MODELING PROTOCOL FOR

PARAMETER SELECTION SPECIFIC TO THE 1-HOUR NO_2 NAAQS REGIONAL MODELING

FOR THE HYDROGEN ENERGY CALIFORNIA (HECA) PROJECT

Prepared for:

U.S. Environmental Protection Agency
Region IX

Prepared on behalf of:

Hydrogen Energy California LLC

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URS

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Acronyms and Abbreviations

ADT	average daily traffic
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
AFC	Revised Application for Certification
BACT	Best Available Control Technology
BFL	Bakersfield Meadows Field Airport
Caltrans	California Department of Transportation
CARB	California Air Resources Board
CEC	California Energy Commission
CO_2	carbon dioxide
CTG/HRSG	combustion turbine generator and heat recovery steam generator
EOR	enhanced oil recovery
ERC	Emission Reduction Credits
°F	degrees Fahrenheit
GEP	good engineering practice
HECA	Hydrogen Energy California
hp	horsepower
IC	internal combustion
IGCC	integrated gasification combined-cycle
$\mu g/m^3$	micrograms per cubic meter
NAAQS	National Ambient Air Quality Standard
NCDC	National Climatic Data Center
NCDNRCD	State of North Carolina, Department of Natural Resources and Community Development
NED	national elevation datum
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_X	nitrogen oxides
OAQPS	Office of Air Quality Planning and Standards
OLM	ozone-limiting method
petcoke	petroleum coke
PM	particulate matter
ppb	parts per billion
ppm	parts per million
PSD	Prevention of Significant Deterioration
PVMRM	plume volume molar ratio method
SIL	Significant Impact Level
SJVAPCD	San Joaquin Valley Air Pollution Control District
ton/yr/km	tons per year per kilometer
U.S. EPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
VERA	Voluntary NO_X Emission Reduction Agreement
WRCC	Western Regional Climate Center

1. INTRODUCTION

On January 22, 2010, the United States Environmental Protection Agency (U.S. EPA) revised the primary nitrogen dioxide (NO_2) National Ambient Air Quality Standard (NAAQS) to a new 1-hour standard. This new standard will apply to the Hydrogen Energy California (HECA) Project, whose Prevention of Significant Deterioration (PSD) application is currently being processed by U.S. EPA Region IX.

In February 2010, the U.S. EPA issued *Notice Regarding Modeling for New Hourly NO_2 NAAQS* (U.S. EPA, 2010b), and in June 2010, the U.S. EPA issued a compliance guidance document, *Guidance Concerning the Implementation of the 1-hour NO_2 NAAQS for the Prevention of Significant Deterioration Program* (U.S. EPA, 2010c). This guidance document includes a description of Tier 3 "detailed screening methods" for modeling compliance with the NO_2 1-hour federal standard.

In preparation for conducting the regional NO_2 modeling analysis described in the guidance document, HECA is requesting concurrence from U.S. EPA Region IX and from the U.S. EPA Office of Air Quality Planning and Standards (OAQPS) staff regarding the acceptability of the input parameters presented in this protocol for the regional NO_2 modeling analysis for the HECA Project. This document describes key model parameters that will be used in conducting the Tier 3 "detailed screening methods" analysis to satisfy the NO_2 1-hour federal standard.

2. PROJECT DESCRIPTION

The HECA Project is a unique, first-of-its-kind project that will produce low-carbon baseload electricity by capturing carbon dioxide (CO_2) and transporting it for enhanced oil recovery (EOR) and sequestration. The Project will gasify petroleum coke (petcoke) (or blends of petcoke and coal, as needed) to produce raw syngas and, ultimately, hydrogen to fuel a combustion turbine operating in combined cycle mode. The net electrical generation output from the Project will provide California with approximately 250 megawatts of low-carbon baseload power to the grid. The Gasification Block will capture approximately 90 percent of the carbon from the raw syngas at steady-state operation, which will be transported to the Elk Hills Field for CO_2 EOR and sequestration. The Project will have significantly lower criteria pollutant emissions than a similarly sized petcoke-fired, coal-fired, or integrated gasification combined-cycle (IGCC) power plant. To minimize air emissions, state-of-the art emission control technologies will be implemented for the HECA Project.

The HECA Project is approximately 7 miles west of the outermost edge of the city of Bakersfield and 1.5 miles northwest of the unincorporated community of Tupman in western Kern County, California. Figure 1 presents an overview map of the HECA Project location, as well as the locations of regional monitoring stations in relation to the HECA Project. The HECA Project is within the San Joaquin Valley Air Basin and is within the jurisdiction of the San Joaquin Valley Air Pollution Control District (SJVAPCD).

In the SJVAPCD's Final Determination of Compliance for the HECA Project, the Best Available Control Technology (BACT) emission limit for the combustion turbine generator and heat recovery steam generator (CTG/HRSG) for nitrogen oxides (NO_X) was set as a target of 2 parts per million (ppm) and an upper emission level of 4 ppm. These terms refer to the BACT analysis in which the control technique (selective catalytic reduction system) will be designed to meet the lower target level (2 ppm), which is expected to be satisfied. Due to the uniqueness of the HECA Project and the use of unproven technology, the upper limit of 4 ppm was granted by SJVAPCD. After the initial 2-year evaluation period, the final emission limits for NO_X will be determined by SJVAPCD based on testing data. HECA expects to be able to show CTG/HRSG NO_X emissions meet the very low target level of 2 ppm within the evaluation period.

3. NO_2 1-HOUR NAAQS MODELING APPROACH

This section outlines the overall modeling approach that will be undertaken by the HECA Project to show compliance with the new 1-hour NO_2 NAAQS. Subsequent sections describe the details of individual parameters that will be included in the modeling analysis.

The new 1-hour NO_2 NAAQS is 100 parts per billion (ppb) (or 188.68 micrograms per cubic meter [$\mu g/m^3$]). The NAAQS is a statistical standard based on the 3-year average of the annual 98th percentile of the daily maximum 1-hour concentrations. Modeling will be conducted per the procedures outlined by the U.S. EPA in their February 2010 notice and their June 2010 guidance documents (U.S. EPA, 2010b and U.S. EPA, 2010c).

The American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) version 09292 will be used to estimate the 1-hour ground level concentrations of NO_2. The ozone-limiting method (OLM) that HECA intends to use is the plume volume molar ratio method (PVMRM) algorithm in AERMOD.

Maximum hourly NO_X emission rates for both the HECA Project and nearby sources will be inputted into AERMOD to predict NO_2 concentrations, and then ambient monitoring background NO_2 concentrations will be added to the modeled concentrations.

The February 2010 U.S. EPA guidance recommends running AERMOD to produce an output file with NO_2 concentrations at every receptor for every hour in the meteorological data set using the hourly POSTFILE option. URS designed a post-processor that adds the hourly POSTFILE modeled NO_2 concentrations to the concurrent hourly NO_2 background data, then determines the eighth-highest (98th percentile) daily maximum 1-hour NO_2 concentration at each receptor for each year modeled. The eighth-highest daily 1-hour maximum concentrations at each receptor are then averaged across the five modeled years and the maximum of these averaged values from all receptors is used to represent the NO_2 design value concentration for comparison with the NAAQS. This post-processor calculates modeling results that will comply with the statistical nature of the NO_2 NAAQS.

If the total regional impacts (i.e., model result plus background) are predicted to be greater than the NAAQS, then for that hour and receptor, the impact from HECA Project operations sources will be compared to the interim Significant Impact Level (SIL). If the predicted impact from just the HECA Project operations sources is less than the interim SIL, then it will be concluded that the HECA Project operations do not contribute to the violation, and thus, compliance with the standard is demonstrated.

3.1 RATIONALE FOR SELECTION OF PVMRM

The OLM that HECA intends to use is the PVMRM algorithm in AERMOD to estimate the 1-hour ground level concentrations of NO_2. Because PVMRM is a non-regulatory option in AERMOD, justification for its use is required. On September 16, 2010, SJVAPCD posted on their website a draft guidance document, *Assessment of Non-Regulatory Options in AERMOD Specifically OLM and PVMRM*, to aid in this justification (SJVAPCD, 2010b). This guidance document is attached to this memo as Attachment A. Based on the SJVAPCD guidance and discussions with U.S. EPA Region IX staff, HECA provides the following five-point justification for use of the PVMRM model.

1. The model has received a scientific peer review.

As noted in the U.S. EPA's June 2010 guidance document, because AERMOD is the preferred model for dispersion for a wide range of applications, the alternative model demonstration for use of the OLM/PVMRM options within AERMOD focuses on the treatment of NO_X chemistry within the model, and does not need to address basic dispersion algorithms within AERMOD. The chemistry for PVMRM has been peer-reviewed, as noted by the documents posted on the U.S. EPA's Support Center for Regulatory Air Modeling web site. The posted documents include *Sensitivity Analysis of PVMRM and OLM in AERMOD* (MACTEC, 2004) and *Evaluation of Bias in AERMOD-PVMRM* (MACTEC, 2005). Both documents indicate that the models appear to perform as expected.

2. The model can be demonstrated to be applicable to the problem on a theoretical basis.

As noted in *Sensitivity Analysis of PVMRM and OLM in AERMOD* (MACTEC, 2004), which was prepared by Roger W. Brode of MACTEC (now with U.S. EPA OAQPS):

> *"Overall the PVMRM option appears to provide a more realistic treatment of the conversion of NO_X to NO_2 as a function of distance downwind from the source than OLM or the other NO_2 screening options (Hanrahan, 1999a; Hanrahan, 1999b). No anomalous behavior of the PVMRM or OLM options was identified as a result of these sensitivity tests."*

Based on this report, the model appears to appropriately account for NO_2 formation and provides a better estimation of the NO_2 impacts, compared to other screening options.

3. The databases that are necessary to perform the analysis are available and adequate.

The data needed to conduct a PVMRM run are (1) hourly meteorological data, (2) hourly O_3 data, and (3) in-stack NO_2/NO_X ratio. A further refinement of the modeling will entail use of hourly ambient NO_2 data. HECA processed the meteorological, O_3, and NO_2 data following applicable U.S. EPA guidance, as discussed in later sections of this modeling protocol. The analysis will use NO_2/NO_X in-stack ratios obtained from published references or engineering estimates.

4. Appropriate performance evaluations of the model have shown that the model is not biased toward underestimates.

As noted in *Evaluation of Bias in AERMOD-PVMRM* (MACTEC, 2005), which was prepared by Roger W. Brode, PVMRM has been judged to provide unbiased estimates based on criteria that are comparable to, or more rigorous than, evaluations performed for other dispersion models.

5. A protocol on methods and procedures to be followed has been established.

When HECA's PSD application was submitted in 2008, HECA set forth a modeling protocol (URS, 2008) that outlined the techniques to be used in the PSD analyses. In 2009, HECA submitted a revision to the modeling protocol to address Project changes and to incorporate the comments that the U.S. EPA Region IX provided on the 2008 protocol (URS, 2009). HECA had additional subsequent discussions with the U.S. EPA Region IX and with U.S. EPA OAQPS to determine appropriate modeling techniques for conducting the 1-hour NO_2 NAAQS modeling. HECA has incorporated the U.S. EPA's (Region IX and OAQPS) comments on these modeling protocols, along with comments from discussions into this modeling protocol for the 1-hour NO_2 NAAQS modeling. Therefore, HECA requests that the U.S. EPA consider the modeling techniques outlined in HECA's previous modeling protocols and the techniques discussed between the U.S. EPA (Region IX and OAQPS) and HECA as they review this document.

3.2 HECA PROJECT OPERATIONS EMISSIONS

In the NO_2 1-hour NAAQS modeling analysis, the maximum hourly emissions from each source at the HECA Project and from the nearby sources will be input into the AERMOD model. Section 3.6 of this modeling protocol discusses the emissions from the nearby sources. Table 1 summarizes the maximum NO_2 hourly emission scenario for each source at HECA. This emission scenario is the same as was used in the modeling that was previously submitted to the U.S. EPA, SJVAPCD and the California Energy Commission (CEC).

It should be noted that emissions from the CTG/HRSG are representative of a hot startup, not normal operations, and are eight times higher than the normal-operations "target BACT" emission level of 2 ppm, and four times higher than maximum-permitted 4 ppm level. HECA expects that the CTG/HRSG NO_X emissions will meet the 2 ppm target BACT level within the initial 2-year evaluation period. The turbine is permitted to start up no more than 30 times per year; however, these startup emissions will be inputted for all hours of the five-year meteorological modeling data set. Since this is a baseload facility, it is expected that the actual number of turbine startups will be significantly fewer than the permitted 30 per year.

In this maximum hourly emission scenario, almost all NO_X sources operate simultaneously and with maximum possible emission rates. This maximum hourly emission scenario would not actually occur, but is used to ensure that potential impacts from HECA Project operations could not possibly be underestimated. This scenario is highly unlikely; for example, the actual maximum hourly emission rate from the gasification flare would occur during an off-line CTG wash, thus the CTG would not be operating at the same time. The maximum emission scenario also includes the simultaneous testing of one of the emergency generators and the fire water pump to determine potential impacts from both sources, although this is never expected to actually occur. Furthermore, actual normal operational emission rates will be less than the permitted rates, and for some equipment, the actual emission rates will be many orders of magnitude smaller than the permitted rates.

Table 1
Maximum Hourly Emission Scenario for all NO_2 Sources at HECA

HECA Project Operations Source	Maximum Hourly Emission Scenario
Turbine/HRSG Stack	Maximum Hot Start-up Emissions
Gasification Flare	Maximum Hourly Emissions associated with Off-line CTG Wash
SRU Flare	Maximum Hourly Emissions associated with Gasifier Startup or Shutdown
Rectisol Flare	Maximum Hourly Emissions associated with Gasifier Startup or Shutdown
Auxiliary Boiler	Not operating when all other sources are operating
Tail Gas Thermal Oxidizer	Maximum Hourly Normal Operations Emissions
Gasifier Warming Vent A	Maximum Hourly Normal Operations Emissions
Gasifier Warming Vent B	Maximum Hourly Normal Operations Emissions
Gasifier Warming Vent C	Not operating, backup for Vent A and B
Emergency Generator 1	Maximum 1-hour Operation for Testing
Emergency Generator 2	Not operating, both generators will not be tested during the same hour
Fire Water Pump Diesel Engine	Maximum 1-hour Operation for Testing

The maximum hourly emission scenario for HECA Project operations was chosen to very conservatively estimate the absolute worst-case hourly emissions for each source. Actual operational emissions are expected to be significantly lower; thus, the impacts predicted from modeling this maximum emission scenario are expected to be significantly higher than any potential impacts from operation of the HECA Project.

3.3 HECA PROJECT STACK PARAMETER SELECTION

The Air Quality section of HECA's 2009 *Revised Application for Certification* (AFC) (HECA, 2009) contains a subsection entitled "*Turbine Impact Screening Modeling*". This subsection described the screening modeling analysis that was performed to determine which CTG/HRSG operating mode and stack parameters produced the worst-case off-site impacts. The turbine impact screening modeling was not revised for this NO_2 modeling analysis; the same stack parameters from the Revised AFC were used in all subsequently refined AERMOD analyses. These stack parameters were associated with Case 2C (i.e., 60 percent load burning natural gas) and had the lowest exhaust temperature and exit velocity.

The stack parameters associated with 60 percent load operation of the turbine have a lower exhaust temperature and exit velocity than when the turbine operates at 100 percent load, which lessens the potential for dispersion of pollutants. As a baseload facility, the turbine will rarely operate at a reduced load; thus, the stack parameters used in the modeling of the turbine will result in predicted impacts that are significantly higher than potential impacts from operation of the HECA Project.

3.4 GOOD ENGINEERING PRACTICE FOR HECA PROJECT OPERATIONS SOURCES

As defined in *Guideline for Determination of Good Engineering Practice Stack Height* (U.S. EPA, 1985), "good engineering practice" (GEP) is defined as the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, or wakes that may be created by the source itself, nearby structures, or nearby terrain obstacles.

All stacks in the HECA Project will be less than or equal to the GEP default height of 65 meters, except for the three flares and the CO_2 vent. The CO_2 vent is not a NO_X emission source; therefore, it will not be included in this modeling. The heights of the three flare stacks and CO_2 vent are as follows:

- SRU Flare: 81.5 meters;
- Gasification Flare: 109.2 meters;
- Rectisol Flare: 93.3 meters; and
- CO_2 Vent: 79.2 meters.

The Building Profile Input Program Plume Rise Model Enhancements building downwash model (BPIP Prime) has been run to determine the GEP height for each stack. The output of this model shows that the GEP for the three flares and the carbon dioxide vent is 152.4 meters. This file was provided to the U.S. EPA Region IX with the other air quality modeling files and will be provided with the NO_2 1-hour NAAQS analysis modeling files.

GEP is calculated based on the following equation:

$$H_g = H + 1.5 * L$$

Where: H_g = GEP stack height (in meters)
H = height of the nearby structure (in meters)
L = lesser dimension of the height or projected width of the nearby structure (in meters)

The largest nearby structure is the gasifier building, which is 60.96 meters high and 70.9 meters long. Therefore, L = 60.96 meters, H = 60.96 meters, and H_g = 152.4 meters.

The gasifier building is located at a distance within five times L (304.8 meters) from the three flares and the CO_2 vent; therefore, GEP for these stacks is calculated based on the gasifier building dimensions. The heights of the three flares and the CO_2 vent are thus well below the GEP height of 152.4 meters.

3.5 RECEPTOR DESCRIPTION

Preliminary modeling showed that potential impacts from HECA Project operations with the maximum hourly emission scenario would generally fall below the interim SIL more than 50 kilometers from the HECA Project Site. Furthermore, potential impacts beyond 50 kilometers exceed the interim SIL in only a few directions. However, the U.S. EPA considers most steady-state Gaussian plume models, including AERMOD, to be applicable out to 50 kilometers, but not beyond. Therefore, impacts from the HECA Project operations and nearby sources will be examined out to a distance of 50 kilometers from the HECA Project Site. Although the receptor grid will stop at 50 kilometers, if a large source is located beyond 50 kilometers, it may be included in the nearby source inventory.

The same receptor grid used in the air quality impact analyses presented in the Revised AFC and subsequent revisions will be used out to 10 kilometers. The base grid is described below, but additional receptors, at 25-meter spacing, were located in the hills southwest of the HECA Project Site where the maximum potential impacts from HECA Project operations were predicted.

For this NO_2 1-hour analysis, additional receptors will be included out to 50 kilometers at 1-kilometer spacing. The base receptor grid to be used in the NO_2 modeling analysis is as follows:

- 25-meter spacing along the HECA Project Site boundary and extending from the boundary out to 100 meters beyond the boundary;
- 50-meter spacing from 100 to 250 meters beyond the HECA Project Site boundary;
- 100-meter spacing from 250 to 500 meters beyond the HECA Project Site boundary;
- 250-meter spacing from 500 meters to 1 kilometer beyond the HECA Project Site boundary;
- 500-meter spacing from 1 to 2 kilometers of the HECA Project Site boundary; and
- 1,000-meter spacing from 2 to 50 kilometers of the HECA Project Site boundary.

Receptors that are located within the property of nearby sources will be removed based on professional judgment, as nearby source impacts do not need to be predicted within their own property boundary. If modeled impacts from HECA Project operations appear that they could potentially cause or contribute to a violation at any removed receptor, a separate model run with HECA Project operations and all nearby sources will be conducted for that receptor, with the exception of the onsite source(s).

Terrain heights at receptor grid points were determined from U.S. Geological Survey (USGS) digital national elevation datum (NED) files using AERMAP.

3.6 EVALUATION OF NEARBY AND OTHER NO_2 EMISSIONS SOURCES

Section 8.2 of Appendix W of 40 CFR, Part 51 (the U.S. EPA's *Revision to the Guideline on Air Quality Models* [U.S. EPA, 2005]) refers to background concentrations as "an essential part of the total air quality concentration to be considered in determining source impacts." For the case that a source is not isolated, a multi-source model (i.e., AERMOD) is prescribed to establish the potential impact of nearby sources. In the recommendations sub-sections for multi-source areas, the following key points are made:

- contributions from ***nearby sources*** and contributions for ***other sources*** should be determined;
- ***nearby sources*** are those expected to cause a significant concentration gradient in the vicinity of the source or sources under consideration; the number of such sources is "expected to be small" given the complexities of modeling specific projects (i.e., unique modeling situations, large numbers of variables), it specifically states that the definition is provided merely as guidance and is not intended to alter professional judgment;
- an appropriate model should be employed along with emission input data as shown in Table 8-1 or 8-2 of the U.S. EPA guidelines (U.S. EPA, 2005); any unpermitted sources should be modeled at their maximum physical capacity to emit;
- only sources that would run simultaneously with the primary source being modeled (i.e., HECA) are to be modeled; as an example it provides: "emergency backup generators that never operate simultaneously with the sources that they back up would not be modeled as nearby sources;"
- interactions between the primary source and the various nearby sources should be evaluated by examining the areas of maximum impact for each separately, followed by examination of the area of maximum impact where the two are combined, on a "trial and error" basis; and
- ***other sources*** are defined as the "portion of the background attributable to all other sources (e.g., natural sources, minor sources, and distant major sources)" to be determined using prescribed methods.

Other sources that are not accounted for in the background data, such as minor sources and distant major sources, will be included in the modeling analysis, and for simplicity in discussions in this protocol, will be referred to as "nearby sources."

URS requested information on NO_2 emissions sources surrounding the HECA Project Site from the SJVAPCD for the PSD analysis. SJVAPCD provided a list of over 8,500 permitted sources to a distance of approximately 75 kilometers from the center of the HECA Project Site. Upon closer inspection, the NO_X emissions data for approximately 75 percent of these sources contained either no values for the daily or annual emission rates or presented values of zero. For the most part, those sources consisted of processes or equipment that would not emit NO_X (e.g., VOC sources, such as gasoline stations, storage tank operations, etc., or particulate matter (PM) sources, such as wood processing, dust control equipment, etc.). This sub-list of sources was screened to identify dormant equipment, using search terms such as “ENGINE” and “TURBINE”; any such equipment was labeled as equipment that was assumed dormant.

Furthermore, equipment was analyzed based upon its distance from the HECA Project Site. The fairly large distance between the HECA Project Site centroid and its property fence line (approximately 1.3 miles) resulted in URS extending the radii (or distance) to screen. For example, the first subset of equipment was limited to equipment within 11.4 miles (18.3 kilometers) of the HECA Project Site, resulting in an analysis of all facilities within 11.4 miles. Subsequent screening distances were for equipment located between 11.4 miles and 32.4 miles (52.1 kilometers) from the HECA Project Site and between 32.4 and 46.4 miles (52.1 and 75 kilometers) from the HECA Project Site. In summary, the following distances were used to evaluate the sources surrounding the HECA Project Site:

- Source distance less than 11.4 miles (18.3 kilometers);
- Source distance greater than or equal to 11.4 miles (18.3 kilometers), and less than or equal to 32.4 miles (52.1 kilometers);
- Source distance greater than 32.4 miles (52.1 kilometers)

3.6.1 Emissions Source Screening Methodology

After omitting sources for which NO_X emissions were either zero or not provided, URS used a qualitative approach to further refine the sources scheduled for consideration (and potential inclusion) in forthcoming modeling analyses to evaluate compliance with the NO_2 standard. This approach was based upon professional judgment and made use of various source metrics or a combination thereof, including, but not limited to the following:

- size (e.g., horsepower [hp], heat input rating, or emissions);
- type of source;
- frequency of use (e.g., emergency/standby internal combustion (IC) engine/ emergency fire pump, test operation);
- relative emission rate (Q) divided by source distance from HECA centroid (d), Q/d;

and, specifically for IC engines:

- U.S. EPA Tier emission rating.

The use of Q/d was prescribed as a viable screening method for PSD projects in a 1985 letter by the State of North Carolina Department of Natural Resources and Community Development (NCDNRCD) (NCDNRCD, 1985). That particular reference suggested that this simple screening method could be employed to:

> "rapidly and objectively eliminate from the emissions inventory those sources that are beyond the PSD impact area yet within the screening area, but are not likely to have significant interaction with the PSD source."

Two Q/d values labeled Q/D-1 and Q/D-2, with units of tons per year per kilometer (ton/yr/km) were calculated for each source by converting the daily and annual emissions values provided by the SJVAPCD (originally in units of pounds per day and pounds per year, respectively). As would be expected, the values calculated using daily emissions are more conservative (except in the case of several flagged sources [errant data]); that is, they would cause more sources to be included in the analysis.

A summary of the number of sources that met a Q/d threshold of 2, one order of magnitude less than the threshold of 20 used in the NCDNRCD document (NCDNRCD, 1985), are provided in Table 2.

Table 2
Summary of Number of Sources with a Q/D Threshold of 2

Distance	Threshold Value	No. of Sources Included, Using ONLY Q/d Calc	
		Q/D-1 ([ton/yr]/km) (based on daily emissions)	Q/D-2 ([ton/yr]/km) (based on annual emissions)
< 11.4 mi (18.3 km)	2	37	25
≥ 11.4 mi (18.3 km) and ≤ 32.4 mi (52.1 km)	2	72	22
> 32.4 mi (52.1 km)	2	3	0

Notes:

Some of these sources may have been omitted due to other factors (e.g., considered dormant), while still others may have been included due to factors such as facility size, type (e.g., cogeneration facilities), or the existence of co-located sources.

< = less than
> = greater than
≤ = less than or equal to
≥ = greater than or equal to
[ton/yr]/km = tons per year per kilometer

Using professional judgment, a number of facilities (especially oil production/refining operations, cogeneration plants, etc.) were included based upon the fact that they had a significant number of sources or yielded significant emissions, even if they had Q/d values less than the screening threshold presented above. As a check on the aforementioned judgment, additional effort was made to evaluate a "totalized" facility Q/d, whereby the sum of the Q/d values for a facility's sources (those sources with NO_X emission rates greater than 2 pounds per hour [or 48 pounds per day]) was compared to the Q/d threshold of 2 used above. No such cases were found; therefore, no additional facilities were included.

Smaller co-located sources within the lesser 10-mile radius were also more likely to be included than those at greater distances. The result of adding the various co-located sources and the sources found at fairly large facilities (even those below threshold values) resulted in the source counts presented in Table 3.

The source counts above are based upon professional judgment, while also taking into account the sources with a Q/D-1 or Q/D-2 greater than or equal to 2; in addition, all sources (co-located or not) with a daily emission rate less than or equal to 48 pounds per day (equates to 2 pounds per hour) were omitted from the source list due to their limited size.

Due to the ongoing nature of this modeling study, the number of sources discussed above that are being considered for inclusion in the modeling are subject to change. Such reasons for removing sources may include, but are not limited to the following:

1. duplicative/backup sources;
2. additional information provided for a given source;
3. including only the largest emergency engine per facility in the inventory; and
4. if a source closer to HECA does not result in a significant concentration gradient, a similar source farther from HECA may be eliminated.

Table 3
Preliminary Estimation of Sources to be Included in the NO_2 1-hour PSD Analysis

	Number of Sources				
Distance Range	**Included (approx. no. of IC emergency units)**	**Dormant, or Assumed Dormant**	**Excluded based upon Professional Judgment**	**Zero or Blank NO_X Emissions**	**Total**
< 11.4 mi (18.3 km)	72 (30)	27	132	578	809
≥ 11.4 mi (18.3 km) and ≤ 32.4 mi (52.1 km)	345 (76)	360	1,390	5,445	7,540
> 32.4 mi (52.1 km)	13 (3)	10	97	189	309
Totals	430 (109)	397	1,619	6,212	8,658

Notes:

Some of these sources may have been omitted due to other factors (e.g., considered dormant), while still others may have been included due to factors such as facility size, type (e.g., cogeneration facilities), or the existence of co-located sources.

< = less than
> = greater than
≤ = less than or equal to
≥ = greater than or equal to
km = kilometer

Sources immediately adjacent to the Shafter monitoring station that would already be included in the background data will be excluded from the analysis.

The nearby sources that will be included in the NO_2 modeling analysis will all use their maximum hourly emission rate. These maximum hourly emission rates will be determined from each source's maximum permitted daily emissions divided by 24 hours. The modeling analysis will include all nearby sources operating simultaneously with maximum emissions; this is an extremely conservative assumption and is guaranteed to overestimate potential impacts from these sources during actual HECA Project operations.

Stack parameters for the nearby sources and other sources included in the analysis will be provided by SJVAPCD or derived from similar equipment based on professional judgment. Justification for stack parameters used will be provided in the model report.

The final modeling report will include a figure showing the locations and relative emission rates for each facility included in the analysis and a detailed table will be provided describing the nearby sources selected and those eliminated.

3.6.2 NO_2/NO_X In-Stack Ratios

For the emergency generators, firewater pump, and auxiliary boiler, the analysis will use the NO_2/NO_X in-stack ratio obtained from the SJVAPCD 2010 draft guidance document, *Assessment of Non-Regulatory Options in AERMOD Specifically OLM and PVMRM* (Attachment A) and the updated Recommended In-Stack NO_2/NO_X Ratios (Attachment B). For the emergency generators and fire water pump, the analysis will use an in-stack ratio of 0.2 from the "IC Engines (Diesel)" category. For the auxiliary boiler, the analysis will use 0.1 for the in-stack ratio from the category "Boilers (NG)."

Currently, limited information is available on in-stack NO_2/NO_X ratios for gasifier refractory heaters, thermal oxidizers, and flares. The gasifier refractory heaters are fueled with natural gas and are expected to have an exhaust profile similar to a natural gas boiler; therefore, an in-stack ratio of 0.1 will be used. The exhaust from the thermal oxidizer or flares will have very little to no residence time in the stack, so almost no conversion of nitrogen oxide (NO) to NO_2 is expected. For these sources, it was conservatively assumed that 10 percent of the NO_X will be NO_2.

No data exist for the NO_2/NO_X in-stack ratio for turbines burning hydrogen-rich fuel. The turbine vendor expects the NO_2/NO_X in-stack ratio will be similar to turbines that burn natural gas. Based on the in-stack NO_2/NO_X ratio of 0.091 for a natural gas turbine as determined by SJVAPCD guidance, and accounting for the conversion of NO to NO_2 across the oxidation catalyst that could be as high as 20 percent (NO_2/NO_X ratio 0.2), HECA proposes to use the conservative NO_2/NO_X in-stack ratio of 0.3 for all turbine operating conditions. Neither the turbine nor oxidation catalyst vendor could provide written documentation regarding the NO_2/NO_X in-stack ratio, although this ratio was their professional engineering estimate.

The NO_2/NO_X in-stack ratio for the nearby sources included in the analysis will be determined per equipment type from the SJVAPCD guidance document and other appropriate documents. Where good information regarding a particular type of source is not available, a high ratio will be used. Justification for each ratio will be provided in the model report.

3.6.3 Ambient NO_2/NO_X Ratio

The PVMRM algorithm uses the ambient or equilibrium NO_2/NO_X ratio in calculating the predicted NO_2 concentrations. On an hourly basis, the ambient NO_2/NO_X ratio will vary depending on nearby sources, meteorological conditions, and ambient O_3 concentrations. The PVMRM algorithm in AERMOD is not designed to accept hourly ambient NO_2/NO_X ratios; therefore, a regional annual ratio must be used in the model.

The annual average equilibrium ratio from all NO_2 monitoring stations in Kern County for the same years used for the meteorological data in the modeling (2004 through 2008) was 0.63. The monitors within Kern County that measure NO_2 are Arvin-Bear Mountain Boulevard, Bakersfield California Avenue, Bakersfield Golden State Highway, Edison, and Shafter. The data were obtained from the California Air Resource Board (CARB) AQMIS website (CARB, 2010). The locations of the monitoring stations considered for this analysis are presented in Figure 1. Closer views of the HECA Project Site and each monitoring station are presented in Figures 2, 3, 4, and 5. Section 3.10 of this protocol discusses monitoring station data in more detail.

The analysis will use a NO_2/NO_X equilibrium ratio of 0.9, which represents the hourly upper bound, as recommended by U.S. EPA Region IX. It should be noted that this value is significantly higher than the annual average ratio of 0.63 for 2004 through 2008, where the ambient NO_2/NO_X ratio was greater than or equal to 0.9 only 4 percent of the time. The use of the NO_2/NO_X equilibrium ratio of 0.9 is yet another conservative assumption in the NO_2 modeling analysis.

3.7 METEOROLOGICAL DATA

Hourly surface data were obtained from the SJVAPCD for the Bakersfield Meadows Field Airport (BFL) meteorological station for the years 2004 through 2008. The SJVAPCD hourly surface observation data included meteorological parameters of temperature, dew point, pressure, wind speed, wind direction, cloud cover, and ceiling height. SJVAPCD has prepared a document describing their meteorological processing methodology, “Procedures for Downloading and Processing NCDC Meteorological Data” (SJVAPCD, 2010a), provided in Attachment C.

The BFL station is approximately 20 miles northeast of the HECA Project, as shown in Figure 1. The data meet the U.S. EPA criteria for representativeness, and are suitable based on proximity and terrain similarities between the Project Site and BFL. The terrain immediately surrounding the meteorological station and the HECA Project is rural, as shown in the aerial photographs of Figure 2. Circles with a 1-kilometer radius around the HECA Project Site and the meteorological station show terrain similarities, specifically open fields and semi-developed land use categories. Projected HECA Project structures will create a more developed site at the Project location, producing some developed land use, similar to the airport. There are no major geographical features that could influence the meteorological conditions between or near the locations. The 2004-2008 data set represents data collected over five years. Although only 1 year of on-site data is required for use in regulatory modeling under U.S. EPA guidelines, a five-year data set was used to better represent the Project Site conditions, as well as to capture worst-case meteorological conditions.

The BFL station and the HECA Project Site each lie within the southern portion of the San Joaquin Valley, between the foothills of the Sierra Nevada Mountains to the east, the Diablo Mountain Range to the west, and the Tehachapi mountains to the south. The HECA Project Site sits at 288 feet above sea level while the BFL station sits at 489 feet. The climate in the valley is warm and semi-arid, with the wet season occurring between October and April. The 30-year average for normal sky coverage in the Bakersfield has an annual average of 189 days of clear skies per year, 80 days of party cloudy skies, and 92 days of cloudy skies. Summers are clear and dry. The relative humidity is low in the summer and high in the winter, with an average annual relative humidity of 54 percent. Winds in the San Joaquin Valley often flow with the axis of the valley, and thus blow frequently from the northwest. During the summer the northwest sea breezes frequent the Bakersfield area; especially during hot summer periods, which may carry dust and bring thermal instability. As air descends downward over the mountain ranges, it warms and dries out, allowing temperatures in the city and adjacent areas of the southeastern San Joaquin Valley to run warmer than areas farther north. A very strong eastern Chinook wind will often blow through the Tehachapi Pass during the winter months. Frontal passages are also common in winter months throughout the valley (NCDC, 2010; NOAA, 2008).

Only two long-term upper air stations exist for the entire State of California that collect enough data for use in air quality modeling. These stations are in Oakland and San Diego. There is an upper air station at Vandenberg Air Force Base in California, but this station has insufficient hourly data for modeling. SJVAPCD chose the Oakland International Airport upper air station for all meteorological data processing. Data were obtained from the National Oceanic and Atmospheric Administration Radiosonde Database for the same years as the surface station data. The Oakland Airport upper air station is approximately 235 miles northwest of the Project Site. Using the Oakland upper air data and the Bakersfield surface data, AERMET creates an hourly wind profile increasing with height to estimate wind parameters at different plume heights.

The U.S. EPA AERMOD Implementation Guide in January 2008 discussed a fairly new developed tool called AERSURFACE, which may be used to establish realistic and reproducible surface characteristic values around the meteorological surface station. SJVAPCD used the AERSURFACE program to determine surface characteristics for input into the AERMET processor program for the Bakersfield meteorological data set. AERSURFACE uses USGS National Land Cover Data 1992 archives to determine the Albedo, Bowen ratio, and surface roughness length representative of the surface meteorological station.

