rates used here are obtained from BenMAP. Age-, cause-, and county-specific mortality rates are calculated by BenMAP using data from the Centers for Disease Control (CDC) WONDER database[42]. Hospitalization rates and emergency room visits were calculated using data from the Healthcare Cost and Utilization Project (HCUP). The relationship between short-term PM exposure and heart attacks was determined using epidemiological studies.

A.4.1 Application of BenMAP

The PGM output data are processed to generate aggregated daily average $PM_{2.5}$ and MDA8 ozone concentrations appropriate for various health endpoints as described above. The PGM concentrations for a Base Case (i.e., without the Project emissions) and a Project Case (i.e., the Base Case plus the contributions of the Project emissions) are used as inputs to BenMAP that internally takes the

[39] http://www.epa.gov/air/benmap/

[40] 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

[41] https://www.epa.gov/benmap/benmap-community-edition

[42] http://wonder.cdc.gov

difference between the Base and Project Cases in order to obtain the incremental ozone and PM contributions due to the Project. The PGM 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 provides multiple C-R functions based on different epidemiological studies for a given health endpoint. We recommend using the USEPA default C-R functions that they use in national rulemakings when evaluating health effects. We also recommend using more refined population data that uses population data from PopGrid, which allocates the census population to each modeled 4x4 kilometer (km) grid cell (e.g., **Figure A-1**).

The population used for both the quantified health effects and the calculation of background health incidence presented here is usually calculated for a future year that has maximum Project emissions.[43]

Although there are a large number of potential health endpoints that could be included in the analysis, we recommend using the key health endpoints that have been the focus of recent 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 $PM_{2.5}$ health endpoints and associated C-R functions that we recommend for use in this BenMAP analysis are presented in **Table A-2**. 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.

The increases in the BenMAP-estimated health effect incidences and percent of background health incidence due to the Project emissions should be presented for each health endpoint in **Table A-2.** These values reflect the total health effects across the modeling domain (e.g., CCOS domain in **Figure A-1** or reduced 4-km Sacramento domain in **Figure B-1**). Reporting the percent increase in each of the health effect endpoints across the Northern California domain puts the incremental increase in health effects due to the Project emissions in context.

[43] 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 A-2. Summary of Recommended $PM_{2.5}$ Health Endpoints

Health Endpoint	Age Range[2]	Daily Metric	Seasonal Metric	Annual Metric	C-R Function Selected[1]
Emergency Room Visits, Asthma	0-99	24-hr mean			Mar et al., 2010
Mortality, All Cause	30-99	24-hr mean	Quarterly mean	Mean	Krewski et al., 2009
Hospital Admissions, Asthma	0-64	24-hr mean	-	-	Sheppard, 2003
Hospital Admissions, All Cardiovascular (excluding Myocardial Infarctions)	65-99	24-hr mean	-	-	Bell, 2012
Hospital Admissions, All Respiratory	65-99	24-hr mean	-	-	Zanobetti et al., 2009
Acute Myocardial Infarction, Nonfatal	18-24	24-hr mean	-	-	Zanobetti et al., 2009
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 (AAI, 2018)
[2] Other age ranges are available, but the studies shown here are the ones used by the EPA in their health assessments. The age ranges are consistent with each epidemiological study conducted for each study.

As noted above, although a larger number of health endpoints could be evaluated, we recommend selecting the ozone health endpoints based on recent USEPA risk assessments (USEPA, 2010; USEPA, 2014). The health endpoints and associated C-R functions for ozone are presented in **Table A-3.** Each ozone 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 should be presented for each health endpoint. These values should reflect the total health effects across the modeling domain.

Table A-3. Summary of Recommended Ozone Health Endpoints

Health Endpoint	Age Range[3]	Daily Metric[2]	Seasonal Metric	Annual Metric	C-R Function Selected[1]
Hospital Admissions, All Respiratory	65 - 99	MDA8	-	-	Katsouyanni et al., 2009
Mortality, Non-Accidental	0 - 99	MDA8	-	-	Smith et al., 2009
Emergency Room Visits, Asthma	0 - 17	MDA8	-	-	Mar and Koenig, 2009
Emergency Room Visits, Asthma	18 - 99	MDA8	-	-	Mar and Koenig, 2009

1. C-R function available in BenMAP (AAI, 2018)
2. MDA8 = Maximum Daily Average 8-hour ozone concentration
3. Other age ranges are available, but the studies shown here are the ones used by the EPA in their health assessments. The age ranges are consistent with each epidemiological study conducted for each study.

The uncertainties in the CEQA Project health effects analysis should be discussed along with assumptions made to ensure that the analysis is conservative (i.e., tending toward overstating the Project's health effects). Many of these uncertainties are discussed below.

Due to the uncertainties in the health effects analysis, the CEQA Friant Ranch health effects analysis approach and methodology should be conducted in a fashion to ensure that the uncertainty is of a conservative nature. In addition to the conservative assumptions that should be built into the emissions noted above (e.g., using maximum 24-hour emissions and year with maximum emissions), 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 in many Projects a large portion of primary PM emissions are from entrained roadway dust and not from combustion.

For both the $PM_{2.5}$ and ozone health effects calculated, each of the pollutants may be a confounder of the other. Thus, while the C-R functions are from studies that evaluated the effects for each pollutant individually, both air pollutants could contribute to the health effect outcomes evaluated, and thus the overall impacts may be overstated.

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 health effects. In summary, health effects presented using the procedures in this guidance are conservatively estimated, and the actual effects may be zero.

A.4.2 Documentation of Results

The results of the human health effects assessment should be documented in a brief technical report in plain English that clearly describes how the Project's emissions of air pollutants are correlated to human health effects. The report should include sufficient detail to enable those who are skilled in the art (and who did not participate in its preparation) to understand the procedures and to consider meaningfully the issues the proposed Project raises.

The technical reports should include the following sections: Introduction, Technical Approach and Results. The technical report should include details on how the PGM was selected, and the source of the database used in its operation. It should include details on the emissions used in the PGM as well as a rationale including information on the geographical distribution of emissions within the modeling domain. This is particularly important if offsite traffic comprises a significant part of the emissions. The technical report should include details on the speciation of emissions, and how the individual emissions were allocated among various source groups. The technical report should include details on how the PGM was operated as well as the important technical choices made. While not recommended unless there is amble evidence to justify it, the user may have some rationale for using C-R responses different from the defaults found in BenMAP. Should those be used, the technical report should contain the justification for departure from default C-R responses, as well as details on the C-R responses that were used. The technical report should also contain information on uncertainties in the various steps of the process.

The report should put the health effects into context by comparing them to background rates in the population at large by expressing them as a percent of the background health effects. This comparison

can be done using data from the BenMAP model. For perspective, previous evaluations of large developments have shown that the estimated increases in those health effect incidences are fairly minor compared to the background values.

The report should also note that the health effects estimation using BenMAP presumes that effects seen at large concentration differences can be linearly scaled down to small increases in concentration. Accordingly, the report should note that the health effects are conservatively estimated.

A.5 REFERENCES

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U.S. Environmental Protection Agency (USEPA). "Health Risk and Exposure Assessment for Ozone Final Report." Risk and Benefits Group, Health and Environmental Impacts Division, Office of Air Quality Planning and Standards, EPA-452/R-14-004a, 2014.

APPENDIX B
SCREENING LEVEL HEATH EFFECTS ANALYSIS

B.1 INTRODUCTION

A screening analysis using PGM and BenMAP modeling of hypothetical Projects within the Sac Metro Air District and adjacent regions was conducted. The screening level health effects analysis was conducted by first identifying locations where potential new Projects may be located within the 5-air districts of the Sacramento Federal Nonattainment Area (SFNA): Sacramento, Placer, El Dorado, Feather River and Yolo Solano.

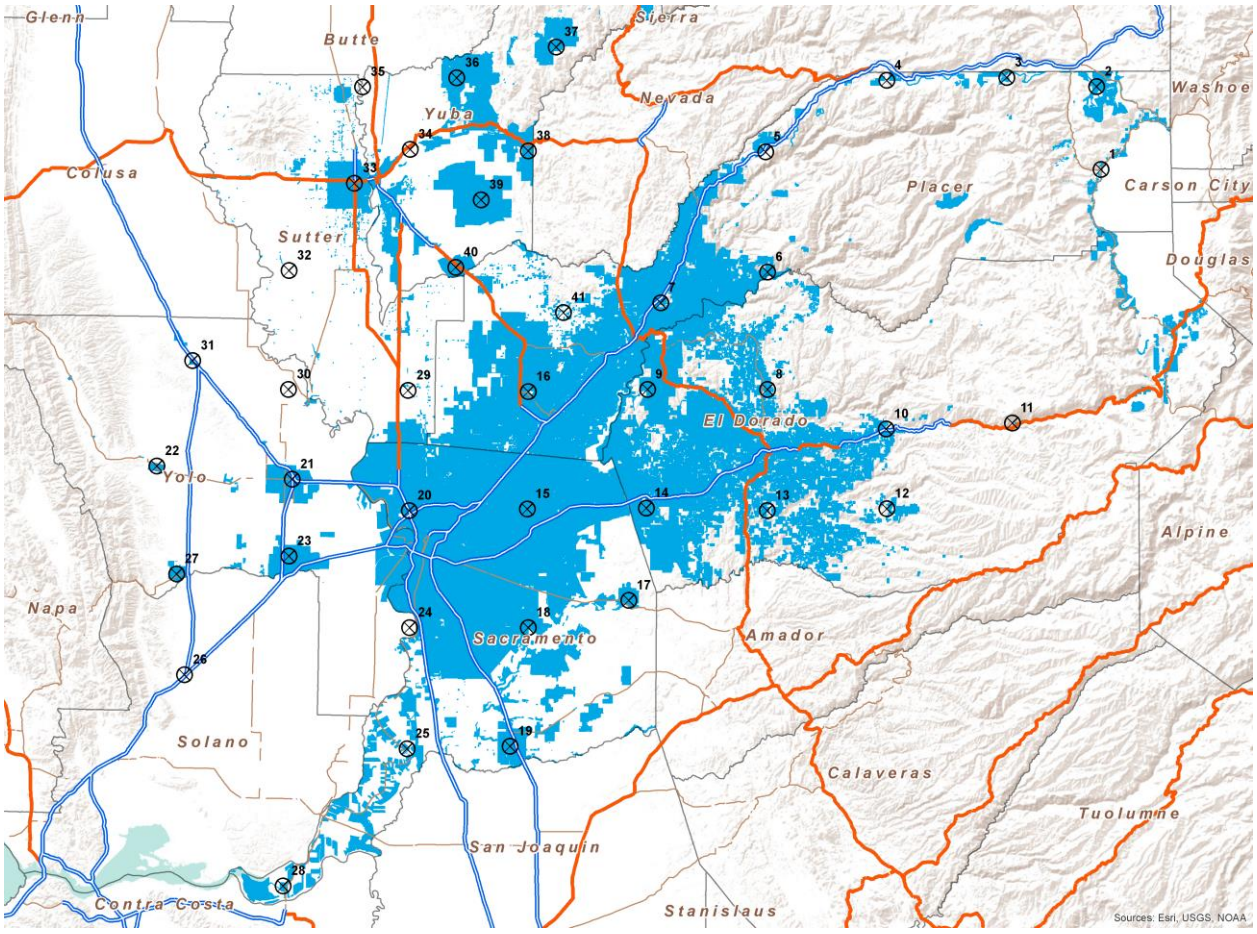
Using the methods described in **Appendix A**, emissions equal to the maximum CEQA Thresholds of Significance were assumed to occur in 41 representative Project locations. The PGM modeling results were then put into BenMAP in order to estimate the health effects that may result from development in each of these locations. The resulting screening level health effects for each of the 41 hypothetical project locations were generated. In addition, Ramboll developed an interactive Minor Project Health Effects Screening Tool in an Excel spreadsheet that allows the user to input a specific proposed Project location and the resultant health effects for a Project at the TOS emission rates are interpolated from the 41 representative Project locations to the point of the proposed Project location. This tool is further described in this section.

B.2 HYPOTHETICAL PROJECT DEFINITIONS

B.2.1 Hypothetical Project Locations

The potential Project locations for the screening level health effects analysis were determined by overlaying the 2050 Sacramento Area Council of Governments estimate of potential Project development in the 7-county region on the 4-km gridded domain area, as shown in the blue shaded area in **Figure B-1**. We then selected a sufficient number of hypothetical Project locations to represent the different meteorological and transport conditions across the region, but not so many that the computational burden of the air quality model simulation became prohibitive. Based on this information, 41 hypothetical Project source locations were chosen, which are also shown in **Figure B-1**. Each hypothetical Project site represents a source of precursor emissions for $PM_{2.5}$ and ozone.

Figure B-1 Potential CEQA Project locations (blue shading) in the 7-county region along with locations of the 41 hypothetical project sources used in the screening modeling.



B.2.2 Emissions for Each Hypothetical Project Source

The screening methodology is intended to provide preparers of environmental documentation a conservative estimate of health effects for Projects at any location within the SFNA that has emissions at or below the significance thresholds for all pollutants. Each of the five air districts within the SFNA have their own Thresholds of Significance for emissions of air pollutants, as shown in **Table B-1**. The highest Threshold of Significance for any district within the SFNA is 82 lbs./day each for NO_X, ROG, $PM_{2.5}$ and PM_{10}. Therefore, 82 lbs./day each of NO_X, ROG and $PM_{2.5}$ was chosen as the emission rate for each of these hypothetical Project sources. Although SO_2 and CO aren't pollutants with Thresholds of Significance levels in the five air districts that comprise the SFNA, they are often associated with Projects and they do impact ozone and secondary particulate formation.

In order to characterize the appropriate emissions of SO_2 and CO, the emissions inventory for six Projects from Sacramento County were reviewed and compared to the emissions of NOx. Based on the ratios of the emissions of SO_2 to NOx and CO, to NOx, the relative SO_2 and CO emissions rates for a project where its NOx emissions were at the Threshold of Significance were calculated to be 0.98 lbs./day and 262 lbs./day, respectively. These emissions rates are therefore representative of SO_2 and CO emissions from residential and commercial Projects relative to the emissions of NO_X at the Threshold of Significance levels of 82 lbs./day. This calculation is further discussed in **Appendix D**.

The health effects from any Project with emissions below the Thresholds of Significance will be lower than the health effects presented in this screening analysis.

Table B-1. Thresholds of Significance

Pollutants in lbs./day (with some exceptions, noted)				
Air District	**NOX**	**ROG**	**PM10**	**PM2.5**
Sacramento	65	65	80	**82**
Placer	55	55	**82**	Not established
El Dorado	**82**	**82**	Cause or contribute to an exceedance of ambient air quality standards (AAQS)	Cause or contribute to an exceedance of ambient air quality standards (AAQS)
Feather River	25	25	80	Not established
Yolo Solano	55[a]	55[a]	80	Not established

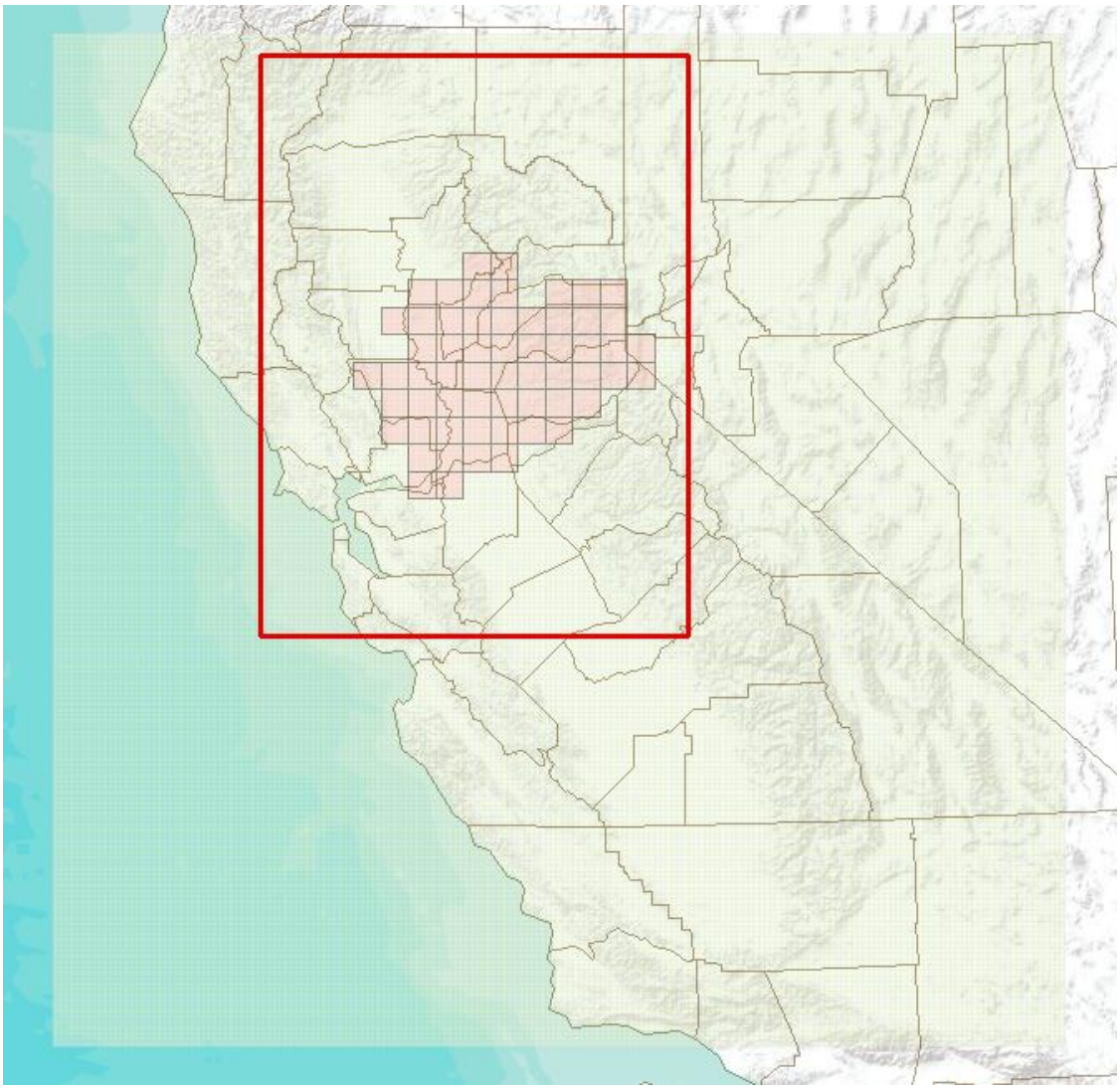
[a.] 55 lbs./day is equivalent to 10 tons/year adopted threshold
[b.] **Red** indicates the highest emission rate among the five districts

B.3 PGM SCREENING MODELING

B.3.1 Reduced 4-km Modeling Domain

The 2012 BAAQMD modeling platform for the CCOS domain shown in **Figure A-1** was adapted for the health effects screening analysis. The CCOS domain covers large portions of northern California and western Nevada where we would expect there would be no significant health effects due to a CEQA Project within the 7-county area. Thus, we reduced the size of the CCOS domain to the red domain embedded in the CCOS domain shown in **Figure B-2**. The boundary conditions for the smaller 4-km domain in **Figure B-2** were based on a CAMx simulation of the larger CCOS domain (**Figure A-1**). As QA for the new 2012 Sacramento reduced modeling domain database, we performed a CAMx base case simulation using the reduced domain and found that it produced essentially the same ozone and PM results as the CAMx full CCOS domain simulation.

