Appendix E

Regional Air Quality Modeling and Health Impact Analysis

REGIONAL AIR QUALITY MODELING
& HEALTH IMPACT ANALYSIS

for the

FRIANT RANCH COMMUNITY DEVELOPMENT PROJECT

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GLOSSARY OF TERMS AND ACRONYMS

Acronym	Description
3D	Three-dimensional
AAQA	Ambient Air Quality Analysis
agl	Above ground level
AQMP	Air Quality Management Plan
Avg	Average
BAAQMD	Bay Area Air Quality Management District
BenMAP-CE	Benefits Mapping and Analysis Program – Community Edition
C-R	Concentration-Response function
CAAQS	California Ambient Air Quality Standards
CalEEMod	California Emissions Estimator Model
CAMx	Comprehensive Air Quality Model with Extensions
CARB	California Air Resources Board
CB06	Carbon Bond 06 chemical mechanism
CEPAM	California Standard Emission Tool
CEQA	California Environmental Quality Act
CI	Confidence Interval
CMAS	Community Modeling and Analysis System
CMAQ	Community Multiscale Air Quality Model
CO	Carbon Monoxide
CSV	Comma Separated Value
DPM	Diesel Particulate Matter
EBI	Euler Backward Iterative solver
EIR	Environmental Impact Report
EMFAC	California Air Resources Board's Mobile Source Emission Factor inventory
EPA	U.S. Environmental Protection Agency
ESMF	Earth System Modeling Framework software
GIS	Geographic Information System
GREASD	Greatly Reduced Execution and Simplified Dynamics Submodel
GRIB	Gridded Binary form
HARP2	Hotspots Analysis and Reporting Program Version 2
HDF	Hierarchical Data Format
HIA	Health Impact Analysis
HRA	Health Risk Assessment
ISA	Integrated Science Assessments
km	Kilometers
lb/day	Pounds per day
LP	Limited Partnership
MDA8	Maximum Daily 8-hour Average Ozone
MPE	Model Performance Evaluation
NAAQS	National Ambient Air Quality Standards
NAM	North American Mesoscale

GLOSSARY OF TERMS AND ACRONYMS

Acronym	Description
NCEP	National Centers for Environmental Protection
NCL	NCAR Command Language
netCDF	Network Common Data form
NO_x	Oxides of Nitrogen
OFFROAD	California Air Resources Board's Offroad Source Emission Factor Inventory
PBL	Planetary Boundary Layer
PGM	Photochemical Grid model
$PM_{2.5}$	Particulate Matter 2.5 Micrometers or less in aerodynamic diameter
PM_{10}	Particulate Matter 10 Micrometers or less in aerodynamic diameter
ppb	Parts per billion
ppbv	Parts per billion by volume
PopGrid	EPA gridded population data for BenMAP
PPM	Piecewise Parabolic Model
ROG	Reactive Organic Gases
SAPRC07	Chemical Mechanism Model 2007
SIL	Significant Impact Level
SIP	State Implementation Plan
SMAQMD	Sacramento Metropolitan Air Quality Management District
SMOKE	Sparse Matrix Operator Kerner Emissions modeling system
SCAQMD	South Coast Air Quality Management District
SJV	San Joaquin Valley
SJVAPCD	San Joaquin Valley Air Pollution Control District
SO_x	Oxides of Sulfur
TOG	Total Organic Gases
$\mu g/m^3$	Micrograms per Cubic Meter
UTM	Universal Transverse Mercator
VERDI	Visual Environment for Rich Data Interpretation program
VOC	Volatile Organic Compounds
WRF	Weather Research and Forecasting model

EXECUTIVE SUMMARY

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 the Project's significant emissions of oxides of nitrogen (NO_x) and Reactive Organic Gases (ROG), which are precursors to ozone formation, and of particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$) 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 scientifically feasible at the time of drafting the analysis.

This technical study describes the work completed to satisfy the Supreme Court's EIR evidentiary requirements as applied to the Friant Ranch Community Development Project (or "the Project"). BlueScape completed photochemical modeling work to support the Project Health Impact Analysis (HIA) as described in this technical study. BlueScape generally followed the California Air Resources Board's (CARB's) 2018 $PM_{2.5}$ State Implementation (SIP) study methods (CARB 2018), to develop regional ozone and $PM_{2.5}$ air quality concentration predictions that were then entered into the U.S. Environmental Protection Agency (EPA) Benefits Mapping and Analysis Program – Community Edition (BenMAP-CE, EPA 2019a) to estimate Project health impacts. CARB used 2013 emissions and modeling files as the base case year for its photochemical modeling effort. In order to determine that the entire modeling system and supporting data bases adequately replicated observed conditions for 2013, CARB compared the 2013 air quality modeling concentration predictions to available 2013 observed air quality concentrations and determined that the modeling system was performant. CARB then projected emissions from 2013 to the 2020 future year, and the modeling system was applied in order to predict 2020 air quality concentrations. In the Project HIA study, it was deemed prudent to set 2020 as the Existing Baseline year for the regional emissions, and use the 2013 meteorological data year to complete the modeling, to ensure consistent and valid model performance with the work CARB performed.

The electronic meteorological and emissions data files used by CARB for the San Joaquin Valley (SJV) for photochemical modeling completed with the Community Multiscale Air Quality (CMAQ) model were initially obtained by Ramboll Corporation (Ramboll) and processed prior to BlueScape obtaining the files and using them to complete the HIA. The 2020 CMAQ files obtained by Ramboll from CARB, which included speciated NO_x, Total Organic Gases (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 the Comprehensive Air Quality Model with Extensions (CAMx) model (Ramboll ENVIRON 2017) with appropriate CMAQ-to-CAMx conversion tools. CARB also provided its 2013 Weather Research and Forecasting Model (WRF v3.8 or later) meteorological data files to Ramboll, which were also converted for use in CAMx using appropriate tools. BlueScape obtained these files prepared by Ramboll from the Project proponent and further developed them for use in the HIA discussed in this report.

Using the 2013 WRF meteorological data coupled with the converted CMAQ input files, CAMx (v.6.5) photochemical modeling was performed for six (6) scenarios:

1) 2020 Existing Baseline year without Project emissions;
2) 2020 Existing Baseline year with unmitigated Project emissions;
3) 2020 Existing Baseline year with mitigated Project emissions;
4) 2031 Future Baseline year without Project emissions;
5) 2031 Future Baseline year with unmitigated Project emissions; and
6) 2031 Future Baseline year with mitigated Project emissions.

The intent of including a 2020 Existing Baseline year is to describe environmental conditions in 2020 and then to add Project emissions to this baseline. The Project emissions include construction emissions, as well as operational emissions from prior completion of Project work, that will occur in the same year. The Future Baseline year describes 2031 environmental conditions without the Project to which Project emissions at full Project buildout are added for a cumulative result. For the 2031 Future Baseline year, the 2020 CAMx regional emissions inventory was "grown" to a 2031 regional emissions inventory based upon growth factors developed using the CARB 2016 SIP - Standard Emission Tool (CEPAM, CARB 2018). The 2031 regional emissions inventory thus accounts for reasonably foreseeable population growth in the affected region by 2031.

A Model Performance Evaluation (MPE) of the 2020 CAMx air quality modeled results was completed. The CAMx model was run for the entire 2020 Existing Baseline year. The MPE was conducted as a comparison of the hourly CAMx model predictions for the Project study, to CARB's original hourly CMAQ model predictions for 2020, using CMAQ modeling output files obtained from CARB. The Environmental Protection Agency (EPA) has issued guidance on how air quality simulation models are to be judged to be adequately performing in order to be used for studies such as conducted here (EPA 2018a). Two statistics that are used to judge such model performance are mean gross error and mean bias. If the gross error is less than 15% and bias is within +/-5%, it is an indicator that the model is adequately performing (Emery et. al. 2017). Average gross error and bias statistics were estimated at the county-level for ozone and $PM_{2.5}$ for each month of 2020 between the base case modeling results supplied to our team and the base case modeling results that we ran. Because the gross error and bias values that resulted were less than 5% for gross error and were near zero for bias (i.e., a few tenths of a part per billion (ppb) for ozone and a few hundredths of a $\mu g/m^3$ for $PM_{2.5}$), the CAMx modeling system results for 2020 and 2031 were deemed suitable for use in the Friant Ranch Project HIA.

For the six 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. BenMAP-CE is open-source software that can be configured to relate the human health impacts and/or benefits to air quality changes. The latest version of BenMAP-CE is Version 1.5, which the EPA released in March 2019. The program includes a subset of air quality monitoring data in preloaded databases for areas within the Continental United States, with recent and projected demographic and baseline health data, concentration-response (C-R) 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.

To estimate human health effects, 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.

The Project maximum estimated change in ozone concentration above both the 2020 Existing Baseline and the 2031 Future Baseline does not exceed the EPA's Significant Impact Level (SIL) for ozone of 1 ppb, 8-hour average. The Project maximum estimated change in $PM_{2.5}$ concentration impacts above baseline levels does not exceed the EPA's and San Joaquin Valley Air Pollution Control District's (SJVAPCD) SIL of 0.2 $\mu g/m^3$, annual average. As discussed in Section 2.0, concentration results that do not exceed a SIL can be used by Fresno County, the lead agency for this Project, as one indicator that the Project concentration impacts, and therefore the related specific health impacts, are likely not meaningful.

The Project-related specific health incidences estimated using BenMAP for ozone and $PM_{2.5}$ concentration changes above baseline, as compared with regional background health incidences, are very small relative to background incidences. For example, for ozone asthma-related emergency room visits for children aged 0 to 17, the Project-related health incidences per year were estimated to be 0.0427, or about 0.00026% of regional background occurrences. For $PM_{2.5}$ and mortality, the Project-related health incidences per year were estimated to be 0.35, or about 0.00054% of regional background occurrences. As the health incidence values estimated for Friant Ranch Project emissions are less than one, and a negligible fraction of the background incidence values, it is not expected that the Project will result in any meaningful health impact greater than zero, that can be established with any certainty.

1.0 INTRODUCTION

This HIA study provides a description of the methodologies used to develop concentration data for ozone and $PM_{2.5}$ for potential health impacts from Friant Ranch Project emissions. The intent of the HIA is to provide quantitative photochemical modeling and specific health impact information that meets the EIR evidentiary requirements for HIAs, as stated by the California Supreme Court in the Friant Ranch Case decision.

The proposed Project is located within the jurisdiction of the San Joaquin Valley Air Pollution Control District (SJVAPCD). CARB conducts photochemical modeling studies for the San Joaquin Valley to address attainment of the ozone and $PM_{2.5}$ state and federal ambient air quality standards. To review regional impacts from these pollutants, CARB recently completed photochemical modeling for the 2018 $PM_{2.5}$ SIP study using the CMAQ model for 2020 emissions (SJVAPCD 2018). As presented in this report, BlueScape obtained electronic files from Ramboll that were developed using CARB's CMAQ files, to run another photochemical model, the CAMx model. Using the CAMx files, BlueScape developed the HIA study to review potential ozone and $PM_{2.5}$ impacts from the Project. As addressed in the HIA, the primary emissions precursors to ozone formation are NO_x and Volatile Organic Compounds (VOC). VOC includes ROG, which is included within the larger category of TOG that is included in CAMx for complete photochemistry calculations. Air quality modeling concentration data developed with the CAMx model were used in health impact calculations completed with BenMAP-CE software.

The following discussion provides the background on California air district guidance, as response to the Friant Ranch Case decision. At the time the decision was released, the SJVAPCD did not develop general guidance to be used for California Environmental Quality Act (CEQA) review, and more specifically, the SJVAPCD did not develop procedures on how to evaluate specific health impacts from a project's ozone precursor and $PM_{2.5}$ emissions. However, the SJVAPCD and the South Coast Air Quality Management District (SCAQMD) did release legal positions on the Friant Ranch case. During the litigation before the California Supreme Court, SJVAPCD submitted an *Amicus Curiae* brief stating that models are not available to conduct an appropriate analysis (SJVAPCD 2015a). In its brief, SJVAPCD acknowledged that while health risk assessments (HRAs) for localized air toxics impacts, such as diesel particulate matter (DPM), 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 an analysis of health impacts solely from the Friant Ranch Project emissions (which equate to less than one-tenth of one percent of the total NO_x and VOC emissions in the San Joaquin Valley) is not likely to yield valid information, and that any such information should not be "*accurate when applied at the local level*."

SJVAPCD has followed up the brief with general guidance to project developers to make "*a reasonable effort to discuss relevant specifics regarding the connection between potential adverse air quality impacts from the Project with the likely nature and magnitude of the potential health impacts. If the potential health impacts from* *the project cannot be specifically correlated, explain what is known and why, given scientific constraints, potential health impacts cannot be translated* (SJVAPCD 2020)."

The SCAQMD also submitted an *Amicus Curiae* brief to the California Supreme Court (SCAQMD 2015). Its brief 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. However, the SCAQMD did conclude that such regional impact modeling could be feasible for larger projects, considered to be much larger in terms of total emissions, than the Friant Ranch Project. The SCAQMD has demonstrated the typical use of a photochemical modeling concentration analysis for regional (not source-specific) ozone and $PM_{2.5}$ emissions impacts, connecting the results to specific predicted health impacts, in the *2016 Air Quality Management Plan* (AQMP, SCAQMD 2017) and related reports.

In late 2019, the Sacramento Metropolitan Air Quality Management District (SMAQMD 2019) 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 $PM_{2.5}$ is feasible. 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-CE 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.

Since releasing the Interim Guidance, the SMAQMD has released the *Guidance to Address the Friant Ranch Ruling for CEQA Projects in the Sac Metro Air District*, which replaces the Interim Guidance (SMAQMD 2020). 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. The guidance provides 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 develop quantitative estimates of ozone and $PM_{2.5}$ concentrations and health impacts from these pollutants.

This report describes the methodology used to complete the ozone and $PM_{2.5}$ concentration modeling for the Friant Ranch Project, 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. A discussion regarding use of SILs for the HIA is provided in Section 2.0. The concentration impacts are discussed in detail in Section 3.7. The health impacts calculated using BenMAP-CE are presented in Section 4.3.

2.0 SIGNIFICANT IMPACT LEVELS FOR REGIONAL AIR QUALITY MODELING AND HEALTH IMPACT ANALYSIS

The Friant Ranch Case decision did not establish, nor provide the means to develop, CEQA significance thresholds for regional air quality and health impact modeling. The Case only states that specific health impact information should be presented to the public in a reliable and meaningful way. This HIA analysis for the Friant Ranch Project has been prepared due to the finding that one or more of the pollutants, NO_x, ROG (or VOC), PM_{10} or $PM_{2.5}$ emitted by the Project may exceed the CEQA mass emissions significance thresholds listed by the SJVAPCD (SJVAPCD 2015b). This section provides a discussion on use of concentration significant impact levels (SILs) for consideration by Fresno County, should the county decide to complete further review on whether the specific health impacts described in the HIA are meaningful.

The EPA and CARB have set ambient health standards – the National Ambient Air Quality Standards (NAAQS) and the California Ambient Air Quality Standards (CAAQS) – for the purpose of meeting regional air pollution management goals. The ambient standards are based upon health impact studies, including health impact studies included in the BenMAP-CE model database and used in this HIA. For ozone and $PM_{2.5}$ health studies used to establish the NAAQS, see the Integrated Science Assessments (ISAs) (EPA 2019b). According to CARB, an ambient air quality standard is established to protect the health of the most sensitive groups in communities (CARB 2021a). The ambient standards represent an acceptable regional level of pollution for a specific compound. The federal and California state ambient health standards for ozone and $PM_{2.5}$ are listed in Table 1 below (CARB 2021b).

TABLE 1
AMBIENT HEALTH STANDARDS

Pollutant	Federal	California
Ozone	70 ppb 8-Hour Avg	90 ppb 1-Hour Avg 70 ppb 8-hour Avg
$PM_{2.5}$	35 $\mu g/m^3$ 24-Hour Avg 12.0 $\mu g/m^3$ Annual Avg	12 $\mu g/m^3$ Annual Avg

The SJVAPCD has established SILs as thresholds that are a small fraction of the ambient standards, to be used for ambient air quality analysis (AAQA) for air permitting, in APR 1925 *Policy for District Rule 2201 AAQA Modeling* (SJVAPCD 2019). The SILs are used to "*determine whether a proposed source's emissions will have a significant impact on air quality in an area*." In areas that are in nonattainment of the ambient standards, such as is the case for $PM_{2.5}$ within the San Joaquin Valley, the

SILs are thresholds that cannot be exceeded by an air permit applicant and still obtain an air permit authorization.

The SJVAPCD recommends use of ambient air quality analysis to determine whether impacts from development projects are significant under CEQA. The approach for development projects is provided in Section 8.4 of the *Guidance for Assessing and Mitigating Air Quality Impacts* (SJVAPCD 2015c) and refers to the APR 1925 AAQA modeling guidance. The $PM_{2.5}$ SILs for non-fugitive sources (or projects) were obtained by SJVAPCD from EPA, as described in the document *Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program* (EPA 2018b). In that EPA guidance document (pages 7, 13), the EPA addresses why, in its judgment, source concentration impacts below a SIL are insignificant: "*the EPA believes an insignificant impact is an impact on air quality concentrations that is small and not meaningful*." Thus, as related to the ambient health standards, a regulating authority can use the SILs as an indication that impacts below the SILs can be considered to be insignificant, or not causing a meaningful difference in a region's air quality as well as in any associated health impacts.

For $PM_{2.5}$, which is a nonattainment pollutant, the SJVAPCD considers project impacts on air quality to be insignificant if the $PM_{2.5}$ SILs are not exceeded. In that case, no further analysis of impacts is required. The SJVAPCD does not list a SIL for regional ozone impacts, because such analysis is not required by APR 1925. The SIL for regional ozone impacts from single projects, 1 ppb 8-hour average, can be obtained from EPA's Guidance on the SILs referenced above.

The air quality analysis SILs listed in the EPA SIL Guidance and SJVAPCD APR 1925 for ozone and $PM_{2.5}$ are shown in Table 2.

TABLE 2
EPA AND SJVAPCD SIGNIFICANT IMPACT LEVELS

Pollutant	**EPA**	**SJVAPCD**
Ozone	1 ppb, 8-Hour Avg	---
$PM_{2.5}$	All sources: 1.2 $\mu g/m^3$, 24-Hour Avg 0.2 $\mu g/m^3$, Annual Avg	Non-Fugitive Sources: 1.2 $\mu g/m^3$, 24-Hour Avg 0.2 $\mu g/m^3$, Annual Avg Fugitive dust: 2.5 $\mu g/m^3$, 24-Hour Avg 0.63 $\mu g/m^3$, Annual Avg

The ozone 8-hour average SIL of 1 ppb is about 1.4% of the 70 ppb federal and state 8-hour ozone standards. The most conservative $PM_{2.5}$ SIL listed in Table 2, which would be associated with long-term health effects of 0.2 $\mu g/m^3$, is about 1.7% of the 12 $\mu g/m^3$ federal and state annual average $PM_{2.5}$ standard. While the purpose of an HIA is not to show compliance with ambient health standards as discussed above (rather to address specific health impacts of ozone and $PM_{2.5}$), if HIA concentration impacts due to a project above the existing regional baseline do not exceed these SIL thresholds, then Fresno County could use this finding as an indication that the project's concentration impacts on regional public health are likely not meaningful, because the SILs are related to regional health studies used to develop ambient health standards.

