Appendix C3

Health Impacts Assessment

C3.a CAMx Photochemical Modeling Study Technical Report

CAMX PHOTOCHEMICAL MODELING STUDY TO SUPPORT A HEALTH IMPACT ANALYSIS

San Jose West Mixed Use Plan Project
San Jose, California

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1.0 INTRODUCTION

The purpose of this technical study is to provide a description of the methodologies used to develop concentration data for ozone and particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$) for potential health impacts from the San Jose West Mixed Use Plan project (the "Project") emissions. The concentration data were used in health impact analysis (HIA) calculations completed with the EPA Benefits Mapping and Analysis Program – Community Edition (BenMAP-CE).[1] The intent is to provide quantitative photochemical modeling results that meet the EIR evidentiary requirements for HIAs, as stated by the California Supreme Court in the Friant Ranch Case decision.

In the California Supreme Court decision in Sierra Club versus County of Fresno (S219783, December 24, 2018), or the "Friant Ranch" case, the Court found the Environmental Impact Report (EIR) to be inadequate because it failed to make a reasonable effort to include an analysis that correlates project emissions to impacts on human health. In particular, the Court focused on air quality impact analysis for significant project oxides of nitrogen (NO_x) emissions, that are a precursor to ozone formation, and $PM_{2.5}$ emissions. The Court concluded that an EIR should meet evidentiary requirements, such as: 1) including sufficient detail to enable reviewers to understand and to consider meaningfully the issues the project raises, and 2) making a reasonable effort to connect a project's air quality impacts to likely health consequences, or explain why such air quality analysis is not feasible at the time of drafting the analysis.

The proposed Project is located within the jurisdiction of the Bay Area Air Quality Management District (BAAQMD). The BAAQMD conducts photochemical modeling studies to address attainment of the ozone and $PM_{2.5}$ state and federal ambient standards, and localized health impacts under the Community Air Protection Program (CAPP) or AB 617. To review regional $PM_{2.5}$ impacts in the Bay Area and specifically, the West Oakland AB 617 community, BAAQMD recently completed a modeling study using a photochemical model, the Community Multiscale Air Quality Model (CMAQ), for 2016 emissions.[2] BlueScape obtained the electronic files used to run CMAQ from BAAQMD. These files were the basis for using another photochemical model, the Comprehensive Air Quality Model with Extensions (CAMx), to review potential ozone and $PM_{2.5}$ impacts from the Project, as presented in this report.[3] The emissions

[1] Environmental Benefits Mapping and Analysis Program – Community Edition (BenMAP-CE), 2019. www.epa.gov/benmap, page last updated August 22, 2019.

[2] Tanrikulu, S., S. Reid, B. Koo, Y. Jia, J. Cordova, J. Matsuoka, and Y. Fang, 2019. Fine Particulate Matter Data Analysis and Regional Modeling in the San Francisco Bay Area to Support AB617. Air Quality modeling and Analysis Section Publication No. 201901-017-PM. www.baaqmd.gov/~/media/files/ab617-community-health/west-oakland/baaqmd_2016_pm_modeling_report-pdf.pdf?la=en (last accessed 30-Mar-2020).

[3] CAMx Support Software, 2020. www.camx.com/download/support-software.aspx (last accessed 30-Mar-2020).

precursors to ozone formation are NO_x and Volatile Organic Compounds (VOCs). VOCs include Reactive Organic Gases (ROG) that comprise Total Organic Gases (TOG).

The BAAQMD has not developed guidance under the California Environmental Quality Act (CEQA) in light of the Friant Ranch decision to date, regarding procedures to evaluate specific health impacts from a project's ozone and $PM_{2.5}$ emissions. Three other air districts in California have released a legal position on the Friant Ranch case or have developed draft modeling guidelines. The SCAQMD wrote an *Amicus Curiae* brief (filed April 13, 2015) which stated the difficulty of quantifying a project's health impacts for such pollutants as ozone, due to the need to consider the impact of a relatively small amount of emissions on overall regional pollution impacts.[4] However, the SCAQMD did conclude that such regional impact modeling could be feasible for larger projects. The SCAQMD has demonstrated the feasibility of completing regional photochemical modeling concentration analysis for regional ozone and $PM_{2.5}$ emissions, connecting the results to specific predicted health impacts, in the *2016 Air Quality Management Plan* (AQMP)[5] and related reports. The photochemical modeling completed by SCAQMD with CMAQ is described in Appendix V to the AQMP.[6] The SCAQMD discusses quantification of public benefits of the 2016 AQMP using BenMAP-CE.

The San Joaquin Valley Air Pollution Control District (SJVAPCD) released a similar *Amicus Curiae* brief stating that models are not available to conduct an appropriate analysis.[7] In its brief, SJVAPCD acknowledged that while health risk assessments for localized air toxics impacts, such as diesel particulate matter, are commonly prepared, "it is not feasible to conduct a similar analysis for criteria air pollutants because currently available computer modeling tools are not equipped for this task." The SJVAPCD further noted that emissions solely from the Friant Ranch project (which equate to less than one-tenth of one percent of the total NO_x and VOC emissions in the Central Valley) is not likely to yield valid information, and that any such information should not be "accurate when applied at the local level."

In late 2019, the Sacramento Metropolitan AQMD (SMAQMD) released Interim Guidance suggesting that, where air quality emission impacts are deemed to be significant under CEQA, project applicants should provide a technical (or quantitative) analysis and make a finding on whether specific health impact review of ozone and

[4] SCAQMD, 2015. Amicus Curiae Brief filed on Case S219783 in the Supreme Court of California, Sierra Club et. al. v County of Fresno and Friant Ranch, L.P. April 13, 2015.

[5] SCAQMD, 2019. Final 2016 AQMP-CARB/EPA/SIP Submittal. www.aqmd.gov/home/air-quality/clean-air-plans/air-quality-mgt-plan/final-2016-aqmp (last accessed 19-Aug-2019).

[6] SCAQMD, 2019. Appendix V: Modeling & Attainment Demonstrations. www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/appendix-v.pdf?sfvrsn=10 (last accessed 19-Aug-2019).

[7] SJVAPCD, 2015. Amicus Curiae brief filed on Case S219783 in the Supreme Court of California, Sierra Club et. al. v. County of Fresno and Friant Ranch, L.P. April 13, 2015.

$PM_{2.5}$ is feasible.[8] If such a health impact analysis (for example using a photochemical model with BenMAP) is not feasible, the guidance suggests that the CEQA documents explain why the analysis is not feasible. Such an explanation could include review and discussion of models typically used currently for health impact analysis, including CalEEMod, EMFAC, OFFROAD, BenMAP and HARP2, combined with an explanation of the extent to which these and any other tools identified could assist in describing the project's health impacts from ozone and $PM_{2.5}$ emissions.

In contrast to the SCAQMD and SJVAPCD legal positions and approach to address the Friant Ranch decision, the SMAQMD has released the draft *Guidance to Address the Friant Ranch Ruling for CEQA Projects in the Sac Metro Air District*, which replaces the Interim Guidance.[9] The guidance document provides insight on potential ozone and $PM_{2.5}$ impacts that may occur due to project development in the Sacramento region, from a project's NO_x, VOC, carbon monoxide (CO) and oxides of sulfur (SO_x) emissions. Screening look-up tables that can be used to estimate specific health effects in certain strategic growth areas. The screening look-up tables were developed using CAMx photochemical modeling. For projects with significant emissions outside of the strategic growth areas, the document provides guidance on the use of a photochemical model to complete quantitative estimates of ozone and $PM_{2.5}$ concentrations and health impacts from these pollutants.

A photochemical modeling study similar to that presented within this technical report was recently competed as a technical appendix to the *Draft EIR for Amendment to the San Jose Mineta Airport Master Plan*.[10] The Mineta Airport site is located about one mile to the northwest of the Project site's northern extent. The Mineta Airport technical study used the CAMx model to review the ozone and $PM_{2.5}$ health impacts from aircraft, airport ground operations, mobile on-road, and other sources, on ozone and $PM_{2.5}$ concentrations, with relative health impact changes estimated using CAMx model concentration output input to the BenMAP model.[11]

2.0 REPORT SUMMARY

To complete the photochemical modeling work to support the Project HIA as described in this technical study, BlueScape generally followed the BAAQMD 2016 $PM_{2.5}$ CMAQ study methods, to develop ozone and $PM_{2.5}$ concentration data that

[8] SMAQMD, 2019. Friant Ranch Interim Recommendation. April 25, 2019. www.airquality.org/LandUseTransportation/Documents/FriantInterimRecommendation.pdf

[9] SMAQMD, 2020. Guidance to Address the Friant Ranch Ruling for CEQA Projects in the Sac Metro Air District (Draft, Revised), prepared by Ramboll. June 2020. www.airquality.org/LandUseTransportation/Documents/SacMetroFriantDraftFinalPublic2020-06-15.pdf#search=friant%20ranch

[10] City of San Jose, 2019. Draft Environmental Impact Report Amendment to Norman Y. Mineta San Jose International Airport Master Plan, City of San Jose PP 18-103, SCH #2018102020, David J. Powers & Associates, November 2019.

[11] EPA, 2019. Environmental Benefits Mapping and Analysis Program - Community Edition (BenMAP-CE). www.epa.gov/benmap (last accessed 05-Apr-2020).

Environmental Science Associates (ESA) then used to run a BenMAP-CE health impact analysis. The BAAQMD used 2016 emissions and modeling files as the base case year for their photochemical modeling effort. In the Project study, it was also deemed prudent to use 2016 as the base case emissions and meteorological data year.

The meteorological and emissions data electronic files used by BAAQMD for their study were delivered to BlueScape Environmental by BAAQMD via a public information request. The 2016 base case CMAQ files provided by BAAQMD, which included the speciated NO_x, TOG, particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM_{10}), and $PM_{2.5}$ emissions, were converted for use in CAMx with appropriate CMAQ-to-CAMx conversion tools.[12] The BAAQMD also provided their 2016 Weather Research and Forecasting Model (WRF v3.8) meteorological data, which were also converted for use in CAMx using appropriate tools. Because of its improved usability over CMAQ, CAMx was chosen as the photochemical model in the study.

Using the 2016 Weather Research and Forecasting Model (WRF) predictions coupled with the converted CMAQ input files, CAMx (v.6.5)[13] photochemical modeling was performed for seven (7) scenarios: the 2016 base case year (for model performance validation), future Project year 2029 and 2032 Baseline emissions without Project emissions added; 2029 and 2032 Baseline emissions with non-mitigated Project[14] emissions added, and 2029 and 2032 Baseline emissions with mitigated Project emissions added. The 2029 Project year includes construction emissions, as well as operational emissions from prior completion of Project work, that will occur in the same year. The 2032 Project year is intended to represent future operational emissions at full Project buildout. For the 2029 and 2032 Baseline years, the 2016 CAMx emissions were grown to the future years based upon growth factors developed using the California Air Resources Board (CARB) CEPAM 2016 SIP Standard Emission Tool.[15]

A Model Performance Evaluation (MPE) of the 2016 CAMx air quality modeled results was completed. The CAMx model was run for the entire 2016 base case year. The MPE was conducted as a comparison of the hourly CAMx model predictions for the Project study, to the original hourly BAAQMD CMAQ model predictions. Average gross error and bias statistics were estimated at the county-level for ozone and $PM_{2.5}$ for each month of 2016. Because the gross error and bias values that resulted were small

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[12] Ramboll ENVIRON, 2016. CMAQ2CAMX. www.camx.com/getmedia/a5932a8e-f133-4658-bb72-f5e78a1d9942/cmaq2camx-22sep16.tgz (last accessed 05-Apr-2020).

[13] Ramboll ENVIRON, 2017. Comprehensive Air Quality Model with Extensions (CAMx). http://www.camx.com.

[14] The Project emissions were considered all to be "new," that is, the incremental localized net emission increases or decreases from shifting current regional or local vehicle trips to the Project location were not considered, only the emissions related to the Project.

[15] CARB, 2018. CEPAM: 2016 SIP - Standard Emission Tool. www.arb.ca.gov/app/emsinv/fcemssumcat/fcemssumcat2016.php (last accessed 05-Apr-2020).

(i.e., a few tenths of a ppb for ozone and a few hundredths of a $\mu g/m^3$ for $PM_{2.5}$), the CAMx modeling system was deemed suitable for use in the study.

For the six future-year modeling scenarios, maximum daily 8-hour average (MDA8) ozone concentrations and maximum annual 24-hour average $PM_{2.5}$ concentrations were developed using CAMx for import into EPA's BenMAP-CE model. This report describes the methodology used to complete the ozone and $PM_{2.5}$ concentration modeling, including the CAMx modeling system, WRF model meteorological data inputs, CAMx model emission inputs and other input assumptions, and the output files prepared for BenMap-CE. The concentration results are described in tables and figures.

3.0 SUMMARY OF THE MODELING SYSTEM

Photochemical grid models (PGMs), are recognized and routinely utilized tools for regulatory analysis such as assessing emission control strategies in pursuit of attaining a particular National Ambient Air Quality Standard (NAAQS). PGMs are large-scale mathematical air quality models that represent the physicochemical processes that occur in the atmosphere. PGMs simulate the changes of atmospheric pollutant concentrations due to changes in the constituent makeup of anthropogenic, biogenic, and geogenic emissions emitted to the atmosphere. PGMs are applied at multiple spatial scales from local, regional, national, and global over periods of time that span weekly, monthly, and annual scales.

Over the last five decades, EPA has devoted significant resources to develop PGMs for the assessment of air pollution issues, including health impact assessments and evaluation of emissions control strategies. The EPA's Air Quality Modeling Group has used photochemical models as part of its modeling analyses to support policy and regulatory decisions. Finally, EPA has developed guidance on the use of these models.[16]

CAMx is a state-of-the-art regional air quality modeling system developed by Ramboll ENVIRON that can be used to simulate the physical and chemical processes that govern the formation, transport, and deposition of gases and particulates in the atmosphere. The structure of the CAMx modeling system is shown in Figure 1.

[16] EPA, 2017. Modeling Guidance and Support. https://www.epa.gov/scram/modeling-guidance-and-support (last accessed 22-Apr-2020).

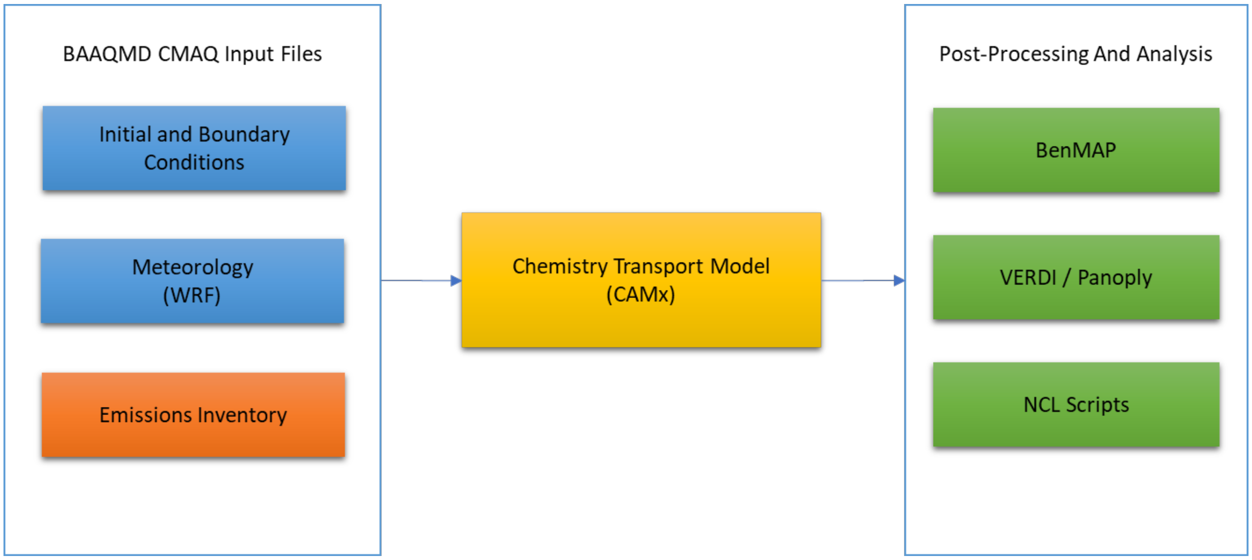

Figure 1. Components of the CAMx Modeling System

The components shown in Figure 1 are:

- **WRF**: Weather Research and Forecasting Model, v3.8. WRF was used to generate the meteorology data for CMAQ modeling by BAAQMD. WRF output files from BAAQMD were post-processed for use in CAMx.
- **CAMx**: Comprehensive Air Quality Model with Extensions, v6.5. The CAMx model was run using converted BAAQMD CMAQ input files and meteorology post-processed from BAAQMD WRF output files.
- **Initial and Boundary Conditions**: Initial and boundary photochemical conditions for the spatial domain and the modeling time period.
- **Emissions Inventory**: An emissions database for the scenario, spanning the time period, spatial domain, and species list required by CAMx. Generally, CAMx obtains its emissions inventories from the EPA's SMOKE (Sparse Matrix Operator Kernel Emissions)[17] Modeling System. In this Project, a complete emissions inventory for Year 2016 in CMAQ-format files was provided by BAAQMD, then converted to CAMx format to be used in this analysis.
- **Post-Processing and Analysis**: Software tools used to post-process CAMx results for further analysis and data visualization. The following tools were used in this Project for CAMx post-processing:
    - **VERDI**: Java program for visualizing meteorology, emissions, and air quality modeling data. With options for overlaying GIS Shapefiles and

[17] CMAS, 2018. SMOKE. www.cmascenter.org/smoke/index.cfm (last accessed 20-Aug-2019).

observational data onto model output, VERDI offers a range of options for viewing atmospheric modeling data. VERDI was used in this Project to validate emissions re-gridding and output concentrations from CAMx.

- **Panoply**: netCDF, HDF and GRIB Data Viewer. Used alongside VERDI to visualize CAMx output data and to extract CSV files from CAMx post-processed output files, stored in netCDF format.
- **NCL Scripts**: The NCAR Command Language (NCL) is a free interpreted language designed specifically for scientific data processing and visualization. In this Project, NCL was used to transform BAAQMD CMAQ emission data files and to incorporate the Project's emissions model into the Baseline emissions.
- **BenMAP-CE**: EPA Benefits Mapping and Analysis Program – Community Edition, BenMAP-CE is an open-source software that calculates the number and economic value of air pollution-related deaths and illnesses.

4.0 MODELING DOMAIN

The modeling domain chosen for the Project study was the same one used in the BAAQMD CMAQ 2016 modeling run. Data from the final modeling grid used by BAAQMD was used for the CAMx run, as boundary and initial conditions from BAAQMD CMAQ already incorporated data from coarser grids. This final grid covered an area 740 by 740 kilometers, using a 4-km grid size and 185 by 185 cells. Figure 2 shows this grid layout, used by both the BAAQMD for CMAQ model runs, and for Project CAMx model runs.

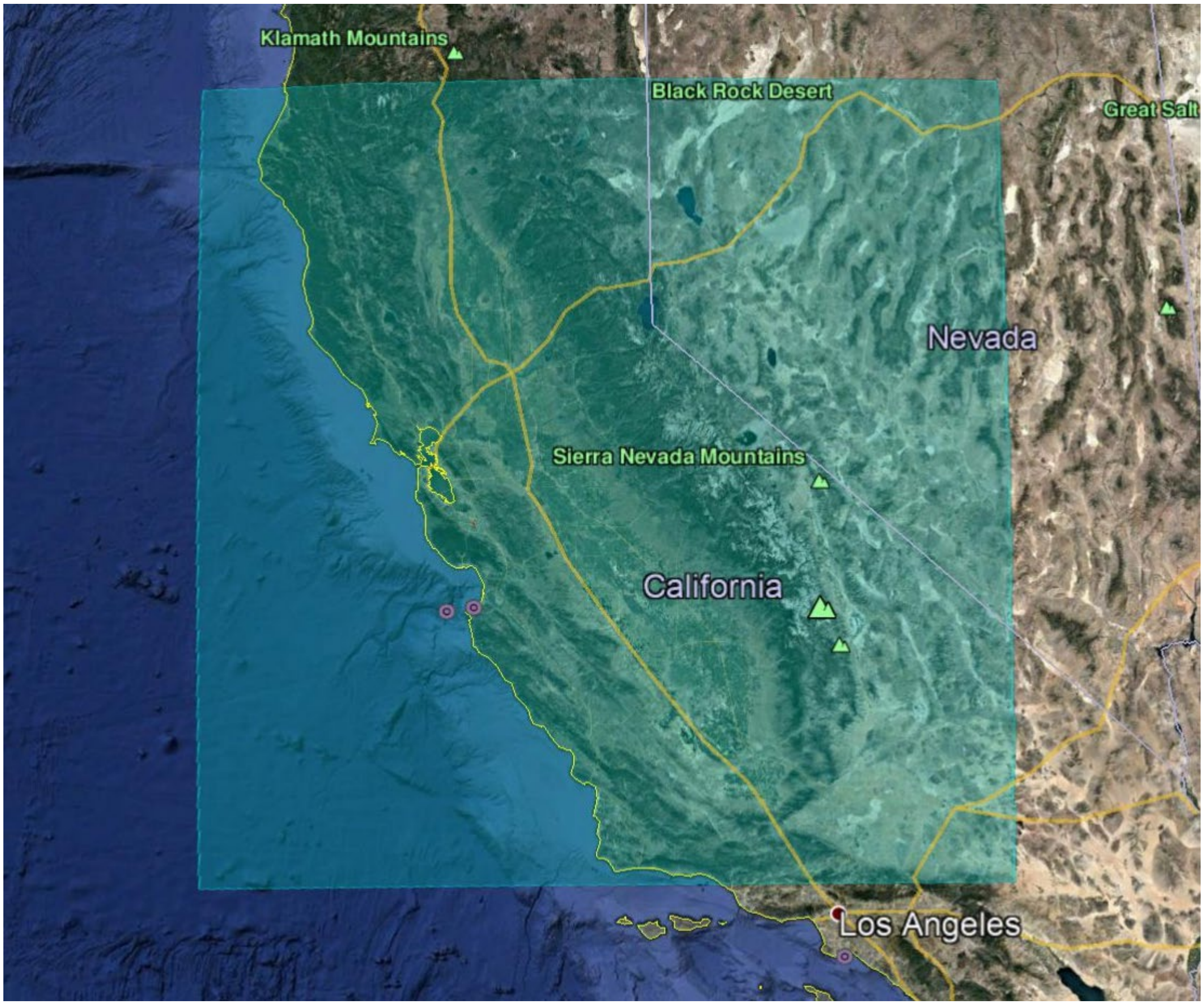

Figure 2. BAAQMD CMAQ and CAMx Modeling Grid

5.0 WRF – WEATHER RESEARCH AND FORECASTING MODEL DATA

The WRF model is a next-generation mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting applications. The model generates 3D wind fields for a specific domain, using telescopic grids to pass regional phenomena down to smaller areas. WRF is an integral part of both CMAQ and CAMx modeling systems.

BAAQMD used WRF v3.8 to generate the meteorological fields needed by for their 2016 CMAQ run. Output files from this WRF run were delivered to BlueScape

Environmental and post-processed using the wrfcamx v4.7 post processing tool.[18] Table 1 below contains the selected WRF modeling configuration used by BAAQMD.

TABLE 1
WRF MODELING CONFIGURATION

Grid Definition	BAAQMD WRF data, final grid: • 4-km grid cell, 189 x 189 grid cells in size, total area: 756 x 756 kms
Initial and Boundary Conditions	NCEP North American Mesoscale (NAM) 12 km Analysis, Grid 218
Vertical Layers	50 Layers with the lowest layer at 18 m agl.
Data Assimilation	Analysis nudging at every 6 hours for the outermost domain only. No temperature and moisture nudging within the PBL.

6.0 CAMX MODEL SETUP

The CAMx model was setup to use the same grid as the final grid from the BAAQMD CMAQ model run. Table 2 contains the general CAMx model configuration used, while Table 3 contains the grid configuration.

[18] Ramboll ENVIRON, 2016. WRF2CAMX. www.camx.com/getmedia/e9277c52-5c22-4417-968b-ea9b18d62a1b/wrfcamx-26feb19_1.tgz (last accessed 05-Apr-2020).

TABLE 2 GENERAL CAMX CONFIGURATION	
Chemical Mechanism	SAPRC07 with version “c” toluene updates gas-phase mechanism
Advection Solver	Piecewise Parabolic Method (PPM)
Chemical Solver	Euler Backward Iterative solver (EBI)
Plume-In-Grid Submodel	Greatly Reduced Execution and Simplified Dynamics Submodel (GREASD)
Dry Deposition Model	Zhang 2003
Photolysis	In-line Calculation

TABLE 3 4-KM GRID CONFIGURATION	
Grid Definition	4-km grid cell, 185 x 185 grid cells in size, total area: 740 x 740 kms

7.0 EMISSIONS INVENTORIES

The CAMx model requires input of hourly, gridded criteria pollutant emissions of both anthropogenic and biogenic sources that have been spatially allocated to the appropriate grid cells and chemically speciated for the model’s applicable chemical mechanism.

Gridded area emissions, elevated point source emissions, boundary and initial conditions were converted from BAAQMD CMAQ input files using the cmaq2camx conversion tool, changing the chemical mechanism from CB06 to SAPRC07. The 2016 CAMx emissions inventory was used for the validation model run. The gridded emission files include TOG, NO_x, PM_{10} and $PM_{2.5}$. PM_{10} was included to obtain the overall particulate concentration results. The TOG and particulate data were entered into CAMx by chemical species. Project SO_x and CO emissions were not included in the analysis, due to their small contribution to secondary $PM_{2.5}$ and ozone formation.

The future year baseline 2029 and 2032 CAMx ROG, NO_x, PM_{10}, and $PM_{2.5}$ emissions were grown, or scaled, from 2016 emissions, using growth factors developed from the CEPAM SIP Standard Emission tool developed by the California Air Resources Board. CEPAM lists emissions by source category; stationary sources, areawide sources, mobile sources, and natural sources. Each source category has subcategories, such as stationary source type, on-road and off-road subcategories.

These CEPAM categories and subcategories were matched with the BAAQMD CMAQ emission files source categories and subcategories. Tables 4-7 summarize the Project Non-Mitigated and Mitigated emissions by source category for the 2029 and 2032 Project years.

TABLE 4
2029 NON-MITIGATED PROJECT EMISSIONS BY SOURCE TYPE, LB/DAY

Type	ROG	NO_x	PM_{10}	$PM_{2.5}$
Construction				
On-road Mobile	3.05	77.5	14.0	3.24
Off-road Mobile	81.8	43.9	11.4	6.79
Total	**84.9**	**121**	**25.4**	**10.0**
Operational				
On-road Mobile	128	241	255	57.5
Off-road Mobile	203	6.49	0.170	0.156
Stationary	0.842	16.0	5.30	3.63
Total	**332**	**263**	**260**	**61.3**

TABLE 5
2032 NON-MITIGATED PROJECT EMISSIONS BY SOURCE TYPE, LB/DAY

Type	ROG	NO_x	PM_{10}	$PM_{2.5}$
Operational				
On-road Mobile	96.6	199	250	56.0
Off-road Mobile	0.508	5.11	0.170	0.156
Stationary	394	32.1	8.61	6.05
Total	**491**	**237**	**259**	**62.2**

TABLE 6 2029 MITIGATED PROJECT EMISSIONS BY SOURCE TYPE, LB/DAY				
Type	**ROG**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**
Construction				
On-road Mobile	1.24	54.2	9.2	2.63
Off-road Mobile	81.3	39.9	11.3	6.65
Total	**82.5**	**94.1**	**20.5**	**9.3**
Operational				
On-road Mobile	94	181	194	43.7
Off-road Mobile	203	5.72	0.144	0.133
Stationary	0.497	1.8	4.86	3.20
Total	**298**	**189**	**199**	**47.0**

TABLE 7 2032 MITIGATED PROJECT EMISSIONS BY SOURCE TYPE, LB/DAY				
Type	**ROG**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**
Operational				
On-road Mobile	65.0	143	183	40.9
Off-road Mobile	0.432	4.35	0.144	0.133
Stationary	393	6.0	7.81	5.27
Total	**458**	**153**	**191**	**46.3**

The incremental Project emissions were incorporated into the baseline 2029 and 2032 emissions using NCL scripts integrated with Earth System Modeling Framework (ESMF) software. Project ROG emissions were converted to TOG emissions using conversion factors. For each Project scenario, in 2029 and 2032, both non-mitigated and mitigated scenarios, the following data was incorporated into the baseline gridded emission files using the NCL scripts:

- Temporal allocation of construction emissions by day-of-week and hour-of-day.
- Temporal profiles extracted from BAAQMD CMAQ files for allocation of non-construction Project emissions, weekend-weekday and by time of day, for aggregated source categories.

- Spatial distribution of Project emissions from mobile sources, in a 9x9 grid centered on the Project site.
- Speciation profiles of Project emissions for CAMx SAPRC07 specific gas and aerosol species.

Using this input data, new Project emissions were generated hour by hour for the entire simulation year. Per relevant CAMx species, incremental emissions were apportioned to the corresponding grid cells, and complete Project emissions database were generated for each scenario. Figure 3 shows the Project site location and emissions apportionment fractions by 4-km grid cell, with all the fractions adding to 1.0. No Project emissions were apportioned outside the grid cells shown in Figure 3.

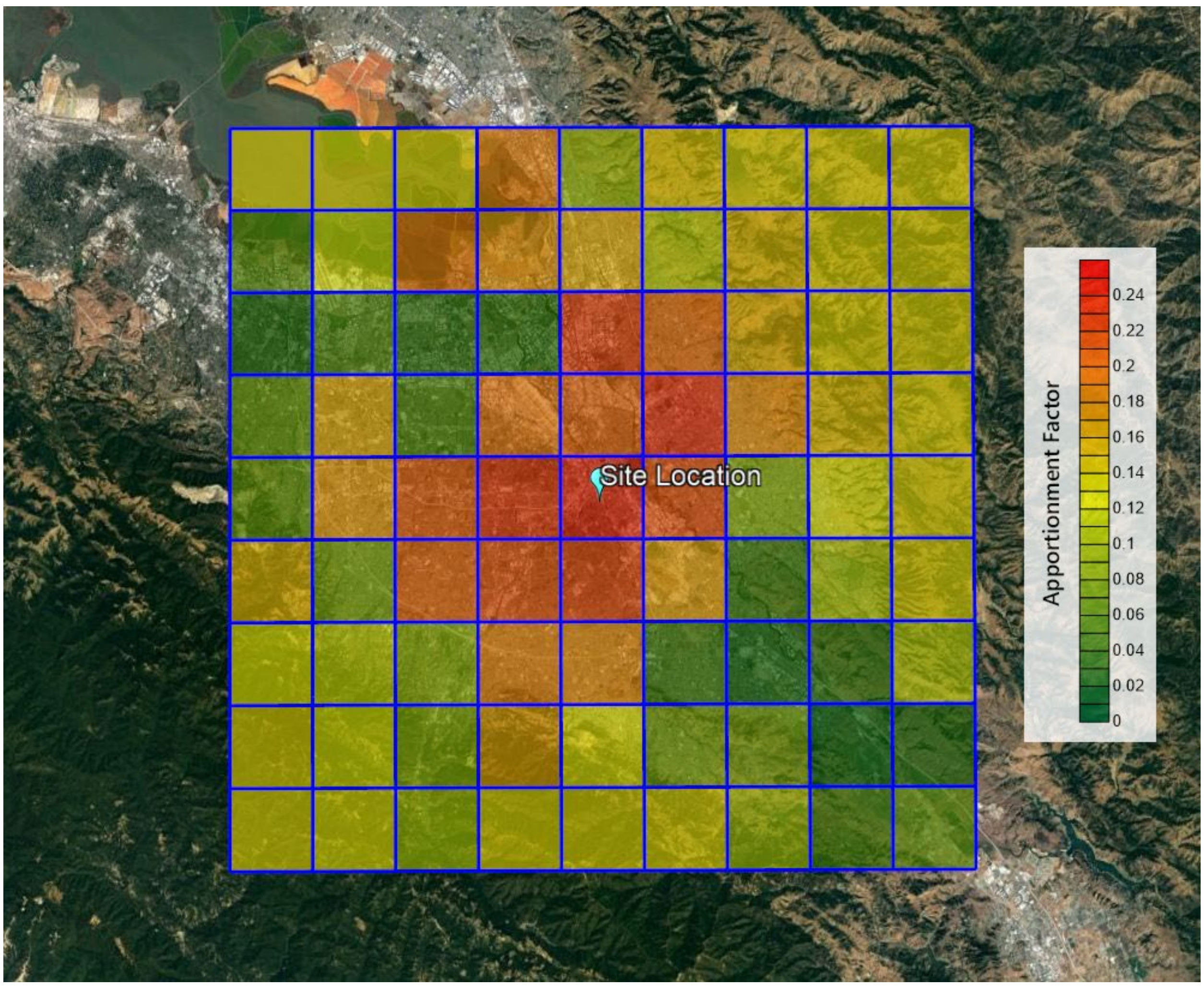

Figure 3. Project Emissions Apportionment to Grid Cells

8.0 MODEL PERFORMANCE EVALUATION

Air quality modeling studies are obliged to include efforts to assess the ability of an air quality modeling system to reliably recreate observed air quality events. In the current context of this study, the air quality modeling system is the combined meteorological modeling system (WRF), the photochemical modeling system (CAMx), and modeling input data sets. The air quality modeling system was derived from the BAAQMD's 2016 air quality modeling system. As BAAQMD used the CMAQ photochemical model, BlueScape adapted the CMAQ data bases for use with the CAMx photochemical model using appropriate tools.

The BAAQMD performed a model performance evaluation (MPE) for the 2016 period and deemed its CMAQ-based air quality modeling system adequate for use in additional studies.[19] Therefore, it is sufficient that if the CAMx-based system, which again was based on the BAAQMD data bases, replicates the CMAQ-based air quality modeling predictions, then the CAMx-based system is also adequate for use in further air quality studies.

The average daily gross error and average daily bias for ozone and $PM_{2.5}$ between the BAAQMD CMAQ-based predictions, and completed CAMx-based prediction that is the subject of this study were computed for each month of 2016 and each California County. As these numbers were small, it was deemed that the CAMx-based system was suitable, and performed well for use in this effort.

9.0 CAMX MODELING RESULTS

The CAMx modeling results are presented in this section. Section 8.1 compares the impact of Project TOG and NO_x emissions on local and regional ozone concentrations, non-mitigated and mitigated, to 2029 and 2032 baseline scenarios. A comparison of the impact of Project $PM_{2.5}$ and PM_{10} emissions, non-mitigated and mitigated, on local and regional $PM_{2.5}$ concentrations is presented in Section 8.2.

9.1 Ozone Concentration Results

Ozone modeling results are presented in Tables 8 to 11, for the CAMx 4-km grid in parts per billion by volume (ppbv), maximum average daily 8-Hour (MDA8) concentrations.

For the 2029 scenario, Tables 8 and 9 compare the Project emissions changes at the grid cell with the highest change, both non-mitigated and mitigated scenarios, to the baseline concentration results. The maximum MDA8 Project change for either scenario is 0.016%, for the non-mitigated emissions scenario.

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[19] Tanrikulu, S., S. Reid, B. Koo, Y. Jia, J. Cordova, J. Matsuoka, and Y. Fang, 2019. Fine Particulate Matter Data Analysis and Regional Modeling in the San Francisco Bay Area to Support AB617.

