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AIR QUALITY MODELING PROTOCOL FOR THE HYDROGEN ENERGY CALIFORNIA (HECA) PROJECT

AIR QUALITY MODELING PROTOCOL FOR THE HECA POWER PROJECT KERN COUNTY, CALIFORNIA

Prepared For:

- San Joaquin Valley Air Pollution Control District

- California Energy Commission

- U.S. Environmental Protection Agency Region IX

- U.S. Forest Service

- National Park Service

Prepared on behalf of

Hydrogen Energy International LLC

February 6, 2009

URS

1333 Broadway, Suite 800
Oakland, CA 94612

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$\mu g/m^3$	Micrograms per cubic meter
AAQS	Ambient Air Quality Standards
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
AFC	Application for certification
APN	Assessor Parcel Number
AQRV	Air quality related values
ARB	Air Resources Board
ARM	Ambient Ratio Method
ATC	Authority to construct
BACT	Best available control technology
BART	Best available retrofit technology
BPAE	BP Alternative Energy
BPIP	Building profile input program
BPIP-Prime	Building Parameter Input Program – Prime
CAAQS	California Ambient Air Quality Standards
CARB	California Air Resources Board
CEC	California Energy Commission
CO	Carbon monoxide
CO_2	Carbon dioxide
CTG	Combustion turbine generator
°C	degrees Celsius
DAT	Deposition analysis threshold
DCS	Distributed Control System
DEGADIS	Dense gas dispersion model
DEM	Digital elevation model
DOC	Determination of compliance
EC	Element carbon
ERC	Emission reduction credit
FLAG	Federal land manager air quality related values group
FLM	Federal Land Manager
°F	Degree Fahrenheit
GEP	Good engineering practice
g/s	Gram per second
H_2S	Hydrogen Sulfide
HARP	Hotspots analysis and reporting program
HECA	Hydrogen Energy California
HEI	Hydrogen Energy Inc
HHV	Higher heating value
HI	Hazard Indices
HNO_3	Nitric acid
HRA	Health risk assessment
HRSG	Heat recovery steam generator
IGCC	Integrated gasification combined cycle
ISCST3	Industrial Source Complex Short Term 3rd version

ISO	International Organization for Standardization
IWAQM	Interagency Workgroup on Air Quality Modeling
km	Kilometers
LAC	Level of acceptable change
LCC	Lambert Conformal Conic
LORS	Laws, ordinances, regulations, and standards
LULC	Land use land cover
MEI	Maximally exposed individual
m	Meters
mm	Millimeters
MICR	Minimum individual cancer risk
MM5	Mesoscale meteorological
MMBtu/hr	Million British thermal unit per hour
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
NH_4NO_3	Ammonium nitrate
$(NH_4)_2SO_4$	Ammonium sulfate
NNSR	Non-attainment New Source Review
NO_2	Nitrogen dioxide
NO_3	Nitrate
NO_x	Nitrogen oxides
NPS	National Park Service
NSR	New source review
NWS	National Weather Service
O_3	Ozone
OEHHA	Office of Environmental Health Hazard Assessment
OLM	Ozone limiting method
Pb	Lead
$PM_{2.5}$	Particulate matter less than 2.5 μm in diameter
PM_{10}	Particulate matter less than 10 μm in diameter
ppb	Parts per billion
ppm	Parts per million
PMS	Particulate Matter Speciation
PSD	Prevention of significant deterioration
PTE	Potential to emit
RH	Relative humidity
ROC	Reactive organic compound
SCR	Selective catalytic reduction
SIL	Significant impact level
SJVAPCD	San Joaquin Valley Air Pollution Control District
SO_2	Sulfur dioxide
SO_x	Sulfur oxides
SOA	Secondary organic aerosol
STG	Steam turbine generator
TAC	Toxic air contaminants

T-BACT	Best available control technology for toxics
TGT	Tail gas treatment
tpy	Tons per year
TSP	Total suspended particles
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
VOC	Volatile organic compound
WRAP	Western regional air partnership
ZOI	Zone of impact

SECTION 1 INTRODUCTION

1.1 BACKGROUND

This document is being submitted to your agency for review and approval. Your agency received a similar document in April 2008 which was commented on and approved. This document was modified from the 2008 version because a new site location about 2.5 km north of the previous site has been selected for the project. All agency comments received for the previous version have been incorporated into this modification. The modeling methodology is unchanged. Ambient monitoring data has been updated.

Hydrogen Energy California (HECA) will be a nominal net 250-megawatt (MW) integrated gasification combined cycle (IGCC) power plant to be constructed on an approximately 1,100-acre parcel near an oil producing area in Kern County, Southern California. The Project will be owned and operated by Hydrogen Energy International LLC, a joint venture of BP Alternative Energy (BPAE) and Rio Tinto. HECA will integrate a gasification block consisting of two active gasification trains (and one spare in hot standby mode) and associated equipment and a power block consisting of one hydrogen-fired or natural gas-fired, or a combination of hydrogen and natural gas, combustion turbine-electrical generator (CTG), duct-fired heat recovery steam generator (HRSG), one condensing steam turbine generator (STG) and associated equipment. HECA will be permitted as a base loaded facility. A blend of petroleum coke and coal or 100 percent petroleum coke will be the primary feedstock to the gasifier. The Carbon Dioxide (CO_2) gas exiting the gasifier will be separated from the hydrogen stream and injected into the nearby oil fields to reduce greenhouse gas emissions from the project and for enhanced recovery of oil. Natural gas will be used in the CTG during startups and at other times in the CTG and the HRSG to supplement the hydrogen fuel. The project will also include an auxiliary CTG for electrical power production for on-site and off-site use. This will be a natural gas-fired simple cycle gas turbine GE model number LMS-100 with an output of approximately 100 MW.

The HECA site area is approximately 543 security fenced acres within a 1,100 acre property located near an oil producing area in Kern County, Southern California. It is 34 km southwest of Bakersfield near Buttonwillow. The parcel is just west of Tupman Road and southeast of the town of Buttonwillow. The legal description of the property is as follows: Southeast ¼ of Section 9 (only the portion north of the West Side Canal), Section 10 (excluding 5 acres in the northwest quadrant), and Section 15 (only the portion north of the West Side Canal) within Township 30 South, Range 24 East in Kern County. The Assessor's Parcel Numbers (APN) are:

- 159-040-02
- 159-040-04
- 159-040-11
- 159-040-16
- 159-040-18
- 159-190-09

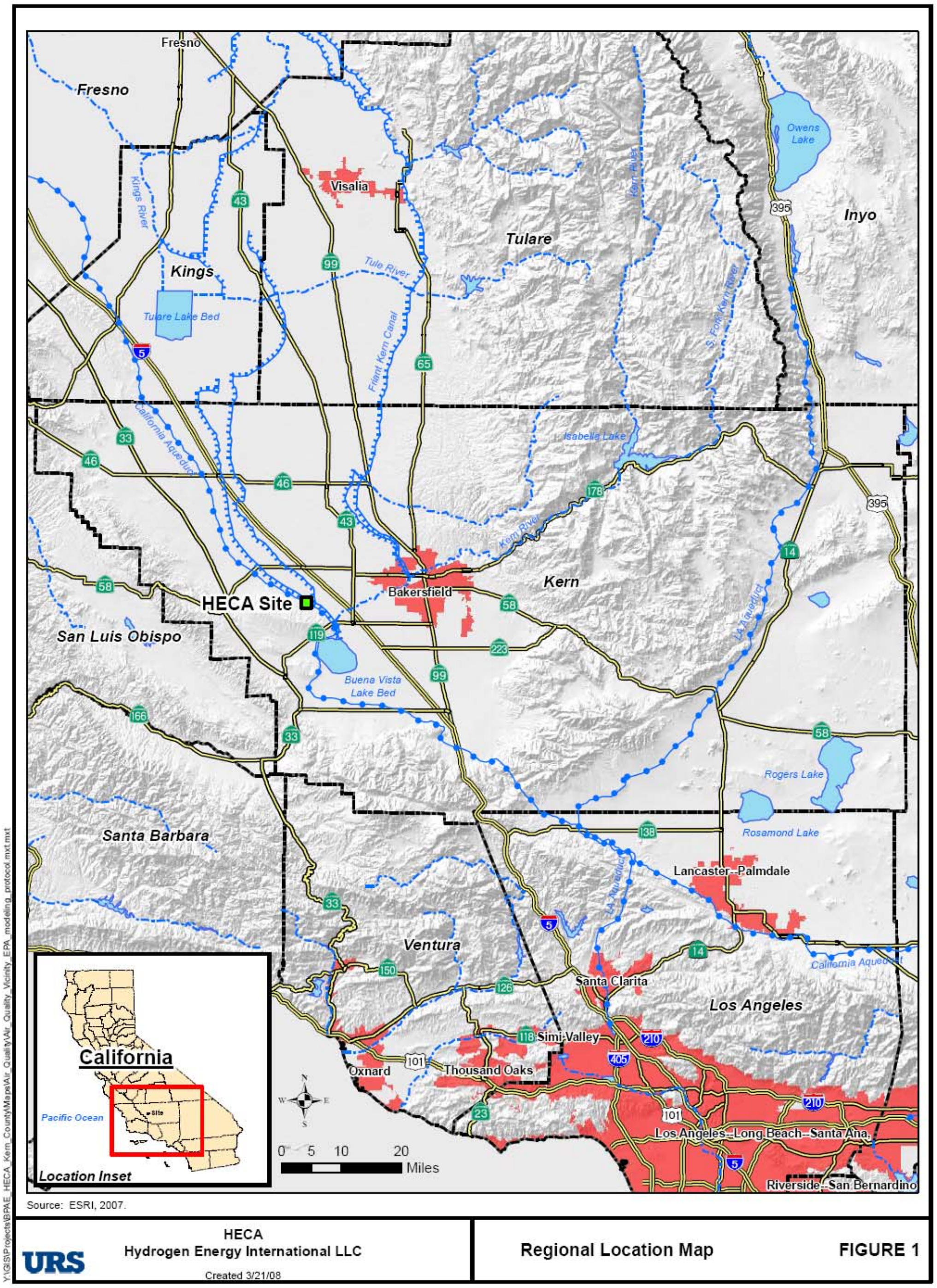
The project is subject to the site licensing requirements of the California Energy Commission (CEC). The CEC will coordinate its independent air quality evaluations with the San Joaquin Valley Air Pollution Control District (SJVAPCD) through the Determination of Compliance (DOC) process. The HECA will be a Major Source as this term is defined in the United States Environmental Protection Agency's (USEPA) Prevention of Significant Deterioration (PSD) regulations, because it is a categorical source (fossil-fuel fired steam electric plant of more than 250 MMBtu/hr heat input), and will have a potential to emit more than 100 tons per year (tpy) of nitrogen oxides (NO_x), particulate matter of diameter less than or equal to 10 microns (PM_{10}) and carbon monoxide (CO). Volatile Organic Compounds (VOC) and sulfur oxides (SO_x) will be emitted in lesser amounts. Because the project will emit more than 100 tpy of at least one attainment pollutant, PSD analyses are also required for any other criteria pollutants for which the proposed facility's Potential to Emit exceeds PSD significant emission levels.

The annual emissions estimates described above are based on the following annual operating parameters:

- One gasification block cold startup and shutdown each year;
- Up to 12 gasifier hot restarts per year;
- Up to 3 cold power block starts, 2 warm power block starts and 5 shutdowns per year of the CTG;
- Up to 7,500 hours/year at steady state operation of the power block;
- Up to 8,520 hours/year operation of the cooling towers;
- Up to 4,000 hours per year operation of the Auxiliary CTG
- Up to 25 percent annual capacity of the auxiliary boiler; and
- Intermittent testing of the emergency diesel generator and the emergency diesel fire pump.

Because the project triggers PSD review, the air dispersion modeling for this project will be conducted in conformance with PSD requirements. For example, worst-case predicted impacts will be compared with the applicable monitoring exemption limits to demonstrate that the project will be exempt from the requirements relating to pre-construction ambient air quality monitoring. The PSD regulations apply only to those pollutants for which the project area is in attainment of the National Ambient Air Quality Standards (NAAQS). State and local new source review (NSR) and non-attainment NSR (NNSR) regulations potentially apply to all criteria pollutants, depending on the quantity of pollutants emitted.