Figure B-2. Sac Metro Air District CAMx 4-km domain (red) used in the screening analysis embedded in the 4-km CCOS domain.



B.3.2 Emissions used in the Screening Analysis

The 2035 anthropogenic emissions for the reduced 4-km modeling domain **(Figure B-2)** were obtained by projecting the BAAQMD 2012 anthropogenic emissions to 2035 using the ARB CEPAM[44] emission projections.

As discussed in **Section B.1.2**, each of the 41 hypothetical Projects were assumed to have NO_X, ROG and $PM_{2.5}$ emissions of 82 lbs./day with SO_2 and CO emissions of 0.98 lbs./day 262 lbs./day, respectively. The hypothetical project ROG (also known as VOC) emissions were speciated into the VOC species used in the SAPRC07 chemical mechanism used by CAMx using speciation profiles based on the typical mix of sources types in a CEQA Project as described in **Appendix D**. The emissions

[44] https://www.arb.ca.gov/app/emsinv/fcemssumcat/fcemssumcat2016.php

were assumed to be released near the surface (i.e., in layer 1), which is also typical for CEQA Projects in the region.

B.3.3 PGM Modeling

The CAMx PGM was used to simulate the incremental ozone and PM concentrations due to emissions from each of the 41 hypothetical Project sources. Emissions from each of the 41 hypothetical sources were separately tagged for treatment by the CAMx APCA/PSAT ozone/PM source apportionment tools. The CAMx standard and source apportionment output was processed to generate Base Case concentrations that consisted of CAMx standard model output minus the contributions of all 41 hypothetical sources. Then, the contributions of each individual hypothetical Project were separately added to the Base Case for each Project Case. The Base Case and Project Case outputs gridded daily concentrations of 24-hour average $PM_{2.5}$ and MDA8 ozone were then used in the health effects modeling.

B.4 HEALTH EFFECTS MODELING

B.4.1 BenMAP Simulator

EPA's BenMAP air pollution health effects tool is a Windows based program with the flexibility of using several alternative Concentration-Response (C-R) functions. The application of BenMAP for the 41 hypothetical projects would be quite time consuming. Thus, a Python-based BenMAP simulator was developed that could efficiently estimate the health effect impacts of the 41 hypothetical projects using the CAMx source apportionment modeling results. The specific default C-R functions identified in **Appendix A** (**Tables A-2** and **A-3**) were implemented in the Python-based BenMAP simulator.

The Python-based BenMAP simulator was run for the 41 hypothetical project locations shown in **Figure B-1** using the CAMx Base Case and Project Case modeling results. We then ran BenMAP using the CAMx 2035 annual source apportionment modeling results for hypothetical project number 20, which is near the City of Sacramento so represents one of the hypothetical sources with relatively higher health effects compared to others. **Tables B-2** and **B-3** display the resultant $PM_{2.5}$ and ozone health effects from running the EPA BenMAP and Python-based BenMAP simulator on the CAMx source apportionment modeling results for hypothetical source number 20. To the three significant digits to, the results are identical. Because the Python-based simulator uses higher precision than BenMAP, the results are not identical when looking out to more significant decimal places. For example, to five significant digits the premature mortality due to PM for hypothetical project number 20 is 2.2900 per year using BenMAP and 2.2866 per year using the Python-based BenMAP simulator. These less than 0.15% differences do not change any aspects of the health effects assessment. Tables like **B-2** and **B-3** for hypothetical source 20 are generated for each one of the 41 hypothetical sources are provided in **Appendix F** and include both the BenMAP-estimated incremental health effects estimate due to the Project's emissions, and the percent increase over the background health effects. For example, for hypothetical source number 20 the increase of 2.29 premature mortalities per year due to increased PM concentrations due to the Project's emissions represents a 0.00124% increase over the background value; thus, this is a very small increase.

Table B-2. Health effects for hypothetical Project number 20 produced by EPA's BenMAP program.

BenMAP			
Run with PopGrid populations - Source 20			
$PM_{2.5}$ Health Endpoint	**Age Range***	**Incidences**	**Percent of Background Health Incidence****
		(Mean)	**(%)**
Emergency Room Visits, Asthma	0 - 99	1.4563	0.0018
Mortality, All Cause	30 - 99	2.2900	0.0012
Hospital Admissions, Asthma	0 - 64	0.0971	0.0011
Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	0.1857	0.0002
Hospital Admissions, All Respiratory	65 - 99	0.3370	0.0004
Acute Myocardial Infarction, Nonfatal	18 - 24	0.0001	0.0008
Acute Myocardial Infarction, Nonfatal	25 - 44	0.0123	0.0011
Acute Myocardial Infarction, Nonfatal	45 - 54	0.0249	0.0009
Acute Myocardial Infarction, Nonfatal	55 - 64	0.0398	0.0008
Acute Myocardial Infarction, Nonfatal	65 - 99	0.1192	0.0006
Ozone Health Endpoint	**Age Range**	**Incidences**	**Percent of Background Incidence**
		(Mean)	**(%)**
Hospital Admissions, All Respiratory	65 - 99	0.0852	0.0001
Mortality, Non-Accidental	0 - 99	0.0528	0.0000
Emergency Room Visits, Asthma	0 - 17	0.4607	0.0019
Emergency Room Visits, Asthma	18 - 99	0.7244	0.0013

* Other age ranges are available, but the studies shown here are the ones used by the EPA in their health assessments. The age ranges are consistent with each epidemiological study conducted for each study.

** The percent of background health incidence uses the mean incidence. The background health incidence is an estimate of the average number of people that are affected by the health endpoint in a given population over a given period of time. In this case, these background incidence rates cover the modeled domain. Health incidence rates and other health data are typically collected by the government as well as the World Health Organization. The background incidence rates used here are obtained from BenMAP.

Table B-3. Health effects for hypothetical Project number 20 produced by the Python-based BenMAP simulator.

BenMAP-Python			
Run with PopGrid populations - Source 20			
$PM_{2.5}$ Health Endpoint	**Age Range***	**Incidences**	**Percent of Background Incidence****
		(Mean)	**(%)**
Emergency Room Visits, Asthma	0 - 99	1.4567	0.0018
Mortality, All Cause	30 - 99	2.2866	0.0012
Hospital Admissions, Asthma	0 - 64	0.0971	0.0011
Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	0.1857	0.0002
Hospital Admissions, All Respiratory	65 - 99	0.3370	0.0004
Acute Myocardial Infarction, Nonfatal	18 - 24	0.0001	0.0008
Acute Myocardial Infarction, Nonfatal	25 - 44	0.0123	0.0011
Acute Myocardial Infarction, Nonfatal	45 - 54	0.0249	0.0009
Acute Myocardial Infarction, Nonfatal	55 - 64	0.0398	0.0008
Acute Myocardial Infarction, Nonfatal	65 - 99	0.1192	0.0006
Ozone Health Endpoint	**Age Range**	**Incidences**	**Percent of Background Incidence**
		(Mean)	**(%)**
Hospital Admissions, All Respiratory	65 - 99	0.0852	0.0001
Mortality, Non-Accidental	0 - 99	0.0528	0.0000
Emergency Room Visits, Asthma	0 - 17	0.4607	0.0019
Emergency Room Visits, Asthma	18 - 99	0.7244	0.0013

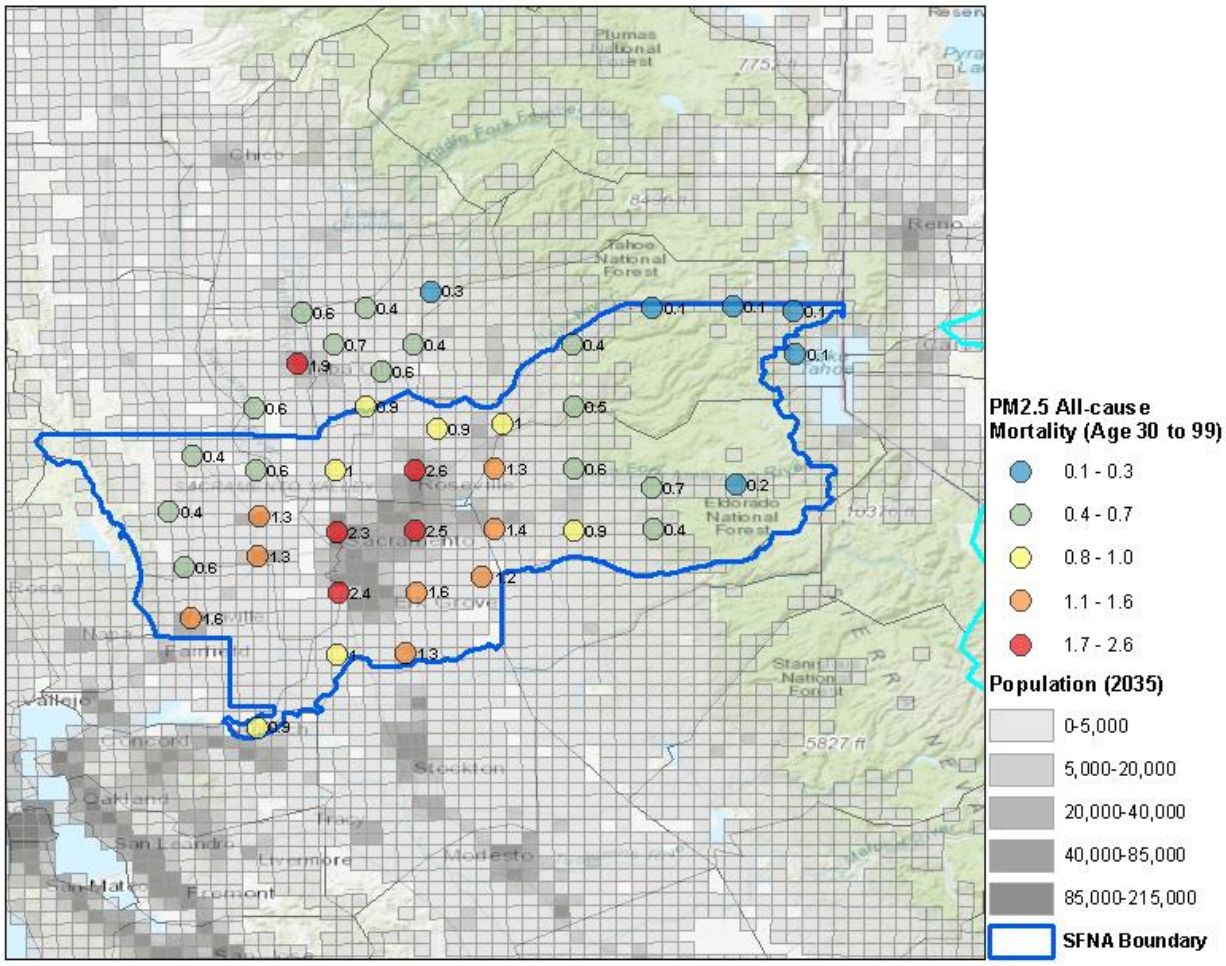
* Other age ranges are available, but the studies shown here are the ones used by the EPA in their health assessments. The age ranges are consistent with each epidemiological study conducted for each study.

** The percent of background health incidence uses the mean incidence. The background health incidence is an estimate of the average number of people that are affected by the health endpoint in a given population over a given period of time. In this case, these background incidence rates cover the modeled domain. Health incidence rates and other health data are typically collected by the government as well as the World Health Organization. The background incidence rates used here are obtained from BenMAP.

B.4.2 Screening Modeling Health Effects Results

The health effects due to a change in $PM_{2.5}$ and ozone concentrations resulting from emissions from each of the 41 hypothetical Project sources were generated in tables similar to **Table B-3** that are provided in **Appendix F**. **Figure B-3** displays the total PM mortality health effects results in a spatial map for all 41 hypothetical Projects. Even though all 41 hypothetical projects have the same emissions, their health effects can vary by over an order of magnitude (i.e., from 0.1 to 2.6). Atmospheric chemistry and dispersion can play a role in the differences in a hypothetical source's concentrations and resulting health effects in different locations, the primary difference in a hypothetical Project's health effects is related to the source's proximity to population centers. For example, those hypothetical sources located in the city of Sacramento have higher health effects than those in the Sierra Nevada mountains.

Figure B-3. Hypothetical Project PM mortality health effects superimposed on population density with SFNA boundary outline.



B.4.3 Minor Project Health Effects Screening Tool

A simple screening health effects spreadsheet tool was developed by interpolating the health effects from the 41 hypothetical source locations to each 4-km grid in the Sac Metro Air District and adjacent regions. The spatial interpolation was performed using python's SciPy implementation of the radial basis function interpolation.[45] Multiple basis functions were tested, but the linear function was selected because it provides higher values for the interpolated health effects and therefore was considered more conservative for the purposes of the screening tool implementation. The user can input the Latitude/Longitude location of their proposed Project and the spreadsheet will generate a table of health effects corresponding to the Threshold of Significance hypothetical source emissions rate.

[45] https://docs.scipy.org/doc/scipy/reference/generated/scipy.interpolate.Rbf.html

APPENDIX C
STRATEGIC AREA PROJECT HEATH EFFECTS ANALYSIS

C.1 STRATEGIC AREA HEALTH EFFECTS RESULTS

This Appendix describes the Friant Ranch strategic area health effects screening modeling analysis for potential projects in the Sac Metro Air District and neighboring districts.

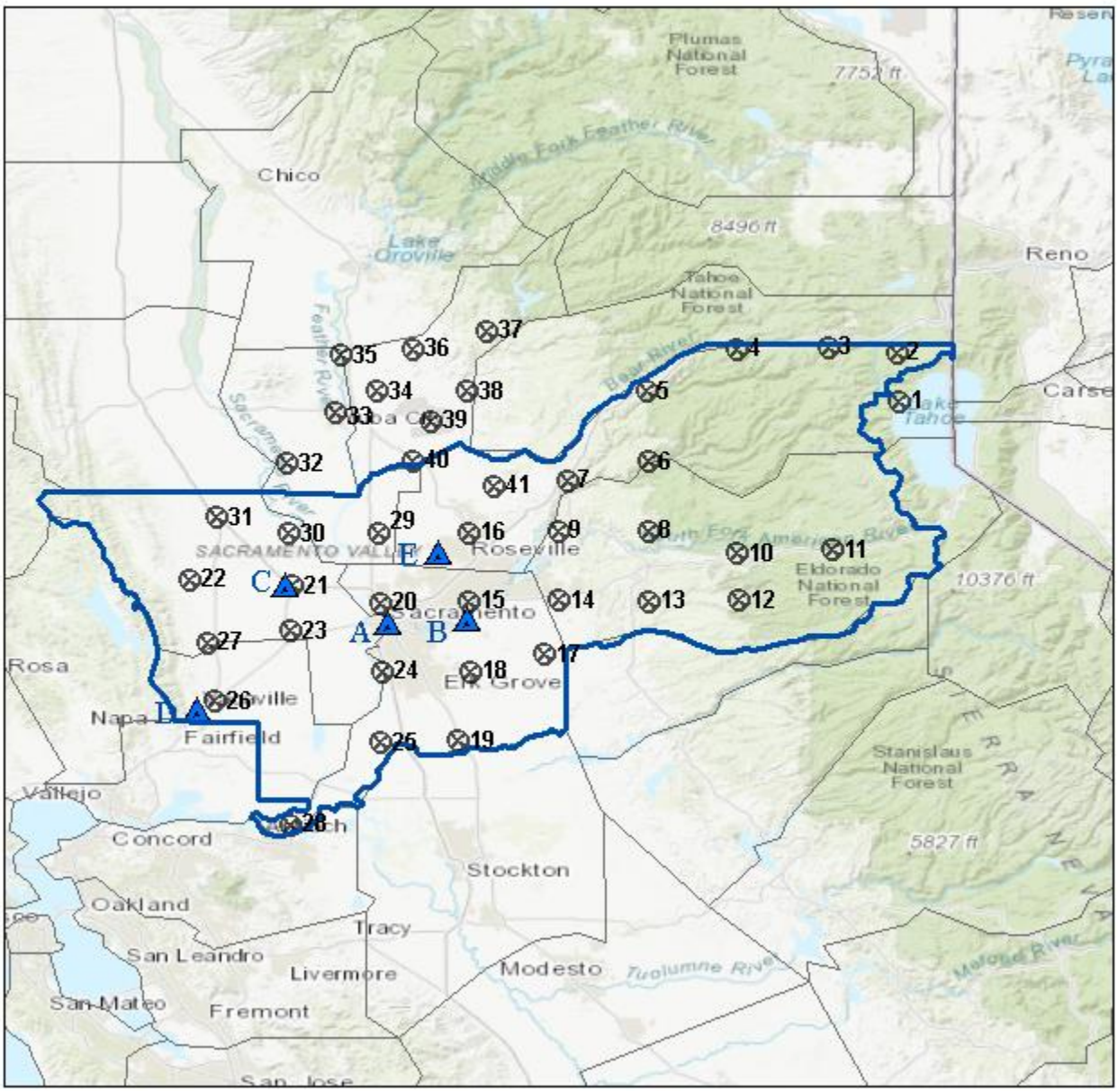
C.1.1 Strategic Area Project Screening Modeling

The Sac Metro Air District provided five locations for potential Projects that represent the general strategic areas Projects exceeding Thresholds of Significance levels would be expected to occur for the health effects screening modeling. The five potential locations are listed in Table C-1 and shown in Figure C-1.