TABLE 8 2029 CAMX MODELING RESULTS FOR THE BASELINE AND NON-MITIGATED PROJECT SCENARIOS, DAILY MAXIMUM 8-HOUR AVERAGE OZONE, AT THE GRID CELL WITH THE HIGHEST CHANGE			
Baseline Scenario (ppbv)	**Project Scenario (ppbv)**	**Maximum Project Change (ppbv)**	**Maximum Project Change (%)**
71.637	71.648	0.011	0.016

TABLE 9 2029 CAMX MODELING RESULTS FOR THE BASELINE AND MITIGATED PROJECT SCENARIOS, DAILY MAXIMUM 8-HOUR AVERAGE OZONE, AT THE GRID CELL WITH THE HIGHEST CHANGE			
Baseline Scenario (ppbv)	**Project Scenario (ppbv)**	**Maximum Project Change (ppbv)**	**Maximum Project Change (%)**
71.637	71.646	0.010	0.014

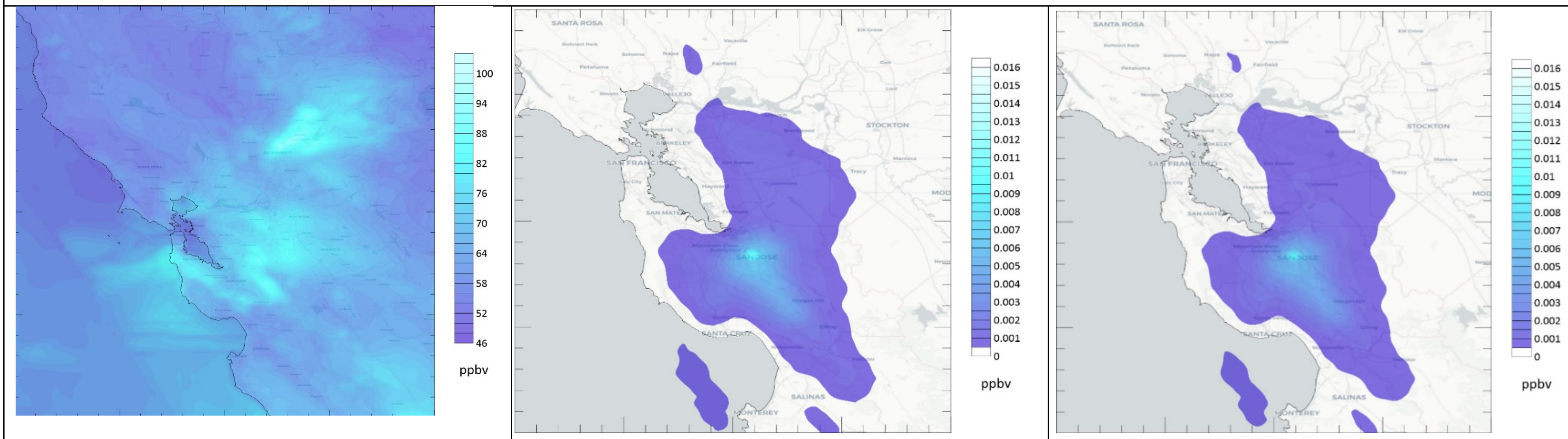
For the 2032 scenario, Tables 10 and 11 compare the Project emission changes at the grid cell with the highest change, both non-mitigated and mitigated scenarios, to the baseline concentration results. The maximum MDA8 Project change for either scenario is 0.016%, for the non-mitigated emissions scenario.

TABLE 10 2032 CAMX MODELING RESULTS FOR THE BASELINE AND NON-MITIGATED PROJECT SCENARIOS, DAILY MAXIMUM 8-HOUR AVERAGE OZONE, AT THE GRID CELL WITH THE HIGHEST CHANGE			
Baseline Scenario (ppbv)	**Project Scenario (ppbv)**	**Maximum Project Change (ppbv)**	**Maximum Project Change (%)**
67.573	67.584	0.011	0.016

TABLE 11 2032 CAMX MODELING RESULTS FOR THE BASELINE AND MITIGATED PROJECT SCENARIOS, DAILY MAXIMUM 8-HOUR AVERAGE OZONE, AT THE GRID CELL WITH THE HIGHEST CHANGE			
Baseline Scenario (ppbv)	**Project Scenario (ppbv)**	**Maximum Project Change (ppbv)**	**Maximum Project Change (%)**
67.573	67.583	0.010	0.014

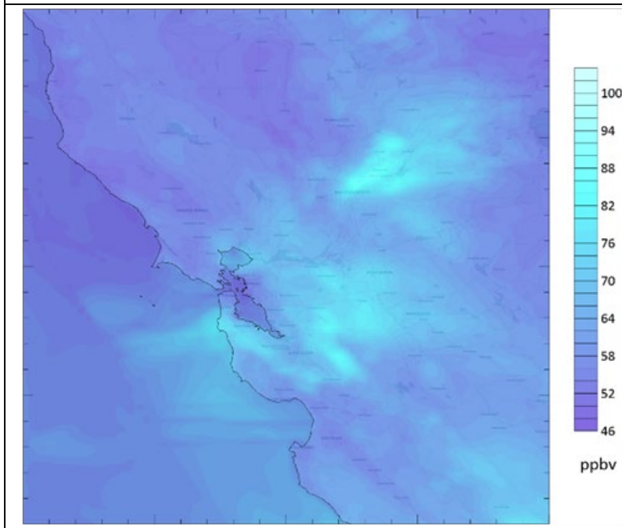
Figures 4 and 5 display the modeled MDA8 ozone concentration results for the 2029 and 2032 scenarios, comparing the difference from non-mitigated (Figure 4 and 5 central panels) or mitigated (Figure 4 and 5 right panels) Project ozone impacts, to baseline concentrations, in units of ppbv.

FIGURE 4. OZONE 2029 SCENARIO MAXIMUM DAILY 8-HOUR (MDA8) AVERAGE CONCENTRATIONS
COMPARISON OF BASELINE TO NON-MITIGATED PROJECT EMISSIONS AND PROJECT MITIGATED EMISSIONS

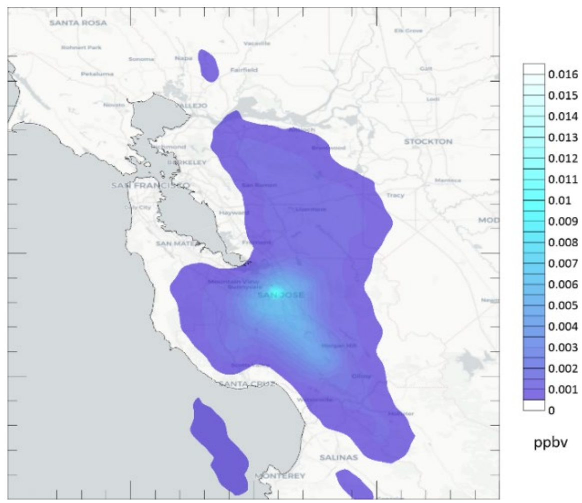


2029 Baseline Ozone MDA8 (ppbv)	2029 Ozone MDA8 Non-Mitigated Project Emissions Difference from Baseline (ppbv)	2029 Ozone MDA8 Mitigated Project Emissions Difference from Baseline (ppbv)

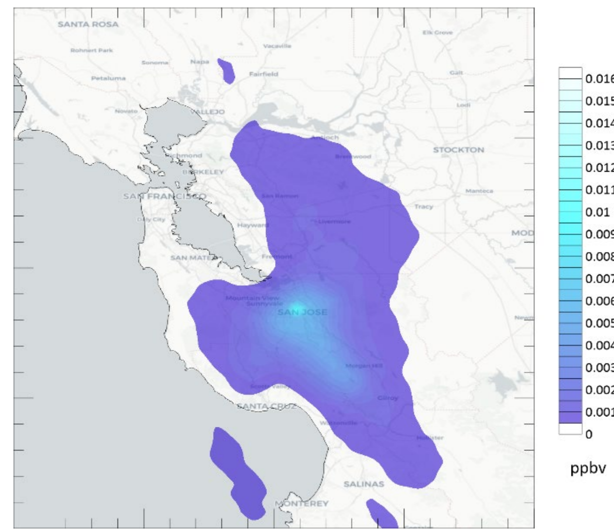
FIGURE 5. OZONE 2032 SCENARIO MAXIMUM DAILY 8-HOUR (MDA8) AVERAGE CONCENTRATIONS COMPARISON OF BASELINE TO NON MITIGATED PROJECT EMISSIONS AND PROJECT MITIGATED EMISSIONS



2032 Baseline Ozone MDA8 (ppbv)



2032 Ozone MDA8 Non-Mitigated Project Emissions Difference from Baseline (ppbv)



2032 Ozone MDA8 Mitigated Project Emissions Difference from Baseline (ppbv)

9.2 $PM_{2.5}$ Concentration Results

The $PM_{2.5}$ modeling results are presented in Tables 12 to 15, for the CAMx 4-km grid in micrograms per meters cubed (μg/m³), annual daily, or 24-hour, average $PM_{2.5}$.

For the 2029 scenario, Tables 12 and 13 compare the Project emissions changes at the grid cell with the highest change, both non-mitigated and mitigated scenarios, to the baseline concentration results. The maximum annual daily $PM_{2.5}$ Project change for either scenario is 1.0%, for the non-mitigated emissions scenario.

TABLE 12
2029 CAMX MODELING RESULTS FOR THE BASELINE AND NON-MITIGATED PROJECT SCENARIOS, DAILY AVERAGE 24-HOUR $PM_{2.5}$, AT THE GRID CELL WITH THE HIGHEST CHANGE

Baseline Scenario (μg/m³)	Project Scenario (μg/m³)	Maximum Project Change (μg/m³)	Maximum Project Change (%)
18.87	19.06	0.19	1.0

TABLE 13
2029 CAMX MODELING RESULTS FOR THE BASELINE AND MITIGATED PROJECT SCENARIOS, DAILY AVERAGE 24-HOUR $PM_{2.5}$, AT THE GRID CELL WITH THE HIGHEST CHANGE

Baseline Scenario (μg/m³)	Project Scenario (μg/m³)	Maximum Project Change (μg/m³)	Maximum Project Change (%)
18.87	19.00	0.13	0.7

For the 2032 scenario, Tables 14 and 15 compare the Project emissions changes at the grid cell with the highest change, both non-mitigated and mitigated scenarios, to the baseline concentration results. The maximum annual daily $PM_{2.5}$ Project change for either scenario is 0.84%, for the non-mitigated emissions scenario.

TABLE 14
2032 CAMX MODELING RESULTS FOR THE BASELINE AND NON-MITIGATED PROJECT SCENARIOS, DAILY AVERAGE 24-HOUR $PM_{2.5}$, AT THE GRID CELL WITH THE HIGHEST CHANGE

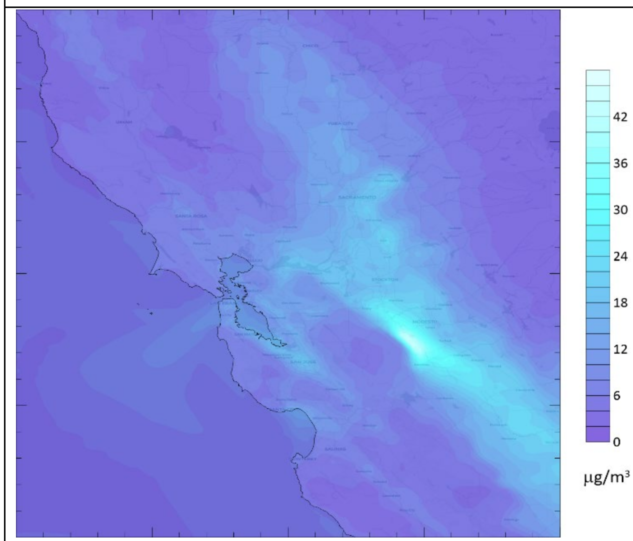
Baseline Scenario (μg/m³)	Project Scenario (μg/m³)	Maximum Project Change (μg/m³)	Maximum Project Change (%)
18.99	19.15	0.16	0.84

TABLE 15
2032 CAMX MODELING RESULTS FOR THE BASELINE AND MITIGATED PROJECT SCENARIOS, DAILY AVERAGE 24-HOUR $PM_{2.5}$, AT THE GRID CELL WITH THE HIGHEST CHANGE

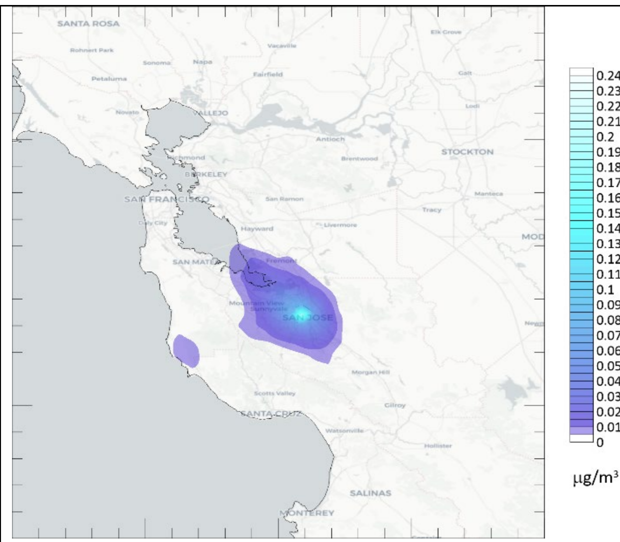
Baseline Scenario ($\mu g/m^3$)	Project Scenario ($\mu g/m^3$)	Maximum Project Change ($\mu g/m^3$)	Maximum Project Change (%)
18.99	19.12	0.12	0.65

Figures 6 and 7 display the modeled annual daily 24-hour $PM_{2.5}$ for the 2029 and 2032 scenarios, comparing the difference from non-mitigated (Figure 6 and 7 central panels) or mitigated (Figure 6 and 7 right panels) Project $PM_{2.5}$ impacts, to the baseline concentrations, in units of ($\mu g/m^3$).

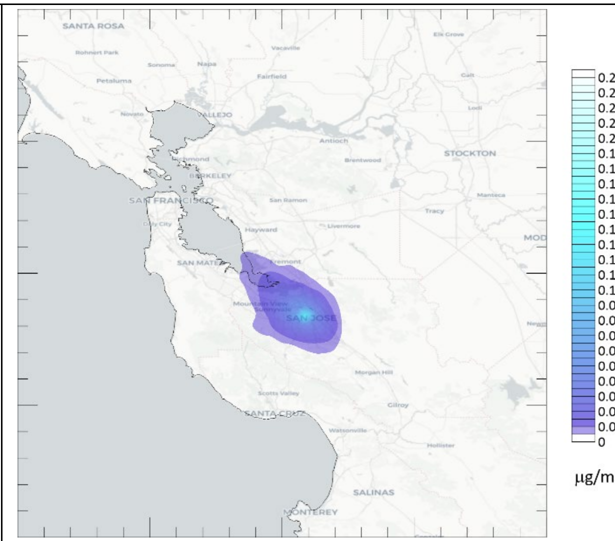
FIGURE 6. $PM_{2.5}$ 2029 SCENARIO ANNUAL 24-HOUR AVERAGE CONCENTRATIONS
COMPARISON OF BASELINE TO NON-MITIGATED PROJECT EMISSIONS AND PROJECT MITIGATED EMISSIONS



2029 Baseline Annual 24-hour Average $PM_{2.5}$ (µg/m³)

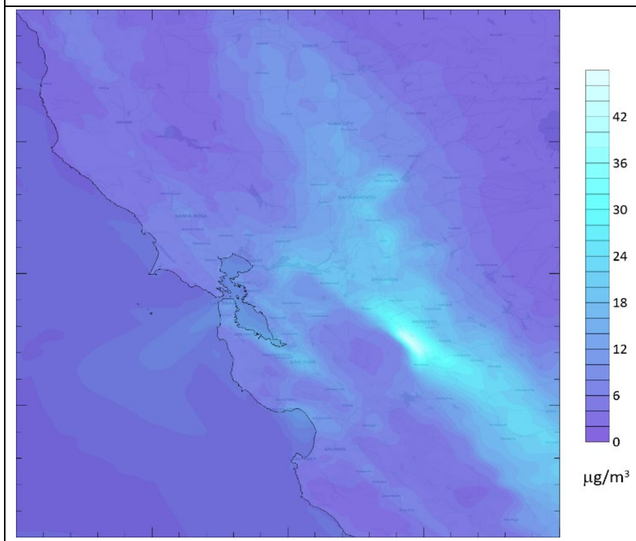


2029 $PM_{2.5}$ Non-Mitigated Project Emissions Difference from Baseline (µg/m³)

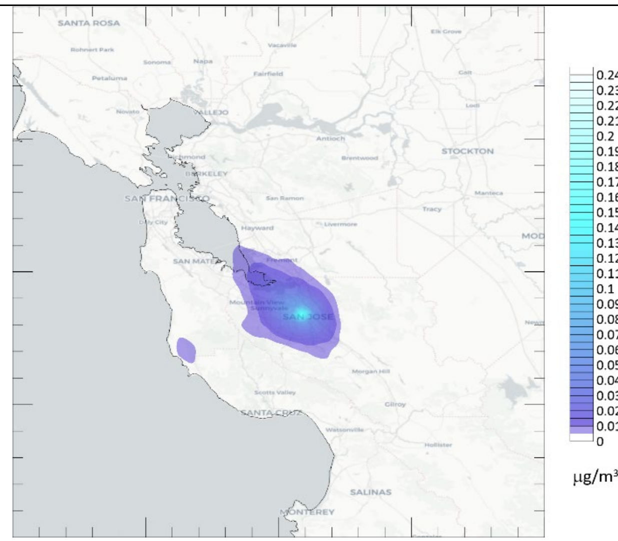


2029 $PM_{2.5}$ Mitigated Project Emissions Difference from Baseline (µg/m3)

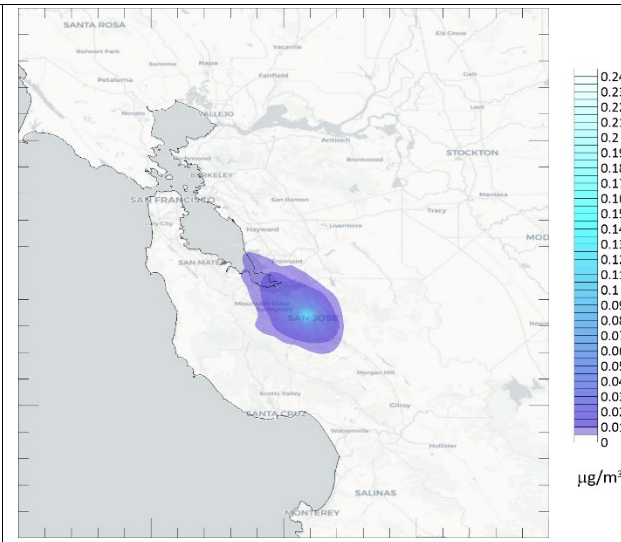
FIGURE 7. $PM_{2.5}$ 2032 SCENARIO ANNUAL 24-HR AVERAGE CONCENTRATIONS
COMPARISON OF BASELINE TO NON-MITIGATED PROJECT EMISSIONS AND PROJECT MITIGATED EMISSIONS



2032 Baseline Annual 24-hour Average $PM_{2.5}$ (µg/m³)



2032 $PM_{2.5}$ Non-Mitigated Project Emissions Difference from Baseline (µg/m³)



2032 $PM_{2.5}$ Mitigated Project Emissions Difference from Baseline (µg/m³)

10.0 UNCERTAINTY IN CAMX PHOTOCHEMICAL MODELING

Uncertainty addresses the potential variability in photochemical modeling concentration results. Variability in a value is due to the differences in the value among different members of a population (e.g., ozone or $PM_{2.5}$ measurements from identical instruments over a common area, precipitation measured from identical rain gauges over a common area). Variability represents heterogeneity in a well-characterized population and is usually not reducible through further measurement. Uncertainty in a value arises due to lack of knowledge regarding the true value of a quantity for a given member of a population (e.g., an emissions factor used to characterize emissions from automobiles, speciation factor to split total organic gases into its constituent chemical species). Uncertainty represents lack of perfect knowledge about poorly characterized phenomena and is sometimes reducible through further measurement.

There has been much research on sensitivities and uncertainties regarding the evaluation of environmental models.[20,21,22] It is widely recognized that validation of a chemical transport model is impossible because natural systems are never closed, and results are always unique. Thus a model can be evaluated by comparisons with observations, but it can never be fully validated because the full array of possible scenarios cannot be included.

A computational photochemical model such as CAMx is used to describe through mathematical representation, the complex and dynamic physical and chemical processes occurring in the atmosphere, in order to calculate regional air pollutant concentration impacts due to anthropogenic and biogenic emissions.[23] As an attempt to mathematically represent physical reality, CAMx modeling is subject to uncertainty that can cause error in model outputs. These uncertainties must be understood to properly validate and interpret CAMx model results.

Uncertainty and error in CAMx predictions arise due to uncertainty and error in the data input to CAMx (e.g., emissions estimates, boundary conditions, meteorological

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[20] Hanna, S. R., Z. Lu, H. C. Frey, N. Wheeler, J. Vukovich, S. Arunachalam, M. Fernau, and D. A. Hansen, 2001. Uncertainties in predicted ozone concentrations due to input uncertainties for the UAM-V photochemical, grid model applied to the July 1995 OTAG domain. *Atmospheric Environment.* 35:891-903.

[21] Biswas, J. and S.T. Rao, 2001. Uncertainties in Episodic Ozone Modeling Stemming from Uncertainties in the Meteorological Fields. *J. Appl. Meteor.*, 40, 117–136, https://doi.org/10.1175/1520-0450(2001)040<0117:UIEOMS>2.0.CO;2

[22] Baker, K. R. and J. O. Bash, 2012. Regional Scale Photochemical Model Evaluation of Total Mercury Wet Deposition and Speciated Ambient Mercury. *Atmospheric Environment*. 49(3):1-424.

[23] Leary R., 1976. Mathematical Models. *In Boundaries of Analysis*. Cambridge, MA: Ballinger.

predictions, chemistry, grid resolution, and model formulation) as well as the model formulation itself.[24,25]

Estimates of emissions are typically the most uncertain inputs to a photochemical model.[26] Emissions estimates include those from on- and off-road mobile sources (e.g., cars, trucks, agricultural equipment such as combines and tractors, airplanes, and ocean-going vessels, lawnmowers), biogenics, stationary sources (e.g., power plants, large dairies), and area sources (e.g., restaurant charbroiling, gasoline stations), among others. A vast amount of data is necessary to estimate emissions from these sources (e.g., fuel consumption, number of lawnmowers, number of cows) utilizing other models (e.g., the Biogenic Emissions Inventory System[27], SMOKE[28]) and tools. Given the suspect quality of some of these data, it is not surprising that there exist large uncertainties in the resulting emissions estimates that are input to CAMx.

Observational data or attendant climate model predictions that are used to initialize the meteorological and photochemical models, provide boundary conditions, or evaluate model performance are uncertain due to limited characterization of their spatial and temporal variability. Observational data are variable and uncertain due to monitoring equipment, user error, monitoring network design, and issues with proper instrument calibration. Some pollutant species are easier to measure than others. For example, measurements of NOx may actually capture NO_y, which includes NO_x plus products of NO_x oxidation.[29]

WRF too is a mathematical representation of the atmospheric processes that drive weather; thus, it is also subject to uncertainties in model formulation and model inputs. The meteorological model relies on observations typically lacking in the spatial and temporal detail needed to initialize meteorological fields. The application of four-dimensional data assimilation dampens the temporal growth in errors by causing model results to conform to observations at regular intervals.[30] Specifically, the three components of wind velocity calculated as a function of time are nudged toward

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[24] Sathya V., A. G. Russel, S. Perego, M. Maignan, M. Junier, A. Clappier, and H. van den Bergh, 2000. Uncertainties in photochemical grid modeling of ozone. In: van Ham J., Baede A.P.M., Meyer L.A., Ybema R. (eds) Non-CO2 Greenhouse Gases: Scientific Understanding, Control and Implementation. Springer, Dordrecht.

[25] Fine, J., L. Vuilleumier, S. Reynolds, P. Roth, and N. Brown, 2003. Evaluating Uncertainties in Regional Photochemical Air Quality Modeling. *Atmos. Rev. Environ. Resour.* 28:59-106.

[26] NRC, 1991. Natl. Res. Counc. *Rethinking the Ozone Problem in Urban and Regional Air Pollution.* Washington, DC: Natl. Acad. 3. Off. Technol.

[27] EPA, 2018-. Biogenic Emissions Inventory System (BEIS). www.epa.gov/air-emissions-modeling/biogenic-emission-inventory-system-beis (last accessed 20-aug-2019).

[28] CMAS, 2018. SMOKE. www.cmascenter.org/smoke/index.cfm (last accessed 20-Aug-2019).

[29] CARB, 1992. *Technical Guidance Document: Photochemical Modeling*. Calif. EPA, Calif. Air Resources Board, Sacramento, CA 9. Morgan MG, Henrion M.

[30] Stauffer D, Seaman N., 1990. Use of four dimensional data assimilation in a limited area mesoscale, part I: experiments with synoptic data. *Mon. Weather Rev*. 118:1250–77.

measured values, and in so doing, reduces the amount of observational data remaining for performance evaluation. Thus, the WRF meteorological predictions that are input to CAMx are subject to uncertainty.

A complete understanding of atmospheric chemistry is unknown. The atmosphere has hundreds to thousands of chemical species that participate in thousands of chemical reactions. How fast these reactions take place and the products of these reactions are still not well known.[31] Even if known completely, atmospheric chemistry cannot be represented in its entirety because it would impose excessive computational demands.[32]

Additional uncertainty can be introduced due to the choice of grid resolution. It is well known that grid resolution can impact model predictions.[33] Further, studies have shown that the use of air quality model predictions at various grid resolutions can impact predicted health outcomes.[34]

Uncertainties associated with model formulation (e.g. representing atmospheric turbulence, processes that remove chemicals from the atmosphere, representation of aerosol formation and portioning to aerosol sizes [$PM_{2.5}$, PM_{10}], and the numerical techniques used to solve the mathematical equations) are generally incomplete representations. Simplified representations are necessary when knowledge is incomplete, or when a more precise formulation excessively increases computational requirements. Further, there typically exists more than one formulation to represent a process, thus, choosing one inevitably means accepting some uncertainties over another.[35,36]

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[31] North American Research Strategy on Tropospheric Ozone, 2000. Chapter 4: The air-quality modeling system. In *An Assessment of Tropospheric Ozone Pollution: A North American Perspective*. Palo Alto, CA: Electric Power Res. Inst./NARST).

[32] Russell, A., and R. Dennis, 2000. NARSTO critical review of photochemical models and modeling. *Atmospheric Environment*. 34, 2283-2324.

[33] N. Gillani and J. E. Pleim, 1996. Sub-grid-scale features of anthropogenic emissions of NO_x and VOC in the context of regional eulerian models. *Atmospheric Environment.* 30(12):2043-2059.

[34] Thompson, T. and S, Noelle, 2012. Influence of Air Quality Model Resolution on Uncertainty Associated With Health Impacts. *Atmospheric Chemistry & Physics*. 12. 9753-9762. 10.5194/acp-12-9753-2012.

[35] NRC, 1991. Rethinking The Ozone Problem In Urban And Regional Air Pollution. Committee on Tropospheric Ozone Formation and Measurement. National Research Council, National Academy Press, Washington, D.C. www.nap.edu/books/0309046319/html/index.html

[36] Barchet, W. R., P. M. Roth, and T. W. Tesche, 1994. Evaluating the Risks of Developing Inaccurate Emissions Control Recommendations Using Regional Photochemical Air Quality Simulation Models, prepared for the Electric Power Research Institute, prepared by Batelle Pacific Northwest Laboratory, Envair, and Alpine Geophysics, LLC.

APPENDIX A

WRF/CAMx Modeling Input and Output (list of electronic files)

The input and output files used and generated by the WRF and CAMx models are detailed in the following table.

NOTE: An asterisk (*) indicates a wildcard, meant to indicate one or more files following that file naming pattern. Most filesets in this list contain one file per day for an entire year (modeled or meteorological).

TABLE A-1
MODELING INPUT AND OUTPUT FILES

Filename	Description
Input files	
input/wrf/wrfout_d03_2015-12-31 … input/wrf/wrfout_d03_2016-12-31	WRF output files from BAAQMD, grid number 3 (1-km resolution), used as input for CAMx.
input/camx/bcon/bc.camx.20160101.bin … input/camx/bcon/bc.camx.20161231.bin	CAMx boundary condition files. One file per day.
input/camx/bcon/ic.camx.2016*	CAMx initial condition files. Monthly files.
input/camx/tuv/tuv.do_SAPRC07.20160101 … input/camx/tuv/tuv.do_SAPRC07.20161231	CAMx photolysis input files. One file per day.
input/camx/o3map/o3map.20160101.bin … input/camx/o3map/bc.camx.20161231.bin	CAMx ozone map input files. One file per day.

TABLE A-1
MODELING INPUT AND OUTPUT FILES

Filename	Description
Input/camx/chem/CAMx6.5.chemparam.SAPRC07_CF_SOAP_ISORROPIA	CAMx SAPRC 2007 chemical parametrization file
input/camx/met/camx.lu	CAMx static surface geophysical parameters (land use, terrain).
input/camx/met/camx.3d.2016010100 … input/camx/met/camx.3d.2016123100	CAMx meteorological 3D data files. One file per day.
input/camx/met/camx.2d.2016010100 … input/camx/met/camx.2d.2016123100	CAMx meteorological 2D surface data files. One file per day.
input/camx/met/camx.kv.2016010100.YSU … input/camx/met/camx.kv.2016123100.YSU	CAMx meteorological vertical diffusivity data files. One file per day.
input/camx/met/camx.cr.2016010100 … input/camx/met/camx.cr.2016123100	CAMx meteorological cloud/rain data files. One file per day.
input/camx/met/camx.cr.2016010100 … input/camx/met/camx.cr.2016123100	CAMx meteorological cloud/rain data files. One file per day.
input/camx/point/2029/base/point.camx.20160101.bin … input/camx/point/2029/base/point.camx.20161231.bin	CAMx point source emissions files. Base scenario 2029. One file per day.

TABLE A-1
MODELING INPUT AND OUTPUT FILES

Filename	Description
input/camx/point/2032/base/point.camx.20160101.bin … input/camx/point/2032/base/point.camx.20161231.bin	CAMx point source emissions files. Base scenario 2032. One file per day.
input/camx/point/2029/unmitigated/point.camx.20160101.bin … input/camx/point/2029/unmitigated/point.camx.20161231.bin	CAMx point source emissions files. Unmitigated project scenario 2029. One file per day.
input/camx/point/2029/mitigated/point.camx.20160101.bin … input/camx/point/2029/mitigated/point.camx.20161231.bin	CAMx point source emissions files. Mitigated project scenario 2029. One file per day.
input/camx/point/2032/unmitigated/point.camx.20160101.bin … input/camx/point/2032/unmitigated/point.camx.20161231.bin	CAMx point source emissions files. Unmitigated project scenario 2032. One file per day.
input/camx/point/2032/mitigated/point.camx.20160101.bin … input/camx/point/2032/mitigated/point.camx.20161231.bin	CAMx point source emissions files. Mitigated project scenario 2032. One file per day.
input/camx/emiss/2029/base/emiss.camx.20160101.bin … input/camx/emiss/2029/base/emiss.camx.20161231.bin	CAMx 3d gridded emissions files. Base scenario 2029. One file per day.
input/camx/emiss/2032/base/emiss.camx.20160101.bin … input/camx/emiss/2032/base/emiss.camx.20161231.bin	CAMx 3d gridded emissions files. Base scenario 2032. One file per day.

TABLE A-1
MODELING INPUT AND OUTPUT FILES

Filename	Description
input/camx/emiss/2029/unmitigated/emiss.camx.20160101.bin … input/camx/emiss/2029/unmitigated/emiss.camx.20161231.bin	CAMx 3d gridded emissions files. Unmitigated project scenario 2029. One file per day.
input/camx/emiss/2029/mitigated/emiss.camx.20160101.bin … input/camx/emiss/2029/mitigated/emiss.camx.20161231.bin	CAMx 3d gridded emissions files. Mitigated project scenario 2029. One file per day.
input/camx/emiss/2032/unmitigated/emiss.camx.20160101.bin … input/camx/emiss/2032/unmitigated/emiss.camx.20161231.bin	CAMx 3d gridded emissions files. Unmitigated project scenario 2032. One file per day.
input/camx/emiss/2032/mitigated/emiss.camx.20160101.bin … input/camx/emiss/2032/mitigated/emiss.camx.20161231.bin	CAMx 3d gridded emissions files. Mitigated project scenario 2032. One file per day.
Output files	
output/all/2029/base/results.20160101.avrg.grd01.nc … output/all/2029/base/results.20161231.avrg.grd01.nc	CAMx output files. NetCDF format. Base scenario 2029. One file per day.
output/all/2032/base/results.20160101.avrg.grd01.nc … output/all/2032/base/results.20161231.avrg.grd01.nc	CAMx output files. NetCDF format. Base scenario 2032. One file per day.

TABLE A-1 MODELING INPUT AND OUTPUT FILES	
Filename	**Description**
output/all/2029/unmitigated/results.20160101.avrg.grd01.nc … output/all/2029/unmitigated/results.20161231.avrg.grd01.nc	CAMx output files. NetCDF format. Unmitigated project scenario 2029. One file per day.
output/all/2029/mitigated/results.20160101.avrg.grd01.nc … output/all/2029/mitigated/results.20161231.avrg.grd01.nc	CAMx output files. NetCDF format. Mitigated project scenario 2029. One file per day.
output/all/2032/unmitigated/results.20160101.avrg.grd01.nc … output/all/2032/unmitigated/results.20161231.avrg.grd01.nc	CAMx output files. NetCDF format. Unmitigated project scenario 2032. One file per day.
output/all/2032/mitigated/results.20160101.avrg.grd01.nc … output/all/2032/mitigated/results.20161231.avrg.grd01.nc	CAMx output files. NetCDF format. Mitigated project scenario 2032. One file per day.

APPENDIX B

RESUMES

James A. Westbrook

President
Principal Air Quality Scientist

Expertise

Air Quality Permitting & Compliance
Litigation Support
Strategic Business and Project Management
Mitigation Programs
Greenhouse Gas Management
Air Dispersion Modeling
CEQA Air Quality Impact Analysis
Chemical Spill Risk Management
Health Risk Assessment
Air Emissions Inventories
Emissions Credit Banking

Industry Focus

Power Generation
Refineries and Chemical Plants
Oil and Gas Production
LNG Facilities
Aggregate and Asphalt Production
Coating Operations
Pharmaceuticals

Building Materials Manufacturing
Aerospace Industry
Metal Plating Operations
General Manufacturing

Education

MS, Environmental Science, Indiana Univ.
BS, Atmospheric Sciences, UCLA

Certifications

Certified Consulting Meteorologist (CCM)
Certified Permitting Professional (CPP)

Associations / Memberships

American Meteorological Society
Air & Waste Management Association
California Alliance for Distributed Energy Resources (CADER)
LA Bar Association
CA Climate Action Registry

Company Background

BlueScape
Kleinfelder
ENVIRON Corporation
Engineering-Science, Inc.

Summary of Experience

In 1997, James A. Westbrook, founded BlueScape Environmental (BlueScape) to help businesses achieve practical, cost-effective air quality compliance solutions. Since then, he has independently grown BlueScape by way of exceptional skills in strategic business planning, marketing, and project management. BlueScape currently serves businesses with annual revenues in excess of one billion dollars, including power generation and manufacturing companies, developers and consulting firms.

Mr. Westbrook helps clients to obtain air permits and achieve strategic business goals by drawing upon his expert skills in regulatory analysis & negotiation, air emissions calculations, greenhouse gas emissions management, dispersion modeling, and human health risk and exposure assessment. Mr. Westbrook serves as an expert witness in litigation cases involving air emissions estimates, dispersion modeling, and health risk assessment. To provide superior customer service, he has assembled a team of engineers and scientists with a wide range of experience and knowledge with industrial equipment, emission control technologies, computer emissions and dispersion modeling tools, and agency contacts throughout the U.S.

Mr. Westbrook actively speaks to industry trade groups regarding air quality compliance issues. He is the co-instructor for the only publicly available training course on the Hotspots Analysis and Reporting Program (HARP) risk assessment software. His work background includes experience obtained at Kleinfelder in Pleasanton, CA, ENVIRON Corporation in Emeryville, CA, and Parsons Engineering-Science in Pasadena, California.

His formal education includes an M.S. in Environmental Science from Indiana University, Bloomington and a B.S. in Atmospheric Sciences from UCLA. He is a Certified Consulting Meteorologist (CCM) and is recognized as a Certified Permitting Professional (CPP) by the South Coast Air Quality Management District. Mr. Westbrook is listed as a CEQA Consultant for Air Quality by the County of San Diego, Planning Department.