While this HIA report concludes that Friant Ranch Project concentration impacts (and therefore likely the related health impacts) are not meaningful, to provide Fresno County and the public with additional information, as well as meet the evidentiary requirements of the Friant Ranch Case, the report also provides specific health impact modeling results, as compared to baseline health impacts on the regional population from all of the emissions occurring in the region.

3.0 CAMX PHOTOCHEMICAL MODELING FOR THE FRIANT RANCH PROJECT

This section provides a discussion of regional photochemical modeling completed for ozone and $PM_{2.5}$ impacts using the CAMx model for the Friant Ranch Project. CAMx was used to develop regional air concentration data for the health impact analysis described in Section 4.0.

3.1 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 ambient health standard. 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 into 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 (EPA 2017).

CAMx is a state-of-the-art regional air quality modeling system developed by Ramboll 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 below.

The components shown in Figure 1 are:

- **WRF**: Weather Research and Forecasting Model, v3.8 or later. WRF was used by CARB on behalf of the SJVAPCD, to generate the meteorology data for CMAQ modeling completed for the San Joaquin Valley. WRF (year 2013) output files from CARB used for the SJVAPCD 2018 $PM_{2.5}$ SIP study 2020 model run were post-processed by Ramboll for use in CAMx. The 2013 meteorological data was used in this HIA for consistency with the CARB modeling study, thus ensuring valid CAMx model performance.

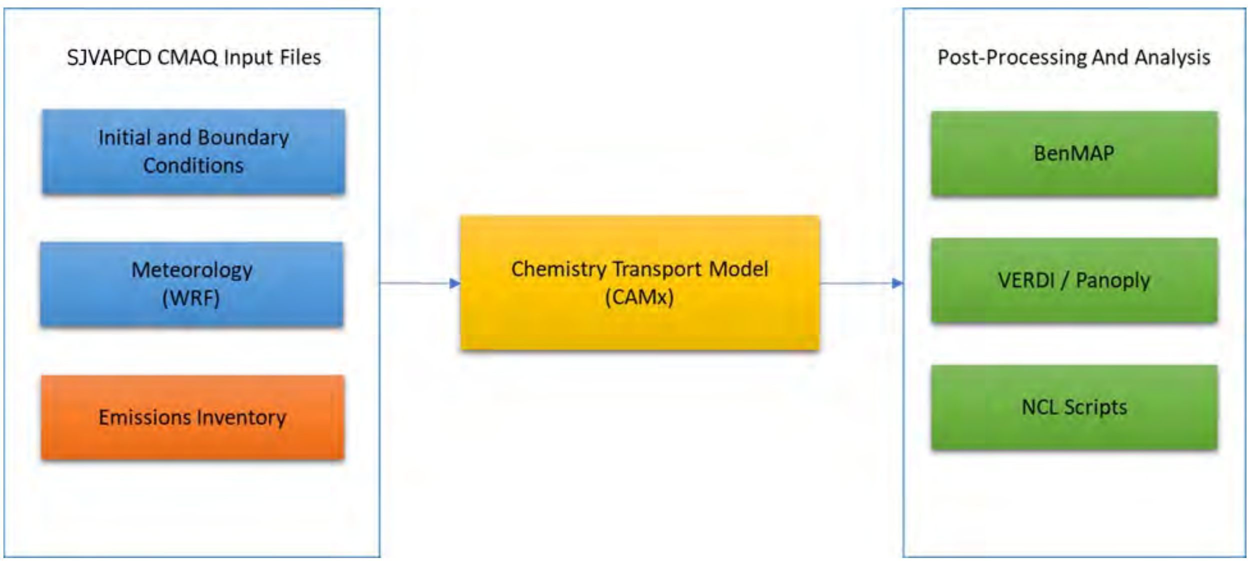


FIGURE 1. COMPONENTS OF THE CAMX MODELING SYSTEM

- **CAMx**: Comprehensive Air Quality Model with Extensions, v6.5. The CAMx model was run by Ramboll using converted CARB CMAQ input files and meteorology post-processed from CARB WRF output files.
- **Initial and Boundary Conditions**: Initial and boundary photochemical conditions for the spatial domain and the modeling time period. Initial conditions represent the state of the air quality of every grid cell of the domain and for every chemical species at the start of the simulation. The boundary conditions represent the estimated, incoming air quality of every chemical species at the north, south, east, and west lateral boundaries of the 4 km domain. The boundary conditions and initial conditions were derived based on modeling from the 12 km domain.
- **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) Modeling System (CMAS 2018). In this Project, a complete emissions inventory for Year 2020 in CMAQ-format files was provided

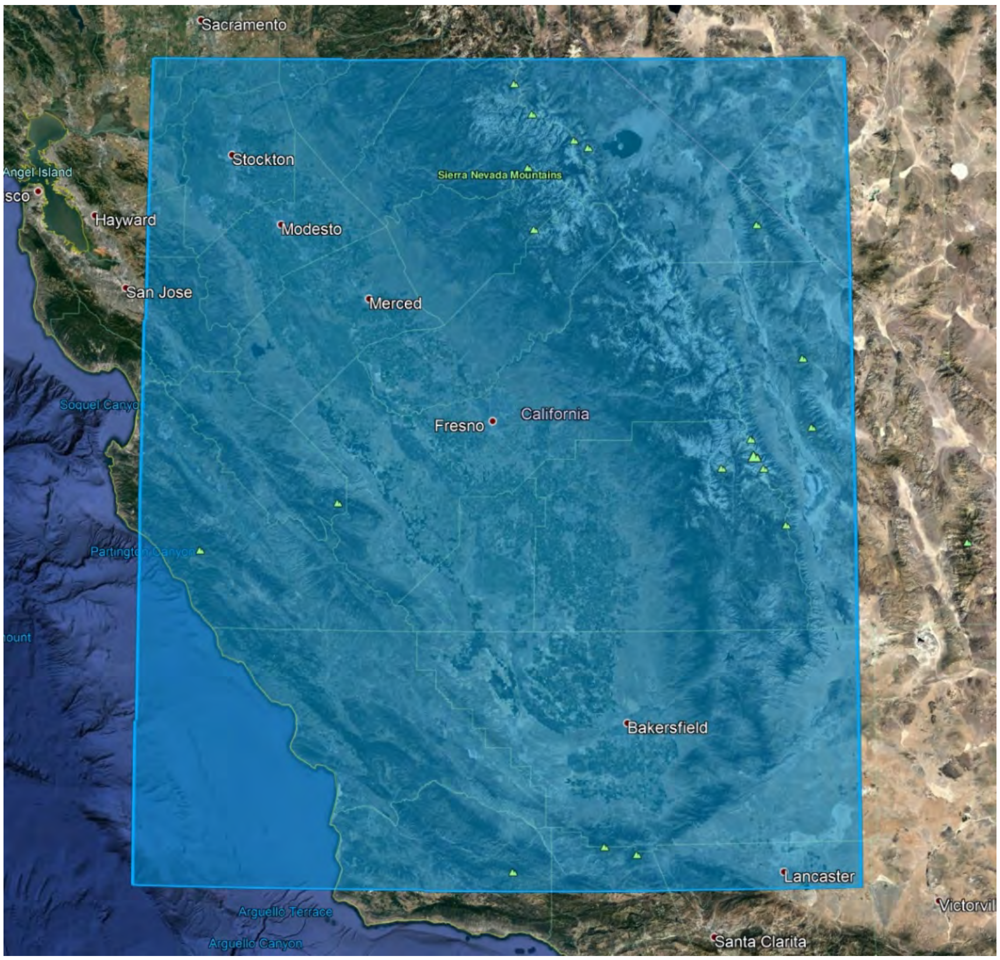
by CARB to Ramboll, then converted by Ramboll to CAMx format to be used in this analysis. BlueScape also obtained the CMAQ files from CARB and used them for model performance evaluation.

- **Post-Processing and Analysis**: The following software tools were available to post-process CAMx results for further analysis and data visualization:
  - **VERDI**: Java program for visualizing meteorology, emissions, and air quality modeling data. With options for overlaying GIS Shapefiles and 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 not used to incorporate the Project's emissions model into the 2020 and 2031 Baseline emissions; rather the emissions were manually formatted and processed.
  - **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. A component of BenMAP-CE is a tool called PopGrid which is used to estimate the population within each grid cell by gender, race, ethnicity, and age range.

3.2 Modeling Domain

The modeling domain chosen for the Project study was obtained from the domain used in the 2018 SJVAPCD $PM_{2.5}$ SIP modeling run completed by CARB. This modeling domain is comprised of three nested domains (i.e., 36 km, 12 km, and 4 km). For the current study, only the 4km domain was used for modeling. As the footprint of the Friant Ranch Project is wholly contained within the 4km domain, it was deemed unnecessary to conduct model simulations using the 36 km and 12 km domains. Further, it is well known that when additional emissions of small magnitude are inserted into a handful of grid cells of the 4 km domain, the modelled impact to air quality in the larger 12 km and 36 km are negligible if not imperceptible. Data from the final modeling grid subset used by CARB was used for the Project CAMx runs, as boundary and initial conditions from CARB for CMAQ already incorporated data from coarser grids. This final grid covered an area of 348 by 412 kilometers, using a 4-km grid size and 87 by 103 cells. Figure 2 shows this grid layout, used by both CARB for CMAQ model runs, and by BlueScape for Project CAMx model runs.

FIGURE 2. CARB CMAQ AND CAMX MODELING GRID



3.3 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 three-dimensional (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.

CARB used WRF v3.8 to generate the meteorological fields needed for their 2020 CMAQ run used for the SJVAPCD $PM_{2.5}$ SIP Study. BlueScape obtained output files from this WRF run that were post-processed by Ramboll using the wrfcamx post-processing tool. Table 3 below contains the selected WRF modeling configuration used by CARB.

TABLE 3 WRF MODELING CONFIGURATION	
Grid Definition	CARB 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 above ground level (agl).
Data Assimilation	Analysis nudging at every 6 hours for the outermost domain only. No temperature and moisture nudging within the Planetary Boundary Layer (PBL).

3.4 CAMx Model Setup

The CAMx model was set up to use the same grid as the final grid from the CARB 2020 CMAQ model run. Table 4 contains the general CAMx model configuration used, while Table 5 contains the grid configuration.

TABLE 4 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 5 4-KM GRID CONFIGURATION	
Grid Definition	4-km grid cell, 87 x 103 grid cells in size, total area: 348 x 412 kms

3.5 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 by Ramboll from CARB CMAQ input files using the cmaq2camx conversion tool, changing the chemical mechanism from CB06 to SAPRC07. The input 2020 CMAQ files used 2013 emissions inventory files, that were updated by CARB for projected 2020 regional emissions. The gridded emission files include TOG, NO_x, PM_{10} and $PM_{2.5}$, 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 Baseline year 2031 CAMx ROG, NO_x, PM_{10}, and $PM_{2.5}$ emissions were grown, or scaled, from 2020 emissions, using growth factors developed from the CEPAM 2016 SIP - Standard Emission Tool developed by CARB (CARB 2018). 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 CARB CMAQ emission files source categories and subcategories. Note that should the Project development and full buildout be delayed past 2031, it is expected that of selection of 2031 emissions for CAMx modeling will be conservative.

The incremental Project emissions were incorporated into the Baseline year 2020 and Future year 2031 emissions. Tables 6 and 7 summarize the Project peak daily unmitigated and mitigated emissions in pounds per day (lb/day) by source category for any of the years between Project construction start in 2022 and the 2031 Buildout year. Note that for NO_x, 2022 emissions were used to represent Project peak daily emissions. This is due to the fact that Community Plan NO_x operational emissions and construction emissions are higher in 2022 than in 2031. This assumption for NO_x is expected to provide a conservative analysis. Further detail on the development of Project emissions for HIA modeling is presented in the *Air Emissions Report for the Friant Ranch Community Development Project* (BlueScape 2021).

TABLE 6
PROJECT PEAK DAILY UNMITIGATED OPERATION AND CONSTRUCTION EMISSIONS (LB/DAY)

Category	ROG	NO_x	Fugitive PM_{10}	Exhaust PM_{10}	Fugitive $PM_{2.5}$	Exhaust $PM_{2.5}$
	Construction					
On-Road Mobile	0.773	3.13	2.59	0.014	0.699	0.013
Off-Road Mobile	9.36	111	15.6	4.10	4.34	3.79
Area/Energy	104	0	0	0	0	0
	Operational (Specific Plan plus Community Plan)					
On-Road Mobile	127	294	124	1.59	33.4	1.51
Off-Road Mobile	0	0	0	0	0	0
Area/Energy	101	28.9	0	27.0	0	27.0
Total	**342**	**438**	**142**	**32.7**	**38.4**	**32.3**

TABLE 7
PROJECT PEAK DAILY MITIGATED OPERATION AND CONSTRUCTION EMISSIONS (LB/DAY)

Category	ROG	NO_x	Fugitive PM_{10}	Exhaust PM_{10}	Fugitive $PM_{2.5}$	Exhaust $PM_{2.5}$
	Construction					
On-Road Mobile	0.773	2.63	2.59	0.014	0.699	0.013
Off-Road Mobile	3.83	60.4	6.08	3.49	1.69	3.49
Area/Energy	104	0	0	0	0	0
	Operational (Specific Plan plus Community Plan)					
On-Road Mobile	126	304	107	1.42	28.8	1.35
Off-Road Mobile	0	0	0	0	0	0
Area/Energy	81.8	22.9	0	4.82	0	4.82
Total	**316**	**389**	**115**	**9.74**	**31.2**	**9.66**

For CAMx modeling, Project ROG emissions were converted to TOG emissions using conversion factors developed based upon SMOKE speciation profiles (CMAS 2018). For each Project scenario, in 2020 and 2031, in both unmitigated and mitigated scenarios, the following data was incorporated into the baseline gridded emission files:

- Temporal allocation of construction emissions by day-of-week and hour-of-day;

- Temporal profiles extracted by Ramboll from CARB 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 ten grid cells near the Project site; and
- 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 a complete Project emissions database was generated for each scenario. Figure 3 shows the Project site location and color-shading to represent emissions apportionment fractions by 4-km grid cell. The darker blue shaded grid cells are closest to the Project site, and have the highest emissions apportionment. No Project emissions were apportioned outside the grid cells shown in Figure 3.

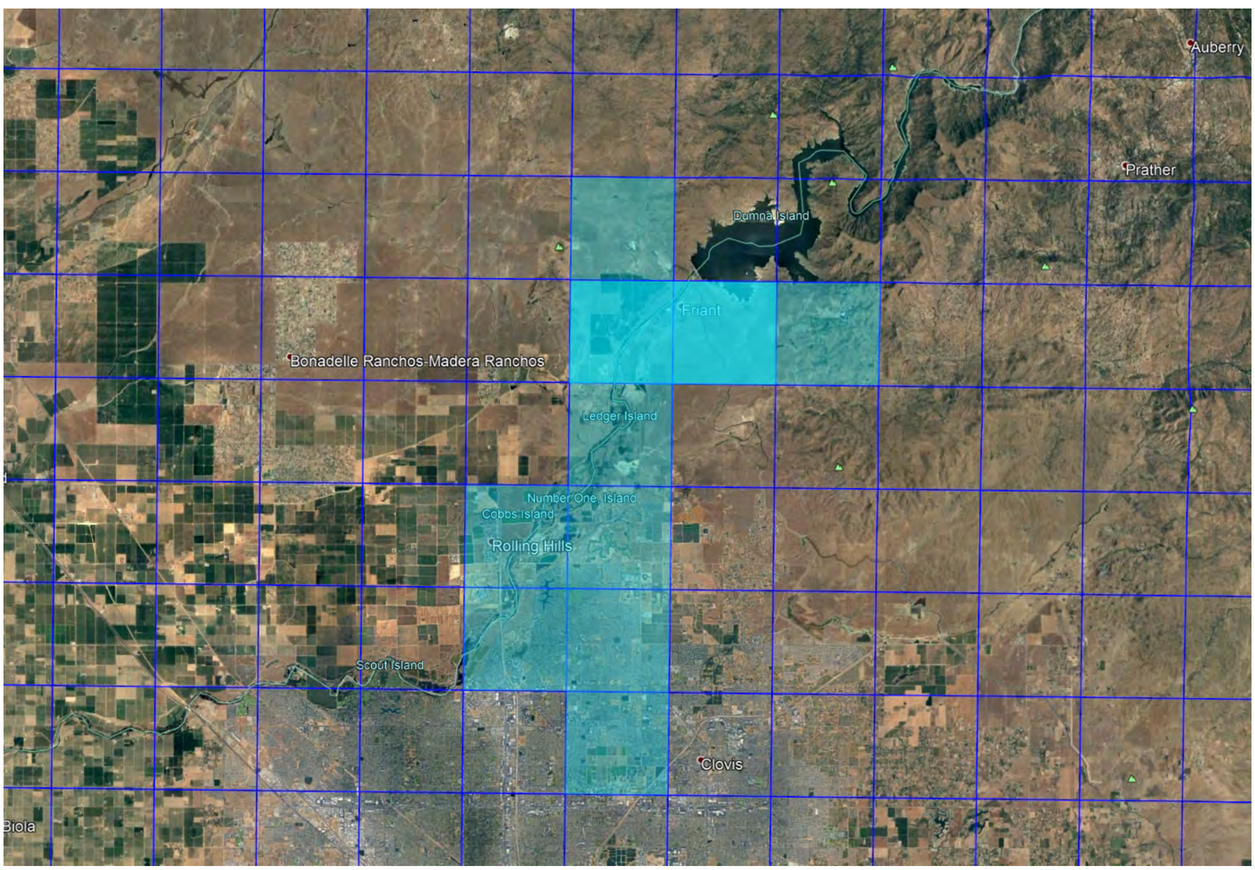


FIGURE 3. PROJECT EMISSIONS APPORTIONMENT TO GRID CELLS

3.6 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 CARB's 2013 air quality modeling system used for the SJVAPCD $PM_{2.5}$ SIP Study to estimate regional ozone and $PM_{2.5}$ concentration impacts in 2020.

CARB performed a model performance evaluation (MPE) for the 2013 period and deemed its CMAQ-based air quality modeling system adequate for use in additional studies (SJVAPCD 2018) for future years. Therefore, it is sufficient that if the CAMx-based system, which was based on the CARB databases, replicates the CMAQ-based air quality modeling predictions, then the CAMx-based system is also adequate for use in further air quality studies.

The Environmental Protection Agency (EPA) has issued guidance on how air quality simulation models are to be judged to be adequately performing in order to be used for studies such as conducted here (EPA 2018a). Two statistics that are used to judge such model performance are mean gross error and mean bias. If the gross error is less than 15% and bias is within +/-5%, it is an indicator that the model is adequately performing (Emery et. al. 2017).

The average daily gross error and average daily bias for ozone and $PM_{2.5}$ between the CARB CMAQ-based predictions, and completed CAMx-based predictions that are the subject of this study were computed for each month of 2020 and each California County. The maximum CMAQ-to-CAMx difference for the ozone 8-hour average concentration in any grid cell was 0.24 ppbv. The maximum CMAQ-to-CAMx difference for the annual $PM_{2.5}$ 24-hour average was 0.091 $\mu g/m^3$. As the gross error values were less than 5% and the bias values near zero relative to the maximum concentrations calculated for 2020 for the same cells by both the CMAQ and CAMx models, it was deemed that the CAMx-based system was suitable, and performed well for use in this HIA.