For the AERSURFACE input, the U.S. EPA-recommended surface parameter distance of 1 kilometer was used to develop surface roughness values and a 10-kilometer radius was used for Albedo and Bowen ratios. Figure 2 displays an aerial view of the HECA Project Site and BFL meteorological station site, with a circle 1 kilometer in radius surrounding both locations. The meteorological station is at an airport, does not receive continuous snow cover in the winter, and is not in an arid region. The Bowen ratio calculation is based on the upper, middle, or lower 30th percentile surface moisture conditions representing wet, average, or dry conditions, respectively.

For reference, an annual wind rose based on the five years of surface Bakersfield data is provided as Figure 6, Annual Wind Rose for BFL, with a frequency distribution table presented in Attachment D. Winds blow predominantly from the northwest with an average annual speed of 6 miles per hour, but winds are often calm. Western Regional Climate Center Bakersfield Meadows Airport temperature data for the years 1937 through 2010 indicate the average annual high and low temperature for this station are 79 degrees Fahrenheit (°F) and 53°F, respectively (WRCC, 2010).

The HECA Project Site is in close proximity to the BFL meteorological station, so the locations have a similar climate, the land use surrounding each location is comparable, and there are no major geographical features between the HECA site and weather station that could cause a difference between the meteorological conditions at the two locations. Therefore, the meteorological data at the BFL station are representative for use in the NO_2 regional modeling analysis.

3.8 O_3 AND NO_2 DATA

To show HECA Project operations compliance with the new NO_2 1-hour NAAQS, NO_2 and O_3 monitoring data are needed for modeling. Hourly O_3 data will be used in conjunction with the PVMRM algorithm in AERMOD. NO_2 hourly data will be used to represent ambient background NO_2 concentrations from sources not included in the regional modeling analysis, such as mobile sources. The hourly NO_2 data will be combined with the hourly NO_2 impacts predicted from the modeling to show the maximum potential regional NO_2 impacts described in the following section. Because the modeled impacts will account for the extremely unlikely event that all nearby sources operate at their maximum hourly emission rates in any given hour, the addition of background data adds another layer of conservatism to the already over-predicted 1-hour modeled impacts.

The NO_2 and O_3 monitored data should cover the same years as the meteorological data used in modeling, and be from the same monitoring station, to represent the balance between ambient NO_2 and O_3 concentrations. As mentioned in the above section, the meteorological data used for modeling are from the BFL, for years 2004 through 2008. Several monitoring stations within Kern County in the San Joaquin Valley Air Basin were considered for the NO_2 and O_3 data; these are shown in Figure 1 and Figures 3 through 5. The monitoring station nearest to the proposed Project Site that measured both these pollutants during these years is in Shafter, California. Raw data for the Shafter monitoring station from CARB also demonstrated data completeness requirements during all quarters (more than 75 percent data capture) for all five years, per 40 Code of Federal Regulations Parts 50 and 58, February 9, 2010, Appendix S, 3.2(b).

The Shafter monitoring station is most representative of the rural location at the HECA Project Site. The Shafter monitoring station is on the roof of the local Department of Motor Vehicles building, which is surrounded by parking lots, and is near several roadways and a railroad, seen in Figure 3. California State Route 43 is 540 feet to the west of the Shafter monitoring station, and currently has an average daily traffic (ADT) volume of 14,000 trips (Caltrans, 2010). The Shafter monitoring station is 350 feet to the west of the Burlington Northern Santa Fe railroad. Due to the close proximity to State Route 43 and the railroad, the data from this station account for potential impacts from sources related to transportation. Since the HECA Project location is several miles from any major roadway, the Shafter monitoring station is expected to measure significantly more pollution from mobile sources than if a monitor were located next to the completed HECA Project. The ADT volumes at the HECA site for the current year and future year (2016, with and without the Project) are given in Table 4. The traffic volume near the Shafter monitoring station is more than 25 times larger than the volume near the Project Site. In future year 2016, the Shafter monitoring station will have at least 3 times the traffic volume nearby than the traffic volume near the Project location. Therefore, it is very conservative to represent the background pollution from transportation sources near the HECA site with Shafter monitoring station data.

Table 4
HECA Project Site Average Daily Traffic Counts

Road Segment	Existing ADT (February 2009 Counts)	2016 ADT Added from Project Operational Trips	2016 ADT Without Project Trips	2016 With Project ADT
Adohr Road between Dairy and Tupman	258	1,650	294	1,944
Tupman Road between Adohr Road and Station Road	121	96	138	234
Dairy Road between Adohr Road and Stockdale Highway	177	1,650	202	1,852
Total ADT around Project Site	**556**	**3,396**	**634**	**4,030**

Source: URS Corporation

The NO_2 and O_3 data used in the regional NO_2 analysis should adequately account for mobile emission sources; thus, selection of the monitoring station should be near mobile sources. Because the NO_2 1-hour analysis that is being conducted is a regional analysis, it would be inappropriate to use O_3 data from a station heavily influenced by local sources.

The monitoring station is not near large industrial sources, but such sources will be accounted for in the regional modeling. Figures 7 and 8 graphically present the hourly and annual emissions (respectively) of stationary sources within 10 kilometers of the Shafter monitoring station. As can be seen, the stationary sources within the city limits are primarily smaller sources. Eight of the ten sources within 2 kilometers of the Shafter monitoring station are owned and operated by the City of Shafter and are electrical generators or pumps powered by emergency standby IC engines. The remaining two sources consist of an emergency standby IC engine and a small natural gas-fired heater, both under different ownership. On Figure 7, the larger hourly contributors (i.e., those with hourly emissions estimated at greater than 10 pounds per hour), beginning due west of the monitor and rotating counter-clockwise around the monitoring station are the following: Oasis Holstein Dairy; Vermeer Goedhart Dairy; North of River Sanitary District; Plains LPG Services, L.P.; and Performance Food Group. Comparison of the respective hourly and annual emissions for these facilities implies that the only equipment that operates on a regular basis is the equipment at Plains LPG Services, L.P., and, to a lesser extent, Oasis Holstein Dairy. The equipment at the remaining facilities consists largely of smaller sources or sources that do not operate on a regular basis (e.g., standby emergency IC engines). It is important to note that neither the smaller sources (i.e., those with lower emissions) that are less frequently operated nor sources close to the monitoring station (as presented in Figures 7 and 8) will be included in the PSD modeling performed to assess compliance with the 1-hour NO_2 standard. A description of the nearby sources to be included in the NO_2 analysis was provided above in Section 3.6.

Because the Shafter monitoring station is near mobile sources but no large industrial sources, and is not downwind from an urban area, the data appropriately represent ambient O_3 concentrations expected to be found throughout the rural San Joaquin Valley. Therefore, the Shafter monitoring station was chosen to represent the background NO_2 and O_3 data in the modeling.

Other stations that were considered for NO_2 and O_3 data are shown in Table 5. These other stations did not meet the following criteria:

1. Meet data completeness requirements;
2. Match the rural land use surface parameters of the proposed Project Site;
3. Show close proximity to the Project Site compared to other monitoring stations;
4. Monitor NO_2 or O_3 data; or
5. Meet a combination of the above-mentioned points.

Bakersfield NO_2 and O_3 data were not used because neither station in Bakersfield met data completeness requirements, and the Bakersfield stations' urban locations are not representative of the rural HECA site. Figure 1 displays an overview image of the HECA Project Site and locations of several nearby monitoring stations. Close-up aerial images of the HECA Project Site next to the surface meteorological station used in the AERMET files (described in Section 3.9 of this modeling protocol) are shown in Figure 2. Finally, zoomed-in locations of the monitoring stations at Shafter, Bakersfield-California Avenue, and Bakersfield-Golden State Highway are presented in Figures 3 through 5, respectively.

Table 5
Monitoring Stations Considered for Ozone and Nitrogen Dioxide Data, Kern County, San Joaquin Valley Air Basin

Monitoring Station	NO_2 Data Availability Years	O_3 Data Availability Years	Distance from Project Site (Miles)	All Quarters Between 2004-2008 Have 75% Raw Data Capture for NO_2 and O_3?[1]
Maricopa-Stanislaus Street	Not Applicable	1987-2008	19	Not Applicable
Shafter-Walker Street	1989-2008	1989-2008	13	Yes
Taft College	Not Applicable	Not Applicable	13	Not Applicable
Bakersfield-Golden State Highway	1994-2008	1994-2008	21	No; 1st and 2nd quarter of 2004 under 75% data capture
Bakersfield-5558 California Avenue	1994-2008	1994-2008	18	No; 3rd quarter of 2004 under 75% data capture
Bakersfield-410 E Planz Road	Not Applicable	Not Applicable	21	Not Applicable

Notes:

[1] Raw data per quarter must meet 75% data capture, per 40 Code of Federal Regulations Parts 50 and 58, February 9, 2010, Appendix S, 3.2(b).

Data from CARB (2010): http://www.arb.ca.gov/aqmis2/aqdselect.php?tab=specialrpt.

A diurnal "peak and valley" fluctuation in the Shafter station NO_2 and O_3 data is apparent in Figures 9 and 10, which present examples of the monitored pollutants during a winter month (January) and a summer month (July) in 2004. Because nitrogen dioxide is a precursor to ozone (where ozone can form by oxidation of nitrogen oxides with sunlight), these pollutants generally have an inverse relationship in ambient air. Figures 9 and 10 show that the hourly NO_2 and O_3 data are correlated, and these data are also dependent upon meteorological conditions.

3.8.1 Filling of Missing Hourly Shafter Data

The Shafter O_3 and NO_2 data for five years were run through a URS FORTRAN program to fill in one or two missing consecutive hour time spans, using interpolation from measured concentrations surrounding the missing hour(s). When more than 2 hours in a row were missing, they were substituted with the maximum value of the monitored concentrations from the same hour from the previous or subsequent day. The data from the previous and subsequent day were reviewed by an air quality scientist to ensure anomalous data did not skew the data files. No anomalous data were encountered.

Figures 11 and 12 provide graphical examples of annual raw and filled-in hourly data for NO_2 and O_3, respectively. Figure 11, for example, shows missing hours in red that were filled in with the techniques discussed above. The year 2004 was, as it exhibited, the lowest NO_2 data capture of all five years (6 percent of the annual hourly values were missing). The longest period of missing NO_2 data in 2004 occurs in March, which can be seen by the higher volume of missing consecutive raw hours (filled hours denoted in red) during this time span. O_3 raw data and filled data for the year 2004 are displayed in Figure 12.

NO_2 and O_3 during the month of March are presented in Figures 13 and 14, respectively, for further examination. The figures demonstrate the daily cyclic pattern in the data and the filling techniques used for creation of full hourly data sets, as needed for modeling.

The filling methods described above will not underestimate the missing background O_3 or NO_2 concentrations, because the maximum concentration for the given hour was substituted. These data are used in the analysis to represent the contribution from mobile sources, then added to the modeling, which very conservatively predicts the contributions from nearby sources simultaneously operating at maximum hourly emissions.

3.9 PAIRING OF BACKGROUND NO_2 DATA WITH MODELING

The NO_2 1-hour NAAQS standard was developed for monitoring to allow for the elimination of outlier hours that may not accurately reflect typical conditions near the monitoring station. In order to conduct modeling to comply with this standard, new post processors have been developed to calculate the eighth-highest daily maximum 1-hour concentration averaged over five years.

To estimate the total NO_2 concentration from both the HECA Project and other sources in the region, the modeling includes nearby sources and background NO_2 data to encompass emission sources not specifically modeled, such as vehicles.

Examination of the Shafter monitoring station raw data showed that the 98th percentile daily maximum 1-hour concentration averaged over the five years was 60 ppb, which is well below the standard. There are very few hours when the background concentration measured is near or above 100 ppb, and more than 80 percent of the data are less than 25 ppb.

During the five-year monitoring period (2004-2008), 2 hours yielded concentrations greater than the standard; these 2 concentrations occurred in two different years. The “first tier” assumption (a term defined in the June 2010 U.S. EPA guidance document [U.S. EPA, 2010c]) of adding the overall highest hourly background NO_2 concentration to the model results is not reasonable in this case. Thus, the additional refinement to the “first tier” approach that HECA will employ is temporal pairing of modeled and monitored values on an hourly basis. Justification for this refinement technique versus use of different temporal pairing techniques is provided below.

One technique of temporal pairing suggested by the U.S. EPA is to develop a background data set that contains the maximum concentration measured for each of the 24 hours of the day and for each month (288 separate default values) for each of the five years. If the background data are paired with the modeled concentrations on a monthly and hourly basis, then from the background data alone, 2 years would have at a minimum 31 daily maximum 1-hour concentrations greater than the standard. Although only 0.005 percent of all hours monitored measured a concentration greater than 100 ppb, this pairing would cause, at a minimum, the standard to be exceeded more than 3 percent of all days in the five-year period. Chances are high that a monitored value measured just under the standard, when added to a low modeled concentration, would also cause the standard to be exceeded for numerous other days. The two 1-hour monitored concentrations that are considered outliers by the standard would now dominate the results of the analysis if this background data set were to be used.

If temporal pairing that is based on meteorological conditions were to be used, the high concentrations measured in the background data alone would cause the standard to be exceeded. To illustrate this point, the data could be paired by matching the highest monitored concentration by wind direction, based on the 16-point cardinal rose. During the 2 hours when the monitored concentrations were greater than the standard, the wind blew from the northwest. The five-year data set shows that the wind blew from the northwest approximately 12 percent of the time. Thus, if this pairing were to be used, 12 percent of the time the standard would be exceeded from the background data alone. Creation of a background concentration data set using this technique would skew the results of the analysis in a way that grossly inflates the possibility of high background concentrations, from 0.005 percent of the time to 12 percent of the time.

This type of exercise could also be used for fabricating a background file using the highest hourly seasonal or annual monitoring values for all five years. All techniques examined for fabricating a background data set skewed these data so much that the background data alone caused the standard to be exceeded. It is an excessive approach to fabricate a background data file, create this kind of bias in the background data file, add it to already conservatively high hourly modeled values, and then compare with the result with the NO_2 1-hour NAAQS.

Instead, the hourly NO_2 monitoring data will be combined with the hourly NO_2 impacts predicted from the modeling to show the maximum potential regional NO_2 impacts. The use of temporal pairing of monitored background concentrations with modeled predicted concentrations on an hourly basis will not under-predict impacts because of numerous conservative assumptions used in the modeling analysis. All of these conservative assumptions are outlined in Section 3.10 of this modeling protocol, although the assumptions with the biggest influence on the predicted impacts are summarized here.

Every concentration predicted with AERMOD will be considered a high impact since every piece of equipment at every source, at HECA and regionally, will be included at its maximum hourly emission rate in the modeling analysis. The maximum emission rates encompass equipment in startup, testing and non-normal operation modes. It is also assumed that all equipment, at HECA and nearby sources, will operate simultaneously with maximum permitted hourly emission rates during any hour of the year. The emissions in the model will be significantly higher than what is expected to actually occur, thus the impacts predicted will be significantly higher than ever expected.

The background NO_2 concentrations from the Shafter monitoring station were obtained to primarily account for vehicular emissions in the region. Maximum 1-hour NO_2 emissions from almost all of the permitted nearby sources are included in the modeling analysis. Although care was taken so that sources very near the Shafter monitoring station were not included in the modeling analysis, it can be expected that emissions from some of the nearby sources were measured at the Shafter monitoring station, thus double-counting the impacts from some of these sources.

The use of five years of data will account for fluctuations in the background NO_2 concentrations. Since the impacts predicted from the model will always be the maximum possible, high background concentrations will occur with high model predicted impacts. When using an hourly temporal pairing technique with the modeled and background monitoring concentrations, the HECA regional modeling will show whether the "NO_X emissions increase from the proposed source will have a significant impact at the *point and time* of any violation" (U.S. EPA, 2010c).

The standard allows for a source to have 8 hours or more in exceedance of the concentration of the standard on an annual basis, yet still be considered in compliance. Use of this pairing technique will still show that the total regional impacts are greater than 100 ppb on at least two occasions based on the background data alone, but because the standard is based on the eighth-highest daily maximum 1-hour concentration, compliance may be achieved even if there are a handful of outliers.

3.9.1 Shafter NO_2 Pollution Rose

Figure 15 presents a pollution rose created for hourly Shafter NO_2 monitoring data with hourly wind direction vectors from BFL for years 2004-2008. Monitoring concentrations were set to zero during calm hours because no wind direction can be associated with a calm hour. Monitored concentrations during calm periods showed a similar distribution as during periods with measurable wind speeds, with no abnormally high concentrations observed.

As seen in Figure 15, hourly monitoring concentrations of 50 $\mu g/m^3$ or greater occur during all wind directions. The associated frequency table is provided in Attachment D. Although measured NO_2 concentrations are dependent upon meteorological conditions, a meaningful pattern that could be used to fabricate a background data set could not be determined.

3.9.2 Preliminary HECA NO_2 Pollution Rose

As requested by U.S. EPA Region IX, pollution roses were created with the intent to compare preliminary modeled HECA operational hourly NO_2 impacts by wind direction for the years used in modeling versus Shafter monitoring data.

A preliminary HECA 1-hour NO_2 modeling run with AERMOD was conducted for the maximum hourly start-up operating scenario (described in Section 3.2 of this modeling protocol) with a receptor grid extending out to 10 kilometers using all five years of meteorological data (2004-2008).

Figures 16 and 17 present pollution roses displaying the preliminary predicted maximum hourly HECA concentration at any modeled receptor with flat terrain and complex terrain, respectively, for all five years of meteorological data (2004-2008). From these preliminary results, the highest modeled concentrations mostly occurred when the wind blew from the north through east wind sector in the flat terrain scenario. With the added variable of terrain in modeling, impacts were higher for the same wind directions due to the location of hills southwest and west of the HECA Project location. The associated frequency tables are provided in Attachment D. Examination of the preliminary HECA NO_2 impacts versus the Shafter monitored NO_2 pollution rose do not present a reasonable technique for pairing background monitoring data with modeled data, other than on an hourly basis.

3.9.3 Technique for Incorporating Hourly NO_2 Background with Hourly Modeled Concentrations

The modeling analysis will be conducted per the procedures outlined by the U.S. EPA in *Notice Regarding Modeling for New Hourly NO_2 NAAQS* (U.S. EPA, 2010b). In this approach, AERMOD with PVMRM is run to produce an output file with NO_2 concentrations at every receptor for every hour in the meteorological data set using the hourly POSTFILE option. Concurrent hourly NO_2 background data are then added to the modeled NO_2 concentrations to obtain the total NO_2 concentration for each hour.

A post-processor program was developed by URS to process the AERMOD POSTFILE output files with the concurrent NO_2 background data. The post-processor program adds the hourly background data to each concurrent 1-hour model predicted concentration at each receptor then determines the eighth-highest daily maximum 1-hour concentration for each year modeled. The eighth-highest concentration is representative of the 98th percentile concentration from the distribution of daily 1-hour maximum values. The 98th percentile daily 1-hour maximum concentrations at each receptor are then averaged across the five years modeled and the maximum of these averaged values from all receptors is used to represent the NO_2 design value concentration, which will determine whether compliance with the 100-ppb NO_2 1-hour NAAQS will be achieved. URS will provide the post-processor program to the U.S. EPA Region IX with the modeling analysis files, upon request.

3.10 CONSERVATISM IN THE MODELING ANALYSIS

By following the U.S. EPA modeling guidance documents, many conservative assumptions will be made in the modeling analysis. The conservative data assumptions that will be used as input to the modeling analysis are outlined below:

1. A maximum hourly start-up NO_X emission rate for the HECA CTG/HRSG will be modeled during all hours of a five-year meteorological data set. This emission rate is 8 times higher than the expected normal operating NO_X emission rate, and the turbine is permitted to start up at most 30 times per year.

2. Maximum potential hourly NO_X emission rates will be used for the other HECA sources. For sources such as the flares, these emission rates will be many times higher than normal operating emissions.

3. The HECA CTG/HRSG stack parameters used in the analysis are associated with a 60 percent load operation of the turbine and have a lower exhaust temperature and exit velocity than when the turbine operates at 100 percent load. HECA is a baseload facility, so the turbine will rarely operate at less than 100 percent load.

4. Emissions from the nearby sources will be input at maximum potential to emit out as far as 75 kilometers, including emergency engines, for all hours during the five-year meteorological data set. For most sources the maximum permitted emission rates are significantly higher than their actual emission rates, thus the modeling will over-predict the impacts from these sources.

5. Simultaneous operation of HECA sources and nearby sources all with maximum hourly permitted emission rates.

6. Approximately 100 emergency IC engines will be included in the modeling analysis, all operating with maximum hourly permitted NO_X emissions. It is extremely unlikely that all 100 engines would be tested in the same hour, let alone a few operating simultaneously.

7. For NO_2/NO_X in-stack ratios, where good information regarding a particular type of source is not available, a high ratio will be used.

8. The hourly upper bound NO_2/NO_X equilibrium ratio of 0.9 will be used, and this value is significantly higher than the annual average ratio of 0.63.

9. Hourly NO_2 background data from the Shafter monitoring station are used as a surrogate for emissions from transportation sources near the HECA Project, although they will also contain contributions from sources near the monitoring station.

10. The traffic volume near the Shafter monitoring station is expected to be at least three times larger than the traffic volume near the HECA Project when it starts

operation. The NO_2 data from the Shafter monitoring station represents significantly more vehicular emissions than are expected near HECA.

11. HECA has purchased Emission Reduction Credits (ERC) to cover the total HECA Project annual NO_X emissions at a 1.5-to-1 ratio, when calculating normal CTG/ HRSG emissions at the 4 ppm level. HECA also has entered into a Voluntary NO_X Emission Reduction Agreement (VERA) with SJVAPCD for the 2-year evaluation period for the NO_X emission difference between the 4 ppm and 2 ppm level. SJVAPCD will use the Air Quality Improvement Fee to fund NO_X emission reduction programs in Kern County. These emission reductions will be concurrent with the operation of the HECA Project and will occur in the same county as the HECA Project. Total offsets will be 4 times the expected normal operating NO_X emission rates. No credit has been taken for these emission reductions in the modeling analysis.

The assumption that HECA will run in start-up mode with maximum hourly emissions, while all nearby sources within 75 kilometers are also running at their maximum hourly emission rate, during that same hour, in addition to adding a high background monitored concentration, is not a realistic scenario. This analysis also does not take into account the benefits the ERCs and VERA will provide to offset HECA Project emissions.

The use of so many conservative inputs into the model have the effect of removing accuracy from the analysis and analyzing a situation that could never be observed in reality, thereby grossly overestimating the potential impact from HECA Project operations and nearby sources.

4. CONCLUSION

The HECA Project is a revolutionary power facility and one of the first projects in U.S. EPA Region IX that is faced with showing compliance with the new, statistically based 1-hour NO_2 NAAQS. Although U.S. EPA has created a guidance document for conducting modeling to show compliance with the new standard, many aspects are still being defined. HECA has been in constant contact with U.S. EPA Region IX, seeking modeling guidance to show compliance with the new NO_2 1-hour NAAQS. This modeling protocol summarizes the techniques agreed to with U.S. EPA Region IX and OAQPS.

This protocol discusses in detail the various parameters needed for a Tier 3 "detailed screening method" NO_2 1-hour NAAQS modeling analysis. Because use of this tier is considered on a case-by-case basis, effort was made to justify the proposed modeling approach and the selection of input parameters. The inclusion of multiple conservative input parameters and techniques outlined in this protocol ensures that the predicted NO_2 1-hour impacts from HECA and nearby regional sources will be unrealistically overestimated. Furthermore, if modeling shows compliance based on the techniques discussed in this protocol, the NO_2 1-hour NAAQS will be protected from the impacts due to HECA sources.

HECA respectfully requests concurrence from U.S. EPA Region IX and from U.S. EPA OAQPS staff regarding the modeling techniques and input parameters presented in this NO_2 1-hour NAAQS modeling protocol.

5. REFERENCES

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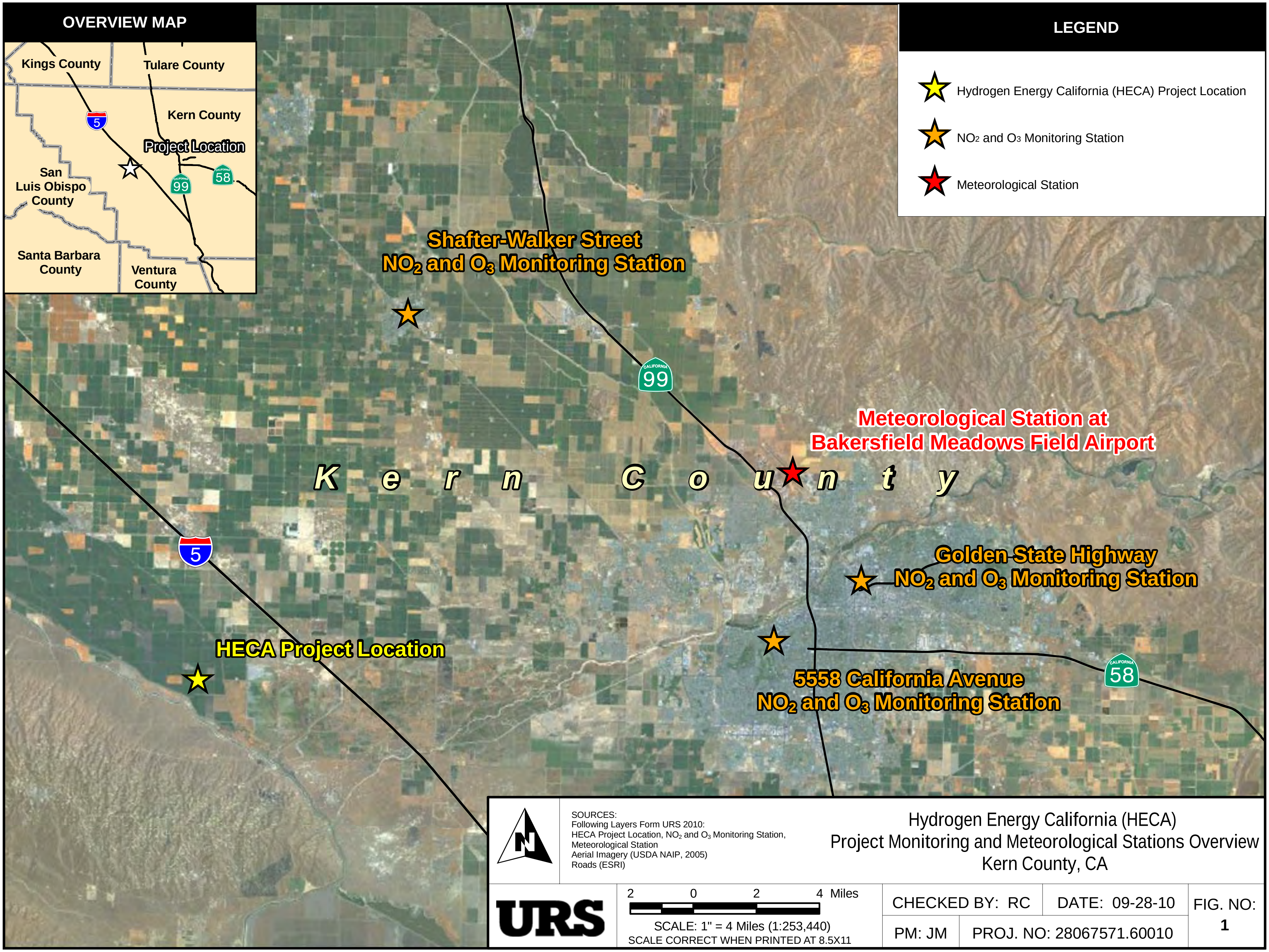
FIGURES



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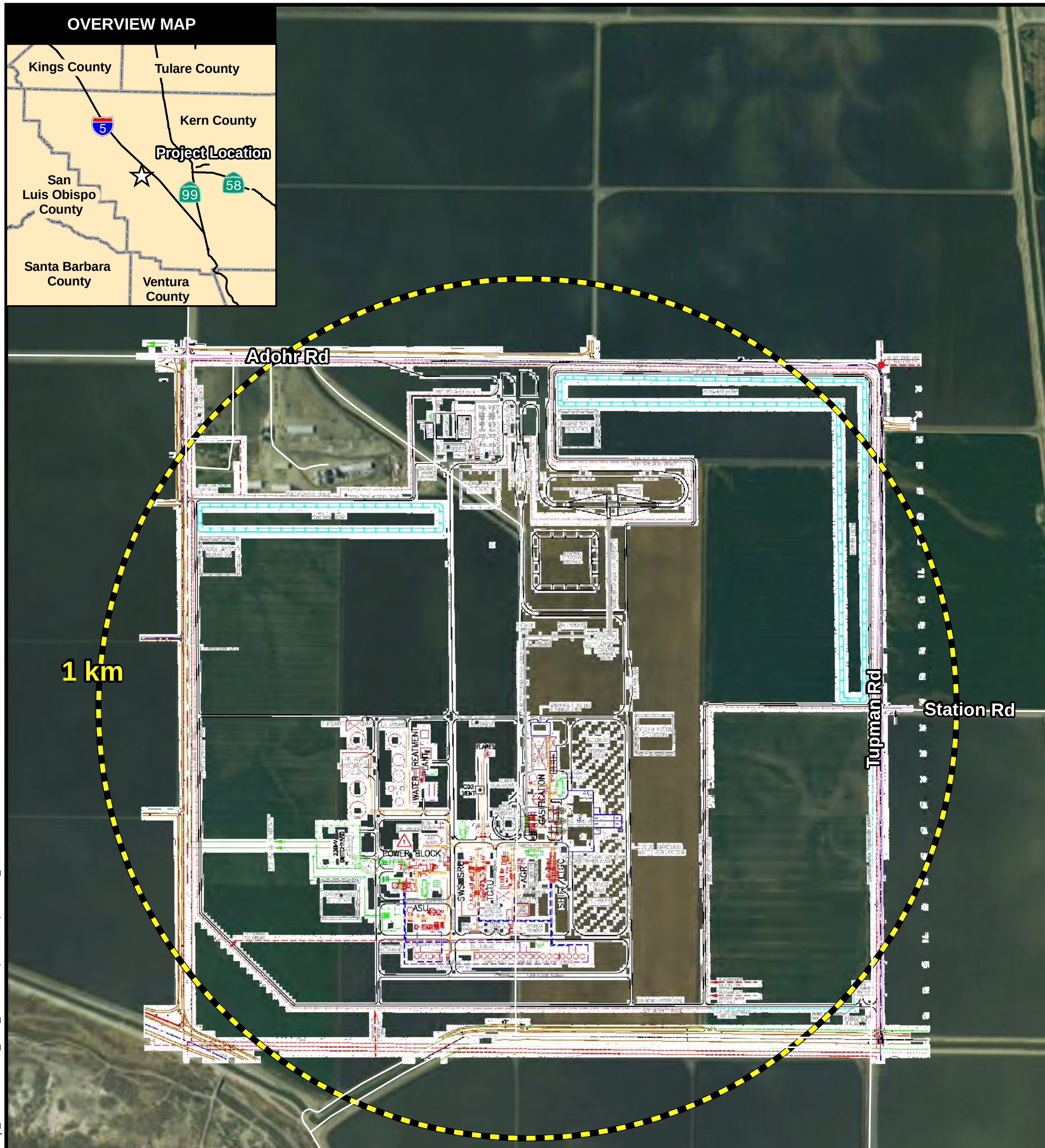

SOURCES:
HECA Location and Site Plan (URS 2010)
Aerial Imagery (USDA NAIP, 2005)
Roads (ESRI)

Hydrogen Energy California (HECA)
Project Location and Site Plan
Kern County, CA

URS

500 0 500 1000 Feet
SCALE: 1" = 1000' (1:12,000)
SCALE CORRECT WHEN PRINTED AT 8.5X11

CHECKED BY: RC | DATE: 09-28-10 | FIG. NO: 2
PM: JM | PROJ. NO: 28067571.60010

SOURCES:
Meteorological Station (URS 2010)
Aerial Imagery (USDA NAIP, 2005)
Roads (ESRI)

Meteorological Station at
Bakersfield Meadows Field Airport
Kern County, CA

URS

500 0 500 1000 Feet
SCALE: 1" = 1000' (1:12,000)
SCALE CORRECT WHEN PRINTED AT 8.5X11

CHECKED BY: RC | DATE: 09-28-10 | FIG. NO: 2
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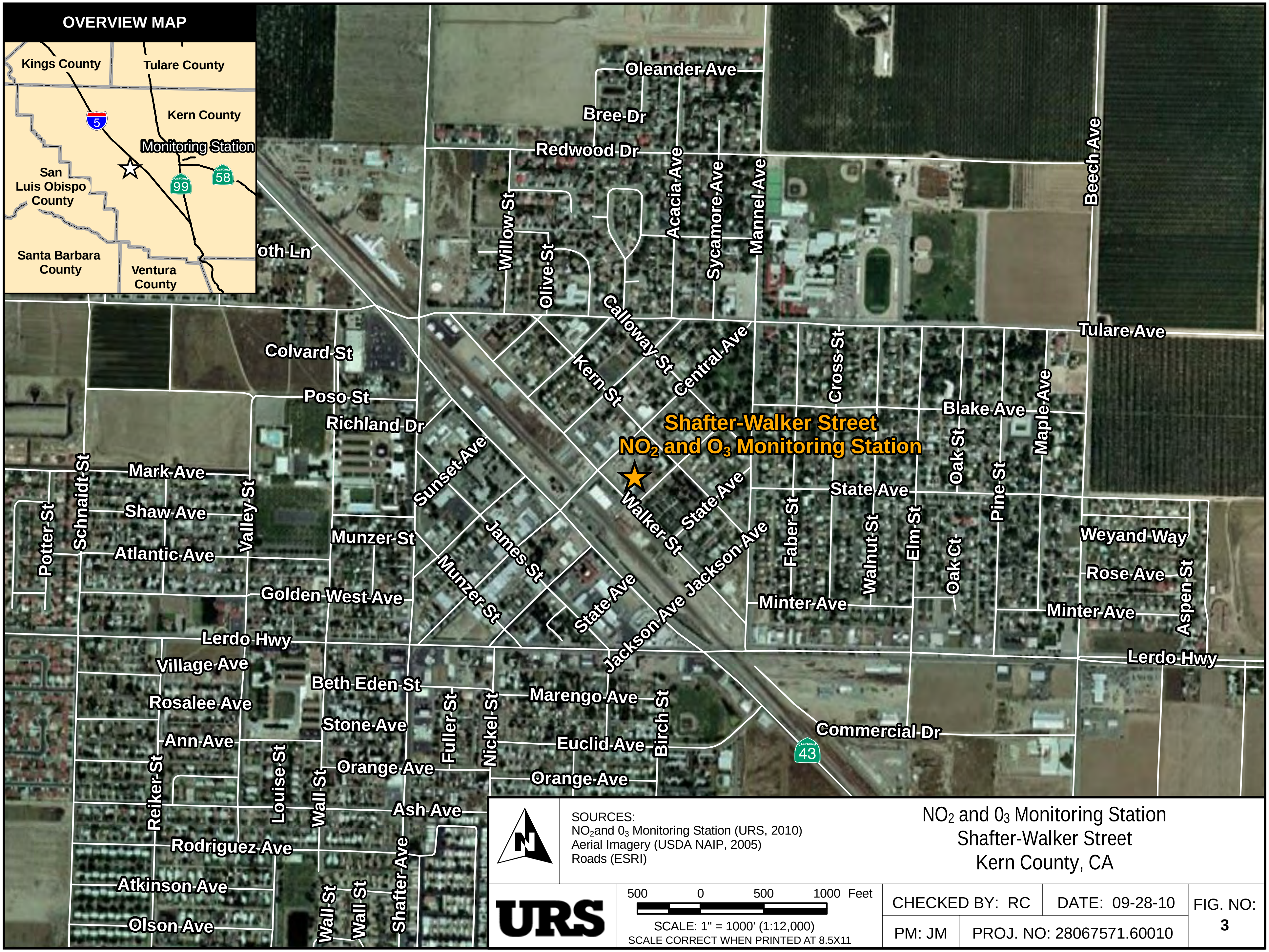

