Interagency Consultation for
Interstate 405 South Improvements Project
from Interstate 5 to Interstate 55
Irvine, California

District 12
Orange County
I-405
Post Miles 0.2 to 8.7
E-FIS No. 1200000370
EA 0K7100

Prepared by

Terry A. Hayes Associates Inc.

For the
California Department of Transportation

Februrary 9, 2016

1. Introduction 1

2. Project Description 2

3. Covered Geographic Area 6

3.1 Air Basin 6

3.2 Meteorology 6

3.3 Attainment Status 7

4. Methodology 9

4.1 Emissions Inventory 10

4.2 Dispersion Modeling 12

4.2.1 Sources 13

4.2.2 Receptors 13

4.3 Meteorological Data 14

4.4 Monitoring Activity and Background Concentrations 16

4.4.1 Monitoring Activity 16

4.4.2 Background Concentrations and Design Values 19

APPENDICES

Appendix A Traffic Data

Appendix B Emission Calculations

List of Figures

Figure 1. Project Vicinity Map 21
Figure 2. Project Location Map 22
Figure 3. Project Location Map 23
Figure 4. Project Location Map 24
Figure 5. Project Location Map 25
Figure 6. South Coast Air Basin 26
Figure 7. PM_{10} Emissions Profiles associated with 2040- Alternatives 2 and 3 Traffic Data 27
Figure 8. $PM_{2.5}$ Emissions Profiles Associated with 2040-Alternative 2 and 3 Traffic Data 28
Figure 9. Modeling Segment 29
Figure 10. Location of Air Monitoring/Meteorological Stations 30
Figure 11. Wind Rose- Mission Viejo 31
Figure 12. Wind Rose- Costa Mesa 32
Figure 13. Wind Rose- Anaheim 33
Figure 14. Flow Chart of Calculation of Design Values 34

List of Tables

Table 1. ADT and Truck ADT Percent Increase: Alternative 2 Compared to Alternative 1 (No Build). 11
Table 2. ADT and Truck ADT Percent Increase: Alternative 3 Compared to Alternative 1 (No Build). 11
Table 3. Total Project Emissions for PM_{10} and $PM_{2.5}$ 12
Table 4. Status Summary of Meteorological Data- Processed by SCAQMD for AERMOD Version 15181 15
Table 5. Particulate Matter Sampling Sites in the Vicinity of the Project 17
Table 6. Background Concentrations 18

1. Introduction

The California Department of Transportation (Caltrans) District 12 in cooperation with Orange County Transportation Authority (OCTA) proposes to add one or two general purpose and auxiliary freeway lanes through an 8.5-mile segment of Interstate 405 (I-405) between Interstate 5 (I-5) and State Route (SR-55). The I-405 South Improvement Project (project) limits, including transition areas, extend from approximately 0.2 miles west of Jamboree Road in the City of Costa Mesa to approximately 0.5-miles west of Irvine Center Drive in the City of Irvine. Construction is anticipated to begin in 2023, with an opening year of 2025 and a design year of 2045.

I-405 freeway is within the project limits experiences high levels of congestion on the mainline and ramps, deteriorated conditions, weaving and merging issues, and inadequate intelligent transportation system infrastructure. This 8.5-mile segment of the I-405 is one of the busiest stretches of freeway in the nation, as well as one of the most congested. Between 207,000 and 316,000 cars travel this segment every day and, with a forecasted increase of nearly 20 percent, the demand is expected to increase by 38,000 to 58,000 daily trips by 2045. The purpose of the project is to address existing and future traffic demand and mobility along the I-405 within the project limits. This will be achieved by adding mainline capacity, improved ramp capacity, improve freeway operations including weaving, merging, diverging, and intelligent transport systems, and enhance safety.

The project is located in South Coast Air Basin (Basin), which is a nonattainment area for particle matters of 2.5 microns or less in diameter ($PM_{2.5}$) and a maintenance area for particle matter of 10 microns or less in diameter (PM_{10}). Interagency Consultation has identified the project as a Project of Air Quality Concern. In addition, Caltrans is preparing a hot-spot analysis related to Transportation Conformity pursuant to the United States Environmental Protection Agency (USEPA) *Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in Nonattainment Areas and Maintenance Areas*.

This Modeling Protocol is organized as follows:

Chapter 1 – Introduction
Chapter 2 - Project Description
Chapter 3 - Covered Geographic Area
Chapter 4 - Methodology

2. Project Description

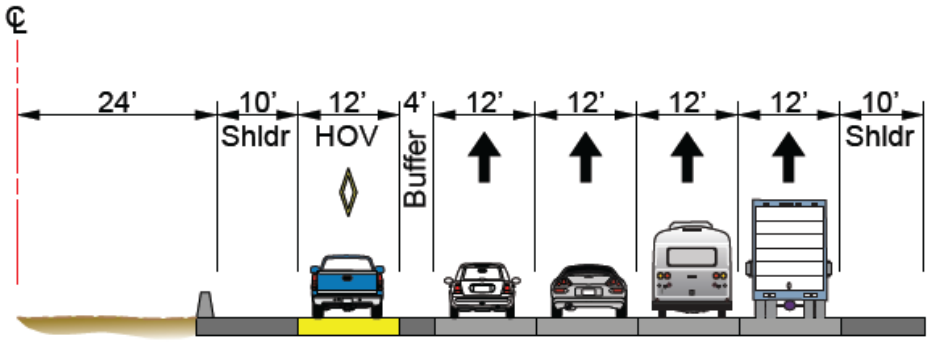
OCTA, in cooperation with Caltrans and City of Irvine, proposes to improve the mainline freeway and interchanges on I-405 or San Diego Freeway in Orange County. The proposed project alternatives would reduce congestion and improve operational efficiency on I-405 between I-5 and SR-55 by adding one or two general purpose (GP) lanes and auxiliary lanes. The approximately 8.5-mile-long project corridor is located primarily in the City of Irvine in Orange County, as well as a small portion of unincorporated Orange County and the City of Costa Mesa at the northern end of the proposed project. The project limits extend from I-5 (Postmile [PM] 0.2) to SR-55 (PM 8.7). **Figures 1** through **5** show the project vicinity and project location maps.

Caltrans is the Lead Agency for compliance with the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). The environmental review, consultation, and any other action required in accordance with applicable federal laws for this project has been or is being carried out by Caltrans under its assumption of responsibility pursuant to 23 United States Code (U.S.C.) 327. OCTA is the project sponsor and the project is included in the Measure M2 Freeway Plan.

Three alternatives are currently under consideration, one No Build Alternative and two Build Alternatives. The following discussion describes each alternative in detail.

Alternative 1 – No Build Alternative

Alternative 1 would not result in any proposed project improvements, but it assumes the completion of projects that are currently programmed by Caltrans in the State Highway Operations and Protection Program, STIP, or Corridor Mobility Improvement Account. These include the construction of a SB auxiliary lane between SR-133 and the Sand Canyon Avenue on-ramp, another between Sand Canyon Avenue off-ramp and the University Drive on-ramp, and the extension of one SB lane between the University Drive off-ramp and the Culver Drive off-ramp.