3.7 CAMx Modeling Results

The CAMx modeling results are presented in this section. Section 3.7.1 compares the impact of Project TOG and NO_x emissions, unmitigated and mitigated, on regional ozone concentration changes, for the 2020 Existing Baseline and 2031 Future Baseline year scenarios. A comparison of the impact of Project $PM_{2.5}$ and PM_{10} emissions, unmitigated and mitigated, on regional $PM_{2.5}$ concentration changes is presented in Section 3.7.2.

3.7.1 Ozone Concentration Change Results

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

For the 2020 Existing Baseline year scenario, Tables 8 and 9 compare the Project concentration changes at the grid cell with the highest change, both unmitigated and mitigated scenarios, to the baseline concentration results. The maximum MDA8 Project concentration change for either scenario is 0.021%, for the unmitigated emissions scenario. The unmitigated emissions impact for this scenario, 0.01 ppbv is well below (1% of) the 1 ppb SIL.

TABLE 8
2020 CAMX MODELING RESULTS FOR THE BASELINE AND UNMITIGATED PROJECT SCENARIOS, MAXIMUM DAILY 8-HOUR AVERAGE (MDA8) OZONE, AT THE GRID CELL WITH THE HIGHEST CHANGE

Baseline Scenario (ppbv)	Project Scenario (ppbv)	Maximum Project Change (ppbv)	Maximum Project Change (%)
48.417	48.427	0.01	0.021

TABLE 9
2020 CAMX MODELING RESULTS FOR THE BASELINE AND MITIGATED PROJECT SCENARIOS, MAXIMUM DAILY 8-HOUR AVERAGE (MDA8) OZONE, AT THE GRID CELL WITH THE HIGHEST CHANGE

Baseline Scenario (ppbv)	Project Scenario (ppbv)	Maximum Project Change (ppbv)	Maximum Project Change (%)
48.417	48.426	0.009	0.019

For the 2031 Future Baseline year scenario, Tables 10 and 11 compare the Project concentration changes at the grid cell with the highest change, both unmitigated and mitigated scenarios, to the baseline concentration results. The maximum MDA8 Project concentration change for either scenario is 0.029%, for the unmitigated emissions scenario. The unmitigated emissions impact for this scenario, 0.013 ppbv is well below (1.3% of) the 1 ppb SIL.

TABLE 10
2031 CAMX MODELING RESULTS FOR THE FUTURE AND UNMITIGATED PROJECT SCENARIO, MAXIMUM DAILY 8-HOUR AVERAGE (MDA8) OZONE, AT THE GRID CELL WITH THE HIGHEST CHANGE

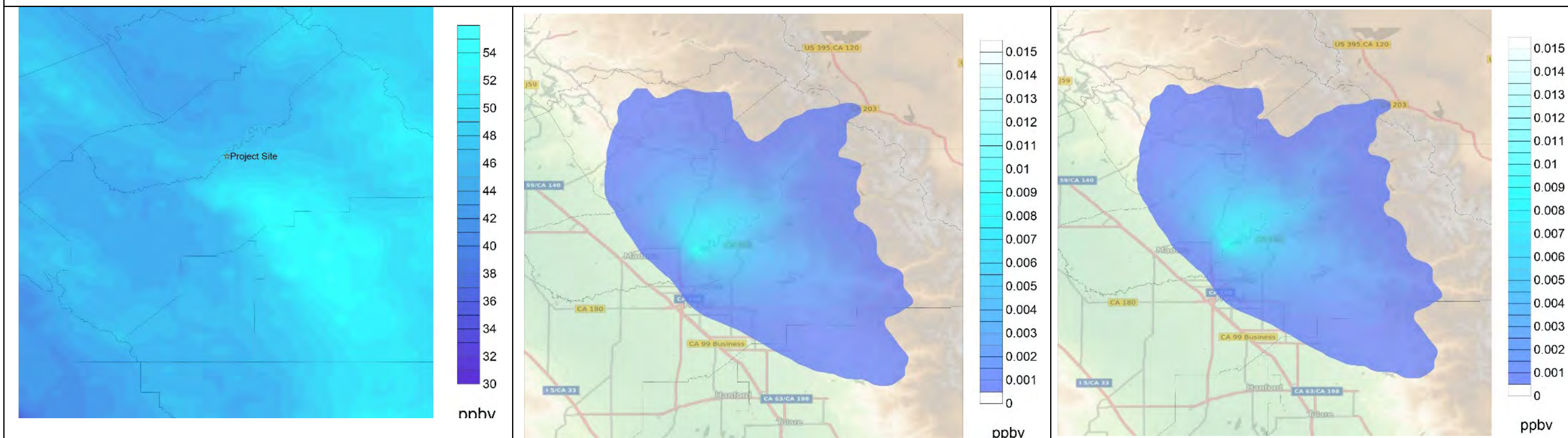
Future Scenario (ppbv)	Project Scenario (ppbv)	Maximum Project Change (ppbv)	Maximum Project Change (%)
44.357	44.370	0.013	0.029

TABLE 11
2031 CAMX MODELING RESULTS FOR THE FUTURE AND MITIGATED PROJECT SCENARIOUS, MAXIMUM DAILY 8-HOUR AVERAGE (MDA8) OZONE, AT THE GRID CELL WITH THE HIGHEST CHANGE

Future Scenario (ppbv)	Project Scenario (ppbv)	Maximum Project Change (ppbv)	Maximum Project Change (%)
44.357	44.369	0.012	0.027

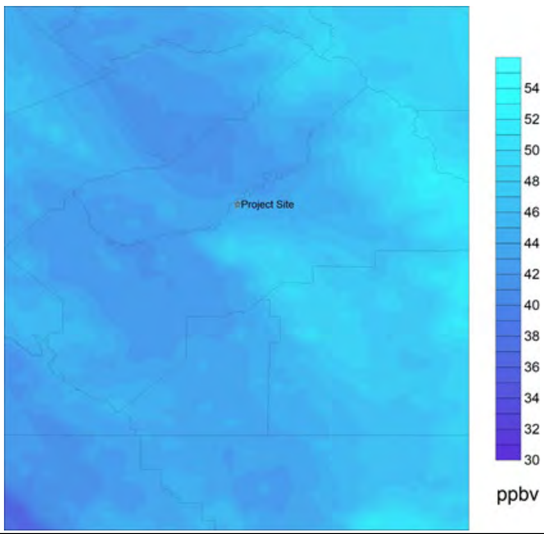
Figures 4 and 5 display the modeled MDA8 ozone concentration results for the 2020 Existing Baseline year and 2031 Future Baseline year scenarios, comparing the difference from unmitigated (Figure 4 and 5 center panels) or mitigated (Figure 4 and 5 right panels) Project ozone impacts, to baseline concentrations, in units of ppbv.

FIGURE 4. OZONE 2020 SCENARIO MAXIMUM DAILY 8-HOUR (MDA8) AVERAGE CONCENTRATIONS COMPARISON OF BASELINE TO UNMITIGATED PROJECT EMISSIONS AND PROJECT MITIGATED EMISSIONS

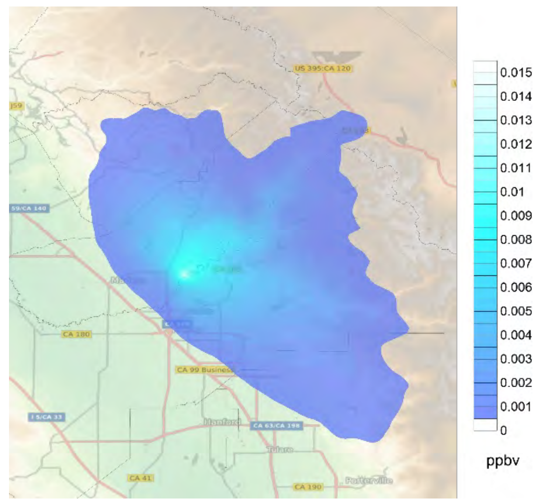


2020 Baseline Ozone MDA8 (ppbv)	2020 Ozone MDA8 Unmitigated Project Emissions Difference from Baseline (ppbv)	2020 Ozone MDA8 Mitigated Project Emissions Difference from Baseline (ppbv)

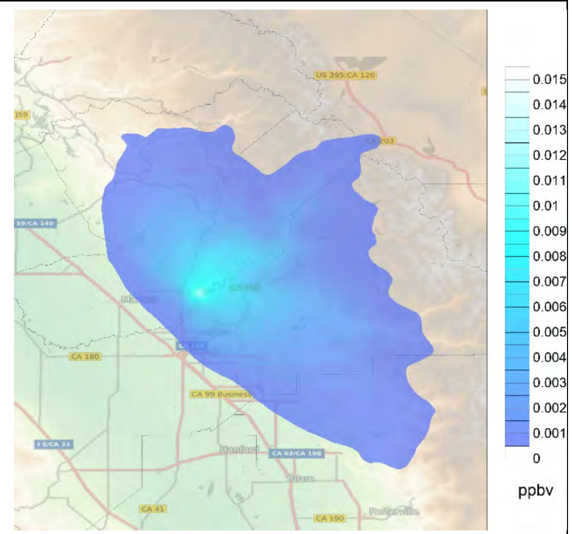
FIGURE 5. OZONE 2031 SCENARIO MAXIMUM DAILY 8-HOUR (MDA8) AVERAGE CONCENTRATIONS COMPARISON OF BASELINE TO UNMITIGATED PROJECT EMISSIONS AND PROJECT MITIGATED EMISSIONS



2031 Baseline Ozone MDA8 (ppbv)



2031 Ozone MDA8 Unmitigated Project Emissions Difference from Baseline (ppbv)



2031 Ozone MDA8 Mitigated Project Emissions Difference from Baseline (ppbv)

3.7.2 $PM_{2.5}$ Concentration Change Results

The $PM_{2.5}$ modeling concentration change results are presented in Tables 12 to 15, for the CAMx 4-km grid in micrograms per meters cubed ($\mu g/m^3$), annual 24-hour average $PM_{2.5}$ concentrations.

For the 2020 Existing Baseline year scenario, Tables 12 and 13 compare the Project concentration changes at the grid cell with the highest change, both unmitigated and mitigated scenarios, to the baseline concentration results. The maximum annual 24-hour $PM_{2.5}$ Project concentration change for either scenario is 0.55%, for the unmitigated emissions scenario. The unmitigated emissions impact for this scenario, 0.051 $\mu g/m^3$, is below (26% of) the 0.2 $\mu g/m^3$ SIL.

TABLE 12
2020 CAMX MODELING RESULTS FOR THE BASELINE AND UNMITIGATED PROJECT SCENARIOS, ANNUAL 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 (%)
9.528	9.580	0.051	0.55

TABLE 13
2020 CAMX MODELING RESULTS FOR THE BASELINE AND MITIGATED PROJECT SCENARIOS, ANNUAL 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 (%)
9.528	9.567	0.038	0.41

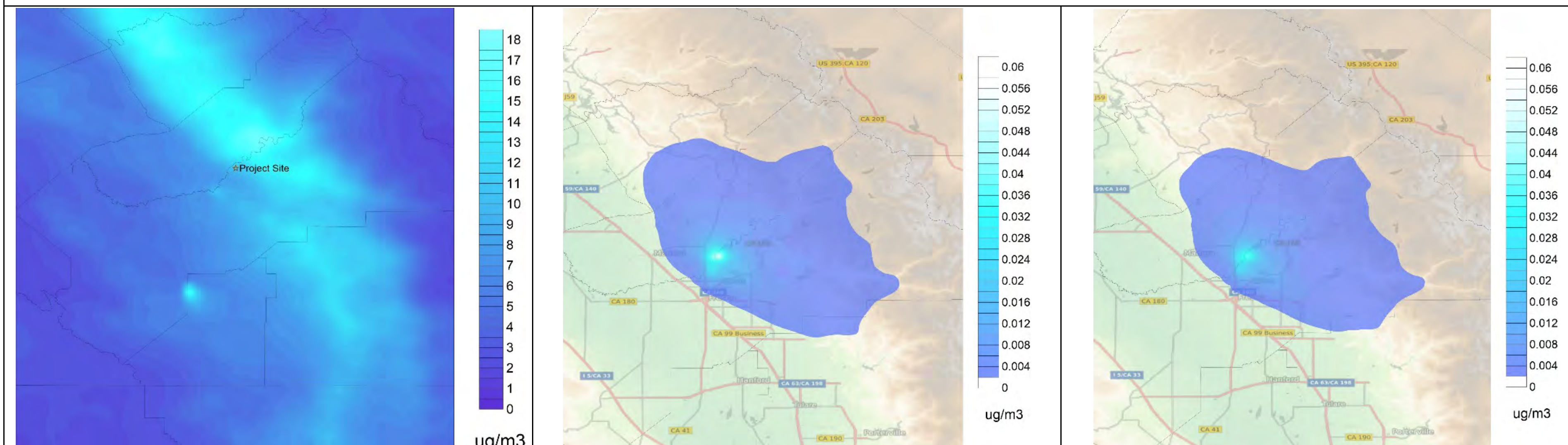
For the 2031 Future Baseline year scenario, Tables 14 and 15 compare the Project concentration changes at the grid cell with the highest change, both unmitigated and mitigated scenarios, to the baseline concentration results. The maximum annual daily $PM_{2.5}$ Project concentration change for either scenario is 0.56%, for the unmitigated emissions scenario. The unmitigated emissions impact for this scenario, 0.058 $\mu g/m^3$, is below (29% of) the 0.2 $\mu g/m^3$ SIL.

TABLE 14 **2031 CAMX MODELING RESULTS FOR THE BASELINE AND UNMITIGATED PROJECT SCENARIOS, ANNUAL 24-HOUR AVERAGE $PM_{2.5}$, 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 (%)**
10.111	10.168	0.058	0.56

TABLE 15 **2031 CAMX MODELING RESULTS FOR THE BASELINE AND MITIGATED PROJECT SCENARIOS, ANNUAL 24-HOUR AVERAGE $PM_{2.5}$, 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 (%)**
10.111	10.155	0.044	0.44

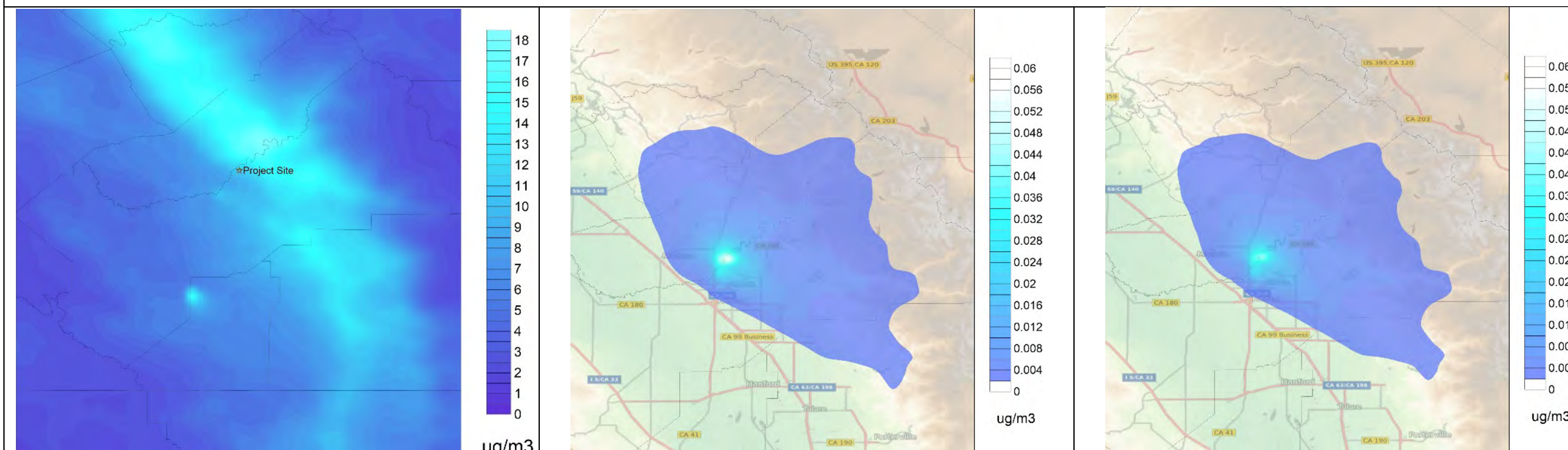
Figures 6 and 7 display the modeled annual daily 24-hour $PM_{2.5}$ for the 2020 Existing Baseline and 2031 Future Baseline year scenarios, comparing the difference from unmitigated (Figure 6 and 7 center panels) or mitigated (Figure 6 and 7 right panels) Project $PM_{2.5}$ impacts, to the baseline concentrations, in units of ($\mu g/m^3$).

FIGURE 6. $PM_{2.5}$ 2020 SCENARIO ANNUAL 24-HOUR AVERAGE CONCENTRATIONS
COMPARISON OF BASELINE TO UNMITIGATED PROJECT EMISSIONS AND PROJECT MITIGATED EMISSIONS



2020 Baseline Annual 24-hour Average $PM_{2.5}$ ($\mu g/m^3$)	2020 $PM_{2.5}$ Unmitigated Project Emissions Difference from Baseline ($\mu g/m^3$)	2020 $PM_{2.5}$ Mitigated Project Emissions Difference from Baseline ($\mu g/m^3$)

FIGURE 7 . $PM_{2.5}$ 2031 SCENARIO ANNUAL 24-HOUR AVERAGE CONCENTRATIONS
COMPARISON OF BASELINE TO UNMITIGATED PROJECT EMISSIONS AND PROJECT MITIGATED EMISSIONS



2031 Baseline Annual 24-hour Average $PM_{2.5}$ ($\mu g/m^3$)	2031 $PM_{2.5}$ Unmitigated Project Emissions Difference from Baseline ($\mu g/m^3$)	2031 $PM_{2.5}$ Mitigated Project Emissions Difference from Baseline ($\mu g/m^3$)

4.0 FRIANT RANCH REGIONAL HEALTH IMPACTS ANALYSIS

This section provides a discussion of the regional health impacts analysis for ozone and $PM_{2.5}$ concentration changes due to Friant Ranch Project emissions. The HIA was completed using the air concentration data developed from CAMx, as described in Section 3.0, and using the EPA's BenMAP-CE model. The results of the specific Project health impact analysis for ozone and $PM_{2.5}$ are provided in this section.

4.1 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 $PM_{2.5}$. Figure 8 summarizes the process that BenMAP-CE uses to calculate human health impacts.

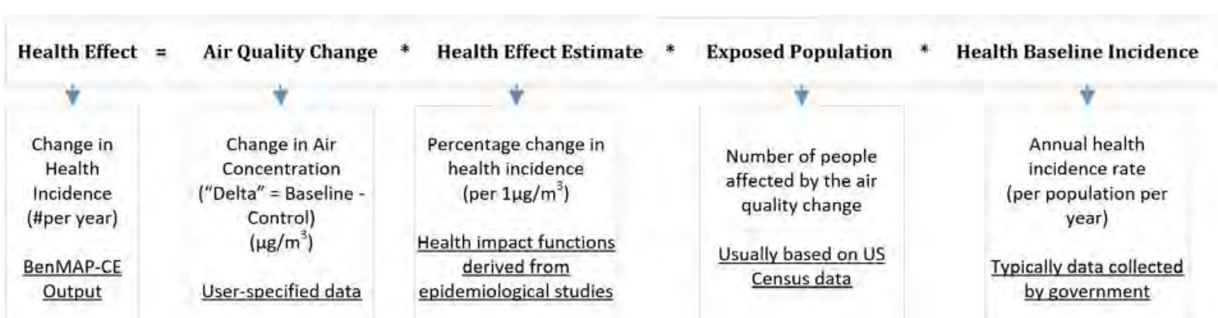


FIGURE 8. OVERVIEW OF THE PROCESS OF HEALTH IMPACT CALCULATIONS IN BENMAP-CE

To estimate human health effects, BenMAP-CE first determines the change in ambient air concentrations using user-specified air quality data for the baseline and controlled scenarios. The software then applies the relationship between the air concentrations with certain health effects (also known as health endpoints) using the 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.