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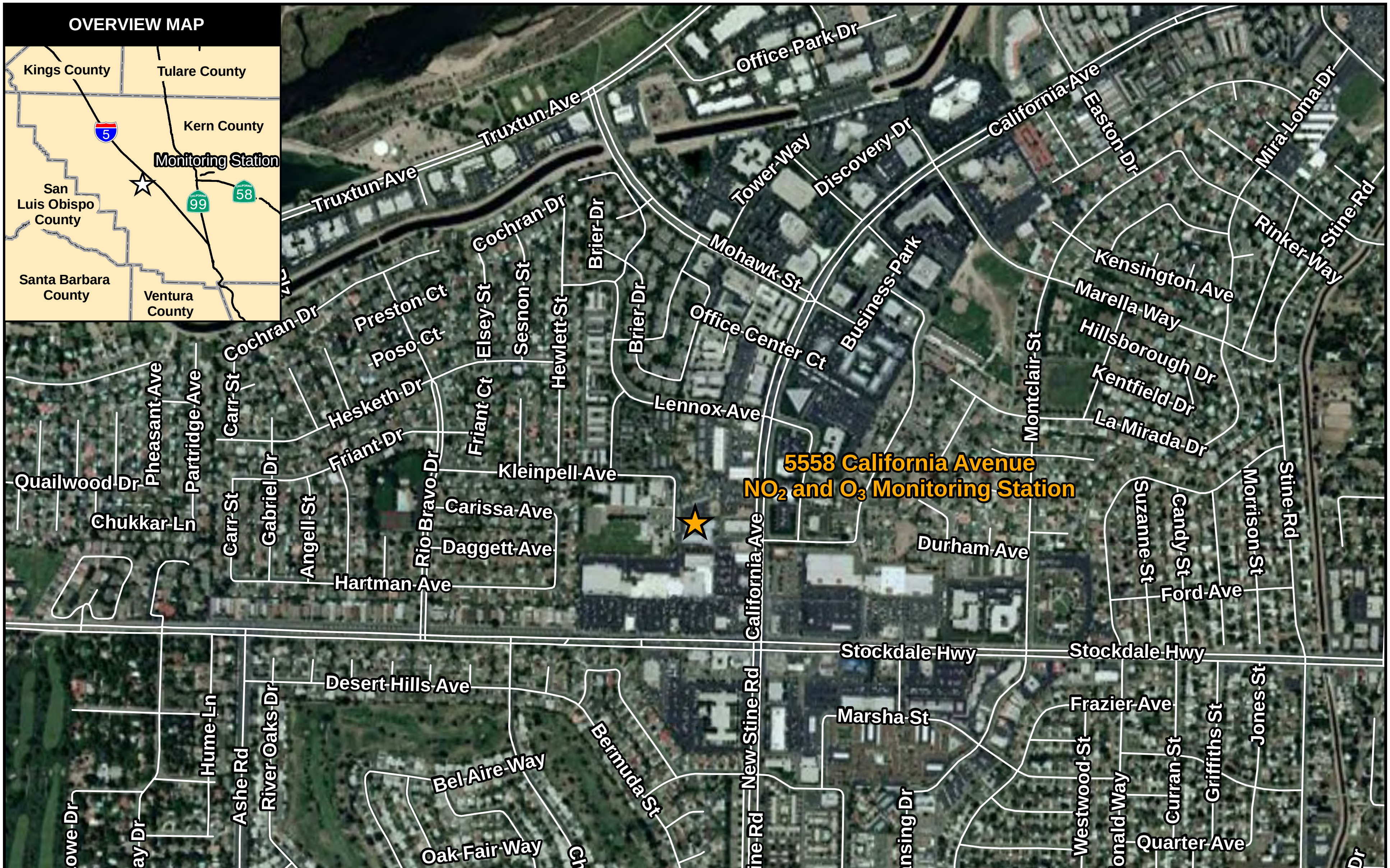

SOURCES:
NO_2 and O_3 Monitoring Station (URS, 2010)
Aerial Imagery (USDA NAIP, 2005)
Roads (ESRI)

N

NO_2 and O_3 Monitoring Station
5558 California, Bakersfield
Kern County, CA

URS

500 0 500 1000 Feet

SCALE: 1" = 1000' (1:12,000)
SCALE CORRECT WHEN PRINTED AT 8.5X11

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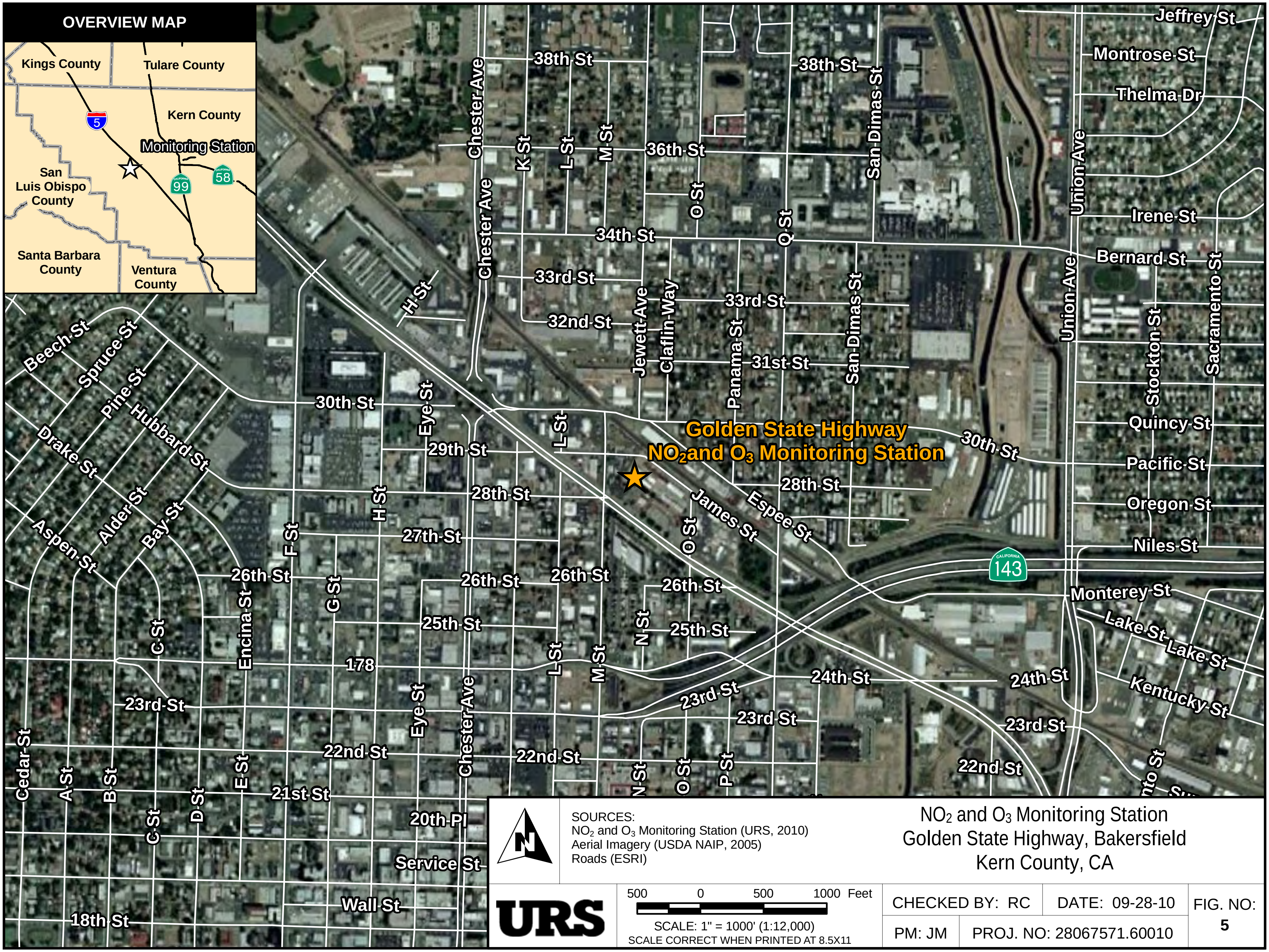

SOURCES:
NO_2 and O_3 Monitoring Station (URS, 2010)
Aerial Imagery (USDA NAIP, 2005)
Roads (ESRI)

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SCALE: 1" = 1000' (1:12,000)
SCALE CORRECT WHEN PRINTED AT 8.5X11

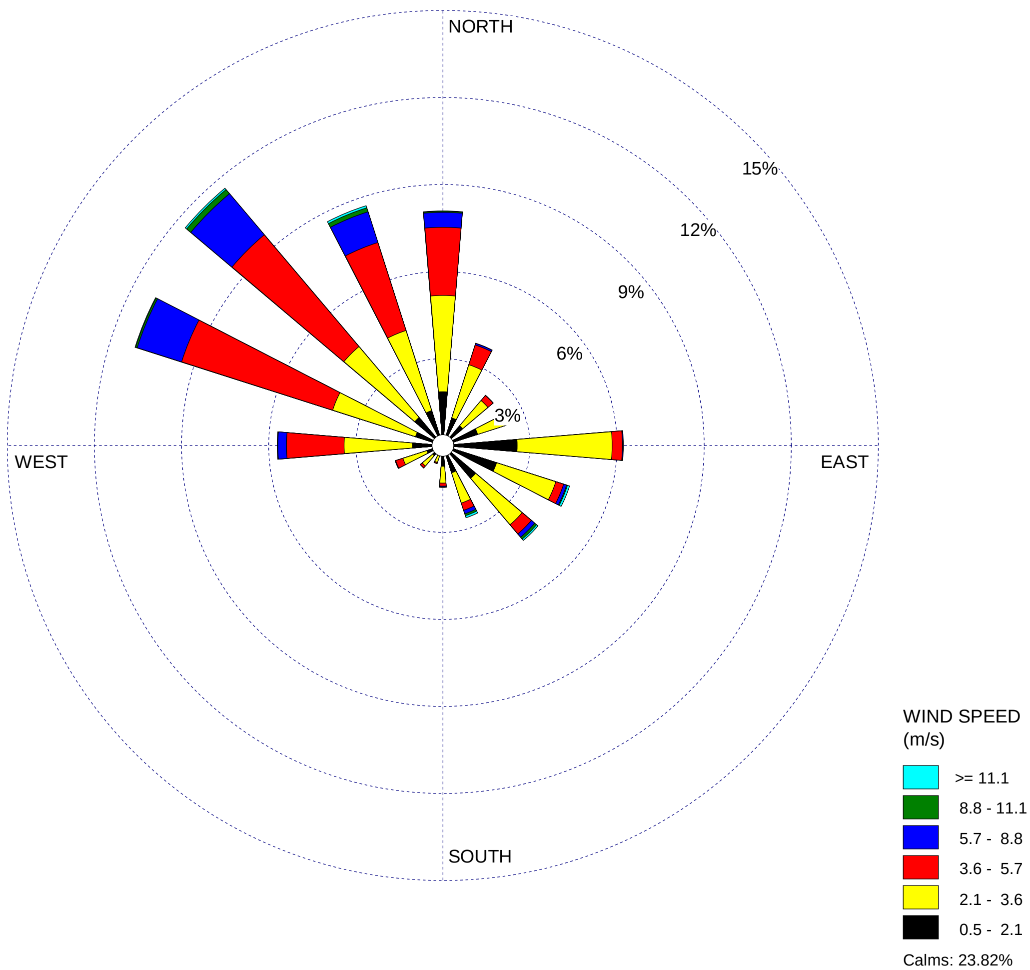
URS

NO_2 and O_3 Monitoring Station
Golden State Highway, Bakersfield
Kern County, CA

CHECKED BY: RC	DATE: 09-28-10	FIG. NO: 5
PM: JM	PROJ. NO: 28067571.60010	

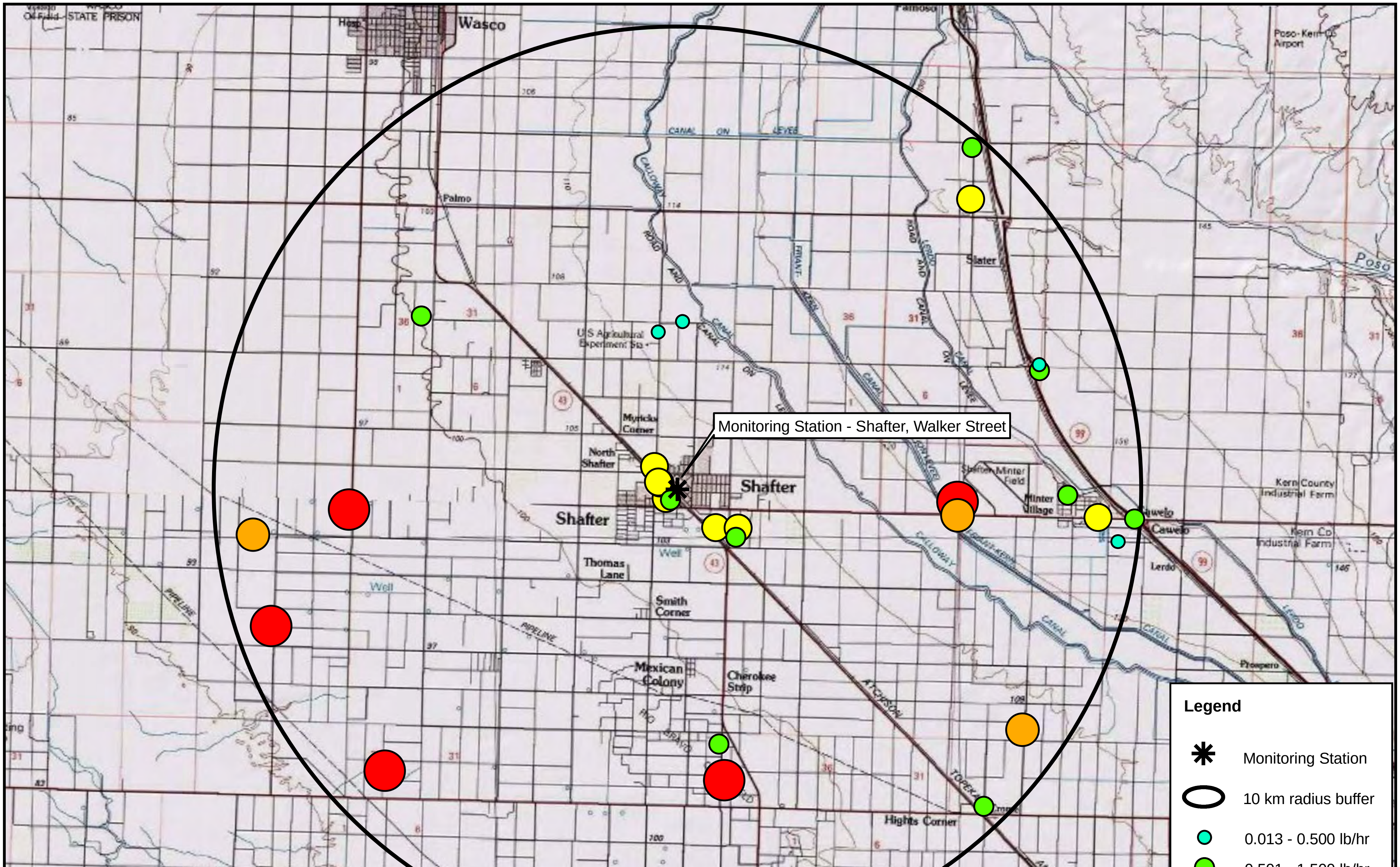
Figure 6
Annual Wind Rose for Bakersfield Meadows Field Airport, Years 2004-2008

WIND ROSE PLOT:	DISPLAY:
Station #23155	**Wind Speed** **Direction (blowing from)**



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2004-2008 **Jan 1 - Dec 31** **00:00 - 23:00**	**URS Corporation**	
		MODELER: **LMB**	URS
	CALM WINDS: **23.82%**	TOTAL COUNT: **43367 hrs.**	
	AVG. WIND SPEED: **2.77 m/s**	DATE: **9/29/2010**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software



PLOT OF HOURLY EMISSION RATES FOR SOURCES WITHIN 10 KM OF MONITORING STATION

SOURCES:
Topo (National Geographic Society, 2009)

URS

1.5 0 1.5 3 km

SCALE: 1" = 3 km (1:118,140)
SCALE CORRECT WHEN PRINTED AT 8.5X11

CREATED BY: DT	DATE: 12-20-10	FIG. NO:
PM: JL	PROJ. NO: 28067571.60010	7

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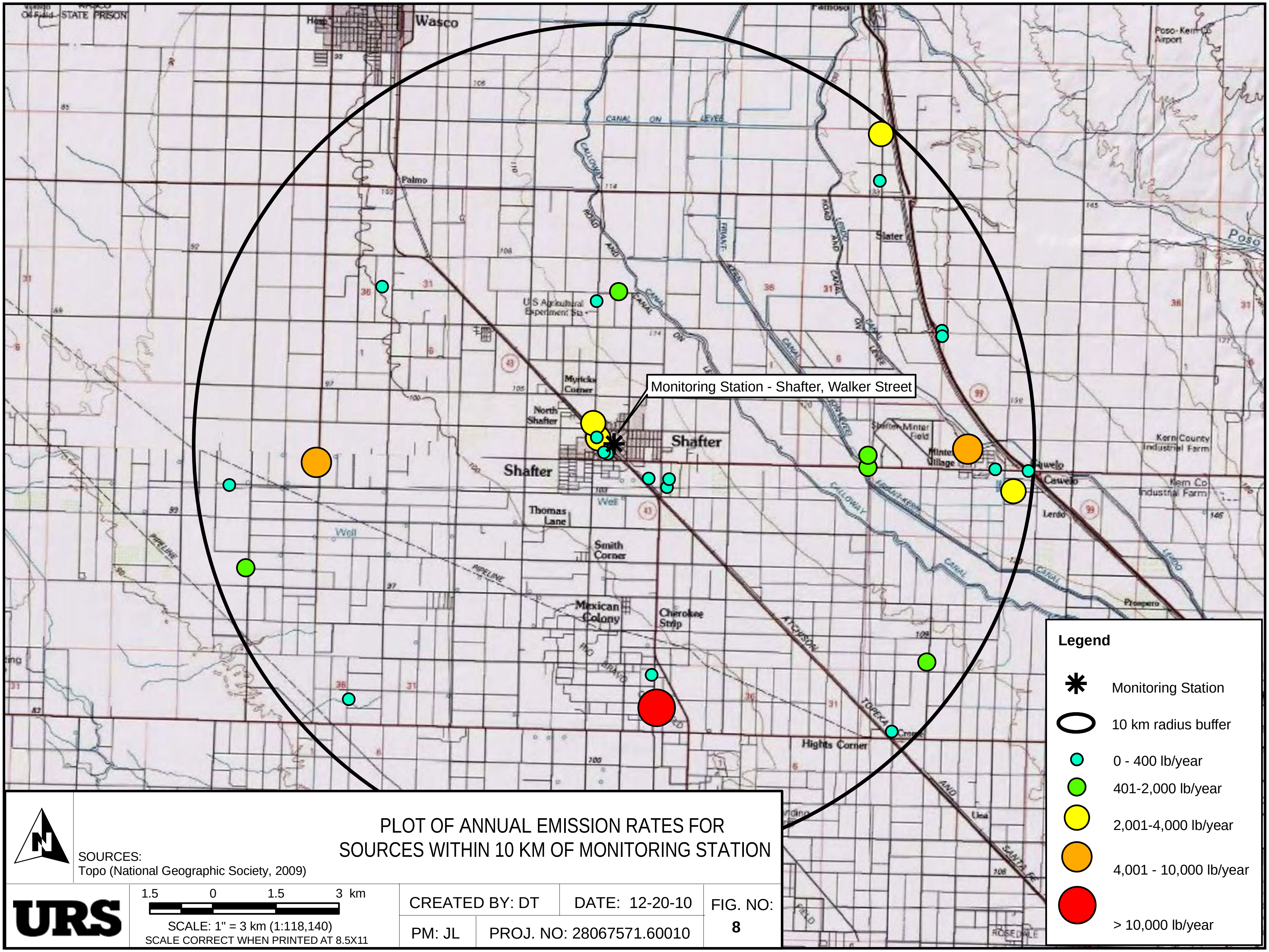

PLOT OF ANNUAL EMISSION RATES FOR SOURCES WITHIN 10 KM OF MONITORING STATION

SOURCES:
Topo (National Geographic Society, 2009)

URS

1.5 0 1.5 3 km

SCALE: 1" = 3 km (1:118,140)
SCALE CORRECT WHEN PRINTED AT 8.5X11

CREATED BY: DT | DATE: 12-20-10 | FIG. NO: 8
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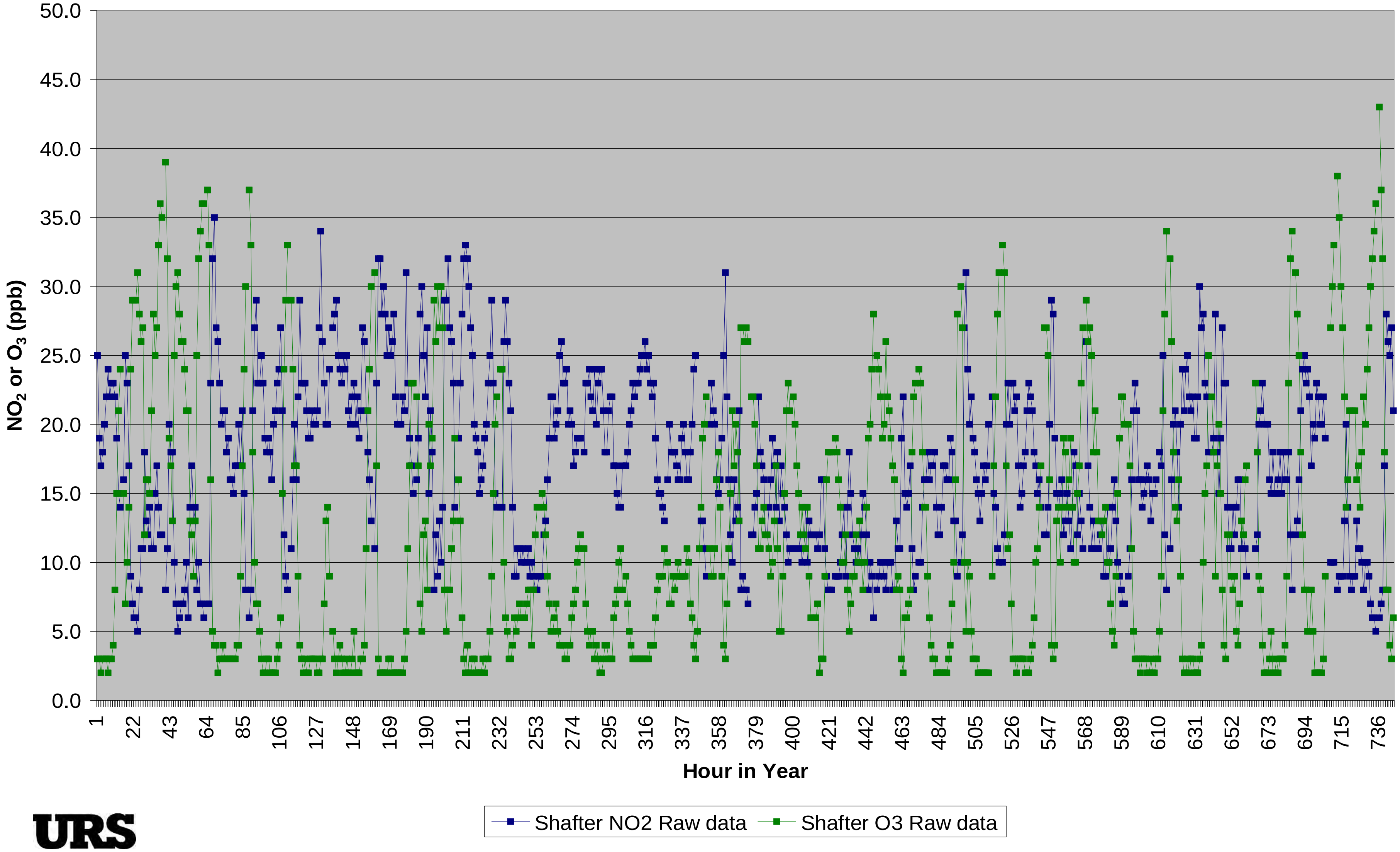
Figure 9

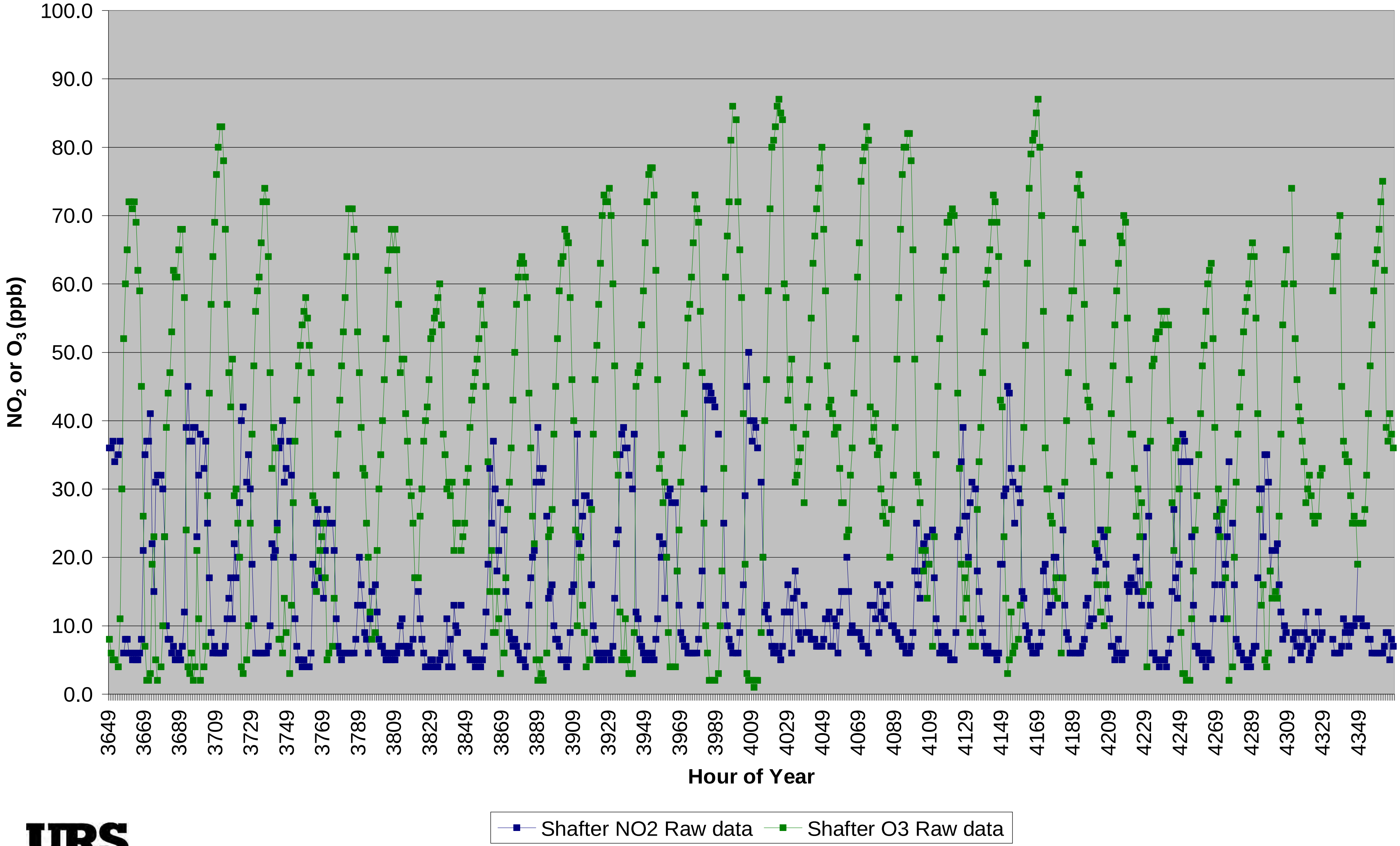
Shafter NO_2 and O_3 Raw Data; January 2004: Time Series Plot