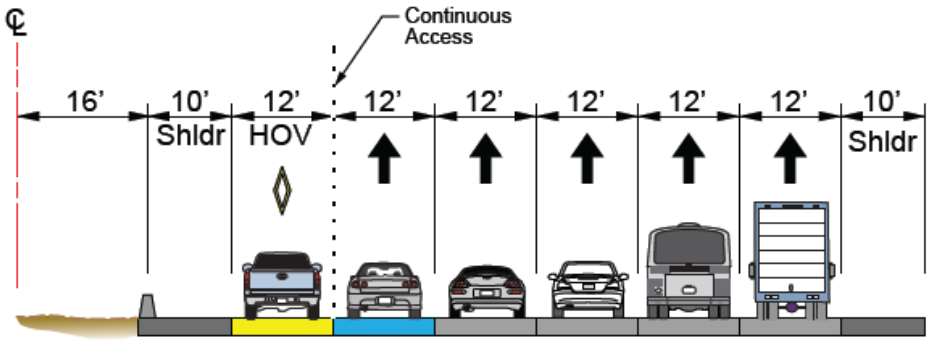
ALTERNATIVE 1 - NO BUILD ALTERNATIVE

Alternative 2 – Add One General Purpose Lane

Alternative 2 would add a single GP lane in the NB direction of I-405 between SR-133 and Culver Drive and in the SB direction between Irvine Center Drive and University Drive/Jeffrey Road. This would provide a fifth continuous GP lane from I-5 to SR-55 in the NB direction and from Irvine Center Drive to SR-55 in the SB direction. Additionally, auxiliary lanes will be provided at locations where required based on traffic merge, diverge and weaving operational analysis and geometric conditions.

Alternative 2A – Same As Alternative 2 with Addition of Southbound Braided Ramp Design Variation

Alternative 2A would be the same as Alternative 2 and adds a braided ramp to grade-separate the SB I-405 Irvine Center Drive off-ramp and the SR-133 to SB I-405 merging branch connector. This action would eliminate the mainline weaving occurring between the closely spaced SR-133 and Irvine Center Drive interchange. This alternative will require widening of the existing San Diego Creek Bridge on the SB side and the construction of a new bridge for the Irvine Center Drive off-ramp.



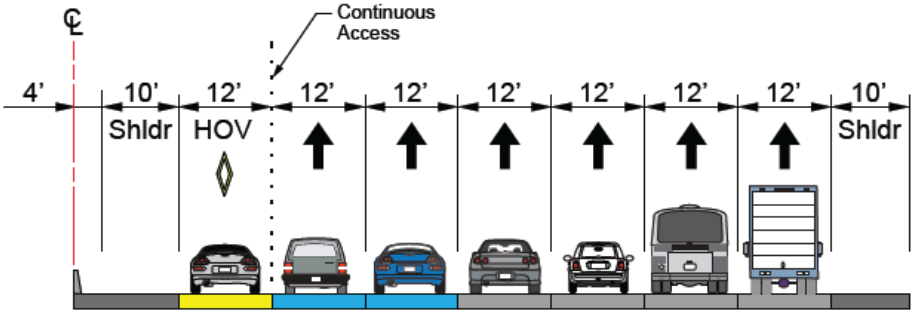
ALTERNATIVE 2 - ONE ADDED GENERAL PURPOSE LANE
IN EACH DIRECTION

Alternative 3 – Add Two General Purpose Lanes

Alternative 3 includes the GP lane included in Alternative 2 and adds a second GP lane in the NB direction of I-405 between SR-133 and Jamboree Road and in the SB direction between SR-133 and Culver Drive. This would provide a sixth continuous GP lane in each direction from SR-133 to Jamboree Road. Additionally, auxiliary lanes will be provided at locations where required based on traffic merge, diverge and weaving operational analysis and geometric conditions.

Alternative 3A – Same As Alternative 3 with Addition of Southbound Braided Ramp Design Variation

Alternative 3A would be the same as Alternative 3 and adds a braided ramp to grade-separate the SB I-405 Irvine Center Drive off-ramp and the SR-133 to SB I-405 merging branch connector. This action would eliminate the mainline weaving occurring between the closely spaced SR-133 and Irvine Center Drive interchange. This alternative will require widening of the existing San Diego Creek Bridge on the SB side and the construction of a new bridge for the Irvine Center Drive off-ramp.



ALTERNATIVE 3- TWO ADDED GENERAL PURPOSE LANES
IN EACH DIRECTION

3. Covered Geographic Area

The I-405 freeway is a major north-south route that traverses through Orange County. Significant trip generators include residential and commercial land uses with associated ancillary land uses (e.g., schools). Individual trip generators include John Wayne Airport, Irvine Spectrum Center shopping mall, University of California at Irvine, and South Coast Plaza Mall.

3.1 Air Basin

The South Coast Air Basin includes the southern two-thirds of Los Angeles County, all of Orange County, and the western urbanized portions of Riverside and San Bernardino Counties (**Figure 6**). The regional climate within the Basin is considered semi-arid and is characterized by warm summers, mild winters, infrequent seasonal rainfall, moderate daytime onshore breezes, and moderate humidity.

3.2 Meteorology

Average temperatures in the coastal area vary from lows in the mid-50s to highs in the mid-70s degrees Fahrenheit, with annual precipitation ranging from 12 to 15 inches. In contrast to a very steady pattern of temperature, rainfall is seasonally and annually highly variable. Almost all rain falls from November through April.

Wind patterns in the coastal area are characterized by westerly and southwesterly onshore winds during the day and easterly or northeasterly breezes at night. Wind speed is somewhat greater during the dry summer months than during the rainy winter season. In both the morning and evening hours, air stagnation may occur between these periods of wind. Air stagnation is one of the critical determinants of air quality conditions on any given day. During the winter and fall months, surface high-pressure systems over the Basin, combined with other meteorological conditions, can result in very strong, down slope Santa Ana winds. These winds normally continue a few days before predominant meteorological conditions are reestablished. The mountain ranges surrounding the Basin affect the transport and diffusion of pollutants by inhibiting the eastward transport of pollutants. The entire region experiences heavy concentrations of air pollutants during prolonged periods of stable atmospheric conditions.

Temperature inversions are common in the region throughout the year. Since the inversion is often lower than the height of the surrounding mountain ranges, the region effectively

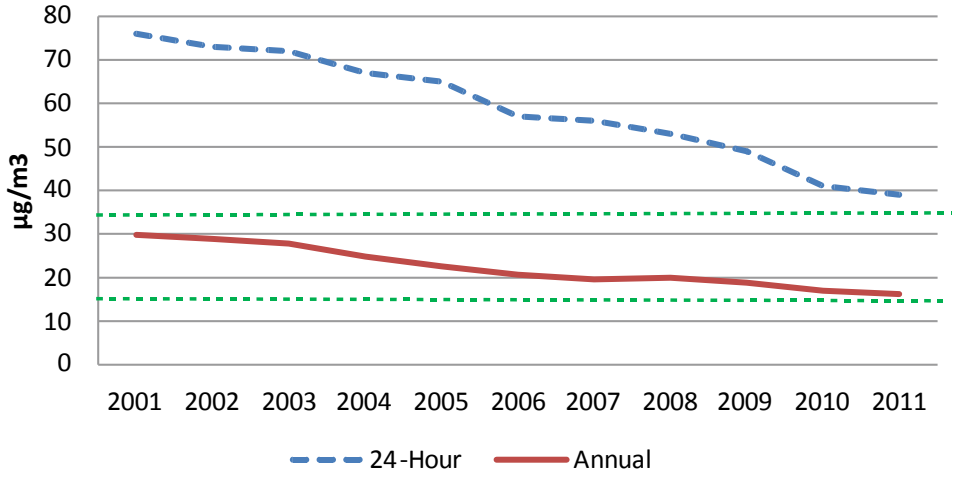
becomes a bowl capped with a lid that traps emissions near the surface. When horizontal dispersion (transport flow) and vertical dispersion (rising air) are minimized, PM_{10} and $PM_{2.5}$ concentrations can build quickly, especially in the winter. These naturally occurring meteorological conditions have the net effect of spatially concentrating direct $PM_{2.5}$ and PM_{10} concentrations near their sources; promoting the formation and regional buildup of secondary species, particularly ammonium nitrate.