4.2 Application of BenMAP-CE to the Friant Ranch Project

As part of an overall health impact analysis (HIA) for the proposed Friant Ranch Community Development Project, this analysis used BenMAP-CE (Version 1.5) to quantify the potential human health effects from the 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.

4.2.1 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 Project is located were estimated using the CAMx as discussed in Section 3.0 of this report. As detailed, for each pollutant (ozone or $PM_{2.5}$), each modeling year (Existing Baseline year 2020 or Future Baseline year 2031), and emissions for both unmitigated and mitigated conditions, each CAMx model run generated two sets of data:

1. The ambient air concentrations based on the 2020 emissions inventory provided by CARB, for the corresponding modeling year, 2020 or scaled to 2031 (referred to as the Existing Baseline year for 2020 and Future Baseline year for 2031); and

2. The resulting ambient air concentrations generated by adding the Project's emissions (unmitigated or mitigated) to the corresponding concentrations developed from the 2013 regional air emission inventory extrapolated by CARB to 2020 (as described in Section 3.5) and scaled for this HIA to 2031 (referred

to as the Existing Baseline plus Project scenarios for 2020, and the Future Baseline plus Project scenarios for 2031).

As detailed in Section 3.7 of this report, due to the orders-of-magnitude smaller emissions from the Project as compared to the 2020 and 2031 Baseline emissions inventories, the difference between the two sets of data (air concentration delta or "delta") was very small. This being the case, for informational purposes, even with the very small delta values between the two sets of concentration data and the inherent and unavoidable uncertainties associated with any CAMx modeling study, BenMAP-CE was used for this HIA to translate the potential Project-incurred changes in ambient air ozone and $PM_{2.5}$ concentrations into potential human health outcomes of the Project. This approach is consistent with the EPA's development and use of BenMAP-CE to understand potential regional health impact changes associated with concentration changes above baseline conditions.

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 to determine the Project's potential health impacts, as summarized below:

- Ozone, Year 2020, Existing Baseline plus unmitigated Project emissions;
- Ozone, Year 2020, Existing Baseline plus mitigated Project emissions;
- Ozone, Year 2031, Future Baseline plus unmitigated Project emissions;
- Ozone, Year 2031, Future Baseline plus mitigated Project emissions;
- $PM_{2.5}$, Year 2020, Existing Baseline plus unmitigated Project emissions;
- $PM_{2.5}$, Year 2020, Existing Baseline plus mitigated Project emissions;
- $PM_{2.5}$, Year 2031, Future Baseline plus unmitigated Project emissions; and
- $PM_{2.5}$, Year 2031, Future Baseline plus mitigated Project emissions.

The CAMx-generated 2020 Existing Baseline and 2031 Future Baseline concentration datasets were imported into the BenMAP-CE program as base case Air Quality Data, and then post-Project (Baseline or Future plus Project, unmitigated and mitigated) concentration datasets were imported as "Control" Air Quality Data. Then BenMAP-CE calculates change (air concentration delta) using Control minus either the Existing Baseline or Future Baseline scenarios from the CAMx-generated input files.

4.2.2 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 (EPA 2021). 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. The projected Friant Community Plan and Specific Plan population projections for 2020 and 2031 were added to the population for two grid cells, to ensure that the local population growth is not under-counted.

4.2.3 Analysis Years

Years 2020 and 2031 were selected for the BenMAP-CE runs, which represents the Project's Existing Baseline year prior to start of construction in 2022, and the full build-out operational Future Baseline year 2031. In order to perform air quality modeling for this study, BlueScape obtained files processed from Ramboll, based upon air quality modeling from CARB, including the regional air quality emission inventory year 2020 from the SJVAPCD $PM_{2.5}$ SIP Study. The regional emissions inventory for 2020 was then scaled to 2031 using growth factors. For the 2020 analysis, the highest daily contribution of Project-related emissions for each pollutant was used in the photochemical modeling, from the construction to the full build-out year. Further, the most conservative emissions (in lb/day) for any Project development year from 2022 to 2031 were used in the model.

4.2.4 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 2020 dataset for analysis year 2020, and year 2030 dataset for analysis year 2031), and the Other Incidence dataset for all the morbidity endpoint groups.

Among the baseline health incidence datasets used, the 2020 BenMAP-CE endpoint groups match the Baseline scenario year (2020 for Existing Baseline year). The 2030 BenMAP-CE endpoint groups for 2031 were used for the Future Baseline year 2031. The mortality C-R functions offer datasets in 5-year increments, so the 2030 dataset preceding the 2031 Project year was assumed representative and conservative. From air quality related health effect perspective, since the ambient air quality is generally getting better (i.e., lower air pollutant concentrations) with more stringent regulations and technology advancement over time, the older years' datasets (i.e., using the 2030 mortality dataset for Project year 2031) will likely have greater health incidences; therefore, the results generated by this analysis are expected to be adequately conservative.

4.2.5 Health Endpoints and Health Impact Functions

The EPA-provided health endpoints 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, 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 run can be found in the attached BenMAP-CE Audit Trial Reports (Appendix B).

4.3 BenMAP-CE Modeling Results and Results Interpretation

For each of the modeled grid cells, BenMAP-CE generates the health incidence value resulting from the 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 16 through 23 summarize the BenMAP-CE results of ozone and $PM_{2.5}$ from the Project, for both the Existing Baseline year 2020 and Future Baseline year 2031 and unmitigated and mitigated Project emission inventories. Each table contains the following columns:

- Group – General grouping of health impact outcomes;
- Health Endpoint – Specific health endpoint in the Health Endpoint Group. Numbers in braces represent the age range for the specific health endpoints, and for specific health endpoints without a specified age range, the age range is for 0 to 99 years old;
- Mean – the mean number of health incidences estimated to occur due to Project-related emissions above the value reported in the column Baseline Incidence (# per year);
- 95% Confidence Interval – In statistics, a confidence interval (CI) provides a range of health incidences for which the true health incidence resides. The 95% CI is a common value reported by researchers. The interpretation of the 95% CI means that a researcher is 95% confident that the true health incidence falls within the associated range of health incidences;
- Baseline Incidence (# per year) – The BenMAP-CE baseline health incidences for the Health Endpoint; and
- Incremental Incidence / Existing Baseline Incidence (%) – The percent increase of health incidences above the baseline calculated as the "Mean" divided by the "Baseline Incidence (# per year)" times 100.

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 Project included incidences of respiratory-related hospital admissions (0.0047 maximum incidences/year), mortality (0.012 maximum incidences/year), and asthma-related emergency room visits (0.0765 maximum incidences/year) for all studied age groups combined. The Project's incremental health incidences for ozone are less than 0.0003% for any of the baseline number of health endpoint occurrences. The baseline is the actual health effect occurrences measured in the regional population without the emissions produced by the Project.

The maximum regional health impacts associated with emissions of $PM_{2.5}$ resulting from the construction and operation of the Project included incidences of acute myocardial infarction (0.0254 maximum incidences/year), mortality (0.35 maximum incidences/year), hospital admissions (0.114 maximum incidences/year) and asthma-related emergency room visits (0.20 maximum incidences/year) for all studied age groups combined. The Project's incremental health incidences for $PM_{2.5}$ are less than 0.00054% for any of the baseline number of health endpoint occurrences. The baseline is the actual health effect occurrences measured in the regional population without the emissions produced by the Project.

The very small Project-related changes in health endpoint occurrences, relative to the substantially larger number of baseline health endpoint occurrences, demonstrates that the Project provides a negligible contribution to regional health impacts; therefore, Fresno County can consider the Project-related health impacts to not be meaningful. In other words, the Project impact is not likely discernible as different than zero, as discussed below.

The health incidences estimated for modeled Project changes in ozone and $PM_{2.5}$ concentrations are calculated within a range that is called the 95% confidence interval. The 95% confidence interval is a standard metric for statistical significance of an estimated unknown parameter from the observed data. It essentially means that 95% of the estimates of the health impact related to a change in concentration (estimated by 4 km grid cell) will include the most likely value within the distribution, but 5% won't (i.e., there is a 1-in-20 chance that the reported confidence intervals in Tables 16-23 do not include the true values). The health incidence values estimated for Tables 16-24 are the composite of values calculated for all the 4 km grid cells included within the modeling domain.

Based upon the wide range of Project incremental health incidence values calculated for the 95% CI shown in the tables, the reported positive mean Project incremental health incidence values are of high statistical uncertainty. In cases where there are negative health incidence values within the 95% confidence interval, meaning the interval includes zero, the result is highly uncertain and there is very low confidence that the result is statistically different than zero. In cases where the health incidence values within the 95% confidence interval are greater than zero but less than one, the values are also a negligible fraction of the background incidence values. In both cases, it is not expected that the Project will result in any meaningful health impact greater than zero that can be established with any certainty.

TABLE 16
BENMAP-CE MODELING RESULTS FOR MAXIMUM DAILY 8-HOUR (MDA8) AVERAGE OZONE, EXISTNG BASELINE YEAR 2020, UNMITIGATED

Human Health Endpoints		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
		Project Incremental Incidence (# per year)			
Health Endpoint Group	Health Endpoint	Mean	95% Confidence Interval	Baseline Incidence (# per year)	
Acute Respiratory Symptoms	Minor Restricted Activity Days	10.959	4.5235 - 17.3852	28,359,911	0.000039%
Asthma Exacerbation	One or More Symptoms	1.6894	-8.6578 - 12.0214	12,205,190	0.000014%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [0-17]	0.0354	0.0064 - 0.0645	14,828	0.000239%
Emergency Room Visits -Respiratory	Emergency Room Visits Asthma [18-99]	0.0239	0.0066 - 0.0412	20,037	0.000119%
Hospital Admissions Respiratory	HA All Respiratory	0.0027	-0.0006 - 0.0061	24,743	0.000011%
Mortality	All Cause	0.0076	0.0036 - 0.0115	51,215	0.000015%
	Cardiopulmonary	0.0027	0.001 - 0.0044	17,114	0.000016%
	Non-Accidental	0.0019	-0.0005 - 0.0043	38,717	0.000005%
	Respiratory	0.0036	0.0012 - 0.006	4,213	0.000085%
School Loss Days	All Cause	9.0324	-1.0498 - 19.0997	7,988,290	0.000113%

TABLE 17
BENMAP-CE MODELING RESUTS FOR MAXIMUM DAILY 8-HOUR AVERAGE (MDA8) OZONE, EXISTING BASELINE YEAR 2020, MITIGATED

Human Health Endpoints		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
		Project Incremental Incidence (# per year)			
Health Endpoint Group	Health Endpoint	Mean	95% Confidence Interval	Baseline Incidence (# per year)	
Acute Respiratory Symptoms	Minor Restricted Activity Days	10.301	4.252 - 16.3417	28,359,911	0.000036%
Asthma Exacerbation	One or More Symptoms	1.5930	-8.1641 - 11.3359	12,205,190	0.000013%
Emergency Room Visits - Respiratory	Emergency Room Visits Asthma [0-17]	0.0322	0.0058 - 0.0585	14,828	0.000217%
Emergency Room Visits - Respiratory	Emergency Room Visits Asthma [18-99]	0.0225	0.0062 - 0.0388	20,037	0.000112%
Hospital Admissions Respiratory	HA All Respiratory	0.0026	-0.0006 - 0.0057	24,743	0.000010%
Mortality	All Cause	0.0070	0.0034 - 0.0107	51,215	0.000014%
	Cardiopulmonary	0.0025	0.001 - 0.0041	17,114	0.000015%
	Non-Accidental	0.0017	-0.0005 - 0.004	38,717	0.000005%
	Respiratory	0.0033	0.0011 - 0.0055	4,213	0.000079%
School Loss Days	All Cause	8.5184	-0.99 - 18.0129	7,988,290	0.000107%

TABLE 18
BENMAP-CE MODELING RESULTS FOR MAXIMUM DAILY 8-HOUR (MDA8) AVERAGE OZONE, FUTURE BASELINE YEAR 2031, UNMITIGATED

Human Health Endpoints		Aggregated Regional Results			
		Project Incremental Incidence (# per year)			
Health Endpoint Group	Health Endpoint	Mean	95% Confidence Interval	Baseline Incidence (# per year)	Incremental Incidence / Existing Baseline Incidence (%)
Acute Respiratory Symptoms	Minor Restricted Activity Days	14.5060	5.9875 - 23.0121	30,640,682	0.000047%
Asthma Exacerbation	One or More Symptoms	2.4333	-12.4705 - 17.3154	13,815,762	0.000018%
Emergency Room Visits - Respiratory	Emergency Room Visits Asthma [0-17]	0.0427	0.0077 - 0.0777	16,541	0.000258%
Emergency Room Visits - Respiratory	Emergency Room Visits Asthma [18-99]	0.0338	0.0093 - 0.0582	22,666	0.000149%
Hospital Admissions Respiratory	HA All Respiratory	0.0047	-0.0011 - 0.0104	34,277	0.000014%
Mortality	All Cause	0.0120	0.0057 - 0.0182	67,316	0.000018%
	Cardiopulmonary	0.0045	0.0017 - 0.0073	23,263	0.000019%
	Non-Accidental	0.0030	-0.0008 - 0.0068	51,566	0.000006%
	Respiratory	0.0058	0.002 - 0.0097	5,750	0.000101%
School Loss Days	All Cause	13.0657	-1.5185 - 27.6286	9,097,769	0.000144%

TABLE 19
BENMAP-CE MODELING RESULTS FOR MAXIMUM DAILY 8-HOUR AVERAGE (MDA8) OZONE, FUTURE BASELINE YEAR 2031, MITIGATED

Human Health Endpoints		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
		Project Incremental Incidence (# per year)		Baseline Incidence (# per year)	
Health Endpoint Group	**Health Endpoint**	**Mean**	**95% Confidence Interval**		
Acute Respiratory Symptoms	Minor Restricted Activity Days	13.7277	5.6663 - 21.7775	30,640,682	0.000045%
Asthma Exacerbation	One or More Symptoms	2.3068	-11.822 - 16.4149	13,815,762	0.000017%
Emergency Room Visits - Respiratory	Emergency Room Visits Asthma [0-17]	0.0393	0.0071 - 0.0714	16,541	0.000237%
Emergency Room Visits - Respiratory	Emergency Room Visits Asthma [18-99]	0.0320	0.0088 - 0.0551	22,666	0.000141%
Hospital Admissions Respiratory	HA All Respiratory	0.0044	-0.001 - 0.0098	34,277	0.000013%
Mortality	All Cause	0.0112	0.0053 - 0.0171	67,316	0.000017%
	Cardiopulmonary	0.0042	0.0016 - 0.0068	23,263	0.000018%
	Non-Accidental	0.0028	-0.0008 - 0.0064	51,566	0.000005%
	Respiratory	0.0055	0.0018 - 0.0091	5,750	0.000095%
School Loss Days	All Cause	12.3866	-1.4396 - 26.1926	9,097,769	0.000136%

TABLE 20
BENMAP-CE MODELING RESULTS FOR MAXIMUM ANNUAL 24-HOUR AVERAGE $PM_{2.5}$, EXISTING BASELINE YEAR 2020, UNMITIGATED

Human Health Endpoints		Fine Modeling Grid			
		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
		Project 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]	0.00001	0.000006 - 0.000018	9	0.000142%
	Acute Myocardial Infarction Nonfatal [25-44]	0.00085	0.000409 - 0.001281	462	0.000183%
	Acute Myocardial Infarction Nonfatal [45-54]	0.00179	0.000866 - 0.002715	1,047	0.000171%
	Acute Myocardial Infarction Nonfatal [55-64]	0.00396	0.001916 - 0.006004	2,152	0.000184%
	Acute Myocardial Infarction Nonfatal [65-99]	0.01032	0.004989 - 0.015636	5,353	0.000193%
Emergency Room Visits - Respiratory	Asthma	0.14501	0.038122 - 0.251735	34,865	0.000416%
Hospital Admissions	All Cardiovascular (less Myocardial Infarctions)	0.01930	0.014227 - 0.024364	28,261	0.000068%
	All Respiratory	0.03885	0.022404 - 0.055276	24,743	0.000157%
	Asthma	0.01182	0.004526 - 0.019101	4,381	0.000270%
Mortality	All Cause	0.21796	0.147276 - 0.288536	49,417	0.000441%

TABLE 21
BENMAP-CE MODELING RESULTS FOR MAXIMUM ANNUAL 24-HOUR AVERAGE $PM_{2.5}$, EXISTING BASELINE YEAR 2020, MITIGATED

Human Health Endpoints		Fine Modeling Grid			
		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
		Project Incremental Incidence (# per year)			
Health Endpoint Group	Health Endpoint	Mean	95% Confidence Interval	Baseline Incidence (# per year)	
Acute Myocardial Infarction	Acute Myocardial Infarction Nonfatal [18-24]	0.00001	0.000005 - 0.000017	9	0.000127%
	Acute Myocardial Infarction Nonfatal [25-44]	0.00075	0.000365 - 0.001144	462	0.000163%
	Acute Myocardial Infarction Nonfatal [45-54]	0.00160	0.000774 - 0.002426	1,047	0.000153%
	Acute Myocardial Infarction Nonfatal [55-64]	0.00354	0.001711 - 0.005362	2,152	0.000164%
	Acute Myocardial Infarction Nonfatal [65-99]	0.00918	0.004441 - 0.013917	5,353	0.000172%
Emergency Room Visits - Respiratory	Asthma	0.12804	0.033662 - 0.222282	34,865	0.000367%
Hospital Admissions	All Cardiovascular (less Myocardial Infarctions)	0.01718	0.012668 - 0.021695	28,261	0.000061%
	All Respiratory	0.03461	0.019959 - 0.049244	24,743	0.000140%

TABLE 21
BENMAP-CE MODELING RESULTS FOR MAXIMUM ANNUAL 24-HOUR AVERAGE $PM_{2.5}$, EXISTING BASELINE YEAR 2020, MITIGATED

Human Health Endpoints		Fine Modeling Grid			
		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
		Project Incremental Incidence (# per year)			
Health Endpoint Group	Health Endpoint	Mean	95% Confidence Interval	Baseline Incidence (# per year)	
	Asthma	0.01039	0.003977 - 0.016787	4,381	0.000237%
Mortality	All Cause	0.19398	0.131076 - 0.256798	49,417	0.000393%

TABLE 22
BENMAP-CE MODELING RESULTS FOR MAXIMUM ANNUAL 24-HOUR AVERAGE $PM_{2.5}$, FUTURE BASELINE YEAR 2031, UNMITIGATED

Human Health Endpoints		Fine Modeling Grid			
		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
		Project Incremental Incidence (# per year)			
Health Endpoint Group	Health Endpoint	Mean	95% Confidence Interval	Baseline Incidence (# per year)	
Acute Myocardial Infarction	Acute Myocardial Infarction Nonfatal [18-24]	0.00002	0.000008 - 0.000024	9	0.000174%
	Acute Myocardial Infarction Nonfatal [25-44]	0.00120	0.00058 - 0.001817	548	0.000219%
	Acute Myocardial Infarction Nonfatal [45-54]	0.00259	0.001254 - 0.003931	1,187	0.000218%
	Acute Myocardial	0.00448	0.002165 - 0.006787	2,072	0.000216%