Table C-1. Coordinates for 5 hypothetical strategic area projects.

ID	Name	Latitude	Longitude	Location
A	Sacramento	38.579336	-121.494119	10th Street & K Street
B	Rancho Cordova	38.588080	-121.286765	Zinfandel Drive & White Rock Road
C	Woodland	38.677388	-121.765759	Main Street & East Street
D	Vacaville	38.347954	-121.998058	Merchant Street & Lincoln Highway
E	West Roseville	38.765833	-121.359299	Fiddyment Road & Pleasant Grove Boulevard

Figure C-1. Locations of five Projects A-E used in the strategic area screening modeling, along with the 41 hypothetical Projects used in the minor Project analysis and boundary of the SFNA.



The Project screening modeling was run at each of the five locations at two levels of emissions, corresponding to two times (2x) and 8 times (8x) the maximum Threshold of Significance (TOS) level, which is 82 lbs./day for NO_X, ROG, $PM_{2.5}$ and PM_{10} (see Table 1). The five Projects also included CO and SO_2 emissions using the same approach as used for the 41 hypothetical minor Project analysis (see Appendices B and D). The ROG and PM emissions for the 5 Projects were also speciated following the same approach as the hypothetical minor Project modeling (see **Appendix D**). Table C-2 displays the Project emissions for the two levels of emissions used. Two levels of emissions were modeled in

the Project screening modeling to account for non-linear effects of ozone and secondary PM formation as a function of NO_X, ROG, SO_2 and CO emissions.

Table C-2. Emissions levels used for modeling strategic area Projects at the five locations that are 2 and 8 times the maximum Threshold of Significance (TOS).

Pollutant	Emissions (lbs./day)	
	2xTOS	8xTOS
NO_X	164	656
$PM_{2.5}$	164	656
ROG	164	656
SO_2	1.96	7.84
CO	524	2096

The ultimate goal of the strategic area screening analysis is to develop an interactive spreadsheet where the user selects one of the five Project locations, inputs the Project total NO_X, $PM_{2.5}$ and VOC emissions, the spreadsheet internally interpolates the health effects from the CAMx/BenMAP modeling for each pollutant, and outputs a health effect summary table. If a user inputs any emissions value above the maximum emissions analyzed (see 8xTOS values in Table C-2), then the spreadsheet will output an error message. If the user inputs emissions below the minimum emissions analyzed (see 2xTOS values in Table C-2), then the spreadsheet output the health effects corresponding to the 2xTOS scenario as a conservative estimate of the health effects.

Two annual CAMx ozone and PM source apportionment model simulations were conducted for the 2012 calendar year using 2035 future year anthropogenic emissions: (1) five strategic area Projects at 2xTOS emissions; and (2) five strategic area Projects at 8xTOS emissions. Emissions from each of the five Projects were tagged for treatment by the CAMx ozone (APCA) and PM (PSAT) source apportionment tool.

The CAMx source apportionment ozone and $PM_{2.5}$ contributions of each of the five Projects at the two levels of emissions were input into BenMAP to obtain health effects, whose results are shown in **Appendix G**. BenMAP was run separately to obtain the ozone and $PM_{2.5}$ health effects from the Project NO_X, ROG and PM emissions. For ozone, the following species mappings were used to attribute ozone (O_3) health effects to NO_X, ROG and PM precursor emissions.

- Ozone(NO_X) = O3N (ozone formed under NOX-limited conditions)
- Ozone(ROG) = O3V (ozone formed under VOC/ROG-limited conditions)
- Ozone(PM) = 0.0

For particulate matter, the following species mappings were used to attribute $PM_{2.5}$ health effects to NO_X, ROG and PM emissions:

- $PM_{2.5}$(NOX) = Nitrate (NO3) + Ammonium (NH4) + Sulfate (SO4)

- $PM_{2.5}$(ROG) = 0.0
- $PM_{2.5}$(PM) = Elemental Carbon (EC) + Primary Organic Aerosol (POA) + Other Fine Particulate (FPRM) + Fine Crustal Particulate (FCRS)

Note that the $PM_{2.5}$ associated with SO_4 is assigned to the Project NO_X precursor emissions because the Project SO_2 emissions were derived as a ratio to the NO_X emissions (see **Appendix D**). Particulate sulfate is expected to be a small component as the SO_2 emissions in the five Projects are only 1.2% of the NO_X emissions (see Table C-2).

The BenMAP results of the five strategic area Project screening modeling at two emissions levels are provided in **Appendix G**.

C.1.2 Strategic Area Project Health Effects Screening Tool

The strategic area Project screening modeling health effects were used to develop a Strategic Area Projects Health Effects Screening Tool, which is spreadsheet that can be used to estimate health effects for potential strategic area Projects with emissions below the 8xTOS level. The Strategic Area Project Health Effects Screening Tool has two interactive components that need to be defined by the user:

1. Project Location: The user selects one of the 5 strategic area project locations (see Table C-1 and Figure C-1) from a dropdown menu and the spreadsheet will use the strategic area Project health effects screening modeling results for that location.
2. Project Emissions: The user inputs the NO_X, ROG and $PM_{2.5}$ emissions in pounds/day for their potential strategic area Project and the tool will linearly interpolate the ozone and PM health effects for the selected Project location from the 2xTOS and 8xTOS CAMx/BenMAP modeling.

Note that if the user inputs NO_X, ROG or PM emissions below the 2xTOS emissions rate, then the health effects for the 2xTOS emissions level is used to provide a conservative estimate of health effects. The assumption of linear interpolation of the ozone and PM health effects between the 2xTOS and 8xTOS CAMx/BenMAP modeling results could potentially introduce uncertainties if the linear assumption is invalid. The health effects Concentration-Response (C-R) functions used in BenMAP are linear in concentration so linear interpolation of the health effects is perfectly valid for the health effects modeling component of the CAMx/BenMAP strategic area Project screening modeling. However, the chemistry of ozone and secondary $PM_{2.5}$ formation is non-linear so the use of linear interpolation of the NO_X and ROG health effects could introduce uncertainties. Since we are analyzing very small changes in ozone and secondary $PM_{2.5}$ concentrations, the non-linear terms are negligible and small changes in the non-linear models can be correctly analyzed as linear, consistent with Taylor's theorem. Furthermore, because we are interpolating between the 2xTOS and 8xTOS modeling scenarios (rather than extrapolating from one scenario) any non-linear effects are bounded.

APPENDIX D
CHARACTERIZATION OF SO_2 AND CO EMISSIONS AND ROG CHEMICAL SPECIATION FOR TYPICAL PROJECT EMISSIONS

D.1 ESTIMATE OF HYPOTHETICAL PROJECT SO_2 AND CO EMISSIONS

To characterize the approximate SO_2 and CO emissions that may result from emissions at the significance thresholds for $PM_{2.5}$, NO_X and VOCs, we analyzed six historical Projects from Sacramento County. The Projects were chosen as they represented a diversity of sources and weren't dependent on a specific type of source.

To conduct the analysis, the Sac Metro Air District provided criteria pollutant emissions inventory information for the six Projects. The information was for the years spanning 2013-2018, and therefore reflected close to current practices and emissions profiles. he emissions inventories were created using CalEEMod to be consistent with past and future Projects occurring within the Sac Metro Air District.

Descriptions of these Projects can be found in **Table D-1**. Descriptions are from the project description section of the development's CEQA document which does not always match the CalEEMod land use inputs also shown in **Table D-1**.

Table D-1. Projects used to estimate the SO_2 and CO emissions ratios

Development	CEQA Project Document Descriptions	CalEEMod Inputs
Newbridge	• 1,095 acre mixed-use development • 3,135 Residential Units • 190,000 sq. ft. Commercial space, 180,000 sq. ft. Office space, 59.6 acres Recreational space, 9.4 acres Educational space	• 297.5 acres modeled • 880 Single Family Homes, 280 unit Low Rise Apartment • 120,000 sq. ft. Regional Shopping Center, 100 acre City Park, 1,000 student Elementary School
Panhandle	• 490 acre area to be annexed into Sacramento • 2,550 Residential Units and associated infrastructure	• Approx. 483 acres modeled • 2,660 Single Family Homes • 500 student Elementary School, 2800 student Junior High School, 57.8 acre City Park, 101,280 sq. ft. Regional Shopping Center
Richards Boulevard Office Complex	• 1.375 million GSF complex • Includes 1.225 million GSF workspace plus: lobbies, cafeterias, fitness center, auditorium, retail	• 1.437 million sq. ft. Government Office Building • 1,020 space Enclosed Parking with Elevator • 400 space Parking Lot
The Core	• 13 acre development • 300 unit luxury apartment complex with parking lot, utilities	• 11.7 acres modeled • 300 unit Mid Rise Apartment
Bilby Ridge	• Proposed annexation of 480 acre area • Description does not include a proposed new land use	• 17.57 acres modeled • 210,000 sq. ft. General Office Building, 110,000 sq. ft. Elementary School, 2.30 acre City Park, 345,000 sq. ft. Strip Mall
Cardoso	• 17.46 acre parcel of former agricultural land • 69 Single Family Homes to be built on 16.84 acres, remaining .62 acres for existing home	• 16.84 acres modeled • 69 Single Family Homes

Overall emissions from the projects are provided in **Table D-2**. The allocated emissions are shown in **Tables D-3a-e**. **Table D-3f** shows the average percentage of emissions for each pollutant for each source type. These tables show that the great majority of SO_2 and CO emissions are associated with mobile sources. Accordingly, we chose to estimate SO_2 and CO emissions from the ratio of mobile source NO_X emissions as mobile source emissions are also the great majority of NO_X emissions.

Table D-2. Total Emissions by Project

Development	Emissions (tons/yr.)				
	ROG	NOx	CO	SO2	PM2.5
Newbridge	38.73	14.09	92.93	0.24	4.50
Panhandle	29.20	25.07	84.31	0.18	5.88
Richards Boulevard Office Complex	8.50	10.63	32.38	0.12	3.18
The Core	2.20	3.39	12.16	0.03	0.68
Bilby Ridge	8.29	19.63	50.30	0.12	2.51
Cardoso	0.80	0.98	3.20	0.01	0.19

Table D-3a. ROG - Percent of Mitigated Operational Emissions Attributed to Each Category by Project

	Newbridge	Panhandle	Richards Blvd	The Core	Bilby Ridge	Cardoso
	Percentage of Operational Emissions (%)					
Architectural Coating	11.20	11.01	6.95	8.54	3.72	9.70
Consumer Products	64.78	70.43	66.46	53.30	31.34	60.55
Landscaping	1.36	4.11	0.04	4.27	0.01	2.70
Energy	0.47	0.11	0.85	0.72	0.41	1.20
Mobile	22.18	14.34	25.54	33.17	64.52	25.85
Stationary	0.00	0.00	0.16	0.00	0.00	0.00
Development Total (lbs./day)	212.21	160.01	46.57	12.04	45.43	4.39
Sac Metro Air District Significance Threshold (lbs./day)	65					

Table D-3b. NOx - Percent of Mitigated Operational Emissions Attributed to Each Category by Development

	Newbridge	Panhandle	Richards Blvd	The Core	Bilby Ridge	Cardoso
	Percentage of Operational Emissions (%)					
Architectural Coating	0.00	0.00	0.00	0.00	0.00	0.00
Consumer Products	0.00	0.00	0.00	0.00	0.00	0.00
Landscaping	1.43	1.84	0.00	1.06	0.00	0.84
Energy	11.20	1.16	6.21	3.98	1.58	8.35
Mobile	87.37	97.00	93.23	94.97	98.42	90.81
Stationary	0.00	0.00	0.56	0.00	0.00	0.00
Development Total (lbs./day)	77.20	137.39	58.23	18.57	107.57	5.39
Sac Metro Air District Significance Threshold (lbs./day)	65					

Table D-3c. CO - Percent of Mitigated Operational Emissions Attributed to Each Category by Development

	Newbridge	Panhandle	Richards Blvd	The Core	Bilby Ridge	Cardoso
	Percentage of Operational Emissions (%)					
Architectural Coating	0.00	0.00	0.00	0.00	0.00	0.00
Consumer Products	0.00	0.00	0.00	0.00	0.00	0.00
Landscaping	18.82	47.41	0.11	25.49	0.02	22.26
Energy	0.77	0.29	1.71	0.47	0.52	1.09
Mobile	80.41	52.30	98.07	74.04	99.46	76.64
Stationary	0.00	0.00	0.10	0.00	0.00	0.00
Development Total (lbs./day)	509.21	462.00	177.43	66.65	275.60	17.55
Sac Metro Air District Significance Threshold (lbs./day)	N/A					

Table D-3d. SO2 - Percent of Mitigated Operational Emissions Attributed to Each Category by Development

	Newbridge	Panhandle	Richards Blvd	The Core	Bilby Ridge	Cardoso
	Percentage of Operational Emissions (%)					
Architectural Coating	0.00	0.00	0.00	0.00	0.00	0.00
Consumer Products	0.00	0.00	0.00	0.00	0.00	0.00
Landscaping	0.39	1.18	0.00	0.56	0.00	0.47
Energy	4.19	0.97	3.22	2.98	1.59	6.07
Mobile	95.42	97.85	96.73	96.46	98.41	93.47
Stationary	0.00	0.00	0.05	0.00	0.00	0.00
Development Total (lbs./day)	1.31	0.99	0.67	0.16	0.64	0.05
Sac Metro Air District Significance Threshold (lbs./day)	N/A					

Table D-3e. PM2.5- Percent of Mitigated Operational Emissions Attributed to Each Category by Development

	Newbridge	Panhandle	Richards Blvd	The Core	Bilby Ridge	Cardoso
	Percentage of Operational Emissions (%)					
Architectural Coating (Total)	0.00	0.00	0.00	0.00	0.00	0.00
Consumer Products (Total)	0.00	0.00	0.00	0.00	0.00	0.00
Landscaping (Total)	2.15	3.78	0.00	2.50	0.00	2.12
Energy (Total)	2.83	0.38	1.58	1.59	0.94	3.58
Mobile (Fugitive)	90.26	94.29	95.73	92.51	93.47	90.92
Mobile (Exhaust)	4.76	1.55	2.63	3.40	5.59	3.38
Stationary (Total)	0.00	0.00	0.06	0.00	0.00	0.00
Development Total (lbs./day)	24.63	32.24	17.43	3.75	13.75	1.02
SMAQMD Significance Threshold (lbs./day)	82					

Table D-3f. Emissions summary for all pollutants for all projects with average percentages of emissions

	ROG			NOx			CO			SO2			PM2.5 Total		
	Avg	Min	Max	**Avg**	Min	Max	**Avg**	Min	Max	**Avg**	Min	Max	**Avg**	Min	Max
	%			%			%			%			%		
Architectural Coating	**8.52**	3.72	11.20	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Consumer Products	**57.81**	31.34	70.43	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Landscaping	**2.08**	0.01	4.27	**0.86**	0.00	1.84	**19.02**	0.02	47.41	**0.43**	0.00	1.18	**1.76**	0.00	3.78
Energy	**0.63**	0.11	1.20	**5.41**	1.16	11.20	**0.81**	0.29	1.71	**3.17**	0.97	6.07	**1.82**	0.38	3.58
Mobile (Total)	**30.93**	14.34	64.52	**93.63**	87.37	98.42	**80.15**	52.30	99.46	**96.39**	93.47	98.41	--	--	--
Mobile (Fugitive)	**--**	--	--	--	--	--	--	--	--	--	--	--	**92.86**	90.26	95.73
Mobile (Exhaust)	--	--	--	--	--	--	--	--	--	--	--	--	**3.55**	1.55	5.59
Stationary	**0.03**	0.00	0.16	**0.09**	0.00	0.56	**0.02**	0.00	0.10	**0.01**	0.00	0.05	**0.01**	0.00	0.06

The ratios of emissions of SO_2 and CO to NO_X is shown in **Table D-4**, below.

Table D-4. Ratio of CO/NOx and SO2/NOx

Source Category	Newbridge		Panhandle		Richards Boulevard		The Core		Bilby Ridge		Cardoso	
	CO/NOx	SO2/NOx	CO/NOx	SO2/NOx	CO/NOx	SO2/NOx	CO/NOx	SO2/NOx	CO/NOx	SO2/NOx	CO/NOx	SO2/NOx
	Unitless (ratio)											
Architectural Coating	--	--	--	--	--	--	--	--	--	--	--	--
Consumer Products	--	--	--	--	--	--	--	--	--	--	--	--
Landscaping	86.7711	0.0046	86.7080	0.0046	110.3030	0.0000	86.6061	0.0045	107.5000	0.0000	86.6464	0.0049
Energy	0.4515	0.0064	0.8400	0.0060	0.8400	0.0060	0.4251	0.0064	0.8401	0.0060	0.4263	0.0063
Mobile	6.0703	0.0185	1.8130	0.0072	3.2051	0.0120	2.7985	0.0086	2.5892	0.0059	2.7488	0.0090
Stationary	--	--	--	--	0.5702	0.0010	--	--	--	--	--	--
Total	6.5958	0.0170	3.3626	0.0072	3.0469	0.0116	3.5894	0.0085	2.5620	0.0059	3.2571	0.0087

The ratio of CO to NO_X for mobile sources varied from a high of 6.07 to a low of 1.81, with many clustered between 2.5 and 3.2. We chose a ratio of 3.2 to be conservative and decided on a default value of 3.2 times 82, or 262 lbs. CO/day. The ratio of SO_2 to NO_X varies for mobile sources from a high of 0.0185 to a low of 0.0059, with most between 0.072 to 0.0090. We chose the second highest value of 0.012 to be conservative and decided on a default value of 0.012 times 82, or 0.98 lbs. SO_2/day

D.2 CHEMICAL SPECIATION FOR HYPOTHETICAL PROJECT ROG AND PM EMISSIONS

In addition to specifying the hypothetical Project primary $PM_{2.5}$, PM_{10} and ROG emissions, they need to be chemically speciated into their individual components used in the CAMx chemical mechanism. Primary $PM_{2.5}$ and PM_{10} are chemically inert and the Concentration-Response (C-R) functions selected for use in the BenMAP health effects model only uses the total $PM_{2.5}$ mass concentrations and doesn't differentiate health effects across different PM species (e.g., elemental carbon, organic aerosol and other fine particulate). Thus, it doesn't matter how the hypothetical Project PM emissions are speciated so all the hypothetical project $PM_{2.5}$ emissions were speciated as the CAMx fine particulate matter (FPRM) species.