Complex terrain and weather patterns make the region a natural sink for the accumulation of emissions and sustained high pollution levels. Along the coastal area, better air quality prevails because of the relatively mild climate, cooler temperatures, and a pattern of onshore airflow. However, in the inland portion of the air basin, a combination of abundant sunshine, warm temperatures, and poor vertical air mixing is conducive to the formation of ozone, commonly referred to as "smog." The problem is further aggravated by the surrounding mountains that act together with the weather and air pollutant emissions.

3.3 Attainment Status

The Basin is classified as nonattainment for the $PM_{2.5}$ federal standard and maintenance area the federal PM_{10} standard.[1] The following graph shows the trend in the 24-hour $PM_{2.5}$ design values, determined from routinely monitored Federal Reference Monitoring (FRM), from 2001 through 2011. The trend illustrates a sharp reduction in $PM_{2.5}$ concentrations. The 24-hour $PM_{2.5}$ design value for 2001 was 76 micrograms per cubic meter ($\mu g/m^3$) while the 2008 design value was 53 $\mu g/m^3$. Furthermore, the latest design value computed by the USEPA, which is for 2011, is 38 $\mu g/m^3$. The annual $PM_{2.5}$ design value has declined by 13.6 $\mu g/m^3$ over the 10-year period from 2001 through 2011.

[1]The USEPA's Green Book Maintenance Areas, http://www3.epa.gov/airquality/greenbook/pmcs .html#CALIFORNIA, accessed January 27, 2016.



SOUTH COAST AIR BASIN 24-HOUR AVERAGE AND ANNUAL $PM_{2.5}$ DESIGN VALUES

4. Methodology

The project-level hot-spot analysis will be completed using the *Transportation Conformity Guidance for Quantitative Hot-Spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* released by the USEPA in November 2013. The guidance was updated by the USEPA on the Project-Level Conformity and Hot-Spot Analyses website in November 2015. The methodology is briefly summarized below and explained in detail within this section of the Protocol.

- The Build Alternatives American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) input emission rates will be calculated using project-specific traffic data, including truck/non-truck percentages, and the emissions rates obtained from EMFAC2014-PL.
- One segment representing the highest emissions will be modeled. It is anticipated that the segment will include approximately one mile of the I-405. If conformity is demonstrated at this segment, then it will be assumed that the conformity is met along the entire length of the alignment. Selection of the segment will be performed according to emission profile (amount of emissions as a function of distance measured from the beginning of the project on the east - Postmile) that were developed based on the traffic data and emission factors obtained from EMFAC2014-PL for all analysis years and build alternatives. The modeling segment will be selected at a location along the length of the alignment where the localized emissions peaked or the one-mile moving average of the emissions consistently showed elevated emissions across different years and alternatives.
- The surface and profile meteorological data will be obtained from the Mission Viejo or Costa Mesa Meteorological Stations depending on the location of the segment.
- Adjacent volume sources will be generated for each lane using ArcGIS. As detailed below, each source will be assigned the appropriate release height, initial horizontal dispersion coefficient, and initial vertical dispersion coefficient.
- Modeling will include a fine grid and a coarse grid at the same time to eliminate the possibility of missing areas of exceedance. A 25×25 meter grid to a distance of 100 meters from the freeway right-of-way (ROW) and a 100×100 meter grid to a distance of 500 meters from the freeway ROW will be included in the modeling.
- The interpretation of the model run outputs will be performed as described briefly below:

- If design values for the Build Alternatives are less than or equal to the relevant National Ambient Air Quality Standards (NAAQS), the project meets the conformity rule's hotspot requirements.
- If design values for the Build Alternatives are greater than the NAAQS, the No Build Alternative will be modeled using the existing alignment and the same methodology described above, although the Build Alternative traffic data will be replaced with No Build Alternative traffic data.

4.1 Emissions Inventory

EMFAC2014 will be utilized to estimate $PM_{2.5}$ and PM_{10} emissions from exhaust, brake wear, and tire wear. Re-entrained road dust is also a significant contributor to regional $PM_{2.5}$ and PM_{10} emissions, and emissions will be estimated using the AP-42 Compilation of Air Pollutant Emission Factors.[2]

According to the California Air Resources Board (CARB) EMFAC2014 Volume I User's Guide, emission rates for project level assessments can now be obtained from the EMFAC2014 model. Unlike EMFAC2011-PL, activity data is included in the EMFAC2014 model in order for the model to be able to calculate emission rates consistent with the default fleet distributions in the region, including running, idling, start exhaust emissions, and PM tire and brake wear.

This project will not include custom activity mode data related to vehicle age distributions. The Default Activity mode will be used for generating emission rates. The average daily relative humidity and ambient temperate are calculated based on hourly data obtained from CARB Air Quality and Meteorological Information System 2 (AQMIS2) website for the Mission Viejo meteorological station in year 2015. The average daily relative humidity is 59.8 and the temperature is 62.8 degree Fahrenheit. The project does not involve vehicle start and idling emissions, and these emissions are not included in the analysis.

It is anticipated that two EMFAC2014 runs, one for year 2025 and one for year 2040, will be needed to obtain annual emission rates for the Build and No Build Scenarios. The output will contain emission rates calculated for truck and non-truck vehicles speeds, ranging from 5 to 80 miles per hour. The analysis will include mainline and ramp links. It is not anticipated that the project will directly or significantly increase volumes on surface streets near the I-405.

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[2]USEPA, AP-42, Fifth Edition, Volume I, Chapter 13: Miscellaneous Sources, Section 13.2.1, Fugitive Dust Sources, Paved Roads.

Tables 1 and **2** show the percent increase in average daily traffic (ADT) volumes for the Alternatives 2 and 3 compared to Alternative 1. For a detailed list of traffic links and data see **Appendix A**.

TABLE 1. ADT AND TRUCK ADT PERCENT INCREASE: ALTERNATIVE 2 COMPARED TO ALTERNATIVE 1 (NO BUILD) TO BE PREPARED AFTER THE TRAFFIC DATA IS FINALIZED.

	2025		2040	
	Bi-Direction		Bi-Direction	
Segment	**ADT**	**Truck ADT**	**ADT**	**Truck ADT**

Source: Parsons, 2016.

TABLE 2. ADT AND TRUCK ADT PERCENT INCREASE: ALTERNATIVE 3 COMPARED TO ALTERNATIVE 1 (NO BUILD) TO BE PREPARED AFTER THE TRAFFIC DATA IS FINALIZED.

	2025		2040	
	Bi-Direction		Bi-Direction	
Segment	**ADT**	**Truck ADT**	**ADT**	**Truck ADT**

Source: Parsons, 2016.

Detailed traffic includes traffic volumes, speeds, and vehicle speciation for peak and off-peak hours. The traffic data is based on the regional travel demand forecasting model that is the basis for air quality conformity determinations. The data splits are for four time periods:

- 3-Hour AM Peak Period (6:00 a.m. – 9:00 a.m.)
- 6-Hour High Off-Peak Period (9:00 a.m. – 3:00 p.m.)
- 4-Hour PM Peak Period (3:00 p.m. – 7:00 p.m.)
- 11-Hour Low Off-Peak Period (7:00 p.m. – 6:00 a.m.)