TABLE 22
BENMAP-CE MODELING RESULTS FOR MAXIMUM ANNUAL 24-HOUR AVERAGE $PM_{2.5}$, FUTURE BASELINE YEAR 2031, UNMITIGATED

Human Health Endpoints		**Fine Modeling Grid**			
		Aggregated Regional Results			**Incremental Incidence / Existing Baseline Incidence (%)**
		Project Incremental Incidence (# per year)		**Baseline Incidence (# per year)**	
Health Endpoint Group	**Health Endpoint**	**Mean**	**95% Confidence Interval**		
	Infarction Nonfatal [55-64]				
	Acute Myocardial Infarction Nonfatal [65-99]	0.01711	0.008276 - 0.025939	7,348	0.000233%
Emergency Room Visits - Respiratory	Asthma	0.20129	0.05292 - 0.34944	39,207	0.000513%
Hospital Admissions	All Cardiovascular (less Myocardial Infarctions)	0.03239	0.023878 - 0.040894	39,203	0.000083%
	All Respiratory	0.06536	0.037689 - 0.092987	34,277	0.000191%
	Asthma	0.01597	0.006114 - 0.025805	4,762	0.000335%
Mortality	All Cause	0.35149	0.237503 - 0.465302	65,401	0.000537%

TABLE 23
BENMAP-CE MODELING RESULTS FOR MAXIMUM ANNUAL 24-HOUR AVERAGE $PM_{2.5}$, FUTURE BASELINE YEAR 2031, MITIGATED

Human Health Endpoints		Fine Modeling Grid			
		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
		Project Incremental Incidence (# per year)			
Health Endpoint Group	Health Endpoint	Mean	95% Confidence Interval	Baseline Incidence (# per year)	
Acute Myocardial Infarction	Acute Myocardial Infarction Nonfatal [18-24]	0.00001	0.000007 - 0.000022	9	0.000157%
	Acute Myocardial Infarction Nonfatal [25-44]	0.00108	0.000523 - 0.001639	548	0.000197%
	Acute Myocardial Infarction Nonfatal [45-54]	0.00234	0.001131 - 0.003546	1,187	0.000197%
	Acute Myocardial Infarction Nonfatal [55-64]	0.00404	0.001955 - 0.006126	2,072	0.000195%
	Acute Myocardial Infarction Nonfatal [65-99]	0.01539	0.007441 - 0.023321	7,348	0.000209%
Emergency Room Visits - Respiratory	Asthma	0.17935	0.047151 - 0.31135	39,207	0.000457%

TABLE 23
BENMAP-CE MODELING RESULTS FOR MAXIMUM ANNUAL 24-HOUR AVERAGE $PM_{2.5}$, FUTURE BASELINE YEAR 2031, MITIGATED

Human Health Endpoints		Fine Modeling Grid			
		Aggregated Regional Results			Incremental Incidence / Existing Baseline Incidence (%)
		Project Incremental Incidence (# per year)			
Health Endpoint Group	Health Endpoint	Mean	95% Confidence Interval	Baseline Incidence (# per year)	
Hospital Admissions	All Cardiovascular (less Myocardial Infarctions)	0.02913	0.021476 - 0.036781	39,203	0.000074%
	All Respiratory	0.05879	0.033903 - 0.083645	34,277	0.000172%
	Asthma	0.01415	0.005419 - 0.02287	4,762	0.000297%
Mortality	All Cause	0.31574	0.213348 - 0.41798	65,401	0.000483%

5.0 UNCERTAINTY IN PHOTOCHEMICAL MODELING AND HEALTH IMPACT ANALYSIS

Air quality impact analysis and health impact studies and the results, as for any technical or scientific study, are subject to "uncertainty." Uncertainty means that there is a range of possible values for the inputs to the modeling studies in which exist the true values, and therefore, there is uncertainty as well in the modeling study outputs. Conclusions from these studies should be made with consideration of the uncertainty. Section 5.1 focuses on uncertainty related to photochemical modeling for air concentration results. Section 5.2 discusses the uncertainty involved in relating concentration data to specific health impact results.

5.1 Uncertainty in 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, a 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 (Hanna et. al. 2001, Biswas and Rao 2001, Baker and Bash 2012). It is widely recognized that full and perfect validation of a chemical transport model against real, natural systems cannot be accomplished by computer modeling systems, 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 against natural systems because all possible scenarios cannot be anticipated nor included in modeling systems.

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 (Leary 1976). 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 inputs to CAMx (e.g., emissions estimates, boundary conditions, meteorological predictions, chemistry, grid resolution, and model formulation) as well as the model formulation itself (Sathya et. al. 2000, Fine et. al. 2003).

Estimates of emissions are typically the most uncertain inputs to a photochemical model (NRC 1991). 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 (EPA 2018c), SMOKE (CMAS 2018) and tools. Given the suspect quality of some of these data, it is not surprising that there are large uncertainties in the resulting emissions estimates that are input into 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 NO_x may actually capture NO_y, which includes NO_x plus products of NO_x oxidation (CARB 1992).

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 (Stauffer and Seaman 1990). Specifically, the three components of wind velocity calculated as a function of time are nudged toward measured values, and in so doing, reduce the amount of observational data remaining for performance evaluation. Thus, the WRF meteorological predictions that are input into 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 (EPRI 2000). Even if known completely, atmospheric chemistry cannot be represented in its entirety because it would impose excessive computational demands (Russell and Dennis 2000).

Additional uncertainty can be introduced due to the choice of grid resolution. It is well known that grid resolution can impact model predictions (Gillani and Pleim 1996). Further, studies have shown that the use of air quality model predictions at various grid resolutions can impact predicted health outcomes (Thompson and Noelle 2012).

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) in the models described above can cause 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 (NRC 1991, Barchet et. al. 1994).

5.2 Uncertainty in Health Impact Analysis

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 imprecision of such analyses is inherent and unavoidable. Uncertainties associated with air quality modeling have been discussed above. Air quality models, including CAMx and BenMAP-CE, rely on assumptions that may not fully or accurately capture 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 to 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 necessarily 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. This is particularly true where, as in this study, 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 the 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 fact that the estimated emissions from the Project are a very small fraction of 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, with very low confidence that the results represent any health impacts greater than zero. Therefore, the small incremental increase in concentrations generated by the Project in the context of regional-scale ambient air modeling should not be taken as a precise or meaningful 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, as opposed to considering the potential variabilities in emissions from year to year; 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 (Sacks et. al. 2018):

  - The absence in the analysis of any linkage between predicted changes in ozone and $PM_{2.5}$ concentrations associated with project operations and any specific *individual* health impact; instead, the analysis 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 in determining from epidemiological studies whether 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;

  - The potential for overstating the overall impacts, since, 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; and

  - The presumption in the estimate of health effects 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.

- 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 uncertainty in how health conditions are reported or categorized under various health studies 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 on people's assumed 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.

6.0 CONCLUSIONS

This Health Impact Analysis (HIA) reviewed the potential regional impacts from increased emissions due to the Friant Ranch Project, including the Community Plan and Specific Plan developments. The study included construction and operational emissions of the ozone precursors NO_x and ROG (or VOC, as a subset of TOG) and particulate matter (PM_{10} and $PM_{2.5}$). The HIA reviewed the Project's potential regional ozone and $PM_{2.5}$ concentration impacts, and specific health impacts, above expected baseline conditions.

Existing Baseline year and Future Baseline year (2020 and 2031) regional air quality modeling scenario databases were simulated using the CAMx modeling system. CAMx was used to apportion pollutant emission increases to Project emissions, including unmitigated and mitigated scenarios. The CAMx modeling estimated that the Project's emissions will increase the regional maximum daily 8-hour (MDA8) average ozone concentration by a maximum of 0.013 ppbv for the 2031 unmitigated scenario. Thus, the ozone concentration changes above baseline conditions for all modeled scenarios are expected to be less than 1.3% of the 1 ppb Significant Impact Level (SIL). The ozone concentration changes due to the Friant Ranch Project can be considered by Fresno County to contribute little to regional ozone formation, such that the specific health impacts due to the Project-related ozone concentration changes are not expected to be meaningful.

The maximum regional annual 24-hour average $PM_{2.5}$ concentration change due to the Project was estimated to be 0.058 $\mu g/m^3$ for the 2031 unmitigated scenario. The $PM_{2.5}$ concentration changes above baseline conditions for all modeled scenarios are expected to be less than 29% of the 0.2 $\mu g/m^3$ SIL. Thus, the changes in emissions due to the Friant Ranch Project can be considered by Fresno County to contribute little to regional $PM_{2.5}$ concentrations, such that the specific health impacts due to the $PM_{2.5}$ concentration changes are not expected to be meaningful.

While the CAMx modeling results show that ozone and $PM_{2.5}$ concentration impacts from the Project above baseline conditions are not expected to be meaningful, BlueScape completed specific health impact modeling. The health impact modeling provides additional information that may be useful to Fresno County and the public, and is intended to meet the evidentiary requirements stated the Friant Ranch Case. The specific health impacts for these pollutants were estimated using the BenMAP-CE health assessment model. The ozone and $PM_{2.5}$ concentration changes above baseline modeled by CAMx were converted to effects (or incidences) on various health endpoints including premature mortality, hospitalizations, and emergency room visits, and others, and then compared to the "background health incidence." The background health incidence is the actual incidence of health effects as measured in the local population in the absence of additional emissions from the Project.

The results of the BenMAP-CE health incidence calculations for the Friant Ranch Project are shown in Section 4.3 of this report. For example, the analysis shows that for ozone-related health endpoints for the 2031 Project unmitigated scenario, asthma-related emergency room visits are: incidences/year = 0.0338 for adults ages 18 to 99, and incidences/year = 0.0427 for children ages 0 to 17. For the $PM_{2.5}$-related health endpoints, for the Project 2031 unmitigated scenario, the health effect on mortality is: incidences/year = 0.35.

When taken into context, the Project-related change in health incidences/year is very small relative to background health incidences. Using the example provided, the largest Project-related ozone health incidence calculated for any scenario for asthma related emergency room visits by children age 0-17 represents 0.00026% of the total of all regional emergency room visits due to asthma. The largest Project-related $PM_{2.5}$ health incidence for mortality calculated for any scenario represents 0.00054% of the total of all regional deaths. As the health incidence values estimated for Friant Ranch Project emissions are less than one, and a negligible fraction of the background incidence values, it is not expected that the Project will result in any meaningful health impact greater than zero, that can be established with any certainty.

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APPENDIX A

CAMx Modeling Input and Output (list of electronic files)

The input and output files used and generated by the 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/camx/bcon/bc_gid555_vint.2013001.bin … input/camx/bcon/bc_gid555_vint.2013365.bin	CAMx boundary condition files. One file per day.
input/camx/icon/ic.*.const.bin	CAMx initial condition files. Monthly files.
input/camx/tuv/tuv.CEQA.FRanch.do_SAPRC07.20130101 … input/camx/tuv/tuv.CEQA.FRanch.do_SAPRC07.20131231	CAMx photolysis input files. One file per day.
input/camx/o3map/o3map.CEQA.FRanch.4km.2013001.txt … input/camx/o3map/o3map.CEQA.FRanch.4km.2013365.txt	CAMx ozone map input files. One file per day.
Input/camx/chem/CAMx6.5.chemparam.SAPRC07_CF_SOAP_ISORROPIA	CAMx SAPRC 2007 chemical parametrization file
input/camx/met/ camx.lu.4km.FRanch.bin	CAMx static surface geophysical parameters (land use, terrain).
input/camx/met/camx.3d.4km.20130101.FRanch.bin … input/camx/met/camx.3d.4km.20131231.FRanch.bin	CAMx meteorological 3D data files. One file per day.
input/camx/met/camx.2d.4km.20130101.FRanch.bin … input/camx/met/camx.2d.4km.20131231.FRanch.bin	CAMx meteorological 2D surface data files. One file per day.
input/camx/met/camx.kvpatch.YSU.OB70.4km.20130101.FRanch.bin … input/camx/met/camx.kvpatch.YSU.OB70.4km.20131231.FRanch.bin	CAMx meteorological vertical diffusivity data files. One file per day.
input/camx/met/camx.3d.4km.20130101.FRanch.bin … input/camx/met/camx.3d.4km.20131231.FRanch.bin	CAMx meteorological cloud/rain data files. One file per day.

TABLE A-1
MODELING INPUT AND OUTPUT FILES

Filename	Description
input/camx/met/camx.cr.2016010100 … input/camx/met/camx.cr.2016123100	CAMx meteorological cloud/rain data files. One file per day.
input/camx/emiss/2020/point/ point.camx.ceqa_FRanch.gid555.20130101.bin … input/camx/emiss/2020/point/ point.camx.ceqa_FRanch.gid555.20131231.bin	CAMx point source emissions files. All scenarios 2020. One file per day.
input/camx/emiss/2031/point/point.bluescape.20130101.2031.bin … input/camx/emiss/2031/point/point.bluescape.20130101.2031.bin	CAMx point source emissions files. All scenarios 2031. One file per day.
input/camx/emiss/2020/area/base/ camx_ar.ceqa_FRanch.wProj.2020proj.4km.20130101.bin … input/camx/emiss/2020/area/base/ camx_ar.ceqa_FRanch.wProj.2020proj.4km.20131231.bin	CAMx 3d gridded emissions files. Base scenario 2020. One file per day.
input/camx/emiss/2031/area/base/ area.bluescape.20130101.2031.base.bin … input/camx/emiss/2031/area/base/ area.bluescape.20131231.2031.base.bin	CAMx 3d gridded emissions files. Base scenario 2031. One file per day.
input/camx/emiss/2020/area/proj/ area.bluescape.20130101.2020.proj.bin … input/camx/emiss/2020/area/proj/ area.bluescape.20131231.2020.proj.bin	CAMx 3d gridded emissions files. Unmitigated project scenario 2020. One file per day.
input/camx/emiss/2020/area/pmit/ area.bluescape.20130101.2020.pmit.bin … input/camx/emiss/2020/area/pmit/ area.bluescape.20131231.2020.pmit.bin	CAMx 3d gridded emissions files. Mitigated project scenario 2020. One file per day.
input/camx/emiss/2031/area/proj/ area.bluescape.20130101.2031.proj.bin … input/camx/emiss/2031/area/proj/ area.bluescape.20131231.2031.proj.bin	CAMx 3d gridded emissions files. Unmitigated project scenario 2031. One file per day.
input/camx/emiss/2031/area/pmit/ area.bluescape.20130101.2031.pmit.bin … input/camx/emiss/2031/area/pmit/ area.bluescape.20131231.2031.pmit.bin	CAMx 3d gridded emissions files. Mitigated project scenario 2031. One file per day.
Output files	
output/all/2020/base/ camx65_SAPRC07.FRanch.4km_SA.2020.base.20130101.avrg.grd01.nc … output/all/2020/base/ camx65_SAPRC07.FRanch.4km_SA.2020.base.20131231.avrg.grd01.nc	CAMx output files. NetCDF format. Base scenario 2020. One file per day.
output/all/2031/base/ camx65_SAPRC07.FRanch.4km_SA.2031.base.20130101.avrg.grd01.nc … output/all/2031/base/ camx65_SAPRC07.FRanch.4km_SA.2031.base.20131231.avrg.grd01.nc	CAMx output files. NetCDF format. Base scenario 2031. One file per day.

TABLE A-1
MODELING INPUT AND OUTPUT FILES

Filename	Description
output/all/2020/proj/ camx65_SAPRC07.FRanch.4km_SA.2020.proj.20130101.avrg.grd01.nc … output/all/2020/proj/ camx65_SAPRC07.FRanch.4km_SA.2020.proj.20131231.avrg.grd01.nc	CAMx output files. NetCDF format. Unmitigated project scenario 2020. One file per day.
output/all/2020/pmit/ camx65_SAPRC07.FRanch.4km_SA.2020.pmit.20130101.avrg.grd01.nc … output/all/2020/pmit/ camx65_SAPRC07.FRanch.4km_SA.2020.pmit.20131231.avrg.grd01.nc	CAMx output files. NetCDF format. Mitigated project scenario 2020. One file per day.
output/all/2031/proj/ camx65_SAPRC07.FRanch.4km_SA.2031.proj.20130101.avrg.grd01.nc … output/all/2031/proj/ camx65_SAPRC07.FRanch.4km_SA.2031.proj.20131231.avrg.grd01.nc	CAMx output files. NetCDF format. Unmitigated project scenario 2031. One file per day.
output/all/2031/pmit/ camx65_SAPRC07.FRanch.4km_SA.2031.pmit.20130101.avrg.grd01.nc … output/all/2031/pmit/ camx65_SAPRC07.FRanch.4km_SA.2031.pmit.20131231.avrg.grd01.nc	CAMx output files. NetCDF format. Mitigated project scenario 2031. One file per day.

