Bowie Power Station LLC

Modeling Protocol for an Air Quality Impact Analysis

June 2013

SOUTHWESTERN
Power Group II, LLC
An Energy Company – Alliance Builder

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BOWIE POWER STATION LLC

MODELING PROTOCOL FOR AN AIR QUALITY IMPACT ANALYSIS

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LIST OF ACRONYMS

°F	Degrees Fahrenheit
$\mu g/m^3$	Micrograms per cubic meter
AAAQS	Arizona Ambient Air Quality Standards
AAC	Arizona Administrative Code
AADT	Annual Average Daily Traffic
ADEQ	Arizona Department of Environmental Quality
AERMOD	AMS/EPA Regulatory Model
AMS	American Meteorological Society
AQRV	Air quality related value
AQS	Air Quality System
AZ	Arizona
BPIP	Building Profile Input Program
CA	California
CAPCOA	California Air Pollution Control Officers Association
CFR	Code of Federal Regulations
CO	Carbon monoxide, Colorado
DAT	Deposition Analysis Thresholds
DLN	Dry low NO_x
EAB	Environmental Appeals Board
EPA	United States Environmental Protection Agency
FLAG	Federal Land Managers' Air Quality Related Values Workgroup
FLM	Federal Land Manager
ft	Feet
GE	General Electric
GEP	Good Engineering Practice
HAP	Hazardous air pollutant
HAPRACT	Hazardous air pollutant reasonable available control technology
hp	Horsepower
HRSG	Heat recovery steam generator
IMPROVE	Interagency Monitoring of Protected Visual Environments
ISA	Integrated Science Assessment
IWAQM	Interagency Workgroup on Air Quality Modeling
K	Kelvin

LIST OF ACRONYMS (CONTINUED)

km	Kilometers
LCC	Lambert conformal coordinates
LMP	Limited Maintenance Plan
m	Meter
mi	Mile
mi^2	Square mile
MM	Mesocale modeled
MMBtu/hr	Million British thermal units per hour
MRPO	Midwest regional Planning Organization
m/s	Meters per second
msl	Mean sea level
MW	Megawatt
NA	Not applicable
NAAQS	National Ambient Air Quality Standards
NACAA	National Association of Clean Air Agencies
NAD83	North American Datum 1983
NCDC	National Climate Data Center
NED	National Elevation Dataset
NLCD	National Land Cover Dataset
NM	National Monument
NMED	New Mexico Environmental Department
NO_x	Nitrogen oxides
NO_2	Nitrogen dioxide
NP	National Park
NPS	National Park Service
NWS	National Weather Service
OC	Organic carbon
OLM	Ozone Limiting Method
PDEQ	Pima County Department of Environmental Quality
$PM_{2.5}$	Particulate matter less than 2.5 micrometers
PM_{10}	Particulate matter less than 10 micrometers
ppb	Parts per billion
ppm	Parts per million

LIST OF ACRONYMS (CONTINUED)

PSD	Prevention of Significant Deterioration
PVMRM	Plume Volume Molar Ratio Method
SCR	Selective catalytic reduction
SIL	Significant impact level
SO_2	Sulfur dioxide
SO_4	Sulfate
SMC	Significant monitoring concentration
SWPG	SouthWestern Power Group II, LLC
TBD	To be determined
TDS	Total dissolved solids
tpy	Tons per year
TSS	Technical Support System
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VOC	Volatile organic compound
WA	Wilderness Area
WRAP	Western Regional Air Partnership
WY	Wyoming

1.0 INTRODUCTION AND PROJECT BACKGROUND

SouthWestern Power Group II, LLC (SWPG), plans to build a 1,000 megawatt (MW; 1,050 with duct firing) natural gas-fired, combined cycle power plant. The facility, called the Bowie Power Station, will be built in phases. Phase one will be 525 MW and is addressed in this modeling protocol. This phase will consist of two General Electric (GE) natural gas-fired 7FA, Model 4 combustion turbine generators, two heat recovery steam generators with supplemental firing, a steam turbine generator, and a nine cell mechanical draft cooling tower. Auxiliary equipment includes a natural gas-fired boiler and a diesel-fired emergency fire pump. The plant will be owned and operated by Bowie Power Station, LLC (Bowie). Bowie Power Station, LLC is wholly owned by SWPG.

The plant will be located approximately 2 miles (mi) north of the unincorporated community of Bowie in Cochise County in southeastern Arizona, approximately 80 miles east of Tucson. The area is attainment for all pollutants.

The project property consists of approximately 2.5 square miles (mi^2) of agricultural land. The power plant site, switchyards, and evaporation impoundment will encompass approximately 150 acres. A project vicinity map is shown as Figure 1-1.

The proposed project will be a new major source as defined in the Arizona Administrative Code (AAC), Title 18, Chapter 2, Article 4, Section R18-2-401 and is required to obtain a Class I (Title V) permit and demonstrate compliance with the provisions in Article 3. This modeling protocol addresses impact analyses that will be performed as part of an application for a Class I Prevention of Significant Deterioration (PSD)/Title V permit.

1.1 Project Description

The project will include the following emission units:

- Two combined-cycle, natural gas-fired, GE Frame 7FA combustion turbines;
- Two heat recovery steam generators (HRSGs), each equipped with a 420 million British thermal unit per hour [MMBtu/hr] heat input) duct burner;
- Nine-cell cooling tower;
- Evaporation pond (not modeled);
- Natural gas-fired auxiliary boiler (50 MMBtu/hr heat input); and
- Diesel-fired emergency fire pump (260 horsepower).

The project plans to use GE Frame 7FA, Model 4 (7FA.04) combustion turbines with a "fast start" configuration.

Nitrogen oxides (NO_x) emissions from the turbines and duct burners will be controlled using selective catalytic reduction (SCR) systems. Carbon monoxide (CO), volatile organic compound (VOC), and organic hazardous air pollutant (HAP) emissions from the turbines and duct burners will be controlled using oxidation catalysts.