These data were used to estimate emissions for highway and ramp links (**Appendix B**). Each link represents a change in volumes and/or alignment. Link emissions were estimated based on truck and non-truck emission rates, volumes, and speeds. Hourly truck percentage averages were calculated using the hourly truck and total traffic hourly volumes for the traffic links. Subsequently, four emission rates associated with each peak and off-peak period were estimated for each link. Emissions from the peak and off-peak period were added up to calculate the daily emissions.

Traffic data has been provided for the End of Construction/Open to Traffic (2025) and Last Year Covered in SCAG Regional Transportation Plan (2040) (**Appendix A**). Two factors

determine the amount of emissions: fleet emission rates and traffic volumes. More efficient engines and better emission control technologies will lower vehicular exhaust emission rates while the traffic volumes will grow and increase overall emissions.

An analysis was conducted using project-specific traffic data, EMFAC2014 emission rates, and the AP-42 re-entrained road dust methodology to determine if more emissions are anticipated in 2025 or 2040. **Table 3** represents the results of this analysis. As shown, Alternatives 2 and 3 would emit X and Y percent more emissions in 2040 compared to 2025, respectively. Therefore, only year 2040 will be modeled. The details of this analysis are included in **Appendix B**.

TABLE 3. TOTAL PROJECT EMISSIONS FOR PM_{10} AND $PM_{2.5}$ IN POUND PER DAY

	PM_{10}		$PM_{2.5}$	
Project Alternative	**2025**	**2040**	**2025**	**2040**
Alternative 1 (No Build Alternative)				
Alternative 2				
Alternative 3				

Source: TAHA, 2016.

The construction phase would not last more than five years in one location. The construction emissions will not be included in this analysis per USEPA guidance.

4.2 Dispersion Modeling

The hot-spot analysis will be completed using AERMOD version 15181, which was published on June 30, 2015. Multiple traffic links will be created to represent the northbound and southbound directions. According to the data from the traffic study, the directional links do not start and end at the same point. Therefore, an analysis will be performed using a script developed in R Statistical Package to calculate the localized emissions (pounds per day per mile) as a function of distance (mile) from the beginning of the project alignment on the east (Postmile).[3] The analysis will show total emissions from neighboring segments on both north and southbound directions.

Figures 7 and **8** represent the PM_{10} and $PM_{2.5}$ one-mile moving average (pounds per mile), localized emissions (pounds per mile), and density plot of the emissions (pounds per mile) associated with 2040 traffic data for Alternatives 2 and 3. The one-mile moving average

[3]R Core Team (2014). R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org/.

represents the average per mile of emissions from any given point on the alignment/x-axis to a mile passed that point towards the east.

According to the results, the project emissions would clearly peak between the post miles X and Y. Therefore, this segment, as shown in **Figure 9**, is selected as the modeling segment with the worst-case daily emissions. This segment covers areas neighboring […].**To be prepared after the traffic data is finalized.**

4.2.1 Sources

Vehicular Emissions. The ESRI ArcGIS geographic information system will be utilized for modeling of the sources and receptors. The volume sources will be created for each traffic link identified by a change in traffic volumes, speeds, or highway alignment. Each lane will be modeled as a separate line of volume sources, and each volume source will have a lateral dimension of 24 feet (the lane width multiplied by 2). Modeling freeway lanes separately will result in smaller exclusion zones. Volume source variables will be estimated as follows:

- Release Height = % Trucks × 3.4 + % Non-Trucks × 1.3
- Initial Vertical Dimension = % Trucks × 6.8 meters + % Non-Trucks × 2.6 meters
- Initial Vertical Dispersion Coefficient = Initial Vertical Dimension / 2.15
- Initial Lateral Dimension = 24 feet for each lane of travel
- Initial Lateral Dispersion Coefficient = Initial Lateral Dimension / 2.15

The volume sources representing the freeway lanes will be extended 0.25 miles at the beginning and end of the selected segment in order to avoid underestimating the concentrations at the start and end locations of the segments. The volume sources representing the ramps will be assumed to be an additional lane that extends parallel to the highway main lanes and gradually merges with the rest of the lanes. The volume sources associated with the links will be manually hard-coded in the AERMOD input file using LOCATION and SCRPARAM. The urban source group will have a surface roughness of 0.300 as obtained from the South Coast Air Quality Management District (SCAQMD) website for Mission Viejo Monitoring Station.

4.2.2 Receptors

Receptors will be placed in order to estimate the highest concentrations of $PM_{2.5}$ and PM_{10} to determine any possible violations of the NAAQS. A 25×25 meter receptor grid to a distance of 100 meters from the freeway ROW and a 100×100 meter grid to a distance 500 meters

from the freeway ROW will be used along the alignment for modeling of all the alternatives. A line of receptors will be placed at the ROW line for conformity analysis.

The spacing will vary slightly along the alignment as receptors will be excluded in areas of restricted access to the public. Areas where there is limited, but not restricted public access will not be excluded. If there are exclusions, a list/map containing areas of exclusion will be included in the report.

4.3 Meteorological Data

The CARB and SCAQMD maintain a network of meteorological and air quality monitoring stations located throughout the Basin to measure atmospheric conditions and record pollutant concentrations in the local ambient air. The Basin is divided into 38 source/receptor areas (SRAs). The project corridor extends along 8.5 miles of I-405, which passes through SRA 18 (North Orange County Coastal) and 20 (Central Orange County Coastal). The meteorological/air monitoring stations near the project corridor include:

Mission Viejo – 26081 Via Pera, located approximately 3.5 miles southeast of the eastern terminus of the project corridor in SRA 20. Five years of meteorological data from this location is available for download on the SCAQMD's website. CO, O_3, PM_{10}, $PM_{2.5}$, wind direction, wind speed, outdoor temperature, relative humidity, and barometric pressure are monitored at this station.

Costa Mesa – 2850 Mesa Verde Drive East, located approximately 3.5 miles west of the western terminus of the project corridor in SRA 18. Five years of meteorological data from this location is available for download on the SCAQMD's website. CO, SO_2, NO_2, O_3, PM_{10}, $PM_{2.5}$, wind direction, and wind speed are monitored at this station.

Anaheim – 1630 Pampas Lane, located approximately 10 miles north of the western terminus of the project corridor in SRA 18. Five years of meteorological data from this location is available for download on the SCAQMD's website. CO, NO_2, O_3, PM_{10}, $PM_{2.5}$, wind direction, wind speed, outdoor temperature, relative humidity, barometric pressure are monitored at this station.

Figure 10 shows an overview of the location of the air monitoring stations in relation to the location of project. It also includes overlays of the wind roses plotted for the cities of Mission Viejo, Costa Mesa, and Anaheim along the alignment. **Figures 11, 12,** and **13** represent the same individual wind roses. Various aspects of each monitoring station shown in **Figure 10**

were examined in order to identify the most appropriate meteorological station for the modeling of the project.

Costa Mesa and Mission Viejo Meteorological Stations are closer to the project than the Anaheim Meteorological Station. The Costa Mesa and Mission Viejo Meteorological Stations are located within an approximately 3-mile radius of the alignment. The Anaheim Meteorological Station located approximately 10 miles from the alignment.

The Costa Mesa and Mission Viejo Meteorological Stations are located within urban areas with similar surface characteristics, as shown in **Table 4**. In terms of land use type, 2.5 miles of the project alignment beginning from the west terminus passes through areas of residential, educational, institutional, retail and other commercial land uses as well as John Wayne International Airport. This portion of the alignment is closest to the Costa Mesa Meteorological Station.