APPENDIX B
BenMAP-CE Audit Trial Reports

ATTACHMENT B-1

BENMAP-CE AUDIT TRAIL REPORT
O3.2020.PROJ.TXT

BenMAP-CE 1.5.0
<Aggregate, Pool & Value>
Create Datetime:2021-04-19 02:59:08
IsRunInPointMode:False
Latin Hypercube Points:20
Population Dataset:PopFriantUpdated-Friant
Year:2020
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:2021-04-15 07:28:36
Pollutant:Ozone
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\Friant\Data\o3.2020.proj.benmap.csv
<Grid.Definition>
Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</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:2021-04-15 07:29:27
Pollutant:Ozone
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\Friant\Data\o3.2020.base.benmap.csv
<Grid.Definition>
Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</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: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 (2020)
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.0>
<Health.impact.function.1>
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.1>
<Health.impact.function.2>
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.2>
<Health.impact.function.3>
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.3>
<Health.impact.function.4>
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.4>
<Health.impact.function.5>
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.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: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.6>
<Health.impact.function.7>
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 (2020)
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.7>
<Health.impact.function.8>
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 (2020)
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.8>
<Health.impact.function.9>
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 (2000)
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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</Selected.health.impact.functions>
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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:-1
</Inflation.Adjustment>
<Income.Growth.Adjustment>
Dataset:
Year : -1
</Income.Growth.Adjustment>
<Incidence.Aggregation>
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ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</Incidence.Aggregation>
<Valuation.Aggregation>

Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
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<MortalityPooling.Method.TypeNone>
<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 (2000)
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 (2020)
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, 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 (2020)
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, 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 (2020)
Beta:0.004471161
Beta distribution:Normal
P1Beta:0.001510347
P2Beta:0
A:0
NameA:
B:0
NameB:
C:0
NameC:
Percentile:0
Weight:0
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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 (2000)
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 (2020)
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, 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 (2020)
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, 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 (2020)
Beta:0.004471161
Beta distribution:Normal
P1Beta:0.001510347
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
Bell:Pooling Method Type:None
Huang:Pooling Method Type:None
Smith:Pooling Method Type:None
Jerrett: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: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
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</Incidence.Pooling.And.Aggregation.>
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School Loss Days
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<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.>
<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>
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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>
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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
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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
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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>
</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
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<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.>
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Acute Respiratory Symptoms
</Valuation.Pooling.Window.Name.Acute.Respiratory.Symptoms>
Processing complete. Valuation processing time: 0 hours 0 minutes 0 seconds.
</Aggregate, Pool & Value>

ATTACHMENT B-2

BENMAP-CE AUDIT TRAIL REPORT
O3.2020.PMIT.TXT

BenMAP-CE 1.5.0
<Aggregate, Pool & Value>
Create Datetime:2021-04-19 02:59:08
IsRunInPointMode:False
Latin Hypercube Points:20
Population Dataset:PopFriantUpdated-Friant
Year:2020
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:2021-04-15 07:28:36
Pollutant:Ozone
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\Friant\Data\o3.2020.pmit.benmap.csv
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Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</Grid.Definition>
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Name:Ozone
Observation Type:Hourly
Season0:May 1-September 30
Metric0:D1HourMax
Metric1:D24HourMean
Metric2:D8HourMax
Metric3:D8HourMean
</Pollutant>
</Baseline.Air.Quality.Surfaces>
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Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</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: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 (2020)
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.0>
<Health.impact.function.1>
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.1>
<Health.impact.function.2>
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.2>
<Health.impact.function.3>
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.3>
<Health.impact.function.4>
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.4>
<Health.impact.function.5>
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.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: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.6>
<Health.impact.function.7>
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 (2020)
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.7>
<Health.impact.function.8>
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 (2020)
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.8>
<Health.impact.function.9>
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 (2000)
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.9>
</Selected.health.impact.functions>
<Log.And.Message>
Processing complete. HIF processing time: 0 hours 23 minutes 14 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:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</Incidence.Aggregation>
<Valuation.Aggregation>

Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</Valuation.Aggregation>
<Incidence.Pooling.And.Aggregation.>
<MortalityPooling.Method.TypeNone>
<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 (2000)
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 (2020)
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, 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 (2020)
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, 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 (2020)
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, 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 (2000)
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 (2020)
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, 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 (2020)
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, 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 (2020)
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
Bell:Pooling Method Type:None
Huang:Pooling Method Type:None
Smith: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>
<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.>
<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.>
<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: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>
<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
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</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: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>
<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>
</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: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>
Processing complete. Valuation processing time: 0 hours 0 minutes 0 seconds.
</Aggregate, Pool & Value>

ATTACHMENT B-3

BENMAP-CE AUDIT TRAIL REPORT
O3.2031.PROJ.TXT

BenMAP-CE 1.5.0
<Aggregate, Pool & Value>
Create Datetime:2021-04-19 04:30:00
IsRunInPointMode:False
Latin Hypercube Points:20
Population Dataset:PopFriantUpdated-Friant
Year:2031
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:2021-04-19 04:07:41
Pollutant:Ozone
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\Friant\Data\o3.2031.proj.benmap.csv
<Grid.Definition>
Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</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:2021-04-19 04:07:19
Pollutant:Ozone
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\Friant\Data\o3.2031.base.benmap.csv
<Grid.Definition>
Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</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: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 (2020)
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.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: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.2>
<Health.impact.function.3>
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.3>
<Health.impact.function.4>
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.4>
<Health.impact.function.5>
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.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: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.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 (2020)
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, 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 (2000)
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.8>
<Health.impact.function.9>
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 (2020)
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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</Selected.health.impact.functions>
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</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>
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ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</Incidence.Aggregation>
<Valuation.Aggregation>

Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</Valuation.Aggregation>
<Incidence.Pooling.And.Aggregation.>
<MortalityPooling.Method.TypeNone>
<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 (2000)
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 (2020)
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, 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 (2020)
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, 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 (2020)
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, 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 (2000)
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 (2020)
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, 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 (2020)
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, 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 (2020)
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
Bell:Pooling Method Type:None
Huang:Pooling Method Type:None
Smith: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>
<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.>
<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.>
<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: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>
<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>
</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: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>
<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>
</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: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>
Processing complete. Valuation processing time: 0 hours 0 minutes 0 seconds.
</Aggregate, Pool & Value>

ATTACHMENT B-4

BENMAP-CE AUDIT TRAIL REPORT
O3.2031.PMIT.TEXT

BenMAP-CE 1.5.0
<Aggregate, Pool & Value>
Create Datetime:2021-04-19 05:35:30
IsRunInPointMode:False
Latin Hypercube Points:20
Population Dataset:PopFriantUpdated-Friant
Year:2031
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:2021-04-19 05:14:11
Pollutant:Ozone
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\Friant\Data\o3.2031.pmit.benmap.csv
<Grid.Definition>
Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</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:2021-04-19 04:07:19
Pollutant:Ozone
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\Friant\Data\o3.2031.base.benmap.csv
<Grid.Definition>
Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</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: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 (2020)
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.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: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.2>
<Health.impact.function.3>
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.3>
<Health.impact.function.4>
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.4>
<Health.impact.function.5>
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.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: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.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 (2020)
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, 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 (2000)
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.8>
<Health.impact.function.9>
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 (2020)
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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</Log.And.Message>
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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:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</Incidence.Aggregation>
<Valuation.Aggregation>

Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</Valuation.Aggregation>
<Incidence.Pooling.And.Aggregation.>
<MortalityPooling.Method.TypeNone>
<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 (2000)
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 (2020)
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, 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 (2020)
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, 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 (2020)
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, 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 (2000)
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 (2020)
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, 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 (2020)
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, 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 (2020)
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
Bell:Pooling Method Type:None
Huang:Pooling Method Type:None
Smith: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>
<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.>
<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.>
<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: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>
<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>
</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: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>
<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>
</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: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>
Processing complete. Valuation processing time: 0 hours 0 minutes 0 seconds.
</Aggregate, Pool & Value>

ATTACHMENT B-5

BENMAP-CE AUDIT TRAIL REPORT
PM25.2020.PROJ.TXT

BenMAP-CE 1.5.0
<Aggregate, Pool & Value>
Create Datetime:2021-04-19 09:06:49
IsRunInPointMode:False
Latin Hypercube Points:20
Population Dataset:PopFriantUpdated-Friant
Year:2020
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:2021-04-19 08:43:47
Pollutant:PM2.5
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\Friant\Data\pm25.2020.proj.benmap.csv
<Grid.Definition>
Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</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:2021-04-19 08:43:19
Pollutant:PM2.5
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\Friant\Data\pm25.2020.base.benmap.csv
<Grid.Definition>
Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984

</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: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 (2000)
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.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: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.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: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.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: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.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: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
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</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>
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ID:33
Columns:87

Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
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<Valuation.Aggregation>
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ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</Valuation.Aggregation>
<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 (2000)
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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<Valuation.Pooling.Window.Name.Mortality>
Mortality
</Valuation.Pooling.Window.Name.Mortality>
<Incidence.Pooling.And.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: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>
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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: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: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: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
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<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
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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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</Incidence.Pooling.And.Aggregation.>
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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
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Hospital Admissions, Cardiovascular
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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>
<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>
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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
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: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.>
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Emergency Room Visits, Respiratory
</Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
Processing complete. Valuation processing time: 0 hours 0 minutes 0 seconds.
</Aggregate, Pool & Value>

ATTACHMENT B-6

BENMAP-CE AUDIT TRAIL REPORT
PM25.2020.PMIT.TXT

BenMAP-CE 1.5.0
<Aggregate, Pool & Value>
Create Datetime:2021-04-19 10:12:52
IsRunInPointMode:False
Latin Hypercube Points:20
Population Dataset:PopFriantUpdated-Friant
Year:2020
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:2021-04-19 09:57:07
Pollutant:PM2.5
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\Friant\Data\pm25.2020.pmit.benmap.csv
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Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</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
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</Baseline.Air.Quality.Surfaces>
<Control.Air.Quality.Surfaces>
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Pollutant:PM2.5
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ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984

</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: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 (2000)
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.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: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.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: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.4>
<Health.impact.function.5>
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.5>
<Health.impact.function.6>
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.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: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.9>
</Selected.health.impact.functions>
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Processing complete. HIF processing time: 0 hours 15 minutes 20 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:Friant
ID:33
Columns:87

Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</Incidence.Aggregation>
<Valuation.Aggregation>
Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</Valuation.Aggregation>
<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 (2000)
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>
<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: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: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: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: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>
<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: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
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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.>
<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: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>
Processing complete. Valuation processing time: 0 hours 0 minutes 0 seconds.
</Aggregate, Pool & Value>

ATTACHMENT B-7

BENMAP-CE AUDIT TRAIL REPORT
PM25.2031.PROJ.TXT

BenMAP-CE 1.5.0
<Aggregate, Pool & Value>
Create Datetime:2021-04-19 13:08:39
IsRunInPointMode:False
Latin Hypercube Points:20
Population Dataset:PopFriantUpdated-Friant
Year:2031
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:2021-04-19 10:17:45
Pollutant:PM2.5
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\Friant\Data\pm25.2031.proj.benmap.csv
<Grid.Definition>
Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</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:2021-04-19 10:17:21
Pollutant:PM2.5
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\Friant\Data\pm25.2031.base.benmap.csv
<Grid.Definition>
Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984

</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: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 (2000)
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.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: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.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: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.4>
<Health.impact.function.5>
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.5>
<Health.impact.function.6>
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.6>
<Health.impact.function.7>
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.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: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.9>
</Selected.health.impact.functions>
<Log.And.Message>
Processing complete. HIF processing time: 0 hours 15 minutes 49 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:Friant
ID:33
Columns:87

Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</Incidence.Aggregation>
<Valuation.Aggregation>
Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</Valuation.Aggregation>
<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 (2000)
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>
<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: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: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: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: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: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: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
</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
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</Incidence.Pooling.And.Aggregation.>
<Valuation.Pooling.Window.Name.Hospital.Admissions.Cardiovascular>
Hospital Admissions, Cardiovascular
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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
</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: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>
Processing complete. Valuation processing time: 0 hours 0 minutes 0 seconds.
</Aggregate, Pool & Value>

ATTACHMENT B-8

BENMAP-CE AUDIT TRAIL REPORT
PM25.2031.PMIT.TXT

BenMAP-CE 1.5.0
<Aggregate, Pool & Value>
Create Datetime:2021-04-19 12:22:02
IsRunInPointMode:False
Latin Hypercube Points:20
Population Dataset:PopFriantUpdated-Friant
Year:2031
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:2021-04-19 12:05:19
Pollutant:PM2.5
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\Friant\Data\pm25.2031.pmit.benmap.csv
<Grid.Definition>
Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</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>
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Pollutant:PM2.5
Model Database File:C:\Users\Frank\Documents\My BenMAP-CE Files\Friant\Data\pm25.2031.base.benmap.csv
<Grid.Definition>
Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984

</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: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 (2000)
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.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: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.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: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.4>
<Health.impact.function.5>
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.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: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.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: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
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Processing complete. HIF processing time: 0 hours 16 minutes 8 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:Friant
ID:33
Columns:87

Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
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<Valuation.Aggregation>
Name:Friant
ID:33
Columns:87
Rows:103
Grid Type:Shapefile
Shapefile Name:CEQA_FRanch_lc_87_103_4000_4000_-108_-256_WGS1984
</Valuation.Aggregation>
<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 (2000)
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>
<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
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<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
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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
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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
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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: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
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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: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
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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
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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
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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: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
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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
Zanobetti:Pooling Method Type:None
Zanobetti:Pooling Method Type:None
Zanobetti:Pooling Method Type:None
Zanobetti:Pooling Method Type:None
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<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
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Hospital Admissions, Cardiovascular
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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
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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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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>
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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
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
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Hospital Admissions, Respiratory
Zanobetti:Pooling Method Type:None
Sheppard: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: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
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<Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
Emergency Room Visits, Respiratory
</Valuation.Pooling.Window.Name.Emergency.Room.Visits.Respiratory>
Processing complete. Valuation processing time: 0 hours 0 minutes 0 seconds.
</Aggregate, Pool & Value>

APPENDIX C
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.

Air Dispersion Modeling Analyses

- *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.

<u>*Mitigation Programs*</u>

- *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.

Litigation Support

- *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.

- Westbrook, J.A. and Dillingham J. 2005. *Air Toxics Health Risk Assessment Featuring HARP Software*. Two-day course presented in Anaheim and San Francisco, California.

- Westbrook J.A. 2004. *Environmental Justice & DER*. Presented at the 2004 California Alliance for Distributed Energy Resources Conference, San Diego, California.

- Tarde J.A. and Westbrook J.A. 2003. *Air Quality Modeling in a Highly Industrialized Valley Regime: A Comparison of AERMOD–PRIME to ISCST–PRIME and ISCST3 Results for PM10 Emissions*. Presented at the "Guideline on Air Quality Models; the Path Forward" Conference, Mystic, Connecticut, October.

- Westbrook, J.A. 1998. *Regional Risk Analysis and CALPUFF: A Review of the Tri-State Initiative.* Presented at the 10th Joint Conference on the Applications of Air Pollution Meteorology with the AW&MA, Phoenix, Arizona.

- Westbrook, J.A. 1998. *Facilitating the Air Permitting Process: Strategic Planning Makes a Difference*. Presented at the 1998 Johns Manville Environmental Coordinator's Conference, Denver, Colorado.

- Westbrook, J.A. 1998. *Air Dispersion Models: Tools to Assess Impacts from Air Pollution Sources.* Natural Resources & Environment New Science and Technology Issue. ABA Section of Natural Resources, Energy, and Environmental Law, Chicago, Illinois, Spring.

- Westbrook J.A., and Tarde J.A., 1995. Dispersion Modeling Techniques for Horizontal, Titled or Capped Emission Sources. Presented at the 88th Meeting of the Air & Waste Management Association, San Antonio, Texas.

- Hayes S.R., and Westbrook J.A. 1992. Analysis of Regulatory Requirements for Petroleum Companies in California. Presented at the DOE California Petroleum Industry Environmental Workshop, Bakersfield, California.

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.

Education

PhD, Engineering and Public Policy, Carnegie Mellon University, Pittsburgh, Pennsylvania, 2004

BS (with honors), Petroleum Engineering, Montana College of Mineral Science and Technology, Butte, Montana, 1985

AA, Computer Science, Montana College of Mineral Science and Technology, Butte, Montana, 1983

Quotes

"You may not remember, but during my freshman year and your junior year (as I was struggling with Physics 1 {mechanics} from Jack Youngblood) you were gracious enough to give me a 30 minute lesson on dimensional analysis which helped me better understand alternative methods for checking my work and applicable to almost all of my engineering classes. I have never forgotten what you did for me...thank you. I've done the same thing for many other engineering students over the years."

Ron Layton
11-Jan-2016

"Jim is an excellent balance of engineer and scientist with a seemingly unlimited capacity for solving complicated problems. He is fearless and dependable, and a real pleasure to work with."

Stephen Andersen
26-Jan-2016

IT Manager,

Senior Consulting Engineer,

Senior Software Developer,

Dr. Wilkinson possesses knowledge and experience in applied research and directly related technical experience in disciplines spanning the physical sciences, geophysical sciences, mathematics, and computational sciences. His experience includes but is not limited to managing large scale, multidisciplinary applied research projects with multiple stakeholders and sponsors, such as urban- to continental-scale air quality (CAMx, CMAQ) and meteorological (WRF, MM5) modeling studies. Jim also has experience in emissions modeling system design, development, and application (e.g., SMOKE, CONCEPT, and EMS-95); micro- to global-scale environmental data base management system design and deployment; design, development, and application of computational mathematical models of the environment (e.g., URM and BIOME).

Dr. Wilkinson has experience in the application of Failure Mode and Effects Analysis (FMEA), Threat and Hazard Identification and Risk Analysis (THIRA), and Hazard Consequence Modeling and Risk Assessment. He has applied the Process Hazard Analysis Software Tool (PHAST) to assess hazards and risks associated with gaseous and liquid hydrocarbon pipelines, carbon dioxide pipelines, and hazardous chemicals storage tanks. He has used these techniques to prepare siting plans for Liquefied Natural Gas (LNG) facilities and acrylonitrile production facilities.

Dr. Wilkinson is an experienced software developer having designed, developed, tested, deployed, and maintained systems across Windows and Linux platforms. He has expertise across the LAMP and WAMP environments working in frameworks such as LINQ, .NET, and Entity Framework with the C#, PHP, and ReactJS languages.

Jim has formulated public policy perspectives associated with the technical and scientific findings of basic and applied research, and taught at the university level.

Employment History

Organic Materials Review Institute (OMRI) – Eugene, Oregon
IT Manager (Mar-2020 to Present)
Senior Software Developer (Jul-2016 to Mar-2020)

Staff mentoring and project supervision. Business development, cost modelling, personal resource deployment and load balancing, project management, technical leader for air quality modeling and meteorological modeling.

Terra-Technologies. – Eugene, Oregon
Senior Consultant (Nov-2015 to Present)

Staff mentoring and project supervision. Business development, cost modelling, personal resource deployment and load balancing, project management, technical leader for air quality modeling and meteorological modeling.

Golder Associates Inc. – Portland, Oregon
Senior Consultant (Aug-2013 to Nov-2015)

Staff mentoring and project supervision. Business development, cost modelling, personal resource deployment and load balancing, project management, technical leader for air quality modeling, process safety management, risk assessment, and hazard consequence studies.

Alpine Geophysics, LLC – Eugene, Oregon
Senior Engineer and Managing Partner (1993 to 2013)

Business development, project management, and technical leader providing guidance on air quality modeling studies. Cost modelling and personal resource deployment.

Radian Corporation – Sacramento, California
Senior Engineer (1992 to 1993)

Project and technical leader who provided guidance on air quality modeling studies.

Radian Corporation – Sacramento, California
Staff Engineer and Computer Scientist/Engineer (1988 to 1992)

Project technical leader who provided environmental engineering and air quality modeling services. Provided database and systems development services for environmental engineers.

ARCO Alaska, Inc. – Anchorage, Alaska
Petroleum Engineer (1985 to 1986)

Drilling engineer and operations engineer supporting production drilling and facilities operations in Prudhoe Bay, Kuparuk River, and Cook Inlet fields.

Montana Tech Computer Services – Butte, Montana
Programmer II (1984 to 1985)

Provided support for campus-wide computer services.

ARCO Alaska, Inc. – Anchorage, Alaska
Petroleum Engineer (1984)

Provided reservoir modeling support on Cray supercomputer.

Montana Tech, Environmental Engineering Department – Butte, Montana
Teaching Assistant (1982 to 1984)

Provided necessary support to a professor to teach environmental engineering to undergraduates. Ran computer laboratory for various classes.

PROJECT EXPERIENCE – METEOROLOGICAL & AIR QUALITY MODELLING

WRF, SMOKE, CMAQ Modelling for the City of Hamilton
Hamilton, Ontario

Dr. Wilkinson developed model inputs for WRF, SMOKE, and CMAQ to support comprehensive air quality modelling over Hamilton for 2012. He prepared data sets for nested 36-12-4-1.33 km domains centered over Hamilton with 30 vertical levels extending to 100 mb. Dr. Wilkinson conducted model performance evaluations for WRF and CMAQ to determine their skill at reproducing historical conditions. Pollutants considered in this assessment included B(a)P, formaldehyde, cadmium, ammonia, mercury, and chromium among others.

Steamboat Springs
Colorado

Estimated the impacts that planned improvements to the Steamboat Resort will have on air quality. Using MOVES2014a and NONROAD2008 to estimate the emissions (volatile organic compounds [VOCs], nitrogen oxides [NOx], sulfur dioxide [SO2], particulate matter [PM], and greenhouse gases [GHG]) from diesel and gasoline-fueled vehicles used during construction and operation. Impacts were estimated based on activities occurring during the summer of 2017.

MOVES2014 Modelling for Chicago, Minneapolis, and Kansas City; Urban Air Initiative

Dr. Wilkinson prepared inputs to and ran the Motor Vehicle Emissions Simulator (MOVES2014) for the subject cities for 2017 based on default data. Based on new fuel parameter data supplied by the sponsor, he adjusted the MOVES2014 inputs to reflect the alternate fuel parameters that were indicative of real-world fuels. A comparison of the on-road emissions estimates based on the default data and those based on the real-world fuel parameters showed that MOVES2014 may incorrectly account for changes in fuel parameters specifically associated with ethanol-blended fuels above E10.