Figure 1
General Vicinity – Hydrogen Energy California



The area around HECA is classified as attainment with respect to the NAAQS for nitrogen dioxide (NO_2), particulate matter with diameter less than 10 micrometers (PM_{10}), CO, and SO_2, and non-attainment for ozone (O_3) and particulate matter with diameter less than 2.5 micrometers ($PM_{2.5}$). With respect to the California Ambient Air Quality Standards (CAAQS), the area around HECA is classified as attainment for NO_2, CO, sulfates, lead (Pb), hydrogen sulfide, and SO_2, and non-attainment for O_3, PM_{10}, and $PM_{2.5}$. NO_2 and SO_2 are regulated as PM_{10} precursors, and NO_2 and volatile organic compounds (VOC) as O_3 precursors. Project emissions of non-attainment pollutants and their precursors will be offset to satisfy federal and local NNSR regulations.

1.2 PURPOSE

The CEC, SJVAPCD and USEPA all require the use of atmospheric dispersion modeling to demonstrate that a new power generation facility or modification to an existing facility will comply with applicable air quality standards. These agencies also require an assessment of the potential impacts on human health from the toxic air contaminants that may be emitted by such projects. In addition, CEC power plant siting regulations require modeling to evaluate the cumulative impacts of the proposed project with other new and reasonably foreseeable projects within 10 km (6 miles) of the project site.

This document summarizes the procedures that are proposed for the air dispersion modeling for project certification and permitting. Modeling of both operation and construction emissions due to the proposed power plant will be performed in accordance with CEC and SJVAPCD guidance. This Protocol is being submitted to the CEC and SJVAPCD for their review and comment prior to completion of the applicable permit applications. The Protocol is also being provided to USEPA Region IX, U.S. Forest Service and National Park Service, because of the need to obtain a separate PSD permit for the proposed project. The proposed model selection and modeling approach is based on review of applicable regulations and agency guidance documents, and recent discussions with staffs of the responsible agencies.

SECTION 2 PROJECT DESCRIPTION

2.1 PROJECT LOCATION

The location of the proposed project is shown on Figure 1, which also illustrates the project site, and nearby roads and other features. The HECA site is approximately 1,100 acres in size. The site is accessible from Bakersfield via State Highway 119 westbound and west of Tupman Road.

2.2 DESCRIPTION OF THE PROPOSED SOURCES

Figure 2 shows the preliminary layout of the proposed power plant, including property lines and the locations of all major equipment. The process diagram of the project is shown in Figure 3. Emission points are identified on Figure 2 by number and shown in the legend. These numbers are used in the discussions below.

The proposed power generation facility (power block) will consist of one GE Model 7FB or equivalent Siemens CTG with an ISO base load gross output of approximately 230 MW. The CTG will be designed and constructed to burn multiple fuels (i.e., a combination of fuels ranging from hydrogen to pipeline-quality natural gas and mixtures of the two) with an evaporative cooling system installed on the inlet air for use when the ambient temperatures exceed 59°F. The CTG will be followed by a Heat Recovery Steam Generator (HRSG). The HRGS will also be designed to burn the same multiple fuels as the CTG. The maximum fuel flow rate for the CTG and HRSG will be approximately 1,850 MMBtu/hr and 500 MMBtu/hr (higher heating value, HHV), respectively. Exhaust from the CTG/HRSG will exit through a stack with a height of 213 feet (Emission Point No. 4).

An air/nitrogen mixture is supplied to the CTG through an inlet air filter, inlet air evaporative cooling system, compressor section of the combustion turbine and then exits through the compressor discharge casing to the combustion chambers. Fuel is also supplied to the combustion chambers where it is ignited with the compressed air/nitrogen mixture, expanding through the turbine blades, driving the turbine, electricity generator, and the CTG compressor. Exhaust gas from the CTG is directed through internally insulated ductwork to the HRSG. Steam generated in the HRSG is admitted to a steam turbine generator (STG) for electric power generation. The STG system, rated at approximately 150 MW consists of a steam turbine, gland steam system, lube oil system, hydraulic control system, and a hydrogen cooled generator with all required accessories.

A diffusion combustor system using nitrogen as a diluent when firing hydrogen and using steam as a diluent when firing natural gas will be used to control the NO_X emissions from the CTG. A selective catalytic reduction (SCR) system will be provided in the HRSG to further reduce the NO_X emissions to the atmosphere. The SCR system for the HRSG will inject aqueous ammonia into the exhaust gas stream upstream of a catalyst bed to reduce NO_X to inert nitrogen and water. An oxidation catalyst system will also be incorporated into the air quality control system to control emissions of CO and ROGs.

The auxiliary CTG will be fired exclusively on natural gas and will be equipped with water injection and selective catalytic reduction (SCR) for the control of NO_x emissions and an oxidation catalyst for control emissions of CO and ROGs. The auxiliary CTG will operate in simple cycle mode and will have an exhaust stack with a height of 110 feet (Emission Point No. 12).

An auxiliary boiler (Emission Point No. 6) will provide steam to facilitate CTG startup and for other purposes. The auxiliary boiler will be designed to burn a single fuel (i.e., pipeline-quality natural gas) at the design maximum fuel flow rate of 142 MMBtu/hr HHV. The auxiliary boiler will be equipped with ultra-low NO_X combustors and will have an estimated annual capacity of 25 percent.

HECA will also incorporate a thermal oxidizer (Emission Point No. 7) on the tail gas treatment (TGT) unit to control emissions during startup of the TGT unit. After the TGT unit is started, emissions from the TGT thermal oxidizer will cease being emitted and will be returned to the process. A Gasification Flare (Emission Point No. 10) will be used to safely dispose of gas streams during startup, shutdown and unplanned upsets or emergency events. A Sulfur Recovery Unit (SRU) Flare (Emission Point No. 9) will be used to safely dispose of gas streams containing sulfur during startup and shutdown (such streams having first passed through an absorber or scrubbing unit for sulfur removal) and gas streams containing sulfur during unplanned upsets or emergency events. A Rectisol Flare (Emission Point No. 13) will be used to safely dispose of low temperature gas streams during unplanned upsets or emergency events.

Each of the three gasification trains will have one natural-gas fired burner used to warm up the gasification train upon start-up (Emission Point Nos. 11a -11c). These burners will not operate when the gasification train is operating.

A 16-celled mechanical draft cooling tower (Emission Point No. 2) will be installed to perform the required cooling for the CTGs, STG, and associated equipment. Other sources of emissions will include a 4-celled mechanical draft cooling tower for the air separation unit (Emission Point No. 1), diesel-fired internal combustion engine drivers for an emergency fire pump rated at about 550 horsepower (Emission Point No. 5), and two 1 MW each emergency generators (Emission Point No. 3).

A CO_2 vent stack (Emission Point No. 8) will provide an alternative operating scenario for releasing the produced CO_2 when the CO_2 injection system is unavailable. The CO_2 vent will enable HECA to operate for brief periods rather than be disabled by a gasifier shutdown and subsequent gasifier restart. The CO_2 vent exhaust stream will be nearly all CO_2, with small amounts of CO and Hydrogen Sulfide (H_2S).

In addition to the sources above, there will be emissions of PM_{10} from feedstock and gasifier solids materials handling operations. These operations include bulk material unloading, loading, belt conveying, belt transfer points, silo loading and reclaim. The PM_{10} emissions will be controlled with the help of a dust collection system consisting of hoods and baghouses.

Figure 2
HECA Facility Plot Plan

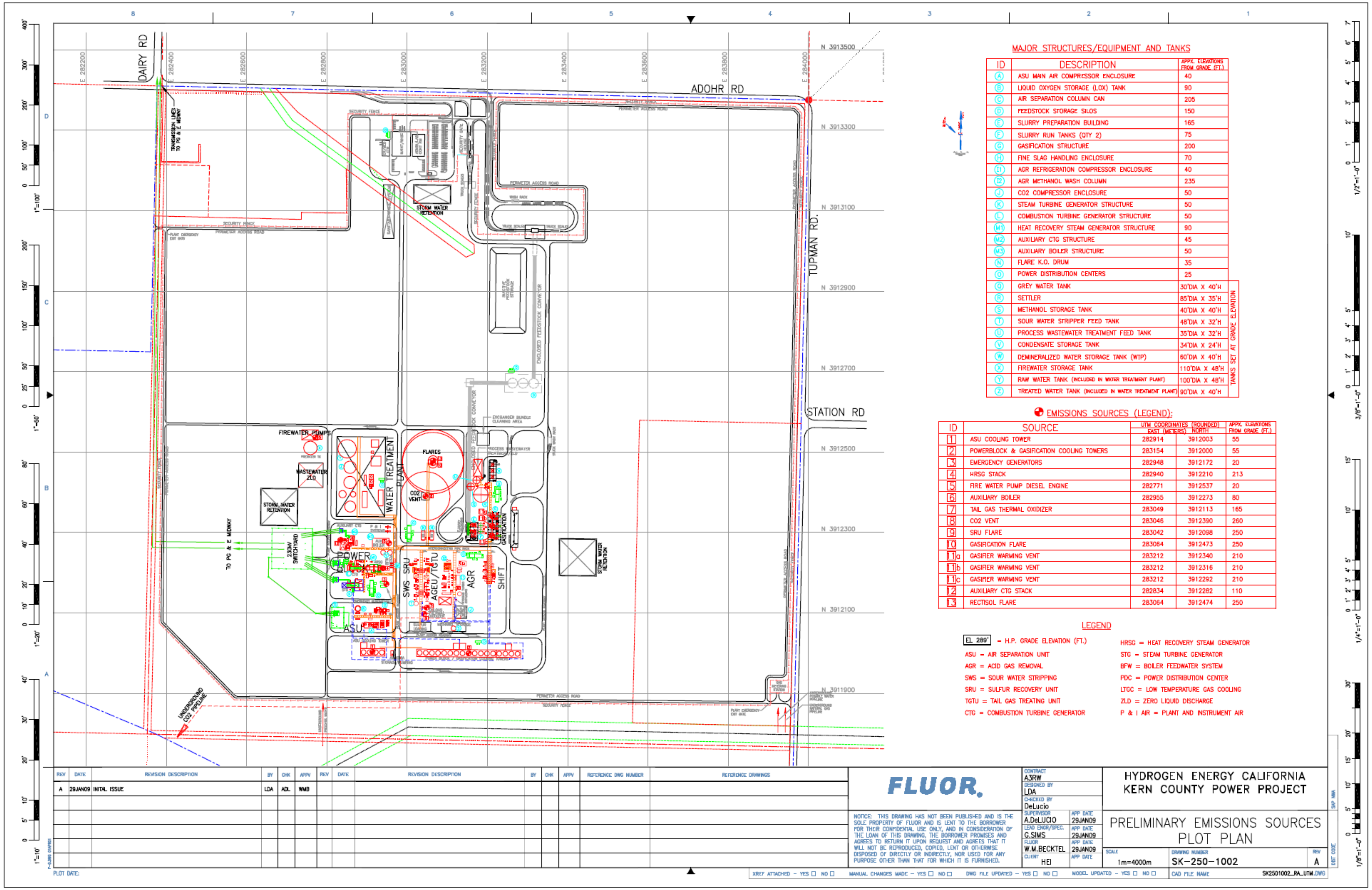
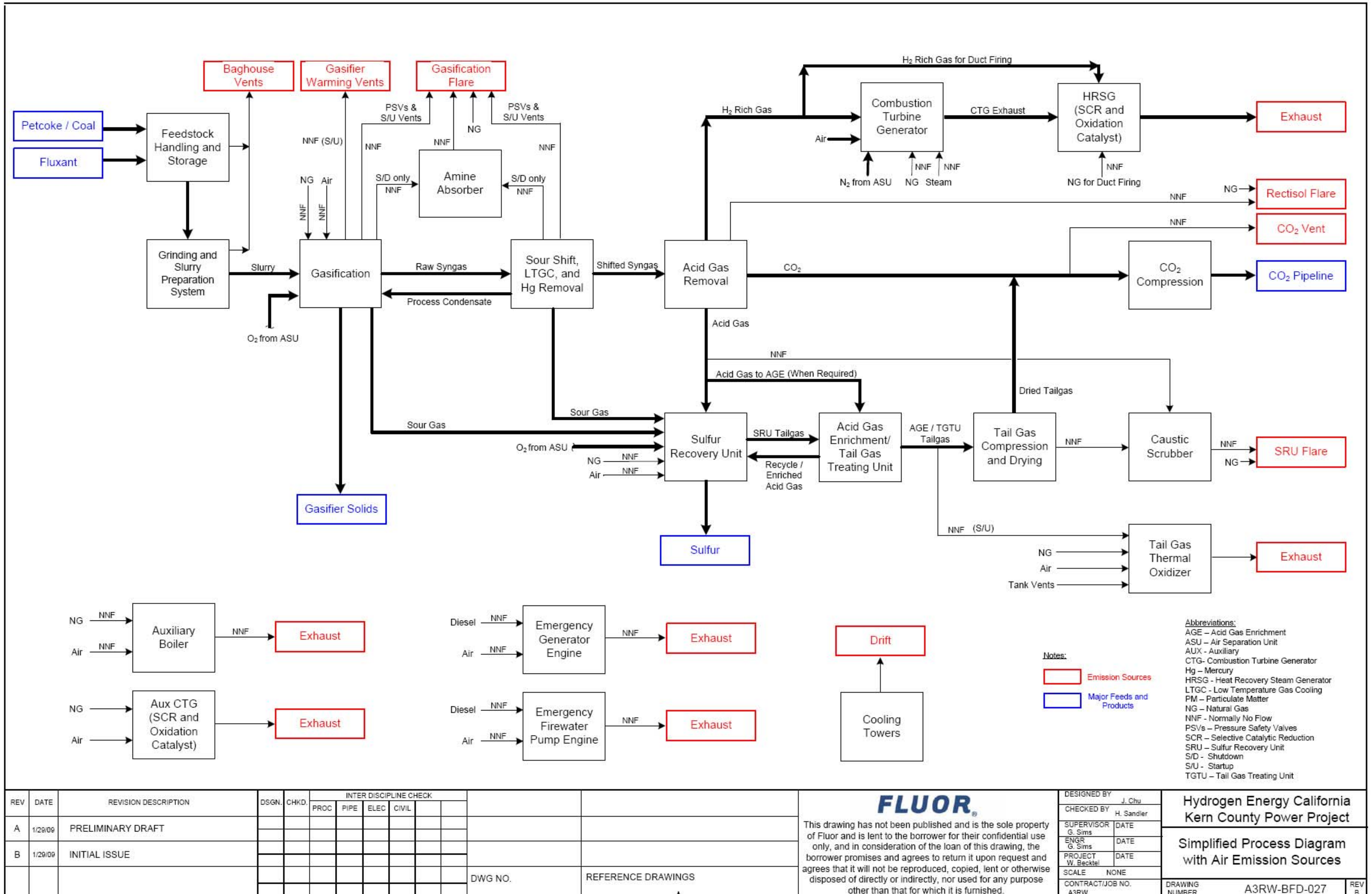