The speciation of the hypothetical Project ROG emissions, however, is important as the different ROG individual species in the SAPRC07 chemical mechanism used in the BAAQMD CAMx 2012 modeling database have different chemical reactivities and ozone formation potentials. The hypothetical Project ROG emissions are speciated into the SAPRC07 chemical mechanism using the SMOKE emissions model that allocates the ROG emissions to SAPRC07 species using chemical speciation profiles from EPA's SPECIATE database[46]. SMOKE cross-references SPECIATE chemical speciation profiles to a source emission types using SCCs. To determine the types of sources with ROG emissions for a typical CEQA Project in the Sac Metro Air District planning area, we examined the percent contribution of ROG emissions for the same six Projects discussed above that are shown in **Table D-3a**. Ignoring the Bilby Ridge Project that is an outlier for the six Projects, we found the following three source categories contributed 95-99% of the ROG emissions so we assumed the following ROG contributions for these three source categories, with the ranges across the five Projects in brackets and the SCCs in parenthesis:

- Consumer Products (2460000000) = 65% [53% - 70%]
- Mobile Sources (220110111B) = 25% [14% - 33%]
- Architectural Coatings (241001000) = 10% [7% - 11%]

The SMOKE emissions model was used with SCC codes listed above to chemically speciate the hypothetical project ROG emissions into the SAPRC07 chemical species.

[46] https://www.epa.gov/air-emissions-modeling/speciate

APPENDIX E
SAMPLE SCC CODES TYPICALLY USED IN CEQA PROJECTS

E.1 APPENDIX E

Table E-1. Example SCCs frequently used to characterize CEQA Project emission source types

Emission Source	SCC	SCC Description
Architectural Coatings	2401001000	Solvent Utilization; Surface Coating; Architectural Coatings; Total: All Solvent Types
Construction Off-road Equipment	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 (Stationary Engines)	20200102	Internal Combustion Engines; Industrial; Distillate Oil (Diesel);Reciprocating
Energy (Natural Gas)	2102006000	Stationary Source Fuel Combustion; Industrial; Natural Gas; Total: Boilers and IC Engines
Marine Vessels (Ferries)	2280002010	Mobile Sources; Marine Vessels, Commercial; Diesel; Ocean-going Vessels
Mobile	220100111B	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Vehicles (LDGV);Rural[47] Interstate: Brake Wear
Mobile	220100111R	Mobile Sources; Highway Vehicles - Gasoline; Light Duty Gasoline Vehicles (LDGV); Rural Interstate: Resting Loss

[47] 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 E-1. Example SCCs frequently used to characterize CEQA Project emission source types

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	2201070110	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV);Rural Interstate: Total
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
Mobile	2201070130	Mobile Sources; Highway Vehicles - Gasoline; Heavy Duty Gasoline Vehicles 2B thru 8B & Buses (HDGV); Rural Other Principal Arterial: Total

Table E-1. Example SCCs frequently used to characterize CEQA Project emission source types

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

Table E-1. Example SCCs frequently used to characterize CEQA Project emission source types

Emission Source	SCC	SCC Description
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: 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
Mobile	223007513T	Mobile Sources; Highway Vehicles - Diesel; Heavy Duty Diesel Buses (School & Transit); Rural Other Principal Arterial: Tire Wear

Table E-1. Example SCCs frequently used to characterize CEQA Project emission source types

Emission Source	SCC	SCC Description
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
Waste Water Treatment Plant	2630010000	Waste Disposal, Treatment, and Recovery; Wastewater Treatment; Industrial; Total Processed

APPENDIX F
BENMAP HEALTH EFFECTS RESULTS FOR THE 41 HYPOTHETICAL SOURCES USED IN THE MINOR PROJECTS

Appendix F: BenMAP Health Effects Results for the 41 Hypothetical Sources used in the Minor Project Screening Modeling in Appendix B

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
1	PM2.5	Emergency Room Visits, Asthma	0 - 99	3.01E-02	3.80E-05
1	PM2.5	Mortality, All Cause	30 - 99	1.10E-01	5.95E-05
1	PM2.5	Hospital Admissions, Asthma	0 - 64	2.04E-03	2.30E-05
1	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	6.65E-03	6.33E-06
1	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.77E-02	1.96E-05
1	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	3.01E-06	1.73E-05
1	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	2.18E-04	1.95E-05
1	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	4.43E-04	1.54E-05
1	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	8.35E-04	1.73E-05
1	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	3.57E-03	1.75E-05
1	O3	Hospital Admissions, All Respiratory	65 - 99	9.91E-03	1.10E-05
1	O3	Mortality, Non-Accidental	0 - 99	5.63E-03	4.58E-06
1	O3	Emergency Room Visits, Asthma	0 - 17	2.84E-02	1.18E-04
1	O3	Emergency Room Visits, Asthma	18 - 99	5.38E-02	9.73E-05
2	PM2.5	Emergency Room Visits, Asthma	0 - 99	5.41E-02	6.83E-05
2	PM2.5	Mortality, All Cause	30 - 99	1.22E-01	6.62E-05
2	PM2.5	Hospital Admissions, Asthma	0 - 64	3.10E-03	3.50E-05
2	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	7.56E-03	7.19E-06
2	PM2.5	Hospital Admissions, All Respiratory	65 - 99	2.06E-02	2.28E-05
2	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	5.04E-06	2.91E-05
2	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	3.33E-04	2.97E-05
2	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	5.67E-04	1.98E-05
2	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	8.40E-04	1.74E-05
2	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	3.81E-03	1.87E-05
2	O3	Hospital Admissions, All Respiratory	65 - 99	1.07E-02	1.18E-05
2	O3	Mortality, Non-Accidental	0 - 99	5.90E-03	4.80E-06
2	O3	Emergency Room Visits, Asthma	0 - 17	3.53E-02	1.47E-04

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
2	O3	Emergency Room Visits, Asthma	18 - 99	6.37E-02	1.15E-04
3	PM2.5	Emergency Room Visits, Asthma	0 - 99	3.55E-02	4.47E-05
3	PM2.5	Mortality, All Cause	30 - 99	1.01E-01	5.49E-05
3	PM2.5	Hospital Admissions, Asthma	0 - 64	2.27E-03	2.56E-05
3	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	6.53E-03	6.21E-06
3	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.74E-02	1.93E-05
3	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	3.14E-06	1.81E-05
3	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	2.31E-04	2.06E-05
3	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	4.44E-04	1.55E-05
3	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	6.97E-04	1.44E-05
3	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	3.33E-03	1.64E-05
3	O3	Hospital Admissions, All Respiratory	65 - 99	9.96E-03	1.10E-05
3	O3	Mortality, Non-Accidental	0 - 99	5.51E-03	4.48E-06
3	O3	Emergency Room Visits, Asthma	0 - 17	3.26E-02	1.36E-04
3	O3	Emergency Room Visits, Asthma	18 - 99	5.86E-02	1.06E-04
4	PM2.5	Emergency Room Visits, Asthma	0 - 99	3.15E-02	3.97E-05
4	PM2.5	Mortality, All Cause	30 - 99	1.00E-01	5.43E-05
4	PM2.5	Hospital Admissions, Asthma	0 - 64	1.93E-03	2.18E-05
4	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	7.08E-03	6.73E-06
4	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.79E-02	1.98E-05
4	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	2.77E-06	1.60E-05
4	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	1.94E-04	1.74E-05
4	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	4.53E-04	1.58E-05
4	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	7.37E-04	1.53E-05
4	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	3.78E-03	1.86E-05
4	O3	Hospital Admissions, All Respiratory	65 - 99	9.85E-03	1.09E-05
4	O3	Mortality, Non-Accidental	0 - 99	5.43E-03	4.42E-06
4	O3	Emergency Room Visits, Asthma	0 - 17	3.36E-02	1.40E-04
4	O3	Emergency Room Visits, Asthma	18 - 99	5.82E-02	1.05E-04

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
5	PM2.5	Emergency Room Visits, Asthma	0 - 99	9.43E-02	1.19E-04
5	PM2.5	Mortality, All Cause	30 - 99	3.59E-01	1.95E-04
5	PM2.5	Hospital Admissions, Asthma	0 - 64	4.93E-03	5.57E-05
5	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	2.39E-02	2.27E-05
5	PM2.5	Hospital Admissions, All Respiratory	65 - 99	6.10E-02	6.75E-05
5	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	7.99E-06	4.60E-05
5	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	4.94E-04	4.41E-05
5	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	1.24E-03	4.33E-05
5	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	2.16E-03	4.49E-05
5	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	1.26E-02	6.18E-05
5	O3	Hospital Admissions, All Respiratory	65 - 99	1.84E-02	2.04E-05
5	O3	Mortality, Non-Accidental	0 - 99	1.03E-02	8.41E-06
5	O3	Emergency Room Visits, Asthma	0 - 17	6.22E-02	2.59E-04
5	O3	Emergency Room Visits, Asthma	18 - 99	1.07E-01	1.94E-04
6	PM2.5	Emergency Room Visits, Asthma	0 - 99	1.12E-01	1.42E-04
6	PM2.5	Mortality, All Cause	30 - 99	4.76E-01	2.59E-04
6	PM2.5	Hospital Admissions, Asthma	0 - 64	6.24E-03	7.05E-05
6	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	2.93E-02	2.79E-05
6	PM2.5	Hospital Admissions, All Respiratory	65 - 99	7.41E-02	8.20E-05
6	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	1.07E-05	6.18E-05
6	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	6.41E-04	5.72E-05
6	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	1.67E-03	5.80E-05
6	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	2.83E-03	5.87E-05
6	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	1.56E-02	7.68E-05
6	O3	Hospital Admissions, All Respiratory	65 - 99	2.27E-02	2.51E-05
6	O3	Mortality, Non-Accidental	0 - 99	1.31E-02	1.07E-05
6	O3	Emergency Room Visits, Asthma	0 - 17	7.54E-02	3.14E-04
6	O3	Emergency Room Visits, Asthma	18 - 99	1.30E-01	2.36E-04
7	PM2.5	Emergency Room Visits, Asthma	0 - 99	1.98E-01	2.50E-04
7	PM2.5	Mortality, All Cause	30 - 99	9.85E-01	5.35E-04

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
7	PM2.5	Hospital Admissions, Asthma	0 - 64	1.06E-02	1.20E-04
7	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	5.76E-02	5.48E-05
7	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.47E-01	1.63E-04
7	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	1.92E-05	1.11E-04
7	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	1.10E-03	9.80E-05
7	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	2.83E-03	9.86E-05
7	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	5.19E-03	1.08E-04
7	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	3.04E-02	1.49E-04
7	O3	Hospital Admissions, All Respiratory	65 - 99	3.72E-02	4.11E-05
7	O3	Mortality, Non-Accidental	0 - 99	2.20E-02	1.79E-05
7	O3	Emergency Room Visits, Asthma	0 - 17	1.07E-01	4.44E-04
7	O3	Emergency Room Visits, Asthma	18 - 99	1.93E-01	3.49E-04
8	PM2.5	Emergency Room Visits, Asthma	0 - 99	1.35E-01	1.71E-04
8	PM2.5	Mortality, All Cause	30 - 99	5.72E-01	3.11E-04
8	PM2.5	Hospital Admissions, Asthma	0 - 64	7.89E-03	8.92E-05
8	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	3.47E-02	3.30E-05
8	PM2.5	Hospital Admissions, All Respiratory	65 - 99	8.63E-02	9.55E-05
8	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	1.29E-05	7.43E-05
8	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	8.57E-04	7.65E-05
8	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	1.95E-03	6.79E-05
8	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	3.29E-03	6.81E-05
8	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	1.83E-02	8.99E-05
8	O3	Hospital Admissions, All Respiratory	65 - 99	2.68E-02	2.97E-05
8	O3	Mortality, Non-Accidental	0 - 99	1.60E-02	1.31E-05
8	O3	Emergency Room Visits, Asthma	0 - 17	8.34E-02	3.47E-04
8	O3	Emergency Room Visits, Asthma	18 - 99	1.45E-01	2.63E-04
9	PM2.5	Emergency Room Visits, Asthma	0 - 99	2.94E-01	3.70E-04
9	PM2.5	Mortality, All Cause	30 - 99	1.26E+00	6.86E-04
9	PM2.5	Hospital Admissions, Asthma	0 - 64	1.64E-02	1.86E-04

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
9	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	7.51E-02	7.14E-05
9	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.85E-01	2.05E-04
9	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	2.90E-05	1.67E-04
9	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	1.84E-03	1.64E-04
9	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	4.33E-03	1.51E-04
9	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	7.33E-03	1.52E-04
9	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	4.05E-02	1.99E-04
9	O3	Hospital Admissions, All Respiratory	65 - 99	4.81E-02	5.32E-05
9	O3	Mortality, Non-Accidental	0 - 99	2.97E-02	2.41E-05
9	O3	Emergency Room Visits, Asthma	0 - 17	1.28E-01	5.31E-04
9	O3	Emergency Room Visits, Asthma	18 - 99	2.34E-01	4.24E-04
10	PM2.5	Emergency Room Visits, Asthma	0 - 99	1.28E-01	1.61E-04
10	PM2.5	Mortality, All Cause	30 - 99	6.45E-01	3.50E-04
10	PM2.5	Hospital Admissions, Asthma	0 - 64	7.55E-03	8.53E-05
10	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	3.64E-02	3.46E-05
10	PM2.5	Hospital Admissions, All Respiratory	65 - 99	9.51E-02	1.05E-04
10	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	1.25E-05	7.20E-05
10	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	8.27E-04	7.38E-05
10	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	1.66E-03	5.79E-05
10	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	2.74E-03	5.68E-05
10	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	1.80E-02	8.83E-05
10	O3	Hospital Admissions, All Respiratory	65 - 99	1.94E-02	2.15E-05
10	O3	Mortality, Non-Accidental	0 - 99	1.15E-02	9.37E-06
10	O3	Emergency Room Visits, Asthma	0 - 17	6.20E-02	2.58E-04
10	O3	Emergency Room Visits, Asthma	18 - 99	1.08E-01	1.95E-04
11	PM2.5	Emergency Room Visits, Asthma	0 - 99	4.60E-02	5.80E-05
11	PM2.5	Mortality, All Cause	30 - 99	1.76E-01	9.56E-05
11	PM2.5	Hospital Admissions, Asthma	0 - 64	2.81E-03	3.18E-05
11	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.11E-02	1.06E-05

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
11	PM2.5	Hospital Admissions, All Respiratory	65 - 99	2.74E-02	3.03E-05
11	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	4.22E-06	2.43E-05
11	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	3.00E-04	2.68E-05
11	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	6.77E-04	2.36E-05
11	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	1.12E-03	2.33E-05
11	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	5.92E-03	2.91E-05
11	O3	Hospital Admissions, All Respiratory	65 - 99	1.20E-02	1.33E-05
11	O3	Mortality, Non-Accidental	0 - 99	6.99E-03	5.69E-06
11	O3	Emergency Room Visits, Asthma	0 - 17	3.82E-02	1.59E-04
11	O3	Emergency Room Visits, Asthma	18 - 99	6.69E-02	1.21E-04
12	PM2.5	Emergency Room Visits, Asthma	0 - 99	1.13E-01	1.42E-04
12	PM2.5	Mortality, All Cause	30 - 99	4.23E-01	2.30E-04
12	PM2.5	Hospital Admissions, Asthma	0 - 64	6.86E-03	7.75E-05
12	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	2.68E-02	2.55E-05
12	PM2.5	Hospital Admissions, All Respiratory	65 - 99	6.39E-02	7.08E-05
12	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	1.01E-05	5.81E-05
12	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	7.53E-04	6.72E-05
12	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	1.71E-03	5.96E-05
12	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	2.81E-03	5.83E-05
12	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	1.44E-02	7.08E-05
12	O3	Hospital Admissions, All Respiratory	65 - 99	1.94E-02	2.15E-05
12	O3	Mortality, Non-Accidental	0 - 99	1.16E-02	9.42E-06
12	O3	Emergency Room Visits, Asthma	0 - 17	6.42E-02	2.67E-04
12	O3	Emergency Room Visits, Asthma	18 - 99	1.10E-01	1.98E-04
13	PM2.5	Emergency Room Visits, Asthma	0 - 99	2.31E-01	2.92E-04
13	PM2.5	Mortality, All Cause	30 - 99	9.25E-01	5.02E-04
13	PM2.5	Hospital Admissions, Asthma	0 - 64	1.41E-02	1.59E-04
13	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	5.78E-02	5.49E-05
13	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.36E-01	1.51E-04
13	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	2.13E-05	1.22E-04

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
13	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	1.59E-03	1.42E-04
13	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	3.57E-03	1.24E-04
13	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	5.82E-03	1.21E-04
13	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	3.08E-02	1.51E-04
13	O3	Hospital Admissions, All Respiratory	65 - 99	3.88E-02	4.30E-05
13	O3	Mortality, Non-Accidental	0 - 99	2.46E-02	2.01E-05
13	O3	Emergency Room Visits, Asthma	0 - 17	1.02E-01	4.26E-04
13	O3	Emergency Room Visits, Asthma	18 - 99	1.86E-01	3.37E-04
14	PM2.5	Emergency Room Visits, Asthma	0 - 99	4.77E-01	6.02E-04
14	PM2.5	Mortality, All Cause	30 - 99	1.38E+00	7.48E-04
14	PM2.5	Hospital Admissions, Asthma	0 - 64	3.00E-02	3.39E-04
14	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	9.63E-02	9.16E-05
14	PM2.5	Hospital Admissions, All Respiratory	65 - 99	2.05E-01	2.27E-04
14	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	4.05E-05	2.33E-04
14	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	3.74E-03	3.34E-04
14	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	8.14E-03	2.84E-04
14	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	1.26E-02	2.60E-04
14	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	5.61E-02	2.76E-04
14	O3	Hospital Admissions, All Respiratory	65 - 99	5.29E-02	5.85E-05
14	O3	Mortality, Non-Accidental	0 - 99	3.33E-02	2.71E-05
14	O3	Emergency Room Visits, Asthma	0 - 17	1.53E-01	6.35E-04
14	O3	Emergency Room Visits, Asthma	18 - 99	2.74E-01	4.96E-04
15	PM2.5	Emergency Room Visits, Asthma	0 - 99	8.92E-01	1.12E-03
15	PM2.5	Mortality, All Cause	30 - 99	2.52E+00	1.37E-03
15	PM2.5	Hospital Admissions, Asthma	0 - 64	5.63E-02	6.36E-04
15	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	2.08E-01	1.98E-04
15	PM2.5	Hospital Admissions, All Respiratory	65 - 99	3.81E-01	4.22E-04
15	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	7.24E-05	4.17E-04
15	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	6.31E-03	5.63E-04
15	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	1.69E-02	5.88E-04