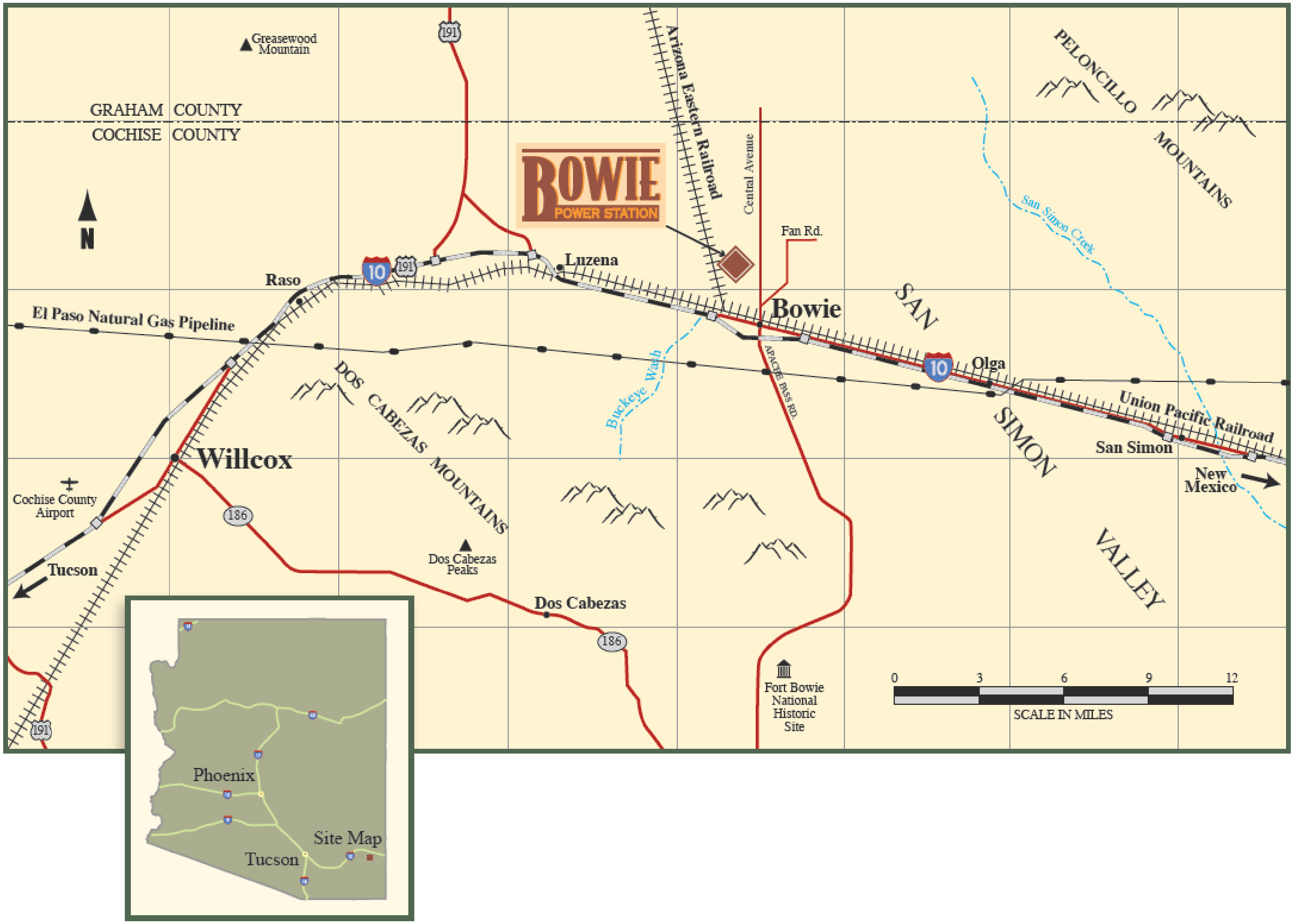


Figure 1-1. Bowie Power Station Location

The project will be a major PSD source, with potential emissions of NO_x and CO greater than 100 tons per year (tpy). Pollutants for which PSD review will be required include not only NO_x and CO, but also particulate matter less than 10 micrometers (PM_{10}) and particulate matter less than 2.5 micrometers ($PM_{2.5}$). The project will be less than significant for sulfur dioxide (SO_2) and VOCs; however, SO_2 will be modeled for comparison with ambient standards in accordance with Arizona Department of Environmental Quality (ADEQ) policy. The project will also be a minor source of HAPs.

1.2 Site Description

The project site and surrounding areas are primarily agricultural. This area lies within the San Simon Valley, defined by the Pinaleno, Dos Cabezas, and Chiricahua Mountain ranges to the west of the site, and the Peloncillo Mountain range to the east. The San Simon Valley has a general northwest-to-southeast orientation, with a gentle slope upward from the northeast to the southwest. The nearest elevated terrain to the project site occurs in the Fisher Hills, located within the valley to the northwest. The leading edge of these hills is within 7 kilometers (km) of the site. The highest terrain feature within a radius of 30 km of the site is Government Peak (7,580 feet above mean sea level [ft msl]), located within the Dos Cabezas Mountain range. The site will be graded to a base elevation of approximately 3,737 ft msl (1,139 meters). The location of the site within the valley is shown in Figure 1-1. The proposed location is in Township 12S, Range 28E, Section 28.

Figure 1-2 shows the site layout; Figure 1-3 shows a more detailed plot plan.

1.3 Regional Climatology

The climate in the Bowie area can be characterized as mild and dry. Seasonal temperatures and precipitation totals observed in Safford, Arizona (approximately 53 km to the north) for the period 1951-1980 are shown in Table 1-1 (Gale 1985). The annual average temperature for the Safford area is 62.5 degrees Fahrenheit (ºF).