Figure 3
HECA Process Diagram



SECTION 3 REGULATORY SETTING

3.1 CALIFORNIA ENERGY COMMISSION REQUIREMENTS

For projects with electrical power generation capacity greater than 50 MW, CEC requires that applicants prepare a comprehensive Application for Certification (AFC) document addressing the proposed project's environmental and engineering features. An AFC must include the following air quality information (CEC, 1997):

- A description of the project, including project emissions of air pollutants and greenhouse gases, fuel type(s), control technologies and stack characteristics;
- The basis for all emission estimates and/or calculations;
- An analysis of Best Available Control Technology (BACT) according to San Joaquin Valley Air Pollution Control District (SJVAPCD) Rules;
- Existing baseline air quality data for all regulated pollutants;
- Existing meteorological data, including temperature, wind speed and direction, and mixing height;
- A listing of applicable laws, ordinances, regulations, standards (LORS), and a determination of compliance with all applicable LORS;
- An emissions offset strategy;
- An air quality impact assessment (i.e., national and state ambient air quality standards [AAQS] and PSD review) and protocol for the assessment of cumulative impacts of the proposed project along with permitted and under construction projects within a 10 km radius; and
- An analysis of human exposure to air toxics (i.e., health risk assessment [HRA]).

For HECA, the air quality impact assessment, the cumulative impacts assessment, and the HRA will be performed using dispersion models.

3.2 SAN JOAQUIN VALLEY AIR POLLUTION CONTROL DISTRICT REQUIREMENTS

The SJVAPCD has promulgated NSR requirements under Rule 2201. In general, all equipment with the potential to emit air pollutants is subject to the requirements of this rule, which has the following major requirements that potentially apply to new sources such as HECA:

- Installation of BACT,
- Ambient air quality impact modeling to demonstrate compliance with NAAQS and CAAQS and to evaluate impacts to plume visibility in Class I areas near the proposed source(s),
- Emission offsets,
- Statewide compliance for all applicant-owned or operated facilities in California,

Assembly Bill 2588, California Air Toxics Hot Spots Program and SJVAPCD Rule 3110 establish allowable incremental health risks for new or modified sources of toxic air contaminant (TAC) emissions This rule specifies limits for maximum individual cancer risk (MICR), cancer burden, and non-carcinogenic acute and chronic hazard indices (HI) for new or modified sources of TAC emissions. The health risks resulting from project emissions, as demonstrated by means of an approved health risk assessment, must not exceed established threshold values.

3.3 U.S. ENVIRONMENTAL PROTECTION AGENCY REQUIREMENTS

USEPA has promulgated PSD regulations applicable to new Major Sources and Major Modifications to existing Major Sources. HECA will be a Major Source because it is a fossil-fuel fired steam electric plant of more than 250 MMBtu/hr heat input and will have the potential to emit more than 100 tpy of NO_x, and CO. Many of the PSD requirements are the same as the AFC and SJVAPCD Rule 2201 requirements described above (e.g., project description, BACT, ambient air quality standards analysis). However, PSD requires the following additional analyses:

- An analysis of the potential impacts from the new emissions from HECA relative to PSD Significant Impact Levels (SILs) and PSD Increments;
- An analysis of air quality related values (AQRV) to ensure the protection of visibility in federal Class I National Parks and National Wilderness Areas within 100 km of the proposed project;
- An evaluation of potential impacts on soils and vegetation of commercial and recreational value; and
- An evaluation of potential growth-inducing impacts.

SECTION 4 AIR QUALITY IMPACT ANALYSIS FOR CLASS II AREAS

This section describes the dispersion models and modeling techniques that will be used in performing the near-field criteria pollutant impact analysis for HECA. The objectives of the modeling are to demonstrate that air emissions from HECA will not cause incremental impacts that exceed the Class II PSD Significant Impact Levels (SILs), nor contribute to exceedances of state and federal ambient air quality standards. A discussion of the Class II visibility analysis for the visible plumes from the cooling towers and the HRSG will be provided in the Visual Resources Section (Section 5.11) of the AFC.

In November 2005, the USEPA officially recognized the American Meteorological Society/ Environmental Protection Agency Regulatory Model (AERMOD) as the preferred dispersion model for regulatory applications, replacing the Industrial Source Complex Short Term 3 (ISCST3) model. Also, both CEC staff recommendations and the SJVAPCD guidance for air dispersion modeling (SJVAPCD, 2006) support the use of AERMOD for power plant licensing/permitting analyses. Accordingly, AERMOD (Version 07026) will be used for the dispersion modeling associated with HECA.

4.1 TURBINE SCREENING MODELING

An initial screening modeling analysis will be conducted to determine the turbine stack parameters for the most important project source, i.e., the CTG/HRSG that correspond to maximum ground-level pollutant concentrations. This information will be obtained by running a series of AERMOD simulations with the full meteorological input data set (see Section 4.6) with source inputs representing a range of different load conditions and ambient temperatures. The stack parameters that align with the highest offsite impact from these sources for each pollutant and averaging time period will be used in the subsequent refined modeling simulations.

4.2 REFINED MODELING

The purpose of the refined modeling analysis is to demonstrate that air emissions from HECA will not cause or contribute to an ambient air quality violation. The AERMOD model (version 07026) will be used for the refined modeling of criteria pollutants. Specific modeling procedures that will be used for evaluating project impacts versus the state and federal ambient air quality standards, PSD significance thresholds and applicable health risk criteria are discussed below. Table 4-1 shows the regulatory criteria that will be used to evaluate the significance of predicted pollutant concentrations.

Analysis of land uses adjacent to HECA was conducted in accordance with Section 8.2.8 of the Guideline on Air Quality Models (EPA-450/2-78-027R and Auer [1978]), EPA AERMOD implementation guide (2004), and its addendum (2006).

Based on the Auer land use procedure, more than 50 percent of the area within a 3-km radius of HECA power plant is classified as rural. Since the Auer classification scheme requires more than 50 percent of the area within the 3-km radius around a proposed new source to be non-rural for an urban classification, the rural mode will be used in the AERMOD modeling analyses. All regulatory default options will be used, including building and stack tip downwash, default wind speed profiles, exclusion of deposition and gravitational settling, consideration of buoyant plume rise, and complex terrain.

Table 4-1
Relevant Ambient Air Quality Standards and Significance Levels

Pollutant	Averaging Time	CAAQS (a, b)	NAAQS (b, c)	PSD Class II Significance Impact Levels (μg/m³)	PSD Significant Emission Rates (tpy)	PSD Increments (μg/m³)	
						Class I	Class II
CO	8-hour	9.0 ppm (10,000 μg/m³)	9.0 ppm (10,000 μg/m³)	500	100		
	1-hour	20 ppm (23,000 μg/m³)	35 ppm (40,000 μg/m³)	2,000			
NO_2[(d)]	Annual	0.030 ppm (57 μg/m³)	0.053 ppm (100 μg/m³)	1	40	2.5	25
	1-hour	0.18 ppm (339 μg/m³)					
SO_2	Annual		0.03 ppm (80 μg/m³)	1	40	2	20
	24-hour	0.04 ppm[(e)] (105 μg/m³)	0.14 ppm (365 μg/m³)	5		5	91
	3-hour		0.5 ppm (1,300 μg/m³)	25		25	512
	1-hour	0.25 ppm (655 μg/m³)					
PM_{10}	Annual	20 μg/m³	See footnote[(e)]	1	15	4	17
	24-hour	50 μg/m³	150 μg/m³	5		8	30
$PM_{2.5}$	Annual	12 μg/m³	15 μg/m³				
	24-hour		35 μg/m³				
O_3	8-hour	0.07 ppm (137 μg/m³)	0.075 ppm (147 μg/m³)	See footnote[(f)]			
	1-hour	0.09 ppm (180 μg/m³)	See footnote[(g)]				
H_2S	1-hour	0.03 ppm[(h)]					

Notes:

a. California standards for ozone (as volatile organic compound), carbon monoxide, sulfur dioxide (1-hour), nitrogen dioxide, and PM_{10}, are values that are not to be exceeded. The visibility standard is not to be equaled or exceeded.

b. Concentrations are expressed first in units in which they were promulgated. Equivalent units are given in parentheses and based on a reference temperature of 25°C and a reference pressure of 760 mm of mercury. All measurements of air quality area to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of mercury (1,013.2 millibars).

c. National standards, other than those for ozone and based on annual averages, are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is ≤ 1.

d. NO_2 is the compound regulated as a criteria pollutant; however, emissions are usually based on the sum of all NO_x.

e. The federal annual PM_{10} standard was revoked by USEPA on October 17, 2006.

f. Modeling is required for any net increase of 100 tons per year or more of ROC subject to PSD.

g. New federal 8-hour ozone and fine particulate matter ($PM_{2.5}$) standards were promulgated by USEPA on July 18, 1997. The federal 1-hour ozone standard was revoked by USEPA on June 15, 2005.

h. The Hydrogen Sulfide ambient air quality standard is an odor based threshold instead of health based.

4.2.1 PSD Modeling Analyses

As the proposed project will trigger PSD as a Major Source, modeling will be required to determine whether its incremental impacts on ambient levels of attainment pollutants (NO_2, SO_2 and CO) will exceed Class II significant impact levels, or SILs. If these SILs were predicted to be exceeded, then an analysis of increment consumption due to all new sources that commenced operation since the local PSD baseline date would be required. However, it is anticipated that the increased emissions of these pollutants due to HECA will not cause incremental effects above the federal SILs.

4.2.2 Ambient Air Quality Standards Analysis

Compliance with the SJVAPCD Rule 2201 modeling requirements for attainment pollutants will be demonstrated by modeling the maximum ground-level concentrations of the proposed Project at any receptor and adding conservative background concentrations, based on recent data from the most representative SJVAPCD air quality monitoring station. HECA will not be considered to cause or contribute to a near-field ambient air quality violation unless impacts from these sources combined with the background concentration exceed the most stringent ambient air quality standard.