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
15	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	2.87E-02	5.96E-04
15	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	1.31E-01	6.41E-04
15	O3	Hospital Admissions, All Respiratory	65 - 99	8.99E-02	9.95E-05
15	O3	Mortality, Non-Accidental	0 - 99	5.73E-02	4.66E-05
15	O3	Emergency Room Visits, Asthma	0 - 17	3.32E-01	1.38E-03
15	O3	Emergency Room Visits, Asthma	18 - 99	5.85E-01	1.06E-03
16	PM2.5	Emergency Room Visits, Asthma	0 - 99	6.58E-01	8.30E-04
16	PM2.5	Mortality, All Cause	30 - 99	2.61E+00	1.42E-03
16	PM2.5	Hospital Admissions, Asthma	0 - 64	3.53E-02	3.99E-04
16	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.50E-01	1.43E-04
16	PM2.5	Hospital Admissions, All Respiratory	65 - 99	3.70E-01	4.10E-04
16	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	7.02E-05	4.05E-04
16	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	4.34E-03	3.87E-04
16	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	8.91E-03	3.10E-04
16	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	1.41E-02	2.93E-04
16	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	8.15E-02	4.01E-04
16	O3	Hospital Admissions, All Respiratory	65 - 99	8.04E-02	8.90E-05
16	O3	Mortality, Non-Accidental	0 - 99	5.12E-02	4.17E-05
16	O3	Emergency Room Visits, Asthma	0 - 17	2.26E-01	9.40E-04
16	O3	Emergency Room Visits, Asthma	18 - 99	4.05E-01	7.34E-04
17	PM2.5	Emergency Room Visits, Asthma	0 - 99	4.66E-01	5.87E-04
17	PM2.5	Mortality, All Cause	30 - 99	1.22E+00	6.60E-04
17	PM2.5	Hospital Admissions, Asthma	0 - 64	2.96E-02	3.34E-04
17	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.01E-01	9.57E-05
17	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.91E-01	2.12E-04
17	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	3.62E-05	2.09E-04
17	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	3.37E-03	3.00E-04
17	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	8.43E-03	2.94E-04
17	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	1.50E-02	3.12E-04
17	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	6.24E-02	3.07E-04

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
17	O3	Hospital Admissions, All Respiratory	65 - 99	4.86E-02	5.37E-05
17	O3	Mortality, Non-Accidental	0 - 99	3.04E-02	2.48E-05
17	O3	Emergency Room Visits, Asthma	0 - 17	1.69E-01	7.03E-04
17	O3	Emergency Room Visits, Asthma	18 - 99	2.90E-01	5.25E-04
18	PM2.5	Emergency Room Visits, Asthma	0 - 99	7.78E-01	9.81E-04
18	PM2.5	Mortality, All Cause	30 - 99	1.60E+00	8.67E-04
18	PM2.5	Hospital Admissions, Asthma	0 - 64	5.15E-02	5.82E-04
18	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.32E-01	1.26E-04
18	PM2.5	Hospital Admissions, All Respiratory	65 - 99	2.44E-01	2.71E-04
18	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	6.50E-05	3.75E-04
18	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	5.86E-03	5.23E-04
18	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	1.50E-02	5.24E-04
18	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	2.35E-02	4.86E-04
18	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	8.34E-02	4.10E-04
18	O3	Hospital Admissions, All Respiratory	65 - 99	5.29E-02	5.85E-05
18	O3	Mortality, Non-Accidental	0 - 99	3.28E-02	2.67E-05
18	O3	Emergency Room Visits, Asthma	0 - 17	2.28E-01	9.47E-04
18	O3	Emergency Room Visits, Asthma	18 - 99	3.72E-01	6.74E-04
19	PM2.5	Emergency Room Visits, Asthma	0 - 99	7.04E-01	8.88E-04
19	PM2.5	Mortality, All Cause	30 - 99	1.33E+00	7.21E-04
19	PM2.5	Hospital Admissions, Asthma	0 - 64	4.53E-02	5.12E-04
19	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.13E-01	1.08E-04
19	PM2.5	Hospital Admissions, All Respiratory	65 - 99	2.19E-01	2.42E-04
19	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	5.61E-05	3.23E-04
19	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	5.01E-03	4.47E-04
19	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	1.23E-02	4.29E-04
19	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	1.99E-02	4.12E-04
19	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	7.06E-02	3.47E-04
19	O3	Hospital Admissions, All Respiratory	65 - 99	3.55E-02	3.93E-05
19	O3	Mortality, Non-Accidental	0 - 99	2.06E-02	1.68E-05

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
19	O3	Emergency Room Visits, Asthma	0 - 17	1.82E-01	7.58E-04
19	O3	Emergency Room Visits, Asthma	18 - 99	2.68E-01	4.86E-04
20	PM2.5	Emergency Room Visits, Asthma	0 - 99	1.46E+00	1.84E-03
20	PM2.5	Mortality, All Cause	30 - 99	2.29E+00	1.24E-03
20	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	9.71E-02	1.10E-03
20	PM2.5	Hospital Admissions, Asthma	0 - 64	1.86E-01	1.77E-04
20	PM2.5	Hospital Admissions, All Respiratory	65 - 99	3.37E-01	3.73E-04
20	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	1.31E-04	7.56E-04
20	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	1.23E-02	1.09E-03
20	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	2.49E-02	8.68E-04
20	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	3.98E-02	8.25E-04
20	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	1.19E-01	5.86E-04
20	O3	Hospital Admissions, All Respiratory	65 - 99	8.52E-02	9.42E-05
20	O3	Mortality, Non-Accidental	0 - 99	5.28E-02	4.30E-05
20	O3	Emergency Room Visits, Asthma	0 - 17	4.61E-01	1.92E-03
20	O3	Emergency Room Visits, Asthma	18 - 99	7.24E-01	1.31E-03
21	PM2.5	Emergency Room Visits, Asthma	0 - 99	4.42E-01	5.57E-04
21	PM2.5	Mortality, All Cause	30 - 99	1.27E+00	6.89E-04
21	PM2.5	Hospital Admissions, Asthma	0 - 64	2.63E-02	2.97E-04
21	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	5.48E-02	5.21E-05
21	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.59E-01	1.76E-04
21	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	6.22E-05	3.59E-04
21	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	2.83E-03	2.53E-04
21	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	5.19E-03	1.81E-04
21	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	7.77E-03	1.61E-04
21	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	3.43E-02	1.69E-04
21	O3	Hospital Admissions, All Respiratory	65 - 99	5.45E-02	6.03E-05
21	O3	Mortality, Non-Accidental	0 - 99	3.38E-02	2.75E-05
21	O3	Emergency Room Visits, Asthma	0 - 17	2.80E-01	1.17E-03

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
21	O3	Emergency Room Visits, Asthma	18 - 99	4.39E-01	7.95E-04
22	PM2.5	Emergency Room Visits, Asthma	0 - 99	1.72E-01	2.17E-04
22	PM2.5	Mortality, All Cause	30 - 99	4.25E-01	2.30E-04
22	PM2.5	Hospital Admissions, Asthma	0 - 64	1.00E-02	1.14E-04
22	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	2.60E-02	2.47E-05
22	PM2.5	Hospital Admissions, All Respiratory	65 - 99	6.42E-02	7.11E-05
22	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	1.86E-05	1.07E-04
22	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	9.72E-04	8.67E-05
22	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	2.20E-03	7.65E-05
22	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	3.51E-03	7.27E-05
22	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	1.51E-02	7.41E-05
22	O3	Hospital Admissions, All Respiratory	65 - 99	4.21E-02	4.66E-05
22	O3	Mortality, Non-Accidental	0 - 99	2.44E-02	1.99E-05
22	O3	Emergency Room Visits, Asthma	0 - 17	2.06E-01	8.58E-04
22	O3	Emergency Room Visits, Asthma	18 - 99	3.36E-01	6.08E-04
23	PM2.5	Emergency Room Visits, Asthma	0 - 99	4.58E-01	5.78E-04
23	PM2.5	Mortality, All Cause	30 - 99	1.33E+00	7.20E-04
23	PM2.5	Hospital Admissions, Asthma	0 - 64	2.55E-02	2.89E-04
23	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	5.81E-02	5.53E-05
23	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.69E-01	1.87E-04
23	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	1.43E-04	8.22E-04
23	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	2.58E-03	2.30E-04
23	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	4.87E-03	1.70E-04
23	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	7.54E-03	1.56E-04
23	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	3.64E-02	1.79E-04
23	O3	Hospital Admissions, All Respiratory	65 - 99	5.98E-02	6.61E-05
23	O3	Mortality, Non-Accidental	0 - 99	3.73E-02	3.03E-05
23	O3	Emergency Room Visits, Asthma	0 - 17	3.06E-01	1.27E-03
23	O3	Emergency Room Visits, Asthma	18 - 99	4.87E-01	8.82E-04

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
24	PM2.5	Emergency Room Visits, Asthma	0 - 99	1.09E+00	1.37E-03
24	PM2.5	Mortality, All Cause	30 - 99	2.38E+00	1.29E-03
24	PM2.5	Hospital Admissions, Asthma	0 - 64	7.13E-02	8.06E-04
24	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.94E-01	1.85E-04
24	PM2.5	Hospital Admissions, All Respiratory	65 - 99	3.57E-01	3.95E-04
24	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	9.32E-05	5.37E-04
24	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	7.90E-03	7.05E-04
24	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	2.02E-02	7.05E-04
24	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	3.35E-02	6.94E-04
24	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	1.24E-01	6.09E-04
24	O3	Hospital Admissions, All Respiratory	65 - 99	9.10E-02	1.01E-04
24	O3	Mortality, Non-Accidental	0 - 99	5.68E-02	4.62E-05
24	O3	Emergency Room Visits, Asthma	0 - 17	5.11E-01	2.13E-03
24	O3	Emergency Room Visits, Asthma	18 - 99	7.88E-01	1.43E-03
25	PM2.5	Emergency Room Visits, Asthma	0 - 99	4.82E-01	6.07E-04
25	PM2.5	Mortality, All Cause	30 - 99	9.72E-01	5.28E-04
25	PM2.5	Hospital Admissions, Asthma	0 - 64	2.99E-02	3.38E-04
25	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	7.84E-02	7.45E-05
25	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.62E-01	1.80E-04
25	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	4.01E-05	2.31E-04
25	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	3.29E-03	2.93E-04
25	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	7.92E-03	2.76E-04
25	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	1.28E-02	2.66E-04
25	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	4.75E-02	2.34E-04
25	O3	Hospital Admissions, All Respiratory	65 - 99	4.78E-02	5.29E-05
25	O3	Mortality, Non-Accidental	0 - 99	2.68E-02	2.18E-05
25	O3	Emergency Room Visits, Asthma	0 - 17	2.54E-01	1.06E-03
25	O3	Emergency Room Visits, Asthma	18 - 99	3.77E-01	6.82E-04
26	PM2.5	Emergency Room Visits, Asthma	0 - 99	5.51E-01	6.95E-04
26	PM2.5	Mortality, All Cause	30 - 99	1.60E+00	8.71E-04

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
26	PM2.5	Hospital Admissions, Asthma	0 - 64	2.15E-02	2.43E-04
26	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.05E-01	1.00E-04
26	PM2.5	Hospital Admissions, All Respiratory	65 - 99	2.53E-01	2.80E-04
26	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	4.13E-05	2.38E-04
26	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	2.07E-03	1.85E-04
26	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	5.50E-03	1.91E-04
26	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	8.73E-03	1.81E-04
26	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	5.63E-02	2.77E-04
26	O3	Hospital Admissions, All Respiratory	65 - 99	6.61E-02	7.31E-05
26	O3	Mortality, Non-Accidental	0 - 99	4.00E-02	3.25E-05
26	O3	Emergency Room Visits, Asthma	0 - 17	3.26E-01	1.36E-03
26	O3	Emergency Room Visits, Asthma	18 - 99	5.39E-01	9.76E-04
27	PM2.5	Emergency Room Visits, Asthma	0 - 99	2.57E-01	3.24E-04
27	PM2.5	Mortality, All Cause	30 - 99	6.27E-01	3.41E-04
27	PM2.5	Hospital Admissions, Asthma	0 - 64	1.37E-02	1.54E-04
27	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	3.65E-02	3.47E-05
27	PM2.5	Hospital Admissions, All Respiratory	65 - 99	9.16E-02	1.01E-04
27	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	2.81E-05	1.62E-04
27	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	1.33E-03	1.19E-04
27	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	3.07E-03	1.07E-04
27	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	4.76E-03	9.86E-05
27	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	2.10E-02	1.03E-04
27	O3	Hospital Admissions, All Respiratory	65 - 99	5.24E-02	5.80E-05
27	O3	Mortality, Non-Accidental	0 - 99	3.13E-02	2.54E-05
27	O3	Emergency Room Visits, Asthma	0 - 17	2.61E-01	1.09E-03
27	O3	Emergency Room Visits, Asthma	18 - 99	4.29E-01	7.76E-04
28	PM2.5	Emergency Room Visits, Asthma	0 - 99	5.44E-01	6.87E-04
28	PM2.5	Mortality, All Cause	30 - 99	9.03E-01	4.90E-04
28	PM2.5	Hospital Admissions, Asthma	0 - 64	3.04E-02	3.44E-04

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
28	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	7.24E-02	6.89E-05
28	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.72E-01	1.90E-04
28	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	4.16E-05	2.40E-04
28	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	2.80E-03	2.50E-04
28	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	6.45E-03	2.25E-04
28	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	1.07E-02	2.22E-04
28	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	4.05E-02	1.99E-04
28	O3	Hospital Admissions, All Respiratory	65 - 99	4.34E-02	4.80E-05
28	O3	Mortality, Non-Accidental	0 - 99	2.14E-02	1.74E-05
28	O3	Emergency Room Visits, Asthma	0 - 17	2.64E-01	1.10E-03
28	O3	Emergency Room Visits, Asthma	18 - 99	3.79E-01	6.86E-04
29	PM2.5	Emergency Room Visits, Asthma	0 - 99	4.39E-01	5.54E-04
29	PM2.5	Mortality, All Cause	30 - 99	1.03E+00	5.59E-04
29	PM2.5	Hospital Admissions, Asthma	0 - 64	2.76E-02	3.12E-04
29	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	7.88E-02	7.50E-05
29	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.63E-01	1.80E-04
29	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	4.00E-05	2.30E-04
29	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	3.10E-03	2.77E-04
29	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	7.52E-03	2.62E-04
29	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	1.22E-02	2.52E-04
29	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	4.83E-02	2.37E-04
29	O3	Hospital Admissions, All Respiratory	65 - 99	8.76E-02	9.69E-05
29	O3	Mortality, Non-Accidental	0 - 99	5.30E-02	4.31E-05
29	O3	Emergency Room Visits, Asthma	0 - 17	3.72E-01	1.55E-03
29	O3	Emergency Room Visits, Asthma	18 - 99	6.06E-01	1.10E-03
30	PM2.5	Emergency Room Visits, Asthma	0 - 99	2.69E-01	3.39E-04
30	PM2.5	Mortality, All Cause	30 - 99	6.13E-01	3.33E-04
30	PM2.5	Hospital Admissions, Asthma	0 - 64	1.66E-02	1.88E-04
30	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	4.29E-02	4.08E-05

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
30	PM2.5	Hospital Admissions, All Respiratory	65 - 99	9.46E-02	1.05E-04
30	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	2.74E-05	1.58E-04
30	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	1.77E-03	1.58E-04
30	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	4.08E-03	1.42E-04
30	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	6.64E-03	1.38E-04
30	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	2.61E-02	1.28E-04
30	O3	Hospital Admissions, All Respiratory	65 - 99	5.13E-02	5.67E-05
30	O3	Mortality, Non-Accidental	0 - 99	3.13E-02	2.55E-05
30	O3	Emergency Room Visits, Asthma	0 - 17	2.62E-01	1.09E-03
30	O3	Emergency Room Visits, Asthma	18 - 99	4.14E-01	7.49E-04
31	PM2.5	Emergency Room Visits, Asthma	0 - 99	1.79E-01	2.25E-04
31	PM2.5	Mortality, All Cause	30 - 99	4.31E-01	2.34E-04
31	PM2.5	Hospital Admissions, Asthma	0 - 64	1.07E-02	1.21E-04
31	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	2.88E-02	2.74E-05
31	PM2.5	Hospital Admissions, All Respiratory	65 - 99	6.80E-02	7.53E-05
31	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	1.79E-05	1.03E-04
31	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	1.06E-03	9.44E-05
31	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	2.48E-03	8.65E-05
31	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	4.07E-03	8.43E-05
31	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	1.69E-02	8.33E-05
31	O3	Hospital Admissions, All Respiratory	65 - 99	3.95E-02	4.37E-05
31	O3	Mortality, Non-Accidental	0 - 99	2.31E-02	1.88E-05
31	O3	Emergency Room Visits, Asthma	0 - 17	1.95E-01	8.12E-04
31	O3	Emergency Room Visits, Asthma	18 - 99	3.12E-01	5.64E-04
32	PM2.5	Emergency Room Visits, Asthma	0 - 99	2.43E-01	3.07E-04
32	PM2.5	Mortality, All Cause	30 - 99	5.58E-01	3.03E-04
32	PM2.5	Hospital Admissions, Asthma	0 - 64	1.52E-02	1.71E-04
32	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	4.11E-02	3.91E-05
32	PM2.5	Hospital Admissions, All Respiratory	65 - 99	8.88E-02	9.82E-05
32	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	2.33E-05	1.34E-04