Table 1-1. Seasonal Temperatures and Precipitation

Season	Temperature (ºF)			Total Average Precipitation (inches)
	Maximum	Minimum	Average	
Spring	78.7	42.6	60.7	0.9
Summer	97.0	64.1	80.6	3.6
Autumn	80.7	46.5	63.7	2.3
Winter	61.3	29.0	45.1	1.9

Notes:
°F = Degrees Fahrenheit
Maximum = Mean daily maximum
Minimum = Mean daily minimum

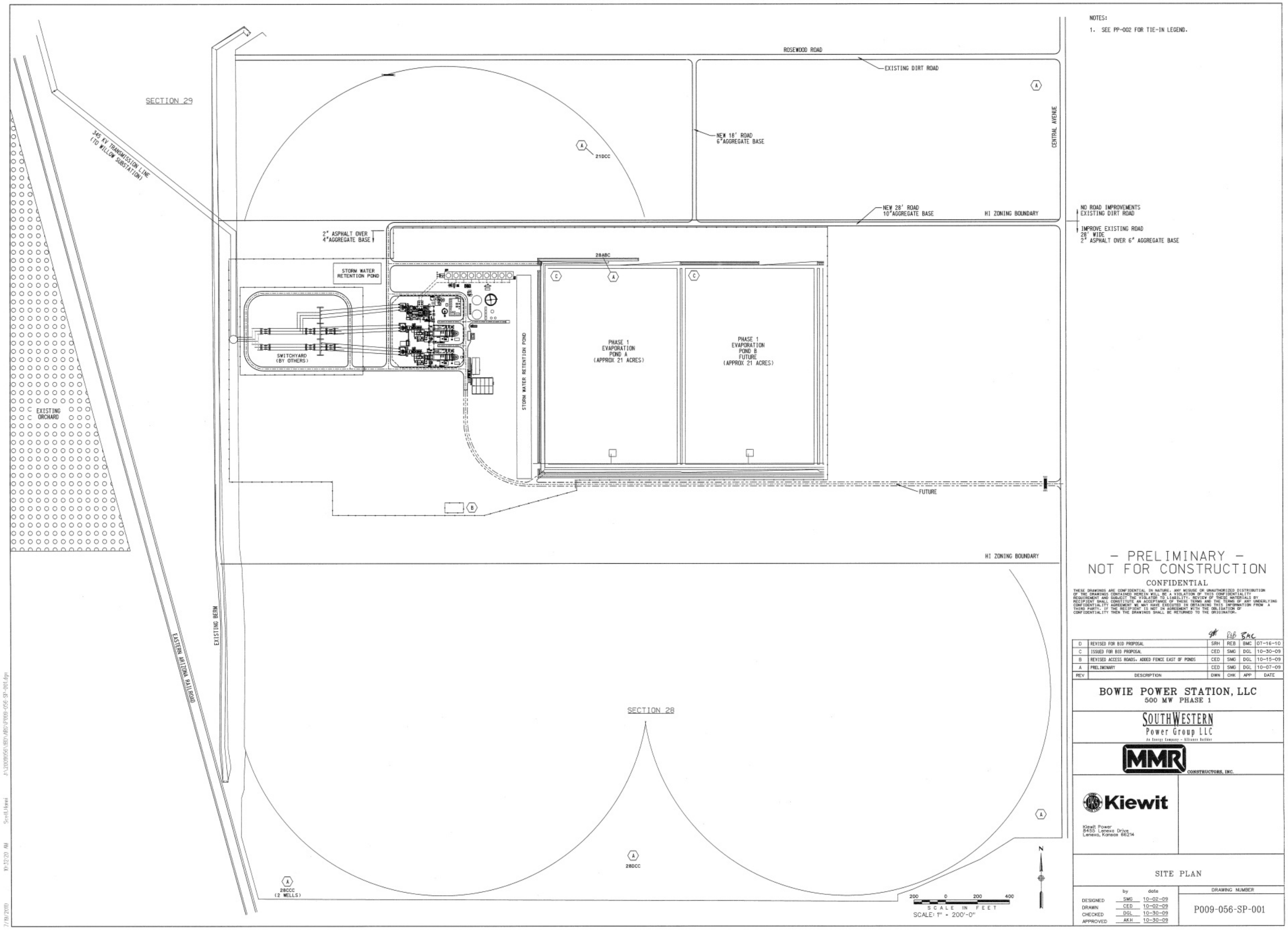


Figure 1-2. Bowie Power Station Site Plan

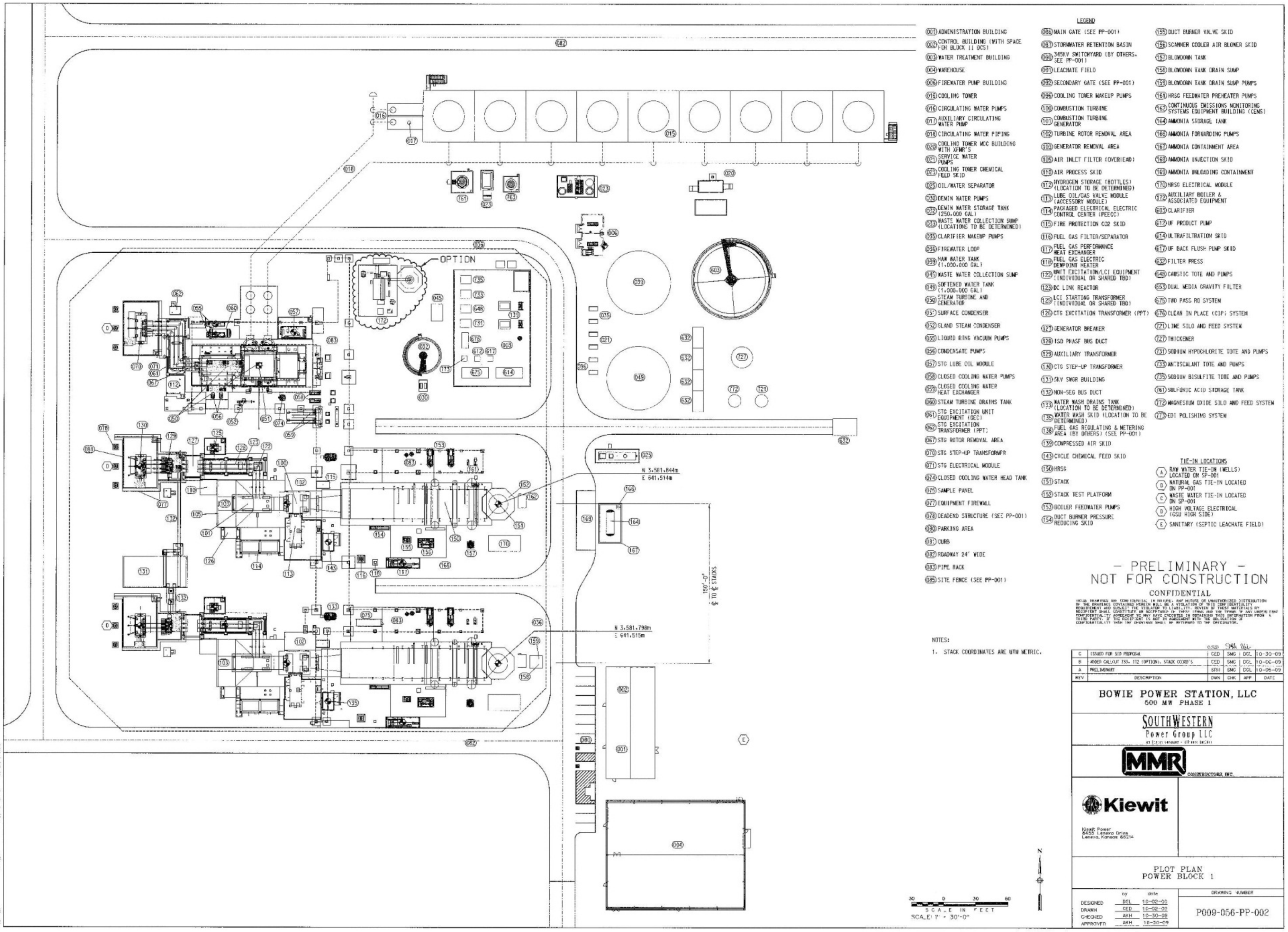


Figure 1-3. Bowie Power Station Plot Plan

2.0 REGULATORY STATUS

The Bowie Power Station will be located in Cochise County, Arizona. The air permitting authority is the ADEQ, Air Quality Division.

2.1 Source Designation

The proposed project will require a Class I permit. The project will have the potential to emit more than 100 tpy of NO_x and CO. In addition, the project will have the potential to emit more than 15 tpy of PM_{10} and 10 tpy of $PM_{2.5}$ (NO_x is also considered a precursor to both PM_{10} and $PM_{2.5}$). An air quality impact analysis will be required for these pollutants. The analysis will include the following components, as necessary:

- Dispersion modeling to determine whether ambient impacts due to the proposed project would exceed modeling significant impact levels (SILs);
- For each pollutant predicted to exceed modeling SILs, a refined dispersion analysis to assess the effect of the proposed project and other sources on ambient air quality (compliance with national and Arizona ambient air quality standards [NAAQS/AAAQS]);
- For each pollutant predicted to exceed modeling SILs for which an increment has been defined, a refined dispersion analysis to assess the effect of the proposed project and other sources on Class II increments of allowable deterioration in air quality (increment consumption);
- An assessment of the proposed project's impacts to soils and vegetation;
- An assessment of the project's impacts to visibility;
- An assessment of regional population growth and associated emissions that may be caused by the proposed project; and
- An assessment of the proposed project's potential to affect increments, visibility, or other air quality related values (AQRVs) in nearby Class I areas.

ADEQ also requested an air quality impact analysis to show compliance with SO_2 NAAQS/AAAQS.