NO_2 impact estimates for both the 1-hour and annual averaging times will be modeled by executing AERMOD with the USEPA ozone limiting method (OLM) option for both hourly and annual impacts. Please note that OLM will use ozone data from 2000-2004, which corresponds to the same range of years that was used for the meteorological data.

Note that emissions reduction credits will be obtained by the applicant to offset Project emissions increases of all non-attainment pollutants and their precursors, i.e. NO_x, ROG, PM_{10} and SO_2 that are above the SJVAPCD offset triggering levels specified in the Districts Rule 2201.4.5.3.

4.2.3 Health Risk Assessment Analysis

Both CEC and SJVAPCD require a health risk assessment (HRA) to evaluate potential health effects of TAC emissions from the operation of the project. Contaminants emitted by the project with potential carcinogenic effects or chronic and/or acute non-carcinogenic effects will be considered. This health risk assessment will be performed following the Office of Environmental Health Hazard Assessment (OEHHA), *Air Toxics Hot Spots Program Risk Assessment Guidelines (OEHHA, 2003)*. As recommended by the *Guidelines*, the California Air Resources Board (CARB) Hotspots Analysis and Reporting Program (HARP) (CARB, 2005) will be used to perform an OEHHA Tier 1 health risk assessment for the project. HARP includes two modules: a dispersion module and a risk module. The HARP dispersion module incorporates the USEPA ISCST3 air dispersion model, and the HARP risk module implements the latest Risk Assessment Guidelines developed by OEHHA. For consistency with the criteria pollutant modeling, the dispersion modeling will be conducted with AERMOD. ARB has created a beta version software package, HARP File Converter, to convert AERMOD dispersion results into a format that can be read into the HARP risk module. Thus HARP with AERMOD will be used for this HRA.

First, ground-level concentrations from HECA emissions will be estimated using the AERMOD dispersion model. The dispersion modeling analysis will be consistent with, and use input parameters that are similar to those discussed above for the criteria pollutant analyses using AERMOD. The same five-year Bakersfield meteorological data set that will be used for the criteria pollutant air quality impact assessment will also be used in the HRA. The maximum 1-hour and annual impacts determined by AERMOD will be used in the HARP model to estimate the corresponding health risks. Receptor spacing will be the same as for the criteria pollutant modeling described later in this Protocol. The HARP simulations will also include the census receptors out to 10 km, and additional receptors will be placed at all sensitive locations (e.g., schools, hospitals, etc.) out to a distance of 5 km (3 miles). Receptors will also be placed at all nearby residents.

Incremental cancer risk will be estimated using the "Derived (Adjusted)" calculation method in HARP. For the calculation of cancer risk, the duration of exposure to project emissions will be assumed to be 24 hours per day, 365 days per year, for 70 years, at all receptors. Chronic non-cancer risks will be calculated by means of the "Derived (OEHHA)" method. No bodies of water are near HECA , thus fish ingestion and drinking water consumption pathways will not be included in this analysis.

The HRA performed by means of the HARP model will follow the following steps:

- Define the location of the maximally exposed individual (MEI) (i.e., the location where the highest carcinogenic risk may occur);
- Define the locations of the maximum chronic non-carcinogenic health effects and the maximum acute health effects;
- Calculate concentrations and health effects at locations of maximum impact for each pollutant; and
- Calculate cancer burden if the maximum cancer risk is predicted to be greater than one in a million.

4.3 MODELING EMISSIONS INVENTORY

4.3.1 Operational Project Sources

Operational emissions from the project will be dominated by the CTG with HRSG. Conceptual plant design includes SCR for NO_x and oxidation catalysts for CO that will comply with recent BACT determinations for similar IGCC projects recently permitted in United States. Emissions of SO_2 and PM_{10} will be maintained at low levels, owing to HECA commitment to have SO_2 and PM_{10} emissions comparable to a similarly sized integrated gasification combined cycle power plant having exclusive use of hydrogen as fuel for the gas turbine. Table 4-2 summarizes the estimated annual emissions from the main project sources for each criteria pollutant. The CTG and HRSG emissions estimates reflect the assumed operating hours and numbers of turbine startups described in Section 1.1. Table 4-2 does not include the small contributions to project emissions that will come from the one emergency diesel generator and the one emergency firewater pump engine, or the startup emissions from the thermal oxidizer and the three flares. The engines will normally be operated only a few hours per year in order to test their operability in the event of an emergency situation. The thermal oxidizer and the three flares will have only pilot flame emissions during normal operation. However, non-emergency emissions from these engines, the thermal oxidizer and the three flares will be included in the dispersion modeling conducted for HECA. A more detailed explanation of the sources and their operations including startup will be provided in AFC Section 2: Project Description and Section 5.1: Air Quality and in the Air Quality Appendix C.

Table 4-2
Approximate Annual Pollutant Emissions for HECA Turbine/HRSG, Auxiliary CTG, Auxiliary Boiler, and the Cooling Towers at Steady State Operation

Pollutant	Annual Emissions (tpy)				
	Turbine/HRSG (1)	Auxiliary CTG	Auxiliary Boiler	Cooling Towers(2)	Total HECA Emission Approximation *
NO_x	169	17	2	0	< 250
CO	132	28	6	0	> 250
SO_2	28	2	0	0	<50
PM_{10}	99	21	0	24	< 250
VOC	31	5	1	0	<50

Note: * Total HECA emission approximations include bulk materials handling dust emissions and fixed duration events such as startups and shutdown

Note: Auxiliary CTG is used to supply additional peaking power for HECA and for external use.

(1) Total annual HRSG emissions represents the maximum emissions rate from a composite firing scenario (all three fuels)

(2) Includes contributions from all three cooling towers

4.3.2 Project Construction Sources

Temporary construction emissions will result from heavy equipment exhaust (primarily NO_x and diesel particulate emissions) and fugitive dust (PM_{10}) from earthmoving activities and vehicle traffic on paved and unpaved surfaces. A detailed Excel Workbook will be created to estimate criteria pollutant emissions for non-overlapping phases of Project construction, based on information from the Project design engineers on the equipment use by month throughout the construction schedule and the area extent of ground disturbance that will occur during different construction phases. Depending on the magnitude of emissions for different pollutants and the proximity of construction activities to the property boundary for each phase, one or more emission scenarios representing reasonable worst-case equipment activity and ground disturbance for each averaging time will be selected for subsequent dispersion modeling to ensure that maximum off-site air quality impacts due to these temporary activities will be assessed. The selected emissions scenarios will be modeled using AERMOD with the same near-field receptor grids and the same meteorological input data used for the modeling of the Project's operational emissions. Fugitive dust emissions from the construction site, including the corridors for new transmission lines, gas lines or water pipelines, parking areas and lay-down areas will be modeled as area or volume sources. Equipment exhaust emissions of gaseous pollutants and particulates will be modeled as a series of point sources distributed over the site and linears corridors, as appropriate. Ultra-low sulfur diesel fuel (15 ppm by weight or less) will be utilized on any emission calculations for construction equipment used at HECA site.

4.3.3 Toxic Air Contaminant Sources

TACs will also be emitted from the operational HECA project due to combustion of natural gas, hydrogen gas and diesel fuels. Only small quantities of TACs will be emitted from these sources - primarily benzene, formaldehyde, and polycyclic aromatic hydrocarbons, when natural gas will be used as fuel for the CTG/HRSG train and the auxiliary boiler. Two new diesel-fired engines are proposed as part of the project. These include one fire pump engine and two standby emergency generator engine drivers. Emission estimates for TACs from these sources will be based on diesel particulate mater (DPM) emission factors obtained from standard SJVAPCD, CARB and EPA factors and/or vendor data, if available. The cooling towers' TAC emissions will be estimated using cooling tower feedwater quality data and drift calculations. Emissions of TACs from the CTG/HRSG train when hydrogen is being used and from the flares and the tailgas incinerator during periods of startup and shutdown will be estimated using a combination of emission factors, inventories from other IGCC facilities and vendor data, if available.

4.3.4 Cumulative Impact Analysis Including Off-Property Sources

A cumulative modeling analyses will be performed using AERMOD to evaluate the combined impacts of HECA Project emissions increases with those of any other new sources within 10 km (6 miles) from HECA that are currently either under construction, undergoing permitting or expected to be permitted in the near future. Requests will be made to the SJVAPCD, Kern County Planning Department, the City of Bakersfield, and adjacent cities to request information that will be used to develop lists of all such new or planned emission sources. When received, these lists will be forwarded to CEC for review. Based on this information, and the CEC response, additional sources may be included in the cumulative source modeling analysis. However, because of the relative remoteness and rural nature of the project site area, few recent new sources are expected to be identified.

4.4 BUILDING WAKE EFFECTS

The effect of building wakes (i.e., downwash) upon the stack plumes of emission sources at the facility will be evaluated in accordance with USEPA guidance (USEPA, 1985). Direction-specific building data will be generated for stacks below good engineering practice (GEP) stack height using the most recent version of USEPA Building Parameter Input Program – Prime (BPIP-Prime). Appropriate information will be provided in the AFC and other permit applications that describe the input assumptions and output results from the BPIP-Prime model.

4.5 RECEPTOR GRID

The receptor grids that will be used in the AERMOD modeling analyses described in this Protocol for operational sources will be as follows:

- 25-m spacing along the fenceline and extending from the fenceline out to 100 m beyond the property line;
- 50-m spacing from 100 to 250 m beyond the property line;
- 100-m spacing from 250 to 500 m beyond the property line;
- 250-m spacing from 500 m to 1 km beyond the property line;
- 500-m spacing within 1 to 2 km of project sources; and
- 1,000-m spacing within 2 to 10 km of project sources.

During the refined modeling analysis for operational Project emissions, if a maximum predicted concentration for a particular pollutant and averaging time is located within the portion of the receptor grid with spacing greater than 25 m, a supplemental dense receptor grid will be placed around the original maximum concentration point and the model will be rerun. The dense grid will use 25-m spacing and will extend to the next grid point in all directions from the original point of maximum concentration.

Due to the large computation time required to run AERMOD, this receptor grid, with the additional dense nested grid points, was determined to best balance the need to predict maximum pollutant concentrations and allow the all operational modeling runs to be completed in less than one week.

Because construction emission sources release pollutants to the atmosphere from small equipment exhaust stacks or from soil disturbances at ground level, maximum predicted construction impacts for all pollutants and averaging times will occur within the first kilometer from the HECA site boundary. Accordingly, only the portion of the above grid with 25 m spacing out to a distance of 1 km will be used for the construction modeling.

The same receptor grid used in the criteria pollutant modeling for the operational project will be used in the HRA modeling, with additional receptors placed at all sensitive locations (e.g., schools, hospitals, etc.) out to 5 km (3 miles). Census receptors out to 10 km will also be included in the populated areas nearest to the proposed HECA facility. Finally, discrete receptors will be placed at the locations of all nearby residences.

A detailed project map and a 7 ½- minute U.S Geological Survey (USGS) map will be provided in the AFC showing the locations of the grid receptors. Actual Universal Transverse Mercator (UTM) coordinates will be used. The CAAQS and NAAQS apply to all locations outside the applicant's facility, i.e. everywhere where public access is not under the control of the applicant. Therefore, the fenceline will be placed along the facility's property boundary, and the receptors will be placed on and outside of the fenceline.

4.6 METEOROLOGICAL AND AIR QUALITY DATA

4.6.1 Meteorological Data

According to the Guidance for Air Dispersion Modeling – San Joaquin Valley Air Pollution Control District (08/06 Rev 1.2), the SJVAPCD prepared regional meteorological data sets for use in AERMOD. The SJVAPCD expressed that "The availability of standard meteorological data will reduce inconsistencies in data quality and requests to the regulatory agency on obtaining data." The SJVAPCD used the following meteorological elements in AERMET processing for the 5 year period from 2000 to 2004: ceiling height, wind speed, wind direction, air temperature, total cloud opacity, and total cloud amount. Hourly surface data for calendar years 2000, 2001, 2002, 2003, and 2004 were obtained from the SJVAPCD for the Bakersfield Airport meteorological station which is located, in the City of Bakersfield approximately 32.2 km (20 miles) ENE of the HECA site. Also, these data have been pre-processed by the SJVAPCD with the Oakland upper air data to create an input data set specifically tailored for input to AERMOD.

The "Bakersfield" meteorological data set is available from the SJVAPCD webpage: *http://www.valleyair.org/busind/pto/Tox_Resources/AirQualityMonitoring.htm*. The guidance describes that the meteorological data provides a standard data set that can be used for air quality studies using AERMOD. The regional data set should not be modified. Therefore, the HECA project site used the SJVAPCD's model-ready AERMET data set.