URS

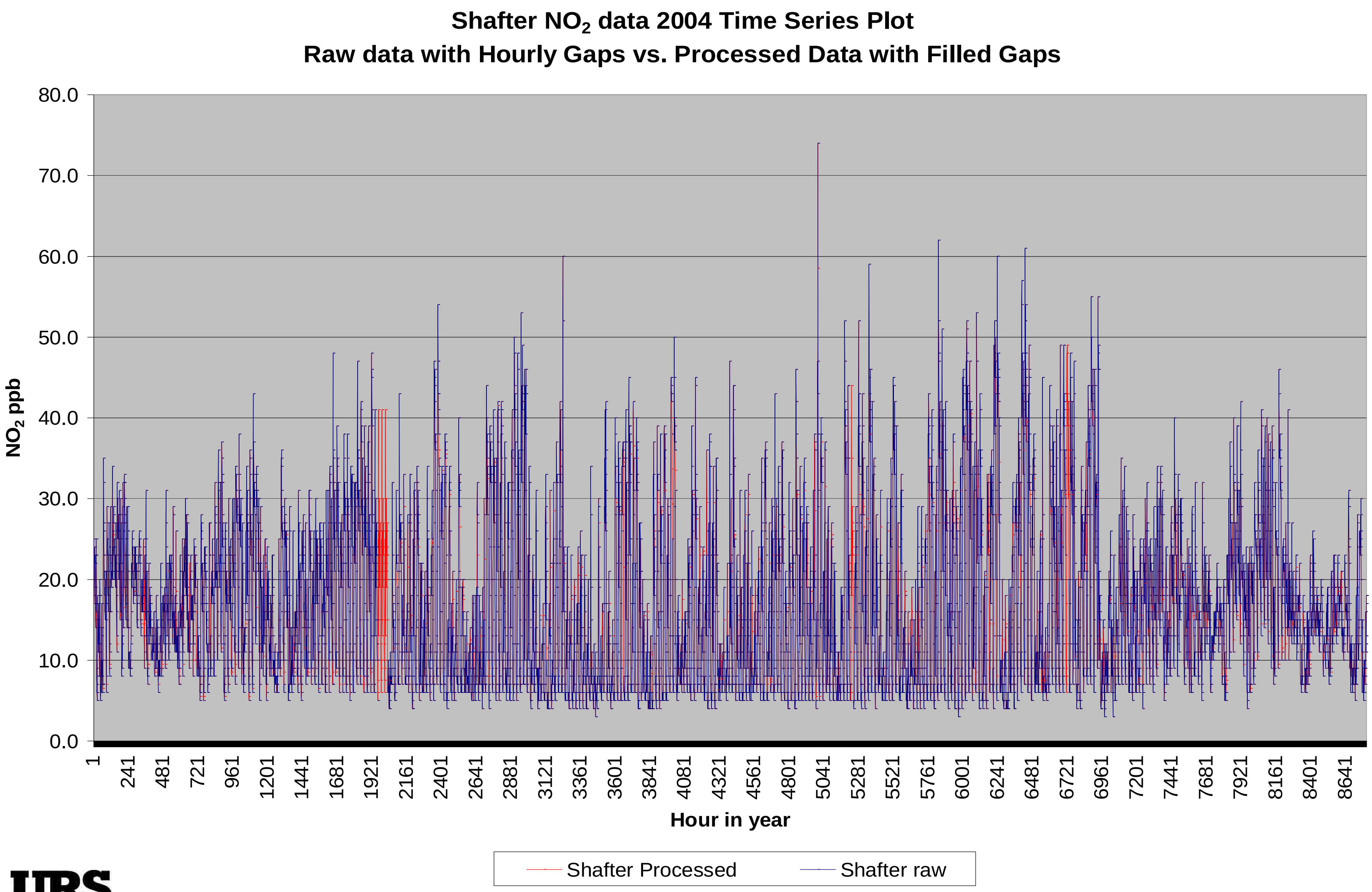
Figure 10

Shafter NO_2 and O_3 Raw Data; July 2004: Time Series Plot



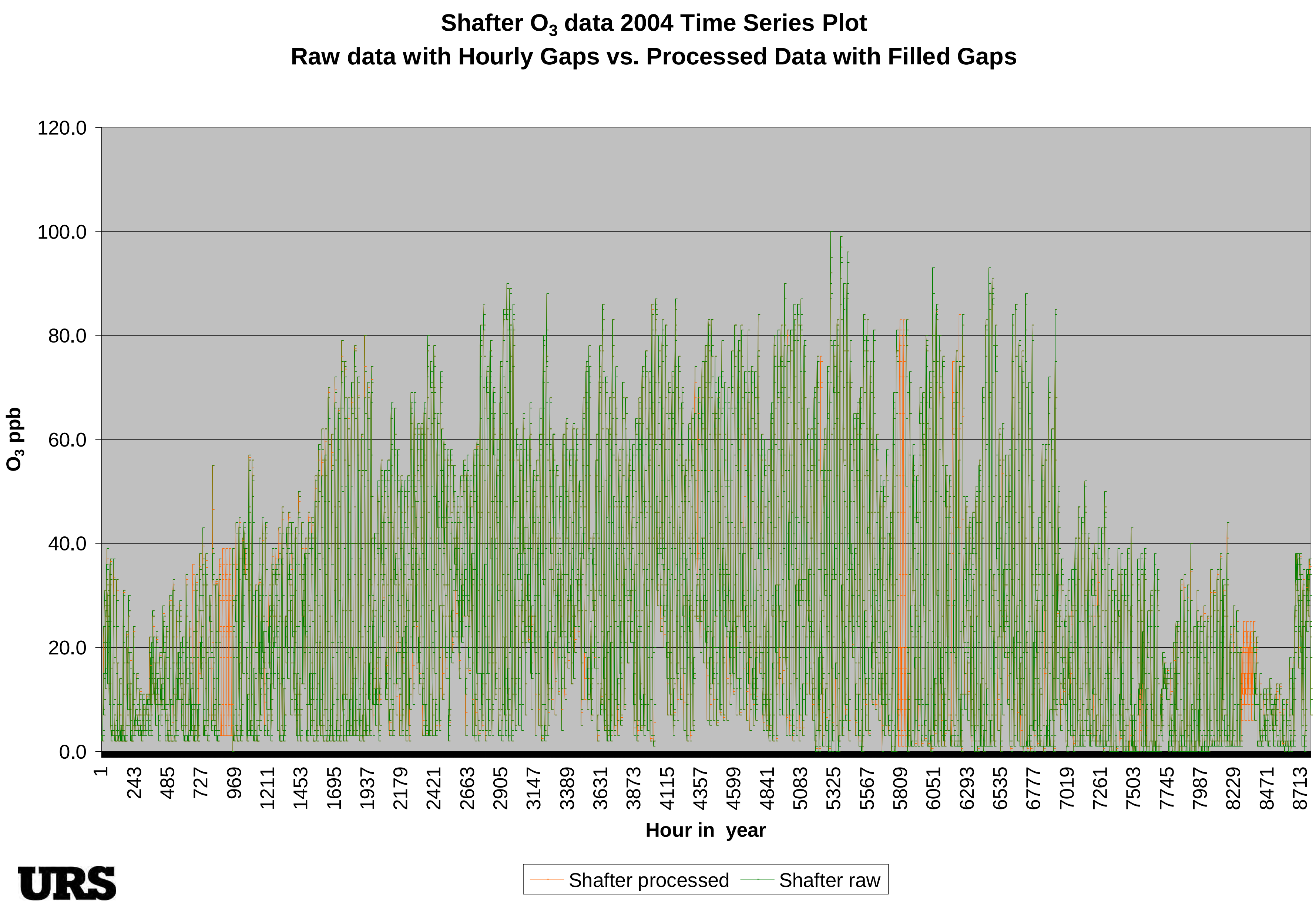
URS

Figure 11



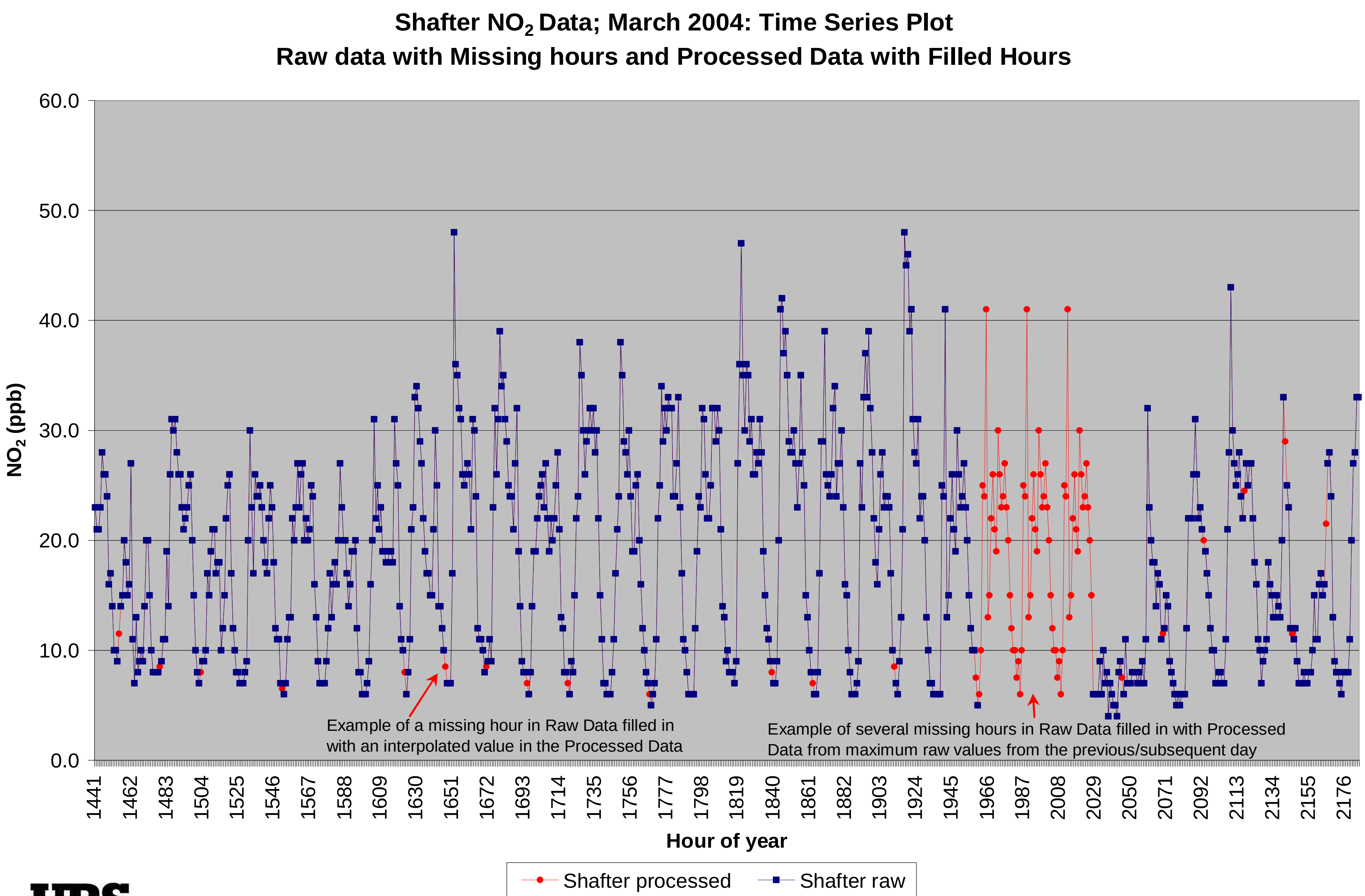
URS

Figure 12



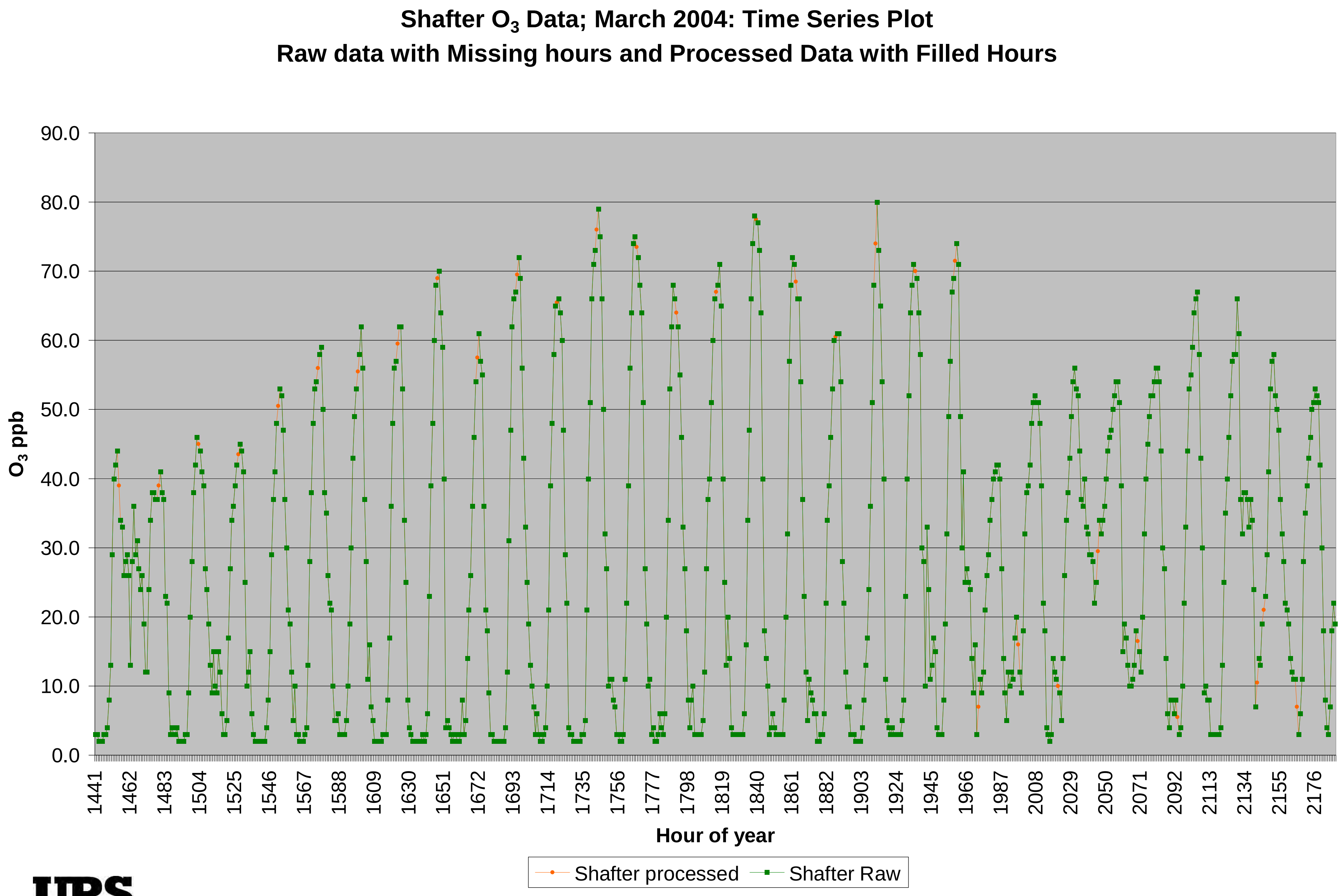
URS

Figure 13



URS

Figure 14



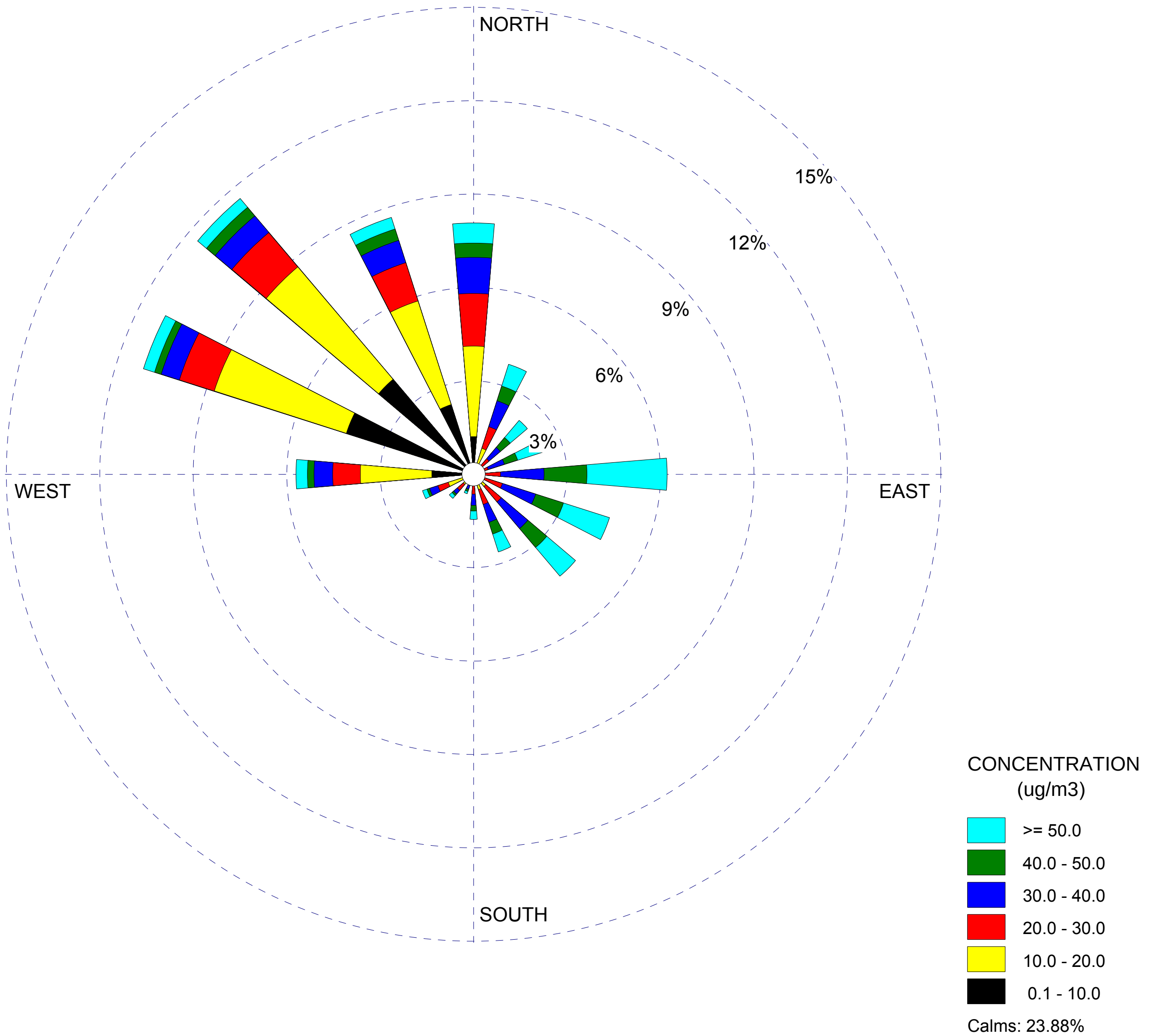
URS

WIND ROSE PLOT:

Bakersfield Wind Direction 2004-2008 vs Shafter NO2 1-hr Monitored Concentrations

DISPLAY:

Monitored NO2 Concentration Direction (blowing from)



COMMENTS: monitored values during calm winds are not included	DATA PERIOD: **2004-2008 Jan 1 - Dec 31 00:00 - 23:00**	COMPANY NAME: **URS Corporation**
		MODELER: **LMB**
	CALM WINDS & ZERO CONCENTRATION: **23.88%**	TOTAL COUNT: **43367 hrs.**
	AVG. CONCENTRATION: **21.35 ug/m3**	DATE: **1/5/2011**

Figure 15

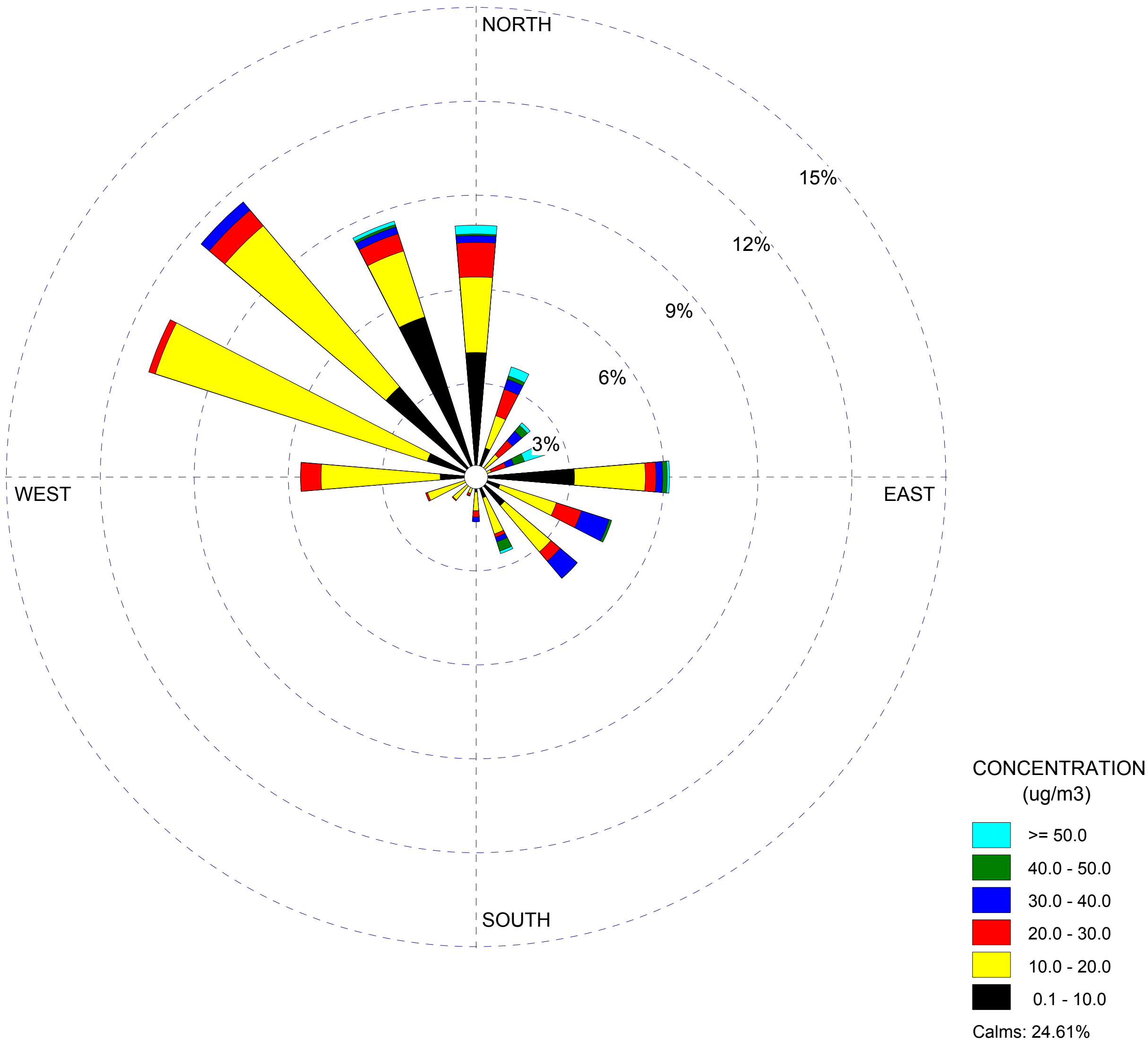
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Bakersfield Wind Direction 2004-2008 vs
HECA Maximum Predicted 1-hr NO2 Concentration with flat terrain

DISPLAY:

NO2 Concentration
Direction (blowing from)



COMMENTS:	DATA PERIOD: **2004-2008** **Jan 1 - Dec 31** **00:00 - 23:00**	COMPANY NAME: **URS Corporation**
		MODELER: **LMB**
	CALM WINDS & ZERO CONCENTRATION: **24.61%**	TOTAL COUNT: **43367 hrs.**
	AVG. CONCENTRATION: **12.06 ug/m3**	DATE: **1/5/2011**

Figure 16

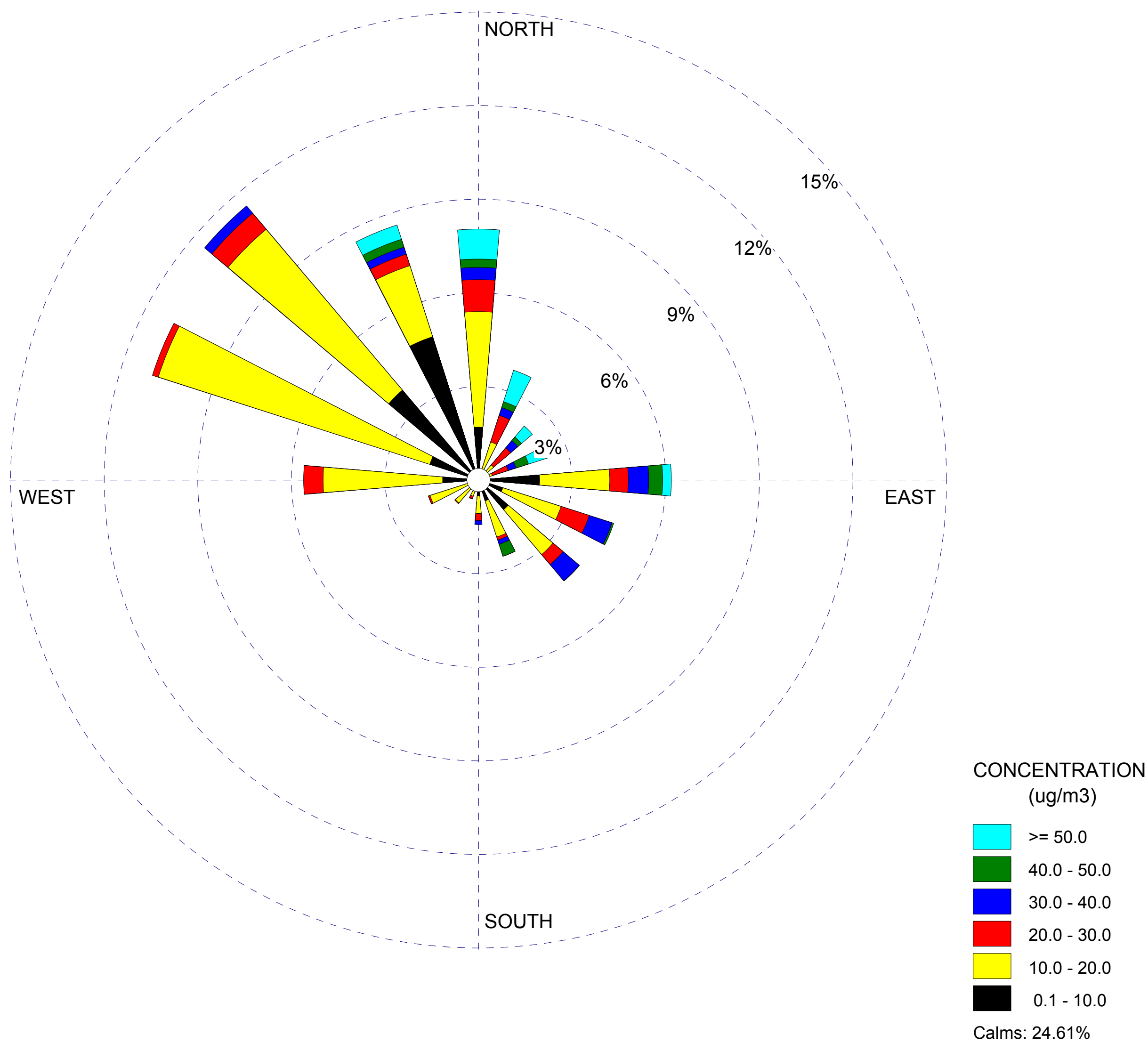
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Bakersfield Wind Direction 2004-2008 vs
HECA Maximum Predicted 1-hr NO2 Concentration with complex terrain

DISPLAY:

NO2 Concentration
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2004-2008 **Jan 1 - Dec 31** **00:00 - 23:00**	**URS Corporation**	
		MODELER: **LMB**	URS
	CALM WINDS & ZERO CONCENTRATION: **24.61%**	TOTAL COUNT: **43367 hrs.**	
	AVG. CONCENTRATION: **14.08 ug/m3**	DATE: **1/5/2011**	Figure 17

WRPLOT View - Lakes Environmental Software

ATTACHMENT A

SJVAPCD, ASSESSMENT OF NON-REGULATORY OPTIONS IN AERMOD SPECIFICALLY OLM AND PVMRM, DRAFT

SEPTEMBER 16, 2010

Assessment of Non-Regulatory Options in AERMOD Specifically OLM and PVMRM

Purpose:
The purpose of this guidance document is to provide consistency between EPA and District modeling guidance. The District will implement this procedure to address issues indentified in the memoranda issued by EPA on June 28 and 29, 2010 concerning the implantation of the new federal 1-hour nitrogen dioxide (NO_2) National Ambient Air Quality Standard (NAAQS) and the use of non-regulatory options in the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD).

Applicability:
The following procedure applies when addressing District Permitting requirements. Projects intending to use the procedures outlined within this document as part of an application with another agency must seek approval from that agency prior to using them to determine compliance with the federal 1-hour NO_2 NAAQS.
.

Background:
In June of 2010, EPA issued two clarification memoranda concerning the implementation of the federal 1-Hour NO_2 standard as it relates to PSD permitting. These memoranda provided guidance on the use of AERMOD as it relates to modeling options and requirements for using alternative models/non-regulatory options.

In brief, the use of non-regulatory options in AERMOD, specifically the Ozone Limiting Method (OLM) and the Plume Volume Molar Ratio Method (PVMRM), would change the status of the model as stated in Section 3.1.2(c) of 40 CFR Part 51, Appendix W, "A preferred model should be operated with the options listed in Appendix A as ''Recommendations for Regulatory Use.'' If other options are exercised, the model is no longer ''preferred.'' Any other modification to a preferred model that would result in a change in the concentration estimates likewise alters its status as a preferred model. Use of the model must then be justified on a case-by-case basis".

In order for non-regulatory options to be used for regulatory purposes the following determination must be made as per section 3.2.2 (e) "… an alternative refined model may be used provided that:"

i. The model has received a scientific peer review;
ii. The model can be demonstrated to be applicable to the problem on a theoretical basis;
iii. The data bases which are necessary to perform the analysis are available and adequate;
iv. Appropriate performance evaluations of the model have shown that the model is not biased toward underestimates; and
v. A protocol on methods and procedures to be followed has been established."

Non-Regulatory Option Determination:
In order to streamline the process, the District will take the following approach when justifying the use of OLM/PVMRM for projects in the San Joaquin Valley; 1) an overall justification will be provided to address each of the five requirements listed in section 3.2.2 (e) and 2) each project will be required to complete a questionnaire intended to provide site specific information that would allow for a streamline determination of the appropriateness of the non-regulatory option(s) used (OLM/PVMRM) on a case-by-case basis, see Appendix B.

Overall Justification:
The following will address each of the five requirements noted in 3.2.2.(e) in order to justify the use of OLM/PVMRM for the purpose of determining compliance with the Federal 1-hour NO_2 standard.

3.2.2 (e)(i):
The requirement of section 3.2.2 (e)(i) is: has the model received a scientific peer review? As noted in the memorandum from Taylor Fox on June 28, 2010; "Since AERMOD is the preferred model for dispersion for a wide range of application, the focus of the alternative model demonstration for use of the OLM/PVMRM options within AERMOD is on the treatment of NOx chemistry within the model, and does not need to address basic dispersion algorithms within AERMOD." Therefore the following will address the basic chemistry of each of the non-regulatory options.

Basic OLM Chemistry:
To provide some background, the following is a simplified explanation of the basic chemistry relevant to the OLM. First, the relatively high temperatures typical of most combustion sources promote the formation of NO_2 by the following thermal reaction:

$2\,NO + O_2 \implies 2\,NO_2$ In-stack formation of NO_2

OLM assumes a default 10% of the NO_x in the exhaust is converted to NO_2 by this reaction, and no further conversion by this reaction occurs once the exhaust leaves the stack. **Please Note:** The District has compiled a list of NO_2/NO_x ratios that can be used as default in-stack NO_2/NO_x ratios until source test data become available, see Table 1. The remaining percentage of the NO_x emissions is assumed to be nitric oxide (NO).

As the exhaust leaves the stack and mixes with the ambient air, the NO reacts with ambient ozone (O_3) to form NO_2 and molecular oxygen (O_2):

$NO + O_3 \implies NO_2 + O_2$ Oxidation of NO by ambient O_3

The OLM assumes that at any given receptor location, the amount of NO that is converted to NO_2 by this reaction is proportional to the ambient O_3 concentration. If the O_3 concentration is less than the NO concentration, the amount of NO_2 formed by this reaction is limited. If the O_3 concentration is greater than or equal to the NO concentration, all of the NO is assumed to be converted to NO_2.

In the presence of radiation from the sun, ambient NO_2 can be destroyed:

NO_2 + sunlight ==> NO + O Photo-dissociation of NO_2

As a conservative assumption, the OLM ignores this reaction.

Another reaction that can form NO_2 in the atmosphere is the reaction of NO with reactive hydrocarbons (HC):

NO + HC ==> NO_2 + HC' Oxidation of NO by reactive HC

The OLM also ignores this reaction. This may be a non-conservative assumption with respect to NO_2 formation in urban/industrial areas with relatively large amounts of reactive HC emissions.

Basic PVMRM Chemistry:
Building on the basic OLM chemistry, the PVMRM determines the conversion rate for NO_x to NO_2 based on a calculation of the NO_x moles emitted into the plume, and the amount of O_3 moles contained within the volume of the plume between the source and receptor. The dispersion algorithms in AERMOD and other steady-state plume models are based on the use of total dispersion coefficients, which are formulated to represent the time-averaged spread of the plume. A more appropriate definition of the volume of the plume for purposes of determining the ozone moles available for conversion of NOx is based on the instantaneous volume of the plume, which is represented by the use of relative dispersion coefficients, (Cole and Summerhays, 1979; Bange, 1991). The implementation of PVMRM in AERMOD is based on the use of relative dispersion coefficients to calculate the plume volume. Weil (1996 and 1998) has defined formulas for relative dispersion that are consistent with the AERMOD treatment of dispersion, and which can be calculated using meteorological parameters available within AERMOD.

The chemistry for both models has been peer-reviewed as noted by the documents posted on EPA's Support Center for Regulatory Air Modeling (SCRAM) web site entitled "Sensitivity Analysis Of PVMRM And OLM In AERMOD" and "Evaluation Of Bias In AERMOD-PVMRM". Both documents indicate that the models appear to perform as expected.

3.2.2 (e)(ii):
The requirement of 3.2.2 (e)(ii) is: can the model (OLM or PVMRM) be demonstrated to be applicable to the problem on a theoretical basis. As noted in the document entitled "Sensitivity Analysis of PVMRM and OLM In AERMOD" prepared by Roger W. Brode of MACTEC Federal Programs, Inc., (Now with EPA's Office of Air Quality Planning and Standards or OAQPS) "This report presents results of a sensitivity

analysis of the PVMRM and OLM options for NO_x to NO_2 conversion in the AERMOD dispersion model. Several single source scenarios were examined as well as a multiple-source scenario. The average conversion ratios of NO_2/NO_x for the PVMRM option tend to be lower than for the OLM option and for the Tier 2 option or the Ambient Ratio Method which has a default value of0.75 for the annual average. The sensitivity of the PVMRM and OLM options to emission rate, source parameters and modeling options appear to be reasonable and are as expected based on the formulations of the two methods. For a given NO_x emission rate and ambient ozone concentration, the NO_2/NO_x conversion ratio for PVMRM is primarily controlled by the volume of the plume, whereas the conversion ratio for OLM is primarily controlled by the ground-level NO_x concentration.

Overall the PVMRM option appears to provide a more realistic treatment of the conversion of NO_x to NO_2 as a function of distance downwind from the source than OLM or the other NO_2 screening options (Hanrahan, 1999a; Hanrahan, 1999b). No anomalous behavior of the PVMRM or OLM options was identified as a result of these sensitivity tests."

Based on this report for both OLM/PVMRM it appears to be applicable to the problem of NO_2 formation and as noted by the author provides a better estimation of the NO_2 impacts compared to other screening options.

3.2.2 (e)(iii):

The requirement of 3.2.2 (e)(iii) is: the data bases which are necessary to perform the analysis are available and adequate. The data needed to conduct an OLM/PVMRM run are 1) hourly meteorological data, 2) hourly ozone data, and 3) In-stack NO_2/NO_x ratio.

Both meteorological and ozone data sets must be processed into AERMOD ready formats. The District will preprocess both the meteorological and ozone data following applicable EPA guidance. The District maintains metrological data (AERMOD ready) for ten National Weather Service and five MM-5 sites in the valley. Additionally the District maintains ozone data (AERMOD ready) for ~21 monitoring sites in the eight counties of the valley.

Currently, limited information is available on In-stack NO_2/NO_x ratios nation-wide. A literature search of available data revealed In-stack NO_2/NO_x ratios for a limited number of sources, see Appendix C. If a source is not listed, the source type that best represents the source under review will be used. In addition the District will start collecting In-stack NO_2/NO_x data that is obtained during annual source testing, if available. These data will be compiled, and new In-stack NO_2/NO_x ratios and source categories will be developed.

3.2.2 (e)(iv):

The requirement of 3.2.2 (e)(iv) is: has an appropriate performance evaluations of the model (OLM/PVMRM) shown that the model is not biased toward underestimates? As noted in the document entitled "Evaluation Of Bias In AERMOD-PVMRM" prepared by Roger W. Brode of MACTEC Federal Programs, Inc.,(Now with EPA OAQPS) "This report presents results of an analysis of evaluation results to determine whether the AERMOD-PVMRM algorithm produces biased or unbiased estimates of the NO_2/NO_x ratio. Evaluation results from two aircraft studies and two long-term field studies were examined, as well as comparisons between AERMOD-PVMRM and other refined chemically reactive plume models. Comparisons between predicted and observed NO_2/NO_x ratios were based on results paired in time and space, providing a more rigorous assessment than is commonly used in evaluating the performance of air dispersion models. While there does not appear to be a clear and objective criterion established by EPA for determining whether a model is biased or unbiased, a general "rule of thumb" that is commonly used as a benchmark in judging the performance of air dispersion models is agreement with observations within a factor of two.

…In all cases, the average ratio between predicted and observed NO_2/NO_x ratios showed agreement within a factor of two, and in most cases within about a factor of 1.5. Based on all of the data available, the AERMOD-PVMRM algorithm is judged to provide unbiased estimates of the NO_2/NO_x ratio based on criteria that are comparable to, or more rigorous than, evaluations performed for other dispersion models that are judged to be refined, implying unbiased performance."

As noted in the above report it has been determined that PVMRM has been judged to provide unbiased estimates based on criteria that are comparable to, or more rigorous than, evaluations performed for other dispersion models.

At the present time no assessment of bias has been conducted for the OLM model. It has been shown in the sensitivity analysis, see discussion on item 3.2.2 (e)(ii) above, that OLM provides similar more conservative results than PVMRM. Therefore is it assumed that OLM would also provide an unbiased estimate of concentration.

3.2.2 (e)(v):
The requirement of 3.2.2 (e)(iv) is: has a protocol on methods and procedures to be followed been established. The methods and procedures outlined in Appendix A which is entitled "Modeling Procedures" will be implemented to comply with this requirement.

Conclusion:
Based on the information provided above, the District has determined that the method for determining hourly NO_2 concentrations using AERMOD in conjunction with the non-regulatory OLM or PVMRM options is acceptable based on the requirements in 40 CFR Part 51, Appendix W, 3.2.2(e), see below.

3.2.2 (e)(i). The model has received a scientific peer review;

- The chemistry for both models have received scientific peer review as noted in “Sensitivity Analysis of PVMRM and OLM in AERMOD” and “Evaluation of Bias in AERMOD-PVMRM”. Both documents indicate that the models appear to perform as expected

3.2.2 (e)(ii). The model can be demonstrated to be applicable to the problem on a theoretical basis;

- Both models have been reviewed and the chemistry has been widely accepted by EPA and other government agencies as being appropriate for addressing the formation of NO_2 and the calculation of NO_2 concentration at receptors downwind. Additionally, the ““Sensitivity Analysis of PVMRM and OLM in AERMOD” report would indicate OLM/PVMRM provides a better estimation of the NO_2 impacts compared to other screening options.

3.2.2 (e)(iii). The data bases which are necessary to perform the analysis are available and adequate;

- The District will process both the meteorological and Ozone data using applicable guidance and procedure. Additionally, the District will continue to gather/develop NO_2 ratios as needed.

3.2.2 (e)(iv). Appropriate performance evaluations of the model have shown that the model is not biased toward underestimates;

- As noted the “Evaluation of Bias In AERMOD-PVMRM” report, PVMRM has been judged to provide an unbiased estimate. Based on the sensitivity study, OLM was estimated to provide similar or more conservative estimates of concentration than PVMRM and therefore would also be judged to be unbiased to underestimation.

3.2.2 (e)(v). A protocol on methods and procedures to be followed has been established.”

- The methods and procedures for conducting an assessment for determining compliance with the federal 1-hour NAAQS are contained in Append A of this document.

Appendix A
Modeling Protocol

This modeling protocol is meant to define the stepwise approach necessary to satisfy the requirements in *General Guidance for Implementing the 1-Hour NO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim NO_2 Significant Impact Level*[1] and the *Applicability of Appendix W Modeling Guidance for 1-Hour NO2 National Ambient Air Quality Standard*[2]. Nothing in this protocol should be taken as overriding guidance contained in those two memoranda, or Appendix W of Part 51 of Title 40 of the *Code of Federal Regulations* (40 CFR 51, Appendix W).

The San Joaquin Valley Air Pollution Control District is not currently classified as to its attainment with regard to the new standard. The U.S. Environmental Protection Agency (EPA) will designate attainment/nonattainment areas by January 2012. It is anticipated based upon current air quality design values in the District that the District will be classified as "unclassifiable". Therefore, any new major sources (i.e., with emissions equal to or greater than 250 tons per year or 100 tons per year for certain classes of sources) or major modifications to major sources will be subject to permitting under the Prevention of Significant Deterioration (PSD). Minor sources or minor modifications will continue to be subject to the air quality modeling requirements in Section 4.14 of Rule 2201. In accordance with the requirements of Section 4.14 of Rule 2201, all demonstrations that new sources or modifications will not cause or contribute to the violation of the 1-hour NO_2 National Ambient Air Quality Standard (NAAQS) shall use this protocol.