The Bowie Power Station will be a minor source of HAPs, with total HAP emissions less than 25 tpy and emissions of each individual HAP less than 10 tpy. The Bowie Power Station does not belong to one of the source categories listed in Table 2 of the Arizona Administrative Code, Title 18, Chapter 2, Article 17 (R18-2-1702) and therefore the Arizona State Hazardous Air Pollutant Program does not apply to the project. As such, neither the imposition of HAP Reasonably Available Control Technology (HAPRACT) nor the demonstration of a lack of adverse effects using a Risk Management Analysis is required for the project. Modeling of HAPs and other noncriteria pollutants will not be performed except as needed to evaluate additional impacts to soils and vegetation in the project vicinity.

2.2 Area Classifications

The proposed project location is attainment/unclassified for the NAAQS/AAAQS for all pollutants regulated under the PSD program. PSD review is required for any pollutant regulated under the program that will be emitted in significant amounts.

The proposed project is located within 50 mi of the Arizona-New Mexico border, which makes New Mexico an affected state. Tribal lands within 50 km of the project's impact area are also generally treated as affected states and informed of the project so that they may provide comments. The nearest tribal land to the project area is the San Carlos Indian Reservation located approximately 75 km to the north and northwest.

2.3 Baseline Dates and Area

For a given pollutant, a PSD increment is the maximum increase in concentration allowed above an established baseline concentration. The baseline concentration represents the actual ambient concentration existing at the initiation of the PSD program in a given area.

Two types of baseline dates have been established: major source baseline dates and minor source baseline dates. The major source baseline date identifies the point in time after which major sources affect available increment, while the minor source baseline date identifies the point in time after which actual emission changes from all sources (both major and minor) affect available increment. The amount of PSD increment that has been consumed within an area is determined from the actual emission increases and decreases that have occurred since the applicable baseline date.