In addition, the meteorological data recorded at Bakersfield Airport are acceptable for use at HECA facility for two reasons, proximity and terrain similarity. The terrain immediately surrounding the Project site can be categorized as a fairly flat, or gradually sloping rural area in an area with developed oil wells. The terrain around the Bakersfield Airport also consists of relatively flat, or gradually sloping rural or suburban areas. Thus the land use and the location with respect to near-field terrain features are similar. Additionally, there are no significant terrain features separating the Bakersfield Airport from the HECA facility site that would cause significant differences in wind or temperature conditions between these respective areas. Therefore the five years of meteorological data selected from the Bakersfield Airport were determined to be representative for purposes of evaluating the Project's air quality impacts. The Bakersfield Airport is the closest full-time meteorological recording station to the HECA facility site, and thus meteorological conditions at the sites will be very similar.

Seasonal and annual wind roses based on the five years of Bakersfield Airport surface meteorological data are provided as Appendix A to this Protocol. Winds for all seasons and all years blow predominantly from the sector between northwest and north, although the directional pattern is more variable during the fall and winter seasons.

4.6.2 Air Quality Monitoring Data

Air quality monitoring data to represent existing air quality in the Project area were obtained from the USEPA AirData (2008) and the CARB-California Air Quality Data website (2008). The most recent three years of data (2006-2008) from the Taft-College, Shafter, Bakersfield Golden State Highway, and Bakersfield 5558 California Avenue monitoring stations were collected to determine the most representative baseline concentrations for each air pollutant and averaging period addressed in the California and National ambient air quality standards. The maximum concentration recorded at these monitoring stations over the three-year period will be used as a conservative representation of existing air quality condition at the proposed Project site. Please note that the background monitoring data from 2006-2008 is used to estimate criteria pollutant impacts using the highest reported values from the most recent three years of available data. This data should not be confused with the ozone data used in the OLM, where the ozone data was obtained from 2000-2004.

The Taft-College monitoring station is located approximately 21 km to the southwest of the HECA facility site. The Taft-College station only monitors PM_{10}, and TSP (until 2005). The Bakersfield Golden Highway station monitors all the criteria pollutants, except SO_2, and is located approximately 56 km to the southeast of the HECA facility site. The Bakersfield 5558 California Avenue station also measures all pollutants except CO and SO_2. This station is located about 30 km east of the HECA site. The only station in the San Joaquin Valley Air Basin that monitors SO_2 is the CARB station at First Street in Fresno, located approximately 163 km to the north. SO_2 data have only been recorded in Fresno County for the last two years (2007 and 2008), a practice that is justified by the low levels that have been recorded for this pollutant when measurements have been made.

The selected maximum baseline concentrations for all pollutants are summarized in Table 4-3. These data will be added to the modeled maximum impacts due to project emissions for each pollutant and averaging time, and the totals will then be compared with the applicable AAQS. This is a conservative approach because it assumes that the highest recorded background values and the modeled maximum impacts occur at the same time and location for each pollutant and averaging time, a highly unlikely scenario. Note that the maximum background concentrations of PM_{10} and $PM_{2.5}$ in the project area currently exceed the corresponding CAAQS and NAAQS.

Table 4-3
Highest Monitored Pollutant Concentrations Near the Proposed HECA Site (2006 – 2008)

Pollutant	Averaging Time	Highest Monitoring Concentration	Monitoring Station Address	Year
CO	8-hour	2.2 ppm (2,444 $\mu g/m^3$)	Bakersfield Golden State Highway	2006
	1-hour	3.5 ppm (4,025 $\mu g/m^3$)	Bakersfield Golden State Highway	2008
NO_2	Annual	0.021 ppm (39.6 $\mu g/m^3$)	Bakersfield Golden State Highway	2006
	1-hour	0.101 ppm (190.1 $\mu g/m^3$)	Shafter-Walker Street	2007
SO_2	Annual	0.010 ppm (26.7 $\mu g/m^3$)	Fresno – 1st Street	2008
	24-hour	0.031 ppm (81.38 $\mu g/m^3$)[a]	Fresno – 1st Street	2007
	3-hour	0.075 ppm (195.0 $\mu g/m^3$)[b]	Fresno – 1st Street	2007
	1-hour	0.130 ppm (340.6 $\mu g/m^3$)[b]	Fresno – 1st Street	2007
PM_{10}[c] (Non-attainment area)	Annual	56.5 $\mu g/m^3$	Bakersfield Golden State Highway	2006
	24-hour	267.4 $\mu g/m^3$	Bakersfield Golden State Highway	2008
$PM_{2.5}$[d] (Non-attainment area)	Annual	25.2 $\mu g/m^3$	Bakersfield Golden State Highway	2007
	24-hour	154 $\mu g/m^3$	Bakersfield Golden State Highway	2007

Source: CARB ADAM website (Last access: February, 2009).

[a] The highest SO_2 monitoring concentration occurred at the Fresno – 1st Street station on July 5, 2007, and was found to be 0.067 ppm. This value was assumed to fall into the category of the EPA Rule 40 CFR 50.14 "Treatment of air quality monitoring data influenced by exceptional events." Because this value occurred on the day after the Independence Day holiday and was twice as high as the next highest monitored 24-hour SO_2 value, it was assumed to have been caused by fireworks. Therefore, the concentration on July 5 2007 was not considered for Table 4-3 and the second highest 24-hour value was used instead. Confirmed in an email from Leland Villalvazo on February 4, 2009

[b] It was observed that higher monitoring concentrations were observed at the Fresno -1st Street station on July 4 and July 5, 2007 (the day of and the day after Independence Day). Because these values are much higher than concentrations observed during the rest of the year, they were assumed to have been caused by fireworks. These values will fall into the category EPA Rule 40 CFR 50.14. Therefore, concentrations on July 4 and Jul 5, 2007 were not considered for Table 4-3 and the next highest 1-hour and 3-hour concentrations were used instead. Confirmed in an email from Leland Villalvazo on February 4, 2009

[c] Although EPA has determined that the San Joaquin Valley Air Basin has attained the federal PM_{10} standards, their determination does not constitute a redesignation to attainment per section 107(d)(3) of the Federal Clean Air Act. The Valley will continue to be designated nonattainment until all of the Section 107(d)(3) requirements are met. This area will be treated as the federal PM_{10} non-attainment area until future redesignation.

[d] The Valley is designated nonattainment for the 1997 $PM_{2.5}$ federal standards. EPA designations for the 2006 $PM_{2.5}$ standards will be finalized in December 2009. The District has determined, as of the 2004-06 PM 2.5 data, that the Valley has attained the 1997 24-Hour $PM_{2.5}$ standard. . This area will be treated as the federal $PM_{2.5}$ non-attainment area until future redesignation.

4.7 FUMIGATION MODELING

Fumigation can occur when a stable layer of air lies a short distance above the release point of a plume and unstable air lies below. Especially on sunny mornings with light winds, the heating of the earth's surface causes a layer of turbulence, which grows in depth over time and may intersect an elevated exhaust plume. The transition from stable to unstable surroundings can rapidly draw a plume down to ground level and create relatively high pollutant concentrations for a short period. Typically, a fumigation analysis is conducted using the USEPA model SCREEN3 when the project site is rural and the stack height is greater than 10 m.

A fumigation analysis will be performed using SCREEN3 to calculate concentrations from inversion breakup fumigation; no shoreline fumigation modeling will be performed for the HECA location. A unit emission rate will be used (1 gram per second) in the fumigation modeling simulations to represent the plant emissions, and the model results will be scaled to reflect expected plant emissions for each pollutant. Inversion breakup fumigation concentrations will be calculated for 1- and 3-hour averaging times using USEPA-approved conversion factors. These multiple-hour model predictions are conservative, since inversion breakup fumigation is a transitory condition that would most likely affect a given receptor location for only a few minutes at a time.

SECTION 5 AIR QUALITY IMPACT ANALYSIS FOR CLASS I AREAS

An evaluation of potential impacts in Class I areas within 100 km of the HECA site will be conducted, because HECA's potential emissions increases of some pollutants will be sufficiently high to be considered a Major Source, thus triggering the federal PSD program. A Major Source must evaluate impacts to visibility and other air quality related values (AQRV) at all Class I areas that are located within a 100-km radius of the facility. All pollutants for which Project emissions are above the Major Source threshold (in this case, 100 tpy) and all pollutants for which emissions are above the PSD Significant Emissions Rates must be evaluated. This section describes the dispersion models and modeling techniques that will be used in performing the Class I area air quality analyses for HECA. The objectives of the modeling are to demonstrate whether air emissions from HECA would cause or contribute to a PSD increment exceedance or cause a significant impact on visibility, regional haze or sulfur or nitrogen deposition in any Class I area.

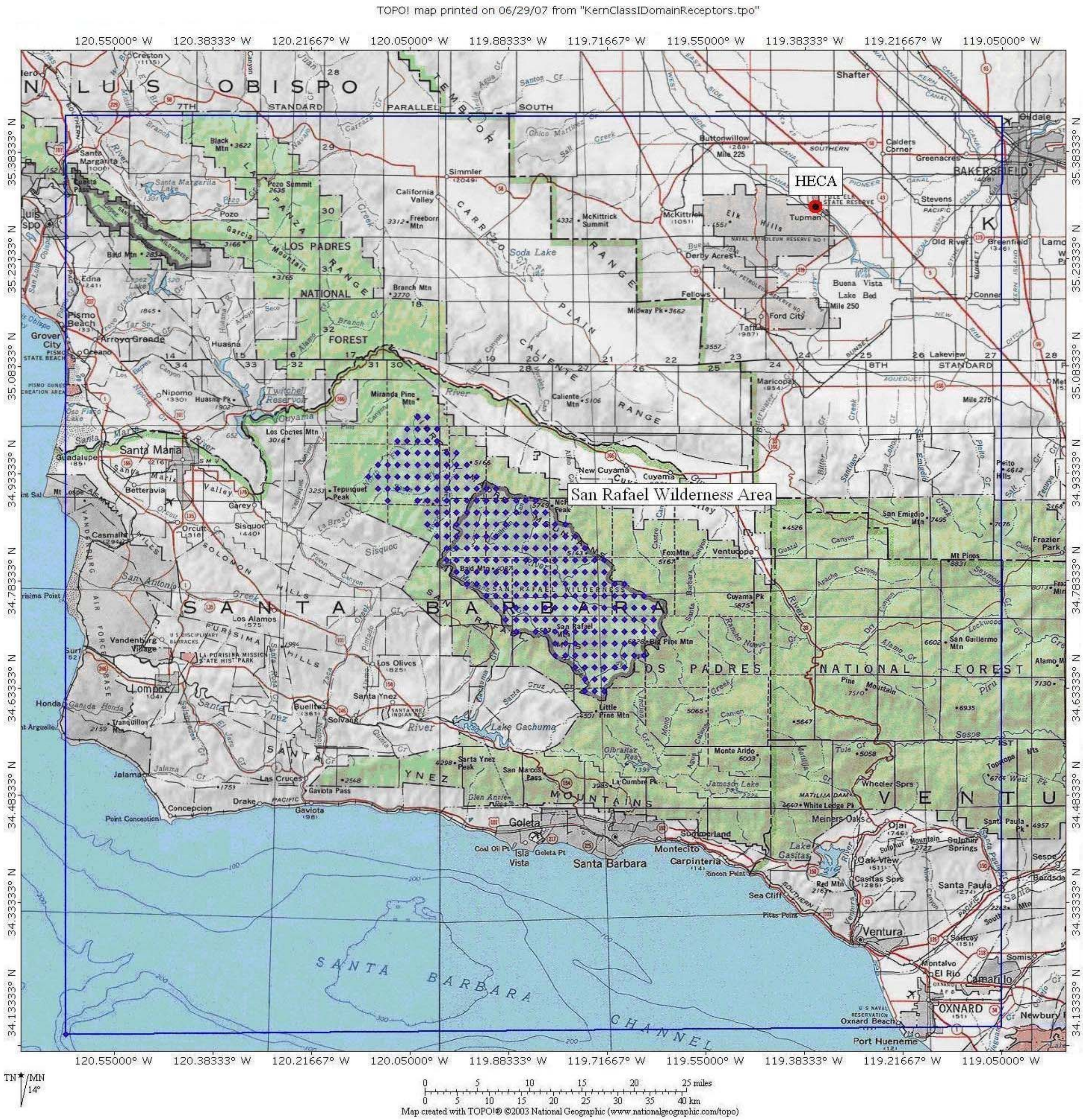
Three Class I areas are located within the region of the HECA site and require further evaluation: Dome Land Wilderness Area, Sequoia National Park, and San Rafael Wilderness Area. However, detailed review of the locations of these Class I areas relative to the HECA site shows that Dome Land Wilderness Area and Sequoia National Park are greater than 100 km from HECA. Therefore, these two Class I areas do not meet the screening criterion of being within 100 km and will not be included in the HECA analysis. NPS has confirmed in comments submitted on a previous version of this document that given the distance and low emissions, they do not believe there will be any significant air quality impacts at Sequoia National Park. The nearest parts of the San Rafael Wilderness are located beyond 50 km and within 100 km from the proposed facility, thus only this Class I area and only far-field AQRV analyses will need to be completed. The CALMET/CALPUFF (full-CALPUFF) model will be used to evaluate potential impacts in the far-field Class I area, including potential air quality impacts, sulfur and nitrogen deposition, and impacts to visibility.