Project Description

An AERMOD Non-Regulatory Option Checklist shall be completed for each project even if the ozone limiting method (OLM) or plume volume molar ratio method (PVMRM) is not used. Specific information to be provided includes the Facility Information, Project Information, Modeling Information, and Final Results. There is no need to obtain approval from a Supervisor if the ambient ratio method (ARM), OLM or PVMRM are not used. Source Parameters for all sources modeled must also be provided with the Checklist. (See Appendix B.) If the ARM is used, provide the ratio used.

Model Selection Discussion and Rationale

The latest version of the American Meteorological Society/Environmental Protection Agency Regulatory Model or AERMOD should be used for all NO_2 modeling. Use of an

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[1] *General Guidance for Implementing the 1-Hour NO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim NO_2 Significant Impact Level,* Anna Marie Wood, Acting Director, Air Quality Policy Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC, June 28, 2010.

[2] *Applicability of Appendix W Modeling Guidance for 1-Hour NO2 National Ambient Air Quality Standard,* Tyler Fox, Leader, Air Quality Modeling Group, Air Quality Assessment Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC, June 28, 2010.

alternative model will require an evaluation as defined in Appendix W. Note that AERMOD is no longer a preferred model if the ambient ratio method (ARM), OLM or PVMRM are used. The use of any of these methods must be justified in accordance with the *Applicability of Appendix W Modeling Guidance for 1-Hour NO2 National Ambient Air Quality Standard.*

Model Control Option Selection

A tiered approach must be taken for the analysis. The following tiers will be used:

- **Tier I:** In Tier I, the maximum predicted 1-hour concentration from all sources in the project modeling 5-years of meteorological data is added to the representative background concentration for a comparison with the 1-hour NO_2 NAAQS. The following stepwise approach will be used:

  1. The actual emissions for each scenario (e.g., normal, commissioning, emergency, or standby) and source will be modeled using the regulatory options in AERMOD. It will be assumed in this step that all NO is completely converted to NO_2. Nothing further need be done if this analysis indicates that the NAAQS will not be exceeded.
  2. The maximum 1-hour contribution from all the sources included in the project (but not any background sources that may be modeled) will be compared to the interim Significant Impact Level (SIL) of 4 ppb if there is a prediction that the NAAQS will be exceeded. If the highest 1-hour maximum concentration predicted by modeling the emissions from all project sources and scenarios using 5-years of meteorological data is less than the SIL, nothing further need be done.
  3. The first and second steps will be duplicated using the ARM. Based on an analysis of NO/NO_2 data in the District, a default ratio of 0.9 will be used for the ARM.
  4. OLM or PVMRM will be used to implement the first two steps. Note that the use of ARM, OLM, or PVMRM must be justified using the procedures in *Applicability of Appendix W Modeling Guidance for 1-Hour NO2 National Ambient Air Quality Standard* and approved by a District supervisor. To document such approval, the AERMOD Non-Regulatory Option Checklist will be completed. For OLM, the OLMGROUP ALL option will be used if there are multiple sources in the project. The default NO_2/NO_X ratio will be the appropriate ratio developed by the District for the type of source modeled. (See Appendix C.) If there are multiple types of sources, the appropriate NO_2/NO_X ratio will be used in the SOURCE pathway of the model. The default ozone concentration will be 40 ppb. If Version 09292 of the model is used with the PVMRM option, variable emission rates must not be modeled. The NO_2/NO_X ambient equilibrium ratio for PVMRM will be 0.90.

- **Tier II:** For Tier II, the same procedure as outlined above for Tier I will be used except that the 8th highest 1-hour maximum concentration predicted will be used.

- **Tier III:** The 98th percentile 1-hour predicted concentration will be determined using the post-processor developed by the District, third-party software developers, or a revised version of the model itself. This value will be used in the same stepwise approach as identified for Tier I.

- **Tier IV:** The predicted concentrations from the model will be paired in time with the monitored NO_2 concentrations. The same approach as identified above for Tier III is used to calculate a value to compare with the standard.

(Specific directions for use of the District's post-processor program are given in the users' guide. Third-party software developers or EPA must be consulted to obtain the appropriate guidance for use of other post-processors or versions of the model.)

Model Emission Inventory

For sources modeled to determine compliance with the 1-hour NO_2 NAAQS, the maximum 1-hour emission rates must be used. Table 8-2 in Appendix W provides specific guidance for calculating specific emission rates. The following is an extract from Table 8-2:

Emission Limit (lbs/MMBtu)	X	Operating Level (MMBtu/hr)	X	Operating Factor (e.g., hr/yr, hr/day)
		Proposed New or Modified Source		
Maximum allowable emission limit or enforceable permit limit		Design capacity or enforceable permit condition		Continuous operation (i.e., all hours of each time period under consideration) for all hours of the meteorological data base
		Nearby Source(s)		
Maximum allowable emission limit or enforceable permit limit		Actual or design capacity (whichever is greater) or enforceable permit condition		Continuous operation (i.e., all hours of each time period under consideration) for all hours of the meteorological data base
		Other Source(s)		
Maximum allowable emission limit or enforceable permit limit		Annual level when actually operating averaged over the most recent 2 years		Continuous operation (i.e., all hours of each time period under consideration) for all hours of the meteorological data base

Model Scenarios

Note that multiple scenarios may need to be run. For example, scenarios should include emissions and operating conditions for 100 percent operation, 75 percent, and 50 percent. For some sources, emissions and operating conditions during commissioning or startup or shutdown may be important as well.

Other Non-Project Sources

The analysis may include sources in addition to those that are part of the project. In accordance with Appendix W, "all sources expected to cause a significant concentration gradient in the vicinity of the source or sources under consideration for emission limit(s) should be explicitly modeled." Professional judgment should be used to identify non-project sources to include in the analysis. The following are some examples:

1. A source with a short-stack subject to downwash is located in an area where there are a number of other sources with short stacks subject to downwash. Unless there is another source within 100-meters, this source could be modeled alone.
2. A source with a relatively tall stack not subject to downwash is located in an area where there are other sources. The impact area (i.e., the area in which the source will have an impact equal to the SIL) should be determined. Other sources that are within that impact area should be included in the analysis. Consideration of Appendix W's guidance regarding the concentration gradient should be given to selecting sources to model.

Background Concentration

All ambient air quality analyses that are intended to determine the total pollutant concentration for comparison with the standard will include explicit modeling of the project sources and other non-project sources as discussed above. In addition, a background concentration must be included that represents the contribution from sources that are not modeled.

The most recent air quality design value (i.e., the three-year average of the 98th percentile of the daily maximum 1-hour concentrations) of a representative monitoring site should be used for the background concentration. The representativeness of the monitoring site will depend upon the following factors:

1. Proximity to the source(s) modeled. In general, the nearest monitoring site is preferable.
2. Similarity of surrounding source(s). Sources in the vicinity of the monitor should be similar to those near the source(s) modeled.
3. Conservativeness of the background concentrations. The intent of any analysis is to ensure that it is "conservative" (i.e., ambient concentrations are overestimated). Thus, an effort should be made to select a background monitoring site where the measured concentrations are equal to or greater than those that would be measured were a monitor to be located in the vicinity of the source(s) to be modeled.

Another issue that must be considered is the contribution by sources in the vicinity of the background monitor to concentrations at the monitor. Because many of the District's existing monitors are located in urban and suburban areas, numerous small sources in the vicinity of the monitor may be contributing to the concentrations measured at the monitor. The analysis of a source that is located in a similar area would not need to include additional sources. But, the analysis of a source located in a remote area using background data from a monitor that is not affected by sources surrounding it may need to include additional sources to ensure that proper consideration is given.

Selection of the background monitoring site and the factors that led to its selection should be documented.

Downwash Characterization

Care should be exercised to ensure that downwash is properly considered. When there is reason to believe that inclusion of downwash in the analysis will result in a higher estimate of pollutant concentrations, downwash should be included. Otherwise, the analysis can proceed without downwash.

Receptor Selection

Receptors should be selected to ensure that the maximum concentration is predicted. It may be necessary to model a nested refined grid if the original coarser grid does not identify the maximum concentration.

Meteorological Data

The District has processed data for all National Weather Service (NWS) sites in the Valley for which data are available. These include Bakersfield, Fresno, Hanford, Lemoore, Madera, Merced, Modesto, Porterville, Visalia, and Stockton. Five-years of data are available for most of these sites. Data availability for these sites will expand in the future as additional years of data are processed. In addition, the District has purchased and processed data from the MM5 meteorological model for 5 sites: Fellows, Los Banos, Missouri Triangle, Tracy, and Turk. These data can be used for any analysis that is not being performed to comply with PSD requirements. The meteorological data used in an analysis should be representative of the area in which the source(s) is located. To determine representativeness, consideration should be given to the land uses in the vicinity of the meteorological site versus that near the source(s). For example, it may be appropriate to use Madera or Hanford data rather than data from the Fresno airport to model a source that is located near Fresno but is in the rural area of Fresno County. Written justification for the choice of a meteorological data set should be provided on the checklist.

Post-Processing of the Results

As discussed above, some analytical tiers may require the use of a post-processor. The District has developed a post-processor for use with Version 09292 of AERMOD. To use this post-processor, formatted post files must be output by the model. This post-processor will calculate the 5-year average 98th percentile concentration. It will also perform the paired-sums calculations for Tier IV. Third-party software companies have developed post-processors to calculate the 5-year average 98th percentile concentrations. Future versions of the model are expected to include the calculation of a 5-year 98th percentile concentration internally.

Documentation of the Results

The District's documentation of ambient air quality analyses will include the standard memorandum from the specialist to the engineer that requested the analysis, this protocol, the completed AERMOD Non-Regulatory Option Checklist, and the justification for the use of ARM, OLM, or PVMRM.

Appendix B
Checklist

AERMOD Non-Regulatory Option Checklist (ARM / OLM / PVMRM)

Approved	**Site Specific Parameters** Items that are required for a Case – By – Case determination are noted with an *	
	Facility Information	
	Permit ID	
	Name	
	Address	
	City / State	
Comments		
	Project Information	
	Project ID	
	Unit ID / Mod (s)	
	Description	
Comments		
	Modeling Information*	
	Model	EPA AERMOD Version (**XXXXX)**
	Operating Scenario	Normal or Commissioning or Emergency or Standby
	Met Data	
	Site Name	
	Years	Start: End:
	Type	NWS or MM5
	Terrain	Flat or Elevated:
	Site Location	Zone: UTME: UTMN:
	Ozone Limiting	ARM or OLM or PVMRM
	Source Parameter	See Tables Below
	Background Site	
	Name	
	Location	Zone: UTME: UTMN:
	Years	Start: End:
	Location Type	Urban or Rural
	Distance From Project (km)	
Comments		
	Final Results*	
	Averaging Period / Concentration (Background + Model)	SIL: Local Hour ARM: 0.9 Tier I – Maximum 1-hour : Tier II – 8th Highest : Tier III – 98th Percentile : Tier IV – Paired Sum :
Comments		
	Conclusion* It has been determined that enough information has been provided to conclude that OLM or PVMRM are appropriate for the above modeling scenario.	

	Supervisor Name	
	Supervisor Signature	
Comments		

Source Parameter:

Each different source that is modeled should have a separate table.

Source Parameters For Unit 1-0 or Unit 1-0,2-0			
Source Type	Point	**Location Type**	Urban / Rural
Stack Height (m)		**Max Hours per Year**	
Stack Diameter. (m)		**Fuel Type**	
Stack Exit Velocity (m/s)		**NO_2 / NO_x Ratio (%)**	/
Stack Exit Temp. (°K)			
Rating (MMBtu/hr)			

Appendix C
In-Stack NO_2/NO_x ratios

Table 1 Recommend In-stack NO2/NOx Ratios		
Emission Source	Range of NO_2/NOx Ratios (%)	Recommended NO_2/NOx Ratio (%)
Boilers (NG)	10	10
Compressors / Turbines (NG)	3-6	6
Glass Furnace	2.45 – 11.59*	4.32**
IC Engines (Diesel)	20	20
IC Engine (Lean Burn NG)	5-10	10
Truck / Cars	3-6	6

*Data is based on CEMs, source test, and portable analyzer data collected in the San Joaquin Valley.
**Value represents the statistical average of all data points

ATTACHMENT B

SJVAPCD, ASSESSMENT OF NON-REGULATORY OPTION IN AERMOD APPENDIX C, *RECOMMENDED IN-STACK NO_2 /NO_X RATIOS*. OCTOBER 2010

Recommend In-stack NO2/NOx Ratios				
Refer #	**Fuel**	**Equipment Category (Controls)**	**Range of Ratios (%)**	**Recommended Ratio (%)**
Boilers				
1	**NG**	Default	10	10
2		6.6 MMBtu/Hr (Force Draft)*[L]	0.0 – 2.90	1.58**
2		7.6 MMBtu/Hr (SCR / FGR)*	3.45 – 15.79	9.65**
2		11.4 MMBtu/Hr (Force Draft)*[L]	1.81 – 3.51	2.68**
Compressor IC Engines				
1	**NG**	Default	60	60
2a		225 BHP IGN Timing BTC 17***	11.61 – 11.86	11.76**
2a		350 BHP IGN Timing BTC 18***	4.37 – 4.83	4.66**
2a		550 BHP IGN Timing BTC 20***	0.93 – 2.98	1.96**
2a		625 BHP IGN Timing BTC 10***	10.97 – 11.96	11.6**
2a		773 BHP IGN Timing BTC 9***	58.04 – 58.54	58.3**
2a		773 BHP IGN Timing BTC 20***	72.65 – 73.42	73.12**
2a		880 BHP IGN Timing BTC 8***	9.79 – 14.14	11.93**
2a		880 BHP IGN Timing BTC 15***	0.7 – 8.28	2.52**
2a		1500 BHP IGN Timing BTC 12***	10.32 – 12.03	11.47**
2a		1500 BHP IGN Timing BTC 6.5***	18.42 – 21.33	19.97**
2a		4000 BHP IGN Timing BTC 5***	22.36 – 25.69	23.82**
2a	**Waste Gas (Field Gas)**	880 BHP IGN Timing BTC 20***	1.77 – 6.10	3.86**
2a		1000 BHP***	0.40 – 0.81	0.64**
Dryer				
	NG	20 MMBTU/Hr (Milk -Tower Dryer)*	3.85 – 11.11	6.88**
Glass Furnace				
2	**NG**	**Glass Furnace**	2.45 – 11.59	4.32**
Heaters				
2	**NG / Refinery Gas**	14.1 MMBTU/Hr (John Zink PSMR)*	11.54 – 52.63	32.0**

Recommend In-stack NO2/NOx Ratios						
Refer #	**Fuel**	**Equipment Category (Controls)**	**Range of Ratios (%)**			**Recommended Ratio (%)**
IC Engines						
2	**Biogas**	200 BHP*	0.0 – 1.90			0.37**
1	**Diesel**	Default	20			20
		322 BHP (WP)*	0.0 – 50.0			15.64**
4	**NG**	Default – Lean Burn	5-10			10
2		120 BHP (3-Way Catalyst)*	0.1 – 2.83			0.9**
2		162 BHP (Catalytic converter, air/fuel ratio)*	0.0 – 12.5			1.81**
2		165 BHP (3-Way Catalyst)*	0.0 – 17.58			3.16**
2		180 BHP (NSCR)*	1.02 – 3.41			1.82**
2		208 BHP (Catalytic converter, air/fuel ratio)*	0.0 – 1.44			0.48**
2		1,070 BHP (LB/WP–Turbocharger/Intercooler)*	20.91 – 39.62			34.41**
2		1,529 BHP (LB - CO Catalyst, SCR)*	2.70 – 4.58			3.59**
2		2,775 BHP (SCR)*	14.53 – 26.33			19.46**
2		4,175 BHP (SCR,CO & VOC Catalysts)*	0.0 – 21.28			1.15**
Transportation Refrigeration Units (TRUs)						
5		CARB= CARB Diesel GTL = Gas To Liquid	Fuel	Eng Speed	Exhaust	NO_2/ NO_x Ratio
			CARB	High	Muffler	15.37
			GTL	High	Muffler	16.17
			CARB	High	pDPF	25.71
			CARB	Low	Muffler	22.66
			GTL	Low	Muffler	25.12
			CARB	Low	pDPF	12.98
Truck / Cars						
6	**Gas/Diesel**	Light / Medium Duty	16-25			25
	Diesel	Heavy Duty	6-11			11
Turbines						
3	**NG**	GE Turbines	8.33 – 9.1			9.1
2a		Solar Centaur T-4702 (3.4 MW)***	8.43 – 12.42			10.32**

* Samples taken each minute or several minutes

**Value represents the statistical average of all data points

*** 30 min / 1 hour Source Test

L = Load ratings have been included in average

LB = Lean Burn

WP = Water Pump

Recommend In-stack NO2/NOx Ratios				
Refer #	**Fuel**	**Equipment Category (Controls)**	**Range of Ratios (%)**	**Recommended Ratio (%)**
References				

1. Barrie Lawrence, Environmental Scientist, Government of Newfoundland and Labrador, "Guideline for Plume Dispersion Modeling" 1st Revision: November 20, 2006, Page 14

2. District Database "NO2 -NOx Ratio.mdb" - Data is based on CEMs, source test, and portable analyzer data collected in the San Joaquin Valley

a. District Database "NO2 -NOx Ratio.mdb" - Data is based on source test data collected from out of state (Arkansas Department of Environmental Quality Office of Air Quality)

3. Roointon Pavri and Gerald D. Moore, GE Energy Services Atlanta, GA, "Gas Turbine Emissions and Control" March 2001 Page 63

4. Nigel N. Clark, Center for Alternative Fuels, Engines and Emissions Department of Mechanical and Aerospace Engineering West Virginia University Morgantown, WV 26506, "Selective NOx Recirculation for Stationary Lean-Burn Natural Gas Engines" April 30, 2007 Page 64

5. Robb A. Barnitt, National Renewable Energy Laboratory, "Emissions of Transport Refrigeration Units with CARB Diesel, Gas-to-Liquid Diesel, and Emissions Control Devices", May 1, 2010

6. P G Boulter, I S McCrae, and J Green, Transportation research Laboratory, "Primary NIO2 Emissions From Road Vehicles in the Hatfield and Bell Commons Tunnels", July 2007

ATTACHMENT C

SJVAPCD, PERMIT SERVICES DEPARTMENT. VILLALVAZO, LELAND AND ESTER DAVILA. *PROCEDURES FOR DOWNLOADING AND PROCESSING NCDC METEOROLOGICAL DATA.* MAY 2010

Procedures for Downloading and Processing NCDC Meteorological Data

Prepared by
San Joaquin Valley APCD
Permit Services Department

Leland Villalvazo, Supervising AQS
Ester Davila, Supervising AQS

NCDC General Statement:

Due to various Federal Laws and Regulations, NOAA National Climatic Data Centers (NCDC) is required to charge for some of its online data to recover the cost of data dissemination. This includes hardware and personnel costs incurred by each Data Center. Charges are required for most domains (e.g., .com, .org, .net). All online data are now free for all .gov, .edu, .k12, .mil, .us, and a few other specific domains. Please see NNDC's Free Data Distribution Statement (**http://www.ncdc.noaa.gov/oa/nndc/freedata.pdf**) (PDF Format) for further information on our FREE data policy. For information on how free access is granted via our web systems, please visit the Free Access (***http://www.ncdc.noaa.gov/oa/about/ncdchelp.html#FREE***) section of the NCDC help page (***http://www.ncdc.noaa.gov/oa/about/ncdchelp.html***)

Questions/Comments can be directed to: nndc.webmaster@noaa.gov

Introduction:

The following procedures are designed in a cookbook fashion to provide the user a step by step approach to downloading and processing local meteorological data. We hope that this approach will allow large and small Districts the ability to generate their own AERMOD data without the cost of hiring a third party. Or if a third party is hired, we hope that this approach will provide enough information to understand the steps that may be taken to process the raw data collected at the met tower(s) into the final met data used in AERMOD.

Where to Start:

The user needs to determine if their organization has FREE access rights to the online NCDC data. The user should go to the following website **Listing of REMOTE Environment Variables** (http://www.ncdc.noaa.gov/whoami/whoami) to determine if the user has one of the acceptable extensions (gov, edu, k12, mil, and us). The user should see his/her *Host Name* and the extension that has been determined.

If the *Host Name* does not have one of the acceptable extensions the user has two options 1) Contact their IT department for assistance or 2) email nndc.webmaster@noaa.gov and explain in the email 1) that you work for an APCD or AQMD in California, 2) that your IP does not have one of the acceptable extensions, 3) what the data is going to be used for (Regulatory Dispersion Modeling with AERMOD), 4) Your contact information, and 5) Request an account or other means that can be used to download the data for free. If NCDC accepts your explanation they will issue a user name and password that can be used to access the online NCDC data.

I have Access, Now What?

Now that you have access to the NCDC's data you will need to follow the steps below to download the quality controlled data.

NCDC Access Type:

There are two types of access rights we will be dealing with in the following steps: 1) Free Access and 2) Free Account Access.

Free Access: Users that have one of the acceptable IP extension determined above:
Free Account Access: Users that have been given an account by NCDC to access the online data

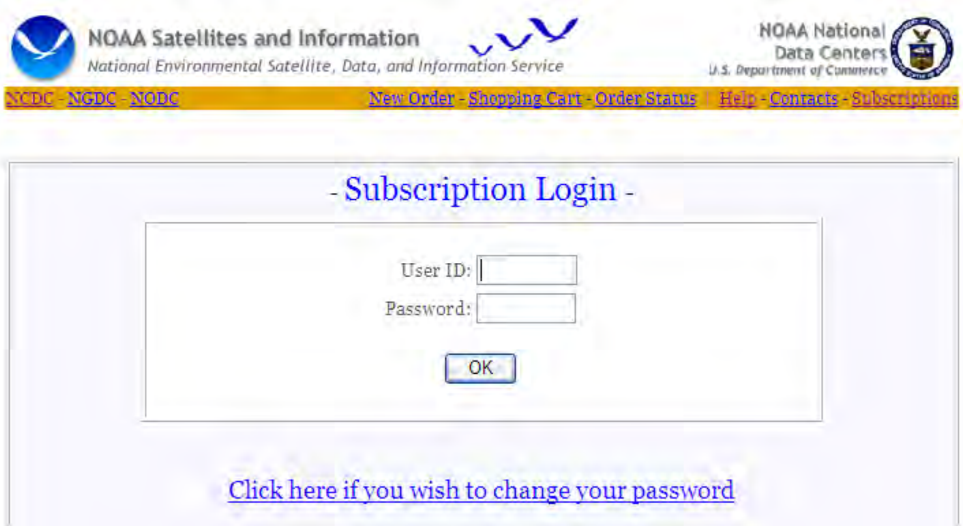
Free Access:
Users with this type of access should use the following steps to access the online data provided by NCDC.

> **Option 1:**
> To access data prior to Jan 2005 use this link
> **Unedited**(http://cdo.ncdc.noaa.gov/ulcd/ULCD)
>
> **Option 2:**
> To access data after Jan 2005 use this link **Quality Controlled**
> (http://cdo.ncdc.noaa.gov/qclcd/QCLCD?prior=N)

Now skip to Step 5 below (The screen shots below are based on Option 2)

Free Account Access:
Users with this type of access should use the following steps to access the online data provided by NCDC.

Step1 - Login into the NCDC https://ols.nndc.noaa.gov/sub-login.html

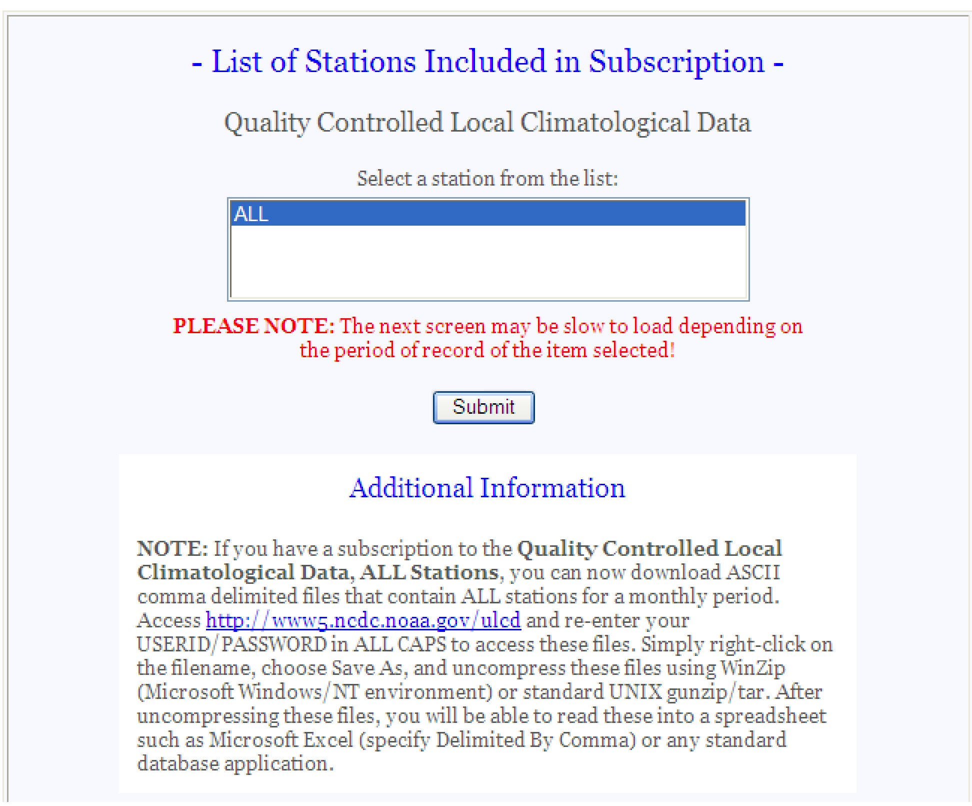


Enter your User ID and Password then click “OK”

Step 2 – Select data type "**Quality Controlled Local Climatological Data**"

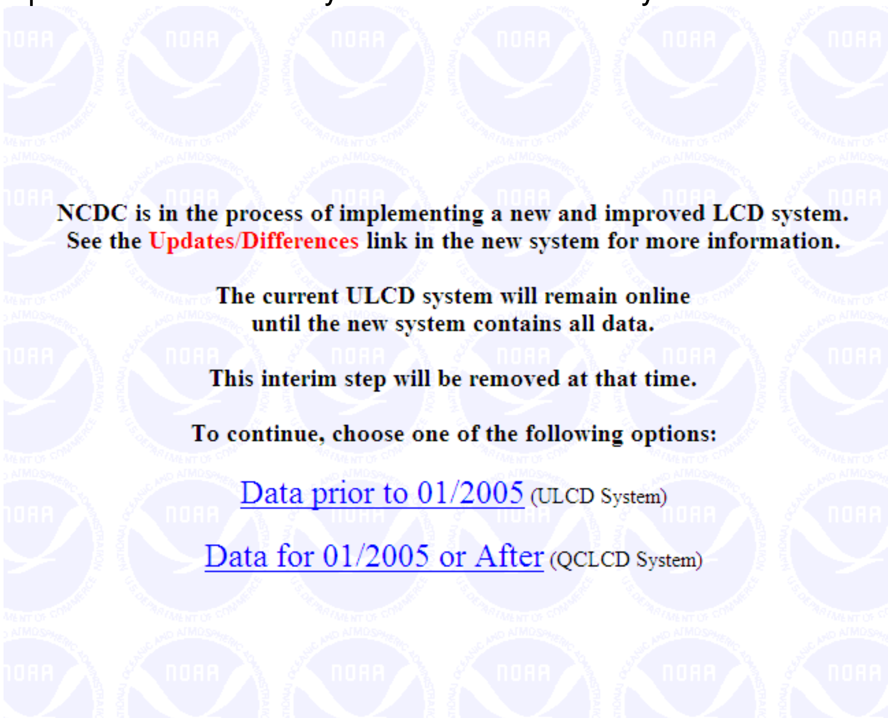
Select "Quality Controlled Local Climatological Data" then click "Continue"

Step 3 – Select "**All**" or a specific station if available



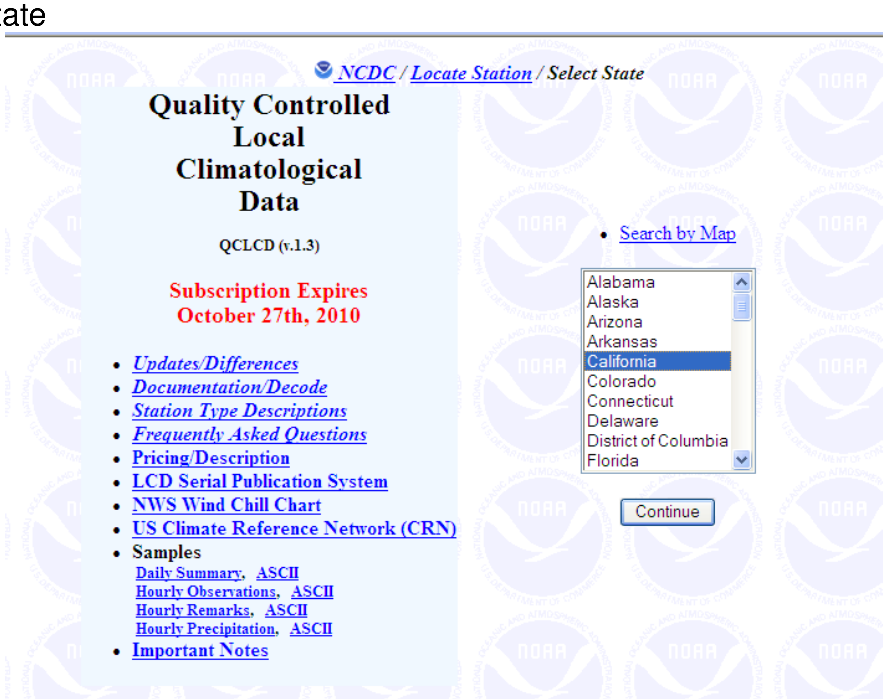
Select "ALL" then click "submit"

Step 4 – Select data period before January 2005 or After January 2005



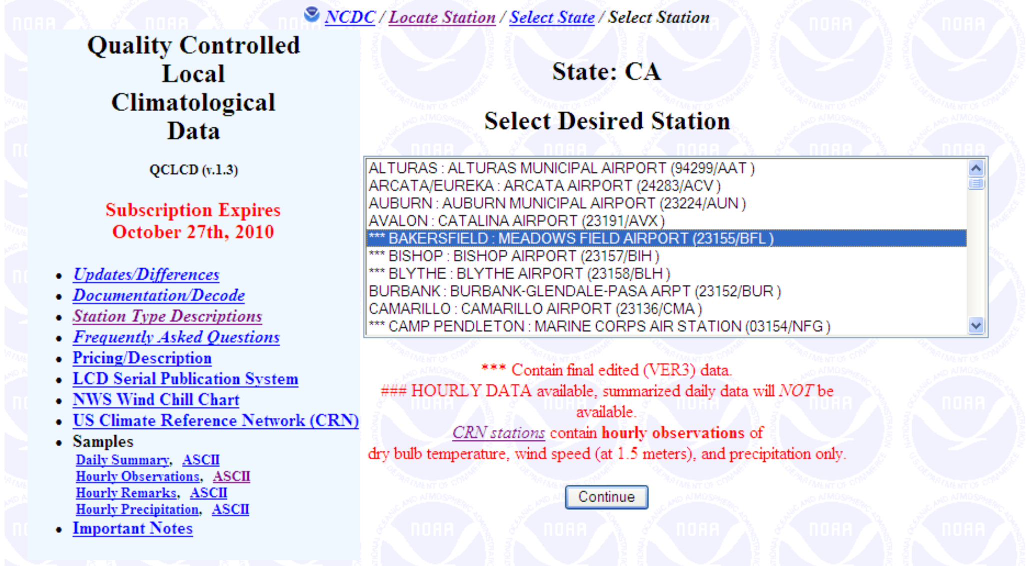
For this walk through click “Data for 01/2005 or After”

Step 5 – Select a state



Select “California” from the list then click “Continue”

Step 6 – Select the meteorological station of interest.



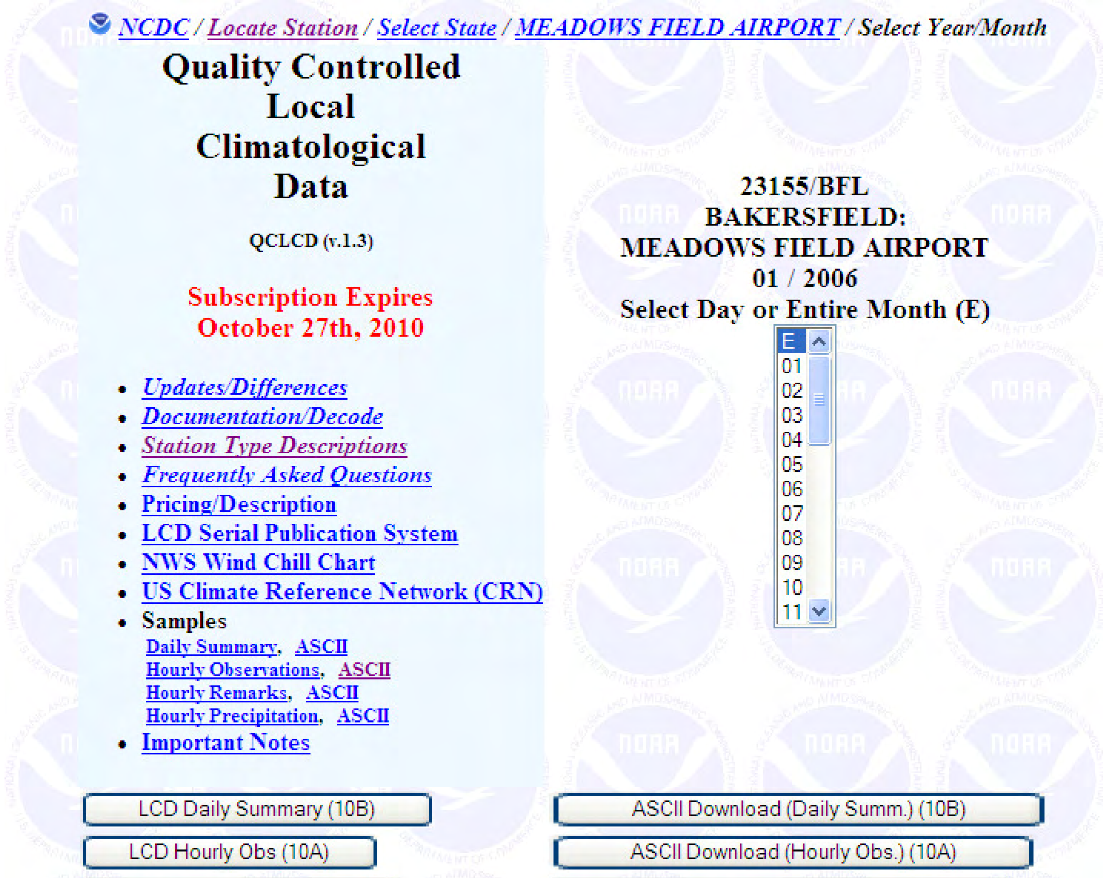
Review the list of available meteorological stations and select the station of Interest, then click “Continue”.