The major source baseline dates are as follows:

- January 6, 1975, for SO_2 and PM_{10};
- February 8, 1988, for nitrogen dioxide (NO_2); and
- October 20, 2010, for $PM_{2.5}$.

The trigger dates are the dates after which a minor source baseline can be established for an area. The trigger dates are as follows:

- August 7, 1977, for SO_2 and PM_{10};
- February 8, 1988, for NO_2; and
- October 20, 2011 for $PM_{2.5}$.

The minor source baseline date in the Southeast Arizona Intrastate Air Quality Control Region for NO_x, SO_2, and PM_{10} is April 5, 2002. The baseline area for the project encompasses the counties of Cochise, Graham, Greenlee, and Santa Cruz. The applicable $PM_{2.5}$ minor source baseline date has not yet been set.

3.0 AMBIENT DATA REQUIREMENTS

Preconstruction and post-construction monitoring requirements are discussed below.

3.1 Representative Data Satisfying the Preconstruction Air Quality Monitoring Requirements

A PSD permit applicant can satisfy the preconstruction monitoring requirements associated with the PSD permitting process by using data from existing monitors that are determined by ADEQ to be representative of background conditions in the affected area. On January 22, 2013, the US Court of Appeals for the DC Circuit issued an opinion granting the US Environmental Protection Agency's (EPA's) request to voluntarily remand the portion of a regulation establishing SILs for $PM_{2.5}$ and invalidating the portion of the regulation establishing the significant monitoring concentration (SMC) for $PM_{2.5}$; the decision contained no holdings, and thus has no effect with respect to the SILs or SMCs for any other pollutant. Subsequently, on March 4, 2013, the EPA issued *Draft Guidance for $PM_{2.5}$ Permit Modeling* in light of the Court's decision. The draft guidance and all associated guidance relate exclusively to $PM_{2.5}$, and do not alter, impact, or otherwise change the ability of ADEQ to use and rely upon the SILs or SMCs for other pollutants. Also, neither the Court opinion nor the draft guidance have altered ADEQ's discretion to use representative data to satisfy the preconstruction monitoring requirements of PSD permitting. See *Draft Guidance for $PM_{2.5}$ Permit Modeling*, p. 11 (EPA 2013): "[T]he EPA believes PSD permit applicants may continue to meet the preconstruction monitoring requirements in these regulations by using data from existing monitors that are determined by the applicable permitting authority to be representative of background conditions in the affected area," citing to *In re: Northern Michigan University Ripley Heating Plant, PSD Appeal* No. 08-02, slip op. at 58 (Feb. 18, 2009): "EPA has long implemented the PSD program pursuant to the understanding that representative data may be substituted where circumstances warrant."

ADEQ has the discretion and authority to use representative data to satisfy the preconstruction monitoring requirements associated with the PSD permitting process and such authority was not impacted or altered by the recent DC Circuit opinion. Therefore, this section contains an expanded analysis of the representativeness of nearby existing monitoring data that will be used in connection with the modeling.

The *Ambient Monitoring Guidelines for Prevention of Significant Deterioration* (EPA 1987) discusses the concept of "representative" air quality data. Use of the *Ambient Monitoring Guidelines for Prevention of Significant Deterioration* has been upheld as appropriate by the EPA's Environmental Appeals Board (EAB), as has the use of representative data to satisfy the preconstruction monitoring requirements of PSD permitting. See, for example, *In re Knauf Fiber Glass, GmbH*, 8 E.A.D. 121, 145-48 (EAB 1999); *In re Haw. Elec. Light Co.*, 8 E.A.D. 66, 97-105 (EAB 1998); *In re Hibbing Taconite Co., 2 E.A.D.* 838, 850-51 (Adm'r 1989), all cited to and relied upon by *In re: Northern Michigan University Ripley Heating Plant, PSD Appeal* No. 08-02, slip op. at 58 (Feb. 18, 2009) for the proposition that representative data may be used to satisfy the preconstruction monitoring requirements.

The *Ambient Monitoring Guidelines for Prevention of Significant Deterioration* (EPA 1987) provide that, with respect to location, the existing monitoring data should be representative of three types of areas: (1) the location(s) of maximum concentration increase from the proposed source or modification, (2) the location(s) of the maximum air pollutant concentration from existing sources, and (3) the location(s) of the maximum impact area (i.e., where the maximum pollutant concentration would hypothetically occur based on the combined effect of the existing sources and the proposed new source). The Guidelines go on to state that if the proposed source will be constructed in an area that is generally free from the impact of other point sources and area sources associated with human activities, then monitoring data from a "regional" site may be used as representative data. Such a site could be out of the maximum impact area but must be similar in nature to the impact area. The Bowie Power Station will be located in an area with low population. Moreover, the Bowie Power Station location is not adjacent to other point sources and is situated such that it is not considered to be in a "multisource" area. As with much of rural southern Arizona, the surrounding land use is a mixture of undisturbed desert and agriculture.

In 2011, the National Association of Clean Air Agencies (NACAA) published a report from the NACAA $PM_{2.5}$ Modeling Implementation Workshop, titled *$PM_{2.5}$ Modeling Implementation for Projects Subject to National Ambient Air Quality Demonstration Requirements Pursuant to New Source Review* (NACAA 2011). A discussion from the Representative Background Concentrations Subgroup expands on the factors to be considered in determining whether a monitoring site is representative of the maximum impact area for a proposed source:

- Proximity to the source(s) modeled. In general, the nearest monitoring site is preferable. A monitoring site that is far from the source(s) modeled may be affected by the secondary formation of $PM_{2.5}$ precursors that are emitted under much different circumstances.
- Similarity of the surrounding source(s). Sources in the vicinity of the monitor should be similar to those near the source(s) modeled. The background concentration should not be affected by major point sources that would not affect receptors in the vicinity of the source being permitted. But, the concentrations at a monitoring site that is impacted by suburban or industrial sources might be representative of the background in an area that has similar sources.
- 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.