Figure 3 shows the locations of the Class I areas relative to the proposed site for HECA and Table 5-1 lists the distances from HECA to the closest and farthest points in each Class I area. Figure 3 also shows the domain to be used for CALPUFF modeling of the San Rafael Wilderness Area (indicated by the blue rectangle). The federal authority in charge of the two Wilderness Areas is the United States Forest Service (USFS) and the National Park Service (NPS) has jurisdiction in Sequoia National Park. The AQRV analyses for the San Rafael Wilderness area will be conducted in a manner consistent with guidance from the NPS and USFS following the procedures set forth in the Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report (USFS, 2000) and the Calpuff Reviewer's Guideline (USFS and NPS, 2005).

Table 5-1
Class I Areas Evaluated with Respect to 100-km Radius of the Proposed HECA Facility

Class I areas	Distance from HECA (km)	
Dome Land Wilderness Area	Closest	110
	Farthest	132
Sequoia National Park	Closest	125
	Farthest	181
San Rafael Wilderness Area	Closest	62
	Farthest	81

Figure 4
Calpuff Domain and Receptor For the Class I Area Surrounding HECA



The CALPUFF modeling domain selected for the modeling analyses will extend at least 50 km past the farthest edge in all directions from any of the Class I area being analyzed in order to reduce the probability that mass will be lost due to possible wind recirculation (Figure 3).

5.1 NEAR-FIELD CLASS I AREAS AIR QUALITY IMPACT ANALYSIS

There are no Class I Areas within 50 km of the proposed project location; therefore, no near field AQRV analyses are necessary.

5.2 FAR-FIELD CLASS I AREA AIR QUALITY IMPACT ANALYSIS: CALPUFF MODELING

To analyze potential impact of project emissions to visibility, PSD increment and sulfur and nitrogen deposition in the Class I area located within 100 km from the proposed project site, the CALPUFF model will be used in conjunction with the CALMET diagnostic meteorological model. CALPUFF is a transport and dispersion model that simulates the advection and dispersion of "puffs" of material emitted from modeled sources. CALPUFF can incorporate three-dimensionally varying wind fields, wet and dry deposition, and atmospheric gas and particle phase chemistry. The CALMET model is used to prepare the necessary gridded wind fields for use in the CALPUFF model. CALMET can also accept as input; mesoscale meteorological (MM5) data, surface station, upper air, precipitation, cloud cover, and over-water meteorological data (all in a variety of input formats). These data are merged and the effects of terrain and land cover types are simulated. This process results in the generation of gridded 3-dimensional wind fields that account for the effects of slope flows, terrain blocking effects, flow channeling, and spatially varying land uses.

The USEPA-approved regulatory air quality dispersion model CALPUFF (version 5.8) will be used for all far-field Class I area impact analyses. In addition, all supporting Version 5.8 editions of the pre- and post-processors will be used. Recommendations from the regulatory guidance documents listed below will be followed.

- *Federal Land Managers Air Quality Related Values Workgroup (FLAG) Phase 1 Report. (USEPA December 2000),*
- *Interagency Workgroup on Air Quality Modeling (IWAQM), Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts. (USEPA December 1998)*, and
- *Calpuff Reviewer's Guide (Draft), (USFS and NPS, 2005).*

Model options will be based on FLM guidance from the above documents and direct discussions with NPS and USFS air quality staff.

Copies of the model input and output files generated in the preparation of this and all other modeling analyses described in this Protocol will be provided with the final application.

5.2.1 CALPUFF/CALMET Description

5.2.1.1 Location and Land-Use

The CALMET and CALPUFF models incorporate assumptions regarding land-use classification, leaf-area index, and surface roughness length to estimate deposition of emitted materials during atmospheric transport. U.S. Geological Survey (USGS) 1:250,000 scale digital elevation models (DEMs) and Land Use Land Cover (LULC) classification files will be used to develop the geophysical input files required by the CALMET model. Outputs of the terrain pre-processor (TERREL) and land use pre-processor (CTGPROC) will be combined in the geo-physical preprocessor (MAKEGEO) to prepare the CALMET geo-physical input file. The CALMET model will incorporate the necessary parameters in the CALMET output files for use in the CALPUFF model.

The CALPUFF modeling domain will extend from the HECA site 150 km to the west, 180 km to the north, 125 km to the east, and 150 km to the south. The grid-cells over this domain will be 4 km wide. The modeling domain will be specified using the Lambert Conformal Conic (LCC) projection system.

5.2.1.2 Meteorological Data

Pursuant to FLM guidance, a three-year meteorological data set will be developed using a combination of surface station and mesoscale meteorological (MM5) data for 2001-2003. Hourly CALMET data derived from the MM5 data for these three years will be obtained from the WRAP BART modeling for the Nevada-Utah domain. Surface meteorological, precipitation and ozone data will also be obtained from the WRAP BART modeling for the Nevada-Utah domain. No upper air stations will be used, since there are none within the domain shown in Figure 3 and the MM5 data provide a good first approximation of the vertical profile of the atmosphere.

CALMET wind fields will be generated using a combination of the MM5 data sets augmented with the surface data from the National Weather Service (NWS) stations described above. Per IWAQM guidance, the MM5 data will be interpolated to the CALMET fine-scale grid to create the “initial-guess” wind fields (IPROG = 14 for MM5).

5.2.1.3 Other Model Options

Size parameters for dry deposition of nitrate, sulfate, and PM_{10} particles will be based on default CALPUFF model options. Chemical parameters for gaseous dry deposition and wet scavenging coefficients will be based on default values presented in the CALPUFF User’s Guide. For the CALPUFF runs that incorporate deposition and chemical transformation rates (i.e. deposition and visibility), the full chemistry option of CALPUFF will be activated (MCHEM = 1). The nighttime loss for SO_2, NO_x and nitric acid (HNO_3) will be set at 0.2 percent per hour, 2 percent per hour and 2 percent per hour, respectively. CALPUFF will also be configured to allow predictions of SO_2, sulfate (SO_4), NO_x, HNO_3, nitrate (NO_3) and PM_{10} using the MESOPUFF II chemical transformation module.

Hourly ozone concentration files for the CALPUFF modeling will be obtained from the WRAP BART modeling data for the Nevada-Utah domain. Only data from the ozone monitoring stations within the HECA domain will be used.

The background ammonia concentration will be set to 10 ppb, which is representative for a grassland or agricultural site, per the FLAG guidelines.

The regulatory default setting for MDISP=3 which utilizes the Pasquill-Gifford dispersion coefficients will be used in the CALPUFF modeling.

5.2.1.4 Receptors

Discrete receptors for the CALPUFF modeling within the San Rafael Wilderness Area will be obtained from the NPS Class One Area receptor database. No modifications to the receptor locations or heights provided in the database will be made. Latitude/Longitude coordinates of the Class I receptors will be converted to Lambert Conformal Conic (LCC) coordinates, based on the domain setup shown in CALMET options. These receptor points are shown in Figure 3.

5.2.2 Far-Field Class I Area Visibility and Regional Haze Analysis

For the analysis of visibility effects due to emissions of air pollutants, CALPUFF requires project emission rate inputs for six pollutant species, i.e., directly emitted PM_{10}, NO_x, and SO_2, and secondary SO_4, HNO_3, and NO_3. The maximum 24-hour averaged emission rates of PM_{10}, NO_x and SO_2 from all sources of HECA will be used for the visibility analysis. The turbine/HRSG emissions of SO_2 will be specified to SO_2 and SO_4 as indicated in the NPS Particulate Matter Speciation (PMS) guidelines for gas fired combustion turbines (NPS, 2008). The total turbine/HRSG PM_{10} emissions will be specified to elemental carbon and organic carbon [emitted as Secondary Organic Aerosol (SOA)] per the PMS. Direct emissions of PM_{10}, NO_x, and SO_2 from the auxiliary boiler, emergency generators and fire pump will be modeled without speciation. The cooling towers will emit only PM_{10}. Direct emissions of the remaining species, HNO_3 and NO_3, are assumed to be zero for the natural gas burning sources of HECA.

Modeled impacts will be converted to visibility impacts using the CALPOST post processor. CALPOST will be used to post-process estimated 24-hour averaged concentrations of ammonium nitrate, ammonium sulfate, EC, and SOA into extinction coefficient values for each day at each modeled receptor.

CALPUFF also requires a background light extinction reference level. The analysis will be run using the FLAG recommended background extinction values for the Class I area. The background extinction coefficient is composed of hygroscopic scattering components, wherein the addition of water enhances particle light-scattering efficiencies, non-hygroscopic scattering components and Rayleigh scattering. Ammonium sulfate and ammonium nitrate compose the hygroscopic scattering components, while organic aerosols, soils, coarse particles, particle absorption from elemental carbon and absorption from gases (primarily from nitrogen dioxide) compose the non-hygroscopic scattering components.

In accordance with the FLAG guideline the total background extinction coefficient is calculated for the Class I area using the following equation:

$$b_{ext} = b_{hygro} \cdot f(RH) + b_{non\text{-}hygro} + b_{Ray}$$

where:

b_{hygro} = the hygroscopic scattering component (Mm^{-1})
= $3[(NH_4)_2SO_4 + NH_4NO_3]$
$b_{non-hygro}$ = the non-hygroscopic scattering component (Mm^{-1})
= $b_{OC} + b_{Soil} + b_{Course} + b_{ap} + b_{ag}$
b_{Ray} = the Rayleigh scattering component (Mm^{-1}) = 10 Mm^{-1} (FLAG)
f(RH) = relative humidity adjustment factor

In the CALPOST post-processing program, the monthly background concentration of ammonium sulfate is set to one-third of the hygroscopic scattering component, and the monthly background concentration of soil particles is set to the non-hygroscopic scattering component, as recommended in the FLAG report. The scattering coefficients that will be used in CALPUFF for the Class I areas are presented in Table 5-2.

The FLAG relative humidity (RH) adjustment factors (MVISBK=2) and the RHMAX = 95 % will be used as suggested by the NPS FLM.

The extinction coefficient percent change (background extinction coefficient vs. modeled extinction coefficient), predicted by CALPUFF will be compared to the level of acceptable change (LAC) of 5%. If the change in extinction is greater than 5%, but less than 10%, the conditions surrounding that prediction will be examined to determine if inclement weather may obscure actual viewing of the plume in the Class I area.

Table 5-2
Scattering Coefficients used in CALPUFF Analysis for the San Rafael Wilderness Class I Area

Class I Area	Total Background Extinction (Mm^{-1})				Hygroscopic Scattering Component (Mm^{-1}) = BKSO4	Non-hygroscopic Scattering Component (Mm^{-1}) = BKSOIL	Rayleigh Scattering (Mm^{-1})
	Winter	Spring	Summer	Fall			
San Rafael Wilderness Area	16.1	16.0	16.0	16.0	0.6	4.5	10.0

5.2.3 PSD Class I Significance Analysis

A PSD analysis of incremental air pollutant concentrations in the Class I area due to project emissions will be required, because HECA will be a Major Source as defined in the PSD regulations. Accordingly, the maximum predicted incremental criteria pollutant concentrations from HECA sources in the Class I area will be compared with the Proposed PSD significant impact level for Class I areas (see Table 5-3) for each pollutant.