TABLE 4. STATUS SUMMARY OF METEOROLOGICAL DATA- PROCESSED BY SCAQMD FOR AERMOD VERSION 15181

Station	Average Wind Speed (m/s)	% Calm Wind	% Data Availability	# of Years Available	Surface Albedo	Surface Roughness (m)	Bowen Ratio
Mission Viejo	1.58	0.02%	99.36%	5	0.18	0.300	1.0
Costa Mesa	1.39	0.40%	98.26%	5	0.18	0.347	1.0
Anaheim	1.88	0.14%	99.04%	5	0.17	0.453	1.0

Source: SCAQMD, 2016.

Moving east, approximately four miles of the alignment is neighboring areas of significant residential land uses and a few undeveloped areas. This portion of the alignment is located to the east of the San Joaquin Hills, and is best represented by meteorological data from the Costa Mesa Meteorological Station. This is due the fact that the width of the area confined by the mountains to the north and San Joaquin Hills to the south decreases to a minimum of five miles where the I-5 and I-405 connects. This sudden change in topography is capable of affecting wind directions as shown by wind rose plots in **Figures 11** through **13**.

The remainder of the alignment, approximately two miles from the east terminus, passes through areas of residential, retail, and commercial land uses. This portion of the alignment is best represented by meteorological data from the Mission Viejo Metrological Station.

Based on the above discussion, meteorological data from either the Costa Mesa or Mission Viejo Metrological Stations will be used for the analysis. This conclusion is based on the distance, prevailing winds patterns, and surface characteristics.

Albedo is a dimensionless quantity which represents the average reflectivity of the surface. Typical values of albedo can range from 0.1 (10 percent reflection) for darkly colored surfaces to 0.9 (90 percent reflection) for white/other bright surfaces. The Bowen ratio is a dimensionless quantity which represents the relationship of the sensible heat flux to the latent heat flux. The amount of soil moisture available for evaporation drives the value of the Bowen ratio, typically ranging from 0.3 for water surfaces to 10 or more for very dry, desert surfaces.[4] The surface roughness length is typically expressed in centimeters or meters and represents the average height of obstructions to wind flow. The values for surface roughness range from 0.001 meter for water surfaces to one meter or more for urban areas. **Table 4** shows the albedo and surface roughness as calculated from the metrological stations. However, the SCAQMD requires a Bowen ratio and surface roughness value of 1.0 for dispersion modeling in the Basin.

In accordance with the hot-spot guidance, five years of processed AERMOD meteorological data will be used for the air dispersion modeling.[5] SCAQMD provides meteorological data that are compatible with the latest version of AERMOD (version 15181) and are developed using site specific surface characteristics (i.e., surface albedo, surface roughness, and Bowen ratio) obtained using AERSURFACE. **Table 4** summarizes the surface characteristics of the meteorological sites.

4.4 Monitoring Activity and Background Concentrations

4.4.1 Monitoring Activity

The USEPA guidance requires that the background concentration be determined based on available measurements for 12 consecutive quarters. Three years of the most recent $PM_{2.5}$ and PM_{10} measurements data were obtained through USEPA's AirData website (http://www.epa.gov/airdata/) for the air monitoring station closest the project modeling segment. **Figure 10** illustrates the locations of the closest air monitoring stations relative to the alignment.

Starting from the eastside of the project location, the Costa Mesa, Mission Viejo, and Anaheim Monitoring Stations are located approximately 3.6, 3.2, and 10.2 miles from the corridor, respectively. However, according to the USEPA AirData website, the Costa Mesa

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[4]Chapin III, F. S., Chapin, M. C., Matson, P. A., & Vitousek, P. (2011). Page 76, Principles of terrestrial ecosystem ecology. Springer.

[5]SCAQMD website, Meteorological Sites, http://www.aqmd.gov/home/library/air-quality-data-studies/meteorological-data/aermod-table-1, accessed Jan 27, 2016.

Monitoring Station does not monitor PM_{10} and $PM_{2.5}$. The next closest monitoring station to the alignment is the Mission Viejo Monitoring Station. Based on the wind rose plots, this monitoring station can be both considered upwind and downwind of the alignment. USEPA AirData website does not specify the measurement scale of the Mission Viejo Monitoring Station. PM_{10} and $PM_{2.5}$ data are available for this air monitoring station.

Table 5 summarizes information from the Mission Viejo and Anaheim Monitoring Stations. **Table 6** summarizes background 24-hour $PM_{2.5}$, annual $PM_{2.5,}$ and 24-hour PM_{10} measurements. The background concentrations are based on the daily $PM_{2.5}$ and PM_{10} concentrations obtained from USEPA website are calculated according to the Transportation Conformity Guidance for PM Hotspot Analysis. Data completeness varies between 17 and 96 percent, depending on the averaging period and the year used.

TABLE 5. PARTICULATE MATTER SAMPLING SITES IN THE VICINITY OF THE PROJECT

Air Monitoring (ID) / CBSA/Address	Measurement Scale (km)	Sampling Duration (hr)	Sampling Frequency	Sample Collection Method	Sample Analysis Method	Monitor Type	FRM / FEM
Mission Viejo (06-059-2022) / Los Angeles-Long Beach-Anaheim/ 26081 Via Pera, Mission Viejo, CA 92691	-	24	Every 6th day	HI-VOL SA/ GMW-1200 (PM_{10})	GRAVIMETRIC	SLAMS	Yes
	-	24	Every 3rd day	Andersen RAAS2.5-300 $PM_{2.5}$ SEQ w/WINS	GRAVIMETRIC	SLAMS	Yes
Anaheim (06-059-0007)/ Los Angeles-Long Beach-Anaheim / 1630 W. Pampas Lane, Anaheim, CA 92802	4 -50	24	Every 6th day	HI-VOL SA/GMW-1200 (PM_{10})	GRAVIMETRIC	SLAMS	Yes
	4 -50	1	Every day	INSTRUMENT MET ONE 4 MODELS (PM_{10})	BETA ATTENUATION	SLAMS	Yes
	4 -50	24	Every 6th day	Andersen RAAS2.5-300 $PM_{2.5}$ SEQ w/WINS	GRAVIMETRIC	SLAMS	Yes

Source: USEPA AirData and TAHA, 2016.

TABLE 6. BACKGROUND CONCENTRATIONS		
Pollutant	**Data Availability/Completeness**	**Background and Design Value Conc. (µg/m^3)**
MISSION VIEJO AIR MONITORING STATION		
24-hour $PM_{2.5}$ Annual $PM_{2.5}$	Daily Mean (95.1%) 1/1/2013-12/31/2015 (3 years)	(98th percentiles) 1st year: 16.9 2nd year: 34.5 3rd year: 15.0 ---------- Design value: 22.1
	Daily Mean (95.1%) 1/1/2013-12/31/2015 (3 years)	9.3 (3-year average)
24-hour PM_{10} 24-hour $PM_{2.5}$	Daily Mean (17%) 1/1/2012-12/31/2014 (3 years)	51 (max 24-hour) Expected exceedance[2]: 0
	Daily Mean (95.1%) 1/1/2013-12/31/2015 (3 years)	(98th percentiles) 1st year: 16.9 2nd year: 34.5 3rd year: 15.0 ---------- Design value: 22.1
ANAHEIM AIR MONITORING STATION		
24-hour $PM_{2.5}$	Daily Mean (88.1%) 1/1/2013-11/30/2015 (3 years)	(98th percentiles) 1st year: 22.6 2nd year: 31.78 3rd year: 29.6 ---------- Design value: 28.0
Annual $PM_{2.5}$	Daily Mean (88.1%) 1/1/2013-11/30/2015 (3 years)	10.1 (3-year average)
24-hour PM_{10}	Daily Mean (96%) 1/1/2012-12/31/2014	122 (max 24-hour) Expected exceedance: 0

Source: USEPA AirData and TAHA, 2016.