Although this guidance relates to modeling for $PM_{2.5}$, it is consistent with EPA's guidance and EAB decisions discussing the factors used in establishing whether particular data are "representative" generally with respect to any pollutant. Thus, this guidance is referenced and used as support for the position that the data relied upon for each pollutant is "representative" such that is satisfies the preconstruction monitoring requirements of PSD permitting.

3.1.1 Ozone

Ambient ozone monitoring data from the nearby Chiricahua National Monument (NM) was previously proposed and accepted by ADEQ as representative ozone data that meets the PSD preconstruction monitoring requirement. The Chiricahua NM monitor is located approximately 41 km to the south-southeast of the project. The ozone monitor is located at an elevation of 5,151 feet (the Bowie Power Station will be located at 3,737 feet elevation). It is the nearest location to the project where ozone is monitored and the only ozone monitoring location in Cochise County. Because ozone is a regional pollutant, the Chiricahua NM data are expected to be representative of the project site. Both the Bowie project and the Chiricahua NM are located in rural areas, far from major areas of ozone precursor emissions (i.e., Tucson, Phoenix, etc.). On April 30, 2012, EPA designated Cochise County attainment/unclassifiable with respect to the 2008 ozone NAAQS based on data from this monitor, along with an analysis of population density, emissions, and commuting patterns. ADEQ has concluded that Cochise County does not contribute to ambient air quality that does not meet the 8-hour ozone standard (ADEQ 2009).

3.1.2 Particulate Matter

Particulate matter ($PM_{2.5}$ and PM_{10}) data are also collected at the Chiricahua NM through the Interagency Monitoring of Protected Visual Environments (IMPROVE) program, monitored on a 1-in-3 day schedule. These data are proposed as representative data for $PM_{2.5}$ and PM_{10}.

Local and regional emissions from upwind urban areas and rural sources can account for 50%-75% of total observed particulate matter concentrations. Generally, PM_{10} consists of 40%-60% $PM_{2.5}$, and the remainder is primarily locally generated, crustal/geological and biological material. In contrast, most of the observed $PM_{2.5}$ mass usually originates as precursor gases and, through various physiochemical processes, is transferred to the condensed phase as secondary particulate matter. (NARSTO 2004)

Locally observed particulate matter is composed of multiple chemicals, largely sulfate, organic carbon, and nitrate, in combinations that differ by geographic region. Non-coastal rural areas are dominated by sulfate, organic carbon, and black carbon, while nitrate-containing particles are important in parts of the west. Almost all sulfate originates from SO_2 oxidation mediated by ammonia. While 95% of SO_2 sources are anthropogenic, from fossil fuel combustion, the majority of ammonia sources are related to agricultural activities. Essentially all particle nitrate is derived from atmospheric oxidation of NO_x. The major anthropogenic source of NO_x is fossil fuel combustion. Organic carbon may be primary and/or secondary, of biogenic (vegetative material, biogenic gases, spontaneous forest fires) and anthropogenic (fossil fuel combustion, prescribed fires, cooking) origin. Black carbon originates as ultrafine or fine particles from primary sources during incomplete combustion of carbon-based fuels. (NARSTO 2004)

$PM_{2.5}$ concentrations tend to be highest in the central portions of urban areas, diminishing to background levels at the urban fringe. The typically smaller spatial variations of $PM_{2.5}$ compared to PM_{10} are consistent with the long atmospheric residence time of fine particles, which permits transport over distances of 10 to 1,000 km and leads to more uniform mass concentrations. PM_{10} concentrations are not spatially distributed smoothly because each monitoring site is strongly influenced by the degree of localized emissions of coarse particles. Concentrations in both size ranges tend to be higher in the late fall and winter, when atmospheric dispersion is at a seasonal low. (NARSTO 2004; ADEQ 2009)

The Chiricahua NM monitoring location is the closest site at which $PM_{2.5}$ and PM_{10} data are recorded (41 km). Both the Chiricahua NM site and the proposed Bowie Power Station location are rural areas without significant nearby population. The surrounding land use in each case includes a mixture of desert and agriculture, both of which are sources of directly emitted $PM_{2.5}$ and PM_{10}. Other southeastern Arizona locations where $PM_{2.5}$ and/or PM_{10} are monitored (Douglas, Arizona; Saguaro National Park [NP] East; and several locations in the Tucson metropolitan area) are located over twice as far from Bowie and the surrounding land uses are different (Tucson and Douglas have larger populations; Douglas is also impacted by nearby particulate matter sources in Agua Prieta, Mexico; and Saguaro NP East is located in an undisturbed desert environment at the eastern edge of the Tucson metropolitan area).

Both the Chiricahua NM and the Bowie Power Station site are potentially impacted by a number of point sources of directly emitted $PM_{2.5}$ and PM_{10}, as well as $PM_{2.5}$ precursor emissions (NO_x and SO_2). ADEQ supplied a listing of permitted sources within approximately 50 km of each location. Table 3-1 lists the nearby point sources of directly emitted $PM_{2.5}$ and PM_{10}, as well as $PM_{2.5}$ precursor emissions, that may impact the Chiricahua monitor location and the Bowie Power Station. Figures 3-1 and 3-2 portray this information graphically (PM_{10} is plotted in Figure 3-1; $PM_{2.5}$ emissions are identical for most sources), while Figure 3-3 compares the cumulative point source emissions with distance from the Bowie Power Station and the Chiricahua NM monitoring site.