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
32	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	1.61E-03	1.44E-04
32	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	3.86E-03	1.34E-04
32	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	6.27E-03	1.30E-04
32	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	2.50E-02	1.23E-04
32	O3	Hospital Admissions, All Respiratory	65 - 99	5.02E-02	5.55E-05
32	O3	Mortality, Non-Accidental	0 - 99	2.97E-02	2.42E-05
32	O3	Emergency Room Visits, Asthma	0 - 17	2.38E-01	9.91E-04
32	O3	Emergency Room Visits, Asthma	18 - 99	3.84E-01	6.96E-04
33	PM2.5	Emergency Room Visits, Asthma	0 - 99	5.59E-01	7.05E-04
33	PM2.5	Mortality, All Cause	30 - 99	1.90E+00	1.03E-03
33	PM2.5	Hospital Admissions, Asthma	0 - 64	3.40E-02	3.85E-04
33	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.19E-01	1.13E-04
33	PM2.5	Hospital Admissions, All Respiratory	65 - 99	3.17E-01	3.50E-04
33	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	7.34E-05	4.23E-04
33	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	3.16E-03	2.82E-04
33	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	9.15E-03	3.19E-04
33	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	1.45E-02	3.01E-04
33	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	7.54E-02	3.71E-04
33	O3	Hospital Admissions, All Respiratory	65 - 99	6.42E-02	7.10E-05
33	O3	Mortality, Non-Accidental	0 - 99	3.22E-02	2.62E-05
33	O3	Emergency Room Visits, Asthma	0 - 17	2.22E-01	9.25E-04
33	O3	Emergency Room Visits, Asthma	18 - 99	3.79E-01	6.86E-04
34	PM2.5	Emergency Room Visits, Asthma	0 - 99	2.76E-01	3.48E-04
34	PM2.5	Mortality, All Cause	30 - 99	6.93E-01	3.76E-04
34	PM2.5	Hospital Admissions, Asthma	0 - 64	1.62E-02	1.83E-04
34	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	6.11E-02	5.81E-05
34	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.56E-01	1.73E-04
34	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	2.69E-05	1.55E-04
34	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	1.57E-03	1.40E-04
34	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	5.10E-03	1.78E-04

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
34	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	7.87E-03	1.63E-04
34	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	3.57E-02	1.75E-04
34	O3	Hospital Admissions, All Respiratory	65 - 99	6.01E-02	6.65E-05
34	O3	Mortality, Non-Accidental	0 - 99	2.88E-02	2.34E-05
34	O3	Emergency Room Visits, Asthma	0 - 17	1.86E-01	7.74E-04
34	O3	Emergency Room Visits, Asthma	18 - 99	3.21E-01	5.80E-04
35	PM2.5	Emergency Room Visits, Asthma	0 - 99	2.36E-01	2.98E-04
35	PM2.5	Mortality, All Cause	30 - 99	6.00E-01	3.26E-04
35	PM2.5	Hospital Admissions, Asthma	0 - 64	1.46E-02	1.65E-04
35	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	4.82E-02	4.58E-05
35	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.19E-01	1.31E-04
35	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	2.32E-05	1.33E-04
35	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	1.62E-03	1.44E-04
35	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	4.03E-03	1.41E-04
35	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	6.01E-03	1.25E-04
35	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	2.82E-02	1.38E-04
35	O3	Hospital Admissions, All Respiratory	65 - 99	6.09E-02	6.74E-05
35	O3	Mortality, Non-Accidental	0 - 99	2.84E-02	2.31E-05
35	O3	Emergency Room Visits, Asthma	0 - 17	2.02E-01	8.39E-04
35	O3	Emergency Room Visits, Asthma	18 - 99	3.40E-01	6.16E-04
36	PM2.5	Emergency Room Visits, Asthma	0 - 99	1.61E-01	2.03E-04
36	PM2.5	Mortality, All Cause	30 - 99	4.23E-01	2.30E-04
36	PM2.5	Hospital Admissions, Asthma	0 - 64	9.77E-03	1.10E-04
36	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	3.77E-02	3.59E-05
36	PM2.5	Hospital Admissions, All Respiratory	65 - 99	9.61E-02	1.06E-04
36	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	1.44E-05	8.32E-05
36	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	1.00E-03	8.95E-05
36	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	2.93E-03	1.02E-04
36	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	4.56E-03	9.46E-05
36	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	2.15E-02	1.06E-04

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
36	O3	Hospital Admissions, All Respiratory	65 - 99	4.81E-02	5.32E-05
36	O3	Mortality, Non-Accidental	0 - 99	2.29E-02	1.87E-05
36	O3	Emergency Room Visits, Asthma	0 - 17	1.40E-01	5.81E-04
36	O3	Emergency Room Visits, Asthma	18 - 99	2.46E-01	4.46E-04
37	PM2.5	Emergency Room Visits, Asthma	0 - 99	1.16E-01	1.46E-04
37	PM2.5	Mortality, All Cause	30 - 99	3.08E-01	1.67E-04
37	PM2.5	Hospital Admissions, Asthma	0 - 64	7.21E-03	8.14E-05
37	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	2.74E-02	2.61E-05
37	PM2.5	Hospital Admissions, All Respiratory	65 - 99	7.08E-02	7.84E-05
37	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	1.00E-05	5.78E-05
37	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	6.75E-04	6.02E-05
37	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	2.11E-03	7.35E-05
37	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	3.76E-03	7.79E-05
37	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	1.55E-02	7.61E-05
37	O3	Hospital Admissions, All Respiratory	65 - 99	3.29E-02	3.64E-05
37	O3	Mortality, Non-Accidental	0 - 99	1.65E-02	1.34E-05
37	O3	Emergency Room Visits, Asthma	0 - 17	1.04E-01	4.31E-04
37	O3	Emergency Room Visits, Asthma	18 - 99	1.81E-01	3.28E-04
38	PM2.5	Emergency Room Visits, Asthma	0 - 99	1.57E-01	1.97E-04
38	PM2.5	Mortality, All Cause	30 - 99	4.37E-01	2.37E-04
38	PM2.5	Hospital Admissions, Asthma	0 - 64	9.00E-03	1.02E-04
38	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	3.52E-02	3.35E-05
38	PM2.5	Hospital Admissions, All Respiratory	65 - 99	8.87E-02	9.82E-05
38	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	1.44E-05	8.28E-05
38	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	8.92E-04	7.96E-05
38	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	2.61E-03	9.08E-05
38	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	4.17E-03	8.65E-05
38	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	1.99E-02	9.77E-05
38	O3	Hospital Admissions, All Respiratory	65 - 99	4.94E-02	5.47E-05
38	O3	Mortality, Non-Accidental	0 - 99	2.62E-02	2.14E-05

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
38	O3	Emergency Room Visits, Asthma	0 - 17	1.38E-01	5.74E-04
38	O3	Emergency Room Visits, Asthma	18 - 99	2.49E-01	4.51E-04
39	PM2.5	Emergency Room Visits, Asthma	0 - 99	2.19E-01	2.77E-04
39	PM2.5	Mortality, All Cause	30 - 99	5.68E-01	3.08E-04
39	PM2.5	Hospital Admissions, Asthma	0 - 64	1.25E-02	1.42E-04
39	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	4.56E-02	4.34E-05
39	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.13E-01	1.26E-04
39	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	2.42E-05	1.39E-04
39	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	1.25E-03	1.11E-04
39	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	3.72E-03	1.30E-04
39	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	5.83E-03	1.21E-04
39	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	2.64E-02	1.30E-04
39	O3	Hospital Admissions, All Respiratory	65 - 99	5.25E-02	5.81E-05
39	O3	Mortality, Non-Accidental	0 - 99	2.84E-02	2.31E-05
39	O3	Emergency Room Visits, Asthma	0 - 17	1.57E-01	6.54E-04
39	O3	Emergency Room Visits, Asthma	18 - 99	2.78E-01	5.03E-04
40	PM2.5	Emergency Room Visits, Asthma	0 - 99	3.63E-01	4.57E-04
40	PM2.5	Mortality, All Cause	30 - 99	9.09E-01	4.94E-04
40	PM2.5	Hospital Admissions, Asthma	0 - 64	2.04E-02	2.31E-04
40	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	8.14E-02	7.75E-05
40	PM2.5	Hospital Admissions, All Respiratory	65 - 99	2.07E-01	2.29E-04
40	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	3.34E-05	1.93E-04
40	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	1.98E-03	1.77E-04
40	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	6.84E-03	2.38E-04
40	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	1.03E-02	2.13E-04
40	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	4.72E-02	2.32E-04
40	O3	Hospital Admissions, All Respiratory	65 - 99	6.78E-02	7.50E-05
40	O3	Mortality, Non-Accidental	0 - 99	3.68E-02	3.00E-05
40	O3	Emergency Room Visits, Asthma	0 - 17	2.09E-01	8.70E-04

Source	Pollutant	Health Endpoint	Age Range[1]	Incidences (per year)[2] (Mean)	Percent of Background Health Incidence[3] (%)
40	O3	Emergency Room Visits, Asthma	18 - 99	3.64E-01	6.59E-04
41	PM2.5	Emergency Room Visits, Asthma	0 - 99	2.42E-01	3.05E-04
41	PM2.5	Mortality, All Cause	30 - 99	9.07E-01	4.92E-04
41	PM2.5	Hospital Admissions, Asthma	0 - 64	1.37E-02	1.55E-04
41	PM2.5	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	5.85E-02	5.57E-05
41	PM2.5	Hospital Admissions, All Respiratory	65 - 99	1.42E-01	1.57E-04
41	PM2.5	Acute Myocardial Infarction, Nonfatal	18 - 24	2.32E-05	1.34E-04
41	PM2.5	Acute Myocardial Infarction, Nonfatal	25 - 44	1.48E-03	1.32E-04
41	PM2.5	Acute Myocardial Infarction, Nonfatal	45 - 54	3.72E-03	1.30E-04
41	PM2.5	Acute Myocardial Infarction, Nonfatal	55 - 64	6.30E-03	1.31E-04
41	PM2.5	Acute Myocardial Infarction, Nonfatal	65 - 99	3.24E-02	1.59E-04
41	O3	Hospital Admissions, All Respiratory	65 - 99	6.34E-02	7.01E-05
41	O3	Mortality, Non-Accidental	0 - 99	3.89E-02	3.16E-05
41	O3	Emergency Room Visits, Asthma	0 - 17	1.62E-01	6.73E-04
41	O3	Emergency Room Visits, Asthma	18 - 99	3.00E-01	5.43E-04

1. Affected age ranges are shown . Other age ranges are available, but the endpoints and age ranges shown here are the ones used by the USEPA in their health assessments. The age ranges are consistent with the epidemiological study that is the basis of the health function.
2. 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 Sacramento reduced 4-km model domain.
3. The percent of background health incidence uses the mean incidence. The background health incidence is an estimate of the average number of people that are affected by the health endpoint in a given population over a given period of time. In this case, these background incidence rates cover the modeled domain. Health incidence rates and other health data are typically collected by the government as well as the World Health Organization. The background incidence rates used here are obtained from BenMAP.

APPENDIX G
BENMAP HEALTH EFFECTS RESULTS FOR FIVE STRATEGIC AREA PROJECTS

Appendix G: BenMAP Health Effects Results for the 5 Sources used in the Strategic Area Project Screening Modeling in Appendix C where BenMAP was run separately to get Ozone (O3) and PM2.5 (PM25) Health Effects for the Three Major Precursors (NOx, VOC and PM) Emissions at the Higher 8xTOS (high_8x) and Lower 2xTOS (low_2x) Emission Rates.

Five Strategic Area Project Identifications and Locations				
ID	**Name**	**Latitude**	**Longitude**	**Location**
A	Sacramento	38.579336	-121.494119	10th Street & K Street
B	Rancho Cordova	38.588080	-121.286765	Zinfandel Drive & White Rock Road
C	Woodland	38.677388	-121.765759	Main Street & East Street
D	Vacaville	38.347954	-121.998058	Merchant Street & Lincoln Highway
E	West Roseville	38.765833	-121.359299	Fiddyment Road & Pleasant Grove Boulevard

Strategic area Src	Emissions	Species-Precursor	Health Endpoint	Age Range[1]	Incidences per year[2] (Mean)	Percent of Background Health Incidence[3] (%)
A	high_8x	O3-NOx	Hospital Admissions, All Respiratory	65 - 99	4.88E-01	5.40E-04
A	high_8x	O3-NOx	Mortality, Non-Accidental	0 - 99	3.02E-01	2.46E-04
A	high_8x	O3-NOx	Emergency Room Visits, Asthma	18 - 99	3.90E+00	7.07E-03
A	high_8x	O3-NOx	Emergency Room Visits, Asthma	0 - 17	2.42E+00	1.01E-02
B	high_8x	O3-NOx	Hospital Admissions, All Respiratory	65 - 99	5.52E-01	6.11E-04
B	high_8x	O3-NOx	Mortality, Non-Accidental	0 - 99	3.49E-01	2.84E-04
B	high_8x	O3-NOx	Emergency Room Visits, Asthma	18 - 99	3.64E+00	6.59E-03
B	high_8x	O3-NOx	Emergency Room Visits, Asthma	0 - 17	2.12E+00	8.81E-03
C	high_8x	O3-NOx	Hospital Admissions, All Respiratory	65 - 99	3.79E-01	4.19E-04
C	high_8x	O3-NOx	Mortality, Non-Accidental	0 - 99	2.33E-01	1.90E-04
C	high_8x	O3-NOx	Emergency Room Visits, Asthma	18 - 99	3.04E+00	5.50E-03
C	high_8x	O3-NOx	Emergency Room Visits, Asthma	0 - 17	1.94E+00	8.06E-03
D	high_8x	O3-NOx	Hospital Admissions, All Respiratory	65 - 99	4.71E-01	5.22E-04
D	high_8x	O3-NOx	Mortality, Non-Accidental	0 - 99	2.86E-01	2.33E-04
D	high_8x	O3-NOx	Emergency Room Visits, Asthma	18 - 99	4.04E+00	7.32E-03
D	high_8x	O3-NOx	Emergency Room Visits, Asthma	0 - 17	2.45E+00	1.02E-02
E	high_8x	O3-NOx	Hospital Admissions, All Respiratory	65 - 99	6.89E-01	7.63E-04
E	high_8x	O3-NOx	Mortality, Non-Accidental	0 - 99	4.42E-01	3.59E-04
E	high_8x	O3-NOx	Emergency Room Visits, Asthma	18 - 99	4.30E+00	7.79E-03
E	high_8x	O3-NOx	Emergency Room Visits, Asthma	0 - 17	2.55E+00	1.06E-02
A	high_8x	O3-VOC	Hospital Admissions, All Respiratory	65 - 99	7.49E-02	8.29E-05
A	high_8x	O3-VOC	Mortality, Non-Accidental	0 - 99	4.72E-02	3.84E-05
A	high_8x	O3-VOC	Emergency Room Visits, Asthma	18 - 99	6.57E-01	1.19E-03
A	high_8x	O3-VOC	Emergency Room Visits, Asthma	0 - 17	4.05E-01	1.68E-03
B	high_8x	O3-VOC	Hospital Admissions, All Respiratory	65 - 99	4.29E-02	4.75E-05
B	high_8x	O3-VOC	Mortality, Non-Accidental	0 - 99	2.68E-02	2.18E-05
B	high_8x	O3-VOC	Emergency Room Visits, Asthma	18 - 99	3.09E-01	5.59E-04
B	high_8x	O3-VOC	Emergency Room Visits, Asthma	0 - 17	1.86E-01	7.72E-04
C	high_8x	O3-VOC	Hospital Admissions, All Respiratory	65 - 99	3.66E-02	4.05E-05
C	high_8x	O3-VOC	Mortality, Non-Accidental	0 - 99	2.28E-02	1.86E-05
C	high_8x	O3-VOC	Emergency Room Visits, Asthma	18 - 99	3.10E-01	5.62E-04
C	high_8x	O3-VOC	Emergency Room Visits, Asthma	0 - 17	1.97E-01	8.21E-04

Strategic area Src	Emissions	Species-Precursor	Health Endpoint	Age Range[1]	Incidences per year[2] (Mean)	Percent of Background Health Incidence[3] (%)
D	high_8x	O3-VOC	Hospital Admissions, All Respiratory	65 - 99	3.60E-02	3.99E-05
D	high_8x	O3-VOC	Mortality, Non-Accidental	0 - 99	2.13E-02	1.73E-05
D	high_8x	O3-VOC	Emergency Room Visits, Asthma	18 - 99	3.14E-01	5.68E-04
D	high_8x	O3-VOC	Emergency Room Visits, Asthma	0 - 17	1.86E-01	7.73E-04
E	high_8x	O3-VOC	Hospital Admissions, All Respiratory	65 - 99	4.25E-02	4.71E-05
E	high_8x	O3-VOC	Mortality, Non-Accidental	0 - 99	2.61E-02	2.13E-05
E	high_8x	O3-VOC	Emergency Room Visits, Asthma	18 - 99	3.01E-01	5.44E-04
E	high_8x	O3-VOC	Emergency Room Visits, Asthma	0 - 17	1.84E-01	7.67E-04
A	high_8x	PM25-NOx	Emergency Room Visits, Asthma	0 - 99	4.69E-01	5.91E-04
A	high_8x	PM25-NOx	Mortality, All Cause	30 - 99	9.99E-01	5.42E-04
A	high_8x	PM25-NOx	Hospital Admissions, Asthma	0 - 64	2.95E-02	3.33E-04
A	high_8x	PM25-NOx	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	7.88E-02	7.50E-05
A	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	18 - 24	4.12E-05	2.37E-04
A	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	25 - 44	3.24E-03	2.89E-04
A	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	45 - 54	7.70E-03	2.68E-04
A	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	55 - 64	1.27E-02	2.64E-04
A	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	65 - 99	4.85E-02	2.38E-04
A	high_8x	PM25-NOx	Hospital Admissions, All Respiratory	65 - 99	1.61E-01	1.78E-04
B	high_8x	PM25-NOx	Emergency Room Visits, Asthma	0 - 99	3.94E-01	4.97E-04
B	high_8x	PM25-NOx	Mortality, All Cause	30 - 99	9.27E-01	5.03E-04
B	high_8x	PM25-NOx	Hospital Admissions, Asthma	0 - 64	2.50E-02	2.82E-04
B	high_8x	PM25-NOx	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	7.45E-02	7.09E-05
B	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	18 - 24	3.38E-05	1.95E-04
B	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	25 - 44	2.77E-03	2.47E-04
B	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	45 - 54	6.87E-03	2.39E-04
B	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	55 - 64	1.12E-02	2.33E-04
B	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	65 - 99	4.59E-02	2.26E-04
B	high_8x	PM25-NOx	Hospital Admissions, All Respiratory	65 - 99	1.46E-01	1.62E-04
C	high_8x	PM25-NOx	Emergency Room Visits, Asthma	0 - 99	2.70E-01	3.40E-04
C	high_8x	PM25-NOx	Mortality, All Cause	30 - 99	5.87E-01	3.19E-04
C	high_8x	PM25-NOx	Hospital Admissions, Asthma	0 - 64	1.62E-02	1.83E-04