Acid Mist Modelling with AERMOD Glencore --Mopani Copper Mines;
Zambia, Africa

Dr. Wilkinson prepared analyzed observational data for sulfuric acid concentrations and meteorology in order to prepare inputs to the MAKEMET and AERMOD models. MAKMET was used to estimate meteorological parameters necessary to drive AERMOD in its screening mode. AERMOD was used in screening mode to predict acid concentrations from an acid mist system used at the copper heap leach pad. The purpose of the modelling was to determine if acid concentrations are predicted to exceed established WHO levels at any time during the year. The team discovered that the proposed location of the heap leach pad was such that acid concentrations were likely to exceed regulatory levels near established neighborhoods. Based on our efforts, we offered alternative nearby locations for the proposed heap leach pad such that during its operation, there were predicted to be no exceedances of the WHO levels.

WRF Modelling for the City of Toronto
Toronto, Ontario

Dr. Wilkinson developed WRF model inputs for the initialization, 3D analysis nudging, and observational nudging fields based on data from the NCEP North American Regional Reanalysis data sets maintained at UCAR and routine monitoring data maintained at NOAA National Climatic Data Centre. He prepared WRF data sets for nested 36-12-4 km domains centered over Toronto with 30 vertical levels extending to 50 mb. WRF was run for each hour of 2012 to predict two- and three-dimensional prognostic meteorological fields including wind speed, wind direction, temperature, solar radiation, and mixing ratio. Dr. Wilkinson conducted a model performance evaluation to determine WRF's skill at reproducing historical meteorological conditions. Finally, he converted WRF outputs for use in CALPUFF simulations.

WRF Modelling over the Chukchi Sea; ConocoPhillips
Chukchi Sea

Using the Weather Research and Forecasting (WRF) system, prognostic meteorological simulations for period July through November, 2007, 2008, and 2009 were constructed and run for a 36-12-04 km nested domain structure, with a 37 layer vertical structure extending to 50 mb, for the Chukchi Sea off the coast of northwest Alaska. NCEP GFS 0.5 degree model data was used for WRF initialization and analysis nudging. NCEP GFS data were also used for sea ice and sea surface temperatures updated every six hours. Model performance evaluation (MPE) was conducted with MAPS and METSTAT at both the surface and aloft using available observations from routine monitoring. Model performance for mixing ratio, temperature, wind speed, and wind direction met or exceeded performance metrics. Finally, WRF outputs were converted for use in CALPUFF.

Eldora Mountain Resort Expansion
Colorado

Examined the impacts that a planned expansion to the Eldora Mountain Ski Resort will have on air quality. Using MOVES2010b and NONROAD2008 to estimate the emissions (VOCs, NOx, SO2, PM, and GHG) from diesel and gasoline-fueled vehicles used in the construction and operation phases of the project. The planned expansion is for the period 2015 through 2019, with peak operation impacts occurring in 2023.

Houston 8-Hour Dual Ozone Phenomena
Texas

Currently involved in research efforts focused on determining the conditions that led to the 8-hour dual-ozone formation phenomena in the Houston-Galveston-Brazoria (HGB) region of Texas. Developing and applying ensemble air quality modeling techniques that can further bound the range of modeled 8-hour ozone. Developing and applying 8-hour modeled ozone bias correction techniques. These methods and techniques, which are based on applied research that are taken from such forecasting efforts as hurricane and tsunami tracking, are directed at developing control scenarios that better address the unique dual ozone formation conditions that arise in the HGB 8-hour ozone non-attainment region.

Ethanol Fuels Study; CRC
Illinois, Michigan, and Georgia

Constructing a turn-key system that integrates the SMOKE emissions modeling platform with the CAMx air quality modeling for the Coordinating Research Council (CRC) to support its study of the impacts of alternative ethanol-blended fuels on air quality in multiple urban regions in the United States. Leading the effort to ingest multiple link-based on-road mobile source networks into SMOKE and apply on-road mobile source emissions factors from the MOVES2010b motor vehicle emissions simulator that have been adjusted to account for effects on emissions factors due to alternative ethanol-blended fuels. An additional component to this effort is likely to be an assessment of the effects of meteorology that is “flexi-nested” from 12 kilometers to 4 kilometers in CAMx, contrasted to a meteorology derived from first principles at 4-kilometer resolution using MM5.

San Joaquin Valley WOE
California

Developed methods that can be used in weight of evidence (WOE) analyses to support State Implementation Plans (SIPs). One method developed concerns determining the plausible range of future year design values for 8-hour ozone in the Central California Ozone Study (CCOS). Analyzed air quality model outputs to determine the range of ozone outcomes in both the base year and future year. Also examined the outputs to determine if grid cells selected for use in the relative response factor (RRF) are inappropriate for more than one monitor. Another method examined concerns the longitudinal trends that are being observed between ambient measurements of ozone and its precursors. Further, this trends analysis was extended to determine how the trends in the planning inventories are tracking with precursor trends.

Agricultural Emissions Tool (AgTool)
California

Developed a geographic information systems (GIS)-based platform in PostgreSQL-PostGIS to store and manipulate agricultural emissions. Developed methods to ingest agricultural surrogate data that can be used to spatially allocate emissions to grid cells. Further, provided a means to better temporalize agricultural emissions. This system was developed in tandem with an agricultural emissions forecasting system.

United States On-road Mobile Source Emissions Estimates
United States

Used MOVES2010a to develop hourly on-road mobile source emissions estimates for the years 2008, 2009, 2010, and 2020 for each county in the United States for each month of the years and for representative weekends and weekdays. Used the MOVES/SMOKE Interface Tool to facilitate the process of using MOVES to create on-road mobile source emissions estimates for use in air quality modeling. The MOVES/SMOKE Interface Tool is comprised of scripts that automate the proper use of the Emission Rate calculations. The SMOKE-MOVES tool provides three major functions: (1) Meteorological data preprocessor; (2) MOVES2010 model processor; and (3) SMOKE model processor. Modified the meteorological data preprocessor (MET4MOVES) to prepare month-specific, hourly profiles of temperature and humidity that are suitable for direct input to MOVES. Built custom SQL scripts to better facilitate the loading of data directly into the MOVES databases.

Areas of Influence; Various Clients
Various

Conducts research in the areas of emissions uncertainty and economic-based incentives (e.g., market trading programs) to control regional emissions. Current primary research project is concerned with determining the geographic extent of areas whose sources may contribute to air quality exceedances. These areas are known as Areas of Influence (AOI). Also interested in elucidating the impacts that uncertainty in biogenic emissions estimates have on urban- and regional-scale emissions control strategies.

Modeling On-Road Mobile Source Emissions Estimates for SESARM
Georgia

Used MOVES2010a to develop on-road mobile source emissions factors that can be used to estimate emissions for 10 states that cover the southeast United States. Modeled the year 2007 for winter and summer fuels for 40 representative counties in the 10 southeast states. Used the MOVES/SMOKE Interface Tool to facilitate the process of using MOVES to create on-road mobile source emissions estimates for use in air quality modeling. The MOVES/SMOKE Interface Tool is comprised of scripts that automate the proper use of the Emission Rate calculations. The SMOKE-MOVES tool provides three major functions: (1) Meteorological data preprocessor; (2) MOVES2010 model processor; and (3) SMOKE model processor. The Meteorological data preprocessor (MET4MOVES) prepares spatially and temporally averaged temperatures and relative humidity data to set up the meteorological input conditions for MOVES2010 and SMOKE using the Meteorology-Chemistry Interface Processor (MCIP) output files. The MOVES2010 model processor creates data input files (i.e., runspec) for use in MOVES2010 that specifies the characteristics of the particular scenario to be modeled, and it reformats the resulting MOVES2010 emission rates lookup tables that are suitable for input to SMOKE. The SMOKE postprocessor (MOVESMRG) estimates emissions from on-road mobile sources based on MOVES2010-based emission rate lookup tables and meteorology data from MET4MOVES.

Review of the Houston 8-hour Ozone SIP; TCEQ
Texas

Provided in-depth analyses of emissions, meteorological, and air quality modeling results developed by the Texas Commission on Environmental Quality (TCEQ) for use in preparing the 8-hour ozone State Implementation Plan (SIP). Six multi-day episodes in 2005, 2006, and 2018 were modeled. Conducted CAMx model performance evaluation of the Houston region to further understand the meteorological phenomena that led to elevated ozone levels. Conducted independent CAMx modeling and sensitivity analyses through the use of OSAT to elucidate the emissions source sectors and source regions that contribute to high ozone in the Houston region. Developed independent sets of stationary, area, non-road, on-road, and biogenic source emissions files suitable for use in SMOKE to provide parallel, corroborative, and alternative base case and future year episodic emissions development capabilities for use by the 8-hour Coalition and the US Environmental Protection Agency (EPA). Produced alternative analyses for the ozone modeled attainment demonstration based on the flexibility that is afforded in EPA's guidance. Performed extensive analysis of the ambient air quality record to examine trends in the regulatory design values (DV) at all monitors in the Houston region. Studied and evaluated the performance of the monitor-specific baseline design values (DVb), relative response factors (RRFs), and future year design values (DVf) with multiple tools including MATS. Models that are being used in this effort include CAMx, CMAQ, MM5, SMOKE, EPS3, MEGAN, BEIS3, GloBEIS, NONROAD, MOBILE6, and MOVES2010a.

Sacramento Air Quality Modeling Study
California

Provided emissions, air quality, and meteorological modeling capabilities to determine impacts to the Sacramento urban heat island, biogenic emissions, and air quality as a result of alternative tree planting scenarios in the Sacramento urban area. The goal of this effort was to quantify the State Implementation Plan (SIP) credit that can be taken for planting new urban forests in Sacramento or exchanging lower-emitting tree species for existing high-emitting tree species. Used urbanized-MM5 (uMM5) to quantify localized meteorological changes that may occur due to landuse/landcover changes as the results of tree planting scenarios. Propagated the meteorological predictions through BEIS3 and MEGAN to estimate changes in biogenic emissions. Finally, used CAMx to determine the outcome on air quality, in particular ozone, due to changes as a result of various tree planting scenarios.

CAMx Google Earth
Illinois

Developed a software tool to display Comprehensive Air Quality Model with extensions (CAMx) predictions in Google Earth. The software tool allows a user to select the time period and chemicals to display from a CAMx output file, and prepares a KMZ file containing PNG graphics and a KML file. The tool is based on Open Source and freeware tools PostgreSQL, PostGIS, and perl. Recently extended the tool to display stationary source daily emissions as estimated by SMOKE. Currently extending the tool to display air quality observations.

Enhancements to the California ITN
California

Developed version three of the Integrated Transportation Network (ITN) for the California Air Resource Board. The ITN was constructed using Open Source and freeware tools PostgerSQL, PostGIS, and perl. The ITN was based on the travel demand modeling results from more than 20 metropolitan planning organizations (MPOs). The ITN was constructed to function within the CONCEPT framework, but can also operate as a stand-alone system. The ITN utilized on-road mobile source emissions factors that were extracted from EMFAC2007. The extraction of emissions factors from EMFAC2007 was automated with the Windows-based tool AutoIt. The goal of this effort was to construct a unified travel demand modeling link-based network with associated travel analysis zone (TAZ) data for the state of California that can be used for such purposes as environmental justice litigation, conformity planning, development of on-road mobile source emissions estimates, and State Implementation Plan (SIP)-level air quality modeling.

Columbia River Gorge Air Quality Modeling Study
Oregon

Worked on a study of historical regional haze in the Columbia River Gorge. The study focused on assigning source culpability to haze and visibility degradation in the Columbia River Gorge. Developed CAMx-ready emissions estimates using SMOKE for winter and summer episodes in 2005 and 2018. Used SMOKE to develop CAMx-ready emissions estimates for such sources as confined animal feeding operations, commercial marine vessels, railroad operations, dairy operations, pulping operations, lumber mills, and electric generating units (EGUs)]. Prepared hourly estimates of sulphur dioxide (SO2) emissions from Mt. St. Helens. Estimated hourly emissions of carbon monoxide (CO), nitrogen oxides (NOx), volatile organic compounds (VOC), particulate matter (PM) 2.5, PM-coarse, and ammonia (NH3) from controlled burns and wildfires. Prepared hourly estimates of emissions from EGUs and pulping facilities based on data extracted from the US Environmental Protection Agency (EPA) continuous emissions monitoring (CEM) archive. The emissions estimates were aggregated into multiple categories for use in the Particulate Matter Source Apportionment Technology (PSAT) tool of the CAMx air quality model. Developed an Excel workbook with associated Visual Basic macros that allows a user to investigate emissions by source category and source region (further extending the Ozone and Particulate Source Apportionment Technology (OSAT/PSAT) capabilities of CAMx. The Excel workbook with Visual Basic macros takes output from the SMOKE/SMKREPORT tool as input to the spreadsheet. Further, the Excel workbook has macros that allow the user to prepare summary graphics of the emissions estimates. Finally, modeled air quality using CAMx for 2018 to determine if air quality objectives for regional haze and visibility can be met.

Control Strategy Tool (CoST); EPA
North Carolina

Worked with the US Environmental Protection Agency (EPA) to develop the Control Strategy Tool (CoST). CoST is EPA's vision to replace AirControlNET. CoST is used to develop overall program costs associated with the selection of control measures and control programs that may be implemented to control emissions to achieve future year air quality objectives. Collected control measure and control program data and costs for criteria pollutants, air toxics, and greenhouse gases (GHGs). Provided analyses to determine the applicability of these data to sources in the US, as some of these data are being derived from programs outside the US.

Integration of the Model of Emissions and Gases from Nature (MEGAN) into ConCEPT
Illinois

Worked with the Lake Michigan Air Directors Consortium (LADCo) to update the Consolidated Community Emissions Processing Tool (ConCEPT) to include the biogenic emissions estimates model MEGAN. MEGAN (the Model for the Emissions of Gases and Aerosols from Nature) is the state-of-the-science model to estimate biogenic emissions. MEGAN is currently designed in MS-Access VBA and MS-Excel VBA. Lead analyst and programmer converting MEGAN to run under the PostgreSQL database. Performed the tasks to improve throughput of MEGAN under the SQL framework, as well as the throughput of the CONCEPT meteorological data processor. Also guided the effort to verify the MEGAN emissions estimates against the BEIS3 emissions estimates.

Retrospective Analysis of Trending Air Quality and Emissions Inventories in California
California

Prepared spatially and temporally resolved emissions estimates from stationary, area, and on-road mobile sources for a period spanning 1990 through 2004. These emissions estimates were compared to air quality measurements made over the same period to determine if trends in the air quality matched trends in the emissions inventory. One goal of this effort was to determine where deficiencies existed in the emissions inventory. Currently working with the California Air Resources Board (ARB) to determine trends of nitrogen oxides (NOx) and volatile organic compound (VOC) emissions versus ozone in Central California from 1990 through 2004. Comparisons of emission trends with ambient air quality trends at an air-basin level of aggregation may obscure important local changes, but the large-scale comparisons serve to illustrate why the rates of progress in improving ozone levels may be of concern in some areas. For example, in both the San Joaquin Valley (SJV) and South Coast Air Basin (SoCAB) areas, emissions of carbon monoxide (CO) declined by approximately 60 percent between 1990 and the present, and maximum ambient concentrations of CO declined by about the same amount (60 percent) in the two areas. In both areas, substantial (albeit somewhat different) decreases occurred in the emissions of both nitrogen oxides (NOx) and reactive organic gases (ROG). In both areas, ambient nitrogen dioxide (NO2) levels declined by approximately the same magnitude as did NOx emissions (35 to 40 percent). Yet, maximum 1-hour and 8-hour ozone levels declined appreciably in the SoCAB while remaining virtually unchanged in the SJV. Providing emissions support for this study, preparing emissions data for use in regression and trends analyses.

Central Regional Air Planning Area of Influence; CENRAP
Oklahoma

Prepared Area of Influence (AOI) diagrams and estimated emissions reductions needed to attain visibility objectives by 2018 for 10 Central Regional Air Planning Association (CENRAP) Class I areas and 12 near-CENRAP Class I areas. Developed AOIs for the 22 Class I areas by synthesizing the following data: Residence Time Difference plots; Probability of Regional Source Contribution to Haze (PORSCH) plots; and Tagged Species Source Apportionment (TSSA) results. The results of this effort were converted to geocoded coverages and maps using ARC/Info. Estimated sensitivity coefficients (for example, a sulphur dioxide [SO2] reduced value of -0.001 µg/m3 of sulfate per ton per day means that for each ton of SO2 reduced within an AOI, the Class I area will exhibit a decrease of 0.001 µg/m3 in sulfate concentration) by synthesizing the results of numerous brute force and DDM-3D air quality model runs. These data were in turn used to estimate the annualized costs to achieve emissions reductions necessary to meet future year air quality objectives in each of the Class I areas.

Consolidated Community Emissions Processing Tool (ConCEPT)
Illinois

Helped design and implement the open source emissions modeling system Consolidated Community Emissions Processing Tool (CONCEPT). CONCEPT is a PostgreSQL-based system whose goal is to house all data related to the emissions modeling process under a single database. Geographic information systems (GIS)-related functions are managed within the same PostgreSQL database using the PostGIS plugin.

California ITN; California ARB
California

Commissioned by the California Air Resources Board (ARB) to develop version two of the California Integrated Transportation Network (ITN). Recently completed the first version of the ITN using data from transportation demand models (TDMs) from 15 California metropolitan planning organizations (MPOs). In version two of the ITN, TDM data from approximately 20 MPOs were used. The ITN is a seamless representation of the on-road mobile source transportation network for all of California. On behalf of the ARB, used the ITN, in conjunction with the on-road emissions factors model EMFAC2002 and the Direct Travel Impact Model (DTIM), to estimate on-road mobile source emissions for a variety of multi-day air quality modeling episodes spanning the years 2000 through 2010. An interesting component of this effort was the development of a transportation gravity model in Excel VBA that can be used to estimate commercial truck trips and their distribution on the ITN.

1997 Southern California Ozone Study
California

In collaborative research with Dr. Robert Bornstein at San Jose State University, used MM5 to develop meteorological fields for the 1997 Southern California Ozone Study (SCOS-97). Developed the initialization fields and the four-dimensional data assimilation (FDDA) fields for use in MM5 for the 4-7 August 1997 modeling period. Developed alternative inputs to MM5 for this period (e.g., updated landuse) in an effort to garner better performance. Responsible for all aspects of model performance evaluation. Ultimately, used the MM5 outputs to prepare meteorological inputs to the CAMx air quality model.

Texas Biogenic Emissions Estimates
Texas

Completed work to estimate emissions for four ozone episodes in the Houston, Texas area using GloBEIS. Estimated emissions for 36-kilometer, 12-kilometer, and 4-kilometer grid structures. Prepared all meteorological inputs (base temperatures, antecedent temperatures, Palmer Drought Index, phased array radar [PAR], wind speed, and mixing ratio) based on predictions from MM5. The episodes ran from 8 to 15 days in duration. GloBEIS outputs were speciated using CB4 and reformatted for use in the CAMx and CMAQ chemical transport models.

Biogenic Emissions in Missouri and Kansas; Missouri DNR
Missouri

Prepared estimates of biogenic emissions for the Missouri Department of Natural Resources (DNR) for 36-kilometer, 12-kilometer, and 4-kilometer grid structures that center on St Louis, Missouri. Used SMOKE/BEIS to model the emissions for three multi-day episodes. Prepared all input files to SMOKE/BEIS. The landuse data were derived from version three of the Biogenic Emissions Landuse Database (BELD3). Temperature and phased array radar [PAR] data were based on MM5 predictions.