The Anaheim Monitoring Station is located approximately 10 miles away from the project alignment and based on its wind rose plot, as shown in **Figure 13**, it is neither upwind nor downwind of the alignment. Although, the USEPA has specified a measurement scale of 4 to 50 kilometers for this monitoring station, considering the prevailing wind directions at this location, the Anaheim Monitoring Station cannot capture the proper background concentrations in the project area. In contrast, the closer Mission Viejo Monitoring Station is able to capture the proper background concentrations in the area. In addition, this monitoring station and the alignment are located in a similar land use composition. Therefore, background concentrations from the closer Mission Viejo Monitoring Station will be used in the modeling.

4.4.2 Background Concentrations and Design Values

The design values necessary to complete the $PM_{2.5}$ and PM_{10} analysis will be calculated using results from AERMOD runs and background concentrations according the Transportation Conformity Guidance for PM Hotspot Analysis.

Design values will be estimated in accordance with the flow chart shown in **Figure 14** for PM_{10} and $PM_{2.5}$. AERMOD will provide the $PM_{2.5}$ and PM_{10} concentrations at each receptor. For the receptor with the maximum modeled concentration, the following steps will be used to determine the design value.

Calculation of Annual $PM_{2.5}$ Design Value

The following steps will estimate the build alternatives annual $PM_{2.5}$ design value at the highest receptor. If the design value is less than the annual $PM_{2.5}$ NAAQS (12.0 $\mu g/m^3$), the project conforms. For each receptor, calculate the average annual concentrations using AERMOD with the air quality modeling results for each quarter and year of meteorological data used (four quarters and five years of meteorological data)

- Identify the receptor with the highest modeled average concentrations;
- Calculate annual average background concentrations;
- Add results from the receptor with highest concentration with the background concentrations; and
- Round to the nearest 0.1 $\mu g/m^3$.

If the calculated design value is more than the annual $PM_{2.5}$ NAAQS, the same calculations will be done for the No Build Alternative using the receptors identified through the modeling of the No Build Alternative. If the build alternative is less than or equal to the No Build Alternative, the project conforms.

Calculation of 24-hr $PM_{2.5}$ Design Value

The following steps will estimate the Build Alternatives 24-hr $PM_{2.5}$ design value at the highest receptor. In order to calculate the 24-hr $PM_{2.5}$ design value, a MySQL script developed by USEPA that is able to calculate the second tier design values will be used. The script simplifies calculation of 24-hr $PM_{2.5}$ design value. The steps involved in the calculations are listed below:

- Identify the receptors with highest average 24-hour contraptions (AERMOD can produce highest average 24-hour concentrations at each receptor);
- Calculate the average 98th percentile 24-hour background from the three most recent years of air quality modeling data;
- Count 24-hour background measurements in each year;
- For each year, rank the eight highest measurements from the highest to the lowest;
- Using a table that is provided in the guidance, the 98th percentile can be extracted from data;
- Add the concentration of the receptors with highest average 24-hour to the average 98th percentile background concentration;
- Round to the nearest whole $\mu g/m^3$ (design value); and
- If design value is less than NAAQS 24-hour $PM_{2.5}$, project conforms.

If the calculated design value is more than the 24-hour $PM_{2.5}$ NAAQS, the same calculations will be done for the No Build Alternative using the receptors identified through the modeling of the No Build Alternative. If the build alternative is less than or equal to the No Build Alternative, the project conforms.

Calculation of 24-hour PM_{10} design value

The following steps will estimate the Build Alternatives 24-hour PM_{10} design value at the highest receptor:

- For each receptor, identify the 6th highest 24-hour concentration across five years of meteorological data (AERMOD)
- Identify the 6th highest of these values
- Identify the highest 24-hour background concentration from the three most recent years of monitoring data
- Add the highest calculated concentration to the highest 24-hour background concentration
- Round to the nearest 10 $\mu g/m^3$
- Identify all receptors with Build Alternative design values > 150 $\mu g/m^3$

If the calculated design value is more than the 24-hour PM_{10} NAAQS, the same calculations will be done for the No Build Alternative. If the build alternative design values are less than or equal to the No Build Alternative, the project conforms.

SOURCE: State of California, Department of Transportation and TAHA, 2016.

Interstate 405 Improvement Project
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FIGURE 1

PROJECT VICINITY

SOURCE: State of California, Department of Transportation and TAHA, 2016.

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FIGURE 2

PROJECT LOCATION MAP

SOURCE: State of California, Department of Transportation and TAHA, 2016.

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FIGURE 3

PROJECT LOCATION MAP

SOURCE: State of California, Department of Transportation and TAHA, 2016.

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FIGURE 4

PROJECT LOCATION MAP

SOURCE: State of California, Department of Transportation and TAHA, 2016.

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FIGURE 5

PROJECT LOCATION MAP

SOURCE: State of California, Department of Transportation and TAHA, 2016.

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FIGURE 6

SOUTH COAST AIR BASIN

Figure 7. PM_{10} Emissions Profiles associated with 2040- Alternatives 2 and 3 Traffic Data To be prepared after the traffic data is finalized.

Figure 8. $PM_{2.5}$ Emissions Profiles Associated with 2040-Alternative 2 and 3 Traffic Data To be prepared after the traffic data is finalized.

Figure 9. Modeling Segment To be prepared after the traffic data is finalized.

SOURCE: State of California, Department of Transportation and TAHA, 2016.