Table 5-3
FLAG (Proposed) Class I Significance Impact Levels

Pollutant and Averaging Time	NO_x	PM_{10}		SO_2		
	Annual	24-hour	Annual	3-hour	24-hour	Annual
Concentration Threshold (µg/m^3)	0.1	0.3	0.2	1	0.2	0.1

All NO_2 and PM_{10}, sources of the proposed project will be modeled at the full potential-to-emit (PTE) in the CALPUFF PSD modeling for each averaging time. The facility SO_2 emission rate will be portioned into SO_2 and SO_4 emissions according to the NPS PMS guidance for natural gas combustion turbines. The full chemistry option of CALPUFF will be activated (MCHEM =1, MESOPUFF II scheme), and deposition options will also be turned on (MWET = 1 and MDRY = 1).

5.2.4 Deposition Analysis

For the Class I area beyond 50 km from the facility, CALPUFF will be used to evaluate the potential for nitrogen and sulfur deposition due to HECA emissions of nitrogen and sulfur oxides emissions. Total deposition rates for each pollutant will be obtained by summing the modeled wet and/or dry deposition rates. The annual average pollutant emission rates for Project sources will be used in this analysis, since annual deposition rates are to be estimated.

For sulfur deposition, the wet and dry fluxes of sulfur dioxide (SO_2) and sulfate (SO_4) are calculated, normalized by the molecular weight of sulfur, and expressed as total sulfur. Total nitrogen deposition is the sum of nitrogen contributed by wet and dry fluxes of nitric acid (HNO_3), nitrate (NO_3^-), ammonium nitrate (NH_4NO_3), ammonium sulfate ($(NH_4)_2SO_4$) and the dry flux of NO_x.

The total modeled nitrogen and sulfur deposition rates will be compared to the NPS/USFS deposition analysis thresholds (DAT) for western states. The DAT values for nitrogen and sulfur are each 0.005 kilogram per hectare per year (kg/ha-yr), which converts to 1.59E-11 g/m^2/s.

5.2.5 Soils and Vegetation

The designated Class I area contains vegetative ecosystems that are identified by the Federal Land Managers (FLM) (USFS, 1992). For each ecosystem, sensitive species or groups of species will be designated to represent potential impacts to each vegetative species in the ecosystem. These species are impacted primarily by ozone but may also be impacted by nitrogen and sulfur compounds. Acidity in rain, snow, cloudwater, and dry deposition can affect soil fertility and nutrient cycling processes in watersheds, and can result in acidification of lakes and streams with low buffering capacity. Therefore, the soil and vegetation analysis will be conducted using the CALPUFF model to predict total sulfur and nitrogen deposition rates and monitored ozone concentrations at the nearest air quality monitoring stations. In order to protect sensitive species, the USFS (1992) recommends that short-term maximum SO_2 levels should not exceed 40 to 50 parts per billion (ppb). Annual average SO_2 concentrations should not exceed 8 to 12 ppb, and annual average NO_2 concentration should not exceed 15 ppb.

SECTION 6 PRESENTATION OF MODELING RESULTS

6.1 PSD, NAAQS AND CAAQS ANALYSES

The results of the PSD and AAQS analyses to evaluate the construction and operational impacts of the HECA facility will be presented in summary tables. A figure indicating the locations of the maximum predicted pollutant concentrations for each applicable pollutant and averaging time will be provided. The maximum modeled values of NO_2, SO_2 and CO will be compared with current Class II and proposed Class I SILs. If the model impact exceeds the SILs, the background concentrations (see Section 4.6.2) will be added to the maximum modeled values from the HECA sources to yield total concentrations, which will be compared with the NAAQS and CAAQS. The cumulative impact values from combination of project sources in HECA and new sources within 10 km (6 miles) of the proposed project site will be added to the background concentrations for the corresponding pollutants and averaging times and will be compared with the NAAQS and CAAQS.

6.2 HEALTH RISK ASSESSMENT ANALYSIS

Maps depicting the following data will be prepared:

- Elevated terrain within a 10-km radius of the project;
- The locations of sensitive receptors, including schools, pre-schools, hospitals, etc., within a 5 -km (3 miles) radius of the project, and the nearby residences included in the HRA;
- Isopleths for any areas where predicted exposures to air toxics result in estimated chronic non-cancer impacts and acute impacts equal to or exceeding a hazard index of 1; and
- Isopleths for any areas where exposures to air toxics lead to an estimated carcinogenic risk equal to or greater than one in one million.

Health risk assessment modeling results will be summarized to include maximum annual (chronic, carcinogenic, and non-carcinogenic) and hourly (acute) adverse health effects from HECA's toxic air contaminant emissions. The estimated cancer burden will be presented if the maximum off-site cancer risk is predicted to be greater than one in a million. Health risk values will be calculated and presented in the summary table for the points of maximum impact and the sensitive receptors with the maximum risk values.

6.3 CLASS I ANALYSIS

The results of the visibility, PSD and deposition analyses to evaluate the operational impacts of the HECA facility will be presented in summary tables and compared with all relevant significance thresholds. Isopleth drawing showing the predicted spatial distributions of criteria pollutant concentrations in the Class I areas due to the proposed project emissions will also be prepared.

6.4 DATA SUBMITTAL

Electronic copies of the modeling input and output files for all the analyses described in this Protocol will be provided to SJVAPCD, CEC and EPA Region IX, U.S. Forest Service and National Park Service.

SECTION 7 REFERENCES

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2000-2004 Annual (Jan - Dec)

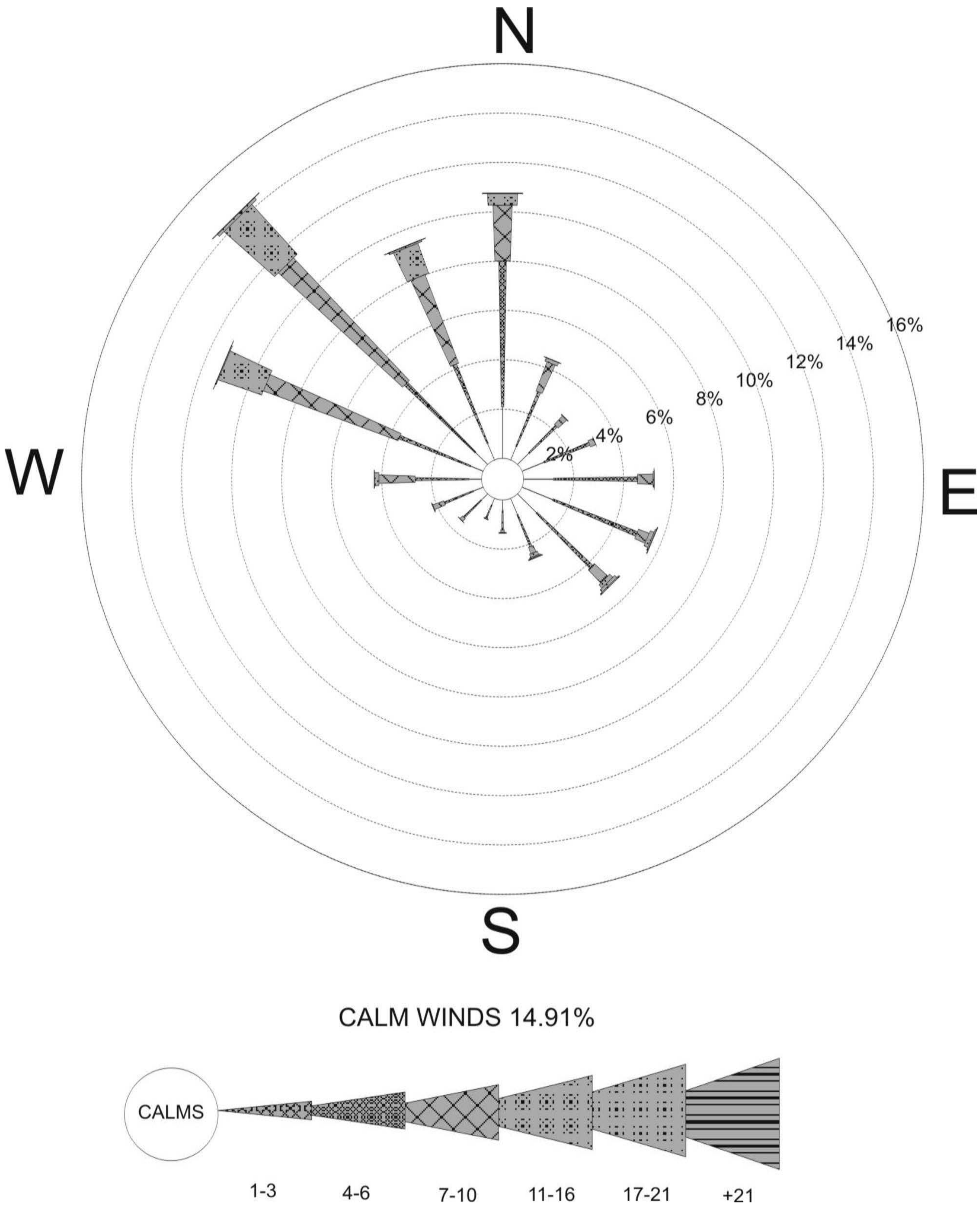

Figure A-1 Annual Windrose for Bakersfield Airport based on Surface Data for 2000-2004

2000-2004 Spring (Mar, Apr, May)

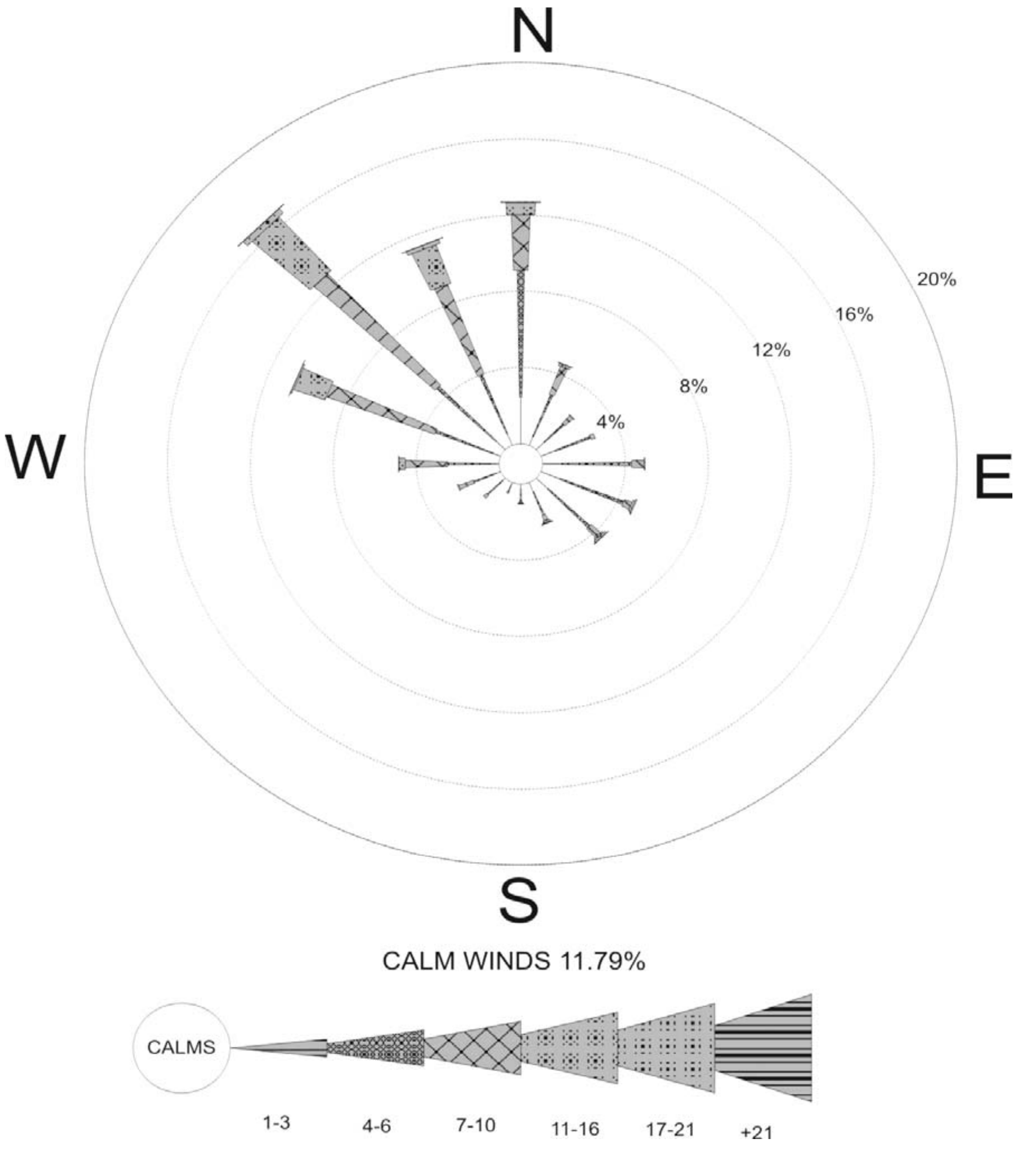

Figure A-2 Spring Season Windrose for Bakersfield Airport based on Surface Data for 2000-2004