Step 7 – Select the meteorological data to open (12 files for each year)

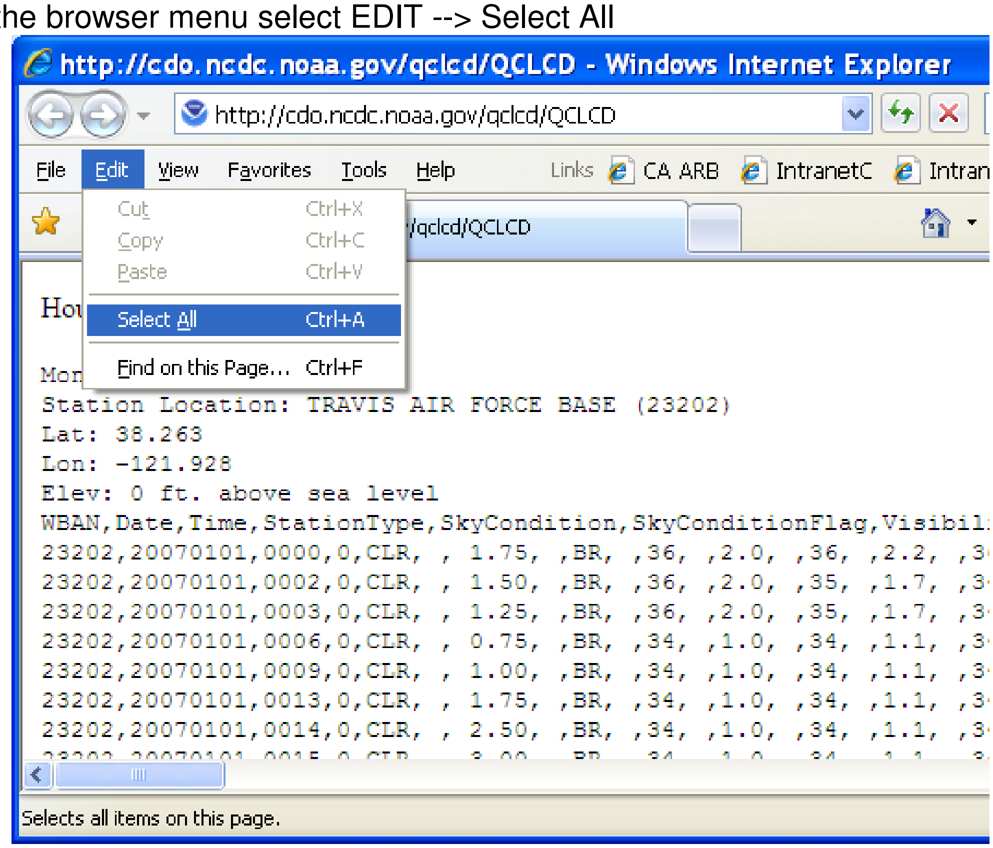
Please note: 1 year of meteorological data is broken into 12 files, one for each month.

From the list of available data select a file to open then click “Continue”

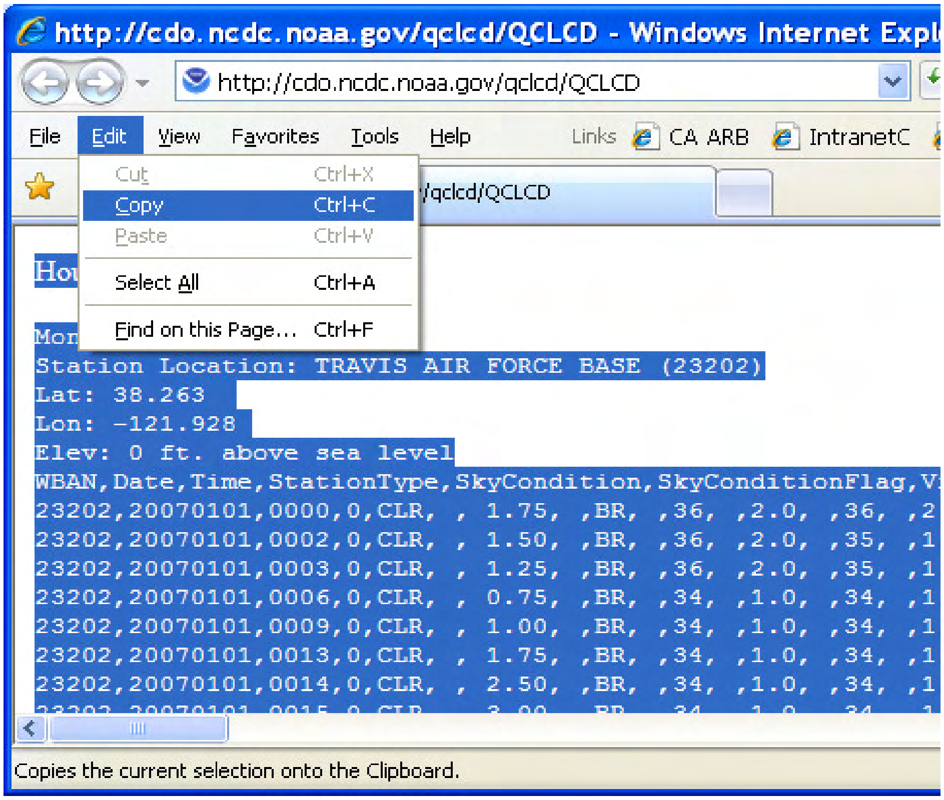
Step 8 – Select E (Entire month) then click on "ASCII Download (Hourly Obs) (10A)". This will open a second browser window.



Step 9 – From the browser menu select EDIT --> Select All

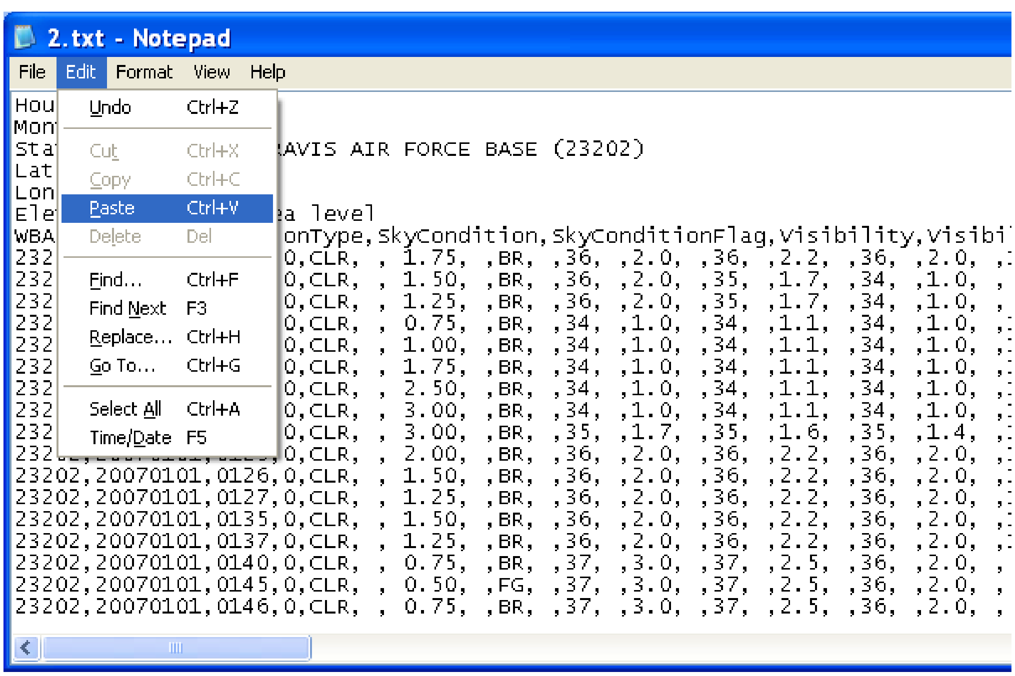


Step 10 – From the browser select EDIT --> COPY

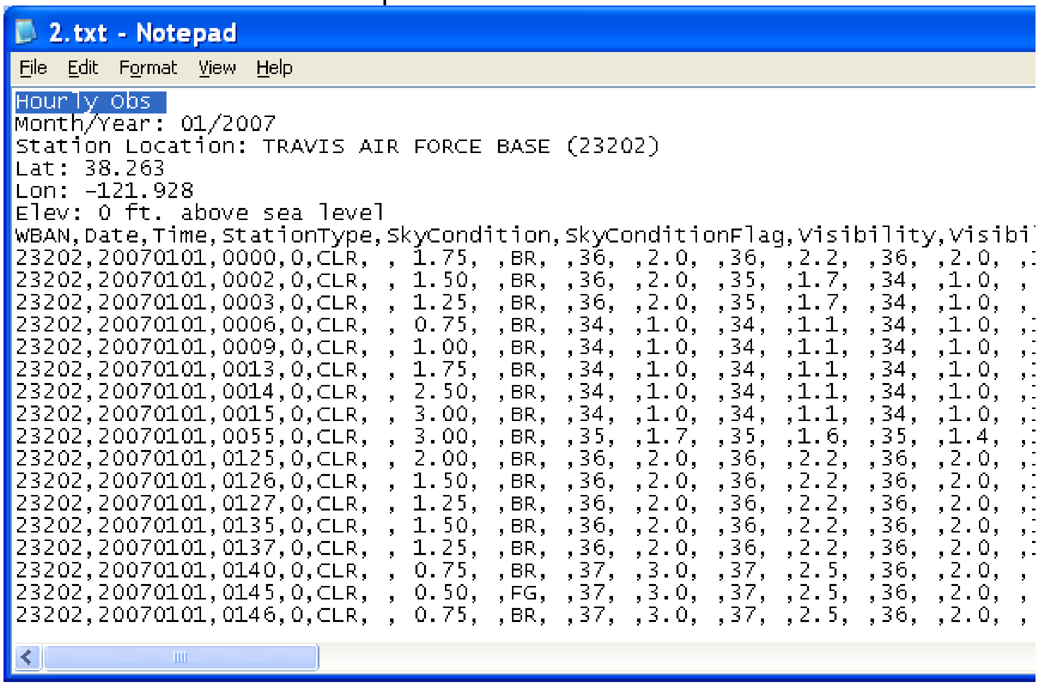


Please note: Steps 9 and 10 can be performed using the following quick keys
CTL + A = Select ALL and CTL + C = Copy

Step 11- Open a text editor like WORD PAD and select EDIT --> PASTE. If you are going to use the data in the section entitled "**How to Process My Data**" then it is recommended that you use the template files included on the CD. Copy the folder called "YEAR" and rename it to represent the year of the meteorological data being downloaded. Within this folder are 12 files numbered 1 thru 12, one for each month of the year. Open the corresponding file for the month being downloaded and paste the data.



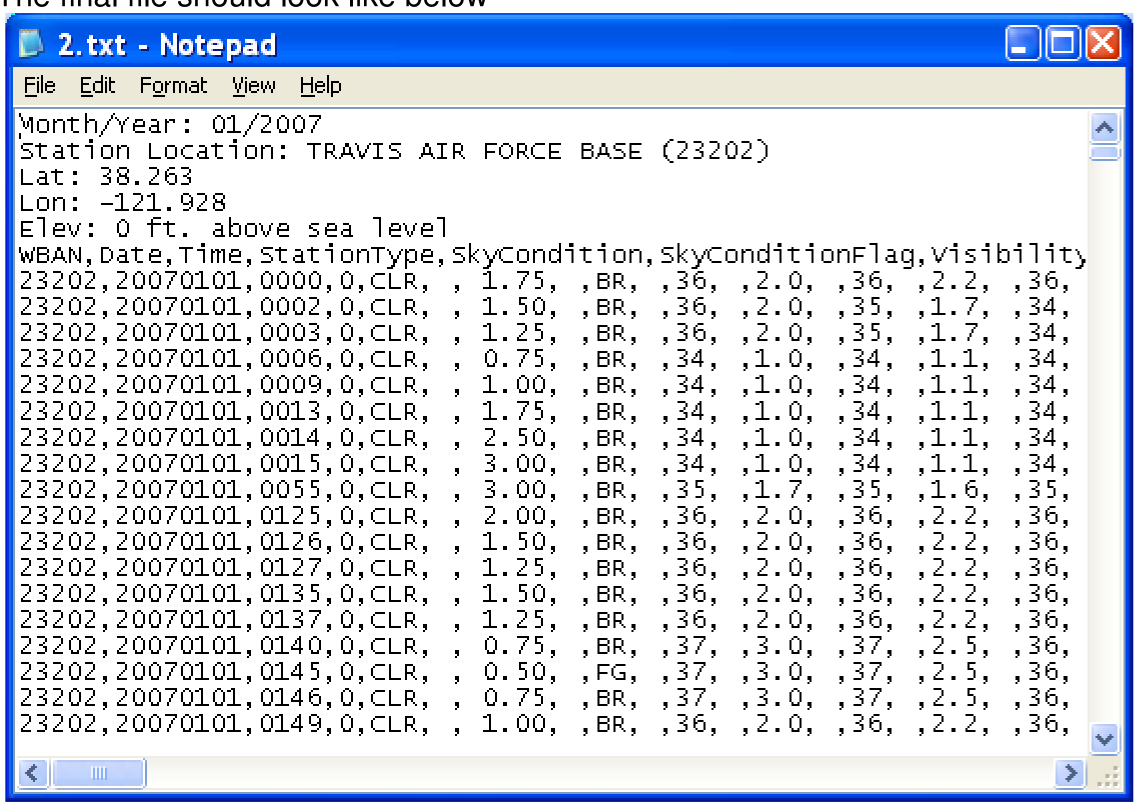
Step 12 – Delete the first line that was copied



```
2.txt - Notepad
File  Edit  Format  View  Help
Hourly Obs
Month/Year: 01/2007
Station Location: TRAVIS AIR FORCE BASE (23202)
Lat: 38.263
Lon: -121.928
Elev: 0 ft. above sea level
WBAN,Date,Time,StationType,SkyCondition,SkyConditionFlag,Visibility,Visibi
23202,20070101,0000,0,CLR, , 1.75, ,BR, ,36, ,2.0, ,36, ,2.2, ,36, ,2.0, ,
23202,20070101,0002,0,CLR, , 1.50, ,BR, ,36, ,2.0, ,35, ,1.7, ,34, ,1.0, ,
23202,20070101,0003,0,CLR, , 1.25, ,BR, ,36, ,2.0, ,35, ,1.7, ,34, ,1.0, ,
23202,20070101,0006,0,CLR, , 0.75, ,BR, ,34, ,1.0, ,34, ,1.1, ,34, ,1.0, ,
23202,20070101,0009,0,CLR, , 1.00, ,BR, ,34, ,1.0, ,34, ,1.1, ,34, ,1.0, ,
23202,20070101,0013,0,CLR, , 1.75, ,BR, ,34, ,1.0, ,34, ,1.1, ,34, ,1.0, ,
23202,20070101,0014,0,CLR, , 2.50, ,BR, ,34, ,1.0, ,34, ,1.1, ,34, ,1.0, ,
23202,20070101,0015,0,CLR, , 3.00, ,BR, ,34, ,1.0, ,34, ,1.1, ,34, ,1.0, ,
23202,20070101,0055,0,CLR, , 3.00, ,BR, ,35, ,1.7, ,35, ,1.6, ,35, ,1.4, ,
23202,20070101,0125,0,CLR, , 2.00, ,BR, ,36, ,2.0, ,36, ,2.2, ,36, ,2.0, ,
23202,20070101,0126,0,CLR, , 1.50, ,BR, ,36, ,2.0, ,36, ,2.2, ,36, ,2.0, ,
23202,20070101,0127,0,CLR, , 1.25, ,BR, ,36, ,2.0, ,36, ,2.2, ,36, ,2.0, ,
23202,20070101,0135,0,CLR, , 1.50, ,BR, ,36, ,2.0, ,36, ,2.2, ,36, ,2.0, ,
23202,20070101,0137,0,CLR, , 1.25, ,BR, ,36, ,2.0, ,36, ,2.2, ,36, ,2.0, ,
23202,20070101,0140,0,CLR, , 0.75, ,BR, ,37, ,3.0, ,37, ,2.5, ,36, ,2.0, ,
23202,20070101,0145,0,CLR, , 0.50, ,FG, ,37, ,3.0, ,37, ,2.5, ,36, ,2.0, ,
23202,20070101,0146,0,CLR, , 0.75, ,BR, ,37, ,3.0, ,37, ,2.5, ,36, ,2.0, ,
```

Highlight the first line as seen above and press the “Delete” key

Step 13 – The final file should look like below



```
2.txt - Notepad
File  Edit  Format  View  Help
Month/Year: 01/2007
Station Location: TRAVIS AIR FORCE BASE (23202)
Lat: 38.263
Lon: -121.928
Elev: 0 ft. above sea level
WBAN,Date,Time,StationType,SkyCondition,SkyConditionFlag,Visibility
23202,20070101,0000,0,CLR, , 1.75, ,BR, ,36, ,2.0, ,36, ,2.2, ,36,
23202,20070101,0002,0,CLR, , 1.50, ,BR, ,36, ,2.0, ,35, ,1.7, ,34,
23202,20070101,0003,0,CLR, , 1.25, ,BR, ,36, ,2.0, ,35, ,1.7, ,34,
23202,20070101,0006,0,CLR, , 0.75, ,BR, ,34, ,1.0, ,34, ,1.1, ,34,
23202,20070101,0009,0,CLR, , 1.00, ,BR, ,34, ,1.0, ,34, ,1.1, ,34,
23202,20070101,0013,0,CLR, , 1.75, ,BR, ,34, ,1.0, ,34, ,1.1, ,34,
23202,20070101,0014,0,CLR, , 2.50, ,BR, ,34, ,1.0, ,34, ,1.1, ,34,
23202,20070101,0015,0,CLR, , 3.00, ,BR, ,34, ,1.0, ,34, ,1.1, ,34,
23202,20070101,0055,0,CLR, , 3.00, ,BR, ,35, ,1.7, ,35, ,1.6, ,35,
23202,20070101,0125,0,CLR, , 2.00, ,BR, ,36, ,2.0, ,36, ,2.2, ,36,
23202,20070101,0126,0,CLR, , 1.50, ,BR, ,36, ,2.0, ,36, ,2.2, ,36,
23202,20070101,0127,0,CLR, , 1.25, ,BR, ,36, ,2.0, ,36, ,2.2, ,36,
23202,20070101,0135,0,CLR, , 1.50, ,BR, ,36, ,2.0, ,36, ,2.2, ,36,
23202,20070101,0137,0,CLR, , 1.25, ,BR, ,36, ,2.0, ,36, ,2.2, ,36,
23202,20070101,0140,0,CLR, , 0.75, ,BR, ,37, ,3.0, ,37, ,2.5, ,36,
23202,20070101,0145,0,CLR, , 0.50, ,FG, ,37, ,3.0, ,37, ,2.5, ,36,
23202,20070101,0146,0,CLR, , 0.75, ,BR, ,37, ,3.0, ,37, ,2.5, ,36,
23202,20070101,0149,0,CLR, , 1.00, ,BR, ,36, ,2.0, ,36, ,2.2, ,36,
```

Step 14 – Save and Close the file. Additionally close the second browser window open in Step 8.

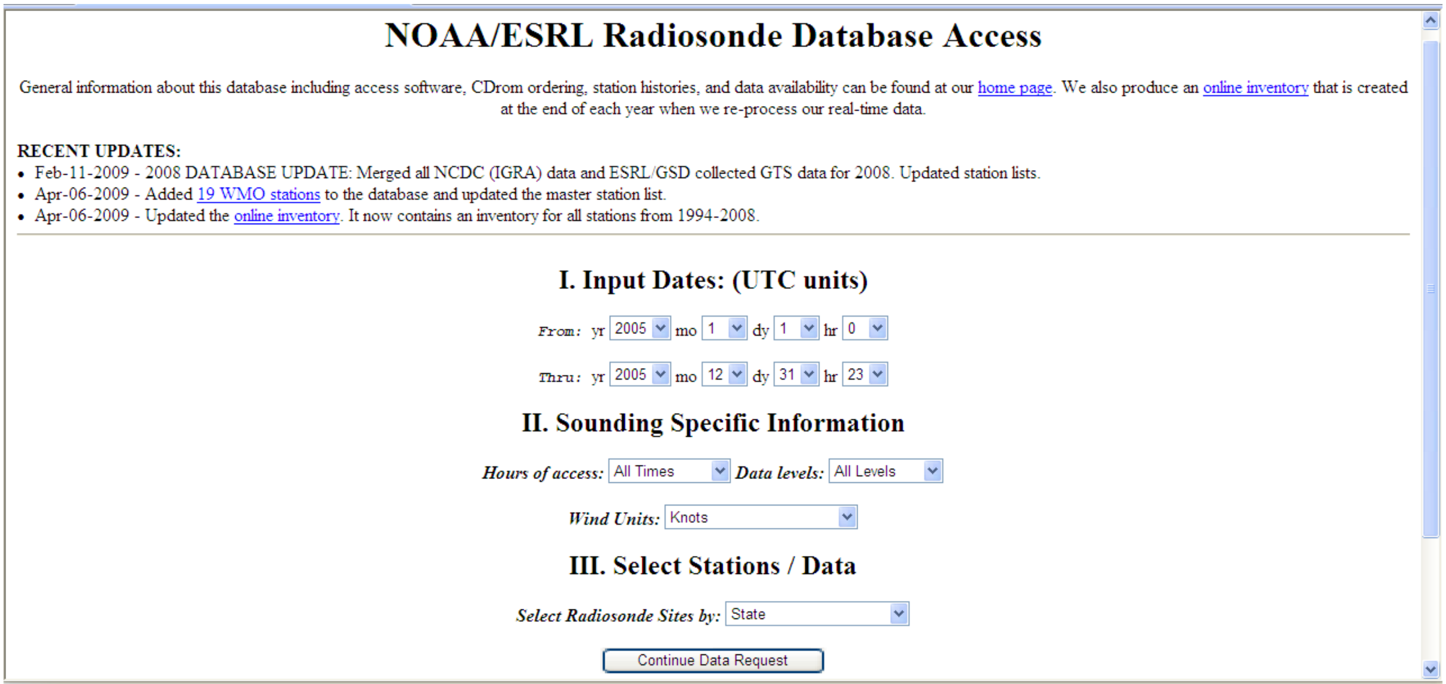
Step 15 – Click the “BACK” button on the browser and Repeat Steps 8 through 14 for each month that is to be downloaded.

Where’s My Upper-Air Data?

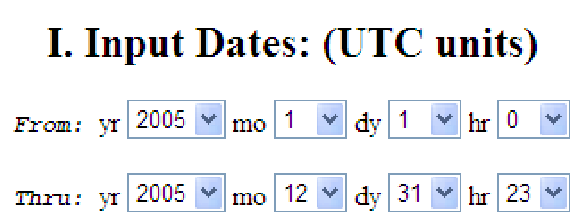
Now that the surface data has been downloaded, the matching upper-air data will also need to be retrieved. This data is freely available without restriction.

Where To Start:

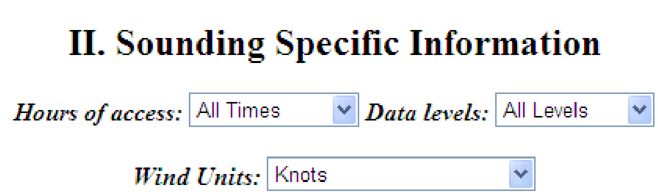
The upper-air data can be downloaded from http://esrl.noaa.gov/raobs/,



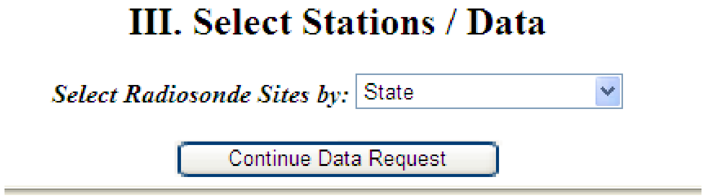
Step 1 – Select the time period to download. Set **From** inputs to: Year = (User define year), Month =1, Day = 1, and Hour=0 (midnight = morning). Set **Thru** inputs to: Year = (same as **From**), Month = 12, Day = 31, Hour = 23.



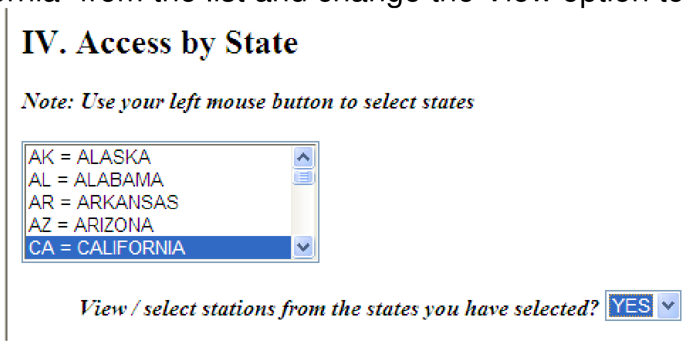
Step 2 – These options do not need to be altered.



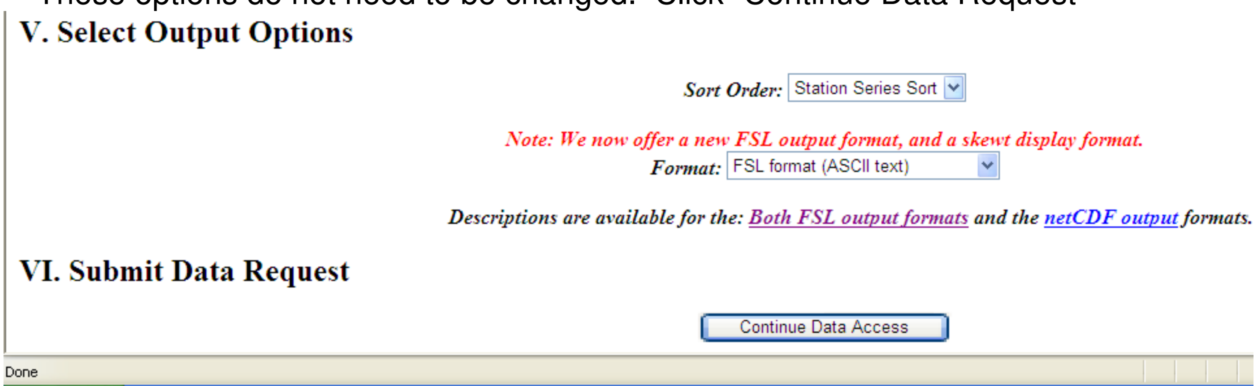
Step 3 – Change Radiosonde Site to "State" then click "Continue Data Request"



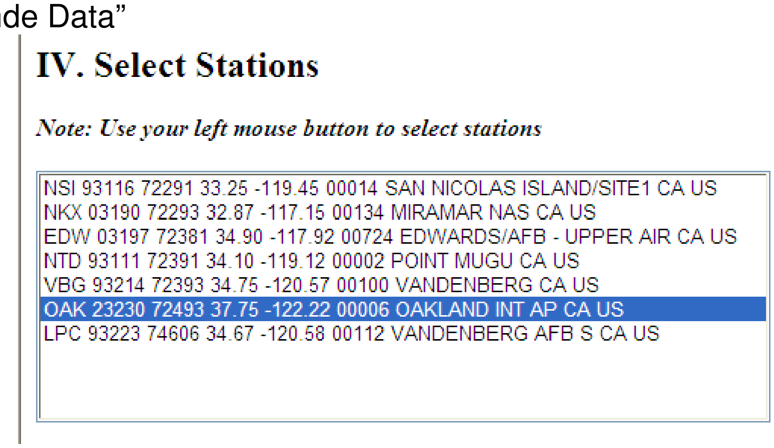
Step 4 – Select "CA-California" from the list and change the View option to "YES"



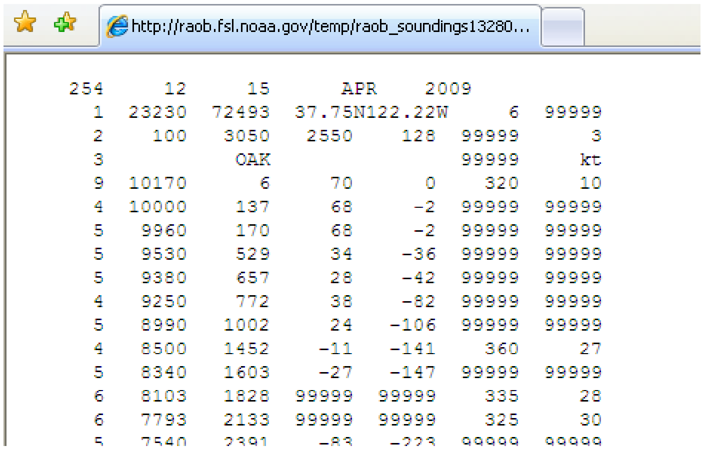
Step 5 – These options do not need to be changed. Click "Continue Data Request"



Step 6 – Select the station to download. The other options on this page do not need to be changed. Click "Get Radiosonde Data"



Step 7 – From the browser menu select EDIT → SELECT ALL then EDIT → COPY



http://raob.fsl.noaa.gov/temp/raob_soundings13280...

```
   254     12      15      APR     2009
     1  23230   72493  37.75N122.22W      6  99999
     2    100    3050    2550     128  99999      3
     3            OAK                  99999     kt
     9  10170       6      70       0    320     10
     4  10000     137      68      -2  99999  99999
     5   9960     170      68      -2  99999  99999
     5   9530     529      34     -36  99999  99999
     5   9380     657      28     -42  99999  99999
     4   9250     772      38     -82  99999  99999
     5   8990    1002      24    -106  99999  99999
     4   8500    1452     -11    -141    360     27
     5   8340    1603     -27    -147  99999  99999
     6   8103    1828   99999   99999    335     28
     6   7793    2133   99999   99999    325     30
     5   7540    2391     -83    -223  99999  99999
```

Step 8 – Paste the contents into a text file with a naming of XXXX.FSL. Where XXXX represents the year of the upper-air data. This will make it easier for AERMET to find the file.

Repeat steps 1 thru 8 for each year upper-air data set needed.

How to Process My Data

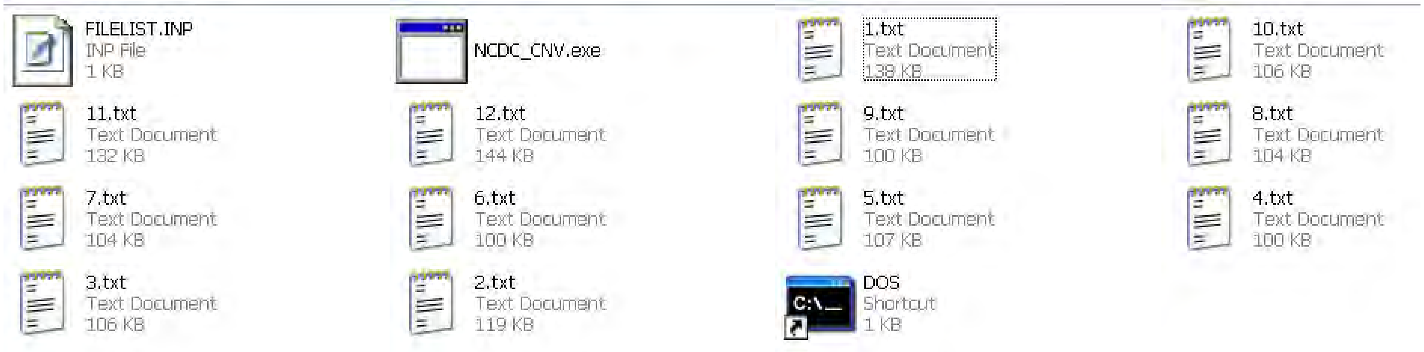
Now that you have downloaded the local meteorological data, it's time to QA/QC the data and convert it into a Samson file format. This will allow AERMET to read and process the data into an AERMOD ready meteorological file.

QA / QC and Converting Local Met Data into Samson Format:

EPA has several requirements for QA/QC meteorological data which are described in "Procedures for Substituting Values for Missing NWS Meteorological Data for Use in Regulatory Air Quality Models" by Dennis Atkinson and Russell F. Lee, 1992. (http://www.rflee.com/RFL_Pages/missdata.pdf). This document describes the EPA-recommended procedures for filling missing data for use in such air quality models as ISCST3 and AERMOD. It is identical to the text file "missdata.txt" available from the EPA SCRAM website, except that formatting has been applied to the text.

Mr. Russell F Lee has also developed a DOS based program that implements the above procedures as well as converts the data into a Samson file format, which AERMET can read. The NCDC_CNV (http://www.rflee.com/RFL_Pages/NCDC_CNV.zip) is a program which can convert the abbreviated hourly surface meteorological data provided online by NCDC in comma-separated ASCII format, and the Integrated Surface Hourly Weather Observations (ISHWO, aka ISH, ISHD) to the SAMSON format. The file is a zipped file containing the program, instructions, and a sample input file. This is being made available "as is" without charge by the developer, and may be freely distributed as long as the instruction file is included intact. The NCDC_CNV zip file has been included with this document for convenience.

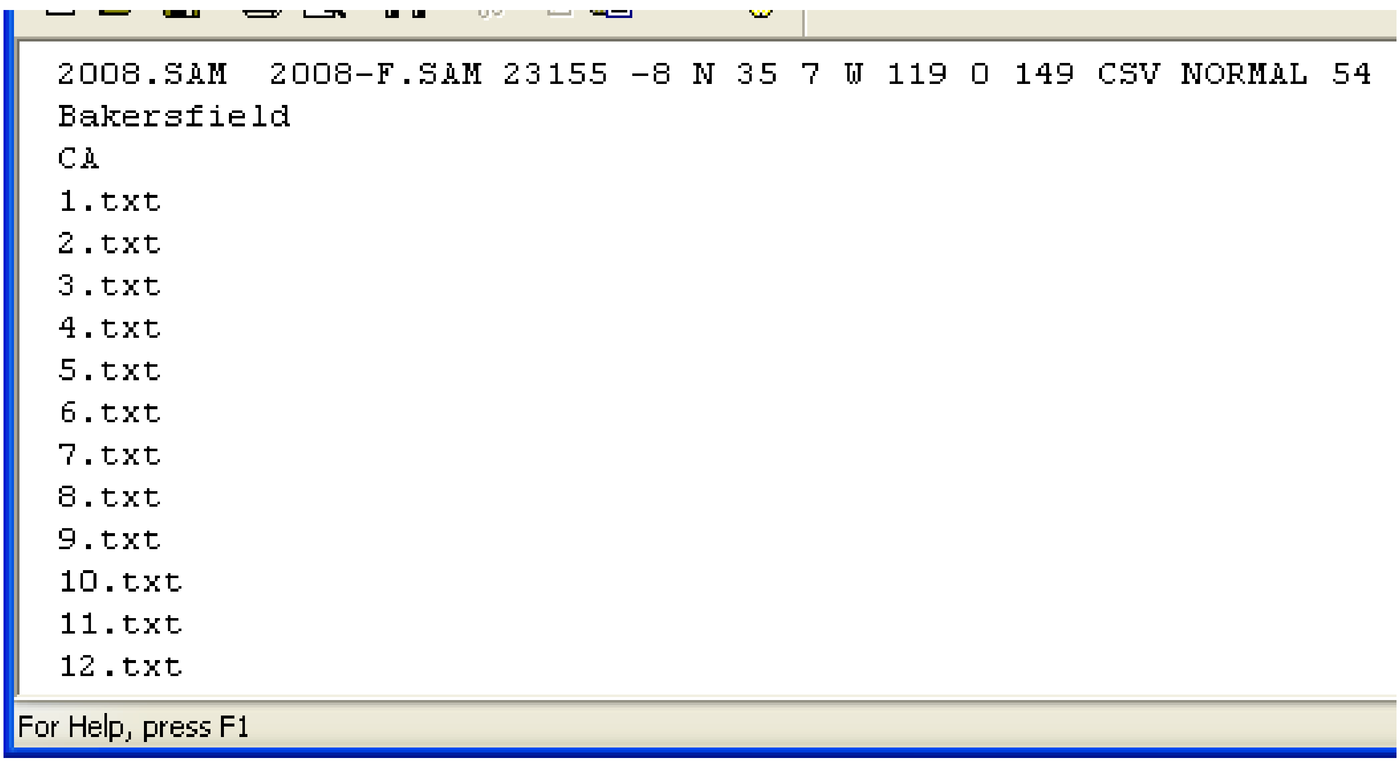
For this part of the walk through we will be using the files located in the "SAMPLE YEAR" directory on the included CD, see below.