Select Project Experience:

Human Health Risk and Exposure Assessment

- ***Diesel Health Risk Assessment, Boeing Corporation, Long Beach***. Project Manager for completion of a health risk assessment for diesel PM emissions from 18 emergency and portable generators at Boeing's facilities in Long Beach. The work was completed using the HARP software. The purpose of the study was to evaluate the potential impacts from the engines, if included in a proposed South Coast Air Quality Management District air toxics rule. The results from the study were used to determine the location and time needed to operate the engines and be in compliance with the proposed rule.

- ***Comprehensive Proposition 65 Audits, Confidential Power Producer, California***. For a confidential independent power producer, completed comprehensive Prop 65 audits for six facilities. The facilities combust petroleum coke, a byproduct of refining. Potential exposure areas covered included occupational and visitor, water discharges, air discharges, and exposure to a co-product from the electricity generation process. A report was prepared stating conclusions and whether there was a need to warn the community.

- ***Duwamish Regional Health Risk Assessment, Seattle, Washington.*** Teamed with Dillingham Software Engineering (DSE), the developer of California Air Resources Board Hotspots Analysis and Reporting Program (HARP), to complete a regional health risk assessment for the Duwamish River Valley just to the south of downtown Seattle. The modeling and health risk study included on-road diesel emissions sources, wood stoves, and criteria pollutant and air toxic emissions from more than 200 industrial facilities. BlueScape was responsible for developing the industrial facility air toxics emissions inventory, and completing a report utilizing modeling output provided by DSE. The study was sponsored by the Washington Department of Health.

- ***AB2588 Health Risk Assessments, Multiple California Facilities***. Project Manager or Technical Lead for more than 20 AB2588 health risk assessment projects for industrial facilities located in Southern California. These included 10 Southern California Edison power plants, a fiberglass manufacturing facility, a spice processing plant, a plumbing supplies plant, the Kwikset manufacturing facility in Anaheim, two petroleum processing/refining facilities, two small parts coatings facilities (hexavalent chromium-based pigments), a resin manufacturer, a specialty resistor manufacturer and two aerospace part manufacturers. Used the SCREEN3 and ISCST3 dispersion models and the ACE2588 and HRA health risk assessment models to calculate and report health risks.

- ***New Source Review Air Permitting Health Risk Assessments, Multiple California Facilities.*** Project Manager or Technical Lead for completing health risk assessments to obtain air permits for a wide range of industrial emission sources located in California, for example, three separate air strippers, a can manufacturing facility, a landfill gas flare, two wood cabinet manufacturing facilities, a fiberglass manufacturing facility, a major refinery, and a power generation company. In the process of obtaining air permits, BLUESCAPE has used techniques ranging from consulting look-up tables and screening dispersion modeling, to full refined dispersion modeling and risk calculations.

- ***Benzene Exposure Analysis, Confidential Refinery, Appalachian Region***. Lead dispersion modeler for an analysis of potential human exposure to benzene emitted from wastewater processing operations at a medium-sized petroleum refinery. Used the ISCST and COMPLEXI models to estimate ground-level impacts due to fugitive sources such as tanks, pipes, and ponds, as well as point sources such as cooling towers. Estimated potential excess cancer risk under various exposure scenarios, accounting for population mobility, indoor concentrations relative to outdoor concentrations, and movement of population between various microenvironments.

- ***Evaluation of U.S. EPA's use of the HAPEM Exposure Model to Estimate Benzene Emissions from Mobile Sources, Confidential Client***. Lead modeler for evaluating U.S. EPA's application of the HAPEM exposure model to mobile source pollutants, especially benzene. Downloaded CO monitoring data from the Aerometric Information Retrieval System. Using statistical and graphical methods, analyzed the relationship between ambient measurements of CO and tailpipe benzene emissions to critically evaluate U.S. EPA's methodology.

Air Permitting: Minor New Source Review, PSD and Title V Air Permitting

- ***Refinery Integration and PSD Review, Annual Emissions Reporting, Confidential Midwest Refineries.*** Project Manager for securing air permits and avoiding major PSD permitting for integration of two refineries located in the Midwest, separated by one mile. Conducted PSD Review of such issues as stationary source definition and common control, project aggregation, projected actual emissions, and capable of accommodating. In addition to integration of refinery operations, future projects included physical modifications and new units. Because the state determined that integration of both refineries was a change in method of operation, any future emissions increases above baseline would trigger major PSD permitting. BlueScape developed a method to use Projected Actual Emissions for integration plus aggregated projects to help the refineries avoid PSD. In addition to PSD review, the refineries hired BlueScape to develop a consistent Annual Emissions Reporting framework for both refineries and create a GHG emissions reporting plan under EPA's MRR program.

- ***Hydrogen Plant Permits, Chevron Refinery, El Segundo, California.*** Project Manager for securing installation permits for a new hydrogen plant, including a 780 MMBtu/hr heater, SCR system, process vents and components. The project was required to replace an old, existing plant under an Order for Abatement. Successfully negotiated installation of the project without requiring scarce and expensive emission credits (PM_{10}, 176 lb/day) that would have rendered the project impossible. Functionally identical replacement and concurrent modification offset exemptions were proposed and accepted by the South Coast AQMD. Negotiated permit conditions to provide operational flexibility during commissioning and startup conditions. Completed dispersion modeling using SCREEN3 and ISCST3 to show that short-term and long term operations will not cause or contribute to an exceedance of the health standards. Completed emission calculations and assembled all supporting documentation required as part of the rule review. Permits were issued in only six months, much less than the typical 1-2 years for similar projects, allowing the plant to be built and started as scheduled. BlueScape was a subcontractor to the Denali Group.

- ***CEC Licensing and Air Quality Permits, Eastshore Energy Facility, Hayward, California.*** Air Quality Project Manager for CEC licensing and air quality permitting for a 115.5 MW peaking power plant consisting of 14 natural gas-fired lean-burn engines. CEC application work supported the Air Quality and Public Health sections of the AFC, including construction emissions and modeling and the health risk assessment. Developed a CEQA PM10 mitigation plan provided to CEC. Participated in workshops and public meetings to resolve issues. Developed air permit conditions for the BAAQMD Final Determination of Compliance (PDOC).

- ***PSD Permit, Confidential Fiberglass Manufacturer, Northern California****.* Project Manager for completion of a PSD air permit application for a fiberglass manufacturing facility located in Northern California. Work included an air quality modeling analysis for PM_{10} and CO emissions. The facility's compliance with federal ambient air quality standards and with allowable PSD increment consumption was assessed. Mr. Westbrook assisted with preparation of a PM_{10} pre-construction monitoring and QA/QC plan, addressing monitor siting issues.

- ***Expedited Distributed Generation Air Permits, RealEnergy Inc., California.*** Managed Phase I & II installation of clean gas-fired internal combustion engines in 10 sites located in the South Coast Region and San Diego County of California. Worked with team members Resource Catalysts and Environmental Compliance Solutions under a very aggressive schedule to successfully obtain permits. Providing RealEnergy with ongoing permitting and compliance management support.

- ***CEC Siting Application for a 62 MW Peaker Turbine Facility, RAMCO Inc. & PG&E, California.*** Project leader with team member Resource Catalysts and other consultants; developed and submitted the licensing application for a peaking generation plant under the California Energy Commission 21-day expedited review process.
- ***Backup Diesel Engine Air Permits, EDS Corporation and the U.S. Navy.*** As subcontractor to Rancho Santa Fe Technologies, prepared air permit applications for five 1 MW diesel-fired engines as part of the U.S. Naval global military intranet system called "SPAWARS."

- ***Title V Permits, Peaking Power Plant, Chowchilla, California.*** BlueScape is prepared Title V permit applications for a peaking power plant consisting of 16 lean-burn gas engines, located in Chowchilla in the Valley Air District. The facility recently entered the program due to lowering of the Title V thresholds of NOx and VOC.

- ***SIP Permit, Confidential Fiberglass Manufacturer, West Virginia****.* Project Manager for completion of air dispersion modeling services for a fiberglass manufacturing facility located in West Virginia. The work was performed to assess the effect of changing the West Virginia State Implementation Plan on attainment of area PM_{10} NAAQS. On-site meteorological data was processed for multiple tower levels. The SCREEN3 model was used to reduce the number of nearby sources to be included in the NAAQS modeling analyses. The IGM model with ISCST and RTDM was used to model impacts from facility sources. ISCST and COMPLEX I were used to model impacts from nearby sources.

- ***Synthetic Minor Air Permits, Three Prestolite Wire Corporation Facilities in the Midwest and Eastern US****.* Project Manager for completion of synthetic minor air permit applications for telecommunication and automotive wire manufacturing facilities located in Nebraska and Arkansas. Assisted facilities in preparing up-to-date emission inventories and avoiding Title V permitting requirements. For a third facility located in Georgia, negotiated with air pollution control agency staff to obtain an exemption from State air permitting requirements.

- ***PSD Permit, Confidential Fiberglass Manufacturer, Georgia****.* Managed and completed the modeling study to support a PSD application submittal for a fiberglass manufacturing facility located near Atlanta. The facility proposed to add sodium nitrate to raw batch materials to reduce odor-causing emissions of hydrogen sulfide from a melter. As a result, PSD for NO_2 was triggered. The project involved estimating process emissions of criteria pollutants, assessing compliance with NAAQS and increment thresholds for NO_2, and completing other required PSD analyses, including a visibility screening analysis.

- ***Synthetic Minor Air Permit, Fisher-Hamilton Scientific, Two Rivers, Wisconsin***. Project Manager for completion of a Federally Enforceable State Operating Permit (FESOP) application for a wood furniture manufacturer. Our staff assisted the facility in implementing strategic measures to reduce VOC emissions and avoid Title V permit requirements. Calculations were performed for both actual and potential emissions based on future production scenarios, and drafted permit limits.

- ***Title V Permits, Three California Facilities.*** Assisted with completion of Title V permit applications for the Owens-Brockway glass facility in Tracy, California, the Lodi Metal Tech Facility in Lodi, California, and the Sony Electronics facility in San Diego, California. Lists of Title V-applicable regulations were developed for the facilities, and application forms were completed using client-supplied information.

- ***Air Permits, Confidential Fiberglass Facility, Southern California.*** Assisted a fiberglass facility in obtaining a modified air permit for an increase in production capacity on a highly restricted line. Although no net increase in emissions was expected following regulatory definitions, the permitting agency wanted air emission increases to be calculated using a restrictive methodology. This methodology triggered a Rule 1401 health risk assessment and led to delays in the permitting process. Assisted the facility throughout the process by analyzing the effect of agency requirements and presented ways to express production limits in a manner that would move the project forward. Ultimately, BlueScape succeeded in showing that the facility could expand production without causing significant health risk impacts or requiring emissions offsets. The facility received the modified air permit.

<u>Air Dispersion Modeling Analyses</u>

- ***AERMOD Modeling, Bradwood Landing LNG Terminal, Oregon.*** As a subcontractor to SRA, used the AERMOD model to assess impacts from a proposed Bradwood Landing LNG carrier vessel offloading terminal on the Columbia River. Developed an air dispersion modeling protocol in consultation with the Oregon Department of Environmental Quality. Analyzed impacts of emissions from submerged combustion vaporizers at rugged terrain along the banks of the river. Assisted the design team with exhaust design to optimize engineering design and satisfy applicable air quality thresholds.

- ***OCD Modeling, Clearwater Port LNG Terminal, Ventura, California*****.** As a subcontractor to SRA, used the Offshore and Coastal Dispersion Model to assess overwater and onshore impacts from a proposed LNG offloading terminal and regasification platform 13 miles off Ventura County. Developed an air dispersion modeling protocol and completed modeling in consultation with the US EPA and the US Coast Guard.
- ***LAX Construction Equipment Modeling Study, Los Angeles, California***. As a subcontractor to ECS, completed a dispersion modeling analysis for the proposed expansion of the Los Angeles International Airport. The majority of emissions resulted from diesel-fueled construction equipment. In order to show compliance with the Federal and State ambient air quality standards, completed ISCST3 air dispersion modeling using the ozone limiting technique for NOx emissions.

- ***PSD Modeling Study, Columbia Ridge Landfill, Arlington, Oregon.*** As a subcontractor to SCS Engineers, managed completion of a dispersion modeling study to assess impacts from increased fugitive PM10 emissions from a landfill. Impacts modeled using AERMOD were compared to the Oregon state ambient standards and increment levels. The project was particularly challenging given the amount of emissions from ground-level sources. Worked closely with the prime contractor to refine the modeling study emissions and source parameter inputs so that future operations will be in compliance with the standards.

- ***Odor Modeling, San Diego Metropolitan Wastewater District (SDMWD), San Diego, California.*** Completed dispersion modeling study using the ISCST3 model to assess potential odor impacts and health risks. The San Diego MWD planned construction of a Wet Weather Storage Facility (WWSF), consisting of two 7 million gallon underground storage tanks, to handle future peak wastewater flows during storm events. Required analysis of potential nuisance odors and health risk impacts as compared to thresholds established by the San Diego APCD under Rule 1200 for surrounding businesses. Developed engineering design data, such as stack height, air flows, and scrubber control efficiency that would be required to meet City's odor design standards of 5 odor units (OU). Used conservative modeling and exposure assumptions, to show that odor impacts and health risks from the Wet Weather Storage Facility would meet design requirements.

- ***Air Dispersion Modeling & Health Risk Assessment, THUMS, Inc., Long Beach, California*.** Owner of natural gas and petroleum production fields, planned to site a 44 MW simple-cycle turbine facility in Long Beach harbor to provide onsite electricity for well pumping. Needed modeling and HRA to show that operation was in compliance with South Coast Air District Rules 1303 and 1401. Modeled impacts from criteria pollutants (NOx, PM10, etc.), ammonia slip, and air toxics found at three candidate site locations. Examined the effect of different stack heights, and the effect of building downwash on air quality impacts. For each candidate site, determined a stack configuration that would result in compliance with the district rules.

- ***Ambient Air Quality Analysis, Motorola 52nd Street, Phoenix, Arizona***. Lead dispersion modeler for an ambient air quality analyses performed for a semiconductor manufacturing facility. Estimated off-site air quality impacts using the ISCST and SHORTZ dispersion models. From estimates of off-site concentrations and emissions data, compared modeling results to state ambient air quality guidelines. Completed feasibility studies to evaluate the impact of modifying facilities.

- ***Stack Increase Study, Confidential Metal Container Manufacturer, Southern California.*** Entrainment of sulfuric acid emissions released from three stacks into building ventilation intakes was apparently resulting in poor product finish quality for some can batches. As a subcontractor to Kleinfelder, made visual observations at the site and confirmed a potential problem during strong northeast winds. Using the ISCST3 model and ASHRAE guidance, stack height increases needed to avoid intake contamination were estimated. Reconstruction of the stacks was commenced based upon study recommendations.

- ***Indoor Contamination Study, Confidential Hospital, Nevada***. A hospital in Nevada was evaluating reports of health effects possibly caused by indoor pollutant contamination. An investigation of rooftop stacks revealed that emissions from two boilers were potentially entrained into building ventilation intakes on the lee side (cavity area) of a downwind structure. The ASHRAE ventilation guidance was used to estimate boiler stack height increases recommended to avoid the building cavity zone.

- ***Third-Party Modeling Review; Instantaneous and Short-Term Releases from Multiple Federal Munitions Disposal Facilities, Eastern United States.*** Health risk assessments were performed by the facilities following the USEPA Human Health Risk Assessment Procedures (HHRAP) guidance document. Models proposed for use included OBODM, ISCST3, INPUFF, and TRPUF. Resulting documentation required third-party review by an independent source. The review focused primarily on the appropriateness of modeling input data assumptions, including emissions, source release parameters, and meteorological data. Comments were provided to Booz-Allen, and submitted along with other comments to USEPA and state air pollution agency staff.

- ***Monitoring/Meteorological Data Validation Study, Confidential Municipal Waste Landfill, Southern California***. Compared vinyl chloride monitoring data to concurrently obtain meteorological measurements. Used on-site meteorological measurements as well as synoptic observations to validate monitoring data.

Mitigation Programs

- ***Air Quality Mitigation and Monitoring Support, Confidential California Utility Transmission Project***. With ZMassociates, Project Director providing air quality mitigation support to a major utility. At the outset of the project the utility was required to mitigate more than 200 tons/year of NOx emissions. Refined project emissions estimates for updated route alignment and construction equipment forecasts. The outcome NOx mitigation requirements were removed. Calculated construction and operational GHG emissions and developed a plan for providing mitigation using carbon credits. Led team development of a Construction Emissions Monitoring Plan to track actual usage of construction equipment.

- ***PM_{10} Mitigation Plan, Escondido, California***. Sempra Energy developed a 500 MW power generation facility in Escondido, California. Sempra was required to fund up to $1.9 million for local PM_{10} mitigation, with a preference for diesel exhaust mitigation. Under contract to City of Escondido, developed a PM_{10} mitigation plan identifying potential sources of local diesel mitigation. The mitigation plan considered the cost-effectiveness of diesel mitigation, as well as reducing emissions from other source types. Helped City of Escondido to apply for up to $500,000 in funding for particulate filters for several on-road and off-road diesel vehicles, and new school buses.

- ***PM_{10} Mitigation Plan, Eastshore Energy Facility, Hayward, California***. Project Manager for developing a PM_{10} mitigation plan under California CEQA requirements. The Eastshore Energy facility is not required to mitigate PM_{10} under BAAQMD regulations. However, CEC requires that PM_{10} emissions be mitigated, especially during potential non-attainment periods. Developed a two-prong plan that proposes using BAAQMD-banked emission reduction credits, or a wood stove and fireplace replacement program. The mitigation is currently being negotiated with CEC.

- ***LAX PM_{10} Mitigation Study, Los Angeles, California***. Completed research of PM_{10} mitigation options for the LAX expansion project. Focus of the research work was on air filtration in air conditioning systems in area schools.

- ***Rule 1309.1 Priority Reserve Rule Review, Southern California***. For a confidential client, applying PM_{10} offsets, closely followed Rule 1309.1 Priority Reserve developments. Challenges to Rule 1309.1 placed many restrictions on facilities needing access to the Priority reserve. This will have a significant impact on the market for PM_{10} Emission Reduction Credits within the SCAQMD.

Greenhouse Gas Management

- ***Johns Manville Corporation, Corporate Greenhouse Gas Inventory Management***. Johns Manville is a Berkshire Hathaway Company that manufactures residential and commercial insulation and roofing products (www.jm.com). The company has 50 manufacturing facilities worldwide. BlueScape conducted baseline emissions inventory work focusing on two California facilities that may be subject to AB32 reporting requirements. The 2006 emissions inventory data were be supplied to the California Climate Action Registry, and successfully verified by a third party. On a corporate level, BlueScape is working with Johns Manville to develop corporate strategies to address climate change issues, considering energy efficiency and credit development opportunities, national Climate Registry participation, and insulation product sales.

- ***Greenhouse Gas Footprint Life Cycle Analysis, Confidential LNG Project, Western US***. BlueScape partnered with WorleyParsons Komex to prepare a GHG footprint life cycle analysis for a proposed liquefied natural gas project. The project will obtain natural gas from fields in Asia or Australia, clean and liquefy the gas and transport LNG across the Pacific Ocean to the US West Coast. Regasification and compression of natural gas will be accomplished utilizing four gas turbines. The project is being completed for submittal to the Coastal Commission, US Coast Guard and other agencies as part of a NEPA review. The life cycle GHG impact with and without the project (no action alternative) will be compared. The no action alternative considers forecasted Western US power industry fuel and generation technology mix, including coal, natural gas, renewable, nuclear and hydroelectric, from 2012 to 2050. To complete the work, BlueScape obtained and analyzed utility, CEC and PUC reports.

- ***Confidential Independent Power Producer, Greenhouse Gas Emissions Inventory and Solutions, California.*** BlueScape completed a baseline greenhouse gas emissions inventory for an independent power producer operating nine plants with 500 MW of total power production capacity. At six plants, the company combusts petroleum coke, a fuel with CO_2 emissions similar to coal. The company is facing contract renewal with PG&E, and is concerned that the facilities will not be competitive to natural gas-fired plants. BlueScape is working with the company to analyze possible solutions to reduce GHG emissions ahead of impending AB32 compliance requirements and PG&E contract renegotiation. Options identified to date include boiler oxy-firing, fuel switching, carbon sequestration, load shifting to re-permitted gas-fired power plants, and plant shutdown. The company is also considering investing in renewable energy projects to offset GHG emissions from fossil fuels. The project goal will be to help the company to remain competitive in the rapidly changing California power generation market.

- ***Greenhouse Gas Emissions Inventory Verification, California Climate Action Registry.*** BlueScape has completed verification work on three greenhouse gas emission inventories. The work was completed as a subcontractor to ICF Consulting, for 2006 inventories submitted to the California Climate Action Registry. The companies include Los Angeles County, Driftwood Dairy, and Termo Oil and Gas., all located in the Los Angeles area. The verification work included initial meetings, site visits, auditing of records and calculations, and filing a verification opinion.

- ***Oil Production CO_2 Life Cycle Analysis, Client: Confidential Refinery, California.*** Managed a project to complete a life cycle analysis to compare the CO_2 emissions from extraction and delivery of Los Angeles heavy crude oil to a Los Angeles refinery versus extraction, marine shipping, and delivery of Alaskan or Middle East light crude oil to a Los Angeles refinery. CO_2 emissions for extraction of Los Angeles heavy crude oil were based on an oil production lease's certified California Climate Action Registry emissions. CO_2 emissions for extraction of Canadian light crude oil were based on average natural gas combustion and production data published by the Alaska Oil and Gas Conservation Commission. CO_2 emissions for extraction of Middle East light crude oil were estimated from Los Angeles/Canada data and a reduced water/oil ratio. CO_2 emissions from transportation considered heavy fuel oil combustion in main and auxiliary engines throughout the tanker travel distance, as well as marine diesel combustion by tugs and during maneuvering and hotelling. Results were compiled as a production carbon intensity to show that the higher CO_2 emissions from heavy crude oil production in Los Angeles were offset by the reduced transportation emissions.

Accidental Release Offsite Consequence Analyses

- ***RMP Offsite Consequence Analysis, Multi-Chem, New Iberia, Louisiana and Denver City, Texas***. As a subcontractor to Denali, Inc., BlueScape completed an offsite consequence analysis for a chemical storage and distribution facility. The facility distributes acrolein, a highly toxic substances used in oil and gas fields in the petroleum industry. The worst-case and alternative release scenarios were assessed, including breach of a storage tank and a PRV release involving a fire. Modeling was completed using RMPComp and Aloha.

- ***RMP Offsite Consequence Analysis, Hill Brothers Chemical Company and Modern Ice and Cold Storage, San Jose, California***. As a subcontractor to Denali, Inc., completed a CalARP (RMP) modeling study for a chemical company that stores and redistributes for sale anhydrous and aqueous ammonia, and a food cold storage facility. For each facility, assessed the worst-case and alternative release scenarios for each process utilizing ammonia, then calculated the source term (ammonia release rates) for each process. The worst-case and alternative case impacts were determined using the DEGADIS and/or other appropriate models or guidance.

- ***Offsite Consequence Analysis, Microchip, Tempe, Arizona.*** A semiconductor manufacturer needed to update its accidental release management plan for compressed gases, hydrochloric acid, and sulfuric acid. The ISCST3 model with one year of meteorological data was used to model compressed gas releases. DEGADIS was used to model acid spills. The radii of impact, based upon the distance to IDLH values, were found to be within the facility boundary. A report presenting the results of the analysis and showing the onsite radii of impact was completed.

- ***Risk Management and Prevention Plan, Komag, Fremont, California.*** For development of an RMPP, analyzed meteorological data to determine typical conditions that could occur during an accidental release. Developed a report section describing typical meteorological conditions in the RMPP.

- ***Accidental Release Models Evaluation, Pure-Etch, Salinas, California***. As part of a CEQA study, an etching solution reclaim facility was required to conduct a "customized" accidental release analysis for a mitigated negative declaration. The chemicals at issue were sulfuric acid, hydrochloric acid, and ammonia. Assisted in the project by locating and evaluating candidate dispersion models for completing offsite consequence analyses.

Air Emissions Inventories

- ***Air Emissions Fee Reports, Johns Manville Corporation, Corona, California.*** Assisted a fiberglass company in Southern California in response to SCAQMD's request for revised Rule 301 emissions inventories for the period 1994-1997 and completed the 1997-1998 report. A full air compliance audit initiated the project to verify permit status and emissions source inclusion. Emission factors were updated to reflect recent source tests and a Title V emissions inventory.

- ***Clean Air Act Emissions Inventory for Two ABEX/NWL Control Systems Facilities***. Managed the completion of facility-wide emissions inventories for two aerospace component manufacturing facilities located in Michigan and Georgia. The emission inventories were submitted to State agencies and became the basis for determining applicable Clean Air Act requirements, including Title V permitting.

- ***Due Diligence Emissions Inventory, Confidential Golf Club Manufacturer, San Diego, California***. A golf club manufacturer was interested in estimating air toxic emissions from one of two facilities. Emissions had not been tracked closely in the past. The project proved to be challenging, since many different paint and solvent products were used, usage logs differed between different production areas, and materials were often transferred from another facility. Data gaps were filled to complete the inventory. Results of the due diligence inventory were compared to local air district regulations to assess compliance.

- ***Dehydration Unit Emissions, Confidential Natural Gas Producer, Western U.S.*** Using natural gas composition information supplied by the client, estimated VOC and hazardous air pollutant emissions from triethylene glycol dehydration units at three facilities. The purpose of the project was to determine if Title V permit applicability thresholds were exceeded. The GlyCalc 3.0 model was used to complete emissions estimates.

- ***AB2588 Emissions Inventory, Johns Manville, Willows, California.*** A fiberglass manufacturing facility was required to update its original AB2588 emissions report. Several new source test results had been completed. Using the source test data and other information sources, a comprehensive air toxics inventory was completed and submitted to the Glenn County Air Pollution Control District using FATES. From the results of the analysis, risk prioritization scores were estimated and the facility was counseled on potential updated risk assessment requirements.

- ***AB2588 Emissions Inventory Plans, Calmat, Southern California***. Completed Air Toxics Inventory Plans for more than 10 sand and aggregate, batch concrete, and batch asphalt plants. Provided detailed information to agencies on processes and emission quantification methods. The plans were the basis for later completion of emissions inventory reports.

Clean Air Regulatory Analyses and Compliance Audits

- ***Confidential Coatings Manufacturing Company, Air Permitting and Compliance – South Coast AQMD –*** A coatings manufacturing facility in Los Angeles required help with emission calculations to avoid Title V major source permitting requirements. BlueScape avoided Title V, by completing alternative emission calculations for more than 20 vessels using EPA's TANKS equations and specific chemical mixture properties. Subsequently, when auditing facility permits, BlueScape found that the facility had not properly permitted several mixing vessels. BlueScape completed permits under SCAQMD's amnesty self-disclosure program, thus avoiding violations. BlueScape is currently working with the facility to triple the amount of throughput in a solvent recovery process. The project will require installation of a vapor condenser to reduce VOC and air toxic emissions increases.

- ***Regulatory Analysis for the Petroleum Industry, Western States Petroleum Association***. Conducted a comparative analysis of over 150 environmental regulations affecting petroleum companies in five key areas: air toxics, new source review, endangered species, hazardous materials, and oil spills. Determined reporting requirements, and assessed inefficiencies and overlaps between regulations.

- ***Clean Air Act Compliance Audits, Confidential National Client***. Task Manager for analyzing the impact of the 1990 Clean Air Act Amendments on over 30 facilities located in 11 states and engaged in a variety of manufacturing activities. Reviewed emissions and process information to determine the applicability of, and compliance with, Federal, State and local air quality regulations. Prioritized issues and gave recommendations for action.

- ***General Motors Environmental Audit, Flint, Michigan***. As a team member with Golden Environmental, completed the air quality audit portion of the environmental for the maintenance services at "Buick City" located in Flint Michigan.

- ***Environmental Compliance Audit, Triptych CD, Stockton, California***. Completed the environmental compliance audit for a company located in Stockton, California, which produces compact discs. Evaluated the facility's compliance with applicable air, solid waste, hazardous waste, and water discharge regulations.

- ***Clean Air Act Compliance Audit, Confidential Aluminum Production Facility, South Carolina.*** Completed a review of Clean Air Act regulations that might apply to the facility as part of an environmental audit. Assessed the applicability of NSPS, NESHAP, MACT, CAA Section 112(r) and other requirements.

Environmental Impact Air Quality Analysis

- ***Air Quality Impact Analysis, Homestead Village, San Ramon, California***. Project Manager for completion of an air quality impact analysis for a hotel development, as part of a CEQA environmental impact report. The analysis was completed efficiently using BAAQMD guidance and a study previously completed for a shopping center. Using traffic information supplied by another consultant, insignificant project impacts were estimated.

- ***Environmental and Air Quality Impact Review, City of Antioch and Pittsburg District Energy Facility.*** Project Manager retained by The City of Antioch, and Intervener, to review the California Energy Commission's (CEC) Preliminary Staff Assessment for the Pittsburg District Energy Facility. Worked with team members to developed written testimony regarding potential impacts to air quality, water quality, and infrastructure. Attended workshops and hearings to obtain information and present City of Anitoch's concerns to CEC staff.

- ***Air Quality Modeling Analysis, Alta Ski Resort Draft EIR, Utah.*** Revised the air quality impact section of a draft EIR for the Alta Ski Resort. The section was expanded to address lead agency comments regarding potential impacts on ambient air quality, visibility, and PSD increments. The SCREEN3 model and CALINE4 model were used to estimate impacts from direct and indirect sources. A formal response satisfying the comments was submitted.

- ***Traffic and Air Emissions Study, Reno, Nevada***. As part of the environmental impact report for the Southern Pacific-Union Pacific railroad merger, estimated automobile air emissions due to increased traffic delays caused by train trips in downtown Reno. Estimated emissions using MOBILE5. Train emissions were estimated using emission factors supplied by the Washoe County Air Agency.

- ***Air Quality Impact Analysis, Vintage Faire Mall, Modesto, California.*** The Vintage Faire Mall was planning to expand to include additional services with added parking spaces. An analysis was completed to determine air quality impacts from increased automobile trips. The EMFAC7F model was run to obtain vehicle emission factors. Impacts from CO and other emissions were estimated using the CALINE4 model and CEQA guidance.

<u>Litigation Support</u>

- ***Litigation Support, SLOAPCD Rule 1001, Oceano Dunes, California***. On behalf of Friends of Oceano Dunes, reviewed the South County Phase 2 Particulate Study for Oceano Dunes and the proposed San Luis Obispo County APCD Rule 1001 to permit and control dust emissions within the State Vehicular Recreation Area (SVRA). BlueScape's report, among other things, challenged a direct connection between monitored PM concentrations and dust generated from within the SVRA, and also the practical enforceability of Rule 1001. The report was presented to the San Luis Obispo County Board of Directors, and used in subsequent litigation.

- ***Confidential Litigation, CO Poisoning Case, New Mexico***. Project Manager and Expert Witness for a litigation case involving a CO exposure and poisoning case at a hotel in New Mexico. Performed site investigation and analysis of meteorological data as a preliminary step to indoor CO exposure modeling. Developed procedures to conduct modeling, considering placement of CO monitors and air flow into and out of emission source and exposure areas. The case was settled.

- ***Confidential Odor Litigation Case, Southern California***. Project Manager and Expert Witness for a litigation case involving a pet food manufacturing plant and reports of odors in the community. Reviewed the previous emission calculations and modeling approach completed by a consultant using ISCST3, and updated air quality modeling using AERMOD, the current EPA-required dispersion model for offsite impacts. Meteorological data were updated to nearby wind monitors and using MM5 prognostic upper air data. Peaking factors were developed to extrapolate one-hour average model impacts to 3-minute average impacts. The case is pending trial.

- ***Litigation Case for a Residential Housing Developer, San Diego***. Project Manager and Expert Witness to support a residential housing developer as Defendant. A resident that lived on the road to a new housing developing sued the developer for dust and diesel emissions entering the property, claiming severe asthma and other health impacts. Developed an analysis of ambient ozone and particulate matter concentrations, and pollen data. Reviewed local wind data and proximity of roadways to the plaintiff's house. The case is pending trial.

- ***Confidential Air Toxics Litigation Case, Southern California***. Project Manager and Expert Witness for a toxic tort litigation case in Southern California. The case involved transport of emissions from open burning and open detonation of waste munitions into a residential community. Developed meteorological data for air dispersion modeling using the CALMET system. Dispersion modeling was completed using ISCST3, OBODM, and CALPUFF to assess various historical operational scenarios. Deposed regarding modeling results. Case was settled out of court.

- ***Litigation Support for an Accidental Chemical Release, Confidential Pesticide Manufacturing Company***. Served as an Expert Witness on behalf of the Defendant, a pesticide manufacturing company, that had released chlorosulfonic acid from a tank.

The Plaintiff claimed injury from exposure to hydrochloric acid (HCL) generated from the release. Work involved meteorological data analysis to show that the Plaintiff could not have been in contact with an acid cloud, and SLAB dispersion modeling to predict downwind concentrations of HCL. Deposed regarding modeling results. The case ended in a settlement favorable to the Defendant.

- ***Proposition 65 Litigation, Confidential California Facility.*** Prepared a Proposition 65 health risk assessment for a metal polishing and plating facility that uses perchloroethylene in a vapor degreasing operation. A citizen's group contended that the facility failed to warn off-site receptors of perchloroethylene levels above the no significant risk level (NSRL). BlueScape used refined analysis methods to show that, given very conservative exposure assumptions that overstate actual risk, exposure values above the NSRL were confined to locations very near the emissions source.

- ***Proposition 65 Litigation and Evaluation Services, Nine Confidential California Companies.*** Project Manager or Technical Lead in Proposition 65 services ranging from due diligence audits to litigation support. Industries served include battery manufacturers, a glass container manufacturer, a golf club manufacturer, two metal plating facilities, an electronics manufacturing firm, and an airplane parts manufacturing company. Completed community exposure assessments using the SCREEN3 and ISCST models. Evaluated representativeness of assumptions used in litigant's and plaintiff's modeling analyses, including meteorological data inputs, monitoring and emissions data referenced, equipment operating schedules, estimates of indoor concentrations of lead relative to outdoor concentrations, and mobility of worker populations.
- ***Litigation Assistance for a Consortium of Confidential Petroleum Refineries, Texas***. Assisted several petroleum refineries located in Texas in class action litigation involving fugitive benzene emissions from piping and tanks, and chromium emissions from cooling towers. Performed dispersion modeling for benzene impacts using plaintiff's input files and ISCST, but revised benzene emissions estimates reflecting more realistic assumptions. Also, used plaintiffs ISCST and FDM input files to evaluate chromium impacts for various particle sizes and surface roughness lengths.

- ***Air Toxics Litigation, Confidential Chemical Manufacturer, Texas***. A chemical company in Texas was being sued by nearby residents alleging exposure to benzene and other chemicals was causing various health ailments. Depositions from over 30 litigants were reviewed to develop an exposure parameters database. Used a visual basic-driven system to estimate benzene exposure under various scenarios. The scenarios accounted for population mobility, indoor concentrations relative to outdoor concentrations, and movement of population between various micro-environments.

Papers and Presentations:

- Westbrook, J.A. 2007. How to Calculate and Reduce Fleet Carbon Emissions. Presented at the National Alternative Fuels & Vehicles Conference, Anaheim, California, April.

- Westbrook, J.A. and Sullivan, P.S. 2006. Fugitive Dust Modeling for PM10 Emissions from a Municipal Waste Landfill. Presented at the "Guideline on Air Quality Models: Applications and FLAG Developments — An A&WMA Specialty Conference", Denver, Colorado, April.

- Westbrook, J.A. and Dillingham, J. 2005. *Rule 1401 Health Risk Assessment Course*. One-day course presented in Anaheim, California.