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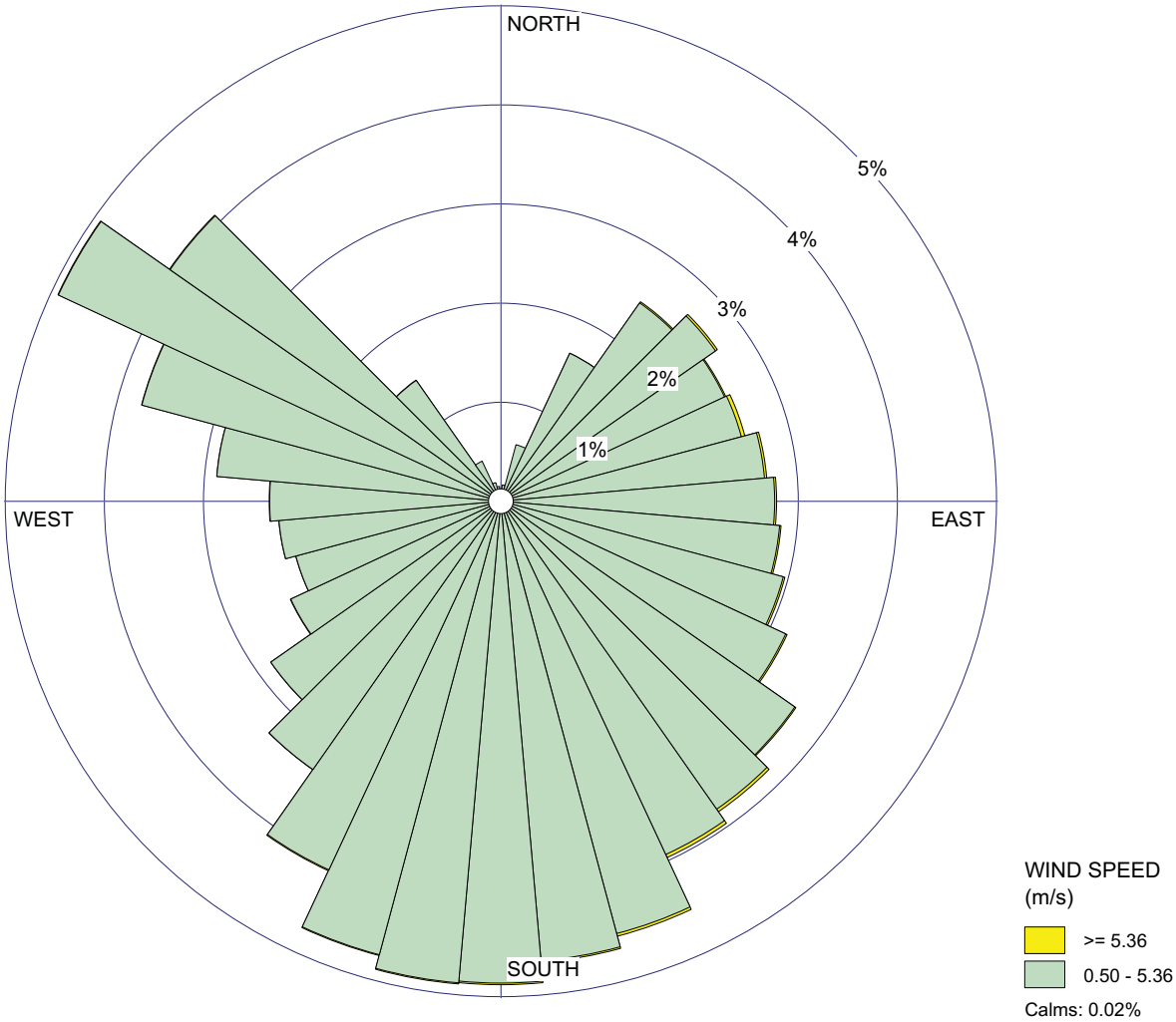
STATE OF CALIFORNIA, DEPARTMENT OF TRANSPORTATION

FIGURE 10

AIR MONITORING/METEOROLOGICAL STATIONS

Figure 11. Mission Viejo Meteorological Station

DISPLAY:
Wind Speed
Direction (blowing from)

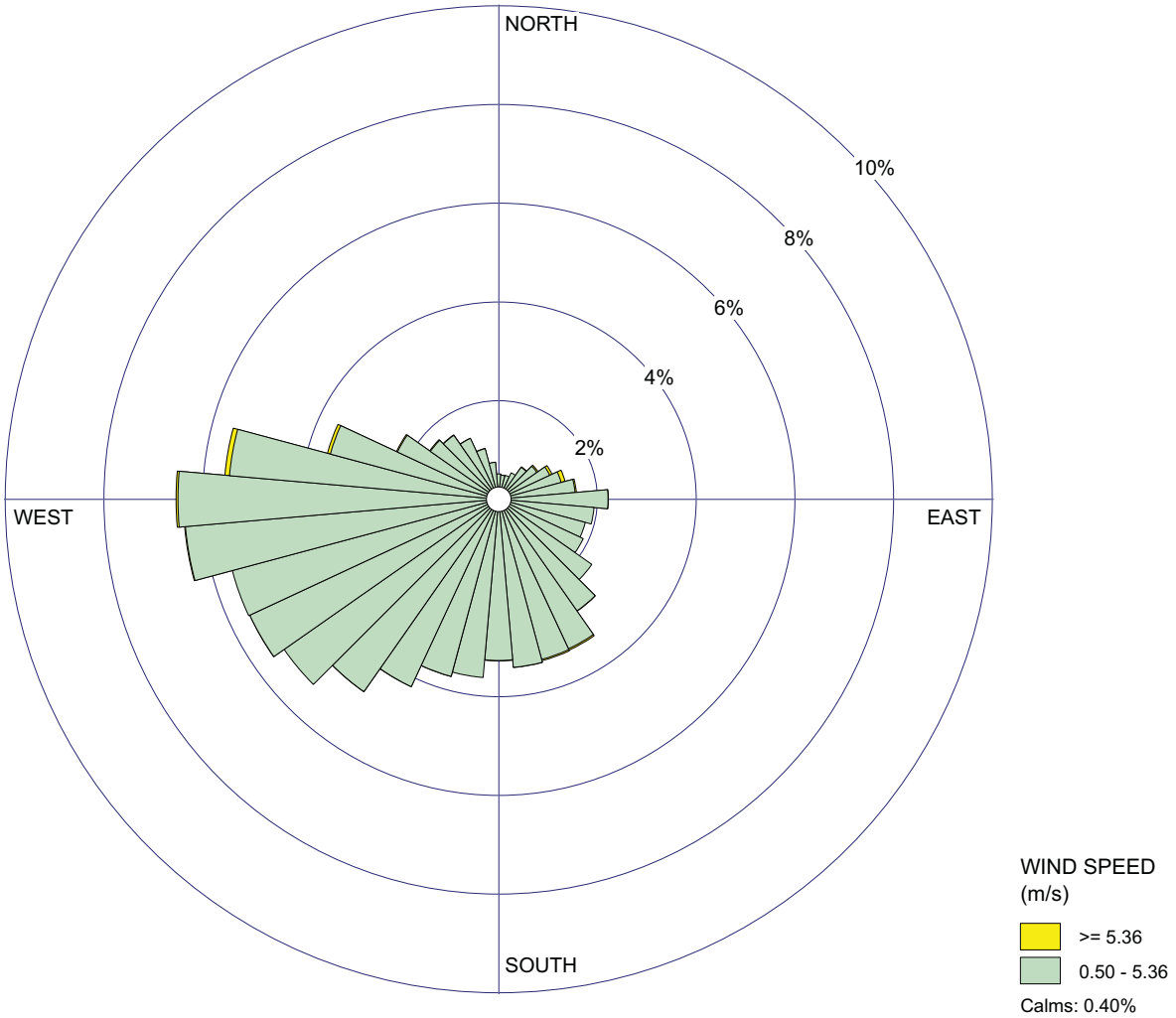


COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/2/2008 - 00:00 **End Date: 12/31/2012 - 23:00**	MODELER:	
	CALM WINDS: **0.02%**	TOTAL COUNT: **43569 hrs.**	
	AVG. WIND SPEED: **1.58 m/s**	DATE: **1/13/2016**	

WRPLOT View - Lakes Environmental Software

Figure 12. Costa Mesa Meteorological Station

DISPLAY:
Wind Speed
Direction (blowing from)