Table 3-1. $PM_{10}/PM_{2.5}$ and $PM_{2.5}$ Precursor Emissions near Bowie Power Station and Chiricahua NM Monitor

Source	Distance From Bowie (km)	Distance from Chiricahua Monitor (km)	$PM_{10}/PM_{2.5}$ Potential to Emit (tpy)	$PM_{2.5}$ Precursors Potential to Emit (tpy)
Pistachio Corporation of America	7.6	33.1	1.3/1.3	17.0
Level 3 Communications	16.9	31.8	0.25/0.25	3.7
EPNG-Bowie Compressor Station	18.9	44.3	1.8/1.8	316.9
EPNG-Cimarron Compressor Station	28.0	51.0	5.2/5.2	51.8
Biad Chili San Simon	32.4	33.9	1.3/1.3	30.3
EPNG-Willcox Compressor Station	32.4	28.1	4.8/4.8	489.5
Maid Rite Feeds	34.0	49.5	4.5/0.35	0.00
Westlawn Chapel & Mortuary	34.4	50.2	0.04/0.03	0.13
Willcox Greenhouse #1	40.1	65.0	1.2/1.2	16.1
Kansas Settlement Gin	41.8	35.9	64/64	7.2
EPNG-San Simon Compressor Station	42.2	36.6	1.6/1.6	306.4
Sunizona Greenhouses	43.8	26.6	7.9/7.9	15.3
Eurofresh Farms	44.3	73.4	10.2/7.7	145.4
Federal Bureau of Prisons-FCI Safford	44.7	84.7	0.39/0.39	16.9
Faria Dairy	44.9	34.9	0.13/0.13	5.7
Apache Generating Station	50.1	48.0	476.6/476.6	27,576
Boral Materials - Apache	50.4	48.0	0.14/0.14	0.00

Notes:

hp	=	Horsepower	km	=	Kilometer
MMBtu/hr	=	Million British thermal units per hour	MW	=	Megawatt
NO_x	=	Nitrogen oxides	NM	=	National Monument
tpy	=	Tons per year			