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Francisco J. Matamala
Photochemical Modeler, Software Engineer

Expertise
Air Quality & Photochemical Models
- CALPUFF
- CALGRID
- CMAQ
- CAMx
- SCIPUFF
- SCICHEM
- AERMOD

Business Solutions
Databases
- MySQL 5
- SQL Server 2005-2014
- PostGREQL 9.0

Environmental Engineering
Meteorological Models
- WRF
- CALMET
- RAMS

Software Development
- Visual Studio .NET (C# .NET 4.6)
- Delphi 7 – BDS 2007
- Java (J2SE, J2EE)
- Fortran 77/90
- C/C+
- PHP 5.0
- JavaScript, HTML & CSS
- JQuery / Bootstrap

Tracer Studies

Industry Focus
Landfill
Lumber Industry
Mining Industry
VisualCheck

Education
Civil Eng, Computer Science
Universidad de Chile

Certifications
MBS, Great Plains Report Writer

Company Background
EnviroModeling Ltda
Lakes Environmental, Inc. Canada
NetCAS Ltda
AeroVironment, Inc. USA

Summary of Experience

Twenty-four (24) years of experience in air quality modeling and in the development of software solutions for environmental engineering companies and the mining industry. Has participated in dozens of environmental engineering projects worldwide, leading modeling teams in every stage of the consulting process. Has designed and developed software for the visualization and analysis of air quality modeling data, emissions inventories and other environmental data sets.

Has extensive experience with air dispersion models, including mastery of the CALPUFF modeling system, SCIPUFF and AERMOD. Has ample experience with complex photochemical models, including CMAQ, CAMx and SCICHEM. Has designed and developed software for the visualization and analysis of air dispersion and photochemical models (CALPUFF, SCIPUFF, CAMx), commercialized and sold all over the world.

Has implemented the Weather Research and Forecast meteorological model WRF (versions 3.5 and newer) and setup dynamic execution clusters in both Lakes Environmental and EnviroModeling. Extensive knowledge of the execution, processing and visualization of WRF, implementing the model in projects worldwide.

Has led development teams in the implementation of intelligent real-time systems for air pollution management (FETS-RT Web), with deployments in Canada, Mexico, and Australia.

Innate problem solver, able to visualize and solve complex tasks. Can perform proper design abstraction and the practical implementation of a solution. Understands and utilizes agile development methodologies, in particular cyclical development with prototypes. Practices domain driven design.

Excellent grasp of most high level development languages, including C/C++/C#, Delphi, Java (J2EE), Fortran, amongst others. Extensive experience with the .NET platform, up to and including .NET 4.6. Comprehensive knowledge of database management and design, having ample experience with SQL Server 2005-2014 and MySQL.

Select Project Experience:

Select Dispersion Modeling and Tracer Studies

- ***ARAMCO Saudi Arabia.*** SF6 tracer studies 2001 – 2002. Validation of the CALPUFF System.

- ***Enami, Chile.*** SF6 tracer studies at Ventana and Paipote cooper smelters. 2006 – 2007. Validation of CALPUFF system.

- ***EnviroModeling Ltda., IT Manager and Senior Partner, Chile***. Main IT support for all air quality consulting projects, such as lead engineer and project manager for WRF execution cluster. Lead developer of CAMx modeling engineer and CalDESK and other software products. Provided main IT support for all air quality consulting projects.

- ***Lakes Environmental, Inc., Senior Developer, Canada***. Implemented a distributed graphical rendering engine. Lead team member built to support air quality software packages, such as FETS-RT that was a three (3) year project. Lead developer and project manager for WRF distributed execution cluster. Team member for Kuwait AQMIS project for UNDP. Provided developer support for CALPUFF View.

- ***WoodTech S.A., Independent Consultant, Las Condes, Las Condes***. Developed main infrastructure and core components of the Logmeter 4000 system.

- ***PROTAB S.A., Independent Consultant, Spain***. Developed multiple business solutions modules.

- ***NetCAS Ltda, IT Manager,*** Designed and implemented business solutions projects for ERPs for Great Plains, Solomon, J.D. Edwards and PeopleSoft). Course Instructor (Crystal Reports and Report Writer of Microsoft Dynamics)

Software Products

- ***CALPUFF Online Modeling System.*** Development of a CALPUFF Online Modeling System (COS) to evaluate in real time the air quality due to odor emission from land fields and similar process. The COS software runs using local meteorology as well as meteorology generated from WRF runs.

- ***CalDESK***. Software for the visualization and analysis of the CALPUFF Modeling System (CALMET/CALPUFF/CALGRID). Sold internationally since 1997, with hundreds of licenses in over 20 countries. Currently at version 2.98. CalDESK has multiple features, including:
  - CALMET, CALPUFF, and CALGRID data visualization with multiple views. Surface views, vertical XZ and YZ slices, vertical profile at a specific point, time series, and a dual slice view provide complete visualization capabilities. Multiple variables can be displayed within a single view, and views can be linked for paired viewing.
  - Visualization of CALMET meteorological data and CALPUFF concentrations at the same time. Wind fields, contours, box fills, streamlines and line graphs are available.
  - Puff visualization in surface and vertical views, using detailed display options that include specific colors per emission source, transparency based on puff concentrations, and color fills based on puff age.
  - Advanced trajectory analysis module, which allows the users to perform complex trajectory analysis, calculating the trajectories for an entire period and allowing the user to visualize specific trajectories with varied display options. Trajectories can be saved for future analysis, independent of the CALMET data file.

- ***FETS-RT Web (Participated as Lead Developer).*** Real-time web-based program which can demonstrate the correlation between pollutant emissions from industrial processes and their impact concentrations. FETS-RT Web performs continuous air dispersion modeling runs to project the most probable outcomes for a collection of user-defined operating scenarios. This involves using forecast meteorology data and real-time data from monitoring stations as input to an air dispersion model which calculates the expected concentrations of a pollutant based on source parameters and emission properties. FETS-RT Web has been implemented in several industrial sites within Canada, Mexico, and Australia.

- **Kuwait AQMIS *(Participated as Developer)*:** Developed for KEPA under a UNDP contract, the Kuwait AQMIS is web-based platform that uses a Geographic Information System (GIS) style user interface to show where sources as they are physically located in relationship to other features. It also includes meteorology data to run five (5) years of AERMOD air modeling in order to identify all possible dispersion options. The AQMIS provides KEPA with a nation-wide tool to manage all elements of air quality. The major functions of the AQMIS are to:
    - Serve as a National Emissions Inventory Repository and prepare periodical reports on hazardous air pollutants and greenhouse gas emissions.
    - Provide air dispersion modeling for all sources and receptors in the country and conduct human health risk assessments based on population exposure.
    - Establish an emission source permitting and tracking program to issue Permits to Construct and Permits to Operate.
    - Collect atmospheric data from mobile and fixed site air monitoring stations, as well as point source data from emissions monitoring systems at major sources.
    - Track site visits to emission sources and manage outstanding violations.

- **SisDCA**: Air Quality Diagnostics System - Management system for the analysis of the results of air quality simulations. Used to generate meteorological input data for the CALPUFF modeling system and to provide analysis tools for the visualization of air quality data.

- **CAMxDESK**: Visualization and analysis platform for the photochemical model CAMx, versions 3.0 to 5.0. Based on CalDESK development platform.

- **GradsDESK**: Visualization and analysis platform for GrADS synoptic data files. Based on CalDESK development platform.

- **ECOSOFT**: Environmental legislation visual database, in a web based platform.

- **SIMPCA**: Air dispersion prediction system, implemented for the copper smelter Fundicion Hernan Videla Lira (ENAMI) in Copiapo, Chile.

- Radomiro Tomic mine of CODELCO Chile.

- ***RIPIO-Gaby***. Similar to RIPIO-RT, developed for the Gaby mine.

- ***MODEEM.*** Estimation model for metallurgical extraction, developed for the South Mine Geo-Metallurgical Plan, CODELCO Chile.

- ***MCA-Teniente***. Graphical implementation of the water quality model developed for the El Teniente division of CODELCO Chile. Developed working under engineers of CIMM.

- ***MCA-Andina***. Similar to MCA-Teniente, developed for the Andina division of CODELCO Chile.

C3.b BenMAP-CE Modeling Technical Report

SAN JOSE DOWNTOWN WEST MIXED-USE PLAN

BenMAP-CE Modeling

Prepared for

City of San Jose

July 2020

ESA

SAN JOSE DOWNTOWN WEST MIXED-USE PLAN

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July 2020

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SAN JOSE DOWNTOWN WEST MIXED-USE PLAN

BenMAP-CE Modeling

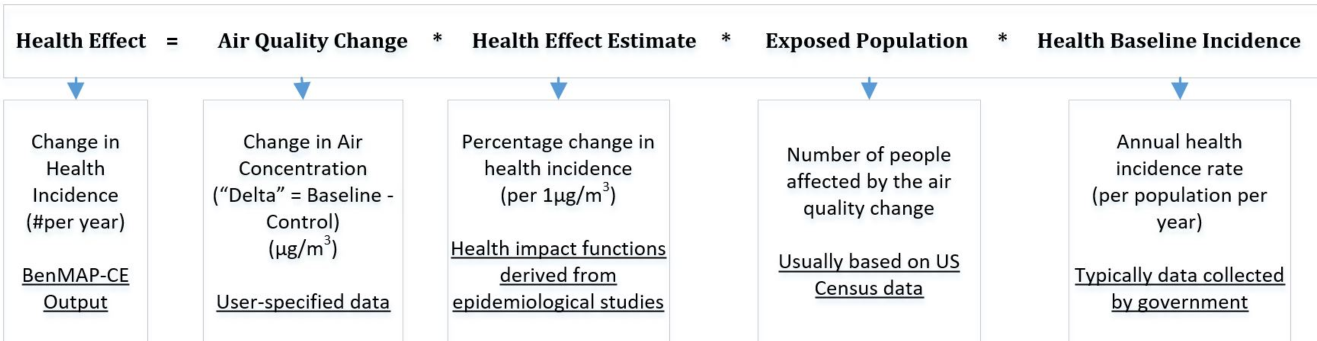
1.0 BenMAP-CE Overview

The U.S. Environmental Protection Agency (EPA) Environmental Benefits Mapping and Analysis Program - Community Edition (BenMAP-CE) tool is a publicly available, PC-based open-source software that can be configured to relate the human health impacts and/or benefits to air quality changes. The program includes a subset of air quality monitoring data, recent and projected demographic and baseline health data, concentration-response relationships drawn from the published epidemiological literature, and economic value estimates based on the published economics literature. The principal function of the software is to apply the findings of epidemiological and economics studies to estimate the health impacts and economic value of air pollution changes.

The latest version of BenMAP-CE is Version 1.5, which the EPA released in March 2019. For analyses that are within the Continental United States, BenMAP-CE includes preloaded databases containing the concentration-response (C-R) relationships, population files, and health data needed to quantify the number and economic value of human health impacts resulting from changes in air quality - specifically, ground-level ozone and fine particles such as $PM_{2.5}$.

To estimate human health effect, BenMAP-CE first determines the change in ambient air pollution using user-specified air quality data for the baseline and controlled scenarios. The software then applies the relationship between the air pollution with certain health effects (also known as health endpoints) using health impact function or the C-R functions that were derived from epidemiology studies. BenMAP-CE applies that relationship to the exposed population to calculate health impacts based on baseline health incidence data. Figure 1 summarizes how BenMAP-CE calculates human health impacts.

Figure 1. Overview of the Process of Health Impact Calculations in BenMAP-CE.



2.0 Application of BenMAP-CE to the Proposed Project

As part of an overall health impact assessment (HIA) for the Proposed Downtown West Mixed-Use Plan (proposed project), this analysis used BenMAP-CE (Version 1.5) to quantify the potential human health effects from the proposed project's emissions of ozone precursors and $PM_{2.5}$. The sections below summarize the data sources and specific BenMAP-CE input and method selections made for this project-level analysis, covering five key pieces of information:

1. The ambient air quality data;
2. Population data representing the population exposed to the change in air pollution;
3. An analysis year;
4. Health endpoints (health effects) and health impact functions; and
5. The baseline rate of death and disease among the exposed population.

2.1 Air Quality Data

BenMAP-CE itself does not model changes in air pollutant emissions or the resultant concentrations. These data must be input into BenMAP-CE as dispersion modeling results or generated from air pollution monitoring data (some monitoring data is pre-loaded in BenMAP-CE). The potential ambient air concentrations of ozone and $PM_{2.5}$ in the region where the proposed project is located were estimated using the Comprehensive Air Quality Model with Extensions (CAMx) model developed by Ramboll Environ, details of associated air quality modeling can be found in the *CAMx Photochemical Modeling Study to Support a Health Impact Analysis* (CAMx Modeling Report) that was prepared for the EIR.[1] As detailed in the CAMx Modeling Report, the CAMx model runs used a 4 kilometer by 4 kilometer grid, with a total of 34,225 grid cells covering a 547,600 square kilometer area. For each pollutant (ozone or $PM_{2.5}$),

[1] BlueScape Environmental. *CAMx Photochemical Modeling Study to Support a Health Impact Analysis*. July 2020.

each modeling year (interim year 2029 and full buildout year 2032), and emissions for both mitigated and unmitigated conditions, each CAMx model run generated two sets of data:

1. The ambient air concentrations based on the 2016 emissions inventory provided by the BAAQMD, scaled to the corresponding modeling year (referred to as "base case" or "baseline") for each pollutant[2,3]; and
2. The resulting ambient air concentrations generated by adding the proposed project's emissions to the corresponding base case regional air emission inventory (referred to as "project" or "control").

As detailed in the CAMx Modeling Report, due to the orders-of-magnitude smaller emissions from the proposed project as compared to the base case emissions inventory (for each of the model runs performed), the difference between the two sets of data (air concentration delta or "delta") were very small. Despite very small delta values between the two sets of concentration data and the inherent and unavoidable uncertainties associated with any CAMx modeling study, this analysis used BenMAP-CE to translate the potential project-incurred changes in ambient air ozone and $PM_{2.5}$ concentrations into potential human health outcomes of the proposed project for informational purposes.

For each BenMAP-CE run, the corresponding grid that matches the CAMx results were defined in the BenMAP-CE's Grid Definition database first. With the combination of pollutant and grid, a total of eight (8) BenMAP-CE model runs were conducted for the "study years" of 2029 and 2032 to determine the proposed project's health effects, as summarized below:

- Ozone, year 2029, unmitigated emissions;
- Ozone, year 2029, mitigated emissions;
- Ozone, year 2032, unmitigated emissions;
- Ozone, year 2032, mitigated emissions;
- $PM_{2.5}$, year 2029, unmitigated emissions;
- $PM_{2.5}$, year 2029, mitigated emissions;
- $PM_{2.5}$, year 2032, unmitigated emissions; and
- $PM_{2.5}$, year 2032, mitigated emissions.

CAMx produces a total of twelve (12) output files for use in the eight (8) BenMAP-CE runs. There are four (4) output files dedicates to base case emission inventories (without proposed project emission contributions), one for each pollutant (ozone and $PM_{2.5}$) and study year (2029 and 2032) combination. There are eight (8) CAMx output files dedicated to base case plus

[2] Throughout this report, "Base Case" will generally refer to the emissions inventory without contributions from the project and "Baseline" will generally refer to the BenMAP-CE health incidence values without contribution from the project.

[3] Please refer to section 2.3 for more information on how emissions are scaled from the 2016 BAAQMD inventory to the base case emission inventory for each study.

proposed project emission inventories for each of the eight (8) BenMAP-CE studies listed above. Then, for each BenMAP-CE model run, the program imports one of the base case plus proposed project CAMx outputs (referred to in the model as the "control") and the base case-only CAMx output corresponding to the same pollutant and study year (referred to in the model as the "baseline"). BenMAP-CE then calculates the change in air concentration (or delta) using control minus baseline from the CAMx-generated input files, which are then used for health effect calculations in each model run.

2.2 Population Data

A customized population dataset matching the air quality grid definitions described above was generated using the EPA's PopGrid software for use in BenMAP-CE. The PopGrid program allocates the 2010 block-level U.S. Census data for the defined air quality grids. When importing the population datasets into BenMAP-CE, the "Use Population Growth Weights" checkbox was checked, so that BenMAP-CE can use the population weights file in forecasting population levels for future years up to 2050.

2.3 Study Years

Years 2029 and 2032 were selected for the BenMAP-CE runs, which represents the proposed project's interim construction and operational year (2029) and the full build-out operational year (2032). The BAAQMD provided regional air quality emission inventory year 2016 from their AB 617-related CMAQ modeling study in order to perform air quality modeling for this study.[4] These emission inventories were then scaled to their corresponding study year (either 2029 or 2032 depending on the model run) using growth factors.[5] For the interim year 2029 analysis, the highest contribution of annual project-related emissions for each pollutant was used in the photochemical modeling, from project start up until the full build-out year. For example, this means that if 2029 had the highest PM10 emissions, but year 2025 had the highest ROG/NOx emissions, both of those respective emissions were used in the interim year 2029 analysis. Further, the most conservative annual emissions for full-build out year 2032 were used in the model.

2.4 Baseline Health Incidence Data

This analysis used the health incidence dataset preloaded within BenMAP-CE. This includes the Mortality Incidence dataset for the mortality endpoint group (year 2025 dataset for study year 2029, and year 2030 dataset for study year 2032), and the Other Incidence dataset for all the morbidity endpoint groups. The year 2014 for all of the morbidity endpoint groups except for the following, which uses the latest available datasets:

- Other Incidence (2000) dataset for School Loss Days, and

4 BlueScape Environmental. *CAMx Photochemical Modeling Study to Support a Health Impact Analysis*. July 2020.
5 Ibid.

- Prevalence (2008) dataset for Asthma Exacerbation.

Among the baseline health incidence datasets used, none of the endpoint groups match either of the study years (2029 for interim and 2032 for full buildout). The mortality C-R functions offer datasets in 5-year increments, so the dataset preceding each study year was used in the analysis (e.g. the C-R function dataset for 2025 was used for the 2029 study year). This approach would be generally representative and conservative, because air pollution and associated health effects typically decline over time ashealth endpoint functions contained in the BenMAP-CE software were used for this analyses. For the same pollutant-health endpoint (like acute respiratory symptoms or asthma exacerbation associated with ozone exposure, for example), BenMAP-CE contains many different functions developed from different epidemiologic studies. This analysis selected the functions that were either studies conducted in California, and/or studies that were conducted for multiple cities and counties in the United States.

More detailed information regarding the BenMAP-CE setup for each model runs can be found in the attached BenMAP-CE Audit Trial Reports (Attachments 1 through 8).

3.0 BenMAP Modeling Results and Results Interpretation

For each of the modeled grid cells, BenMAP-CE generates the health incidence value resulting from the proposed project's incremental increase in air pollutant concentrations that corresponds with each health endpoint and each C-R function. For many of the health endpoints (e.g., respiratory hospital admissions), the premade setups in BenMAP-CE contain many different C-R functions from different studies. To summarize the regional health incidence estimates, the incidence results were exported into an Access database and summed across all cells of the modeled geographic grid to generate one set of numerical values for each pollutant-health endpoint group combination.

Tables 1 through 8 summarize the BenMAP-CE results of ozone and $PM_{2.5}$ from the proposed project, for both study years 2029 and 2032 and unmitigated and mitigated emission inventories. As the data shown in these tables demonstrate, the maximum regional health impacts associated with the emissions of ozone precursors and corresponding formation of ozone in the atmosphere associated with the construction and operation of the proposed project included incidences of respiratory-related hospital admissions (0.029 maximum incidences), mortality (0.05 maximum incidences), and asthma-related emergency room visits (0.34 maximum incidences) for all studied age groups combined.[6] The project's incremental health incidences for ozone are less than 0.001% for any of the future year without project (or baseline) number of health endpoint occurrences.

[6] These values represent unmitigated project emissions for the full buildout year of 2032, as presented in Table 3.

The maximum regional health impacts associated with emissions of $PM_{2.5}$ resulting from the construction and operation of the proposed project included incidences of acute myocardial infarction (0.19 maximum incidences), mortality (1.68 maximum incidences), hospital admissions (0.41 maximum incidences) and asthma-related emergency room visits (0.97 maximum incidences) for all studied age groups combined.[7] The project's incremental health incidences for $PM_{2.5}$ are less than 0.0012% for any of the future year without project number of health endpoint occurrences.

The very small occurrence in health endpoint occurrences, relative to the substantially larger number of baseline occurrences, demonstrates that the proposed project contributes a negligible amount to regional and local health impacts. The 95% confidence interval is a standard metric for statistical significance, it essentially means that 95% of our estimates of the health impact will include the true value, but 5% won't (i.e., there is a 1-in-20 chance that the reported confidence intervals in Tables 8-11 do not include the true values). Based on that, the incremental incidence results shown in our tables in indicating that the reported positive value is of high statistical uncertainty.

[7] These values represent unmitigated project emissions for the full buildout year of 2032, as presented in Table 7, with the exception of hospital admissions, with the maximum occurring in interim year 2029, as presented in Table 5.

TABLE 1. BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 8-HOUR AVERAGE OZONE IMPACT, STUDY YEAR 2029, UNMITIGATED

Human Health Endpoints		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
Health Endpoint Group	Health Endpoint	Incremental Incidence (# per year)		Baseline Incidence (# per year)	
		Mean	95% Confidence Interval		
Acute Respiratory Symptoms	Minor Restricted Activity Days	128.9	56.5 – 201.2	40,804,879	0.0003158%
Asthma Exacerbation	One or More Symptoms	15.7	-76.4 – 107.9	15,360,219	0.0001024%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [0-17]	0.13	0.03 – 0.2	15,742	0.0008309%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [18-99]	0.21	0.1 – 0.4	30,113	0.0006933%
Hospital Admissions Respiratory	HA All Respiratory	0.03	-0.005 – 0.1	46,372	0.0000593%
Mortality	All Cause	0.05	0.03 – 0.1	71,372	0.0000720%
	Cardiopulmonary	0.02	0.01 – 0.03	29,052	0.0000699%
	Non-Accidental	0.02	-0.003 – 0.03	67,137	0.0000234%
	Respiratory	0.06	0.02 – 0.1	17,718	0.0003554%
School Loss Days	All Cause	84.6	-5.7 – 174.6	10,112,544	0.0008351%

Notes:

Aggregated regional results - BenMAP generates incidences results for each grid cell, aggregated regional results means the summation of results of all modeled grid cells together.

TABLE 2. BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 8-HOUR AVERAGE OZONE IMPACT, STUDY YEAR 2029, MITIGATED

Human Health Endpoints		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
		Incremental Incidence (# per year)		Baseline Incidence (# per year)	
Health Endpoint Group	Health Endpoint	Mean	95% Confidence Interval		
Acute Respiratory Symptoms	Minor Restricted Activity Days	111.2	48.8 – 173.6	40,804,879	0.0002725%
Asthma Exacerbation	One or More Symptoms	13.6	-66.0 – 93.1	15,360,219	0.0000884%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [0-17]	0.11	0.02 – 0.2	15,742	0.0007171%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [18-99]	0.18	0.1 – 0.3	30,113	0.0005983%
Hospital Admissions Respiratory	HA All Respiratory	0.02	-0.004 – 0.1	46,372	0.0000512%
Mortality	All Cause	0.04	0.02 – 0.1	71,372	0.0000621%
	Cardiopulmonary	0.02	0.01 – 0.03	29,052	0.0000604%
	Non-Accidental	0.01	-0.003 – 0.03	67,137	0.0000202%
	Respiratory	0.05	0.02 – 0.1	17,718	0.0003067%
School Loss Days	All Cause	72.9	--4.9 – 150.6	10,112,544	0.0007207%

Notes:

Aggregated regional results - BenMAP generates incidences results for each grid cell, aggregated regional results means the summation of results of all modeled grid cells together.

TABLE 3. BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 8-HOUR AVERAGE OZONE IMPACT, STUDY YEAR 2032, UNMITIGATED

Human Health Endpoints		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
Health Endpoint Group	Health Endpoint	Incremental Incidence (# per year)		Baseline Incidence (# per year)	
		Mean	95% Confidence Interval		
Acute Respiratory Symptoms	Minor Restricted Activity Days	125.8	55.2 – 196.5	41,609,792	0.0003024%
Asthma Exacerbation	One or More Symptoms	15.5	-75.4 – 106.5	15,914,655	0.0000976%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [0-17]	0.13	0.03 – 0.2	16,159	0.0007943%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [18-99]	0.21	0.1 – 0.3	30,956	0.0006682%
Hospital Admissions Respiratory	HA All Respiratory	0.03	-0.005 – 0.1	49,799	0.0000583%
Mortality	All Cause	0.05	0.03 – 0.1	73,083	0.0000701%
	Cardiopulmonary	0.02	0.01 – 0.03	30,177	0.0000681%
	Non-Accidental	0.02	-0.003 – 0.03	69,020	0.0000227%
	Respiratory	0.06	0.02 – 0.1	18,340	0.0003468%
School Loss Days	All Cause	83.2	-5.6 – 172.0	10,452,211	0.0007962%

Notes:

Aggregated regional results - BenMAP generates incidences results for each grid cell, aggregated regional results means the summation of results of all modeled grid cells together.

TABLE 4. BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 8-HOUR AVERAGE OZONE IMPACT, STUDY YEAR 2032, MITIGATED

Human Health Endpoints		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
Health Endpoint Group	Health Endpoint	Incremental Incidence (# per year)		Baseline Incidence (# per year)	
		Mean	95% Confidence Interval		
Acute Respiratory Symptoms	Minor Restricted Activity Days	101.8	44.7 – 159.0	41,609,792	0.0002447%
Asthma Exacerbation	One or More Symptoms	12.6	-61.1 – 86.2	15,914,655	0.0000790%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [0-17]	0.10	0.02 – 0.2	16,159	0.0006428%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [18-99]	0.17	0.1 – 0.3	30,956	0.0005408%
Hospital Admissions Respiratory	HA All Respiratory	0.02	-0.004 – 0.1	49,799	0.0000472%
Mortality	All Cause	0.04	0.02 – 0.1	73,083	0.0000567%
	Cardiopulmonary	0.02	0.01 – 0.03	30,177	0.0000551%
	Non-Accidental	0.01	-0.003 – 0.03	69,020	0.0000184%
	Respiratory	0.05	0.02 – 0.1	18,340	0.0002807%
School Loss Days	All Cause	67.3	-4.5 – 139.2	10,452,211	0.0006443%

Notes:

Aggregated regional results - BenMAP generates incidences results for each grid cell, aggregated regional results means the summation of results of all modeled grid cells together.

TABLE 5. BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 24-HOUR AVERAGE PM2.5 IMPACT STUDY YEAR 2029, UNMITIGATED

Human Health Endpoints		Fine Modeling Grid			
		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
Health Endpoint Group	Health Endpoint	Incremental Incidence (# per year)		Baseline Incidence (# per year)	
		Mean	95% Confidence Interval		
Acute Myocardial Infarction	Acute Myocardial Infarction Nonfatal [18-24]	1.40E-04	0.0001 – 0.0002	26	0.0005%
	Acute Myocardial Infarction Nonfatal [25-44]	0.008	0.004 – 0.01	1,556	0.000528%
	Acute Myocardial Infarction Nonfatal [45-54]	0.02	0.01 – 0.03	3,628	0.000509%
	Acute Myocardial Infarction Nonfatal [55-64]	0.040	0.02 – 0.06	6,652	0.000597%
	Acute Myocardial Infarction Nonfatal [65-99]	0.12	0.06 – 0.2	24,794	0.000481%
Emergency Room Visits - Respiratory	Asthma	0.97	0.29 – 1.7	109,394	0.000886%
Hospital Admissions	All Cardiovascular (less Myocardial Infarctions)	0.23	0.17 – 0.29	129,627	0.000178%
	All Respiratory	0.40	0.24 – 0.57	110,626	0.000364%
	Asthma	0.088	0.04 – 0.1	12,809	0.000688%
Mortality	All Cause	1.68	1.2 – 2.2	166,573	0.001009%

Notes:

Aggregated regional results - BenMAP generates incidences results for each grid cell, aggregated regional results means the summation of results of all modeled grid cells together.

TABLE 6. BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 24-HOUR AVERAGE PM2.5 IMPACT STUDY YEAR 2029, MITIGATED

Human Health Endpoints		Fine Modeling Grid			
		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
		Incremental Incidence (# per year)		Baseline Incidence (# per year)	
Health Endpoint Group	Health Endpoint	Mean	95% Confidence Interval		
Acute Myocardial Infarction	Acute Myocardial Infarction Nonfatal [18-24]	8.92E-05	0.00005 – 0.0001	26	0.0003%
	Acute Myocardial Infarction Nonfatal [25-44]	0.005	0.003 – 0.01	1,556	0.000335%
	Acute Myocardial Infarction Nonfatal [45-54]	0.012	0.01 – 0.02	3,628	0.000324%
	Acute Myocardial Infarction Nonfatal [55-64]	0.025	0.01 – 0.04	6,652	0.000379%
	Acute Myocardial Infarction Nonfatal [65-99]	0.076	0.04 – 0.1	24,794	0.000305%
Emergency Room Visits - Respiratory	Asthma	0.61	0.18 – 1.0	109,394	0.000563%
Hospital Admissions	All Cardiovascular (less Myocardial Infarctions)	0.15	0.11 – 0.18	129,627	0.000113%
	All Respiratory	0.26	0.15 – 0.36	110,626	0.000231%
	Asthma	0.056	0.02 – 0.1	12,809	0.000437%
Mortality	All Cause	1.07	0.7 – 1.4	166,573	0.000641%

Notes:

Aggregated regional results - BenMAP generates incidences results for each grid cell, aggregated regional results means the summation of results of all modeled grid cells together.

TABLE 7. BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 24-HOUR AVERAGE PM2.5 IMPACT STUDY YEAR 2032, UNMITIGATED

Human Health Endpoints		Fine Modeling Grid			
		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
Health Endpoint Group	Health Endpoint	Incremental Incidence (# per year)		Baseline Incidence (# per year)	
		Mean	95% Confidence Interval		
Acute Myocardial Infarction	Acute Myocardial Infarction Nonfatal [18-24]	1.26E-04	0.00006 – 0.0002	26	0.0005%
	Acute Myocardial Infarction Nonfatal [25-44]	0.008	0.004 – 0.01	1,587	0.000483%
	Acute Myocardial Infarction Nonfatal [45-54]	0.017	0.01 – 0.03	3,812	0.000451%
	Acute Myocardial Infarction Nonfatal [55-64]	0.037	0.02 – 0.06	6,665	0.000556%
	Acute Myocardial Infarction Nonfatal [65-99]	0.12	0.06 – 0.2	26,465	0.000451%
Emergency Room Visits - Respiratory	Asthma	0.91	0.27 – 1.6	112,397	0.000813%
Hospital Admissions	All Cardiovascular (less Myocardial Infarctions)	0.23	0.17 – 0.29	139,003	0.000167%
	All Respiratory	0.408	0.24 – 0.57	118,802	0.000343%
	Asthma	0.082	0.03 – 0.1	13,102	0.000627%
Mortality	All Cause	1.61	1.1 – 2.1	170,920	0.000941%

Notes:

Aggregated regional results - BenMAP generates incidences results for each grid cell, aggregated regional results means the summation of results of all modeled grid cells together.

TABLE 8. BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 24-HOUR AVERAGE PM2.5 IMPACT STUDY YEAR 2032, MITIGATED

Human Health Endpoints		Fine Modeling Grid			
		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
Health Endpoint Group	Health Endpoint	Incremental Incidence (# per year)		Baseline Incidence (# per year)	
		Mean	95% Confidence Interval		
Acute Myocardial Infarction	Acute Myocardial Infarction Nonfatal [18-24]	9.37E-05	0.00005 – 0.0001	26	0.0004%
	Acute Myocardial Infarction Nonfatal [25-44]	0.006	0.003 – 0.01	1,587	0.000358%
	Acute Myocardial Infarction Nonfatal [45-54]	0.013	0.01 – 0.02	3,812	0.000335%
	Acute Myocardial Infarction Nonfatal [55-64]	0.027	0.01 – 0.04	6,665	0.000412%
	Acute Myocardial Infarction Nonfatal [65-99]	0.089	0.04 – 0.1	26,465	0.000335%
Emergency Room Visits - Respiratory	Asthma	0.68	0.20 – 1.2	112,397	0.000603%
Hospital Admissions	All Cardiovascular (less Myocardial Infarctions)	0.17	0.13 – 0.22	139,003	0.000124%
	All Respiratory	0.30	0.18 – 0.43	118,802	0.000255%
	Asthma	0.061	0.03 – 0.1	13,102	0.000466%
Mortality	All Cause	1.19	0.8 – 1.6	170,920	0.000698%

Notes:

Aggregated regional results - BenMAP generates incidences results for each grid cell, aggregated regional results means the summation of results of all modeled grid cells together.

4.0 Uncertainty

As many regional-scale health impact assessments and this project-level analysis demonstrate, performing a quantitative HIA is complex and difficult, but it is possible to perform such analyses. Nevertheless, the limits of such analyses should be noted. The BenMAP-CE model outputs provide precise values. It would be inappropriate, however, to assume that these values, though seemingly precise, give an accurate understanding of the project's actual impacts. The unavoidable imprecision of such analyses is inherent and unavoidable. Uncertainties associated with air quality modeling have been discussed in the CAMx Modeling Report. Air quality models, including CAMx and BenMAP-CE, rely on assumptions that may not capture fully or accurately the complexity or dynamism of the physical world. Each step in the modeling process, and each assumption incorporated into each model, adds a degree of uncertainty into the reported results. These inputs include air pollutant emission estimates, ambient air concentration modeling, and health impact calculations using various health impact functions. The combination and compounding of the uncertainties from each step of the modeling analysis, in the context of the very small increments of change that are predicted associated with a single project, could result in large margins of error for the overall modeled outcomes. That does not mean the modeled results are invalid or meaningless. Rather, it means that one should not have undue confidence in the seeming precision of the reported outcome. In other words, the modeled results may be valid, but they should not be misinterpreted as an exact calculation of something as complex as criteria air pollutant dispersion modeling, or as correlating a given level of emissions with specific health effects. That is particularly true where, as here, regional models have been adapted for use at the project-level. In this case, the calculated impact may be smaller than the reasonable margin of errors of such analyses.

Specific to the application of BenMAP-CE model itself, although it can be a powerful tool, it has the following limitations which impact the precision of the generated results. These are especially relevant when applying this tool to a project-level analysis such as this study.

- In its current form, BenMAP–CE cannot conduct source-specific modeling without inputs from other modeling programs, such as CAMx. The differences among the mathematical and/or statistical algorithms used by these additional air quality modeling programs and those used by BenMAP-CE to process the air quality inputs and then correlate these inputs to specific health effects introduces layers of uncertainty into the generated results. In addition, the air pollutant concentrations that BenMAP–CE uses represent overall ambient concentrations of ozone and $PM_{2.5}$. Due to the magnitude smaller emissions from a single project as compared the base case regional emission inventory, the incremental increase in concentrations and health incidences associated with the project, as shown in this analysis, are very small. Therefore, the small incremental increase in concentrations generated by the project in the context of regional-scale ambient air modeling should not be taken a precise representation of the project-specific contributions.

- There are a number of conservative assumptions built into the analysis, which include but are not limited to the following:
  - Maximum annual average emissions were used in the modeling and were assumed to occur for the same year for each pollutant; and
  - Emissions from activities currently occurring on the project site were not removed from the model (although emissions from project-related VMT are net of existing mobile-source emissions in the traffic study area).
- The health impact functions that BenMAP-CE uses are based on findings from population-based epidemiological studies that develop statistical relationships between human health effects and air pollution exposures. Thus, each cause-and-effect relationship used by BenMAP-CE has some inherent uncertainty due to important limitations associated with the epidemiological studies including but not limited to: [8]
  - The analysis does not link predicted changes in ozone and $PM_{2.5}$ concentrations associated with project operations to any specific *individual* health impact; instead, it uses studies that report *correlations* between health effects and exposure to ozone and $PM_{2.5}$, to estimate potential effects on the population in the modeling domain;
  - Difficulty to determine from epidemiological studies if health effects are caused from exposure to the air pollutant of interest, or from other factors such as weather, other pollutants, or life style factors like smoking and diet;
  - Inconsistencies across different epidemiological studies regarding the cause-and-effect relationship for the same pollutant and health endpoint combination, as demonstrated by the multiple health impact functions preloaded in BenMAP-CE for the same pollutant and health endpoint combinations;
  - Limitations in application of concentration-response functions based on epidemiological studies. For example, estimates of all-cause mortality impacts from $PM_{2.5}$ are based on a single epidemiological study that found an association between $PM_{2.5}$ concentrations and mortality. Similar studies suggest that such an association exists, but uncertainty remains 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 or exposures to other air pollutants;
  - For both the $PM_{2.5}$ and ozone health effects calculated, each pollutant may confound the other and both air pollutants could contribute to the health effect outcomes evaluated, so the overall impacts may be overstated; and

[8] Sacks et. al, 2018. The Environmental Benefits Mapping and Analysis Program – Community Edition (BenMAP–CE): A tool to estimate the health and economic benefits of reducing air pollution. Environ Model Softw. 2018 Feb 11; 104: 118–129.