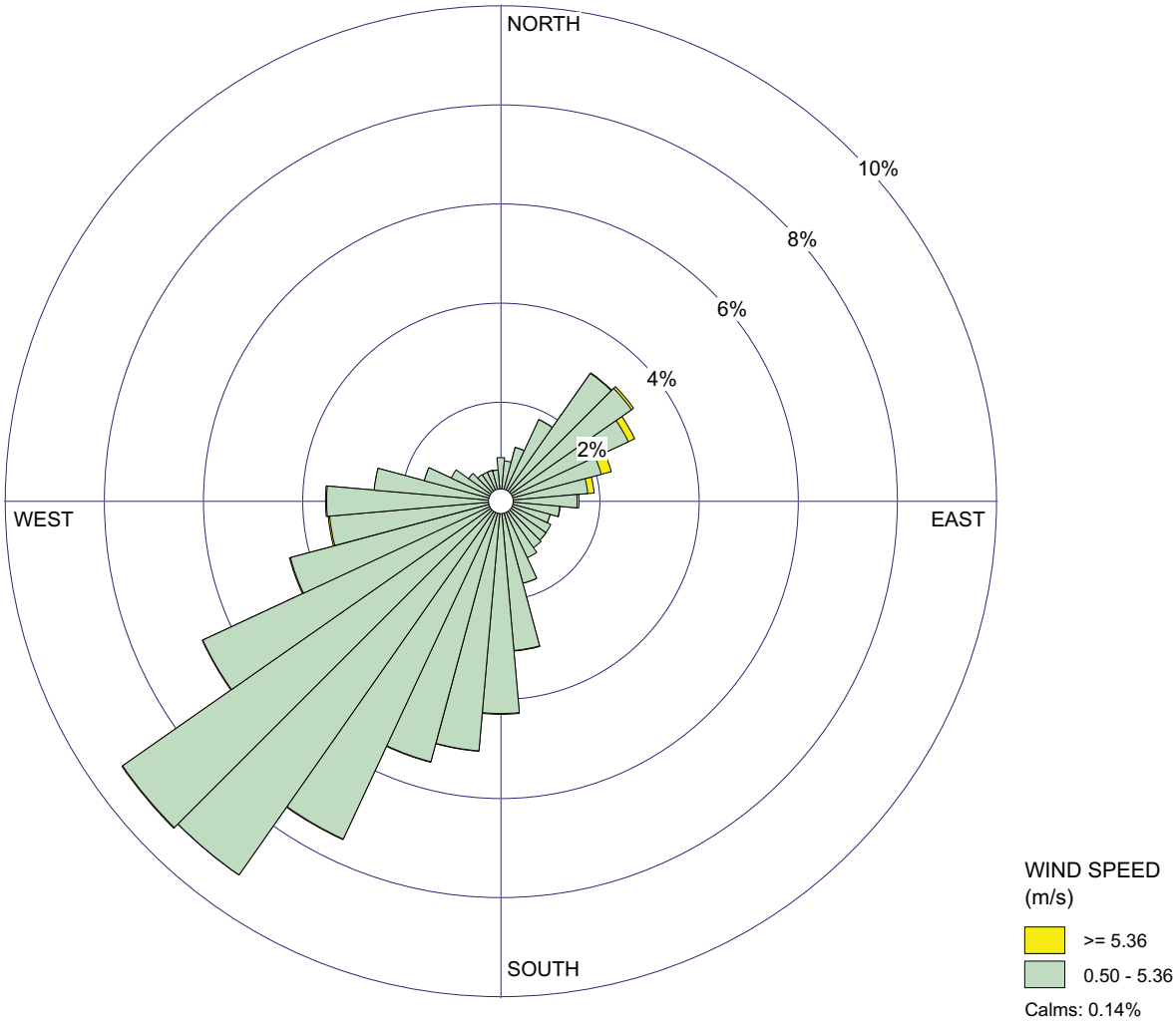


COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2007 - 00:00 **End Date: 12/31/2011 - 23:00**	MODELER:	
	CALM WINDS: **0.40%**	TOTAL COUNT: **43062 hrs.**	
	AVG. WIND SPEED: **1.39 m/s**	DATE: **1/13/2016**	

WRPLOT View - Lakes Environmental Software

Figure 13. Anaheim Meteorological Station

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 1/1/2006 - 00:00 **End Date: 12/31/2012 - 23:00**	MODELER:	
	CALM WINDS: **0.14%**	TOTAL COUNT: **43426 hrs.**	
	AVG. WIND SPEED: **1.88 m/s**	DATE: **1/13/2016**	

WRPLOT View - Lakes Environmental Software

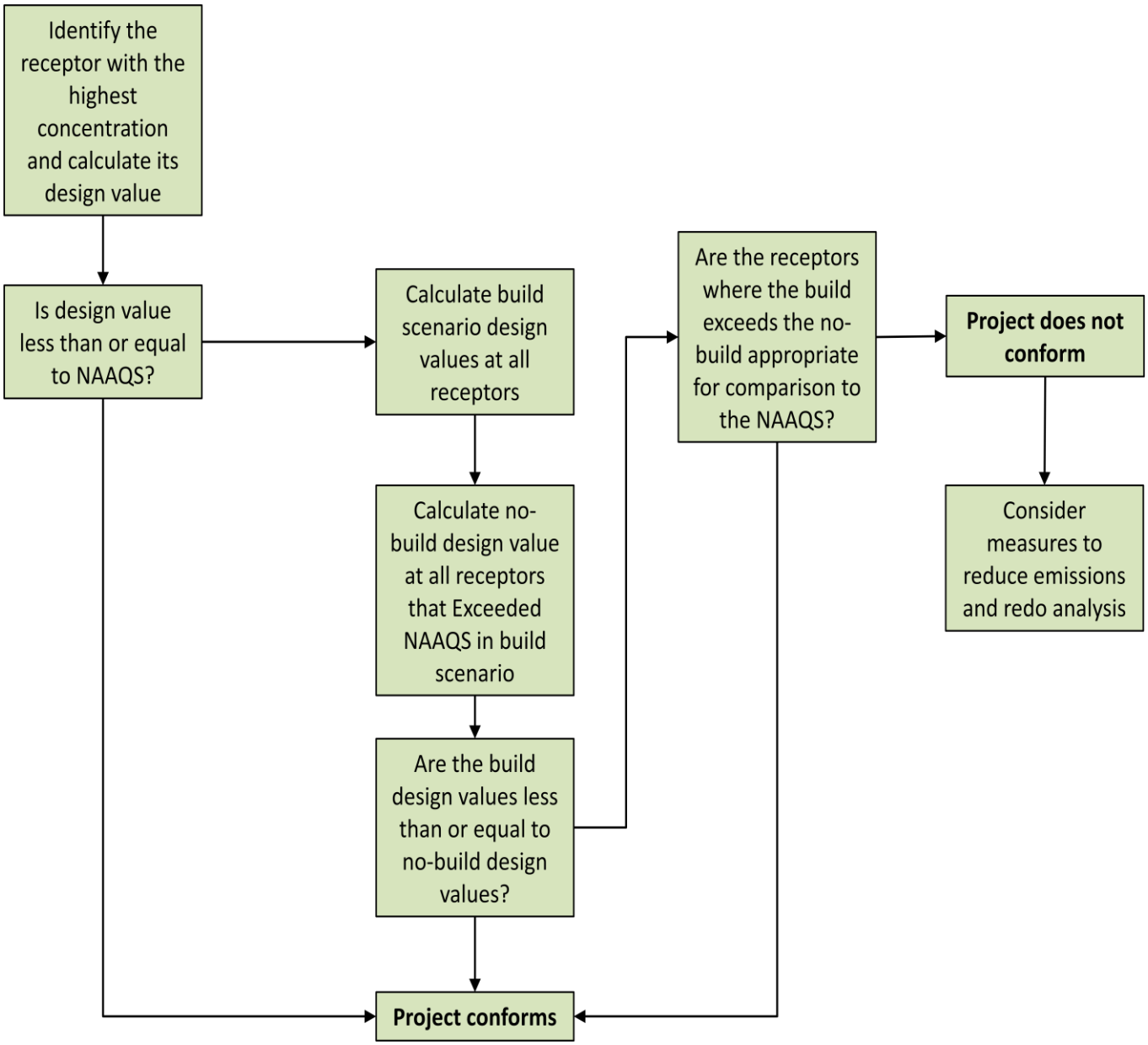



Figure 14. Flow Chart of Calculation of Design Values