Strategic area Src	Emissions	Species-Precursor	Health Endpoint	Age Range[1]	Incidences per year[2] (Mean)	Percent of Background Health Incidence[3] (%)
C	high_8x	PM25-NOx	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	4.19E-02	3.99E-05
C	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	18 - 24	2.69E-05	1.55E-04
C	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	25 - 44	1.66E-03	1.48E-04
C	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	45 - 54	3.83E-03	1.33E-04
C	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	55 - 64	6.25E-03	1.29E-04
C	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	65 - 99	2.49E-02	1.22E-04
C	high_8x	PM25-NOx	Hospital Admissions, All Respiratory	65 - 99	9.56E-02	1.06E-04
D	high_8x	PM25-NOx	Emergency Room Visits, Asthma	0 - 99	2.22E-01	2.80E-04
D	high_8x	PM25-NOx	Mortality, All Cause	30 - 99	4.75E-01	2.58E-04
D	high_8x	PM25-NOx	Hospital Admissions, Asthma	0 - 64	1.22E-02	1.37E-04
D	high_8x	PM25-NOx	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	3.52E-02	3.35E-05
D	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	18 - 24	1.93E-05	1.11E-04
D	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	25 - 44	1.19E-03	1.07E-04
D	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	45 - 54	2.97E-03	1.04E-04
D	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	55 - 64	4.76E-03	9.87E-05
D	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	65 - 99	2.01E-02	9.86E-05
D	high_8x	PM25-NOx	Hospital Admissions, All Respiratory	65 - 99	7.88E-02	8.72E-05
E	high_8x	PM25-NOx	Emergency Room Visits, Asthma	0 - 99	4.15E-01	5.24E-04
E	high_8x	PM25-NOx	Mortality, All Cause	30 - 99	9.73E-01	5.28E-04
E	high_8x	PM25-NOx	Hospital Admissions, Asthma	0 - 64	2.62E-02	2.96E-04
E	high_8x	PM25-NOx	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	7.58E-02	7.21E-05
E	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	18 - 24	3.65E-05	2.10E-04
E	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	25 - 44	2.91E-03	2.60E-04
E	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	45 - 54	7.09E-03	2.47E-04
E	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	55 - 64	1.15E-02	2.38E-04
E	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	65 - 99	4.63E-02	2.28E-04
E	high_8x	PM25-NOx	Hospital Admissions, All Respiratory	65 - 99	1.53E-01	1.70E-04
A	high_8x	PM25-PM	Emergency Room Visits, Asthma	0 - 99	8.31E+00	1.05E-02
A	high_8x	PM25-PM	Mortality, All Cause	30 - 99	2.10E+01	1.14E-02
A	high_8x	PM25-PM	Hospital Admissions, Asthma	0 - 64	5.33E-01	6.02E-03
A	high_8x	PM25-PM	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.48E+00	1.41E-03

Strategic area Src	Emissions	Species-Precursor	Health Endpoint	Age Range[1]	Incidences per year[2] (Mean)	Percent of Background Health Incidence[3] (%)
A	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	18 - 24	7.59E-04	4.37E-03
A	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	25 - 44	6.41E-02	5.72E-03
A	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	45 - 54	1.44E-01	5.00E-03
A	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	55 - 64	2.44E-01	5.06E-03
A	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	65 - 99	9.53E-01	4.69E-03
A	high_8x	PM25-PM	Hospital Admissions, All Respiratory	65 - 99	2.93E+00	3.24E-03
B	high_8x	PM25-PM	Emergency Room Visits, Asthma	0 - 99	7.02E+00	8.86E-03
B	high_8x	PM25-PM	Mortality, All Cause	30 - 99	1.79E+01	9.74E-03
B	high_8x	PM25-PM	Hospital Admissions, Asthma	0 - 64	4.49E-01	5.08E-03
B	high_8x	PM25-PM	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.52E+00	1.45E-03
B	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	18 - 24	5.76E-04	3.32E-03
B	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	25 - 44	5.08E-02	4.54E-03
B	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	45 - 54	1.31E-01	4.57E-03
B	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	55 - 64	2.12E-01	4.40E-03
B	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	65 - 99	9.61E-01	4.73E-03
B	high_8x	PM25-PM	Hospital Admissions, All Respiratory	65 - 99	2.74E+00	3.03E-03
C	high_8x	PM25-PM	Emergency Room Visits, Asthma	0 - 99	3.27E+00	4.12E-03
C	high_8x	PM25-PM	Mortality, All Cause	30 - 99	9.58E+00	5.20E-03
C	high_8x	PM25-PM	Hospital Admissions, Asthma	0 - 64	1.94E-01	2.20E-03
C	high_8x	PM25-PM	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	3.97E-01	3.77E-04
C	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	18 - 24	4.70E-04	2.71E-03
C	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	25 - 44	2.10E-02	1.88E-03
C	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	45 - 54	3.77E-02	1.31E-03
C	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	55 - 64	5.59E-02	1.16E-03
C	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	65 - 99	2.50E-01	1.23E-03
C	high_8x	PM25-PM	Hospital Admissions, All Respiratory	65 - 99	1.18E+00	1.30E-03
D	high_8x	PM25-PM	Emergency Room Visits, Asthma	0 - 99	6.86E+00	8.65E-03
D	high_8x	PM25-PM	Mortality, All Cause	30 - 99	1.29E+01	7.00E-03
D	high_8x	PM25-PM	Hospital Admissions, Asthma	0 - 64	2.43E-01	2.74E-03
D	high_8x	PM25-PM	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	8.10E-01	7.70E-04
D	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	18 - 24	5.37E-04	3.10E-03

Strategic area Src	Emissions	Species-Precursor	Health Endpoint	Age Range[1]	Incidences per year[2] (Mean)	Percent of Background Health Incidence[3] (%)
D	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	25 - 44	2.53E-02	2.25E-03
D	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	45 - 54	6.61E-02	2.30E-03
D	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	55 - 64	9.00E-02	1.87E-03
D	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	65 - 99	4.37E-01	2.15E-03
D	high_8x	PM25-PM	Hospital Admissions, All Respiratory	65 - 99	1.95E+00	2.15E-03
E	high_8x	PM25-PM	Emergency Room Visits, Asthma	0 - 99	5.87E+00	7.41E-03
E	high_8x	PM25-PM	Mortality, All Cause	30 - 99	1.66E+01	9.03E-03
E	high_8x	PM25-PM	Hospital Admissions, Asthma	0 - 64	3.60E-01	4.07E-03
E	high_8x	PM25-PM	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.16E+00	1.10E-03
E	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	18 - 24	5.29E-04	3.05E-03
E	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	25 - 44	4.18E-02	3.73E-03
E	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	45 - 54	9.84E-02	3.43E-03
E	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	55 - 64	1.55E-01	3.22E-03
E	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	65 - 99	6.85E-01	3.37E-03
E	high_8x	PM25-PM	Hospital Admissions, All Respiratory	65 - 99	2.46E+00	2.72E-03
A	high_8x	O3-NOx	Hospital Admissions, All Respiratory	65 - 99	4.88E-01	5.40E-04
A	high_8x	O3-NOx	Mortality, Non-Accidental	0 - 99	3.02E-01	2.46E-04
A	high_8x	O3-NOx	Emergency Room Visits, Asthma	18 - 99	3.90E+00	7.07E-03
A	high_8x	O3-NOx	Emergency Room Visits, Asthma	0 - 17	2.42E+00	1.01E-02
B	high_8x	O3-NOx	Hospital Admissions, All Respiratory	65 - 99	5.52E-01	6.11E-04
B	high_8x	O3-NOx	Mortality, Non-Accidental	0 - 99	3.49E-01	2.84E-04
B	high_8x	O3-NOx	Emergency Room Visits, Asthma	18 - 99	3.64E+00	6.59E-03
B	high_8x	O3-NOx	Emergency Room Visits, Asthma	0 - 17	2.12E+00	8.81E-03
C	high_8x	O3-NOx	Hospital Admissions, All Respiratory	65 - 99	3.79E-01	4.19E-04
C	high_8x	O3-NOx	Mortality, Non-Accidental	0 - 99	2.33E-01	1.90E-04
C	high_8x	O3-NOx	Emergency Room Visits, Asthma	18 - 99	3.04E+00	5.50E-03
C	high_8x	O3-NOx	Emergency Room Visits, Asthma	0 - 17	1.94E+00	8.06E-03
D	high_8x	O3-NOx	Hospital Admissions, All Respiratory	65 - 99	4.71E-01	5.22E-04
D	high_8x	O3-NOx	Mortality, Non-Accidental	0 - 99	2.86E-01	2.33E-04
D	high_8x	O3-NOx	Emergency Room Visits, Asthma	18 - 99	4.04E+00	7.32E-03
D	high_8x	O3-NOx	Emergency Room Visits, Asthma	0 - 17	2.45E+00	1.02E-02

Strategic area Src	Emissions	Species-Precursor	Health Endpoint	Age Range[1]	Incidences per year[2] (Mean)	Percent of Background Health Incidence[3] (%)
E	high_8x	O3-NOx	Hospital Admissions, All Respiratory	65 - 99	6.89E-01	7.63E-04
E	high_8x	O3-NOx	Mortality, Non-Accidental	0 - 99	4.42E-01	3.59E-04
E	high_8x	O3-NOx	Emergency Room Visits, Asthma	18 - 99	4.30E+00	7.79E-03
E	high_8x	O3-NOx	Emergency Room Visits, Asthma	0 - 17	2.55E+00	1.06E-02
A	high_8x	O3-VOC	Hospital Admissions, All Respiratory	65 - 99	7.49E-02	8.29E-05
A	high_8x	O3-VOC	Mortality, Non-Accidental	0 - 99	4.72E-02	3.84E-05
A	high_8x	O3-VOC	Emergency Room Visits, Asthma	18 - 99	6.57E-01	1.19E-03
A	high_8x	O3-VOC	Emergency Room Visits, Asthma	0 - 17	4.05E-01	1.68E-03
B	high_8x	O3-VOC	Hospital Admissions, All Respiratory	65 - 99	4.29E-02	4.75E-05
B	high_8x	O3-VOC	Mortality, Non-Accidental	0 - 99	2.68E-02	2.18E-05
B	high_8x	O3-VOC	Emergency Room Visits, Asthma	18 - 99	3.09E-01	5.59E-04
B	high_8x	O3-VOC	Emergency Room Visits, Asthma	0 - 17	1.86E-01	7.72E-04
C	high_8x	O3-VOC	Hospital Admissions, All Respiratory	65 - 99	3.66E-02	4.05E-05
C	high_8x	O3-VOC	Mortality, Non-Accidental	0 - 99	2.28E-02	1.86E-05
C	high_8x	O3-VOC	Emergency Room Visits, Asthma	18 - 99	3.10E-01	5.62E-04
C	high_8x	O3-VOC	Emergency Room Visits, Asthma	0 - 17	1.97E-01	8.21E-04
D	high_8x	O3-VOC	Hospital Admissions, All Respiratory	65 - 99	3.60E-02	3.99E-05
D	high_8x	O3-VOC	Mortality, Non-Accidental	0 - 99	2.13E-02	1.73E-05
D	high_8x	O3-VOC	Emergency Room Visits, Asthma	18 - 99	3.14E-01	5.68E-04
D	high_8x	O3-VOC	Emergency Room Visits, Asthma	0 - 17	1.86E-01	7.73E-04
E	high_8x	O3-VOC	Hospital Admissions, All Respiratory	65 - 99	4.25E-02	4.71E-05
E	high_8x	O3-VOC	Mortality, Non-Accidental	0 - 99	2.61E-02	2.13E-05
E	high_8x	O3-VOC	Emergency Room Visits, Asthma	18 - 99	3.01E-01	5.44E-04
E	high_8x	O3-VOC	Emergency Room Visits, Asthma	0 - 17	1.84E-01	7.67E-04
A	high_8x	PM25-NOx	Emergency Room Visits, Asthma	0 - 99	4.69E-01	5.91E-04
A	high_8x	PM25-NOx	Mortality, All Cause	30 - 99	9.99E-01	5.42E-04
A	high_8x	PM25-NOx	Hospital Admissions, Asthma	0 - 64	2.95E-02	3.33E-04
A	high_8x	PM25-NOx	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	7.88E-02	7.50E-05
A	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	18 - 24	4.12E-05	2.37E-04
A	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	25 - 44	3.24E-03	2.89E-04
A	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	45 - 54	7.70E-03	2.68E-04

Strategic area Src	Emissions	Species-Precursor	Health Endpoint	Age Range[1]	Incidences per year[2] (Mean)	Percent of Background Health Incidence[3] (%)
A	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	55 - 64	1.27E-02	2.64E-04
A	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	65 - 99	4.85E-02	2.38E-04
A	high_8x	PM25-NOx	Hospital Admissions, All Respiratory	65 - 99	1.61E-01	1.78E-04
B	high_8x	PM25-NOx	Emergency Room Visits, Asthma	0 - 99	3.94E-01	4.97E-04
B	high_8x	PM25-NOx	Mortality, All Cause	30 - 99	9.27E-01	5.03E-04
B	high_8x	PM25-NOx	Hospital Admissions, Asthma	0 - 64	2.50E-02	2.82E-04
B	high_8x	PM25-NOx	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	7.45E-02	7.09E-05
B	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	18 - 24	3.38E-05	1.95E-04
B	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	25 - 44	2.77E-03	2.47E-04
B	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	45 - 54	6.87E-03	2.39E-04
B	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	55 - 64	1.12E-02	2.33E-04
B	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	65 - 99	4.59E-02	2.26E-04
B	high_8x	PM25-NOx	Hospital Admissions, All Respiratory	65 - 99	1.46E-01	1.62E-04
C	high_8x	PM25-NOx	Emergency Room Visits, Asthma	0 - 99	2.70E-01	3.40E-04
C	high_8x	PM25-NOx	Mortality, All Cause	30 - 99	5.87E-01	3.19E-04
C	high_8x	PM25-NOx	Hospital Admissions, Asthma	0 - 64	1.62E-02	1.83E-04
C	high_8x	PM25-NOx	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	4.19E-02	3.99E-05
C	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	18 - 24	2.69E-05	1.55E-04
C	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	25 - 44	1.66E-03	1.48E-04
C	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	45 - 54	3.83E-03	1.33E-04
C	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	55 - 64	6.25E-03	1.29E-04
C	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	65 - 99	2.49E-02	1.22E-04
C	high_8x	PM25-NOx	Hospital Admissions, All Respiratory	65 - 99	9.56E-02	1.06E-04
D	high_8x	PM25-NOx	Emergency Room Visits, Asthma	0 - 99	2.22E-01	2.80E-04
D	high_8x	PM25-NOx	Mortality, All Cause	30 - 99	4.75E-01	2.58E-04
D	high_8x	PM25-NOx	Hospital Admissions, Asthma	0 - 64	1.22E-02	1.37E-04
D	high_8x	PM25-NOx	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	3.52E-02	3.35E-05
D	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	18 - 24	1.93E-05	1.11E-04
D	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	25 - 44	1.19E-03	1.07E-04
D	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	45 - 54	2.97E-03	1.04E-04
D	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	55 - 64	4.76E-03	9.87E-05

Strategic area Src	Emissions	Species-Precursor	Health Endpoint	Age Range[1]	Incidences per year[2] (Mean)	Percent of Background Health Incidence[3] (%)
D	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	65 - 99	2.01E-02	9.86E-05
D	high_8x	PM25-NOx	Hospital Admissions, All Respiratory	65 - 99	7.88E-02	8.72E-05
E	high_8x	PM25-NOx	Emergency Room Visits, Asthma	0 - 99	4.15E-01	5.24E-04
E	high_8x	PM25-NOx	Mortality, All Cause	30 - 99	9.73E-01	5.28E-04
E	high_8x	PM25-NOx	Hospital Admissions, Asthma	0 - 64	2.62E-02	2.96E-04
E	high_8x	PM25-NOx	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	7.58E-02	7.21E-05
E	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	18 - 24	3.65E-05	2.10E-04
E	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	25 - 44	2.91E-03	2.60E-04
E	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	45 - 54	7.09E-03	2.47E-04
E	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	55 - 64	1.15E-02	2.38E-04
E	high_8x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	65 - 99	4.63E-02	2.28E-04
E	high_8x	PM25-NOx	Hospital Admissions, All Respiratory	65 - 99	1.53E-01	1.70E-04
A	high_8x	PM25-PM	Emergency Room Visits, Asthma	0 - 99	8.31E+00	1.05E-02
A	high_8x	PM25-PM	Mortality, All Cause	30 - 99	2.10E+01	1.14E-02
A	high_8x	PM25-PM	Hospital Admissions, Asthma	0 - 64	5.33E-01	6.02E-03
A	high_8x	PM25-PM	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.48E+00	1.41E-03
A	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	18 - 24	7.59E-04	4.37E-03
A	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	25 - 44	6.41E-02	5.72E-03
A	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	45 - 54	1.44E-01	5.00E-03
A	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	55 - 64	2.44E-01	5.06E-03
A	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	65 - 99	9.53E-01	4.69E-03
A	high_8x	PM25-PM	Hospital Admissions, All Respiratory	65 - 99	2.93E+00	3.24E-03
B	high_8x	PM25-PM	Emergency Room Visits, Asthma	0 - 99	7.02E+00	8.86E-03
B	high_8x	PM25-PM	Mortality, All Cause	30 - 99	1.79E+01	9.74E-03
B	high_8x	PM25-PM	Hospital Admissions, Asthma	0 - 64	4.49E-01	5.08E-03
B	high_8x	PM25-PM	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.52E+00	1.45E-03
B	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	18 - 24	5.76E-04	3.32E-03
B	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	25 - 44	5.08E-02	4.54E-03
B	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	45 - 54	1.31E-01	4.57E-03
B	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	55 - 64	2.12E-01	4.40E-03
B	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	65 - 99	9.61E-01	4.73E-03