San Francisco Bay Area Air Quality Modeling Study; BAAQMD
California

Completed an emissions modeling study for the Bay Area Air Quality Management District (BAAQMD). Estimated emissions for multi-day ozone episodes for base case years in July 1999 and July 2000. Estimated emissions for future years 2002, 2005, 2007, and 2010. Estimated emissions for area sources, stationary sources, non-road mobile sources, on-road mobile source, commercial marine shipping, and biogenics for an airshed that encompassed most of California. The emissions estimates developed by him were used to model base year air quality levels over California with particular emphasis on model performance over the San Francisco Bay Area. Further, the future year emissions estimates will be used in on-going air quality modeling efforts to develop emissions control strategies for mitigation of the 1-hour and 8-hour ozone National Ambient Air Quality Standards. In an effort to understand where potential deficiencies in the emissions inventory exists, also completed an in-depth, comparative analysis of emissions estimates among common source categories between the Central California Ozone Study (CCOS) emissions database and the VISTAS emissions database.

Southern Appalachian Mountains Initiative
Georgia

Lead emissions and air quality modeler for the Southern Appalachian Mountains Initiative (SAMI) project. The SAMI was a multi-episodic, integrated (i.e., acid deposition, ozone, and visibility/particulate matter), regional-scale air quality modeling study over the eastern United States with particular focus on the southern Appalachian Mountains. The selected episodes were 7 to 15 days in length and span 1990 through 1995, with future years of 2010 and 2040. In the SAMI project, responsible for the preparation of all aspects of the air quality model ready inputs including, but not limited to, emissions estimates (e.g., area source spatial surrogates, mobile source emissions estimates, biogenic emissions estimates, emissions estimates speciation, and data management of the emissions data); conversion of prognostic meteorological modeling results from RAMS and MM5 to URM-ready meteorological fields (including interpolation of the fields from the meteorological grid structure to the air quality modeling grid structure); and diagnosis of boundary and initial air quality conditions. In the SAMI study, designed, implemented, and maintained the geographic information system (GIS)-based components of the emissions and air quality modeling system. As part of the GIS for the SAMI project, maintained coverages of population, housing, urban areas, water, political boundaries (i.e., states, counties, national boundaries, and airsheds), forests, biogenic land cover, railroads, major roadways, water ports, airports, major stationary sources of air pollution, and air quality monitoring stations. The GIS-based data were used to disaggregate county-wide estimates of emissions from minor emissions sources into sub-county areas for the purposes of air quality modeling. Used the GIS-based data to link and display emissions estimates to sources, air quality observations, and air quality model predictions. Further, responsible for developing inputs to URM so air quality model performance goals for ozone, particulates, and wet/dry acid deposition were met.

Peninsula Florida Ozone Study
Florida

Prepared point source, area source, on-road mobile source, and biogenic emissions estimates for multiple ozone episodes over peninsular Florida. Developed a wildfire emissions estimates model that could estimate temporally and spatially varying wildfire emissions based on fuel types and fuel loads. Collected day-specific emissions for all electric generating utilities in the air quality modeling domain. Prepared alternative emissions estimates for commercial marine shipping. Point and area source emissions were based on the 1996 NEI, supplemented with emissions data and estimates from the Florida Department of Environmental Protection (DEP). Biogenic emissions were estimated using BEIS, BEIS2, and GloBEIS. Future year inventories were grown using E-GAS derived growth and control factors, supplemented with growth and control factors developed for specific source categories as determined by the Florida Department of Environmental Protection (DEP).

Biogenic Emissions from Mexico
Mexico

Performed a study to develop the first biogenic emissions inventory for northern Mexico. The new biogenic emissions inventory was integrated with existing anthropogenic emissions in an effort to better understand transboundary air pollution along the Mexico-United States border. The biogenic emissions inventory was developed from Mexican-supplied ground-truthed agricultural and forest coverage data, as well as satellite-based land use data. The data were compiled for use in BEIS2.

Breton Island Air Monitoring Program
Louisiana

Helped to complete a design of an air quality and meteorological monitoring network for the Breton Island National Wildlife Refuge Class I Area, located in the Gulf of Mexico just east of New Orleans, Louisiana. Designed the geographic information system (GIS) emissions, air quality, and meteorological database management system that will be used to house these data when the Breton Island Air Monitoring Program (BAMP) field program is implemented.

NH3 from Concentrated Animal Feeding Operations (CAFOs) in San Joaquin Valley
California

Completed a study to evaluate and improve existing ammonia emissions estimate techniques for use in the San Joaquin Valley of California. This study included a comprehensive literature review that focused on the following: methods that were used to estimate ammonia emissions; the development of a new ammonia emissions inventory for the study domain; the implementation of a pilot field study to improve upon methods to estimate ammonia emissions from dairy livestock, soils, and wastewater treatment plants; and the development of methods to estimate quantitative values of uncertainty about the ammonia emissions estimates. Developed a statistical model to estimate ammonia emissions from dairies.

Pittsburgh-Beaver Valley 1-hour Ozone SIP
Pennsylvania

Helped to complete the technical analysis for the State Implementation Plan (SIP) for the Pittsburgh-Beaver Valley 1-hour ozone non-attainment area. The technical analysis included the emissions modeling, air quality modeling, and attainment demonstration work needed for the SIP.

Study of Particulates and Health in Atlanta
Georgia

Completed work to determine the association of airborne pollutants to increased visits of children with respiratory problems to Atlanta-area emergency rooms. Using the geospatial statistical method known as kreiging, prepared maps of temporally and spatially disaggregated air quality measurements over greater Atlanta, Georgia. Coupled these data with information derived from emergency room visits to Atlanta-area hospitals to determine that there was a statistically significant increase in respiratory-associated visits to the emergency room in the presence of elevated ozone levels.

Horizontal Advection Solver
Pennsylvania

Involved in examining the impacts of the horizontal advection solver in three-dimensional air quality models on emissions control strategies. In that study, responsible for running the UAM-IV and CIT models for established air quality modeling studies, and statistical analysis of the air quality modeling outputs. The statistical analyses were conducted to isolate and quantify the numerical interference due to various horizontal advection solvers that were introduced into the UAM and CIT air quality models.

OTAG
NE United States

Involved in the Ozone Transport and Assessment Group's (OTAG) efforts to examine regional-scale air quality in the eastern United States. Primary engineer tasked with preparing emissions modeling inputs (e.g., area source spatial surrogates, on-road mobile source transportation network, and geographic information systems [GIS]-based EMS-95 foundation data) for the Emissions Modeling System version 1995 (EMS-95). Provided technical support to the OTAG participants in the application of EMS-95 to the eastern United States and southern Canada.

GEMAP
California

Instrumental in the design and development of the Geocoded Emissions Modeling and Projections System (GEMAP) which was the predecessor of EMS-95. Prepared design documents for the overall architecture of the system, as well as for the point and area source models. Developed both SAS and ARC/Info code for the point source, area source, and on-road mobile source models. Applied GEMAP to develop emissions estimates for the SARMAP and LMOS air quality modeling studies.

Houston 8-hour Ozone Coalition
Texas

Currently involved in research efforts focused on determining the conditions that led to the 8-hour dual-ozone formation phenomena in the Houston-Galveston-Brazoria (HGB) region of Texas. Developing and applying ensemble air quality modeling techniques that can further bound the range of modeled 8-hour ozone. Developing and applying 8-hour modeled ozone bias correction techniques. These methods and techniques, which are based on applied research that are taken from such forecasting efforts as hurricane and tsunami tracking, are directed at developing control scenarios that better address the unique dual ozone formation conditions that arise in the HGB 8-hour ozone non-attainment region.

PROJECT EXPERIENCE – HAZARD CONSEQUENCE ASSESSMENT

UEO DTI; Momentum, LLC
Leesville, Ohio

15 MMscfd of natural gas is conveyed along a 4 mile long, 15 inch diameter underground pipeline operating at 525 psi and 38°F. The purpose of the study was to determine if high consequence areas (HCAs) (i.e., sensitive ecosystems, drinking water supply, or populated areas) were impacted due various leak and rupture scenarios that result in natural gas being released. Using PHAST, models of hazardous events were constructed. Consequences that were modelled include pooling-evaporation and 10% lower explosive level assessment that might result in an explosion or fire. Model results were overlaid on a geo-referenced aerial photograph to graphical show the areal extent of impacts to HCAs.

Facility Hazard Assessment Review; National Renewable Energy Laboratory
Golden, Colorado

Conducted hazard consequence modelling for scenarios involving accidental releases of arsine, silane, ammonia, dodecane, and hydrogen. Using PHAST, estimated hazard distances to IDLH-AEGL-ERPG toxic thresholds, overpressure threshold (1 psi) from explosions, and thermal threshold (4 $kW \cdot m^{-2}$) from fires. Estimated thermal intensity for grassland wildfire to determine if ethanol storage facility was at risk. Determined likely impacts to worker and general public health and safety. Conducted asphyxiation assessment due to liquid nitrogen spill. Conducted asphyxiation assessment due to carbon monoxide release. Conducted dropped load risk assessment due to excessive crane load.

Aqueous NH3 Storage Tank Consequence & Risk Assessment; TransAlta Canada
Edmonton, Alberta

Aqueous ammonia is transported, stored, and utilized at a gas-fired power plant. Accidental release scenarios were developed including the rupture of the delivery line, the rupture of the transfer pipe, and a ten minute release. Five years of meteorological data were analyzed to determine the joint probability of the occurrences of wind speed, wind direction, and atmospheric stability. The Process Hazard Analysis Software Tool (PHAST) was used to estimate the hazard distance for each hazard scenario. Maximum concentration plume footprints were estimated based on IDLH, ERPG-1, ERPG-2, ERPG-3, AEGL-1, AEGL-2, and AEGL-3 values. The likelihood of these events was estimated based on historical accidental release data. The 1-in-1,000,000 individual risk of fatality was estimated should an event occur. The number of residences was estimated to be impacted by a hazardous event. The information was used to develop a Risk Management Plan, including shelter-in-place and emergency evacuation procedures, for mitigation and communication.

Anhydrous NH3 Storage Tank Consequence & Risk Assessment; TransAlta Canada
Edmonton, Alberta

Liquid anhydrous ammonia is transported, stored, and utilized at a gas-fired power plant. Accidental release scenarios were developed including the rupture of the delivery line, the rupture of the transfer pipe, activation of the relief valve, and a ten minute release. Five years of meteorological data were analyzed to determine the joint probability of the occurrences of wind speed, wind direction, and atmospheric stability, which impact the transport and dispersion of ammonia released to the atmosphere. The consequences of these hazard events were modelled using PHAST, and the hazard distance estimated for each hazard scenario. The likelihood of these events was estimated based on historical hazard events. Overall risk was estimated as number of chances in one million that event would occur. Maximum concentration plume footprints were estimated based on IDLH and ERPG-2 values, and the number of residences was estimated to be impacted by the hazardous event. The information was used to develop a Risk Management Plan for mitigation and communication purposes.

Diesel & Bitumen Pipelines Emergency Release and Odour Analyses; TransCanada Pipelines Limited (TransCanada) Ft. McKay, Alberta	Conducted an air quality modelling assessment using PHAST of odour effects resulting from a potential accidental leak from the proposed pipelines near the Hamlet of Fort MacKay, Alberta. The project included two buried pipelines (a Diluent Pipeline and a Bitumen Pipeline) that are located together on the same right-of-way. The goal of the air quality modelling assessment was to address concerns over possible odour effects and exceedances of Alberta Ambient Air Quality Objectives for H2S, BTX, and mercaptans from an accidental release of product. Accidental release events considered were three sizes of corrosion leaks, and a full rupture of a pipeline by an impact such as a backhoe strike. Leak sizes assumed were 20 mm, 50 mm, and 80 mm in diameter. A full rupture was assumed to last for 10 minutes before the line fully emptied and was shut down. These events are considered worst case, and possible leaks or ruptures may not be as large or continue for as long as the hypothetical scenarios.
UEO M3 HCA; M3 Midstream, LLC Scio, Ohio	LNG, ethane, and propane are being transported via three separate pipelines (both above and below ground). The purpose of the study is to determine the consequences of a pipeline rupture due to a strike from a backhoe during uncovering and to determine if there adverse impacts to populated areas. Using PHAST, a model of the hazardous event has been constructed. Consequences that have been modelled include the following: pooling and evaporation; toxic endpoint (IDLH) assessment; jet-fire assessment; and explosion assessment. Model results have been overlaid on a geo-referenced aerial photograph to graphical show the areal extent of impacts to populated areas.
Propane-Air Plant & Storage Facility FMEA; Puget Sound Energy Renton, WA	Conducted a failure mode effects analysis (FMEA) of a Propane-Air Plant and Storage facility. The purpose of the FMEA was to determine if any of the identified potential failure modes could result in significant adverse safety consequences (e.g., bodily injury, death). Each potential failure mode was evaluated based on a qualitative assessment of the probability of failure, the severity of effects, and the likelihood of detection. The scales assigned to the probability of failure, the severity of effects, and the likelihood of detection ranged from one to five with the higher value indicating a more detrimental effect. The product of these three values provided a qualitative means to rate the potential failure modes. Based on the FMEA results, it was determined that no additional quantitative risk analysis would be required for the facility.

CO_2 Pipeline Rupture Consequence Analysis; Anadarko Petroleum Company
Casper, WY

CO2 is transported via pipeline to wellheads for use in enhanced oil recovery (i.e., injection). Two PHAST modelling scenarios were considered: breach of a 20" pipe operating at approximately 1400 psi; and breach of a 30" pipe at approximately 300 psi (both operating at 40 F). Ambient meteorological conditions modelled included wind speed of 5 mph, D atmospheric stability class, temperature of 14 F, and atmospheric pressure of 11.5 psia. The total weighted average permissible limit (TWA) for CO2 is 5,000 ppm, and the short term exposure limit (STEL) is 30,000 ppm based on NIOSH and OSHA standards. Steady state was achieved almost instantly for both cases when concerning the 30,000 ppm STEL boundary. The higher pressure 20" pipe spread to a distance of approximately 90' and the lower pressure release achieved a distance of 14'. Both scenarios showed high elevations (>60') at this concentration. The 5,000 ppm cloud from the high pressure 20" pipe rupture did not descend to the ground until approximately 135' from the source. Final diffusion to concentrations lower than 5,000 ppm occurred at 522' from the source (at steady-state). The lower pressure 30" pipe rupture reached steady state almost instantly and did not reach ground level before diffusion reduced concentrations below 5,000 ppm. The cloud did reach a distance of approximately 112' (at an elevation of 102') from the source before diffusion.

PROJECT EXPERIENCE – EXPERT TESTIMONY

Garfield County, Colorado Oil and Gas Commission
Denver, Colorado

Dr. Wilkinson provided testimony to the Colorado Oil and Gas Commission on behalf of Garfield County who represented the Energy Producing Attainment Counties of Colorado in their efforts to challenge expansion of new emissions controls on oil and gas exploration/production operations outside the Denver 8-hr ozone non-attainment area. Dr. Wilkinson prepared and delivered evidence refuting claims by Environmental Defense Fund (EDF) that expansion of emissions controls state-wide would be beneficial to society. He demonstrated that air quality modelling results were incorrectly interpreted by the EDF, and that an alternative explanation of the modelling results showed virtually no predicted improvement in air quality would occur with the state-wide expansion of changes to Regulation 7; however, the cost to implement such state-wide changes would be large..

Columbia Pacific Bio-Refinery (CPBR), Oregon Department of Environmental Quality (DEQ)
Portland, Oregon

Dr. Wilkinson conducted research into claims made by plaintiffs that accused CPBR of using incorrect data to determine its facility-wide emissions, which kept the facility under PSD permitting requirements. CPBR is a facility that transloads Bakken crude oil from trains to barges on the Columbia River. He specifically focused on chemical analyses of the crude oil and its vapor, which the plaintiffs claimed were grossly underestimated by CPBR. Based on his research, Dr. Wilkinson determined that the data used by CPBR to estimate its facility-wide emissions were appropriate.

MOVES2014 Modelling for Chicago, Minneapolis, and Kansas City; Urban Air Initiative

Dr. Wilkinson prepared inputs to and ran the Motor Vehicle Emissions Simulator (MOVES2014) for the subject cities for 2017 based on default data. Based on new fuel parameter data supplied by the sponsor, he adjusted the MOVES2014 inputs to reflect the alternate fuel parameters that were indicative of real-world fuels. A comparison of the on-road emissions estimates based on the default data and those based on the real-world fuel parameters showed that MOVES2014 may incorrectly account for changes in fuel parameters specifically associated with ethanol-blended fuels above E10.

TransAlta Sundance 7, Alberta Utilities Commission
Edmonton, Alberta

Dr. Wilkinson provided testimony on behalf of TransAlta and its application to install an 856 MW natural gas-fired electricity generating facility in the Lake Wabamun area west of Edmonton, Alberta. He delivered testimony to the Alberta Utilities Commission, which is the provincial licensing agency in Alberta. As approximately 15 to 40 metric tons of ammonia need be stored on site for use in the selective catalytic reduction system, Dr. Wilkinson spoke specifically to the consequences of an accidental release of anhydrous and aqueous ammonia. He spoke specifically to the modelling methods and tools used to estimate the consequences of an accidental release and the probability of such events occurring. He explained the differences in the toxic endpoints (i.e., AEGL, ERPG, and IDLH) that were used to determine hazard distances.

Western Energy Operators, Colorado Oil and Gas Commission
Denver, Colorado

Dr. Wilkinson provided testimony on behalf of Davis, Graham and Stubbs, LLP, who represented the Western Energy Operators, in its efforts to challenge new emissions controls on oil and gas exploration/production operations proposed under Regulation 7. He delivered testimony to the Colorado Oil and Gas Commission. Dr. Wilkinson prepared and delivered evidence refuting claims by the Colorado Department of Public Health and the Environment (CDPHE) that air quality modelling showed that the proposed emissions controls would be beneficial to society. He demonstrated that air quality modelling results were incorrectly interpreted by the CDPHE, and that an alternative explanation of the modelling results showed virtually no predicted improvement in air quality would occur with the implementation of changes to Regulation 7.

Houston 8-hour Ozone SIP Coalition, Texas Commission on Environmental Quality
Austin, Texas

Dr. Wilkinson provided testimony on behalf of the Houston 8-hour Ozone SIP Coalition in its efforts to modify emissions control rules for industrial facilities in the Houston-region. He delivered testimony indicating that some elevated ozone days in Houston were due to fires occurring in the Pacific Northwest, Alberta, and British Columbia. He also demonstrated the contribution of flaring emissions to overall predicted air quality.

Bay Area Air Quality Management District (BAAQMD)
San Francisco, California

Dr. Wilkinson provided testimony to support BAAQMD in its efforts to defend the adequacy of its comprehensive air quality modelling studies. Plaintiffs claimed that BAAQMD made inappropriate assumptions in its modelling analyses, which led to the construction of emissions control strategies that were far less stringent than needed to be in order to attain the ozone NAAQS for the greater San Francisco Bay Area. Dr. Wilkinson's analyses showed that for each assumption made by the BAAQMD, the modelling assumption was appropriate and in some cases more conservative than needed to be.

PROFESSIONAL AFFILIATIONS

Air and Waste Management Association (AWMA)

Institute of Electrical and Electronics Engineers (IEEE)

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