Please note: the FILELIST.INP and the NCDC_CNV.exe file will need to be located in the same directory as the files to be QA/QC in order to run properly.

The Input File Review:

For a detailed explanation of the NCDC_CNV input file please refer to the file entitled "INSTRUCTIONS_VERS_2008-09-17.txt" located on the provided CD



```
2008.SAM  2008-F.SAM 23155 -8 N 35 7 W 119 0 149 CSV NORMAL 54
Bakersfield
CA
1.txt
2.txt
3.txt
4.txt
5.txt
6.txt
7.txt
8.txt
9.txt
10.txt
11.txt
12.txt
```


The Input file can be broken down into three basic parts; Program Control Line, Station Name and State, and the Meteorological File(s) to Read.

Program Control Line:

```
2007.SAM  2007-F.SAM 23155 -8 N 35 7 W 119 0 149 CSV NORMAL 54
```

1 - No QA/QC Samson File
2 - Final QA/QC Samson File
3 - Station ID number
4 - Time Difference (GMT)
5 - Met Station Location
6 - Met Station Elevation
7 - Met File Format
8 – Included Station Pressure
9 – Normal sampling time

Detailed Item Description:

1) Filename of the output file converted to SAMSON format.
   Missing hours are not filled in this file.
2) Name of output file with missing data filled per Atkinson & Lee.
3) Station ID (5-digit number). This number will appear in the output SAMSON file.
4) Time zone (EST = -5, CST = -6, MST = -7, PST = -8, etc.)
5a) 'N' or 'S' to indicate North or South latitude.
5b) Latitude--whole degrees portion.
5c) Latitude--minutes portion.
5d) 'E' or 'W' to indicate East or West longitude.
5e) Longitude--whole degrees portion.
5f) Longitude--minutes portion.
6) Elevation of station above mean sea level, in meters.
7) Type of input data:
   CSV, csv: Comma-separated values from NCDC online store. This accommodates all known variants of the format, and will likely accommodate future ones as well.
8) NORMAL or SUBSLP. NORMAL gives the SAMSON format the station pressure.
   SUBSLP substitutes sea level pressure for station pressure. CAUTION: Use SUBSLP only for stations fairly near sea level, when the station pressure is missing.
9) Code to identify minutes value(s) used for regular hourly (not special) data.
   This is only used for space-delimited data (ABBRDS), but must always be present.

Station Name and State:

```
Bakersfield
CA
```

The City or Station name, up to 22 characters

State or province abbreviation, 2 characters

Meteorological File(s) to Read:

List of input files to be read and converted. These files will be concatenated in the order listed into the Samson output files noted in the Control Line.

```
1.txt
2.txt
3.txt
4.txt
5.txt
6.txt
7.txt
8.txt
9.txt
10.txt
11.txt
12.txt
```

Local meteorological file downloaded from NCDC

Step 1 – Updating the Input File
For each year of meteorological data to be processed the Control Line should be adjusted to reflect the parameters of the station to be processed.

Step 2 – Open a DOS Window and go to the directory that contains the files to be processed.

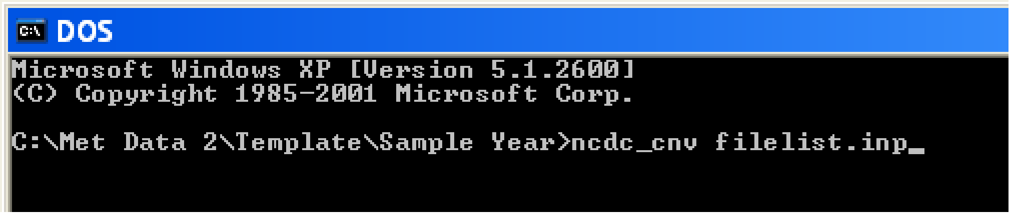
```
DOS
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Met Data 2\Template\Sample Year>
```

Step 3 – Run the NCDC_CNV.exe program. By typing

NCDC_CNV filelist.inp

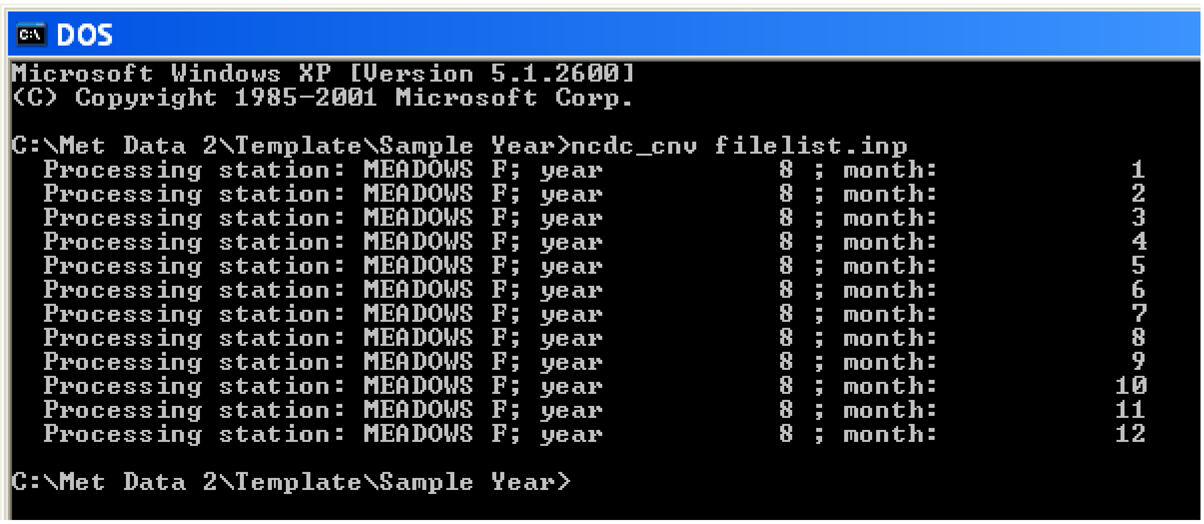
Then pressing Enter on the keyboard



```
DOS
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Met Data 2\Template\Sample Year>ncdc_cnv filelist.inp_
```

This will start the program. It should read each file listed in the INP file, one for each month of the year. Below is an example of the screen output after the program has run successfully.



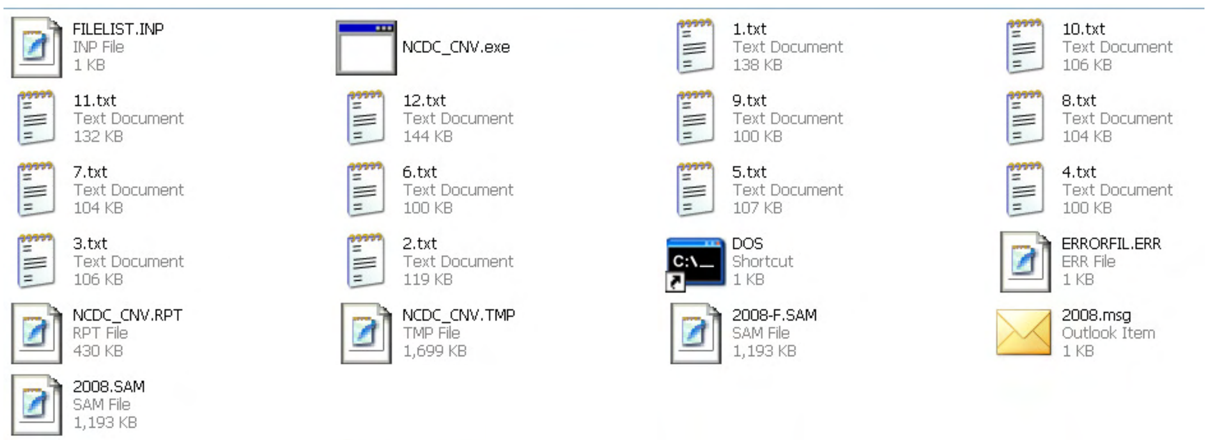
```
DOS
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Met Data 2\Template\Sample Year>ncdc_cnv filelist.inp
  Processing station: MEADOWS F; year          8 ; month:        1
  Processing station: MEADOWS F; year          8 ; month:        2
  Processing station: MEADOWS F; year          8 ; month:        3
  Processing station: MEADOWS F; year          8 ; month:        4
  Processing station: MEADOWS F; year          8 ; month:        5
  Processing station: MEADOWS F; year          8 ; month:        6
  Processing station: MEADOWS F; year          8 ; month:        7
  Processing station: MEADOWS F; year          8 ; month:        8
  Processing station: MEADOWS F; year          8 ; month:        9
  Processing station: MEADOWS F; year          8 ; month:       10
  Processing station: MEADOWS F; year          8 ; month:       11
  Processing station: MEADOWS F; year          8 ; month:       12

C:\Met Data 2\Template\Sample Year>
```

Station Name Year Month

Files Created by the NCDC_CNV Program:



List of Files Created:

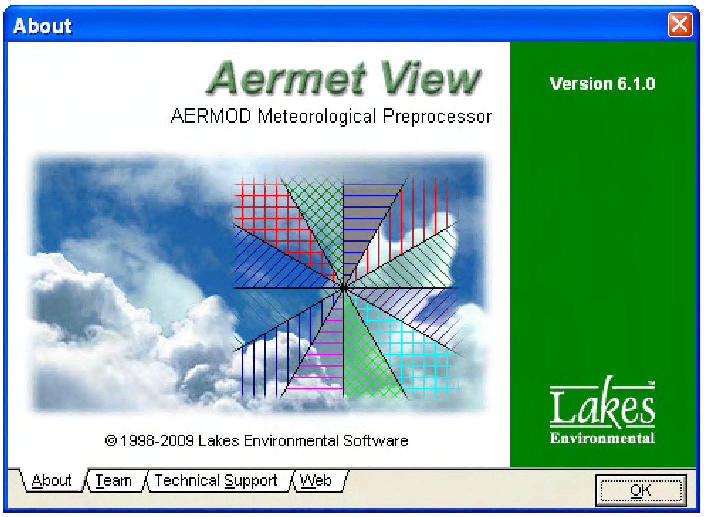
2008.SAM – Downloaded meteorological data converted into Samson format
2008-F.SAM – The 2007.SAM file that has been QA/QC
2008.msg – Provides a list of the missing data that has been filled using EPA guidance
Errorfil.err – Provides a list of program errors, if any.
NCDC_CNV.RPT – Detailed list of each hour for each month that was read.
NCDC_CNV.TMP – Temporary file used when reading data from the 12 individual files before converting it into the Samson Format.

Step 4 – Close the DOS window by typing "Exit"

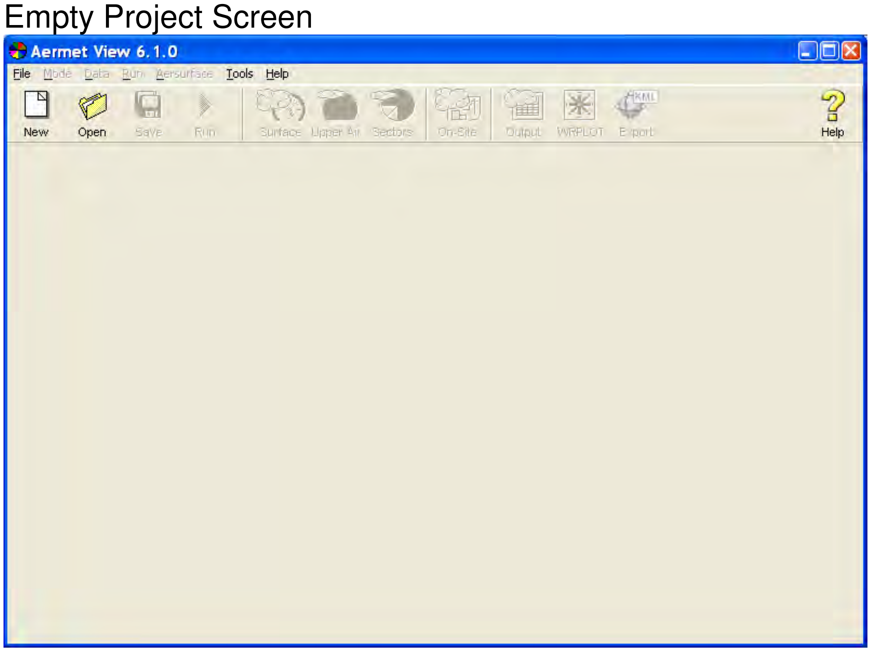
AERMET Processing:

The final step in processing the meteorological data is to run AERMET with both the upper-air data and Samson file created in the previous section. For this part of the walk through we will be using the Lakes Environmental AERMET user interface.

Step 1 – Create a new AERMET project file using Lakes Environmental AERMET View.
On starting the AERMET View program the "ABOUT" screen will appear. Click the "OK" button to continue.

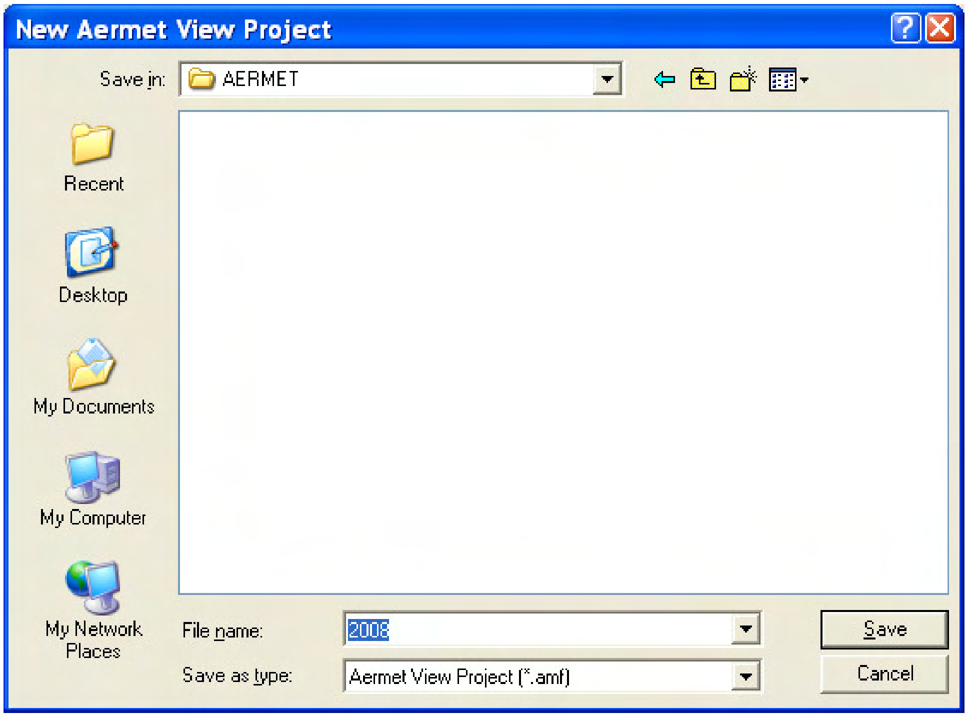


Empty Project Screen



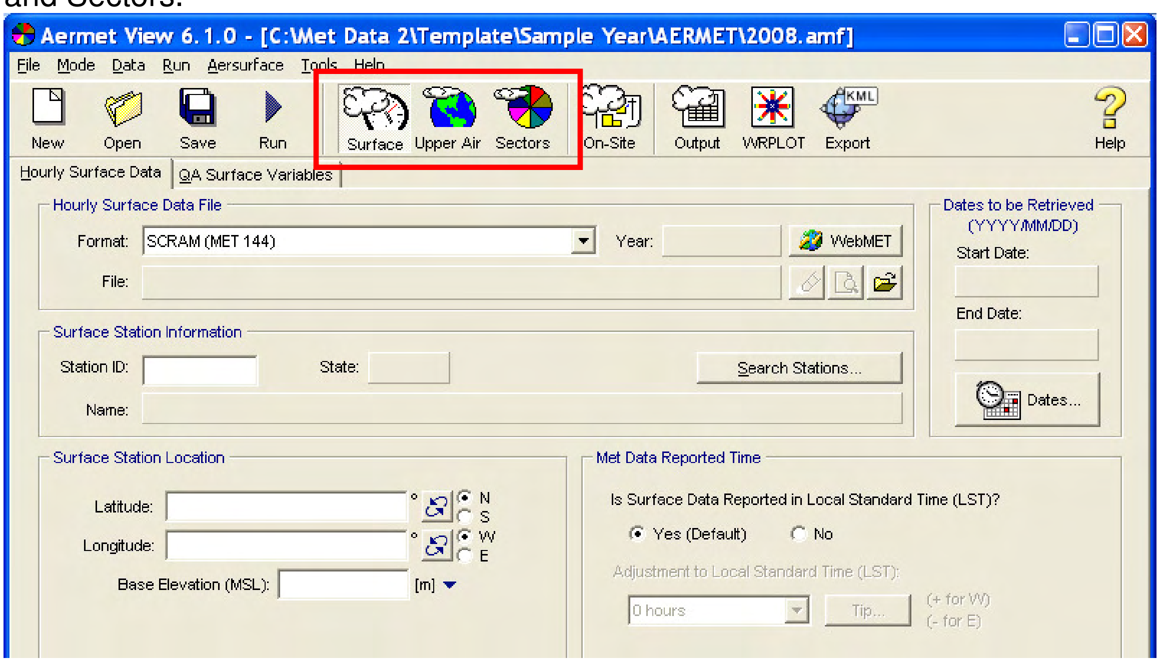
Click the "NEW" button or from the menu select File →New Project

On the “New Aermet View Project“ screen, enter a file name that will be used to store your inputs. It is recommended that you use the year for the meteorological data as the name for the project. It is also recommended that you create a separate directory for the other files downloaded and generated in the previous sections. Once the file name has been entered click “SAVE”.



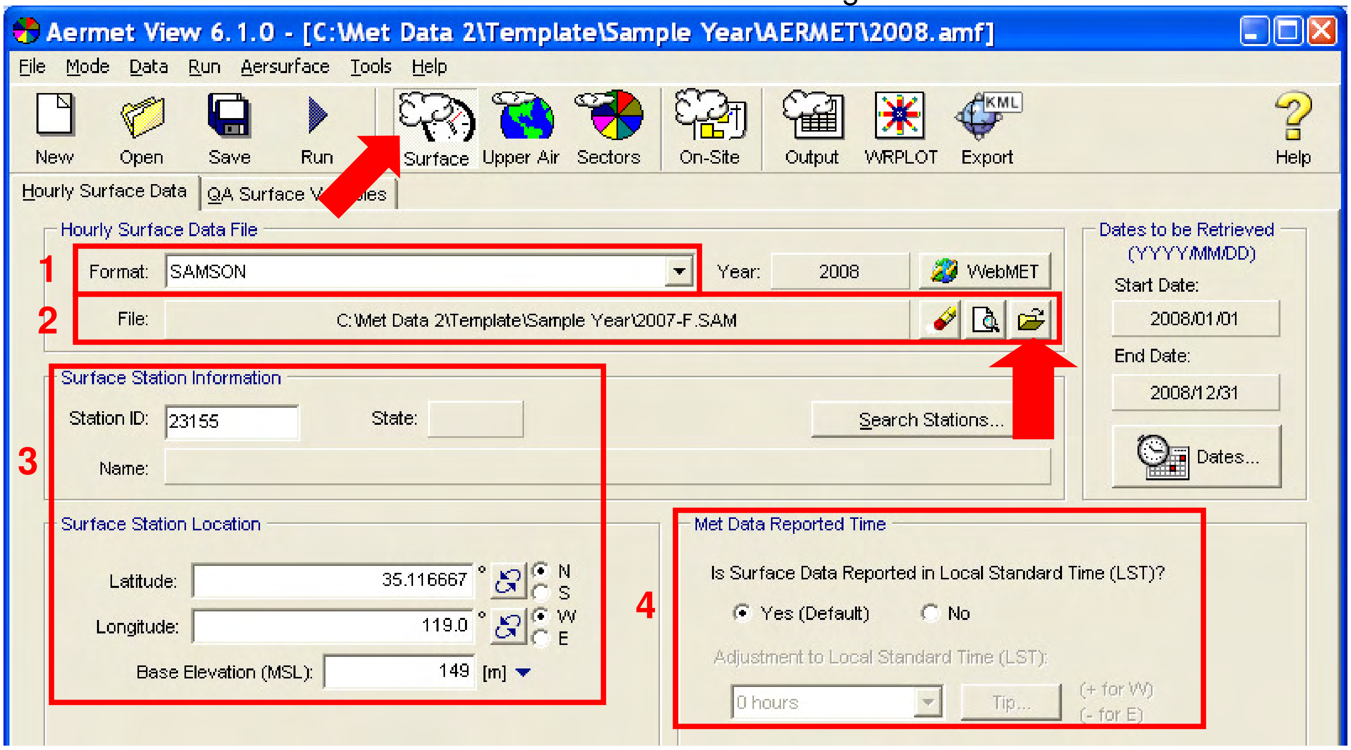
AERMET Input Screen

For this part of the walk through we will be dealing with three main screens Surface, Upper Air, and Sectors.



Surface Screen

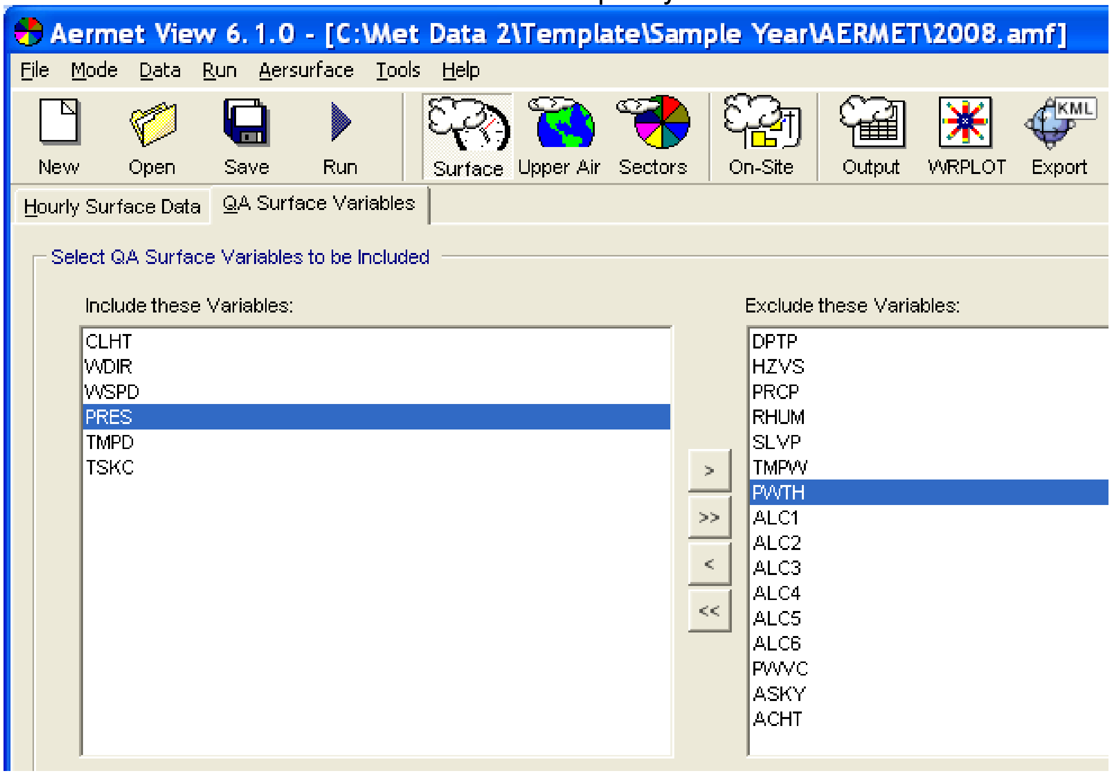
The Surface screen has two tabs that need to be reviewed. The first tab is the “Hourly Surface Data” which allows the user to select the surface meteorological file and format.



Screen Details:

Detail #	Description
1	From the pull down select the “SAMSON” option.
2	Using the Open File button navigate to, and select the Samson file created by the NCDC_CNV program in the previous section.
3	The data in this section will be entered automatically after the Samson file is selected.
4	Insure that the “Yes (Default)” option is selected.

The Second tab on the Surface Screen is the "QA Surface Variable" tab. This tab allows the user to select variables to be used in the quality assessment of the surface data.



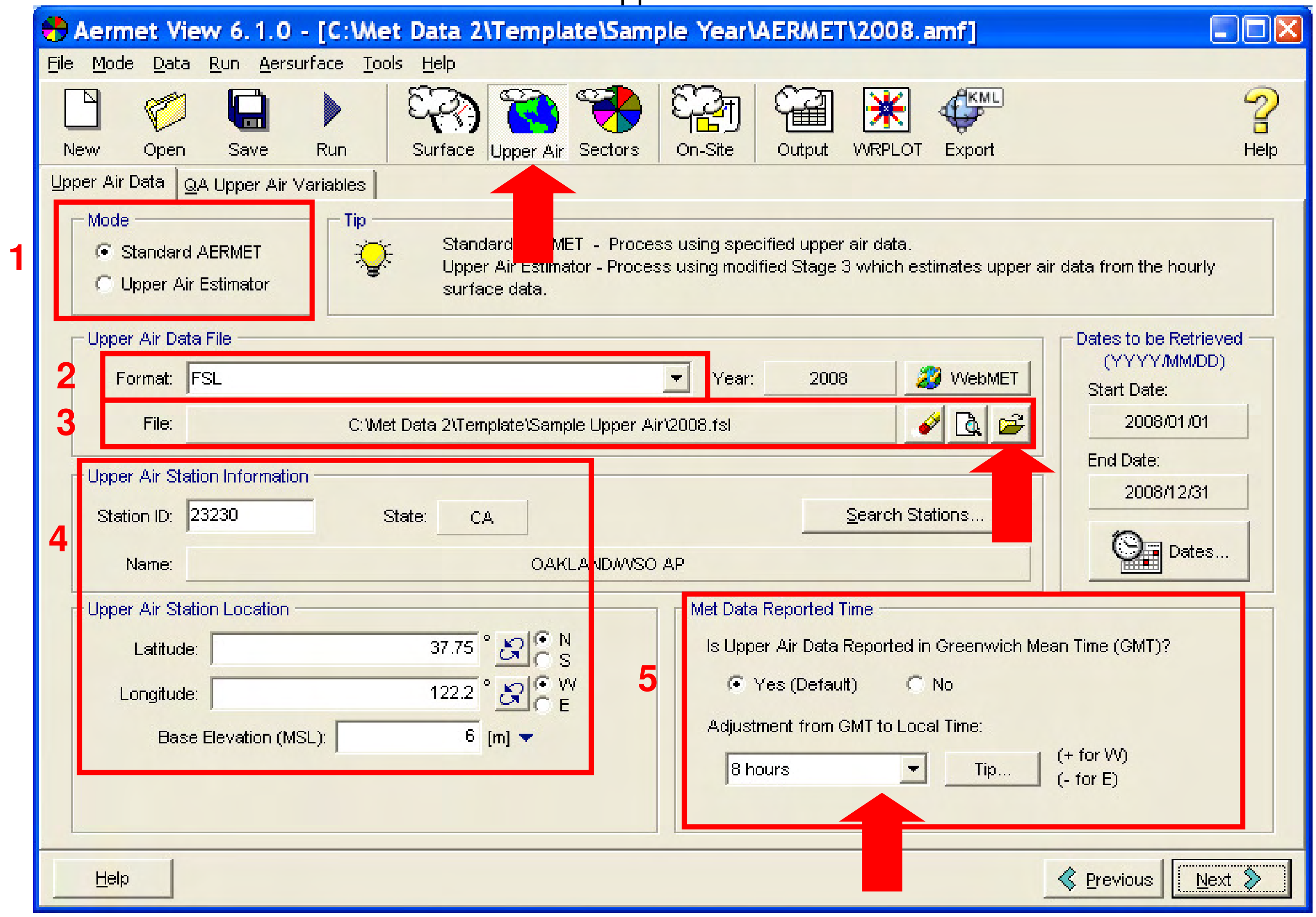
Detailed descriptions of the available variables.

Hourly Surface QA Variables

Variable Name	Description	Units	Boundary Type	Missing Indicator	Lower Bound	Upper Bound
CLHT	Ceiling height	kilometers * 10	Include (<=)	999	0	300
DPTP	Dew-point temperature	deg C * 10	Exclude (<)	999	-650	350
HZVS	Horizontal visibility	kilometers * 10	Include (<=)	99999	0	1640
PRCP	Precipitation amount	millimeters * 1000	Include (<=)	-9	0	25400
PRES	Station pressure	millibars * 10	Exclude (<)	99999	9000	10999
RHUM	Relative humidity	whole percent	Include (<=)	999	0	100
SLVP	Sea level pressure	millibars * 10	Exclude (<)	99999	9000	10999
TMPD	Dry bulb temperature	deg C * 10	Exclude (<)	999	-300	360
TMPW	Wet bulb temperature	deg C * 10	Exclude (<)	999	-650	350
TSKC	Total // opaque sky cover	tenths // tenths	Include (<=)	9999	0	1010
WDIR	Wind direction	tens of degrees	Include (<=)	999	0	36
PWTH	Present weather		Include (<=)	9999	0	9800
WSPD	Wind speed	meters/second * 10	Include (<=)	999	0	500
ALC1	Sky cond // height, level 1	code // hundredths ft	Include (<=)	9999	0	7300
ALC2	Sky cond // height, level 2	code // hundredths ft	Include (<=)	9999	0	7300
ALC3	Sky cond // height, level 3	code // hundredths ft	Include (<=)	9999	0	7300
ALC4	Sky cond // height, level 4	code // hundredths ft	Include (<=)	9999	0	7850
ALC5	Sky cond // height, level 5	code // hundredths ft	Include (<=)	9999	0	7850
ALC6	Sky cond // height, level 6	code // hundredths ft	Include (<=)	9999	0	7850
PWVC	Present weather (vicinity)		Include (<=)	9999	0	9800
ASKY	ASOS Sky condition	tenths	Include (<=)	99	0	10
ACHT	ASOS Ceiling	kilometers * 10	Include (<=)	999	0	888

Upper AIR Screen:

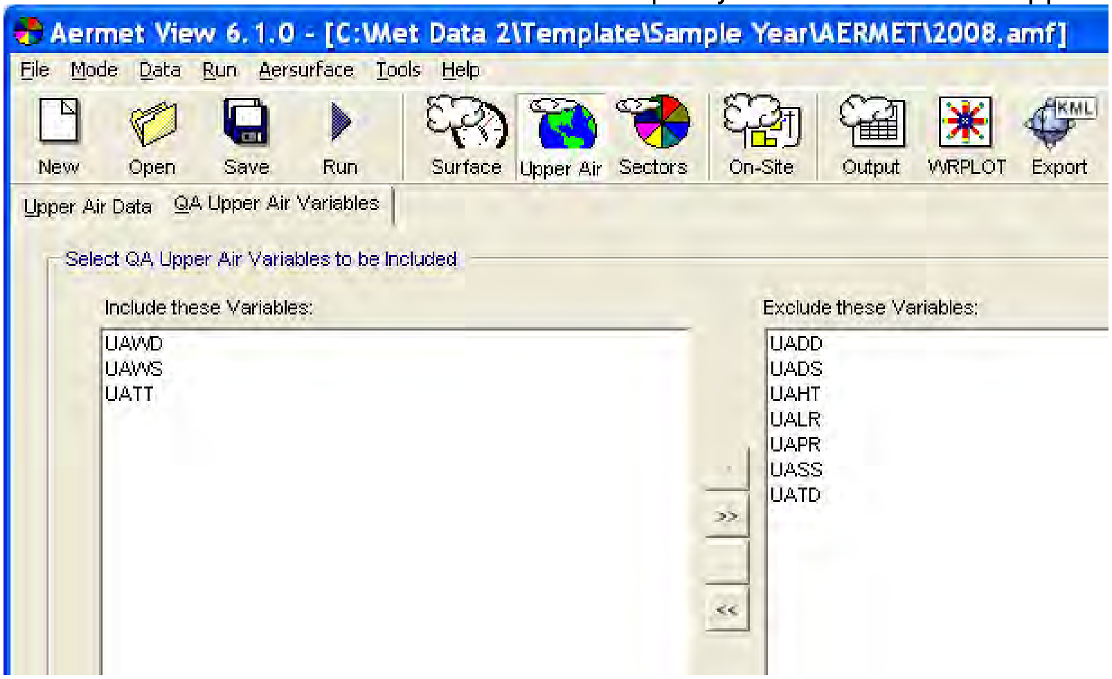
The Upper Air screen has two tabs that need to be reviewed. The first tab is the “Upper Air Data” which allows the user to select the Upper Air file and format.



Upper Air Details:

Detail #	Description
1	Select “Standard AERMET“.
2	From the pull down select the “FSL” option.
3	Using the Open File button navigate to, and select the FSL file (upper air data) that was previously downloaded.
4	The data in this section will be entered automatically after the FSL file is selected.
5A	Insure that the “Yes (Default)” option is selected. Upper air data is reported in GMT (Greenwich Mean Time) and need to be adjusted to local time.
5B	In the pull down select the “8 hours” option. California is 8 hours behind GMT. This will adjust the upper air data to match the surface data being processed (LST- Local Standard Time).

The Second tab on the Upper Air Screen is the “QA Upper Air Variable” tab. This tab allows the user to select variables to be used in the quality assessment of the upper air data.



Detailed descriptions of the available variables.