2000-2004 Summer (Jun, July, Aug)

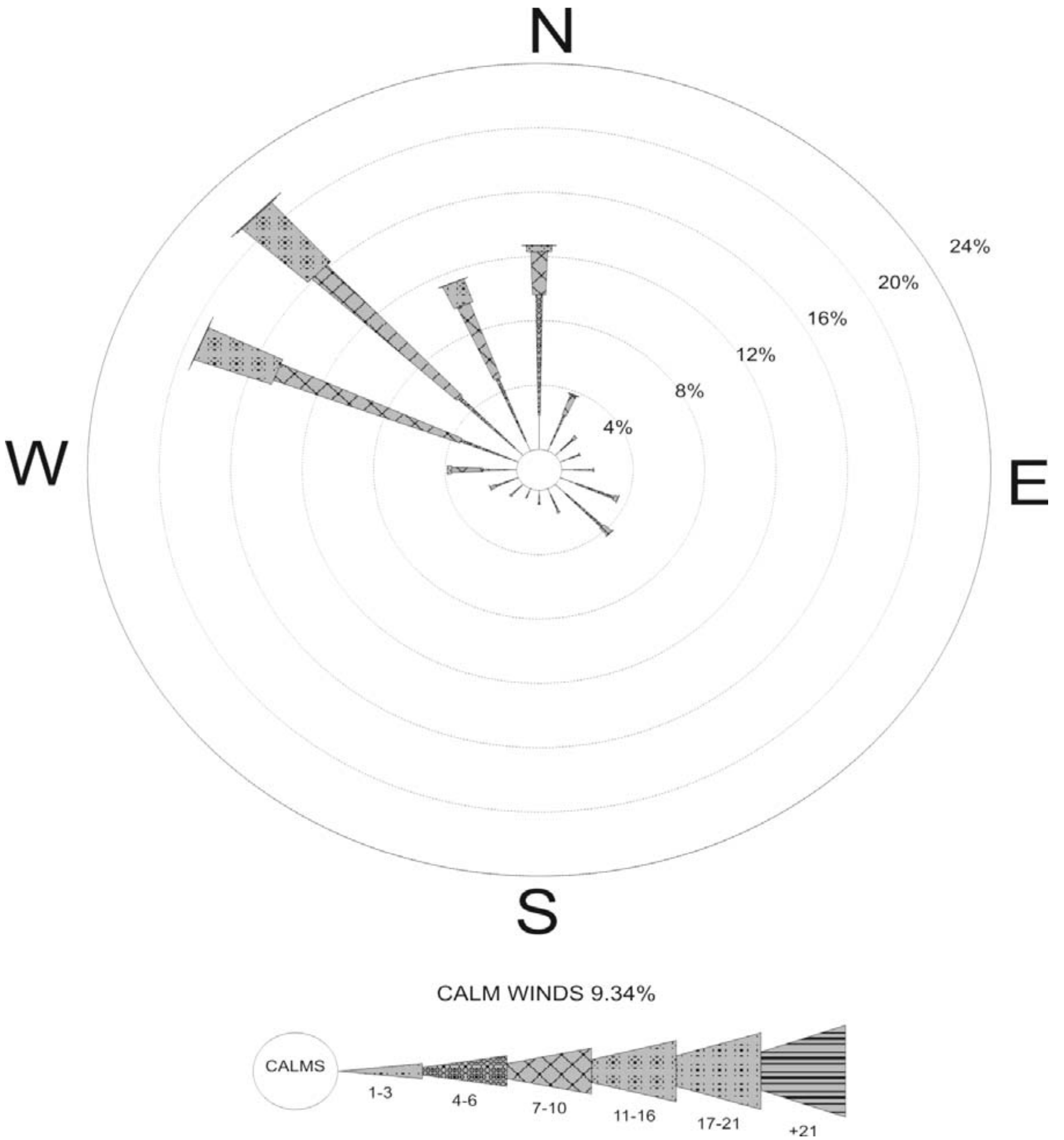

Figure A-3 Summer Season Windrose for Bakersfield Airport based on Surface Data for 2000-2004

2000-2004 Fall (Sep, Oct, Nov)

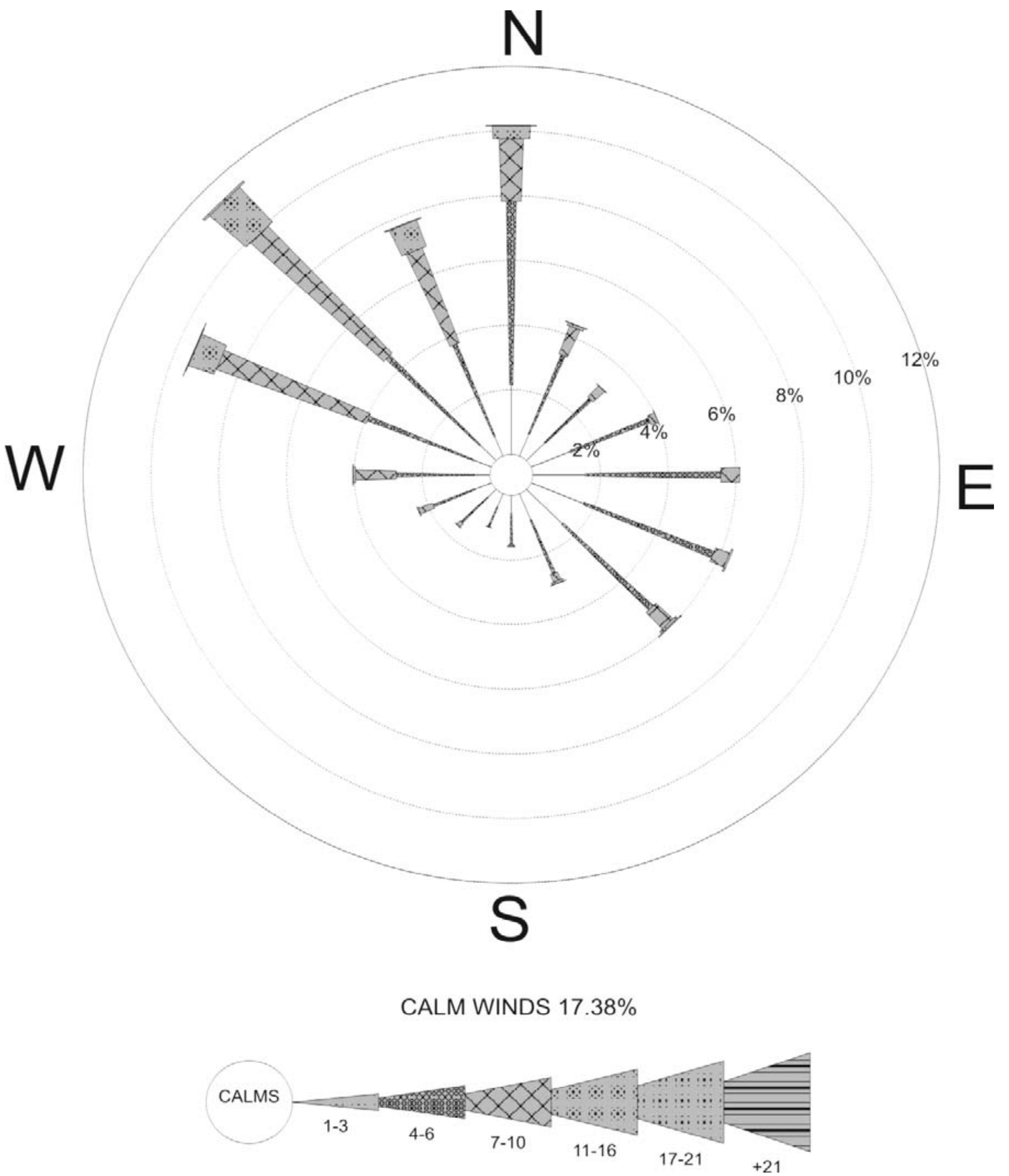

Figure A-4 Fall Season Windrose for Bakersfield Airport based on Surface Data for 2000-2004

2000-2004 (Dec, Jan, Feb)

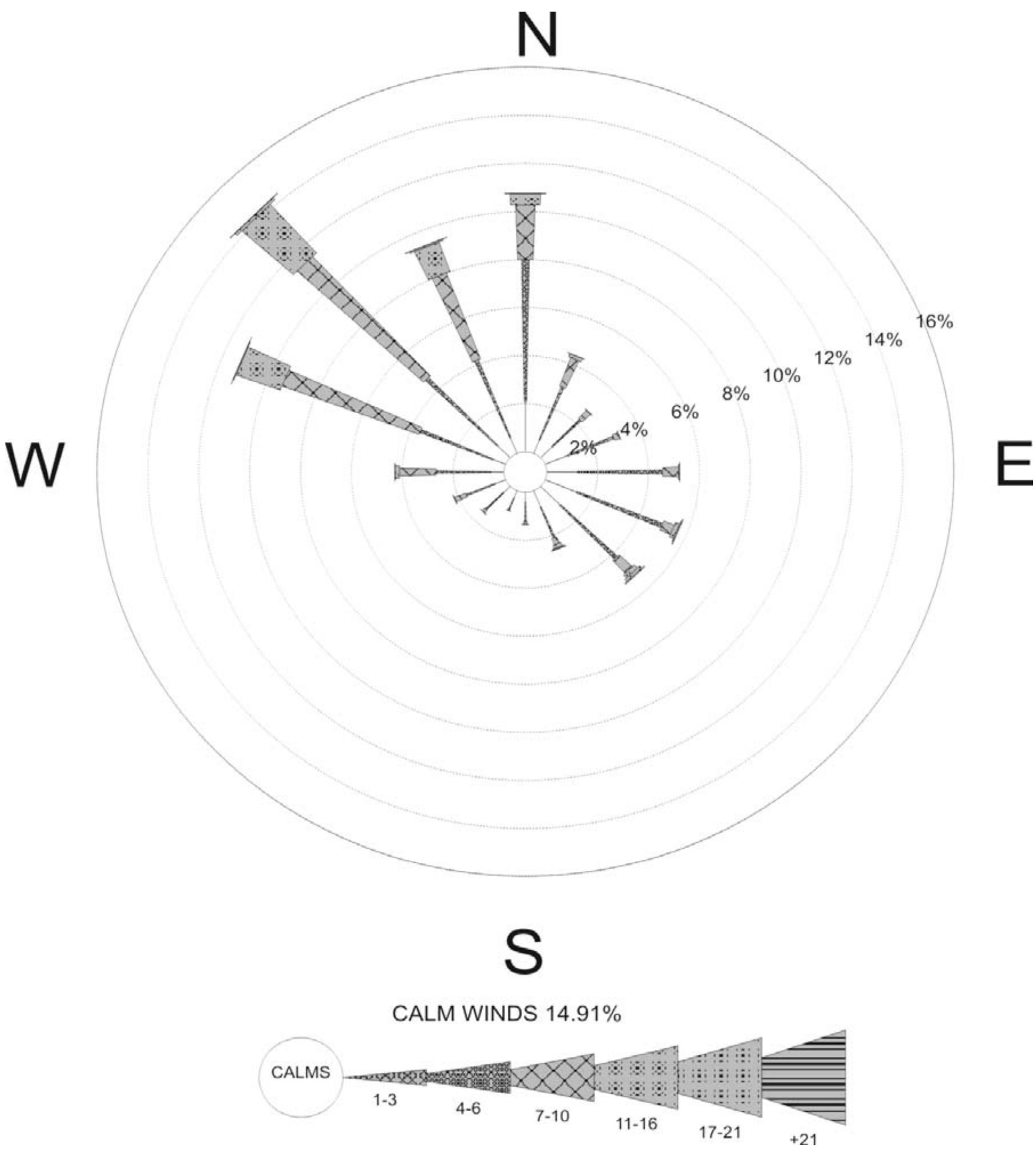

Figure A-5 Winter Season Windrose for Bakersfield Airport based on Surface Data for 2000-2004