  - The estimate of health effects presumes that impacts seen at large concentration differences can be linearly scaled down to small concentration differences, with no consideration of the potential thresholds below which health effects may not occur. This method of linearly scaling impacts is broadly accepted for use in regulatory evaluations and is considered to be health protective.[9]

- There is inherent uncertainty in the reporting of health effects. For example, asthma exacerbations may be reported as other conditions that fall under another endpoint group. This not only increases the difficulty and uncertainty in the development of cause-and-effect relationships, but also increases the uncertainty of the reported baseline health incidence data.

- The estimated health impact by BenMAP-CE is based people's exposures to outdoor ambient air concentrations; however, these concentration values may be very different from the actual exposures that people experience. For example, ozone and $PM_{2.5}$ exposures may be significantly lower for those who spend much of their day indoors.

Attachment 1

BenMAP-CE Audit Trial Report – O3_2029UM

BenMAP-CE 1.5.0
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Latin Hypercube Points:10
Population Dataset:SJDomainPop-GooglePCM4
Year:2029
Threshold:0
Incidence averaging:All
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<Pollutant>
Name:Ozone
Observation Type:Hourly
Season0:May 1-September 30
Metric0:D1HourMax
Metric1:D24HourMean
Metric2:D8HourMax
Metric3:D8HourMean
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ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Grid.Definition>
<Pollutant>
Name:Ozone
Observation Type:Hourly
Season0:May 1-September 30
Metric0:D1HourMax
Metric1:D24HourMean
Metric2:D8HourMax
Metric3:D8HourMean
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Shapefile Name:googlepcm
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Name:Ozone
Observation Type:Hourly

Season0:May 1-September 30
Metric0:D1HourMax
Metric1:D24HourMean
Metric2:D8HourMax
Metric3:D8HourMean
</Pollutant>
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Endpoint group:Acute Respiratory Symptoms
Endpoint:Minor Restricted Activity Days
Start age:18
End age:64
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Ostro and Rothschild
Qualifier:8-hour max from 1-hour max.
Function:(1-(1/EXP(Beta*DELTAQ)))*A*POP
Year:1989
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Ostro, B.D. and S. Rothschild. Air Pollution and Acute Respiratory Morbidity - an Observational Study of Multiple Pollutants. Environ Res, 1989. 50(2): p. 238-247.
Baseline functional form:A*POP
Incidence dataset:
Prevalence dataset:
Variable dataset:
Beta:0.002596
Beta distribution:Normal
P1Beta:0.00077644
P2Beta:0
A:0.02137
NameA:mRAD18to64; Ostro and Rothschild, 1989, p 243.
B:0
NameB:
C:0
NameC:
Percentile:0
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Health impact function dataset:EPA Standard Health Functions
Endpoint group:Asthma Exacerbation
Endpoint:Asthma Exacerbation, One or More Symptoms
Start age:6
End age:18
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None

Author:O'Connor et al.
Qualifier:
Function:(1-EXP(-Beta*DELTAQ))*A*POP*Prevalence
Year:2008
Geographic area:Everywhere
Other pollutants:PM2.5,NO2
Reference:O'Connor, G. T., L. Neas, et al. (2008). "Acute respiratory health effects of air pollution on children with asthma in US inner cities." J Allergy Clin Immunol 121(5): 1133-1139 e1131
Baseline functional form:A*POP*Prevalence
Incidence dataset:
Prevalence dataset:Prevalence (2008)
Variable dataset:
Beta:0.000966054
Beta distribution:Normal
P1Beta:0.002991454
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NameB:
C:0
NameC:
Percentile:0
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Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Start age:18
End age:99
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Adult model, 8 hour maximum metric, 4 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.007696104
Beta distribution:Normal
P1Beta:0.002837389
P2Beta:0
A:0
NameA:
B:0
NameB:

C:0
NameC:
Percentile:0
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Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Start age:0
End age:17
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Child model, 8 hour maximum metric, 3 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.010436002
Beta distribution:Normal
P1Beta:0.004357595
P2Beta:0
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B:0
NameB:
C:0
NameC:
Percentile:0
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Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Start age:65
End age:99
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Katsouyanni et al.
Qualifier:Summer, 1985-1994, penalized splines, 8 df
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009

Geographic area:Everywhere
Other pollutants:
Reference:Katsouyanni, K., Samet, J. M., Anderson, H. R., Atkinson, R., Tertre, A. L., Medina, S., et al. (2009). Air Pollution and Health: A European and North American Approach (APHENA): Health Effects Institute.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.000636757
Beta distribution:Normal
P1Beta:0.000400294
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
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Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Non-Accidental
Start age:0
End age:99
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Smith et al.
Qualifier:Ozone season
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:PM10
Reference:Richard L. Smith, Baowei Xu, and Paul Switzer (2009). Reassessing the relationship between ozone and short-term mortality in U.S. urban communities. Inhalation Toxicology, 2009; 21(S2): 37?65
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2025)
Prevalence dataset:
Variable dataset:
Beta:0.000257743
Beta distribution:Normal
P1Beta:0.000167
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
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<Health.impact.function.6>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause
Start age:0
End age:99
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Bell et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L., F. Dominici, and J.M. Samet. A meta-analysis of time-series studies of ozone and mortality with comparison to the national morbidity, mortality, and air pollution study. Epidemiology, 2005. 16(4): p. 436-45.
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2025)
Prevalence dataset:
Variable dataset:
Beta:0.000795
Beta distribution:Normal
P1Beta:0.00021227
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
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<Health.impact.function.7>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Cardiopulmonary
Start age:0
End age:99
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Huang et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Huang, Y., F. Dominici and M. L. Bell. 2005. Bayesian hierarchical distributed lag models for summer ozone exposure and cardio-respiratory mortality. Environmetrics. Vol. 16: 547?562.

Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2025)
Prevalence dataset:
Variable dataset:
Beta:0.0008125
Beta distribution:Normal
P1Beta:0.000258673
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
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Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Respiratory
Start age:30
End age:99
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:Mean
Author:Jerrett et al.
Qualifier:Metric adjusted using a ratio of 1.14 based on table 2 of Anderson & Bell
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Jerrett, Michael, Burnett, Richard T, Pope, Arden C, et al. 2009. Long-Term Ozone Exposure and Mortality. New England Journal of Medicine.
Baseline functional form:Incidence*POP
Incidence dataset:Mortality Incidence (2025)
Prevalence dataset:
Variable dataset:
Beta:0.004471161
Beta distribution:Normal
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P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
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<Health.impact.function.9>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:School Loss Days
Endpoint:School Loss Days, All Cause
Start age:5

End age:17
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Gilliland et al.
Qualifier:All year. 8-hour max from 8-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A*B
Year:2001
Geographic area:Everywhere
Other pollutants:
Reference:Gilliland, F.D., K. Berhane, E.B. Rappaport, D.C. Thomas, E. Avol, W.J. Gauderman, S.J. London, H.G. Margolis, R. McConnell, K.T. Islam and J.M. Peters. 2001. The effects of ambient air pollution on school absenteeism due to respiratory illnesses. Epidemi
Baseline functional form:Incidence*POP*A*B
Incidence dataset:Other Incidence (2000)
Prevalence dataset:
Variable dataset:
Beta:0.007824
Beta distribution:Normal
P1Beta:0.004444898
P2Beta:0
A:0.3929
NameA:Scalar for % of school days in ozone season
B:0.945
NameB:Population of school children at-risk for a new absence
C:0
NameC:
Percentile:0
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Processing complete. HIF processing time: 0 hours 2 minutes 5 seconds.
</Log.And.Message>
Sort Incidence LHPs:False
Default Advanced Pooling Method:Roundweightstotwodigits
Default Monte Carlo Iterations:5000
Random Seed:1
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Dataset:
Year:2029
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Year : -1
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Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Respiratory Symptoms
Endpoint:Minor Restricted Activity Days
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Ostro and Rothschild
Qualifier:8-hour max from 1-hour max.
Function:(1-(1/EXP(Beta*DELTAQ)))*A*POP
Year:1989
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Ostro, B.D. and S. Rothschild. Air Pollution and Acute Respiratory Morbidity - an Observational Study of Multiple Pollutants. Environ Res, 1989. 50(2): p. 238-247.
Start age:18
End age:64
Baseline functional form:A*POP
Incidence dataset:
Beta:0.002596
Beta distribution:Normal
P1Beta:0.00077644
P2Beta:0
A:0.02137
NameA:mRAD18to64; Ostro and Rothschild, 1989, p 243.
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Acute.Respiratory.Symptoms>
Acute Respiratory Symptoms
</Valuation.Pooling.Window.Name.Acute.Respiratory.Symptoms>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Asthma Exacerbation
Endpoint:Asthma Exacerbation, One or More Symptoms
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:O'Connor et al.
Qualifier:
Function:(1-EXP(-Beta*DELTAQ))*A*POP*Prevalence
Year:2008

Geographic area:Everywhere
Other pollutants:PM2.5,NO2
Reference:O'Connor, G. T., L. Neas, et al. (2008). "Acute respiratory health effects of air pollution on children with asthma in US inner cities." J Allergy Clin Immunol 121(5): 1133-1139 e1131
Start age:6
End age:18
Baseline functional form:A*POP*Prevalence
Incidence dataset:
Beta:0.000966054
Beta distribution:Normal
P1Beta:0.002991454
P2Beta:0
A:0.207142857
NameA:Incidence rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Asthma.Exacerbation>
Asthma Exacerbation
</Valuation.Pooling.Window.Name.Asthma.Exacerbation>
<Incidence.Pooling.And.Aggregation.>
<Emergency.Room.Visits.RespiratoryPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Year:2009
Location:Seattle,WA
Other pollutants:
Geographic area:Everywhere
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:18
End age:99
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.007696104
Beta distribution:Normal
P1Beta:0.002837389
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0

Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Year:2009
Location:Seattle,WA
Other pollutants:
Geographic area:Everywhere
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:0
End age:17
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.010436002
Beta distribution:Normal
P1Beta:0.004357595
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Emergency.Room.Visits.RespiratoryPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Adult model, 8 hour maximum metric, 4 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:18
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.007696104
Beta distribution:Normal

P1Beta:0.002837389
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Child model, 8 hour maximum metric, 3 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:
End age:17
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.010436002
Beta distribution:Normal
P1Beta:0.004357595
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
Emergency Room Visits, Respiratory
Mar:Pooling Method Type:None
Mar:Pooling Method Type:None
</Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Pollutant:Ozone
Metric:D8HourMax

Metric statistic:None
Author:Katsouyanni et al.
Qualifier:Summer, 1985-1994, penalized splines, 8 df
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Katsouyanni, K., Samet, J. M., Anderson, H. R., Atkinson, R., Tertre, A. L., Medina, S., et al. (2009). Air Pollution and Health: A European and North American Approach (APHENA): Health Effects Institute.
Start age:65
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.000636757
Beta distribution:Normal
P1Beta:0.000400294
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Hospital.Admissions.Respiratory>
Hospital Admissions, Respiratory
</Valuation.Pooling.Window.Name.Hospital.Admissions.Respiratory>
<Incidence.Pooling.And.Aggregation.>
<MortalityPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Non-Accidental
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Smith et al.
Year:2009
Location:98 US cities
Other pollutants:PM10
Geographic area:Everywhere
Reference:Richard L. Smith, Baowei Xu, and Paul Switzer (2009). Reassessing the relationship between ozone and short-term mortality in U.S. urban communities. Inhalation Toxicology, 2009; 21(S2): 37?65
Start age:0
End age:99
Baseline functional form:PM10
Incidence dataset:Mortality Incidence (2025)
Beta:0.000257743
Beta distribution:Normal
P1Beta:0.000167
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate

B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Bell et al.
Year:2005
Location:US & non-US
Other pollutants:
Geographic area:Everywhere
Reference:Bell, M.L., F. Dominici, and J.M. Samet. A meta-analysis of time-series studies of ozone and mortality with comparison to the national morbidity, mortality, and air pollution study. Epidemiology, 2005. 16(4): p. 436-45.
Start age:0
End age:99
Baseline functional form:
Incidence dataset:Mortality Incidence (2025)
Beta:0.000795
Beta distribution:Normal
P1Beta:0.00021227
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Cardiopulmonary
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Huang et al.
Year:2005
Location:19 US cities
Other pollutants:
Geographic area:Everywhere
Reference:Huang, Y., F. Dominici and M. L. Bell. 2005. Bayesian hierarchical distributed lag models for summer ozone exposure and cardio-respiratory mortality. Environmetrics. Vol. 16: 547?562.
Start age:0
End age:99
Baseline functional form:
Incidence dataset:Mortality Incidence (2025)

Beta:0.0008125
Beta distribution:Normal
P1Beta:0.000258673
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Respiratory
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:Mean
Author:Jerrett et al.
Year:2009
Location:86 urban areas
Other pollutants:PM2.5
Geographic area:Everywhere
Reference:Jerrett, Michael, Burnett, Richard T, Pope, Arden C, et al. 2009. Long-Term Ozone Exposure and Mortality. New England Journal of Medicine.
Start age:30
End age:99
Baseline functional form:PM2.5
Incidence dataset:Mortality Incidence (2025)
Beta:0.004471161
Beta distribution:Normal
P1Beta:0.001510347
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</MortalityPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Non-Accidental
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Smith et al.
Qualifier:Ozone season
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere

Other pollutants:PM10
Reference:Richard L. Smith, Baowei Xu, and Paul Switzer (2009). Reassessing the relationship between ozone and short-term mortality in U.S. urban communities. Inhalation Toxicology, 2009; 21(S2): 37?65
Start age:
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2025)
Beta:0.000257743
Beta distribution:Normal
P1Beta:0.000167
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Bell et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L., F. Dominici, and J.M. Samet. A meta-analysis of time-series studies of ozone and mortality with comparison to the national morbidity, mortality, and air pollution study. Epidemiology, 2005. 16(4): p. 436-45.
Start age:
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2025)
Beta:0.000795
Beta distribution:Normal
P1Beta:0.00021227
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Cardiopulmonary

Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Huang et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Huang, Y., F. Dominici and M. L. Bell. 2005. Bayesian hierarchical distributed lag models for summer ozone exposure and cardio-respiratory mortality. Environmetrics. Vol. 16: 547?562.
Start age:
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2025)
Beta:0.0008125
Beta distribution:Normal
P1Beta:0.000258673
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Respiratory
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:Mean
Author:Jerrett et al.
Qualifier:Metric adjusted using a ratio of 1.14 based on table 2 of Anderson & Bell
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Jerrett, Michael, Burnett, Richard T, Pope, Arden C, et al. 2009. Long-Term Ozone Exposure and Mortality. New England Journal of Medicine.
Start age:30
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Mortality Incidence (2025)
Beta:0.004471161
Beta distribution:Normal
P1Beta:0.001510347
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:

Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Mortality>
Mortality
Smith:Pooling Method Type:None
Bell:Pooling Method Type:None
Huang:Pooling Method Type:None
Jerrett:Pooling Method Type:None
</Valuation.Pooling.Window.Name.Mortality>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:School Loss Days
Endpoint:School Loss Days, All Cause
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Gilliland et al.
Qualifier:All year. 8-hour max from 8-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A*B
Year:2001
Geographic area:Everywhere
Other pollutants:
Reference:Gilliland, F.D., K. Berhane, E.B. Rappaport, D.C. Thomas, E. Avol, W.J. Gauderman, S.J. London, H.G. Margolis, R. McConnell, K.T. Islam and J.M. Peters. 2001. The effects of ambient air pollution on school absenteeism due to respiratory illnesses. Epidemi
Start age:5
End age:17
Baseline functional form:Incidence*POP*A*B
Incidence dataset:Other Incidence (2000)
Beta:0.007824
Beta distribution:Normal
P1Beta:0.004444898
P2Beta:0
A:0.3929
NameA:Scalar for % of school days in ozone season
B:0.945
NameB:Population of school children at-risk for a new absence
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.School.Loss.Days>
School Loss Days
</Valuation.Pooling.Window.Name.School.Loss.Days>
Processing complete. Valuation processing time: 0 hours 0 minutes 0 seconds.
</Aggregate, Pool & Value>

Attachment 2

BenMAP-CE Audit Trial Report – O3_2029Mit

BenMAP-CE 1.5.0
<Aggregate, Pool & Value>
Create Datetime:2020-05-21 17:44:06
IsRunInPointMode:False
Latin Hypercube Points:10
Population Dataset:SJDomainPop-GooglePCM4
Year:2029
Threshold:0
Incidence averaging:All
<Baseline.And.Control.Group0>
<Pollutant>
Name:Ozone
Observation Type:Hourly
Season0:May 1-September 30
Metric0:D1HourMax
Metric1:D24HourMean
Metric2:D8HourMax
Metric3:D8HourMean
</Pollutant>
<Baseline.Air.Quality.Surfaces>
Create Datetime:2020-05-20 07:38:07
Pollutant:Ozone
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\o3.2029_f2_mu.csv
<Grid.Definition>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Grid.Definition>
<Pollutant>
Name:Ozone
Observation Type:Hourly
Season0:May 1-September 30
Metric0:D1HourMax
Metric1:D24HourMean
Metric2:D8HourMax
Metric3:D8HourMean
</Pollutant>
</Baseline.Air.Quality.Surfaces>
<Control.Air.Quality.Surfaces>
Create Datetime:2020-05-18 09:15:45
Pollutant:Ozone
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\o3.2029.csv
<Grid.Definition>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Grid.Definition>
<Pollutant>
Name:Ozone
Observation Type:Hourly

Season0:May 1-September 30
Metric0:D1HourMax
Metric1:D24HourMean
Metric2:D8HourMax
Metric3:D8HourMean
</Pollutant>
</Control.Air.Quality.Surfaces>
</Baseline.And.Control.Group0>
<Selected.health.impact.functions>
<Health.impact.function.0>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Respiratory Symptoms
Endpoint:Minor Restricted Activity Days
Start age:18
End age:64
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Ostro and Rothschild
Qualifier:8-hour max from 1-hour max.
Function:(1-(1/EXP(Beta*DELTAQ)))*A*POP
Year:1989
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Ostro, B.D. and S. Rothschild. Air Pollution and Acute Respiratory Morbidity - an Observational Study of Multiple Pollutants. Environ Res, 1989. 50(2): p. 238-247.
Baseline functional form:A*POP
Incidence dataset:
Prevalence dataset:
Variable dataset:
Beta:0.002596
Beta distribution:Normal
P1Beta:0.00077644
P2Beta:0
A:0.02137
NameA:mRAD18to64; Ostro and Rothschild, 1989, p 243.
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.0>
<Health.impact.function.1>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Asthma Exacerbation
Endpoint:Asthma Exacerbation, One or More Symptoms
Start age:6
End age:18
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None

Author:O'Connor et al.
Qualifier:
Function:(1-EXP(-Beta*DELTAQ))*A*POP*Prevalence
Year:2008
Geographic area:Everywhere
Other pollutants:PM2.5,NO2
Reference:O'Connor, G. T., L. Neas, et al. (2008). "Acute respiratory health effects of air pollution on children with asthma in US inner cities." J Allergy Clin Immunol 121(5): 1133-1139 e1131
Baseline functional form:A*POP*Prevalence
Incidence dataset:
Prevalence dataset:Prevalence (2008)
Variable dataset:
Beta:0.000966054
Beta distribution:Normal
P1Beta:0.002991454
P2Beta:0
A:0.207142857
NameA:Incidence rate
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.1>
<Health.impact.function.2>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Start age:18
End age:99
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Adult model, 8 hour maximum metric, 4 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.007696104
Beta distribution:Normal
P1Beta:0.002837389
P2Beta:0
A:0
NameA:
B:0
NameB:

C:0
NameC:
Percentile:0
</Health.impact.function.2>
<Health.impact.function.3>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Start age:0
End age:17
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Child model, 8 hour maximum metric, 3 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.010436002
Beta distribution:Normal
P1Beta:0.004357595
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.3>
<Health.impact.function.4>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Start age:65
End age:99
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Katsouyanni et al.
Qualifier:Summer, 1985-1994, penalized splines, 8 df
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009

Geographic area:Everywhere
Other pollutants:
Reference:Katsouyanni, K., Samet, J. M., Anderson, H. R., Atkinson, R., Tertre, A. L., Medina, S., et al. (2009). Air Pollution and Health: A European and North American Approach (APHENA): Health Effects Institute.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.000636757
Beta distribution:Normal
P1Beta:0.000400294
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.4>
<Health.impact.function.5>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Non-Accidental
Start age:0
End age:99
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Smith et al.
Qualifier:Ozone season
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:PM10
Reference:Richard L. Smith, Baowei Xu, and Paul Switzer (2009). Reassessing the relationship between ozone and short-term mortality in U.S. urban communities. Inhalation Toxicology, 2009; 21(S2): 37?65
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2025)
Prevalence dataset:
Variable dataset:
Beta:0.000257743
Beta distribution:Normal
P1Beta:0.000167
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.5>

<Health.impact.function.6>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause
Start age:0
End age:99
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Bell et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L., F. Dominici, and J.M. Samet. A meta-analysis of time-series studies of ozone and mortality with comparison to the national morbidity, mortality, and air pollution study. Epidemiology, 2005. 16(4): p. 436-45.
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2025)
Prevalence dataset:
Variable dataset:
Beta:0.000795
Beta distribution:Normal
P1Beta:0.00021227
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.6>
<Health.impact.function.7>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Cardiopulmonary
Start age:0
End age:99
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Huang et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Huang, Y., F. Dominici and M. L. Bell. 2005. Bayesian hierarchical distributed lag models for summer ozone exposure and cardio-respiratory mortality. Environmetrics. Vol. 16: 547?562.

Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2025)
Prevalence dataset:
Variable dataset:
Beta:0.0008125
Beta distribution:Normal
P1Beta:0.000258673
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.7>
<Health.impact.function.8>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Respiratory
Start age:30
End age:99
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:Mean
Author:Jerrett et al.
Qualifier:Metric adjusted using a ratio of 1.14 based on table 2 of Anderson & Bell
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Jerrett, Michael, Burnett, Richard T, Pope, Arden C, et al. 2009. Long-Term Ozone Exposure and Mortality. New England Journal of Medicine.
Baseline functional form:Incidence*POP
Incidence dataset:Mortality Incidence (2025)
Prevalence dataset:
Variable dataset:
Beta:0.004471161
Beta distribution:Normal
P1Beta:0.001510347
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.8>
<Health.impact.function.9>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:School Loss Days
Endpoint:School Loss Days, All Cause
Start age:5

End age:17
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Gilliland et al.
Qualifier:All year. 8-hour max from 8-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A*B
Year:2001
Geographic area:Everywhere
Other pollutants:
Reference:Gilliland, F.D., K. Berhane, E.B. Rappaport, D.C. Thomas, E. Avol, W.J. Gauderman, S.J. London, H.G. Margolis, R. McConnell, K.T. Islam and J.M. Peters. 2001. The effects of ambient air pollution on school absenteeism due to respiratory illnesses. Epidemi
Baseline functional form:Incidence*POP*A*B
Incidence dataset:Other Incidence (2000)
Prevalence dataset:
Variable dataset:
Beta:0.007824
Beta distribution:Normal
P1Beta:0.004444898
P2Beta:0
A:0.3929
NameA:Scalar for % of school days in ozone season
B:0.945
NameB:Population of school children at-risk for a new absence
C:0
NameC:
Percentile:0
</Health.impact.function.9>
</Selected.health.impact.functions>
<Log.And.Message>
Processing complete. HIF processing time: 0 hours 24 minutes 46 seconds.
</Log.And.Message>
Sort Incidence LHPs:False
Default Advanced Pooling Method:Roundweightstotwodigits
Default Monte Carlo Iterations:5000
Random Seed:1
<Inflation.Adjustment>
Dataset:
Year:2029
</Inflation.Adjustment>
<Income.Growth.Adjustment>
Dataset:
Year : -1
Adjust Income Growth EndpointGroups
</Income.Growth.Adjustment>
<Incidence.Aggregation>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Incidence.Aggregation>

<Valuation.Aggregation>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Valuation.Aggregation>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Respiratory Symptoms
Endpoint:Minor Restricted Activity Days
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Ostro and Rothschild
Qualifier:8-hour max from 1-hour max.
Function:(1-(1/EXP(Beta*DELTAQ)))*A*POP
Year:1989
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Ostro, B.D. and S. Rothschild. Air Pollution and Acute Respiratory Morbidity - an Observational Study of Multiple Pollutants. Environ Res, 1989. 50(2): p. 238-247.
Start age:18
End age:64
Baseline functional form:A*POP
Incidence dataset:
Beta:0.002596
Beta distribution:Normal
P1Beta:0.00077644
P2Beta:0
A:0.02137
NameA:mRAD18to64; Ostro and Rothschild, 1989, p 243.
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Acute.Respiratory.Symptoms>
Acute Respiratory Symptoms
</Valuation.Pooling.Window.Name.Acute.Respiratory.Symptoms>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Asthma Exacerbation
Endpoint:Asthma Exacerbation, One or More Symptoms
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:O'Connor et al.
Qualifier:
Function:(1-EXP(-Beta*DELTAQ))*A*POP*Prevalence
Year:2008

Geographic area:Everywhere
Other pollutants:PM2.5,NO2
Reference:O'Connor, G. T., L. Neas, et al. (2008). "Acute respiratory health effects of air pollution on children with asthma in US inner cities." J Allergy Clin Immunol 121(5): 1133-1139 e1131
Start age:6
End age:18
Baseline functional form:A*POP*Prevalence
Incidence dataset:
Beta:0.000966054
Beta distribution:Normal
P1Beta:0.002991454
P2Beta:0
A:0.207142857
NameA:Incidence rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Asthma.Exacerbation>
Asthma Exacerbation
</Valuation.Pooling.Window.Name.Asthma.Exacerbation>
<Incidence.Pooling.And.Aggregation.>
<Emergency.Room.Visits.RespiratoryPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Year:2009
Location:Seattle,WA
Other pollutants:
Geographic area:Everywhere
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:18
End age:99
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.007696104
Beta distribution:Normal
P1Beta:0.002837389
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0

Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Year:2009
Location:Seattle,WA
Other pollutants:
Geographic area:Everywhere
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:0
End age:17
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.010436002
Beta distribution:Normal
P1Beta:0.004357595
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Emergency.Room.Visits.RespiratoryPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Adult model, 8 hour maximum metric, 4 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:18
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.007696104
Beta distribution:Normal

P1Beta:0.002837389
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Child model, 8 hour maximum metric, 3 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:
End age:17
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.010436002
Beta distribution:Normal
P1Beta:0.004357595
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
Emergency Room Visits, Respiratory
Mar:Pooling Method Type:None
Mar:Pooling Method Type:None
</Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Pollutant:Ozone
Metric:D8HourMax

Metric statistic:None
Author:Katsouyanni et al.
Qualifier:Summer, 1985-1994, penalized splines, 8 df
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Katsouyanni, K., Samet, J. M., Anderson, H. R., Atkinson, R., Tertre, A. L., Medina, S., et al. (2009). Air Pollution and Health: A European and North American Approach (APHENA): Health Effects Institute.
Start age:65
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.000636757
Beta distribution:Normal
P1Beta:0.000400294
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Hospital.Admissions.Respiratory>
Hospital Admissions, Respiratory
</Valuation.Pooling.Window.Name.Hospital.Admissions.Respiratory>
<Incidence.Pooling.And.Aggregation.>
<MortalityPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Non-Accidental
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Smith et al.
Year:2009
Location:98 US cities
Other pollutants:PM10
Geographic area:Everywhere
Reference:Richard L. Smith, Baowei Xu, and Paul Switzer (2009). Reassessing the relationship between ozone and short-term mortality in U.S. urban communities. Inhalation Toxicology, 2009; 21(S2): 37?65
Start age:0
End age:99
Baseline functional form:PM10
Incidence dataset:Mortality Incidence (2025)
Beta:0.000257743
Beta distribution:Normal
P1Beta:0.000167
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate

B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Bell et al.
Year:2005
Location:US & non-US
Other pollutants:
Geographic area:Everywhere
Reference:Bell, M.L., F. Dominici, and J.M. Samet. A meta-analysis of time-series studies of ozone and mortality with comparison to the national morbidity, mortality, and air pollution study. Epidemiology, 2005. 16(4): p. 436-45.
Start age:0
End age:99
Baseline functional form:
Incidence dataset:Mortality Incidence (2025)
Beta:0.000795
Beta distribution:Normal
P1Beta:0.00021227
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Cardiopulmonary
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Huang et al.
Year:2005
Location:19 US cities
Other pollutants:
Geographic area:Everywhere
Reference:Huang, Y., F. Dominici and M. L. Bell. 2005. Bayesian hierarchical distributed lag models for summer ozone exposure and cardio-respiratory mortality. Environmetrics. Vol. 16: 547?562.
Start age:0
End age:99
Baseline functional form:
Incidence dataset:Mortality Incidence (2025)

Beta:0.0008125
Beta distribution:Normal
P1Beta:0.000258673
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Respiratory
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:Mean
Author:Jerrett et al.
Year:2009
Location:86 urban areas
Other pollutants:PM2.5
Geographic area:Everywhere
Reference:Jerrett, Michael, Burnett, Richard T, Pope, Arden C, et al. 2009. Long-Term Ozone Exposure and Mortality. New England Journal of Medicine.
Start age:30
End age:99
Baseline functional form:PM2.5
Incidence dataset:Mortality Incidence (2025)
Beta:0.004471161
Beta distribution:Normal
P1Beta:0.001510347
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</MortalityPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Non-Accidental
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Smith et al.
Qualifier:Ozone season
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere

Other pollutants:PM10
Reference:Richard L. Smith, Baowei Xu, and Paul Switzer (2009). Reassessing the relationship between ozone and short-term mortality in U.S. urban communities. Inhalation Toxicology, 2009; 21(S2): 37?65
Start age:
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2025)
Beta:0.000257743
Beta distribution:Normal
P1Beta:0.000167
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Bell et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L., F. Dominici, and J.M. Samet. A meta-analysis of time-series studies of ozone and mortality with comparison to the national morbidity, mortality, and air pollution study. Epidemiology, 2005. 16(4): p. 436-45.
Start age:
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2025)
Beta:0.000795
Beta distribution:Normal
P1Beta:0.00021227
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Cardiopulmonary

Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Huang et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Huang, Y., F. Dominici and M. L. Bell. 2005. Bayesian hierarchical distributed lag models for summer ozone exposure and cardio-respiratory mortality. Environmetrics. Vol. 16: 547?562.
Start age:
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2025)
Beta:0.0008125
Beta distribution:Normal
P1Beta:0.000258673
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Respiratory
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:Mean
Author:Jerrett et al.
Qualifier:Metric adjusted using a ratio of 1.14 based on table 2 of Anderson & Bell
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Jerrett, Michael, Burnett, Richard T, Pope, Arden C, et al. 2009. Long-Term Ozone Exposure and Mortality. New England Journal of Medicine.
Start age:30
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Mortality Incidence (2025)
Beta:0.004471161
Beta distribution:Normal
P1Beta:0.001510347
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:

Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Mortality>
Mortality
Smith:Pooling Method Type:None
Bell:Pooling Method Type:None
Huang:Pooling Method Type:None
Jerrett:Pooling Method Type:None
</Valuation.Pooling.Window.Name.Mortality>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:School Loss Days
Endpoint:School Loss Days, All Cause
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Gilliland et al.
Qualifier:All year. 8-hour max from 8-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A*B
Year:2001
Geographic area:Everywhere
Other pollutants:
Reference:Gilliland, F.D., K. Berhane, E.B. Rappaport, D.C. Thomas, E. Avol, W.J. Gauderman, S.J. London, H.G. Margolis, R. McConnell, K.T. Islam and J.M. Peters. 2001. The effects of ambient air pollution on school absenteeism due to respiratory illnesses. Epidemi
Start age:5
End age:17
Baseline functional form:Incidence*POP*A*B
Incidence dataset:Other Incidence (2000)
Beta:0.007824
Beta distribution:Normal
P1Beta:0.004444898
P2Beta:0
A:0.3929
NameA:Scalar for % of school days in ozone season
B:0.945
NameB:Population of school children at-risk for a new absence
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.School.Loss.Days>
School Loss Days
</Valuation.Pooling.Window.Name.School.Loss.Days>
Processing complete. Valuation processing time: 0 hours 0 minutes 0 seconds.
</Aggregate, Pool & Value>

Attachment 3

BenMAP-CE Audit Trial Report – O3_2032UM

BenMAP-CE 1.5.0
<Aggregate, Pool & Value>
Create Datetime:2020-05-21 20:41:12
IsRunInPointMode:False
Latin Hypercube Points:10
Population Dataset:SJDomainPop-GooglePCM4
Year:2032
Threshold:0
Incidence averaging:All
<Baseline.And.Control.Group0>
<Pollutant>
Name:Ozone
Observation Type:Hourly
Season0:May 1-September 30
Metric0:D1HourMax
Metric1:D24HourMean
Metric2:D8HourMax
Metric3:D8HourMean
</Pollutant>
<Baseline.Air.Quality.Surfaces>
Create Datetime:2020-05-21 12:21:08
Pollutant:Ozone
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\o3.2032_f2_p.csv
<Grid.Definition>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Grid.Definition>
<Pollutant>
Name:Ozone
Observation Type:Hourly
Season0:May 1-September 30
Metric0:D1HourMax
Metric1:D24HourMean
Metric2:D8HourMax
Metric3:D8HourMean
</Pollutant>
</Baseline.Air.Quality.Surfaces>
<Control.Air.Quality.Surfaces>
Create Datetime:2020-05-20 11:17:48
Pollutant:Ozone
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\o3.2032.csv
<Grid.Definition>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Grid.Definition>
<Pollutant>
Name:Ozone
Observation Type:Hourly

Season0:May 1-September 30
Metric0:D1HourMax
Metric1:D24HourMean
Metric2:D8HourMax
Metric3:D8HourMean
</Pollutant>
</Control.Air.Quality.Surfaces>
</Baseline.And.Control.Group0>
<Selected.health.impact.functions>
<Health.impact.function.0>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Respiratory Symptoms
Endpoint:Minor Restricted Activity Days
Start age:18
End age:64
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Ostro and Rothschild
Qualifier:8-hour max from 1-hour max.
Function:(1-(1/EXP(Beta*DELTAQ)))*A*POP
Year:1989
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Ostro, B.D. and S. Rothschild. Air Pollution and Acute Respiratory Morbidity - an Observational Study of Multiple Pollutants. Environ Res, 1989. 50(2): p. 238-247.
Baseline functional form:A*POP
Incidence dataset:
Prevalence dataset:
Variable dataset:
Beta:0.002596
Beta distribution:Normal
P1Beta:0.00077644
P2Beta:0
A:0.02137
NameA:mRAD18to64; Ostro and Rothschild, 1989, p 243.
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.0>
<Health.impact.function.1>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Asthma Exacerbation
Endpoint:Asthma Exacerbation, One or More Symptoms
Start age:6
End age:18
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None

Author:O'Connor et al.
Qualifier:
Function:(1-EXP(-Beta*DELTAQ))*A*POP*Prevalence
Year:2008
Geographic area:Everywhere
Other pollutants:PM2.5,NO2
Reference:O'Connor, G. T., L. Neas, et al. (2008). "Acute respiratory health effects of air pollution on children with asthma in US inner cities." J Allergy Clin Immunol 121(5): 1133-1139 e1131
Baseline functional form:A*POP*Prevalence
Incidence dataset:
Prevalence dataset:Prevalence (2008)
Variable dataset:
Beta:0.000966054
Beta distribution:Normal
P1Beta:0.002991454
P2Beta:0
A:0.207142857
NameA:Incidence rate
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.1>
<Health.impact.function.2>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Start age:18
End age:99
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Adult model, 8 hour maximum metric, 4 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.007696104
Beta distribution:Normal
P1Beta:0.002837389
P2Beta:0
A:0
NameA:
B:0
NameB:

C:0
NameC:
Percentile:0
</Health.impact.function.2>
<Health.impact.function.3>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Start age:0
End age:17
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Child model, 8 hour maximum metric, 3 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.010436002
Beta distribution:Normal
P1Beta:0.004357595
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.3>
<Health.impact.function.4>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Start age:65
End age:99
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Katsouyanni et al.
Qualifier:Summer, 1985-1994, penalized splines, 8 df
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009

Geographic area:Everywhere
Other pollutants:
Reference:Katsouyanni, K., Samet, J. M., Anderson, H. R., Atkinson, R., Tertre, A. L., Medina, S., et al. (2009). Air Pollution and Health: A European and North American Approach (APHENA): Health Effects Institute.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.000636757
Beta distribution:Normal
P1Beta:0.000400294
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.4>
<Health.impact.function.5>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Non-Accidental
Start age:0
End age:99
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Smith et al.
Qualifier:Ozone season
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:PM10
Reference:Richard L. Smith, Baowei Xu, and Paul Switzer (2009). Reassessing the relationship between ozone and short-term mortality in U.S. urban communities. Inhalation Toxicology, 2009; 21(S2): 37?65
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2030)
Prevalence dataset:
Variable dataset:
Beta:0.000257743
Beta distribution:Normal
P1Beta:0.000167
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.5>

<Health.impact.function.6>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause
Start age:0
End age:99
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Bell et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L., F. Dominici, and J.M. Samet. A meta-analysis of time-series studies of ozone and mortality with comparison to the national morbidity, mortality, and air pollution study. Epidemiology, 2005. 16(4): p. 436-45.
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2030)
Prevalence dataset:
Variable dataset:
Beta:0.000795
Beta distribution:Normal
P1Beta:0.00021227
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.6>
<Health.impact.function.7>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Cardiopulmonary
Start age:0
End age:99
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Huang et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Huang, Y., F. Dominici and M. L. Bell. 2005. Bayesian hierarchical distributed lag models for summer ozone exposure and cardio-respiratory mortality. Environmetrics. Vol. 16: 547?562.

Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2030)
Prevalence dataset:
Variable dataset:
Beta:0.0008125
Beta distribution:Normal
P1Beta:0.000258673
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.7>
<Health.impact.function.8>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Respiratory
Start age:30
End age:99
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:Mean
Author:Jerrett et al.
Qualifier:Metric adjusted using a ratio of 1.14 based on table 2 of Anderson & Bell
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Jerrett, Michael, Burnett, Richard T, Pope, Arden C, et al. 2009. Long-Term Ozone Exposure and Mortality. New England Journal of Medicine.
Baseline functional form:Incidence*POP
Incidence dataset:Mortality Incidence (2030)
Prevalence dataset:
Variable dataset:
Beta:0.004471161
Beta distribution:Normal
P1Beta:0.001510347
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.8>
<Health.impact.function.9>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:School Loss Days
Endpoint:School Loss Days, All Cause
Start age:5

End age:17
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Gilliland et al.
Qualifier:All year. 8-hour max from 8-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A*B
Year:2001
Geographic area:Everywhere
Other pollutants:
Reference:Gilliland, F.D., K. Berhane, E.B. Rappaport, D.C. Thomas, E. Avol, W.J. Gauderman, S.J. London, H.G. Margolis, R. McConnell, K.T. Islam and J.M. Peters. 2001. The effects of ambient air pollution on school absenteeism due to respiratory illnesses. Epidemi
Baseline functional form:Incidence*POP*A*B
Incidence dataset:Other Incidence (2000)
Prevalence dataset:
Variable dataset:
Beta:0.007824
Beta distribution:Normal
P1Beta:0.004444898
P2Beta:0
A:0.3929
NameA:Scalar for % of school days in ozone season
B:0.945
NameB:Population of school children at-risk for a new absence
C:0
NameC:
Percentile:0
</Health.impact.function.9>
</Selected.health.impact.functions>
<Log.And.Message>
Processing complete. HIF processing time: 0 hours 2 minutes 7 seconds.
</Log.And.Message>
Sort Incidence LHPs:False
Default Advanced Pooling Method:Roundweightstotwodigits
Default Monte Carlo Iterations:5000
Random Seed:1
<Inflation.Adjustment>
Dataset:
Year:2032
</Inflation.Adjustment>
<Income.Growth.Adjustment>
Dataset:
Year : -1
Adjust Income Growth EndpointGroups
</Income.Growth.Adjustment>
<Incidence.Aggregation>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Incidence.Aggregation>

<Valuation.Aggregation>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Valuation.Aggregation>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Respiratory Symptoms
Endpoint:Minor Restricted Activity Days
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Ostro and Rothschild
Qualifier:8-hour max from 1-hour max.
Function:(1-(1/EXP(Beta*DELTAQ)))*A*POP
Year:1989
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Ostro, B.D. and S. Rothschild. Air Pollution and Acute Respiratory Morbidity - an Observational Study of Multiple Pollutants. Environ Res, 1989. 50(2): p. 238-247.
Start age:18
End age:64
Baseline functional form:A*POP
Incidence dataset:
Beta:0.002596
Beta distribution:Normal
P1Beta:0.00077644
P2Beta:0
A:0.02137
NameA:mRAD18to64; Ostro and Rothschild, 1989, p 243.
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Acute.Respiratory.Symptoms>
Acute Respiratory Symptoms
</Valuation.Pooling.Window.Name.Acute.Respiratory.Symptoms>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Asthma Exacerbation
Endpoint:Asthma Exacerbation, One or More Symptoms
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:O'Connor et al.
Qualifier:
Function:(1-EXP(-Beta*DELTAQ))*A*POP*Prevalence
Year:2008

Geographic area:Everywhere
Other pollutants:PM2.5,NO2
Reference:O'Connor, G. T., L. Neas, et al. (2008). "Acute respiratory health effects of air pollution on children with asthma in US inner cities." J Allergy Clin Immunol 121(5): 1133-1139 e1131
Start age:6
End age:18
Baseline functional form:A*POP*Prevalence
Incidence dataset:
Beta:0.000966054
Beta distribution:Normal
P1Beta:0.002991454
P2Beta:0
A:0.207142857
NameA:Incidence rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Asthma.Exacerbation>
Asthma Exacerbation
</Valuation.Pooling.Window.Name.Asthma.Exacerbation>
<Incidence.Pooling.And.Aggregation.>
<Emergency.Room.Visits.RespiratoryPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Year:2009
Location:Seattle,WA
Other pollutants:
Geographic area:Everywhere
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:18
End age:99
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.007696104
Beta distribution:Normal
P1Beta:0.002837389
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0

Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Year:2009
Location:Seattle,WA
Other pollutants:
Geographic area:Everywhere
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:0
End age:17
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.010436002
Beta distribution:Normal
P1Beta:0.004357595
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Emergency.Room.Visits.RespiratoryPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Adult model, 8 hour maximum metric, 4 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:18
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.007696104
Beta distribution:Normal

P1Beta:0.002837389
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Child model, 8 hour maximum metric, 3 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:0
End age:17
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.010436002
Beta distribution:Normal
P1Beta:0.004357595
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
Emergency Room Visits, Respiratory
Mar:Pooling Method Type:None
Mar:Pooling Method Type:None
</Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Pollutant:Ozone
Metric:D8HourMax

Metric statistic:None
Author:Katsouyanni et al.
Qualifier:Summer, 1985-1994, penalized splines, 8 df
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Katsouyanni, K., Samet, J. M., Anderson, H. R., Atkinson, R., Tertre, A. L., Medina, S., et al. (2009). Air Pollution and Health: A European and North American Approach (APHENA): Health Effects Institute.
Start age:65
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.000636757
Beta distribution:Normal
P1Beta:0.000400294
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Hospital.Admissions.Respiratory>
Hospital Admissions, Respiratory
</Valuation.Pooling.Window.Name.Hospital.Admissions.Respiratory>
<Incidence.Pooling.And.Aggregation.>
<MortalityPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Non-Accidental
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Smith et al.
Year:2009
Location:98 US cities
Other pollutants:PM10
Geographic area:Everywhere
Reference:Richard L. Smith, Baowei Xu, and Paul Switzer (2009). Reassessing the relationship between ozone and short-term mortality in U.S. urban communities. Inhalation Toxicology, 2009; 21(S2): 37?65
Start age:0
End age:99
Baseline functional form:PM10
Incidence dataset:Mortality Incidence (2030)
Beta:0.000257743
Beta distribution:Normal
P1Beta:0.000167
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate

B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Bell et al.
Year:2005
Location:US & non-US
Other pollutants:
Geographic area:Everywhere
Reference:Bell, M.L., F. Dominici, and J.M. Samet. A meta-analysis of time-series studies of ozone and mortality with comparison to the national morbidity, mortality, and air pollution study. Epidemiology, 2005. 16(4): p. 436-45.
Start age:0
End age:99
Baseline functional form:
Incidence dataset:Mortality Incidence (2030)
Beta:0.000795
Beta distribution:Normal
P1Beta:0.00021227
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Cardiopulmonary
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Huang et al.
Year:2005
Location:19 US cities
Other pollutants:
Geographic area:Everywhere
Reference:Huang, Y., F. Dominici and M. L. Bell. 2005. Bayesian hierarchical distributed lag models for summer ozone exposure and cardio-respiratory mortality. Environmetrics. Vol. 16: 547?562.
Start age:0
End age:99
Baseline functional form:
Incidence dataset:Mortality Incidence (2030)

Beta:0.0008125
Beta distribution:Normal
P1Beta:0.000258673
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Respiratory
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:Mean
Author:Jerrett et al.
Year:2009
Location:86 urban areas
Other pollutants:PM2.5
Geographic area:Everywhere
Reference:Jerrett, Michael, Burnett, Richard T, Pope, Arden C, et al. 2009. Long-Term Ozone Exposure and Mortality. New England Journal of Medicine.
Start age:30
End age:99
Baseline functional form:PM2.5
Incidence dataset:Mortality Incidence (2030)
Beta:0.004471161
Beta distribution:Normal
P1Beta:0.001510347
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</MortalityPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Non-Accidental
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Smith et al.
Qualifier:Ozone season
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere

Other pollutants:PM10
Reference:Richard L. Smith, Baowei Xu, and Paul Switzer (2009). Reassessing the relationship between ozone and short-term mortality in U.S. urban communities. Inhalation Toxicology, 2009; 21(S2): 37?65
Start age:0
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2030)
Beta:0.000257743
Beta distribution:Normal
P1Beta:0.000167
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Bell et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L., F. Dominici, and J.M. Samet. A meta-analysis of time-series studies of ozone and mortality with comparison to the national morbidity, mortality, and air pollution study. Epidemiology, 2005. 16(4): p. 436-45.
Start age:0
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2030)
Beta:0.000795
Beta distribution:Normal
P1Beta:0.00021227
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Cardiopulmonary

Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Huang et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Huang, Y., F. Dominici and M. L. Bell. 2005. Bayesian hierarchical distributed lag models for summer ozone exposure and cardio-respiratory mortality. Environmetrics. Vol. 16: 547?562.
Start age:0
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2030)
Beta:0.0008125
Beta distribution:Normal
P1Beta:0.000258673
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Respiratory
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:Mean
Author:Jerrett et al.
Qualifier:Metric adjusted using a ratio of 1.14 based on table 2 of Anderson & Bell
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Jerrett, Michael, Burnett, Richard T, Pope, Arden C, et al. 2009. Long-Term Ozone Exposure and Mortality. New England Journal of Medicine.
Start age:30
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Mortality Incidence (2030)
Beta:0.004471161
Beta distribution:Normal
P1Beta:0.001510347
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:

Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Mortality>
Mortality
Smith:Pooling Method Type:None
Bell:Pooling Method Type:None
Huang:Pooling Method Type:None
Jerrett:Pooling Method Type:None
</Valuation.Pooling.Window.Name.Mortality>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:School Loss Days
Endpoint:School Loss Days, All Cause
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Gilliland et al.
Qualifier:All year. 8-hour max from 8-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A*B
Year:2001
Geographic area:Everywhere
Other pollutants:
Reference:Gilliland, F.D., K. Berhane, E.B. Rappaport, D.C. Thomas, E. Avol, W.J. Gauderman, S.J. London, H.G. Margolis, R. McConnell, K.T. Islam and J.M. Peters. 2001. The effects of ambient air pollution on school absenteeism due to respiratory illnesses. Epidemi
Start age:5
End age:17
Baseline functional form:Incidence*POP*A*B
Incidence dataset:Other Incidence (2000)
Beta:0.007824
Beta distribution:Normal
P1Beta:0.004444898
P2Beta:0
A:0.3929
NameA:Scalar for % of school days in ozone season
B:0.945
NameB:Population of school children at-risk for a new absence
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.School.Loss.Days>
School Loss Days
</Valuation.Pooling.Window.Name.School.Loss.Days>
Processing complete. Valuation processing time: 0 hours 0 minutes 0 seconds.
</Aggregate, Pool & Value>

Attachment 4

BenMAP-CE Audit Trial Report – O3_2032Mit

BenMAP-CE 1.5.0
<Aggregate, Pool & Value>
Create Datetime:2020-05-21 20:32:42
IsRunInPointMode:False
Latin Hypercube Points:10
Population Dataset:SJDomainPop-GooglePCM4
Year:2032
Threshold:0
Incidence averaging:All
<Baseline.And.Control.Group0>
<Pollutant>
Name:Ozone
Observation Type:Hourly
Season0:May 1-September 30
Metric0:D1HourMax
Metric1:D24HourMean
Metric2:D8HourMax
Metric3:D8HourMean
</Pollutant>
<Baseline.Air.Quality.Surfaces>
Create Datetime:2020-05-21 12:50:44
Pollutant:Ozone
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\o3.2032_f2_mp.csv
<Grid.Definition>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Grid.Definition>
<Pollutant>
Name:Ozone
Observation Type:Hourly
Season0:May 1-September 30
Metric0:D1HourMax
Metric1:D24HourMean
Metric2:D8HourMax
Metric3:D8HourMean
</Pollutant>
</Baseline.Air.Quality.Surfaces>
<Control.Air.Quality.Surfaces>
Create Datetime:2020-05-20 11:17:48
Pollutant:Ozone
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\o3.2032.csv
<Grid.Definition>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Grid.Definition>
<Pollutant>
Name:Ozone
Observation Type:Hourly

Season0:May 1-September 30
Metric0:D1HourMax
Metric1:D24HourMean
Metric2:D8HourMax
Metric3:D8HourMean
</Pollutant>
</Control.Air.Quality.Surfaces>
</Baseline.And.Control.Group0>
<Selected.health.impact.functions>
<Health.impact.function.0>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Respiratory Symptoms
Endpoint:Minor Restricted Activity Days
Start age:18
End age:64
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Ostro and Rothschild
Qualifier:8-hour max from 1-hour max.
Function:(1-(1/EXP(Beta*DELTAQ)))*A*POP
Year:1989
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Ostro, B.D. and S. Rothschild. Air Pollution and Acute Respiratory Morbidity - an Observational Study of Multiple Pollutants. Environ Res, 1989. 50(2): p. 238-247.
Baseline functional form:A*POP
Incidence dataset:
Prevalence dataset:
Variable dataset:
Beta:0.002596
Beta distribution:Normal
P1Beta:0.00077644
P2Beta:0
A:0.02137
NameA:mRAD18to64; Ostro and Rothschild, 1989, p 243.
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.0>
<Health.impact.function.1>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Asthma Exacerbation
Endpoint:Asthma Exacerbation, One or More Symptoms
Start age:6
End age:18
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None

Author:O'Connor et al.
Qualifier:
Function:(1-EXP(-Beta*DELTAQ))*A*POP*Prevalence
Year:2008
Geographic area:Everywhere
Other pollutants:PM2.5,NO2
Reference:O'Connor, G. T., L. Neas, et al. (2008). "Acute respiratory health effects of air pollution on children with asthma in US inner cities." J Allergy Clin Immunol 121(5): 1133-1139 e1131
Baseline functional form:A*POP*Prevalence
Incidence dataset:
Prevalence dataset:Prevalence (2008)
Variable dataset:
Beta:0.000966054
Beta distribution:Normal
P1Beta:0.002991454
P2Beta:0
A:0.207142857
NameA:Incidence rate
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.1>
<Health.impact.function.2>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Start age:18
End age:99
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Adult model, 8 hour maximum metric, 4 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.007696104
Beta distribution:Normal
P1Beta:0.002837389
P2Beta:0
A:0
NameA:
B:0
NameB:

C:0
NameC:
Percentile:0
</Health.impact.function.2>
<Health.impact.function.3>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Start age:0
End age:17
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Child model, 8 hour maximum metric, 3 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.010436002
Beta distribution:Normal
P1Beta:0.004357595
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.3>
<Health.impact.function.4>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Start age:65
End age:99
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Katsouyanni et al.
Qualifier:Summer, 1985-1994, penalized splines, 8 df
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009

Geographic area:Everywhere
Other pollutants:
Reference:Katsouyanni, K., Samet, J. M., Anderson, H. R., Atkinson, R., Tertre, A. L., Medina, S., et al. (2009). Air Pollution and Health: A European and North American Approach (APHENA): Health Effects Institute.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.000636757
Beta distribution:Normal
P1Beta:0.000400294
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.4>
<Health.impact.function.5>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Non-Accidental
Start age:0
End age:99
Race:ALL
Ethnicity:ALL
Gender:ALL
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Smith et al.
Qualifier:Ozone season
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:PM10
Reference:Richard L. Smith, Baowei Xu, and Paul Switzer (2009). Reassessing the relationship between ozone and short-term mortality in U.S. urban communities. Inhalation Toxicology, 2009; 21(S2): 37?65
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2030)
Prevalence dataset:
Variable dataset:
Beta:0.000257743
Beta distribution:Normal
P1Beta:0.000167
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.5>

<Health.impact.function.6>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause
Start age:0
End age:99
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Bell et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L., F. Dominici, and J.M. Samet. A meta-analysis of time-series studies of ozone and mortality with comparison to the national morbidity, mortality, and air pollution study. Epidemiology, 2005. 16(4): p. 436-45.
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2030)
Prevalence dataset:
Variable dataset:
Beta:0.000795
Beta distribution:Normal
P1Beta:0.00021227
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.6>
<Health.impact.function.7>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Cardiopulmonary
Start age:0
End age:99
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Huang et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Huang, Y., F. Dominici and M. L. Bell. 2005. Bayesian hierarchical distributed lag models for summer ozone exposure and cardio-respiratory mortality. Environmetrics. Vol. 16: 547?562.

Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2030)
Prevalence dataset:
Variable dataset:
Beta:0.0008125
Beta distribution:Normal
P1Beta:0.000258673
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.7>
<Health.impact.function.8>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Respiratory
Start age:30
End age:99
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:Mean
Author:Jerrett et al.
Qualifier:Metric adjusted using a ratio of 1.14 based on table 2 of Anderson & Bell
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Jerrett, Michael, Burnett, Richard T, Pope, Arden C, et al. 2009. Long-Term Ozone Exposure and Mortality. New England Journal of Medicine.
Baseline functional form:Incidence*POP
Incidence dataset:Mortality Incidence (2030)
Prevalence dataset:
Variable dataset:
Beta:0.004471161
Beta distribution:Normal
P1Beta:0.001510347
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.8>
<Health.impact.function.9>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:School Loss Days
Endpoint:School Loss Days, All Cause
Start age:5

End age:17
Race:
Ethnicity:
Gender:
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Gilliland et al.
Qualifier:All year. 8-hour max from 8-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A*B
Year:2001
Geographic area:Everywhere
Other pollutants:
Reference:Gilliland, F.D., K. Berhane, E.B. Rappaport, D.C. Thomas, E. Avol, W.J. Gauderman, S.J. London, H.G. Margolis, R. McConnell, K.T. Islam and J.M. Peters. 2001. The effects of ambient air pollution on school absenteeism due to respiratory illnesses. Epidemi
Baseline functional form:Incidence*POP*A*B
Incidence dataset:Other Incidence (2000)
Prevalence dataset:
Variable dataset:
Beta:0.007824
Beta distribution:Normal
P1Beta:0.004444898
P2Beta:0
A:0.3929
NameA:Scalar for % of school days in ozone season
B:0.945
NameB:Population of school children at-risk for a new absence
C:0
NameC:
Percentile:0
</Health.impact.function.9>
</Selected.health.impact.functions>
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Processing complete. HIF processing time: 0 hours 2 minutes 5 seconds.
</Log.And.Message>
Sort Incidence LHPs:False
Default Advanced Pooling Method:Roundweightstotwodigits
Default Monte Carlo Iterations:5000
Random Seed:1
<Inflation.Adjustment>
Dataset:
Year:-1
</Inflation.Adjustment>
<Income.Growth.Adjustment>
Dataset:
Year : -1
</Income.Growth.Adjustment>
<Incidence.Aggregation>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Incidence.Aggregation>
<Valuation.Aggregation>

Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Valuation.Aggregation>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Respiratory Symptoms
Endpoint:Minor Restricted Activity Days
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Ostro and Rothschild
Qualifier:8-hour max from 1-hour max.
Function:(1-(1/EXP(Beta*DELTAQ)))*A*POP
Year:1989
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Ostro, B.D. and S. Rothschild. Air Pollution and Acute Respiratory Morbidity - an Observational Study of Multiple Pollutants. Environ Res, 1989. 50(2): p. 238-247.
Start age:18
End age:64
Baseline functional form:A*POP
Incidence dataset:
Beta:0.002596
Beta distribution:Normal
P1Beta:0.00077644
P2Beta:0
A:0.02137
NameA:mRAD18to64; Ostro and Rothschild, 1989, p 243.
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Acute.Respiratory.Symptoms>
Acute Respiratory Symptoms
</Valuation.Pooling.Window.Name.Acute.Respiratory.Symptoms>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Asthma Exacerbation
Endpoint:Asthma Exacerbation, One or More Symptoms
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:O'Connor et al.
Qualifier:
Function:(1-EXP(-Beta*DELTAQ))*A*POP*Prevalence
Year:2008
Geographic area:Everywhere

Other pollutants:PM2.5,NO2
Reference:O'Connor, G. T., L. Neas, et al. (2008). "Acute respiratory health effects of air pollution on children with asthma in US inner cities." J Allergy Clin Immunol 121(5): 1133-1139 e1131
Start age:6
End age:18
Baseline functional form:A*POP*Prevalence
Incidence dataset:
Beta:0.000966054
Beta distribution:Normal
P1Beta:0.002991454
P2Beta:0
A:0.207142857
NameA:Incidence rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Asthma.Exacerbation>
Asthma Exacerbation
</Valuation.Pooling.Window.Name.Asthma.Exacerbation>
<Incidence.Pooling.And.Aggregation.>
<Emergency.Room.Visits.RespiratoryPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Year:2009
Location:Seattle,WA
Other pollutants:
Geographic area:Everywhere
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:18
End age:99
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.007696104
Beta distribution:Normal
P1Beta:0.002837389
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0

</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Year:2009
Location:Seattle,WA
Other pollutants:
Geographic area:Everywhere
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:0
End age:17
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.010436002
Beta distribution:Normal
P1Beta:0.004357595
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Emergency.Room.Visits.RespiratoryPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Adult model, 8 hour maximum metric, 4 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:18
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.007696104
Beta distribution:Normal
P1Beta:0.002837389

P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Mar and Koenig
Qualifier:Child model, 8 hour maximum metric, 3 day lag, May-September
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., & Koenig, J. Q. (2009). Relationship between visits to emergency departments for asthma and ozone exposure in greater Seattle, Washington. Annals of Allergy, Asthma, & Immunology, 103, 474-479.
Start age:0
End age:17
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.010436002
Beta distribution:Normal
P1Beta:0.004357595
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
Emergency Room Visits, Respiratory
Mar:Pooling Method Type:None
Mar:Pooling Method Type:None
</Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None

Author:Katsouyanni et al.
Qualifier:Summer, 1985-1994, penalized splines, 8 df
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Katsouyanni, K., Samet, J. M., Anderson, H. R., Atkinson, R., Tertre, A. L., Medina, S., et al. (2009). Air Pollution and Health: A European and North American Approach (APHENA): Health Effects Institute.
Start age:65
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.000636757
Beta distribution:Normal
P1Beta:0.000400294
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Hospital.Admissions.Respiratory>
Hospital Admissions, Respiratory
</Valuation.Pooling.Window.Name.Hospital.Admissions.Respiratory>
<Incidence.Pooling.And.Aggregation.>
<MortalityPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Non-Accidental
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Smith et al.
Year:2009
Location:98 US cities
Other pollutants:PM10
Geographic area:Everywhere
Reference:Richard L. Smith, Baowei Xu, and Paul Switzer (2009). Reassessing the relationship between ozone and short-term mortality in U.S. urban communities. Inhalation Toxicology, 2009; 21(S2): 37?65
Start age:0
End age:99
Baseline functional form:PM10
Incidence dataset:Mortality Incidence (2030)
Beta:0.000257743
Beta distribution:Normal
P1Beta:0.000167
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0

NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Bell et al.
Year:2005
Location:US & non-US
Other pollutants:
Geographic area:Everywhere
Reference:Bell, M.L., F. Dominici, and J.M. Samet. A meta-analysis of time-series studies of ozone and mortality with comparison to the national morbidity, mortality, and air pollution study. Epidemiology, 2005. 16(4): p. 436-45.
Start age:0
End age:99
Baseline functional form:
Incidence dataset:Mortality Incidence (2030)
Beta:0.000795
Beta distribution:Normal
P1Beta:0.00021227
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Cardiopulmonary
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Huang et al.
Year:2005
Location:19 US cities
Other pollutants:
Geographic area:Everywhere
Reference:Huang, Y., F. Dominici and M. L. Bell. 2005. Bayesian hierarchical distributed lag models for summer ozone exposure and cardio-respiratory mortality. Environmetrics. Vol. 16: 547?562.
Start age:0
End age:99
Baseline functional form:
Incidence dataset:Mortality Incidence (2030)
Beta:0.0008125

Beta distribution:Normal
P1Beta:0.000258673
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Respiratory
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:Mean
Author:Jerrett et al.
Year:2009
Location:86 urban areas
Other pollutants:PM2.5
Geographic area:Everywhere
Reference:Jerrett, Michael, Burnett, Richard T, Pope, Arden C, et al. 2009. Long-Term Ozone Exposure and Mortality. New England Journal of Medicine.
Start age:30
End age:99
Baseline functional form:PM2.5
Incidence dataset:Mortality Incidence (2030)
Beta:0.004471161
Beta distribution:Normal
P1Beta:0.001510347
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</MortalityPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Non-Accidental
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Smith et al.
Qualifier:Ozone season
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:PM10

Reference:Richard L. Smith, Baowei Xu, and Paul Switzer (2009). Reassessing the relationship between ozone and short-term mortality in U.S. urban communities. Inhalation Toxicology, 2009; 21(S2): 37?65
Start age:0
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2030)
Beta:0.000257743
Beta distribution:Normal
P1Beta:0.000167
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Bell et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L., F. Dominici, and J.M. Samet. A meta-analysis of time-series studies of ozone and mortality with comparison to the national morbidity, mortality, and air pollution study. Epidemiology, 2005. 16(4): p. 436-45.
Start age:0
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2030)
Beta:0.000795
Beta distribution:Normal
P1Beta:0.00021227
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Cardiopulmonary
Pollutant:Ozone

Metric:D8HourMax
Metric statistic:None
Author:Huang et al.
Qualifier:Warm season. 8-hour max from 24-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2005
Geographic area:Everywhere
Other pollutants:
Reference:Huang, Y., F. Dominici and M. L. Bell. 2005. Bayesian hierarchical distributed lag models for summer ozone exposure and cardio-respiratory mortality. Environmetrics. Vol. 16: 547?562.
Start age:0
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Mortality Incidence (2030)
Beta:0.0008125
Beta distribution:Normal
P1Beta:0.000258673
P2Beta:0
A:0.0027397
NameA:Scalar to convert annual mortality rate to daily rate
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, Respiratory
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:Mean
Author:Jerrett et al.
Qualifier:Metric adjusted using a ratio of 1.14 based on table 2 of Anderson & Bell
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:PM2.5
Reference:Jerrett, Michael, Burnett, Richard T, Pope, Arden C, et al. 2009. Long-Term Ozone Exposure and Mortality. New England Journal of Medicine.
Start age:30
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Mortality Incidence (2030)
Beta:0.004471161
Beta distribution:Normal
P1Beta:0.001510347
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0

Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Mortality>
Mortality
Smith:Pooling Method Type:None
Bell:Pooling Method Type:None
Huang:Pooling Method Type:None
Jerrett:Pooling Method Type:None
</Valuation.Pooling.Window.Name.Mortality>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:School Loss Days
Endpoint:School Loss Days, All Cause
Pollutant:Ozone
Metric:D8HourMax
Metric statistic:None
Author:Gilliland et al.
Qualifier:All year. 8-hour max from 8-hour mean.
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A*B
Year:2001
Geographic area:Everywhere
Other pollutants:
Reference:Gilliland, F.D., K. Berhane, E.B. Rappaport, D.C. Thomas, E. Avol, W.J. Gauderman, S.J. London, H.G. Margolis, R. McConnell, K.T. Islam and J.M. Peters. 2001. The effects of ambient air pollution on school absenteeism due to respiratory illnesses. Epidemi
Start age:5
End age:17
Baseline functional form:Incidence*POP*A*B
Incidence dataset:Other Incidence (2000)
Beta:0.007824
Beta distribution:Normal
P1Beta:0.004444898
P2Beta:0
A:0.3929
NameA:Scalar for % of school days in ozone season
B:0.945
NameB:Population of school children at-risk for a new absence
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.School.Loss.Days>
School Loss Days
</Valuation.Pooling.Window.Name.School.Loss.Days>
Processing complete. Valuation processing time: 0 hours 0 minutes 0 seconds.
</Aggregate, Pool & Value>

Attachment 5

BenMAP-CE Audit Trial Report – PM25_2029UM

BenMAP-CE 1.5.0
<Aggregate, Pool & Value>
Create Datetime:2020-05-21 21:06:37
IsRunInPointMode:False
Latin Hypercube Points:10
Population Dataset:SJDomainPop-GooglePCM4
Year:2029
Threshold:0
Incidence averaging:All
<Baseline.And.Control.Group0>
<Pollutant>
Name:PM2.5
Observation Type:Daily
Season0:January 1-March 31
Season1:April 1-June 30
Season2:July 1-September 30
Season3:October 1-December 31
Metric0:D24HourMean
Seasonal Metric0:QuarterlyMean
</Pollutant>
<Baseline.Air.Quality.Surfaces>
Create Datetime:2020-05-21 15:03:17
Pollutant:PM2.5
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\pm25.2029_f2_p.csv
<Grid.Definition>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Grid.Definition>
<Pollutant>
Name:PM2.5
Observation Type:Daily
Season0:January 1-March 31
Season1:April 1-June 30
Season2:July 1-September 30
Season3:October 1-December 31
Metric0:D24HourMean
Seasonal Metric0:QuarterlyMean
</Pollutant>
</Baseline.Air.Quality.Surfaces>
<Control.Air.Quality.Surfaces>
Create Datetime:2020-05-21 13:59:06
Pollutant:PM2.5
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\pm25.2029.csv
<Grid.Definition>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Grid.Definition>
<Pollutant>

Name:PM2.5
Observation Type:Daily
Season0:January 1-March 31
Season1:April 1-June 30
Season2:July 1-September 30
Season3:October 1-December 31
Metric0:D24HourMean
Seasonal Metric0:QuarterlyMean
</Pollutant>
</Control.Air.Quality.Surfaces>
</Baseline.And.Control.Group0>
<Selected.health.impact.functions>
<Health.impact.function.0>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:18
End age:24
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.0>
<Health.impact.function.1>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:25
End age:44
Race:
Ethnicity:
Gender:

Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.1>
<Health.impact.function.2>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:45
End age:54
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days

B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.2>
<Health.impact.function.3>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:55
End age:64
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.3>
<Health.impact.function.4>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:65
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A

Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.925661
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.4>
<Health.impact.function.5>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Cardiovascular
Endpoint:HA, All Cardiovascular (less Myocardial Infarctions)
Start age:65
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Bell
Qualifier:National; Yearly
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2012
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L. 2012. Assessment of the Health Impacts of Particulate Matter Characteristics. Research Report 161. Health Effects Institute. Research Report 161: 1-59.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.0008
Beta distribution:Normal
P1Beta:0.000107143
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.5>

<Health.impact.function.6>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Start age:0
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Mar et al.
Qualifier:Entire study period (January 3, 1999 - May 30, 2002)
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2010
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., J. Q. Koenig and J. Primomo. 2010. Associations between asthma emergency visits and particulate matter sources, including diesel emissions from stationary generators in Tacoma, Washington. Inhal Toxicol. Vol. 22 (6): 445-8. http://www.ncbi.nlm
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.005602959
Beta distribution:Normal
P1Beta:0.002103073
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.6>
<Health.impact.function.7>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Start age:65
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.

Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00207
Beta distribution:Normal
P1Beta:0.000446429
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.7>
<Health.impact.function.8>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, Asthma
Start age:0
End age:64
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Sheppard
Qualifier:
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2003
Geographic area:Everywhere
Other pollutants:
Reference:Sheppard, L. Ambient Air Pollution and Nonelderly Asthma Hospital Admissions in Seattle, Washington, 1987-1994. In: Revised Analyses of Time-Series Studies of Air Pollution and Health. 2003, Health Effects Institute: Boston, MA. p. 227-230.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.003323789
Beta distribution:Normal
P1Beta:0.00104459
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.8>
<Health.impact.function.9>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause

Start age:30
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:Mean
Seasonal metric:QuarterlyMean
Author:Krewski et al.
Qualifier:Random effects cox; 44 individual and 7 ecologic co-variates; 1999--2000 follow-up (Commentary table 4)
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:TSP, O3, SO4, SO2
Reference:Krewski D, Jerrett M, Burnett R, et al. 2009. Extended Follow-Up and Spatial analysis of the American Cancer Society Linking Particulate Air Pollution and Mortality. Health Effects Institute, Cambridge MA
Baseline functional form:Incidence*POP
Incidence dataset:Mortality Incidence (2025)
Prevalence dataset:
Variable dataset:
Beta:0.005826891
Beta distribution:Normal
P1Beta:0.000962763
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.9>
</Selected.health.impact.functions>
<Log.And.Message>
Processing complete. HIF processing time: 0 hours 1 minutes 29 seconds.
</Log.And.Message>
Sort Incidence LHPs:False
Default Advanced Pooling Method:Roundweightstotwodigits
Default Monte Carlo Iterations:5000
Random Seed:1
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Dataset:
Year:-1
</Inflation.Adjustment>
<Income.Growth.Adjustment>
Dataset:
Year : -1
</Income.Growth.Adjustment>
<Incidence.Aggregation>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile

Shapefile Name:googlepcm
</Incidence.Aggregation>
<Valuation.Aggregation>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Valuation.Aggregation>
<Incidence.Pooling.And.Aggregation.>
<Acute.Myocardial.InfarctionPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:18
End age:24
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.