Strategic area Src	Emissions	Species-Precursor	Health Endpoint	Age Range[1]	Incidences per year[2] (Mean)	Percent of Background Health Incidence[3] (%)
B	high_8x	PM25-PM	Hospital Admissions, All Respiratory	65 - 99	2.74E+00	3.03E-03
C	high_8x	PM25-PM	Emergency Room Visits, Asthma	0 - 99	3.27E+00	4.12E-03
C	high_8x	PM25-PM	Mortality, All Cause	30 - 99	9.58E+00	5.20E-03
C	high_8x	PM25-PM	Hospital Admissions, Asthma	0 - 64	1.94E-01	2.20E-03
C	high_8x	PM25-PM	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	3.97E-01	3.77E-04
C	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	18 - 24	4.70E-04	2.71E-03
C	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	25 - 44	2.10E-02	1.88E-03
C	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	45 - 54	3.77E-02	1.31E-03
C	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	55 - 64	5.59E-02	1.16E-03
C	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	65 - 99	2.50E-01	1.23E-03
C	high_8x	PM25-PM	Hospital Admissions, All Respiratory	65 - 99	1.18E+00	1.30E-03
D	high_8x	PM25-PM	Emergency Room Visits, Asthma	0 - 99	6.86E+00	8.65E-03
D	high_8x	PM25-PM	Mortality, All Cause	30 - 99	1.29E+01	7.00E-03
D	high_8x	PM25-PM	Hospital Admissions, Asthma	0 - 64	2.43E-01	2.74E-03
D	high_8x	PM25-PM	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	8.10E-01	7.70E-04
D	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	18 - 24	5.37E-04	3.10E-03
D	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	25 - 44	2.53E-02	2.25E-03
D	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	45 - 54	6.61E-02	2.30E-03
D	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	55 - 64	9.00E-02	1.87E-03
D	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	65 - 99	4.37E-01	2.15E-03
D	high_8x	PM25-PM	Hospital Admissions, All Respiratory	65 - 99	1.95E+00	2.15E-03
E	high_8x	PM25-PM	Emergency Room Visits, Asthma	0 - 99	5.87E+00	7.41E-03
E	high_8x	PM25-PM	Mortality, All Cause	30 - 99	1.66E+01	9.03E-03
E	high_8x	PM25-PM	Hospital Admissions, Asthma	0 - 64	3.60E-01	4.07E-03
E	high_8x	PM25-PM	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.16E+00	1.10E-03
E	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	18 - 24	5.29E-04	3.05E-03
E	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	25 - 44	4.18E-02	3.73E-03
E	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	45 - 54	9.84E-02	3.43E-03
E	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	55 - 64	1.55E-01	3.22E-03
E	high_8x	PM25-PM	Acute Myocardial Infarction, Nonfatal	65 - 99	6.85E-01	3.37E-03
E	high_8x	PM25-PM	Hospital Admissions, All Respiratory	65 - 99	2.46E+00	2.72E-03

Strategic area Src	Emissions	Species-Precursor	Health Endpoint	Age Range[1]	Incidences per year[2] (Mean)	Percent of Background Health Incidence[3] (%)
A	low_2x	O3-NOx	Hospital Admissions, All Respiratory	65 - 99	1.30E-01	1.43E-04
A	low_2x	O3-NOx	Mortality, Non-Accidental	0 - 99	8.05E-02	6.55E-05
A	low_2x	O3-NOx	Emergency Room Visits, Asthma	18 - 99	1.04E+00	1.89E-03
A	low_2x	O3-NOx	Emergency Room Visits, Asthma	0 - 17	6.44E-01	2.68E-03
B	low_2x	O3-NOx	Hospital Admissions, All Respiratory	65 - 99	1.49E-01	1.65E-04
B	low_2x	O3-NOx	Mortality, Non-Accidental	0 - 99	9.42E-02	7.67E-05
B	low_2x	O3-NOx	Emergency Room Visits, Asthma	18 - 99	9.89E-01	1.79E-03
B	low_2x	O3-NOx	Emergency Room Visits, Asthma	0 - 17	5.76E-01	2.40E-03
C	low_2x	O3-NOx	Hospital Admissions, All Respiratory	65 - 99	9.97E-02	1.10E-04
C	low_2x	O3-NOx	Mortality, Non-Accidental	0 - 99	6.18E-02	5.03E-05
C	low_2x	O3-NOx	Emergency Room Visits, Asthma	18 - 99	8.00E-01	1.45E-03
C	low_2x	O3-NOx	Emergency Room Visits, Asthma	0 - 17	5.11E-01	2.13E-03
D	low_2x	O3-NOx	Hospital Admissions, All Respiratory	65 - 99	1.23E-01	1.36E-04
D	low_2x	O3-NOx	Mortality, Non-Accidental	0 - 99	7.45E-02	6.06E-05
D	low_2x	O3-NOx	Emergency Room Visits, Asthma	18 - 99	1.06E+00	1.92E-03
D	low_2x	O3-NOx	Emergency Room Visits, Asthma	0 - 17	6.39E-01	2.66E-03
E	low_2x	O3-NOx	Hospital Admissions, All Respiratory	65 - 99	1.93E-01	2.13E-04
E	low_2x	O3-NOx	Mortality, Non-Accidental	0 - 99	1.24E-01	1.01E-04
E	low_2x	O3-NOx	Emergency Room Visits, Asthma	18 - 99	1.21E+00	2.19E-03
E	low_2x	O3-NOx	Emergency Room Visits, Asthma	0 - 17	7.18E-01	2.99E-03
A	low_2x	O3-VOC	Hospital Admissions, All Respiratory	65 - 99	1.82E-02	2.02E-05
A	low_2x	O3-VOC	Mortality, Non-Accidental	0 - 99	1.15E-02	9.33E-06
A	low_2x	O3-VOC	Emergency Room Visits, Asthma	18 - 99	1.60E-01	2.90E-04
A	low_2x	O3-VOC	Emergency Room Visits, Asthma	0 - 17	9.84E-02	4.10E-04
B	low_2x	O3-VOC	Hospital Admissions, All Respiratory	65 - 99	1.02E-02	1.13E-05
B	low_2x	O3-VOC	Mortality, Non-Accidental	0 - 99	6.35E-03	5.17E-06
B	low_2x	O3-VOC	Emergency Room Visits, Asthma	18 - 99	7.35E-02	1.33E-04
B	low_2x	O3-VOC	Emergency Room Visits, Asthma	0 - 17	4.43E-02	1.84E-04
C	low_2x	O3-VOC	Hospital Admissions, All Respiratory	65 - 99	8.81E-03	9.75E-06
C	low_2x	O3-VOC	Mortality, Non-Accidental	0 - 99	5.46E-03	4.45E-06
C	low_2x	O3-VOC	Emergency Room Visits, Asthma	18 - 99	7.47E-02	1.35E-04
C	low_2x	O3-VOC	Emergency Room Visits, Asthma	0 - 17	4.74E-02	1.97E-04

Strategic area Src	Emissions	Species-Precursor	Health Endpoint	Age Range[1]	Incidences per year[2] (Mean)	Percent of Background Health Incidence[3] (%)
D	low_2x	O3-VOC	Hospital Admissions, All Respiratory	65 - 99	8.81E-03	9.75E-06
D	low_2x	O3-VOC	Mortality, Non-Accidental	0 - 99	5.19E-03	4.22E-06
D	low_2x	O3-VOC	Emergency Room Visits, Asthma	18 - 99	7.66E-02	1.39E-04
D	low_2x	O3-VOC	Emergency Room Visits, Asthma	0 - 17	4.53E-02	1.89E-04
E	low_2x	O3-VOC	Hospital Admissions, All Respiratory	65 - 99	1.01E-02	1.12E-05
E	low_2x	O3-VOC	Mortality, Non-Accidental	0 - 99	6.18E-03	5.03E-06
E	low_2x	O3-VOC	Emergency Room Visits, Asthma	18 - 99	7.17E-02	1.30E-04
E	low_2x	O3-VOC	Emergency Room Visits, Asthma	0 - 17	4.40E-02	1.83E-04
A	low_2x	PM25-NOx	Emergency Room Visits, Asthma	0 - 99	1.18E-01	1.48E-04
A	low_2x	PM25-NOx	Mortality, All Cause	30 - 99	2.51E-01	1.36E-04
A	low_2x	PM25-NOx	Hospital Admissions, Asthma	0 - 64	7.40E-03	8.37E-05
A	low_2x	PM25-NOx	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.98E-02	1.88E-05
A	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	18 - 24	1.03E-05	5.95E-05
A	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	25 - 44	8.14E-04	7.26E-05
A	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	45 - 54	1.93E-03	6.73E-05
A	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	55 - 64	3.20E-03	6.63E-05
A	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	65 - 99	1.22E-02	5.98E-05
A	low_2x	PM25-NOx	Hospital Admissions, All Respiratory	65 - 99	4.02E-02	4.45E-05
B	low_2x	PM25-NOx	Emergency Room Visits, Asthma	0 - 99	9.82E-02	1.24E-04
B	low_2x	PM25-NOx	Mortality, All Cause	30 - 99	2.31E-01	1.25E-04
B	low_2x	PM25-NOx	Hospital Admissions, Asthma	0 - 64	6.22E-03	7.03E-05
B	low_2x	PM25-NOx	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.86E-02	1.77E-05
B	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	18 - 24	8.41E-06	4.84E-05
B	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	25 - 44	6.90E-04	6.16E-05
B	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	45 - 54	1.71E-03	5.97E-05
B	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	55 - 64	2.80E-03	5.80E-05
B	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	65 - 99	1.15E-02	5.63E-05
B	low_2x	PM25-NOx	Hospital Admissions, All Respiratory	65 - 99	3.64E-02	4.03E-05
C	low_2x	PM25-NOx	Emergency Room Visits, Asthma	0 - 99	6.70E-02	8.45E-05
C	low_2x	PM25-NOx	Mortality, All Cause	30 - 99	1.46E-01	7.93E-05
C	low_2x	PM25-NOx	Hospital Admissions, Asthma	0 - 64	4.03E-03	4.55E-05

Strategic area Src	Emissions	Species-Precursor	Health Endpoint	Age Range[1]	Incidences per year[2] (Mean)	Percent of Background Health Incidence[3] (%)
C	low_2x	PM25-NOx	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.04E-02	9.91E-06
C	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	18 - 24	6.71E-06	3.86E-05
C	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	25 - 44	4.12E-04	3.67E-05
C	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	45 - 54	9.52E-04	3.32E-05
C	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	55 - 64	1.55E-03	3.22E-05
C	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	65 - 99	6.18E-03	3.03E-05
C	low_2x	PM25-NOx	Hospital Admissions, All Respiratory	65 - 99	2.38E-02	2.63E-05
D	low_2x	PM25-NOx	Emergency Room Visits, Asthma	0 - 99	5.58E-02	7.03E-05
D	low_2x	PM25-NOx	Mortality, All Cause	30 - 99	1.19E-01	6.46E-05
D	low_2x	PM25-NOx	Hospital Admissions, Asthma	0 - 64	3.04E-03	3.43E-05
D	low_2x	PM25-NOx	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	8.80E-03	8.37E-06
D	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	18 - 24	4.83E-06	2.78E-05
D	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	25 - 44	2.98E-04	2.66E-05
D	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	45 - 54	7.43E-04	2.59E-05
D	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	55 - 64	1.19E-03	2.46E-05
D	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	65 - 99	5.01E-03	2.46E-05
D	low_2x	PM25-NOx	Hospital Admissions, All Respiratory	65 - 99	1.97E-02	2.18E-05
E	low_2x	PM25-NOx	Emergency Room Visits, Asthma	0 - 99	1.02E-01	1.28E-04
E	low_2x	PM25-NOx	Mortality, All Cause	30 - 99	2.39E-01	1.30E-04
E	low_2x	PM25-NOx	Hospital Admissions, Asthma	0 - 64	6.41E-03	7.24E-05
E	low_2x	PM25-NOx	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	1.86E-02	1.77E-05
E	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	18 - 24	8.93E-06	5.15E-05
E	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	25 - 44	7.14E-04	6.37E-05
E	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	45 - 54	1.74E-03	6.06E-05
E	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	55 - 64	2.82E-03	5.84E-05
E	low_2x	PM25-NOx	Acute Myocardial Infarction, Nonfatal	65 - 99	1.14E-02	5.58E-05
E	low_2x	PM25-NOx	Hospital Admissions, All Respiratory	65 - 99	3.75E-02	4.15E-05
A	low_2x	PM25-PM	Emergency Room Visits, Asthma	0 - 99	2.08E+00	2.62E-03
A	low_2x	PM25-PM	Mortality, All Cause	30 - 99	5.25E+00	2.85E-03
A	low_2x	PM25-PM	Hospital Admissions, Asthma	0 - 64	1.33E-01	1.51E-03
A	low_2x	PM25-PM	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	3.71E-01	3.53E-04

Strategic area Src	Emissions	Species-Precursor	Health Endpoint	Age Range[1]	Incidences per year[2] (Mean)	Percent of Background Health Incidence[3] (%)
A	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	18 - 24	1.90E-04	1.09E-03
A	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	25 - 44	1.60E-02	1.43E-03
A	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	45 - 54	3.59E-02	1.25E-03
A	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	55 - 64	6.11E-02	1.27E-03
A	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	65 - 99	2.39E-01	1.17E-03
A	low_2x	PM25-PM	Hospital Admissions, All Respiratory	65 - 99	7.31E-01	8.09E-04
B	low_2x	PM25-PM	Emergency Room Visits, Asthma	0 - 99	1.76E+00	2.22E-03
B	low_2x	PM25-PM	Mortality, All Cause	30 - 99	4.48E+00	2.43E-03
B	low_2x	PM25-PM	Hospital Admissions, Asthma	0 - 64	1.12E-01	1.27E-03
B	low_2x	PM25-PM	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	3.79E-01	3.60E-04
B	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	18 - 24	1.44E-04	8.30E-04
B	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	25 - 44	1.27E-02	1.13E-03
B	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	45 - 54	3.28E-02	1.14E-03
B	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	55 - 64	5.30E-02	1.10E-03
B	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	65 - 99	2.40E-01	1.18E-03
B	low_2x	PM25-PM	Hospital Admissions, All Respiratory	65 - 99	6.84E-01	7.57E-04
C	low_2x	PM25-PM	Emergency Room Visits, Asthma	0 - 99	8.16E-01	1.03E-03
C	low_2x	PM25-PM	Mortality, All Cause	30 - 99	2.39E+00	1.30E-03
C	low_2x	PM25-PM	Hospital Admissions, Asthma	0 - 64	4.86E-02	5.49E-04
C	low_2x	PM25-PM	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	9.92E-02	9.44E-05
C	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	18 - 24	1.18E-04	6.78E-04
C	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	25 - 44	5.25E-03	4.68E-04
C	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	45 - 54	9.43E-03	3.28E-04
C	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	55 - 64	1.40E-02	2.90E-04
C	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	65 - 99	6.24E-02	3.07E-04
C	low_2x	PM25-PM	Hospital Admissions, All Respiratory	65 - 99	2.94E-01	3.25E-04
D	low_2x	PM25-PM	Emergency Room Visits, Asthma	0 - 99	1.70E+00	2.15E-03
D	low_2x	PM25-PM	Mortality, All Cause	30 - 99	3.20E+00	1.74E-03
D	low_2x	PM25-PM	Hospital Admissions, Asthma	0 - 64	6.05E-02	6.84E-04
D	low_2x	PM25-PM	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	2.01E-01	1.91E-04
D	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	18 - 24	1.33E-04	7.68E-04

Strategic area Src	Emissions	Species-Precursor	Health Endpoint	Age Range[1]	Incidences per year[2] (Mean)	Percent of Background Health Incidence[3] (%)
D	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	25 - 44	6.30E-03	5.62E-04
D	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	45 - 54	1.65E-02	5.74E-04
D	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	55 - 64	2.25E-02	4.66E-04
D	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	65 - 99	1.09E-01	5.34E-04
D	low_2x	PM25-PM	Hospital Admissions, All Respiratory	65 - 99	4.83E-01	5.35E-04
E	low_2x	PM25-PM	Emergency Room Visits, Asthma	0 - 99	1.45E+00	1.83E-03
E	low_2x	PM25-PM	Mortality, All Cause	30 - 99	4.13E+00	2.24E-03
E	low_2x	PM25-PM	Hospital Admissions, Asthma	0 - 64	8.88E-02	1.00E-03
E	low_2x	PM25-PM	Hospital Admissions, All Cardiovascular (less Myocardial Infarctions)	65 - 99	2.87E-01	2.73E-04
E	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	18 - 24	1.31E-04	7.54E-04
E	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	25 - 44	1.03E-02	9.20E-04
E	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	45 - 54	2.43E-02	8.45E-04
E	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	55 - 64	3.83E-02	7.95E-04
E	low_2x	PM25-PM	Acute Myocardial Infarction, Nonfatal	65 - 99	1.70E-01	8.34E-04
E	low_2x	PM25-PM	Hospital Admissions, All Respiratory	65 - 99	6.11E-01	6.76E-04

1. Affected age ranges are shown . Other age ranges are available, but the endpoints and age ranges shown here are the ones used by the USEPA in their health assessments. The age ranges are consistent with the epidemiological study that is the basis of the health function.
2. 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 Sacramento reduced 4-km model domain.
3. The percent of background health incidence uses the mean incidence. The background health incidence is an estimate of the average number of people that are affected by the health endpoint in a given population over a given period of time. In this case, these background incidence rates cover the modeled domain. Health incidence rates and other health data are typically collected by the government as well as the World Health Organization. The background incidence rates used here are obtained from BenMAP.