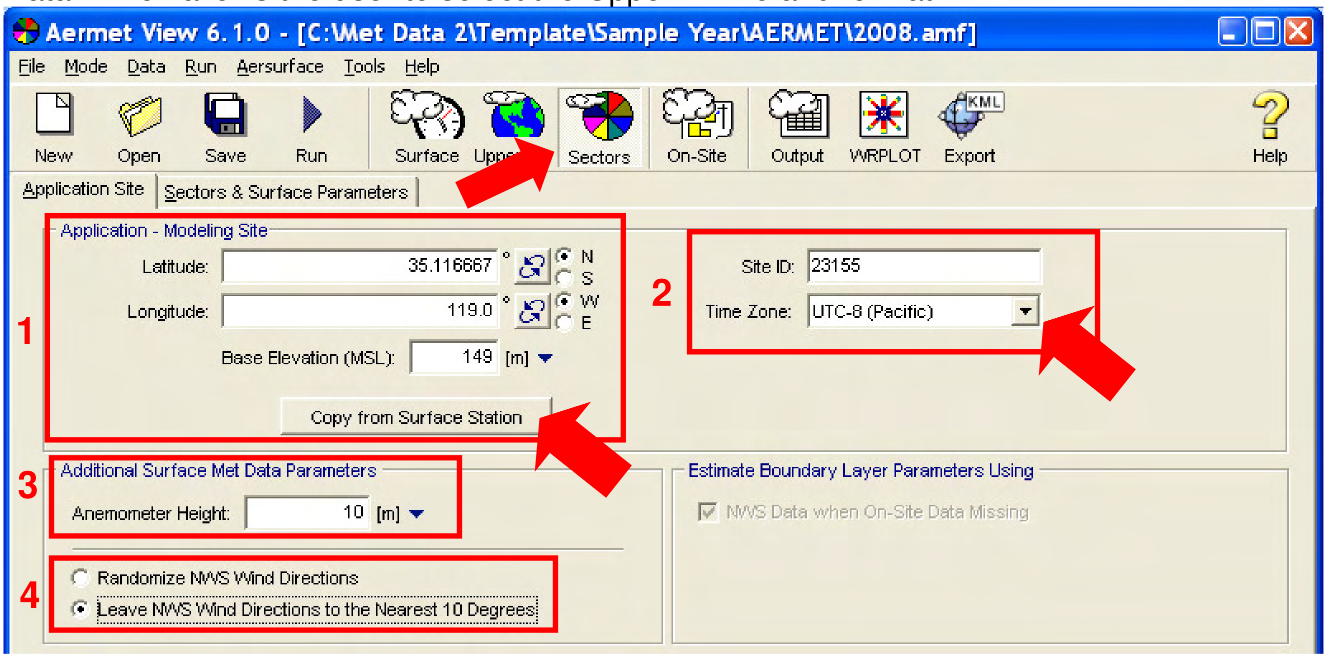
Upper Air QA Variables

Variable Name	Description	Units	Boundary Type	Missing Indicator	Lower Bound	Upper Bound
UADD	Dew point deviation	deg C / (100 meters)	Include (<=)	-9999	0	2
UADS	Wind direction shear	degrees / (100 meters)	Include (<=)	-9999	0	90
UAHT	Height above ground	meters	Include (<=)	-99999	0	5000
UALR	Temperature lapse rate	deg C / (100 meters)	Include (<=)	-9999	-2	5
UAPR	Atmospheric pressure	millibars * 10	Exclude (<)	99999	5000	10999
UASS	Wind speed shear	(m/s) / (100 meters)	Include (<=)	-9999	0	5
UATD	Dew-point temperature	deg C * 10	Exclude (<)	-9990	-350	350
UATT	Dry bulb temperature	deg C * 10	Exclude (<)	-9990	-350	350
UAWD	Wind direction	degrees from north	Include (<=)	999	0	360
UAWS	Wind speed	meters/second *10	Exclude (<)	9990	0	500

Help Close

Sectors Screen:

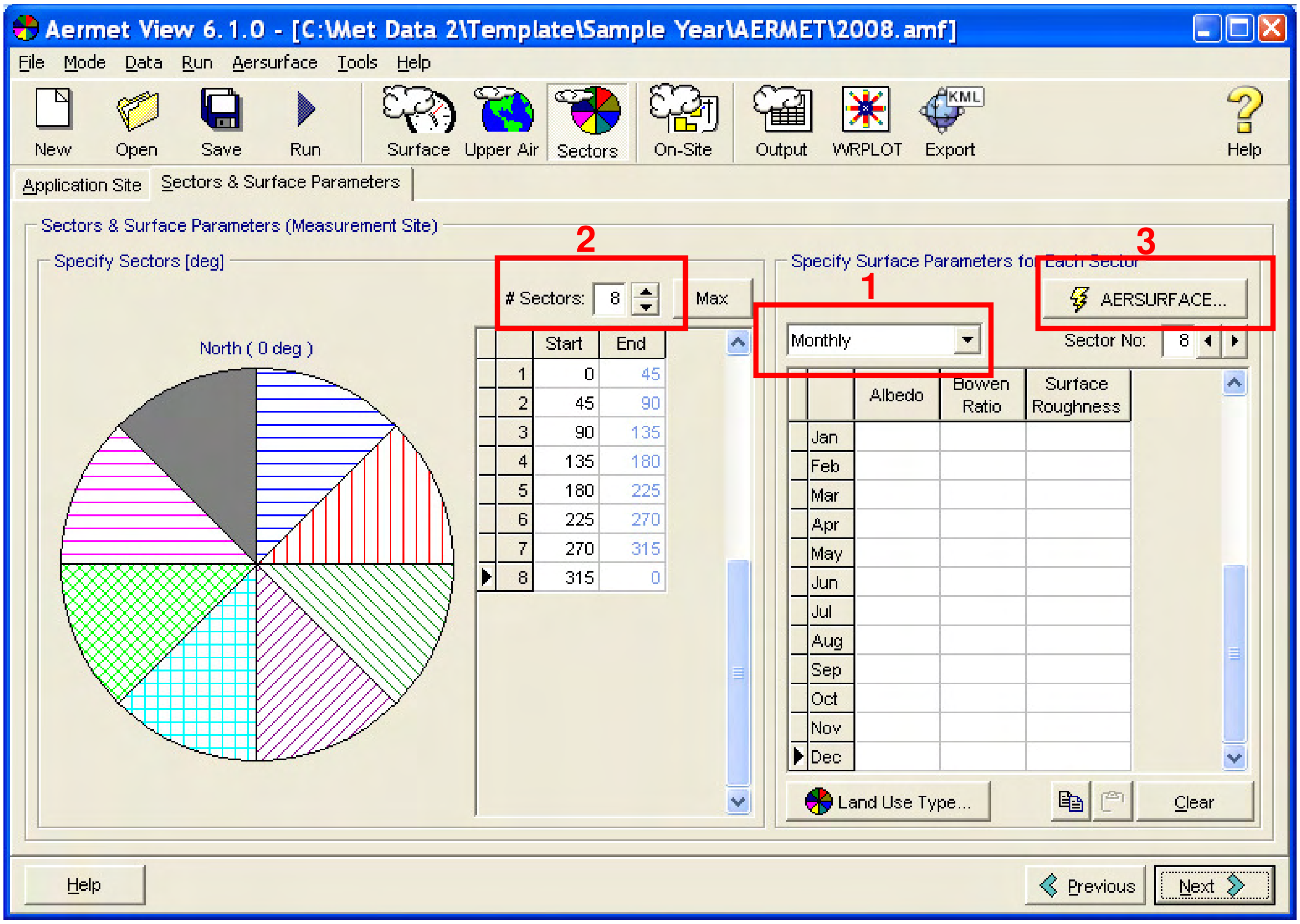
The Sectors screen has two tabs that need to be reviewed. The first tab is the "Upper Air Data" which allows the user to select the Upper Air file and format.



Sectors Details:

Detail #	Description
1	Click the "Copy From Surface Station". This information will be used to determine the Bowen Ratio, Albedo, and Surface roughness parameters on the second tab. Current EPA guidance suggests that the sector parameters be based on the location where the surface meteorological data was collected.
2A	Ensure that the Site ID field contains the surface station ID found on the "Hourly Surface Data" tab under the Surface screen.
2B	Ensure that the Tome Zone field contains the appropriate value. For California it should read "UTC–8 (Pacific)". UTC (coordinated universal time) is basically the 20th century GMT better know as the atomic clock.
3	The anemometers at ASOS station are typically set at 10 meters.
4	**Randomize NWS Wind Directions:** Select this option to randomize the NWS wind directions in order to avoid a bias toward the cardinal compass points (N, S, E, and W). The wind directions are randomized for each 10 degree sector to one degree increments. A bias would occur for the un-randomized wind directions because three 10-degree sectors would contribute to the N, S, E, and W sector statistics (e.g., 350, 360 and 10 degrees for the north sector), while only two 10-degree sectors would contribute to the other 22.5 degree sectors. **Leave NWS Wind Directions to the Nearest 10 Degrees:** This is the default option and reports the NWS wind directions to the nearest 10 deg. For example, a direction of 164 deg would be reported as 160. **<u>Please Note:</u>** this value should be set to Randomize NWS Wind Direction as required by EPA

The Second tab on the Sectors Screen is the "Sector & Surface Parameters" tab. This tab allows the user to enter surface parameters for sectors surrounding the meteorological station. EPA recommends that a 1 km radius be used to develop surface roughness parameters per sector and a 10 km radius be used to develop the Albedo and Bowen Ratio. Therefore it is recommended that AERSURFACE be used. The latest version of AERSUFACE incorporates the above recommendations.

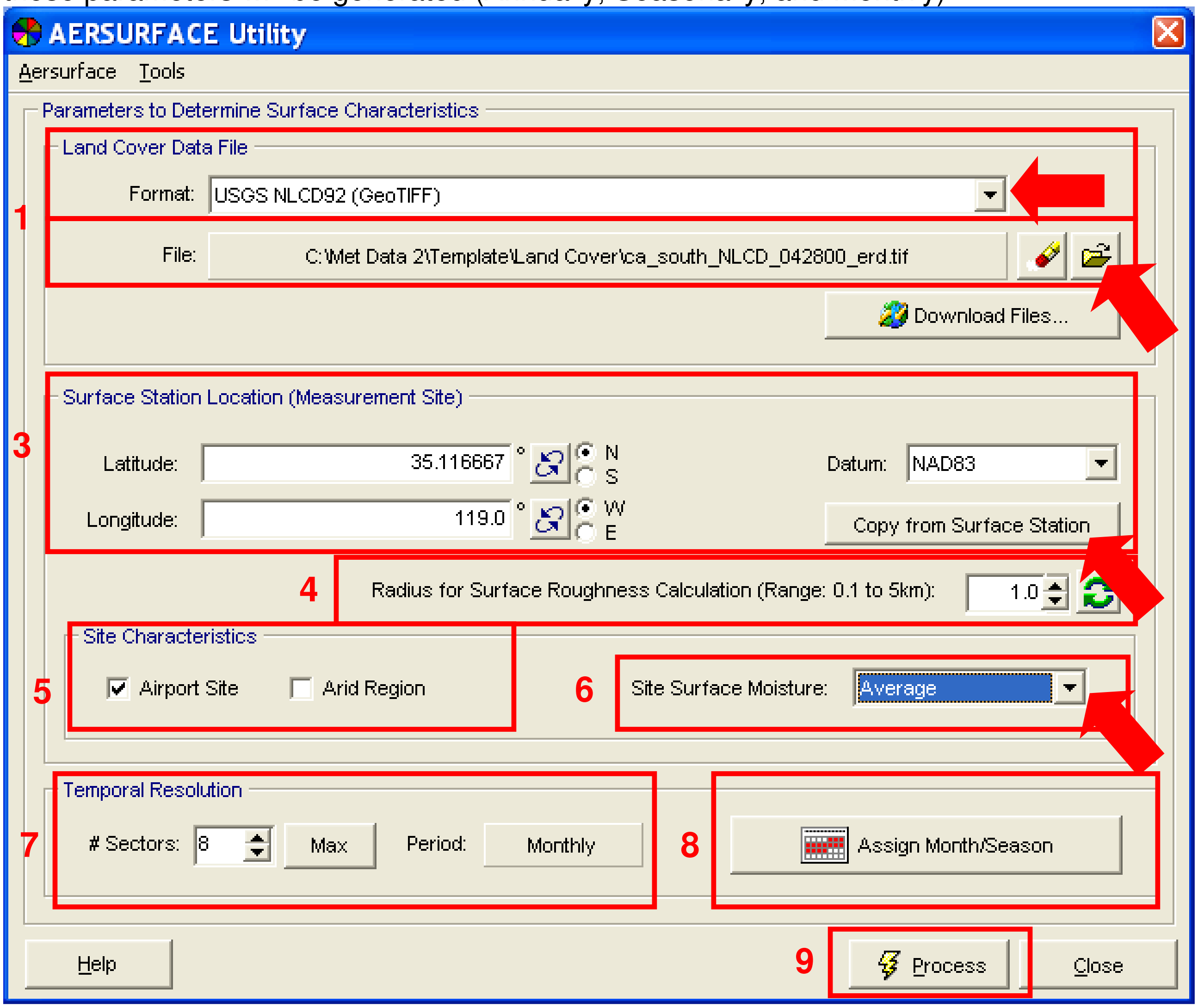


Sectors Details:

Detail #	Description
1	It is recommended that the surface parameters be based on a monthly basis.
2	It is recommended that the "# Sectors" field not be set to a value less than eight sectors.
3	Click on the AERSURFACE button to import surface parameters using land cover data. Land cover data is included on the CD for all of California and is located in a folder call "Land Cover".

AERSURFACE Utility Screen:

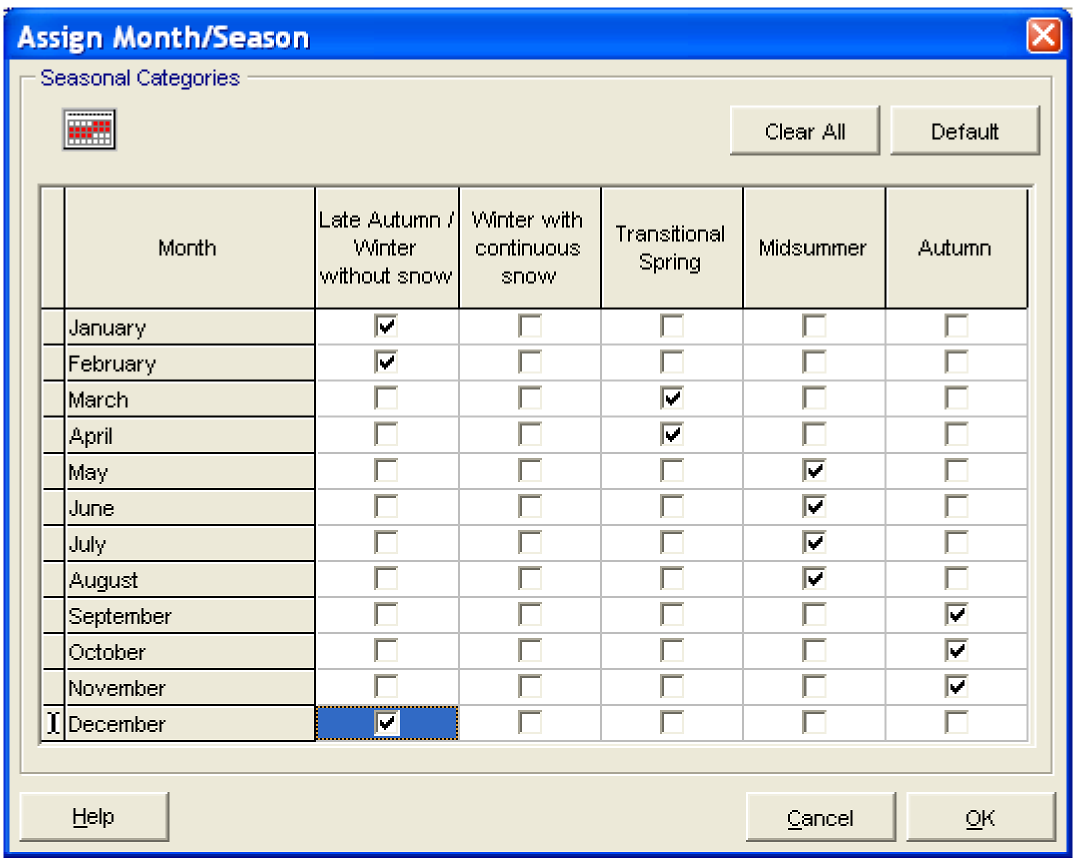
The AERSURFACE program is used to read land cover data contained in the Tiff files, which are included, using EPA guidance discussed above. It also allows the user to determine how those parameters will be generated (Annually, Seasonally, and Monthly).



Sectors Details:

Detail #	Description
1	From the pull down select "USGS NLCD92 (GEOTII)"
2	Using the Open File button navigate to, and select the Tiff file to be used to determine the site specific surface parameters for this project.
3	EPA guidance is to use the location of the monitoring site to determine surface parameters. Therefore, click the "Copy from Surface Station" button to copy the location information from the Surface screen.
4	As discussed above, EPA guidance as of Jan 9, 2008 is to us a 1km radius around the surface station to determine surface roughness.
5	Most ASOS sites are located at an airport. AERSURFACE will use surface characteristics that reflect an area more dominated by transportation land cover.
6	Project surface moisture conditions compared to a 30 year average ○ **Wet** if precipitation is in the upper 30th-percentile

Detail #	Description
	○ **Dry** if precipitation is in the lower 30th-percentile ○ **Average** if precipitation is in the middle 40th-percentile. The monthly and annual 30 year averages (1971 – 2000) are located in the LAND Cover folder on the CD.
7	This information comes from the previous screen and should not be altered.
8	If you are calculating **Annually** or **Monthly**, you have the option to assign the months of the year to seasons other than the default, see screen shot below. AERSURFACE will use the surface parameters based on the month vs. the season allocated on this screen.
9	To start AERSURFACE running Click the “Process” button. AERSURFACE will access the Tiff file for the location selected and derive the necessary parameters based on the month/season allocation determined by the user.



Land Cover Data:

Spatial Domains for Land Cover Files:

California – North (ca_north_NLCD_042800_erd.tif)

Bounding Coordinates:

West Bounding Coordinate: -125.091
East Bounding Coordinate: -118.088
North Bounding Coordinate: 41.826
South Bounding Coordinate: 37.660

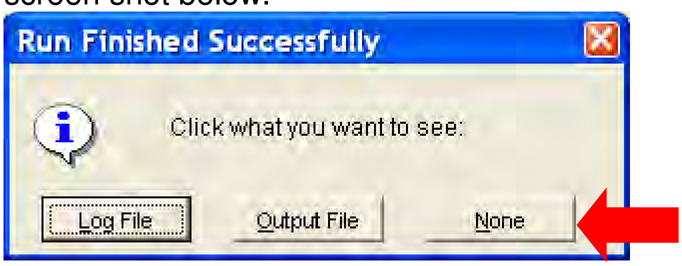
California – South (ca_south_NLCD_042800_erd.tif)

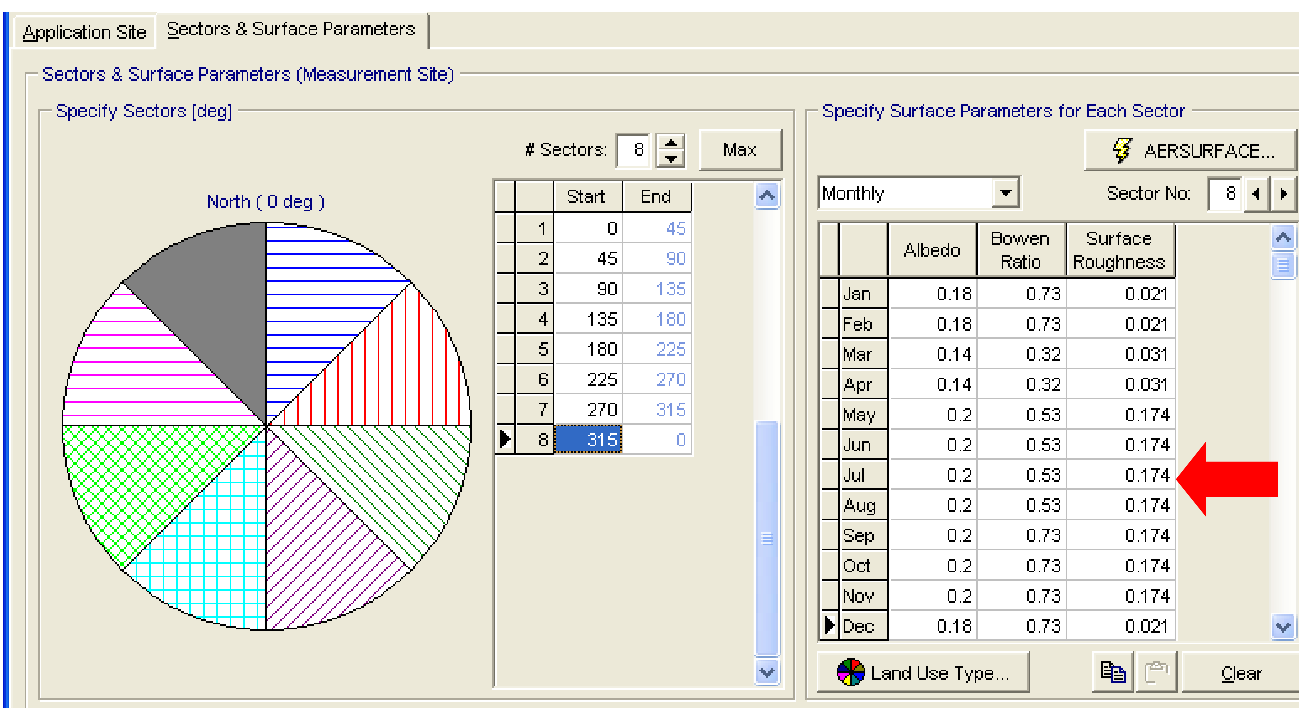
Bounding Coordinates:

West Bounding Coordinate: -123.029
East Bounding Coordinate: -113.800
North Bounding Coordinate: 36.651
South Bounding Coordinate: 32.858

Surface Parameters Have Been Derived:

Once AERSURFACE completes running the user should see the following screen and the parameters on the “Sectors & Surface Parameters” tabs should be filled in, see the second screen shot below.



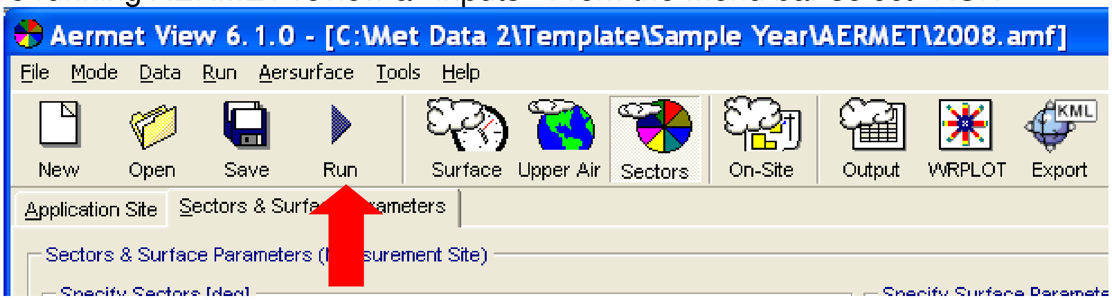


Are We There Yet?

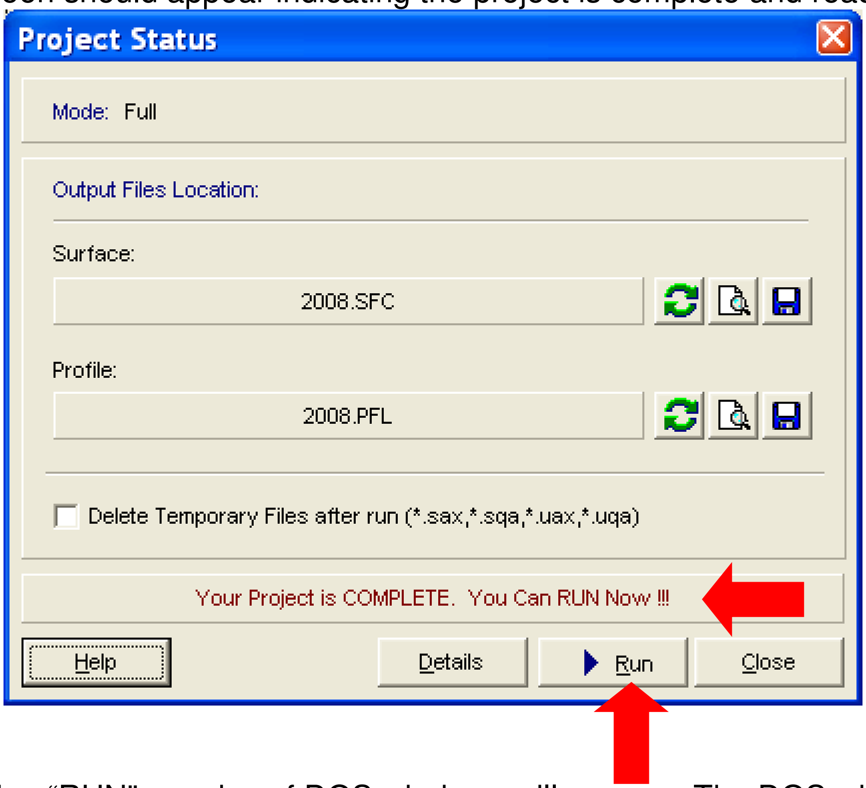
We are almost done. There are two final steps to completing the process. The first is to run AERMET and generate the Surface and Profile data files for AERMOD.

Running AERMET

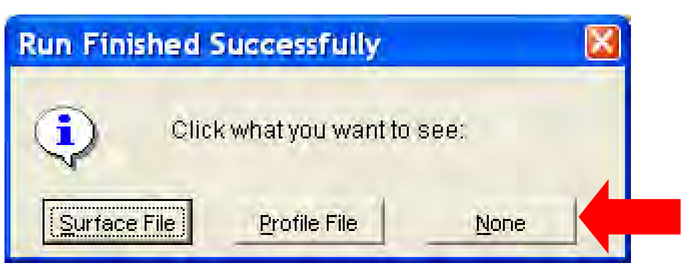
Before running AERMET review all inputs. From the Menu bar select "RUN".



The following screen should appear indicating the project is complete and ready to run.

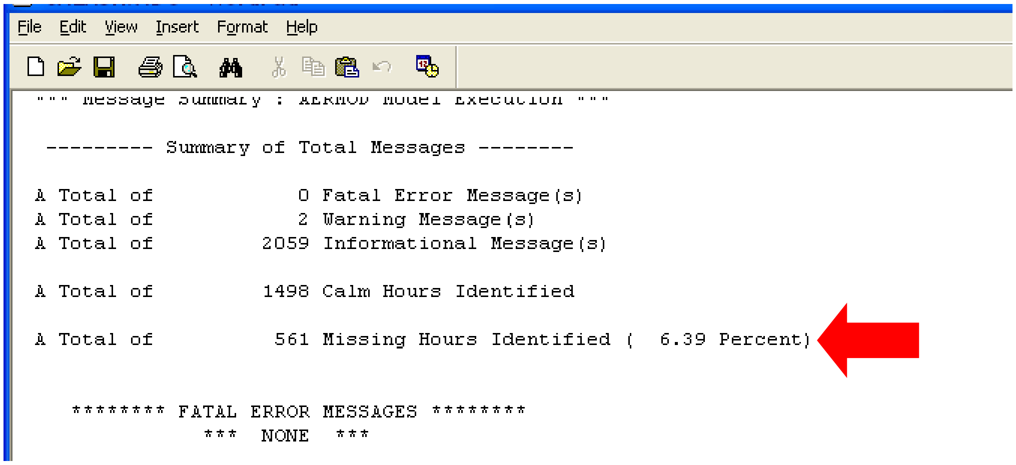


After clicking "RUN" a series of DOS windows will appear. The DOS windows represent the three stages OF THE AERMET process. The following screen should appear once the process is completed, allowing the user to view the new surface and profile files generated.



You are **DONE**. Close the AERMET program.

The Final Step is to run AERMOD and ensure that the number of missing hours is not greater than 10 percent. If your AERMOD run indicates that you have more than 10 percent missing hours, the data should not be used for regulatory purposes. An Air District can decide that this data is acceptable on a case by case basis.



ATTACHMENT D

WIND ROSE AND POLLUTION ROSE FREQUENCY DISTRIBUTIONS

Bakersfield Meadows Field Airport
Windrose Frequency Distribution 2004-2008

	Directions / Wind Classes (m/s)	0.1 - 10.0	10.0 - 20.0	20.0 - 30.0	30.0 - 40.0	40.0 - 50.0	>= 50.0	Total
1	348.75 - 11.25	0.08045	0.00023	0	0	0	0	0.08068
2	11.25 - 33.75	0.03696	0	0	0	0	0	0.03696
3	33.75 - 56.25	0.02269	0	0	0	0	0	0.02269
4	56.25 - 78.75	0.02566	0	0	0	0	0	0.02566
5	78.75 - 101.25	0.06196	0.00002	0	0	0	0	0.06198
6	101.25 - 123.75	0.04483	0.00092	0	0	0	0	0.04575
7	123.75 - 146.25	0.04185	0.00099	0	0	0	0	0.04284
8	146.25 - 168.75	0.02497	0.00118	0	0	0	0	0.02615
9	168.75 - 191.25	0.01439	0.00009	0	0	0	0	0.01448
10	191.25 - 213.75	0.00657	0.00005	0	0	0	0	0.00662
11	213.75 - 236.25	0.01019	0.00002	0	0	0	0	0.01022
12	236.25 - 258.75	0.0172	0.00002	0	0	0	0	0.01723
13	258.75 - 281.25	0.05677	0.00014	0	0	0	0	0.05691
14	281.25 - 303.75	0.11066	0.00037	0	0	0	0	0.11103
15	303.75 - 326.25	0.1146	0.00136	0	0	0	0	0.11596
16	326.25 - 348.75	0.0852	0.00141	0	0	0	0	0.08661
	Sub-Total	0.75497	0.0068	0	0	0	0	0.75342
	Calms							0.24
	Missing/Incomplete							0.01
	Total							1

Shafter Monitoring Station Hourly NO2 Concentrations and
Bakersfield Meadows Field Airport Wind Direction
Pollution Rose Frequency Distribution 2004-2008

	Directions / Concentration (ug/m3)	**0.1 - 10.0**	**10.0 - 20.0**	**20.0 - 30.0**	**30.0 - 40.0**	**40.0 - 50.0**	**>= 50.0**	**Total**
1	348.75 - 11.25	0.01213	0.02899	0.01683	0.01158	0.00457	0.00646	0.08055
2	11.25 - 33.75	0.00198	0.00676	0.00726	0.00869	0.00498	0.00729	0.03696
3	33.75 - 56.25	0.0006	0.00228	0.00362	0.0048	0.0041	0.00726	0.02267
4	56.25 - 78.75	0.00051	0.00189	0.00251	0.00546	0.00447	0.01081	0.02566
5	78.75 - 101.25	0.00035	0.00247	0.00586	0.01393	0.0137	0.02569	0.06198
6	101.25 - 123.75	0.00042	0.00337	0.00593	0.01121	0.00936	0.01547	0.04575
7	123.75 - 146.25	0.00051	0.00461	0.00655	0.01118	0.00793	0.01206	0.04284
8	146.25 - 168.75	0.00065	0.00457	0.005	0.00595	0.00397	0.00602	0.02615
9	168.75 - 191.25	0.00048	0.00309	0.00284	0.00355	0.00184	0.00267	0.01448
10	191.25 - 213.75	0.00037	0.00178	0.00166	0.00129	0.00074	0.00078	0.00662
11	213.75 - 236.25	0.00069	0.00357	0.00251	0.00159	0.00067	0.00118	0.01022
12	236.25 - 258.75	0.00194	0.00657	0.0035	0.00279	0.00083	0.00159	0.01723
13	258.75 - 281.25	0.0134	0.02287	0.00885	0.006	0.00208	0.00369	0.05689
14	281.25 - 303.75	0.04282	0.04439	0.01176	0.00606	0.00226	0.00369	0.11098
15	303.75 - 326.25	0.03987	0.0472	0.01441	0.00692	0.00367	0.00371	0.11578
16	326.25 - 348.75	0.02343	0.03493	0.01287	0.00745	0.0038	0.00392	0.0864
	Sub-Total	0.14013	0.21934	0.11197	0.10845	0.06897	0.1123	0.75281
	Calms							0.24
	Missing/Incomplete							0.01
	Total							1

Preliminary HECA Maximum Modeled Hourly NO2 Concentrations with flat terrain and Bakersfield Meadows Field Airport Wind Direction
Pollution Rose Frequency Distribution 2004-2008

	Directions / Concentration (ug/m3)	0.1 - 10.0	10.0 - 20.0	20.0 - 30.0	30.0 - 40.0	40.0 - 50.0	>= 50.0	Total
1	348.75 - 11.25	0.03971	0.02405	0.01098	0.00219	0.00055	0.00277	0.08025
2	11.25 - 33.75	0.00968	0.01084	0.00888	0.0033	0.00113	0.00302	0.03685
3	33.75 - 56.25	0.00244	0.00694	0.00586	0.00387	0.00238	0.00118	0.02267
4	56.25 - 78.75	0.00164	0.00344	0.00489	0.00267	0.00357	0.00943	0.02564
5	78.75 - 101.25	0.03134	0.02262	0.00339	0.0021	0.00145	0.00076	0.06166
6	101.25 - 123.75	0.00802	0.01886	0.00842	0.00925	0.00085	0	0.0454
7	123.75 - 146.25	0.01197	0.01925	0.00392	0.00713	0.00007	0	0.04234
8	146.25 - 168.75	0.00699	0.01211	0.00108	0.0015	0.00314	0.00085	0.02566
9	168.75 - 191.25	0.00482	0.00593	0.00203	0.00157	0	0	0.01434
10	191.25 - 213.75	0.00224	0.00323	0.00085	0.00012	0	0	0.00643
11	213.75 - 236.25	0.0035	0.00613	0.00035	0	0	0	0.00998
12	236.25 - 258.75	0.00314	0.0131	0.00058	0.00002	0	0	0.01683
13	258.75 - 281.25	0.01148	0.03789	0.00653	0.00002	0	0	0.05592
14	281.25 - 303.75	0.01635	0.09097	0.00224	0	0	0	0.10955
15	303.75 - 326.25	0.03763	0.06729	0.00648	0.00341	0	0	0.11481
16	326.25 - 348.75	0.05354	0.02209	0.00579	0.00224	0.00081	0.00111	0.08557
	Sub-Total	0.24449	0.36472	0.07224	0.03938	0.01395	0.01912	0.74564
	Calms							0.24
	Missing/Incomplete							0.01
	Total							1

Preliminary HECA Maximum Modeled Hourly NO2 Concentrations with complex terrain and
Bakersfield Meadows Field Airport Wind Direction
Pollution Rose Frequency Distribution 2004-2008

	Directions / Concentration (ug/m3)	0.1 - 10.0	10.0 - 20.0	20.0 - 30.0	30.0 - 40.0	40.0 - 50.0	>= 50.0	Total
1	348.75 - 11.25	0.0169	0.03694	0.01019	0.0039	0.00272	0.00959	0.08025
2	11.25 - 33.75	0.00224	0.01054	0.00895	0.00261	0.00196	0.01056	0.03685
3	33.75 - 56.25	0.00035	0.00597	0.00717	0.003	0.00152	0.00466	0.02267
4	56.25 - 78.75	0.00127	0.00341	0.00528	0.00267	0.00417	0.00883	0.02564
5	78.75 - 101.25	0.01958	0.02237	0.00593	0.00659	0.0044	0.00279	0.06166
6	101.25 - 123.75	0.00816	0.01958	0.00948	0.00763	0.00055	0	0.0454
7	123.75 - 146.25	0.01247	0.01879	0.0042	0.0068	0.00007	0	0.04234
8	146.25 - 168.75	0.00706	0.01211	0.00101	0.00148	0.00394	0.00007	0.02566
9	168.75 - 191.25	0.00498	0.00579	0.00219	0.00138	0	0	0.01434
10	191.25 - 213.75	0.00224	0.00327	0.00081	0.00012	0	0	0.00643
11	213.75 - 236.25	0.00357	0.00611	0.0003	0	0	0	0.00998
12	236.25 - 258.75	0.00323	0.01303	0.00055	0.00002	0	0	0.01683
13	258.75 - 281.25	0.01153	0.03819	0.00618	0.00002	0	0	0.05592
14	281.25 - 303.75	0.01637	0.0912	0.00198	0	0	0	0.10955
15	303.75 - 326.25	0.03766	0.0674	0.00676	0.003	0	0	0.11481
16	326.25 - 348.75	0.0481	0.02387	0.00387	0.00233	0.00267	0.00473	0.08557
	Sub-Total	0.1957	0.37856	0.07485	0.04155	0.02202	0.04123	0.74564
	Calms							0.24
	Missing/Incomplete							0.01
	Total							1