Start age:25
End age:44
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:45
End age:54
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009

Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:55
End age:64
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
End age:99
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.925661
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Acute.Myocardial.InfarctionPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction

Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:18
End age:24
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:25
End age:44
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0

NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:45
End age:54
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:55
End age:64
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal

P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.925661
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Acute.Myocardial.Infarction>
Acute Myocardial Infarction
Zanobetti:Pooling Method Type:None
Zanobetti:Pooling Method Type:None
Zanobetti:Pooling Method Type:None
Zanobetti:Pooling Method Type:None
Zanobetti:Pooling Method Type:None
</Valuation.Pooling.Window.Name.Acute.Myocardial.Infarction>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Cardiovascular
Endpoint:HA, All Cardiovascular (less Myocardial Infarctions)

Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Bell
Qualifier:National; Yearly
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2012
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L. 2012. Assessment of the Health Impacts of Particulate Matter Characteristics. Research Report 161. Health Effects Institute. Research Report 161: 1-59.
Start age:65
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.0008
Beta distribution:Normal
P1Beta:0.000107143
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Hospital.Admissions.Cardiovascular>
Hospital Admissions, Cardiovascular
</Valuation.Pooling.Window.Name.Hospital.Admissions.Cardiovascular>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Mar et al.
Qualifier:Entire study period (January 3, 1999 - May 30, 2002)
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2010
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., J. Q. Koenig and J. Primomo. 2010. Associations between asthma emergency visits and particulate matter sources, including diesel emissions from stationary generators in Tacoma, Washington. Inhal Toxicol. Vol. 22 (6): 445-8. http://www.ncbi.nlm
Start age:0
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.005602959
Beta distribution:Normal
P1Beta:0.002103073
P2Beta:0

A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
Emergency Room Visits, Respiratory
</Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
<Incidence.Pooling.And.Aggregation.>
<Hospital.Admissions.RespiratoryPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
End age:99
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00207
Beta distribution:Normal
P1Beta:0.000446429
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, Asthma
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Sheppard
Year:2003
Location:Seattle, WA
Other pollutants:

Geographic area:Everywhere
Reference:Sheppard, L. Ambient Air Pollution and Nonelderly Asthma Hospital Admissions in Seattle, Washington, 1987-1994. In: Revised Analyses of Time-Series Studies of Air Pollution and Health. 2003, Health Effects Institute: Boston, MA. p. 227-230.
Start age:0
End age:64
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.003323789
Beta distribution:Normal
P1Beta:0.00104459
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Hospital.Admissions.RespiratoryPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.00207
Beta distribution:Normal
P1Beta:0.000446429
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory

Endpoint:HA, Asthma
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Sheppard
Qualifier:
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2003
Geographic area:Everywhere
Other pollutants:
Reference:Sheppard, L. Ambient Air Pollution and Nonelderly Asthma Hospital Admissions in Seattle, Washington, 1987-1994. In: Revised Analyses of Time-Series Studies of Air Pollution and Health. 2003, Health Effects Institute: Boston, MA. p. 227-230.
Start age:0
End age:64
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.003323789
Beta distribution:Normal
P1Beta:0.00104459
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Hospital.Admissions.Respiratory>
Hospital Admissions, Respiratory
Zanobetti:Pooling Method Type:None
Sheppard:Pooling Method Type:None
</Valuation.Pooling.Window.Name.Hospital.Admissions.Respiratory>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:Mean
Seasonal metric:QuarterlyMean
Author:Krewski et al.
Qualifier:Random effects cox; 44 individual and 7 ecologic co-variates; 1999--2000 follow-up (Commentary table 4)
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:TSP, O3, SO4, SO2
Reference:Krewski D, Jerrett M, Burnett R, et al. 2009. Extended Follow-Up and Spatial analysis of the American Cancer Society Linking Particulate Air Pollution and Mortality. Health Effects Institute, Cambridge MA
Start age:30
End age:99

Baseline functional form:Incidence*POP
Incidence dataset:Mortality Incidence (2025)
Beta:0.005826891
Beta distribution:Normal
P1Beta:0.000962763
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Mortality>
Mortality
</Valuation.Pooling.Window.Name.Mortality>
Processing complete. Valuation processing time: 0 hours 0 minutes 0 seconds.
</Aggregate, Pool & Value>

Attachment 6

BenMAP-CE Audit Trial Report – PM25_2029Mit

BenMAP-CE 1.5.0
<Aggregate, Pool & Value>
Create Datetime:2020-05-21 21:12:53
IsRunInPointMode:False
Latin Hypercube Points:10
Population Dataset:SJDomainPop-GooglePCM4
Year:2029
Threshold:0
Incidence averaging:All
<Baseline.And.Control.Group0>
<Pollutant>
Name:PM2.5
Observation Type:Daily
Season0:January 1-March 31
Season1:April 1-June 30
Season2:July 1-September 30
Season3:October 1-December 31
Metric0:D24HourMean
Seasonal Metric0:QuarterlyMean
</Pollutant>
<Baseline.Air.Quality.Surfaces>
Create Datetime:2020-05-21 15:05:14
Pollutant:PM2.5
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\pm25.2029_f2_mp.csv
<Grid.Definition>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Grid.Definition>
<Pollutant>
Name:PM2.5
Observation Type:Daily
Season0:January 1-March 31
Season1:April 1-June 30
Season2:July 1-September 30
Season3:October 1-December 31
Metric0:D24HourMean
Seasonal Metric0:QuarterlyMean
</Pollutant>
</Baseline.Air.Quality.Surfaces>
<Control.Air.Quality.Surfaces>
Create Datetime:2020-05-21 13:59:06
Pollutant:PM2.5
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\pm25.2029.csv
<Grid.Definition>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Grid.Definition>
<Pollutant>

Name:PM2.5
Observation Type:Daily
Season0:January 1-March 31
Season1:April 1-June 30
Season2:July 1-September 30
Season3:October 1-December 31
Metric0:D24HourMean
Seasonal Metric0:QuarterlyMean
</Pollutant>
</Control.Air.Quality.Surfaces>
</Baseline.And.Control.Group0>
<Selected.health.impact.functions>
<Health.impact.function.0>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:18
End age:24
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.0>
<Health.impact.function.1>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:25
End age:44
Race:
Ethnicity:
Gender:

Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.1>
<Health.impact.function.2>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:45
End age:54
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days

B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.2>
<Health.impact.function.3>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:55
End age:64
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.3>
<Health.impact.function.4>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:65
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A

Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.925661
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.4>
<Health.impact.function.5>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Cardiovascular
Endpoint:HA, All Cardiovascular (less Myocardial Infarctions)
Start age:65
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Bell
Qualifier:National; Yearly
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2012
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L. 2012. Assessment of the Health Impacts of Particulate Matter Characteristics. Research Report 161. Health Effects Institute. Research Report 161: 1-59.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.0008
Beta distribution:Normal
P1Beta:0.000107143
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.5>

<Health.impact.function.6>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Start age:65
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00207
Beta distribution:Normal
P1Beta:0.000446429
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.6>
<Health.impact.function.7>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Start age:0
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Mar et al.
Qualifier:Entire study period (January 3, 1999 - May 30, 2002)
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2010
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., J. Q. Koenig and J. Primomo. 2010. Associations between asthma emergency visits and particulate matter sources, including diesel emissions from stationary generators in Tacoma, Washington. Inhal Toxicol. Vol. 22 (6): 445-8. http://www.ncbi.nlm

Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.005602959
Beta distribution:Normal
P1Beta:0.002103073
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.7>
<Health.impact.function.8>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, Asthma
Start age:0
End age:64
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Sheppard
Qualifier:
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2003
Geographic area:Everywhere
Other pollutants:
Reference:Sheppard, L. Ambient Air Pollution and Nonelderly Asthma Hospital Admissions in Seattle, Washington, 1987-1994. In: Revised Analyses of Time-Series Studies of Air Pollution and Health. 2003, Health Effects Institute: Boston, MA. p. 227-230.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.003323789
Beta distribution:Normal
P1Beta:0.00104459
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.8>
<Health.impact.function.9>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause

Start age:30
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:Mean
Seasonal metric:QuarterlyMean
Author:Krewski et al.
Qualifier:Random effects cox; 44 individual and 7 ecologic co-variates; 1999--2000 follow-up (Commentary table 4)
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:TSP, O3, SO4, SO2
Reference:Krewski D, Jerrett M, Burnett R, et al. 2009. Extended Follow-Up and Spatial analysis of the American Cancer Society Linking Particulate Air Pollution and Mortality. Health Effects Institute, Cambridge MA
Baseline functional form:Incidence*POP
Incidence dataset:Mortality Incidence (2025)
Prevalence dataset:
Variable dataset:
Beta:0.005826891
Beta distribution:Normal
P1Beta:0.000962763
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.9>
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Processing complete. HIF processing time: 0 hours 1 minutes 28 seconds.
</Log.And.Message>
Sort Incidence LHPs:False
Default Advanced Pooling Method:Roundweightstotwodigits
Default Monte Carlo Iterations:5000
Random Seed:1
<Inflation.Adjustment>
Dataset:
Year:-1
</Inflation.Adjustment>
<Income.Growth.Adjustment>
Dataset:
Year : -1
</Income.Growth.Adjustment>
<Incidence.Aggregation>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile

Shapefile Name:googlepcm
</Incidence.Aggregation>
<Valuation.Aggregation>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Valuation.Aggregation>
<Incidence.Pooling.And.Aggregation.>
<Acute.Myocardial.InfarctionPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:18
End age:24
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.

Start age:25
End age:44
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:45
End age:54
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009

Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:55
End age:64
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
End age:99
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.925661
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Acute.Myocardial.InfarctionPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction

Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:18
End age:24
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:25
End age:44
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0

NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:45
End age:54
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:55
End age:64
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal

P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.925661
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
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</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Acute.Myocardial.Infarction>
Acute Myocardial Infarction
Zanobetti:Pooling Method Type:None
Zanobetti:Pooling Method Type:None
Zanobetti:Pooling Method Type:None
Zanobetti:Pooling Method Type:None
Zanobetti:Pooling Method Type:None
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<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Cardiovascular
Endpoint:HA, All Cardiovascular (less Myocardial Infarctions)

Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Bell
Qualifier:National; Yearly
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2012
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L. 2012. Assessment of the Health Impacts of Particulate Matter Characteristics. Research Report 161. Health Effects Institute. Research Report 161: 1-59.
Start age:65
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.0008
Beta distribution:Normal
P1Beta:0.000107143
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Hospital.Admissions.Cardiovascular>
Hospital Admissions, Cardiovascular
</Valuation.Pooling.Window.Name.Hospital.Admissions.Cardiovascular>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Mar et al.
Qualifier:Entire study period (January 3, 1999 - May 30, 2002)
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2010
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., J. Q. Koenig and J. Primomo. 2010. Associations between asthma emergency visits and particulate matter sources, including diesel emissions from stationary generators in Tacoma, Washington. Inhal Toxicol. Vol. 22 (6): 445-8. http://www.ncbi.nlm
Start age:
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.005602959
Beta distribution:Normal
P1Beta:0.002103073
P2Beta:0

A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
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<Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
Emergency Room Visits, Respiratory
</Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
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Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
End age:99
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00207
Beta distribution:Normal
P1Beta:0.000446429
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
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Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, Asthma
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Sheppard
Year:2003
Location:Seattle, WA
Other pollutants:

Geographic area:Everywhere
Reference:Sheppard, L. Ambient Air Pollution and Nonelderly Asthma Hospital Admissions in Seattle, Washington, 1987-1994. In: Revised Analyses of Time-Series Studies of Air Pollution and Health. 2003, Health Effects Institute: Boston, MA. p. 227-230.
Start age:0
End age:64
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.003323789
Beta distribution:Normal
P1Beta:0.00104459
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
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</Hospital.Admissions.RespiratoryPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.00207
Beta distribution:Normal
P1Beta:0.000446429
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory

Endpoint:HA, Asthma
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Sheppard
Qualifier:
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2003
Geographic area:Everywhere
Other pollutants:
Reference:Sheppard, L. Ambient Air Pollution and Nonelderly Asthma Hospital Admissions in Seattle, Washington, 1987-1994. In: Revised Analyses of Time-Series Studies of Air Pollution and Health. 2003, Health Effects Institute: Boston, MA. p. 227-230.
Start age:
End age:64
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.003323789
Beta distribution:Normal
P1Beta:0.00104459
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Hospital.Admissions.Respiratory>
Hospital Admissions, Respiratory
Zanobetti:Pooling Method Type:None
Sheppard:Pooling Method Type:None
</Valuation.Pooling.Window.Name.Hospital.Admissions.Respiratory>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:Mean
Seasonal metric:QuarterlyMean
Author:Krewski et al.
Qualifier:Random effects cox; 44 individual and 7 ecologic co-variates; 1999--2000 follow-up (Commentary table 4)
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:TSP, O3, SO4, SO2
Reference:Krewski D, Jerrett M, Burnett R, et al. 2009. Extended Follow-Up and Spatial analysis of the American Cancer Society Linking Particulate Air Pollution and Mortality. Health Effects Institute, Cambridge MA
Start age:30
End age:99

Baseline functional form:Incidence*POP
Incidence dataset:Mortality Incidence (2025)
Beta:0.005826891
Beta distribution:Normal
P1Beta:0.000962763
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Mortality>
Mortality
</Valuation.Pooling.Window.Name.Mortality>
Processing complete. Valuation processing time: 0 hours 0 minutes 0 seconds.
</Aggregate, Pool & Value>

Attachment 7

BenMAP-CE Audit Trial Report – PM25_2032UM

BenMAP-CE 1.5.0
<Aggregate, Pool & Value>
Create Datetime:2020-05-22 10:41:30
IsRunInPointMode:False
Latin Hypercube Points:10
Population Dataset:SJDomainPop-GooglePCM4
Year:2032
Threshold:0
Incidence averaging:All
<Baseline.And.Control.Group0>
<Pollutant>
Name:PM2.5
Observation Type:Daily
Season0:January 1-March 31
Season1:April 1-June 30
Season2:July 1-September 30
Season3:October 1-December 31
Metric0:D24HourMean
Seasonal Metric0:QuarterlyMean
</Pollutant>
<Baseline.Air.Quality.Surfaces>
Create Datetime:2020-05-21 18:08:11
Pollutant:PM2.5
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\pm25.2032_f2_p.csv
<Grid.Definition>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Grid.Definition>
<Pollutant>
Name:PM2.5
Observation Type:Daily
Season0:January 1-March 31
Season1:April 1-June 30
Season2:July 1-September 30
Season3:October 1-December 31
Metric0:D24HourMean
Seasonal Metric0:QuarterlyMean
</Pollutant>
</Baseline.Air.Quality.Surfaces>
<Control.Air.Quality.Surfaces>
Create Datetime:2020-05-21 17:24:01
Pollutant:PM2.5
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\pm25.2032.csv
<Grid.Definition>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Grid.Definition>
<Pollutant>

Name:PM2.5
Observation Type:Daily
Season0:January 1-March 31
Season1:April 1-June 30
Season2:July 1-September 30
Season3:October 1-December 31
Metric0:D24HourMean
Seasonal Metric0:QuarterlyMean
</Pollutant>
</Control.Air.Quality.Surfaces>
</Baseline.And.Control.Group0>
<Selected.health.impact.functions>
<Health.impact.function.0>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:18
End age:24
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.0>
<Health.impact.function.1>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:25
End age:44
Race:
Ethnicity:
Gender:

Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.1>
<Health.impact.function.2>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:45
End age:54
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days

B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.2>
<Health.impact.function.3>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:55
End age:64
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.3>
<Health.impact.function.4>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:65
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A

Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.925661
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.4>
<Health.impact.function.5>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Cardiovascular
Endpoint:HA, All Cardiovascular (less Myocardial Infarctions)
Start age:65
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Bell
Qualifier:National; Yearly
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2012
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L. 2012. Assessment of the Health Impacts of Particulate Matter Characteristics. Research Report 161. Health Effects Institute. Research Report 161: 1-59.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.0008
Beta distribution:Normal
P1Beta:0.000107143
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.5>

<Health.impact.function.6>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Start age:0
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Mar et al.
Qualifier:Entire study period (January 3, 1999 - May 30, 2002)
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2010
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., J. Q. Koenig and J. Primomo. 2010. Associations between asthma emergency visits and particulate matter sources, including diesel emissions from stationary generators in Tacoma, Washington. Inhal Toxicol. Vol. 22 (6): 445-8. http://www.ncbi.nlm
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.005602959
Beta distribution:Normal
P1Beta:0.002103073
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.6>
<Health.impact.function.7>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Start age:65
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.

Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00207
Beta distribution:Normal
P1Beta:0.000446429
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.7>
<Health.impact.function.8>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, Asthma
Start age:0
End age:64
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Sheppard
Qualifier:
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2003
Geographic area:Everywhere
Other pollutants:
Reference:Sheppard, L. Ambient Air Pollution and Nonelderly Asthma Hospital Admissions in Seattle, Washington, 1987-1994. In: Revised Analyses of Time-Series Studies of Air Pollution and Health. 2003, Health Effects Institute: Boston, MA. p. 227-230.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.003323789
Beta distribution:Normal
P1Beta:0.00104459
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.8>
<Health.impact.function.9>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause

Start age:30
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:Mean
Seasonal metric:QuarterlyMean
Author:Krewski et al.
Qualifier:Random effects cox; 44 individual and 7 ecologic co-variates; 1999--2000 follow-up (Commentary table 4)
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:TSP, O3, SO4, SO2
Reference:Krewski D, Jerrett M, Burnett R, et al. 2009. Extended Follow-Up and Spatial analysis of the American Cancer Society Linking Particulate Air Pollution and Mortality. Health Effects Institute, Cambridge MA
Baseline functional form:Incidence*POP
Incidence dataset:Mortality Incidence (2030)
Prevalence dataset:
Variable dataset:
Beta:0.005826891
Beta distribution:Normal
P1Beta:0.000962763
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.9>
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</Log.And.Message>
Sort Incidence LHPs:False
Default Advanced Pooling Method:Roundweightstotwodigits
Default Monte Carlo Iterations:5000
Random Seed:1
<Inflation.Adjustment>
Dataset:
Year:2032
</Inflation.Adjustment>
<Income.Growth.Adjustment>
Dataset:
Year : -1
Adjust Income Growth EndpointGroups
</Income.Growth.Adjustment>
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ID:34
Columns:185
Rows:185

Grid Type:Shapefile
Shapefile Name:googlepcm
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ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Valuation.Aggregation>
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Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:18
End age:24
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components

in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:25
End age:44
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:45
End age:54
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al

Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:55
End age:64
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
End age:99
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.925661
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Acute.Myocardial.InfarctionPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions

Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:18
End age:24
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:25
End age:44
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:

C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
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Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:45
End age:54
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
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Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:55
End age:64
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225

Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
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Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.925661
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
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Acute Myocardial Infarction
Zanobetti:Pooling Method Type:None
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</Valuation.Pooling.Window.Name.Acute.Myocardial.Infarction>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Cardiovascular

Endpoint:HA, All Cardiovascular (less Myocardial Infarctions)
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Bell
Qualifier:National; Yearly
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2012
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L. 2012. Assessment of the Health Impacts of Particulate Matter Characteristics. Research Report 161. Health Effects Institute. Research Report 161: 1-59.
Start age:65
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.0008
Beta distribution:Normal
P1Beta:0.000107143
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Hospital.Admissions.Cardiovascular>
Hospital Admissions, Cardiovascular
</Valuation.Pooling.Window.Name.Hospital.Admissions.Cardiovascular>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Mar et al.
Qualifier:Entire study period (January 3, 1999 - May 30, 2002)
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2010
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., J. Q. Koenig and J. Primomo. 2010. Associations between asthma emergency visits and particulate matter sources, including diesel emissions from stationary generators in Tacoma, Washington. Inhal Toxicol. Vol. 22 (6): 445-8. http://www.ncbi.nlm
Start age:0
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.005602959
Beta distribution:Normal
P1Beta:0.002103073

P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
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<Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
Emergency Room Visits, Respiratory
</Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
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<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
End age:99
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00207
Beta distribution:Normal
P1Beta:0.000446429
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, Asthma
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Sheppard
Year:2003
Location:Seattle, WA

Other pollutants:
Geographic area:Everywhere
Reference:Sheppard, L. Ambient Air Pollution and Nonelderly Asthma Hospital Admissions in Seattle, Washington, 1987-1994. In: Revised Analyses of Time-Series Studies of Air Pollution and Health. 2003, Health Effects Institute: Boston, MA. p. 227-230.
Start age:0
End age:64
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.003323789
Beta distribution:Normal
P1Beta:0.00104459
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
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</Hospital.Admissions.RespiratoryPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.00207
Beta distribution:Normal
P1Beta:0.000446429
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions

Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, Asthma
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Sheppard
Qualifier:
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2003
Geographic area:Everywhere
Other pollutants:
Reference:Sheppard, L. Ambient Air Pollution and Nonelderly Asthma Hospital Admissions in Seattle, Washington, 1987-1994. In: Revised Analyses of Time-Series Studies of Air Pollution and Health. 2003, Health Effects Institute: Boston, MA. p. 227-230.
Start age:0
End age:64
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.003323789
Beta distribution:Normal
P1Beta:0.00104459
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Hospital.Admissions.Respiratory>
Hospital Admissions, Respiratory
Zanobetti:Pooling Method Type:None
Sheppard:Pooling Method Type:None
</Valuation.Pooling.Window.Name.Hospital.Admissions.Respiratory>
<Incidence.Pooling.And.Aggregation.>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:Mean
Seasonal metric:QuarterlyMean
Author:Krewski et al.
Qualifier:Random effects cox; 44 individual and 7 ecologic co-variates; 1999--2000 follow-up (Commentary table 4)
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:TSP, O3, SO4, SO2
Reference:Krewski D, Jerrett M, Burnett R, et al. 2009. Extended Follow-Up and Spatial analysis of the American Cancer Society Linking Particulate Air Pollution and Mortality. Health Effects Institute, Cambridge MA
Start age:30

End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Mortality Incidence (2030)
Beta:0.005826891
Beta distribution:Normal
P1Beta:0.000962763
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
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</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Mortality>
Mortality
</Valuation.Pooling.Window.Name.Mortality>
Processing complete. Valuation processing time: 0 hours 0 minutes 0 seconds.
</Aggregate, Pool & Value>

Attachment 8

BenMAP-CE Audit Trial Report – PM25_2032Mit

BenMAP-CE 1.5.0
<Aggregate, Pool & Value>
Create Datetime:2020-05-22 10:32:25
IsRunInPointMode:False
Latin Hypercube Points:10
Population Dataset:SJDomainPop-GooglePCM4
Year:2032
Threshold:0
Incidence averaging:All
<Baseline.And.Control.Group0>
<Pollutant>
Name:PM2.5
Observation Type:Daily
Season0:January 1-March 31
Season1:April 1-June 30
Season2:July 1-September 30
Season3:October 1-December 31
Metric0:D24HourMean
Seasonal Metric0:QuarterlyMean
</Pollutant>
<Baseline.Air.Quality.Surfaces>
Create Datetime:2020-05-21 18:30:12
Pollutant:PM2.5
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\pm25.2032_f2_mp.csv
<Grid.Definition>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Grid.Definition>
<Pollutant>
Name:PM2.5
Observation Type:Daily
Season0:January 1-March 31
Season1:April 1-June 30
Season2:July 1-September 30
Season3:October 1-December 31
Metric0:D24HourMean
Seasonal Metric0:QuarterlyMean
</Pollutant>
</Baseline.Air.Quality.Surfaces>
<Control.Air.Quality.Surfaces>
Create Datetime:2020-05-21 17:24:01
Pollutant:PM2.5
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\pm25.2032.csv
<Grid.Definition>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Grid.Definition>
<Pollutant>

Name:PM2.5
Observation Type:Daily
Season0:January 1-March 31
Season1:April 1-June 30
Season2:July 1-September 30
Season3:October 1-December 31
Metric0:D24HourMean
Seasonal Metric0:QuarterlyMean
</Pollutant>
</Control.Air.Quality.Surfaces>
</Baseline.And.Control.Group0>
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<Health.impact.function.0>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:18
End age:24
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.0>
<Health.impact.function.1>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:25
End age:44
Race:
Ethnicity:
Gender:

Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.1>
<Health.impact.function.2>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:45
End age:54
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days

B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.2>
<Health.impact.function.3>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:55
End age:64
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.3>
<Health.impact.function.4>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Start age:65
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A

Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.925661
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.4>
<Health.impact.function.5>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Cardiovascular
Endpoint:HA, All Cardiovascular (less Myocardial Infarctions)
Start age:65
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Bell
Qualifier:National; Yearly
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2012
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L. 2012. Assessment of the Health Impacts of Particulate Matter Characteristics. Research Report 161. Health Effects Institute. Research Report 161: 1-59.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.0008
Beta distribution:Normal
P1Beta:0.000107143
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.5>

<Health.impact.function.6>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Emergency Room Visits, Respiratory
Endpoint:Emergency Room Visits, Asthma
Start age:0
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Mar et al.
Qualifier:Entire study period (January 3, 1999 - May 30, 2002)
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2010
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., J. Q. Koenig and J. Primomo. 2010. Associations between asthma emergency visits and particulate matter sources, including diesel emissions from stationary generators in Tacoma, Washington. Inhal Toxicol. Vol. 22 (6): 445-8. http://www.ncbi.nlm
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.005602959
Beta distribution:Normal
P1Beta:0.002103073
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.6>
<Health.impact.function.7>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Start age:65
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.

Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.00207
Beta distribution:Normal
P1Beta:0.000446429
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.7>
<Health.impact.function.8>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, Asthma
Start age:0
End age:64
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Sheppard
Qualifier:
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2003
Geographic area:Everywhere
Other pollutants:
Reference:Sheppard, L. Ambient Air Pollution and Nonelderly Asthma Hospital Admissions in Seattle, Washington, 1987-1994. In: Revised Analyses of Time-Series Studies of Air Pollution and Health. 2003, Health Effects Institute: Boston, MA. p. 227-230.
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Prevalence dataset:
Variable dataset:
Beta:0.003323789
Beta distribution:Normal
P1Beta:0.00104459
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
</Health.impact.function.8>
<Health.impact.function.9>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Mortality
Endpoint:Mortality, All Cause

Start age:30
End age:99
Race:
Ethnicity:
Gender:
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:Mean
Seasonal metric:QuarterlyMean
Author:Krewski et al.
Qualifier:Random effects cox; 44 individual and 7 ecologic co-variates; 1999--2000 follow-up (Commentary table 4)
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:TSP, O3, SO4, SO2
Reference:Krewski D, Jerrett M, Burnett R, et al. 2009. Extended Follow-Up and Spatial analysis of the American Cancer Society Linking Particulate Air Pollution and Mortality. Health Effects Institute, Cambridge MA
Baseline functional form:Incidence*POP
Incidence dataset:Mortality Incidence (2030)
Prevalence dataset:
Variable dataset:
Beta:0.005826891
Beta distribution:Normal
P1Beta:0.000962763
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
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Processing complete. HIF processing time: 0 hours 1 minutes 34 seconds.
</Log.And.Message>
Sort Incidence LHPs:False
Default Advanced Pooling Method:Roundweightstotwodigits
Default Monte Carlo Iterations:5000
Random Seed:1
<Inflation.Adjustment>
Dataset:
Year:2032
</Inflation.Adjustment>
<Income.Growth.Adjustment>
Dataset:
Year : -1
Adjust Income Growth EndpointGroups
</Income.Growth.Adjustment>
<Incidence.Aggregation>
Name:GooglePCM4
ID:34
Columns:185
Rows:185

Grid Type:Shapefile
Shapefile Name:googlepcm
</Incidence.Aggregation>
<Valuation.Aggregation>
Name:GooglePCM4
ID:34
Columns:185
Rows:185
Grid Type:Shapefile
Shapefile Name:googlepcm
</Valuation.Aggregation>
<Incidence.Pooling.And.Aggregation.>
<Acute.Myocardial.InfarctionPooling.Method.TypeNone>
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Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:18
End age:24
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components

in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:25
End age:44
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:45
End age:54
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al

Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:55
End age:64
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
End age:99
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.925661
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Acute.Myocardial.InfarctionPooling.Method.TypeNone>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions

Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:18
End age:24
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:25
End age:44
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.98148
NameA:% of hospMI surviving 28 days
B:0
NameB:

C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:45
End age:54
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:55
End age:64
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225

Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.971812
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
<Health.impact.function>
Health impact function dataset:EPA Standard Health Functions
Endpoint group:Acute Myocardial Infarction
Endpoint:Acute Myocardial Infarction, Nonfatal
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP*A
Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
End age:99
Baseline functional form:Incidence*POP*A
Incidence dataset:Other Incidence (2014)
Beta:0.00225
Beta distribution:Normal
P1Beta:0.000591837
P2Beta:0
A:0.925661
NameA:% of hospMI surviving 28 days
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
</Health.impact.function>
</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Acute.Myocardial.Infarction>
Acute Myocardial Infarction
Zanobetti:Pooling Method Type:None
Zanobetti:Pooling Method Type:None
Zanobetti:Pooling Method Type:None
Zanobetti:Pooling Method Type:None
Zanobetti:Pooling Method Type:None
</Valuation.Pooling.Window.Name.Acute.Myocardial.Infarction>
<Incidence.Pooling.And.Aggregation.>
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Health impact function dataset:EPA Standard Health Functions
Endpoint group:Hospital Admissions, Cardiovascular

Endpoint:HA, All Cardiovascular (less Myocardial Infarctions)
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Bell
Qualifier:National; Yearly
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2012
Geographic area:Everywhere
Other pollutants:
Reference:Bell, M.L. 2012. Assessment of the Health Impacts of Particulate Matter Characteristics. Research Report 161. Health Effects Institute. Research Report 161: 1-59.
Start age:65
End age:99
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.0008
Beta distribution:Normal
P1Beta:0.000107143
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B:0
NameB:
C:0
NameC:
Percentile:0
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Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Mar et al.
Qualifier:Entire study period (January 3, 1999 - May 30, 2002)
Function:(1-EXP(-Beta*DELTAQ))*Incidence*POP
Year:2010
Geographic area:Everywhere
Other pollutants:
Reference:Mar, T. F., J. Q. Koenig and J. Primomo. 2010. Associations between asthma emergency visits and particulate matter sources, including diesel emissions from stationary generators in Tacoma, Washington. Inhal Toxicol. Vol. 22 (6): 445-8. http://www.ncbi.nlm
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Incidence dataset:Other Incidence (2014)
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Beta distribution:Normal
P1Beta:0.002103073

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Endpoint group:Hospital Admissions, Respiratory
Endpoint:HA, All Respiratory
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Year:2009
Location:26 U.S. Communities
Other pollutants:
Geographic area:Everywhere
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
End age:99
Baseline functional form:
Incidence dataset:Other Incidence (2014)
Beta:0.00207
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NameC:
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Endpoint:HA, Asthma
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Metric statistic:None
Author:Sheppard
Year:2003
Location:Seattle, WA

Other pollutants:
Geographic area:Everywhere
Reference:Sheppard, L. Ambient Air Pollution and Nonelderly Asthma Hospital Admissions in Seattle, Washington, 1987-1994. In: Revised Analyses of Time-Series Studies of Air Pollution and Health. 2003, Health Effects Institute: Boston, MA. p. 227-230.
Start age:0
End age:64
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Endpoint:HA, All Respiratory
Pollutant:PM2.5
Metric:D24HourMean
Metric statistic:None
Author:Zanobetti et al
Qualifier:All Seasons
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Year:2009
Geographic area:Everywhere
Other pollutants:
Reference:Zanobetti, A., M. Franklin and J. Schwartz. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. Environmental Health Vol. 8: 58-60.
Start age:65
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Author:Sheppard
Qualifier:
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2003
Geographic area:Everywhere
Other pollutants:
Reference:Sheppard, L. Ambient Air Pollution and Nonelderly Asthma Hospital Admissions in Seattle, Washington, 1987-1994. In: Revised Analyses of Time-Series Studies of Air Pollution and Health. 2003, Health Effects Institute: Boston, MA. p. 227-230.
Start age:0
End age:64
Baseline functional form:Incidence*POP
Incidence dataset:Other Incidence (2014)
Beta:0.003323789
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Endpoint:Mortality, All Cause
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Metric:D24HourMean
Metric statistic:Mean
Seasonal metric:QuarterlyMean
Author:Krewski et al.
Qualifier:Random effects cox; 44 individual and 7 ecologic co-variates; 1999--2000 follow-up (Commentary table 4)
Function:(1-(1/EXP(Beta*DELTAQ)))*Incidence*POP
Year:2009
Geographic area:Everywhere
Other pollutants:TSP, O3, SO4, SO2
Reference:Krewski D, Jerrett M, Burnett R, et al. 2009. Extended Follow-Up and Spatial analysis of the American Cancer Society Linking Particulate Air Pollution and Mortality. Health Effects Institute, Cambridge MA
Start age:30

End age:99
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C3.c Supplemental CAMx Technical Report

MEMORANDUM

Date: July 29, 2020

To: Heidi Rous, Environmental Science Associates (ESA)

From: James Westbrook, BlueScape Environmental

Subject: Supplemental Information for the CAMx Photochemical Modeling Study to Support a Health Impact Analysis, San Jose West Mixed Use Plan Project

INTRODUCTION

The purpose of this document is to provide supplemental information for the CAMx photochemical modeling study that supports the ozone and $PM_{2.5}$ health impact analysis (HIA) for the San Jose West Mixed Use Plan Project (the Project). From the time modeling was originally completed based upon Project emissions developed in May 2020, new information regarding Project emissions has become available, as of late July 2020. ESA has revised the Project emissions analysis conducted for the purposes of the California Environmental Quality Act (CEQA) draft environmental impact report (EIR). As a result, there are differences between the Project emissions used for the original modeling analysis, and updated Project emissions.

To account for the Project emissions inventory changes, it is appropriate to use a linear scaling approach to adjust the CAMx model output concentrations, which then are used as input to BenMAP-CE to yield health incidence model input concentrations. This memorandum report presents the result of proportionally scaling up the CAMx ozone concentrations, that were obtained using the May 2020 Project emissions inventory, by the increase in Oxides of Nitrogen (NO_x) emissions calculated for the July 2020 emissions inventory. Ozone concentrations have not been scaled for Project decreases in Reactive Organic Gas (ROG) emissions, because southern Bay Area region ozone formation is NO_x-limited.[1] The $PM_{2.5}$ concentrations from CAMx, that were obtained from modeling using the May 2020 Project emissions inventory, have been scaled proportionally up by the increases in Project $PM_{2.5}$ emissions calculated

[1] Reynolds, Steven D., Blanchard, Charles L., and Ziman, Stephen D. *Understanding the Effectiveness of Precursor Reductions in Lowering 8-hr Ozone Concentrations*. Journal of the Air & Waste Management Association 53:195-205. ISSN 1047-3289, 2003.

for the July 2020 inventory. As a conservative approach, modeled ozone and $PM_{2.5}$ concentrations have not been scaled down for Project NO_x or $PM_{2.5}$ emissions decreases.

The CAMx modeling could be re-run with the updated Project emissions, but such modeling would not be expected to change the updated HIA study conclusions, from results approximated with linear scaling. The substantial additional effort and delays with re-running the CAMx model is not warranted for the Project emissions changes, and would not provide any additional useful information to the public. The emission changes are relatively small compared to Project impacts, but more importantly, the conclusions from the HIA are expected to be adjusted appropriately with the adjustment in concentration data. With the proportional changes in Project emissions and modeled concentration results, the health incidences calculated in BenMAP were adjusted in the same manner.

A description of the updated Project emissions inventory and linear scaling approach is provided in the first two sections of this memorandum. The results of the linear scaling of the CAMx modeling ozone and $PM_{2.5}$ concentrations for the updated Project emissions are provided in the last section.

UPDATED PROJECT EMISSIONS INVENTORY

The July 2020 Project emissions inventory updates in lb/day, with % differences from the May 2020 Project emissions inventory by pollutant, ROG, NO_x, ozone (O_3), PM_{10}, and $PM_{2.5}$, are shown in Table 1 below. The % differences for ozone are the same as for NO_x. Table 1 includes the 2029 mitigated and non-mitigated Project scenarios, and the 2032 mitigated and non-mitigated Project scenarios.

TABLE 1
EMISSIONS FROM 2029 AND 2032 MITIGATED AND NON-MITIGATED SCENARIOS

Type	May 2020 Inventory				July 2020 Updates				Difference (%)				
	ROG	NO_x	PM_{10}	$PM_{2.5}$	ROG	NOx	PM_{10}	$PM_{2.5}$	ROG	NOx	O3	PM_{10}	$PM_{2.5}$
2029 Non-Mitigated Emissions Scenario by Source Type, lb/day													
Construction	84.9	121	25.4	10.0	**77.2**	**93.1**	**14.7**	**3.91**	-9.1%	-23%	-23%	-42%	-61%
Operational	332	263	260	61.3	**329**	**276**	**264**	**62.8**	-0.9%	4.7%	4.7%	1.3%	2.5%
Total	**417**	**385**	**286**	**71.3**	**407**	**369**	**279**	**66.7**	**-2.6%**	**-4.1%**	**-4.1%**	**-2.5%**	**-6.5%**
2032 Non-Mitigated Emissions Scenario by Source Type, lb/day													
Construction	0	0	0	0	**78.4**	**5.30**	**0.142**	**0.142**	*	*	*	*	*
Operational	491	237	259	62.2	**471**	**306**	**330**	**78.4**	-4.1%	29%	29%	27%	26%
Total	**491**	**237**	**259**	**62.2**	**549**	**311**	**330**	**78.5**	**12%**	**31%**	**31%**	**27%**	**26%**
2029 Mitigated Emissions Scenario by Source Type, lb/day													
Construction	82.5	94.1	20.5	9.28	**11.5**	**65.4**	**10.3**	**3.01**	-86%	-30%	-30%	-50%	-68%
Operational	298	188	199	47.0	**273**	**193**	**202**	**48.2**	-8.3%	2.3%	2.3%	1.4%	2.6%
Total	**380**	**283**	**219**	**56.3**	**285**	**258**	**212**	**51**	**-25%**	**-8.6%**	**-8.6%**	**-3.3%**	**-9.0%**

TABLE 1
EMISSIONS FROM 2029 AND 2032 MITIGATED AND NON-MITIGATED SCENARIOS

Type	May 2020 Inventory				July 2020 Updates				Difference (%)				
	ROG	NO_x	PM_{10}	$PM_{2.5}$	ROG	NOx	PM_{10}	$PM_{2.5}$	ROG	NOx	O3	PM_{10}	$PM_{2.5}$
2032 Mitigated Emissions Scenario by Source Type, lb/day													
Construction	0	0	0	0	6.30	5.30	0.141	0.141	*	*	*	*	*
Operational	458	153	191	46.3	395	195	242	57.9	-14%	28%	28%	27%	25%
Total	**458**	**153**	**191**	**46.3**	**401**	**200**	**242**	**58.0**	**-12%**	**31%**	**31%**	**27%**	**25%**

*Note: Construction is now assumed to occur in 2032; total values were used for scaling.

A brief summary of primary reasons for the Project emissions changes are as follows:

- Traffic: Vehicle trips were increased by up to 30%, to account not only for incremental job changes, but also total Project land uses.
- Construction Block: Contingency was added for excavation for building foundations and additional future parking. Compliance for MY2014 trucks was updated to 90% for the mitigation scenario. Adjustments were also made for EPA Tier compliance for various construction-related engine uses.
- Construction Schedule: One month was added for flexibility, which slips construction into 2032.
- Diesel Generators: Increased to 47 from 33.
- CUP: Increased flow to 30,272 gpm from 28,800 gpm to accommodate a new cooling tower diagram.
- Water Use: Adjusted downward to 1 billion gal/year to match the Water Supply Assessment.
- Distribution of Land Uses: Changed the distribution of land uses on the blocks with general shifting of construction to later phases.

For 2029 construction emissions, there was a large variation in emissions reduction (9.1% to 86%), depending on the pollutant and the Project scenario. For 2029 operational emissions, there was a modest decrease in ROG emissions, and a modest increase in NO_x and $PM_{2.5}$ emissions. Overall for both construction and operations for 2029, the result is a modest decrease (2.6% to 6.5%) for all pollutant emissions in the non-mitigated scenario, and a greater decrease (3.3% to 9.0%) for most pollutant emissions, with a 25% decrease in ROG, for the mitigated scenario. With only Project emissions reductions as a conservative measure, for 2029 mitigated and non-mitigated scenarios, no scaling of modeled Project concentrations for those scenarios was done, as a conservative measure.

As construction is now anticipated to continue into 2032, construction emissions for 2032 have increased since the May 2020 inventory. For 2032 operational emissions, there was a 4.1% decrease in ROG for the non-mitigated scenario, and a 14% decrease in ROG for the mitigated scenario. For NO_x and $PM_{2.5}$, there was a 25% to 29% increase in both 2032 scenarios. The 2032 ozone and $PM_{2.5}$ concentrations from Project-related modeling have been scaled for the increases.

The differences, as increases, between the May and July data seen in Table 1 above were used to scale values previously modeled in CAMx. The NO_x emissions increases were used in order to scale 2032 ozone concentrations (seen in Tables 2 through 5, below), and $PM_{2.5}$ emissions increases were used to scale $PM_{2.5}$ concentrations (seen in Tables 6 through 9, below). The modeled 2029 concentrations were not scaled due to only Project emissions decreases.

PROJECT EMISSION CHANGES AND CONCENTRATION SCALING APPROACH

For calculating the emissions scalar for Project-related ozone impacts, the 2032 changes in NO_x emissions is about a 31% increase. The emissions scalar used to scale Project modeled 2032 ozone concentrations is the same percentage. For that same year, ROG emissions range from a 12% increase for non-mitigated emissions to a 12% decrease for mitigated emissions. Bay Area ozone formation is NO_x-limited, and therefore, it is not expected that either an increase or a reduction in Project ROG emissions will have any appreciable impact on Project-related ozone concentration impacts. The 2029 Project NO_x emissions were reduced, and therefore, no emission scalars were calculated for 2029 as a conservative approach.

For calculating the emissions scalar for Project-related $PM_{2.5}$ impacts, the 2032 changes range from about a 25% to a 26% increase. The emissions scalars used to scale Project modeled 2032 $PM_{2.5}$ concentrations are at the same percentages. The 2029 Project $PM_{2.5}$ emissions were reduced, and therefore, no emissions scalars were calculated for 2029 as a conservative approach. While PM_{10} is included in the CAMx modeling as coarse PM contributing to $PM_{2.5}$ impacts, the contribution to $PM_{2.5}$ concentrations is small. No scaling of modeled $PM_{2.5}$ concentrations for Project PM_{10} emissions changes was performed.

To test the impact of scaling concentration data, the original PM (PM_{10} and $PM_{2.5}$) concentration inputs from CAMx were scaled by 15% and loaded into BenMAP. The response on the BenMAP-CE side, health incidences, was an increase of about 16.5-16.7%. Therefore, scaling concentrations is not exactly linear to changes in health impacts but is a good approximation.

RESULTS SUMMARY

The results of scaling CAMx modeling concentrations due to changes in the Project emissions inventory between May 2020 and July 2020, are provided in this section. The first subsection provides the results of scaling the modeled ozone concentrations. The second subsection shows the results of scaling the modeled $PM_{2.5}$ concentrations.

Ozone Concentration Results

Ozone modeling results, including linear scaling for concentration changes due to Project emission inventory changes, are presented in Tables 2 to 5, for the CAMx 4-km grid in parts per billion by volume (ppbv), maximum daily average 8-Hour (MDA8) concentrations.

For the 2029 scenario, Tables 2 and 3 compare the Project emissions changes at the grid cell with the highest change, both non-mitigated and mitigated scenarios, to the baseline concentration results. The maximum MDA8 Project change for either scenario is 0.016%, for the non-mitigated emissions scenario. As stated previously, ozone concentrations for 2029 scenarios were not scaled because Project emissions are reduced.

TABLE 2
2029 CAMX MODELING RESULTS FOR THE BASELINE AND NON-MITIGATED PROJECT SCENARIOS, DAILY MAXIMUM 8-HOUR AVERAGE OZONE, AT THE GRID CELL WITH THE HIGHEST CHANGE

Inventory	Baseline Scenario (ppbv)	Project Scenario (ppbv)	Maximum Project Change (ppbv)	Maximum Project Change (%)
May 2020 Inventory	71.637	71.648	0.011	0.016%
July 2020 Updates	71.637	71.648	0.011	0.016%

TABLE 3
2029 CAMX MODELING RESULTS FOR THE BASELINE AND MITIGATED PROJECT SCENARIOS, DAILY MAXIMUM 8-HOUR AVERAGE OZONE, AT THE GRID CELL WITH THE HIGHEST CHANGE

Inventory	Baseline Scenario (ppbv)	Project Scenario (ppbv)	Maximum Project Change (ppbv)	Maximum Project Change (%)
May 2020 Inventory	71.637	71.646	0.010	0.014%
July 2020 Updates	71.637	71.646	0.010	0.014%

For the 2032 scenario, Tables 4 and 5 compare the Project emissions changes at the grid cell with the highest change, both non-mitigated and mitigated scenarios, to the baseline concentration results, including scaling the Project modeled impacts. The maximum MDA8 Project change for either scenario is 0.021%, for the non-mitigated emissions scenario.

TABLE 4
2032 CAMX MODELING RESULTS FOR THE BASELINE AND NON-MITIGATED PROJECT SCENARIOS, DAILY MAXIMUM 8-HOUR AVERAGE OZONE, AT THE GRID CELL WITH THE HIGHEST CHANGE

Inventory	Baseline Scenario (ppbv)	Project Scenario (ppbv)	Maximum Project Change (ppbv)	Maximum Project Change (%)
May 2020 Inventory	67.573	67.584	0.011	0.016%
July 2020 Updates	67.573	67.587	0.014	0.021%

TABLE 5
2032 CAMX MODELING RESULTS FOR THE BASELINE AND MITIGATED PROJECT SCENARIOS, DAILY MAXIMUM 8-HOUR AVERAGE OZONE, AT THE GRID CELL WITH THE HIGHEST CHANGE

Inventory	Baseline Scenario (ppbv)	Project Scenario (ppbv)	Maximum Project Change (ppbv)	Maximum Project Change (%)
May 2020 Inventory	67.573	67.583	0.010	0.014%
July 2020 Updates	67.573	67.586	0.013	0.019%

$PM_{2.5}$ Concentration Results

The $PM_{2.5}$ modeling results, including linear scaling for concentration changes due to Project emission inventory changes are presented in Tables 6 to 9, for the CAMx 4-km grid in micrograms per meters cubed ($\mu g/m^3$), annual daily, or 24-hour, average $PM_{2.5}$.

For the 2029 scenario, Tables 6 and 7 compare the Project emissions changes at the grid cell with the highest change, both non-mitigated and mitigated scenarios, to the baseline concentration results. The maximum annual daily $PM_{2.5}$ Project change for either scenario is 1.01%, for the non-mitigated emissions scenario. As stated previously, $PM_{2.5}$ concentrations for 2029 scenarios were not scaled because Project emissions are reduced.

TABLE 6
2029 CAMX MODELING RESULTS FOR THE BASELINE AND NON-MITIGATED PROJECT SCENARIOS, DAILY AVERAGE 24-HOUR $PM_{2.5}$, AT THE GRID CELL WITH THE HIGHEST CHANGE

Inventory	Baseline Scenario ($\mu g/m^3$)	Project Scenario ($\mu g/m^3$)	Maximum Project Change (($\mu g/m^3$)	Maximum Project Change (%)
May 2020 Inventory	18.87	19.06	0.190	1.01%
July 2020 Updates	18.87	19.06	0.190	1.01%

TABLE 7
2029 CAMX MODELING RESULTS FOR THE BASELINE AND MITIGATED PROJECT SCENARIOS, DAILY AVERAGE 24-HOUR $PM_{2.5}$, AT THE GRID CELL WITH THE HIGHEST CHANGE

Inventory	Baseline Scenario ($\mu g/m^3$)	Project Scenario ($\mu g/m^3$)	Maximum Project Change ($\mu g/m^3$)	Maximum Project Change (%)
May 2020 Inventory	18.87	19.0	0.126	0.67%
July 2020 Updates	18.87	19.0	0.126	0.67%

For the 2032 scenario, Tables 8 and 9 compare the Project emissions changes at the grid cell with the highest change, both non-mitigated and mitigated scenarios, to the baseline concentration results, including scaling the Project modeled impacts. The maximum annual daily $PM_{2.5}$ Project change for either scenario is 1.06%, for the non-mitigated emissions scenario.

TABLE 8
2032 CAMX MODELING RESULTS FOR THE BASELINE AND NON-MITIGATED PROJECT SCENARIOS, DAILY AVERAGE 24-HOUR $PM_{2.5}$, AT THE GRID CELL WITH THE HIGHEST CHANGE

Inventory	Baseline Scenario ($\mu g/m^3$)	Project Scenario ($\mu g/m^3$)	Maximum Project Change ($\mu g/m^3$)	Maximum Project Change (%)
May 2020 Inventory	18.99	19.15	0.160	0.84%
July 2020 Updates	18.99	19.20	0.201	1.06%

TABLE 9
2032 CAMX MODELING RESULTS FOR THE BASELINE AND MITIGATED PROJECT SCENARIOS, DAILY AVERAGE 24-HOUR $PM_{2.5}$, AT THE GRID CELL WITH THE HIGHEST CHANGE

Inventory	Baseline Scenario ($\mu g/m^3$)	Project Scenario ($\mu g/m^3$)	Maximum Project Change ($\mu g/m^3$)	Maximum Project Change (%)
May 2020 Inventory	18.99	19.12	0.123	0.65%
July 2020 Updates	18.99	19.15	0.154	0.81%

CONCLUSIONS

The San Jose West Mixed Use Plan Project emissions inventory was updated between May 2020 and July 2020, including emission increases of up to 31.5% and 26.2% for NO_x and $PM_{2.5}$, respectively. The CAMx modeling output ozone and $PM_{2.5}$ concentration impacts above the Baseline were scaled linearly, or proportionally, to the changes in the Project NO_x and PM emissions inventory. As shown in the results tables, with this approach the Project ozone change in impacts above Baseline is a maximum 0.021% for the 2032 non-mitigated scenario. The Project $PM_{2.5}$ change in impacts above Baseline is a maximum 1.06% for the 2032 non-mitigated scenario. In order to be more conservative, the 2029 Project impacts on ozone and $PM_{2.5}$ have not been scaled due to a decrease in emissions.

The result of the linear scaling of CAMx concentration results for the changes in the Project emissions inventory approximates the changes in inputs to the BenMAP-CE model, and therefore, the adjusted health incidence impacts from Project-related ozone and $PM_{2.5}$ concentrations. Full CAMx re-modeling with the updated emissions inventory, given all of the effort and delays that would be involved, would not be expected to provide the public with any new or meaningful information beyond this memorandum's stated conclusions. The conclusions from this memorandum are not expected to change when re-running the CAMx model.

C3.d Supplemental BenMAP-CE Technical Report

SAN JOSE DOWNTOWN WEST MIXED-USE PLAN

Supplemental BenMAP-CE Technical Report

Prepared for

City of San Jose

July 2020

ESA

SAN JOSE DOWNTOWN WEST MIXED-USE PLAN

Supplemental BenMAP-CE Technical Report

Prepared for **July 2020**

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SAN JOSE DOWNTOWN WEST MIXED-USE PLAN

Supplemental BenMAP-CE Technical Report

1.0 Introduction

The purpose of this document is to provide supplemental information for the BenMAP-CE modeling study for the ozone and particulate matter 2.5 microns or less in diameter ($PM_{2.5}$) health impact analysis (HIA) associated with the proposed San Jose Downtown West Mixed Use Plan project (proposed project). The CAMx photochemical and BenMAP-CE modeling was originally completed based upon emissions inventories for the proposed project developed in May 2020 and the original technical reports for each study were completed in early July 2020. This analysis is subsequently referred to as the "preliminary May HIA." However, new information regarding the proposed project's emissions has become available as of July 2020, after the completion of the original technical studies, for the purposes of the California Environmental Quality Act (CEQA) draft environmental impact report (EIR). The new emissions inventory is subsequently referred to as the "draft EIR emissions inventory." The list of changes made for the draft EIR emissions inventory is available in the supplemental CAMx photochemical modeling study performed by BlueScape Environmental (BlueScape study). The differences between the two inventories are primarily related to revised traffic and construction assumptions.[1] As a result, there are slight differences between the preliminary May HIA emissions inventory and the draft EIR emissions inventory. The draft EIR emissions inventory is based on final numbers, consistent with those presented in the EIR, following refinements to the proposed project since the preliminary May HIA was performed.

Because photochemical modeling is resource-intensive and time consuming, once the draft EIR emissions inventory was finalized there was not available time to rerun the CAMx modeling with the final project-related emissions. Thus, it was determined that the results of the earlier photochemical and BenMAP-CE modeling could be scaled to account for the differences in the draft EIR emissions inventory. To account for the health effects associated with the draft EIR emissions inventory, it is appropriate to use a linear scaling approach to adjust the BenMAP-CE health incidence results (see rationale below). This report presents the results achieved by proportionally scaling up the ozone health effects in the preliminary May HIA based on the increases in oxides of nitrogen (NO_X) emissions calculated for the draft EIR emissions inventory.

[1] BlueScape Environmental. July 2020. *Supplemental Information for the CAMx Photochemical Modeling Study to Support a Health Impact Analysis, San Jose West Mixed Use Plan Project*

The draft EIR emissions inventory also includes decreases in emissions of reactive organic gases (ROG) emissions compared to the preliminary May HIA emissions inventory. However, Ozone health effects have not been scaled for decreases in ROG emissions because the southern Bay Area region ozone formation is NOx-limited[2] and therefore this approach would be conservative. The $PM_{2.5}$ health effects that were estimated in the preliminary May HIA have been scaled up proportionally by the increases in $PM_{2.5}$ emissions calculated for the draft EIR emissions inventory.

Typically, BenMAP-CE models are run using outputs from the CAMx photochemical model. The CAMx modeling could be rerun with the draft EIR proposed project emissions, but such modeling would not be expected to change the conclusions presented in the preliminary May HIA, especially when compared to results approximated with linear scaling. The substantial additional effort and delays with rerunning the CAMx model is not warranted for the finalization of the draft EIR emissions inventory, and would not provide any additional useful information to the public. This is discussed further in the supplemental BlueScape study.[3] The changes between the preliminary May HIA emissions inventory and draft EIR emissions inventory are relatively small. More importantly however, the health effects from the preliminary May HIA are expected to adjust proportionally with the change in emissions based on modeling tests performed. Regional air concentrations of ozone and $PM_{2.5}$ for the proposed project study area, as predicted by CAMx, are proportional to emissions. Therefore, it is appropriate to linearly scale concentrations by the change in emissions. In order to test the impact on health incidences predicted by BenMAP-CE from scaling air concentrations, the original PM_{10} and $PM_{2.5}$ concentration inputs from CAMx were scaled by 15% and loaded into BenMAP-CE. The model produced scaled health incidences within a small (approximately 10%) deviation of the scaled concentrations. Although the relationship was not directly linear, the slight deviation is likely, at least in part, due to the potential effects of compounding assumptions and uncertainties within each of the various models and modeling steps used in the analysis (as discussed in the preliminary May HIA technical report).[4] Therefore, linearly scaling health incidences by the change in emissions is a reasonable approach.

With the proportional changes in emissions, the health incidences calculated in BenMAP-CE will be adjusted linearly. A description of the updated proposed project emissions inventory and the linear scaling approach is provided in Section 2.0, *Scaling Approach Results*. The results of the linear scaling of the BenMAP-CE health incidence results for the proposed project are provided in Section 3.0, *Results Summary*.

2 Ozone formation in a NOx-limited environment means that there is much less NOx relative to ROG in the atmosphere, and the formation of ozone is much more dependent on changes to ambient concentrations of NOx than ROG.

3 BlueScape Environmental. July 2020. *Supplemental Information for the CAMx Photochemical Modeling Study to Support a Health Impact Analysis, San Jose West Mixed Use Plan Project*

4 ESA. July 2020. *San Jose Downtown West Mixed-Use Plan BenMAP-CE Modeling.*

2.0 Scaling Approach Results

The sections below summarize the results of the scaling approach used to adjust the BenMAP-CE results in the preliminary May HIA[5], including information on the draft EIR emission inventory and the health incidence scaling results. For more information on how the original BenMAP-CE modeling was performed, please refer to the preliminary May HIA.[6]

2.1 Updated Project Emissions Inventory

The draft EIR emissions inventory (in pounds per day) is compared to the preliminary May HIA emissions inventory in Table 1 below. This table includes the percent difference in emissions used to scale the health effect results. Table 1 includes the 2029 mitigated and unmitigated proposed project scenarios, along with the full buildout 2032 mitigated and unmitigated proposed project scenarios.

TABLE 1. COMPARISON OF 2029 AND 2032 MITIGATED AND UNMITIGATED PROPOSED PROJECT EMISSIONS[7]

Type	Preliminary May HIA Emissions Inventory				Draft EIR Emissions Inventory				Difference (%)				
	ROG	NO_x	PM_{10}	$PM_{2.5}$	ROG	NO_x	PM_{10}	$PM_{2.5}$	ROG	NO_x	O_3	PM_{10}	$PM_{2.5}$
2029 Unmitigated Emissions Scenario by Source Type, lbs/day													
Construction	84.9	121	25.4	10.0	77.2	93.1	14.7	3.91	-9.1%	-23%	-23%	-42%	-61%
Operational	332	263	260	61.3	329	276	264	62.8	-0.9%	4.7%	4.7%	1.3%	2.5%
Total	**417**	**385**	**286**	**71.3**	**407**	**369**	**279**	**66.7**	**-2.6%**	**-4.1%**	**-4.1%**	**-2.5%**	**-6.5%**
2032 Unmitigated Emissions Scenario by Source Type, lbs/day													
Construction	0	0	0	0	78.4	5.30	0.142	0.142	*	*	*	*	*
Operational	491	237	259	62.2	471	306	330	78.4	-4.1%	29%	29%	27%	26%
Total	**491**	**237**	**259**	**62.2**	**549**	**311**	**330**	**78.5**	**12%**	**31%**	**31%**	**27%**	**26%**
2029 Mitigated Emissions Scenario by Source Type, lbs/day													
Construction	82.5	94.1	20.5	9.28	11.5	65.4	10.3	3.01	-86%	-30%	-30%	-50%	-68%
Operational	298	188	199	47.0	273	193	202	48.2	-8.3%	2.3%	2.3%	1.4%	2.6%
Total	**380**	**283**	**219**	**56.3**	**285**	**258**	**212**	**51**	**-25%**	**-8.6%**	**-8.6%**	**-3.3%**	**-9.0%**
2032 Mitigated Emissions Scenario by Source Type, lb/day													
Construction	0	0	0	0	6.30	5.30	0.1414	0.1413	*	*	*	*	*
Operational	458	153	191	46.3	395	195	242	57.9	-14%	28%	28%	27%	25%
Total	**458**	**153**	**191**	**46.3**	**401**	**200**	**242**	**58.0**	**-12%**	**31%**	**31%**	**27%**	**25%**

An asterisk (*) is indicative of no percent difference calculation due to completely new contribution of construction emissions in 2032.

The differences between the preliminary May HIA and draft EIR emissions inventories presented in Table 1 above were used to scale the health incidence values previously estimated using BenMAP-CE. As discussed above, NO_X was conservatively used in order to scale ozone-related health incidences, while $PM_{2.5}$ was used to scale $PM_{2.5}$-related health incidences.[8]

5 ESA. July 2020. *San Jose Downtown West Mixed-Use Plan BenMAP-CE Modeling.*

6 Ibid.

7 BlueScape Environmental. July 2020. *Supplemental Information for the CAMx Photochemical Modeling Study to Support a Health Impact Analysis, San Jose West Mixed Use Plan Project*

8 BlueScape Environmental. July 2020. *Supplemental Information for the CAMx Photochemical Modeling Study to Support a Health Impact Analysis, San Jose West Mixed Use Plan Project*

2.2 BenMAP-CE Scaling Approach Results

The percent difference in emissions between the preliminary May HIA emissions inventory and the draft EIR emissions inventory, as presented in Table 1, were used to develop BenMAP-CE results "scalars" or multipliers. The scalars were used to calculate revised BenMAP-CE results associated with any emissions increases in the draft EIR emissions inventory. For example, for the 2032 full buildout mitigated emissions scenario, a 31% increase in NO_X emissions corresponds to a 31% increase in ozone health effects. Similarly, a 25% increase mitigated $PM_{2.5}$ emissions in 2032 corresponds to a 25% increase in $PM_{2.5}$ health effects.

In order to provide a conservative analysis of revised health effects, when emissions reductions were observed between the preliminary May HIA emissions inventory and draft EIR emissions inventory, the original BenMAP-CE health effect results were not scaled; instead, the original health effects were retained. This is conservative because decreasing emissions would likely result in lower health effects.

3.0 Results Summary

The results of scaling the BenMAP-CE health effects to the draft EIR emissions inventory are provided below. For more information related to original BenMAP-CE modeling results, please refer to the preliminary May HIA.[9]

Because the same emissions calculation methods were used for both the preliminary May HIA emissions inventory and the draft EIR emissions inventory, the ozone and $PM_{2.5}$ health effects for all endpoints would likely increase commensurately with increases in NO_X and $PM_{2.5}$ emissions, respectively. Additionally, the results presented in this section only address the linear increase in health effects associated with increases in emissions; the likely reduction in health effects due to decreases in emissions was not estimated.

Tables 2 through 9 summarize the scaled BenMAP-CE health effect results from the proposed project's emissions of ozone and $PM_{2.5}$, for both study years 2029 and 2032, and unmitigated and mitigated emissions. As these tables demonstrate, the maximum scaled regional ozone-related health outcomes attributed to project-related increases in ambient air concentrations included incidences of respiratory-related hospital admissions (0.038 maximum incidences), mortality (0.07 maximum incidences), and asthma-related emergency room visits (0.44 maximum incidences) for all studied age groups combined.[10] The project's incremental health incidences for ozone are less than 0.0011% for any of the future year without project (i.e. baseline) number of health endpoint occurrences.

The maximum scaled regional $PM_{2.5}$-related health outcomes attributed to project-related increases in ambient air concentrations included incidences of acute myocardial infarction (0.23 maximum incidences), mortality (2.03 maximum incidences), hospital admissions (0.51

9 Ibid.

10 These values represent unmitigated project emissions for the full buildout year of 2032, as presented in Table 3.

maximum incidences) and asthma-related emergency room visits (1.15 maximum incidences) for all studied age groups combined.[11] The project's incremental health incidences for $PM_{2.5}$ are less than 0.0012% for any of the future year without project number of health endpoint occurrences.

As stated in the original BenMAP-CE technical study, the very small increase in health endpoint occurrences, relative to the substantially larger number of baseline endpoint occurrences, demonstrates that the proposed project contributes a negligible amount to regional and local health impacts. After the finalization of the emissions inventory for the draft EIR, the health effects from the preliminary May HIA would likely increase by a maximum of 31% for $PM_{2.5}$-related endpoints, with health effect incidences remaining very small relative to the previously modeled background health incidence rates (e.g. the project's incremental health incidences are approximately 0.001% or less of the future year without project health incidences). The changes between the preliminary May HIA emissions inventory and the draft EIR emissions inventory do not change any conclusions originally presented nor do they warrant a full reproduction of the photochemical and BenMAP-CE modeling work.

TABLE 2. SCALED BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 8-HOUR AVERAGE OZONE IMPACT, STUDY YEAR 2029, UNMITIGATED

Human Health Endpoints		Aggregated Regional Results		Incremental Incidence / Existing Baseline Incidence (%)
Health Endpoint Group	Health Endpoint	Incremental Incidence (# per year) Mean	Baseline Incidence (# per year)	
Acute Respiratory Symptoms	Minor Restricted Activity Days	128.86	40,804,879	0.0003158%
Asthma Exacerbation	One or More Symptoms	15.73	15,360,219	0.0001024%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [0-17]	0.131	15,742	0.0008309%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [18-99]	0.209	30,113	0.0006933%
Hospital Admissions Respiratory	HA All Respiratory	0.026	46,372	0.0000593%
Mortality	All Cause	0.051	71,372	0.0000720%
	Cardiopulmonary	0.020	29,052	0.0000699%
	Non-Accidental	0.016	67,137	0.0000234%
	Respiratory	0.063	17,718	0.0003554%
School Loss Days	All Cause	84.45	10,112,544	0.0008351%

11 These values represent unmitigated project emissions for the full buildout year of 2032, as presented in Table 7, with the exception of hospital admissions, with the maximum occurring in interim year 2029, as presented in Table 5.

TABLE 3. SCALED BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 8-HOUR AVERAGE OZONE IMPACT, STUDY YEAR 2029, MITIGATED

Human Health Endpoints		Aggregated Regional Results		Incremental Incidence / Existing Baseline Incidence (%)
Health Endpoint Group	Health Endpoint	Incremental Incidence (# per year) Mean	Baseline Incidence (# per year)	
Acute Respiratory Symptoms	Minor Restricted Activity Days	111.21	40,804,879	0.0002725%
Asthma Exacerbation	One or More Symptoms	13.58	15,360,219	0.0000884%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [0-17]	0.113	15,742	0.0007171%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [18-99]	0.180	30,113	0.0005983%
Hospital Admissions Respiratory	HA All Respiratory	0.024	46,372	0.0000512%
Mortality	All Cause	0.044	71,372	0.0000621%
	Cardiopulmonary	0.018	29,052	0.0000604%
	Non-Accidental	0.014	67,137	0.0000202%
	Respiratory	0.054	17,718	0.0003067%
School Loss Days	All Cause	72.884	10,112,544	0.0007207%

TABLE 4. SCALED BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 8-HOUR AVERAGE OZONE IMPACT, STUDY YEAR 2032, UNMITIGATED

Human Health Endpoints		Aggregated Regional Results		Incremental Incidence / Existing Baseline Incidence (%)
Health Endpoint Group	Health Endpoint	Incremental Incidence (# per year) Mean	Baseline Incidence (# per year)	
Acute Respiratory Symptoms	Minor Restricted Activity Days	165.42	41,609,792	0.0003975%
Asthma Exacerbation	One or More Symptoms	20.41	15,914,655	0.0001283%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [0-17]	0.169	16,159	0.0010442%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [18-99]	0.272	30,956	0.0008784%
Hospital Admissions Respiratory	HA All Respiratory	0.038	49,799	0.0000767%
Mortality	All Cause	0.067	73,083	0.0000921%
	Cardiopulmonary	0.027	30,177	0.0000895%
	Non-Accidental	0.021	69,020	0.0000299%
	Respiratory	0.084	18,340	0.0004559%
School Loss Days	All Cause	109.40	10,452,211	0.0010466%

TABLE 5. SCALED BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 8-HOUR AVERAGE OZONE IMPACT, STUDY YEAR 2032, MITIGATED

Human Health Endpoints		Aggregated Regional Results		Incremental Incidence / Existing Baseline Incidence (%)
Health Endpoint Group	Health Endpoint	Incremental Incidence (# per year) Mean	Baseline Incidence (# per year)	
Acute Respiratory Symptoms	Minor Restricted Activity Days	133.509	41,609,792	0.0003209%
Asthma Exacerbation	One or More Symptoms	16.474	15,914,655	0.0001035%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [0-17]	0.136	16,159	0.0008428%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [18-99]	0.219	30,956	0.0007090%
Hospital Admissions Respiratory	HA All Respiratory	0.031	49,799	0.0000619%
Mortality	All Cause	0.054	73,083	0.0000743%
	Cardiopulmonary	0.022	30,177	0.0000722%
	Non-Accidental	0.017	69,020	0.0000241%
	Respiratory	0.067	18,340	0.0003680%
School Loss Days	All Cause	88.295	10,452,211	0.0008448%

TABLE 6. SCALED BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 24-HOUR AVERAGE PM2.5 IMPACT STUDY YEAR 2029, UNMITIGATED

Human Health Endpoints		Fine Modeling Grid		
		Aggregated Regional Results		Incremental Incidence / Existing Baseline Incidence (%)
Health Endpoint Group	Health Endpoint	Incremental Incidence (# per year) Mean	Baseline Incidence (# per year)	
Acute Myocardial Infarction	Acute Myocardial Infarction Nonfatal [18-24]	1.40E-04	26	0.0005376%
	Acute Myocardial Infarction Nonfatal [25-44]	0.008	1,556	0.0005280%
	Acute Myocardial Infarction Nonfatal [45-54]	0.018	3,628	0.0005094%
	Acute Myocardial Infarction Nonfatal [55-64]	0.040	6,652	0.0005975%
	Acute Myocardial Infarction Nonfatal [65-99]	0.119	24,794	0.0004805%
Emergency Room Visits - Respiratory	Asthma	0.969	109,394	0.0008858%
Hospital Admissions	All Cardiovascular (less Myocardial Infarctions)	0.230	129,627	0.0001778%
	All Respiratory	0.403	110,626	0.0003641%
	Asthma	0.088	12,809	0.0006876%
Mortality	All Cause	1.681	166,573	0.0010090%

TABLE 7. SCALED BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 24-HOUR AVERAGE PM2.5 IMPACT STUDY YEAR 2029, MITIGATED

Human Health Endpoints		Fine Modeling Grid		
		Aggregated Regional Results		Incremental Incidence / Existing Baseline Incidence (%)
Health Endpoint Group	Health Endpoint	Incremental Incidence (# per year) Mean	Baseline Incidence (# per year)	
Acute Myocardial Infarction	Acute Myocardial Infarction Nonfatal [18-24]	8.924E-05	26	0.0003414%
	Acute Myocardial Infarction Nonfatal [25-44]	0.005	1,556	0.0003353%
	Acute Myocardial Infarction Nonfatal [45-54]	0.012	3,628	0.0003235%
	Acute Myocardial Infarction Nonfatal [55-64]	0.025	6,652	0.0003795%
	Acute Myocardial Infarction Nonfatal [65-99]	0.076	24,794	0.0003052%
Emergency Room Visits - Respiratory	Asthma	0.615	109,394	0.0005626%
Hospital Admissions	All Cardiovascular (less Myocardial Infarctions)	0.146	129,627	0.0001129%
	All Respiratory	0.256	110,626	0.0002312%
	Asthma	0.056	12,809	0.0004367%
Mortality	All Cause	1.067	166,573	0.0006409%

TABLE 8. SCALED BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 24-HOUR AVERAGE PM2.5 IMPACT STUDY YEAR 2032, UNMITIGATED

Human Health Endpoints		Fine Modeling Grid		
		Aggregated Regional Results		Incremental Incidence / Existing Baseline Incidence (%)
Health Endpoint Group	Health Endpoint	Incremental Incidence (# per year) Mean	Baseline Incidence (# per year)	
Acute Myocardial Infarction	Acute Myocardial Infarction Nonfatal [18-24]	1.59E-04	26	0.0006042%
	Acute Myocardial Infarction Nonfatal [25-44]	0.010	1,587	0.0006090%
	Acute Myocardial Infarction Nonfatal [45-54]	0.022	3,812	0.0005691%
	Acute Myocardial Infarction Nonfatal [55-64]	0.047	6,665	0.0007009%
	Acute Myocardial Infarction Nonfatal [65-99]	0.151	26,465	0.0005694%
Emergency Room Visits - Respiratory	Asthma	1.152	112,397	0.0010251%
Hospital Admissions	All Cardiovascular (less Myocardial Infarctions)	0.293	139,003	0.0002107%
	All Respiratory	0.515	118,802	0.0004333%
	Asthma	0.104	13,102	0.0007913%
Mortality	All Cause	2.028	170,920	0.0011868%

TABLE 9. SCALED BENMAP-CE MODELING RESULTS FOR DAILY MAXIMUM 24-HOUR AVERAGE PM2.5 IMPACT STUDY YEAR 2032, MITIGATED

Human Health Endpoints		Fine Modeling Grid		
		Aggregated Regional Results		Incremental Incidence / Existing Baseline Incidence (%)
Health Endpoint Group	Health Endpoint	Incremental Incidence (# per year) Mean	Baseline Incidence (# per year)	
Acute Myocardial Infarction	Acute Myocardial Infarction Nonfatal [18-24]	1.17E-04	26	0.0004455%
	Acute Myocardial Infarction Nonfatal [25-44]	0.007	1,587	0.0004491%
	Acute Myocardial Infarction Nonfatal [45-54]	0.016	3,812	0.0004197%
	Acute Myocardial Infarction Nonfatal [55-64]	0.034	6,665	0.0005168%
	Acute Myocardial Infarction Nonfatal [65-99]	0.111	26,465	0.0004199%
Emergency Room Visits - Respiratory	Asthma	0.850	112,397	0.0007559%
Hospital Admissions	All Cardiovascular (less Myocardial Infarctions)	0.216	139,003	0.0001553%
	All Respiratory	0.380	118,802	0.0003195%
	Asthma	0.076	13,102	0.0005835%
Mortality	All Cause	1.496	170,920	0.0008751%