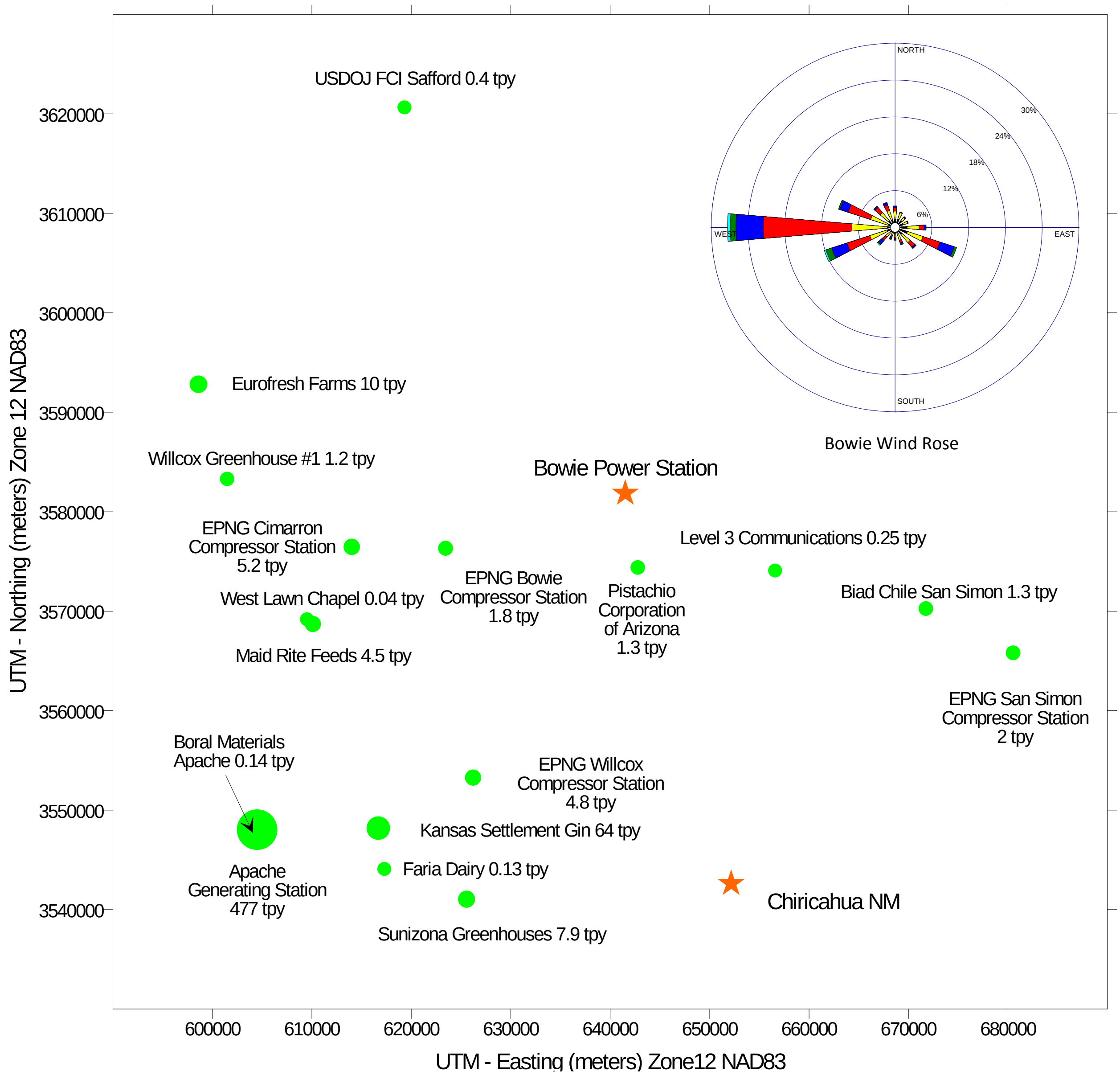


Figure 3-1. PM_{10} Emissions near Bowie Power Station and Chiricahua NM Monitor

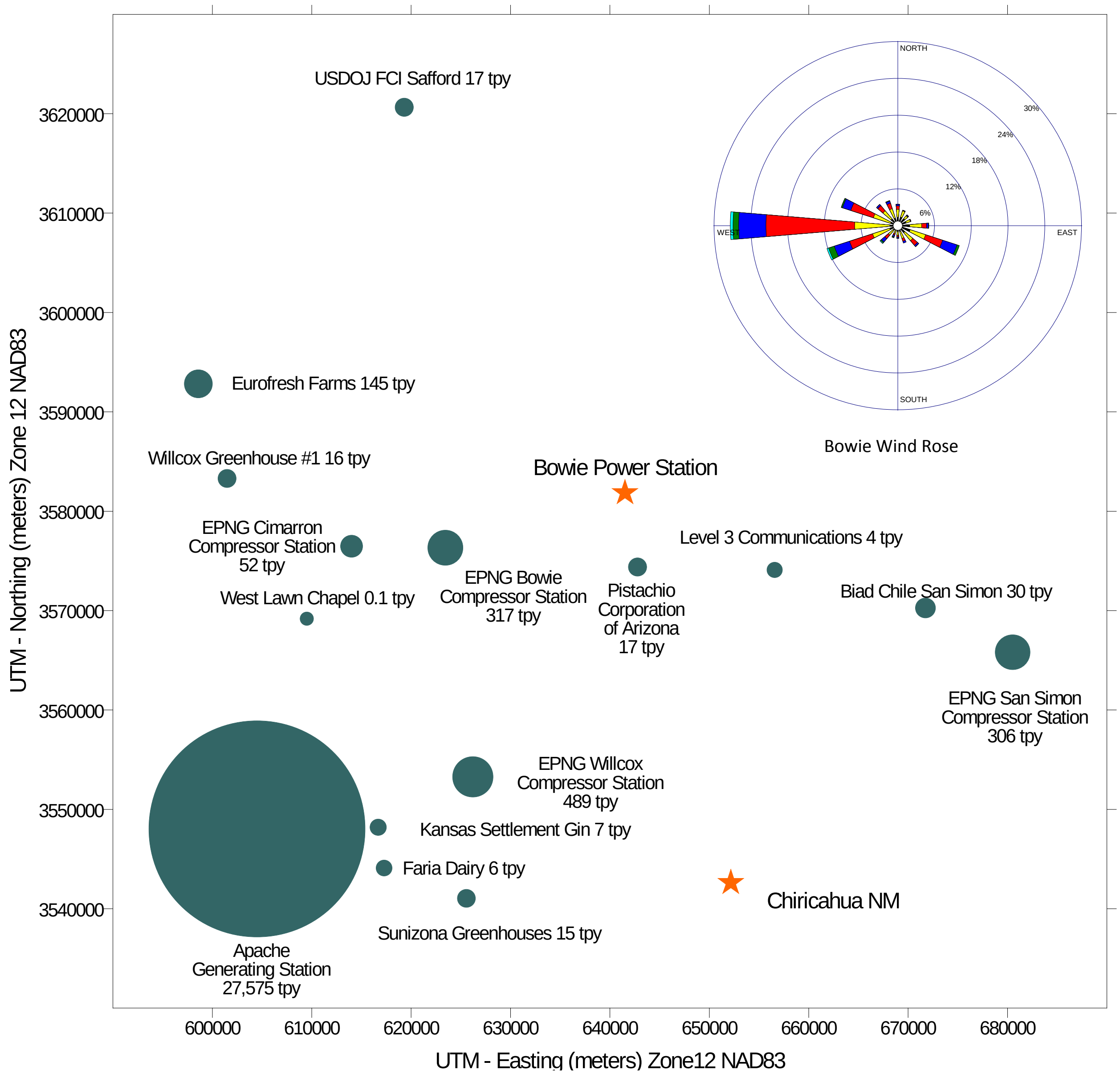
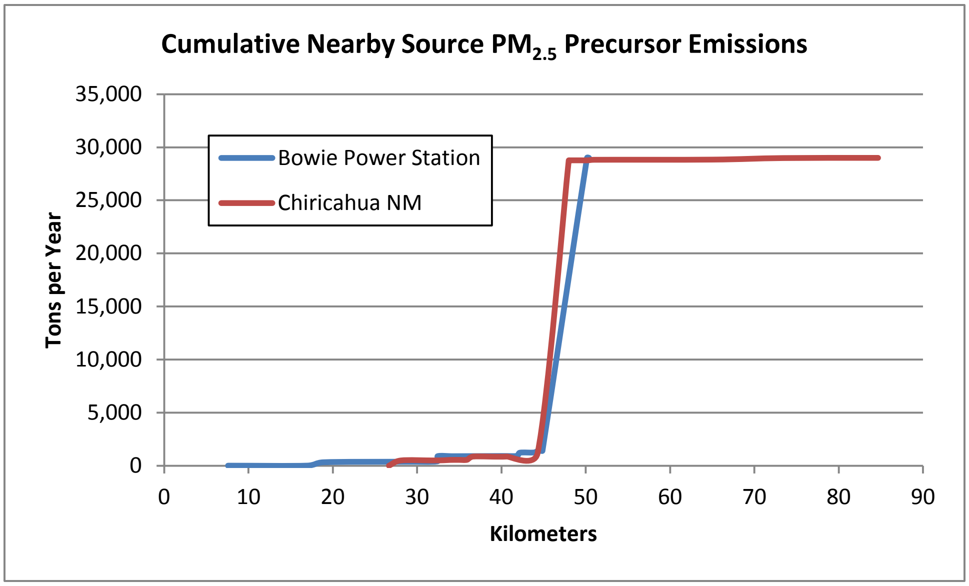


Figure 3-2. $PM_{2.5}$ Precursor Emissions near Bowie Power Station and Chiricahua NM Monitor



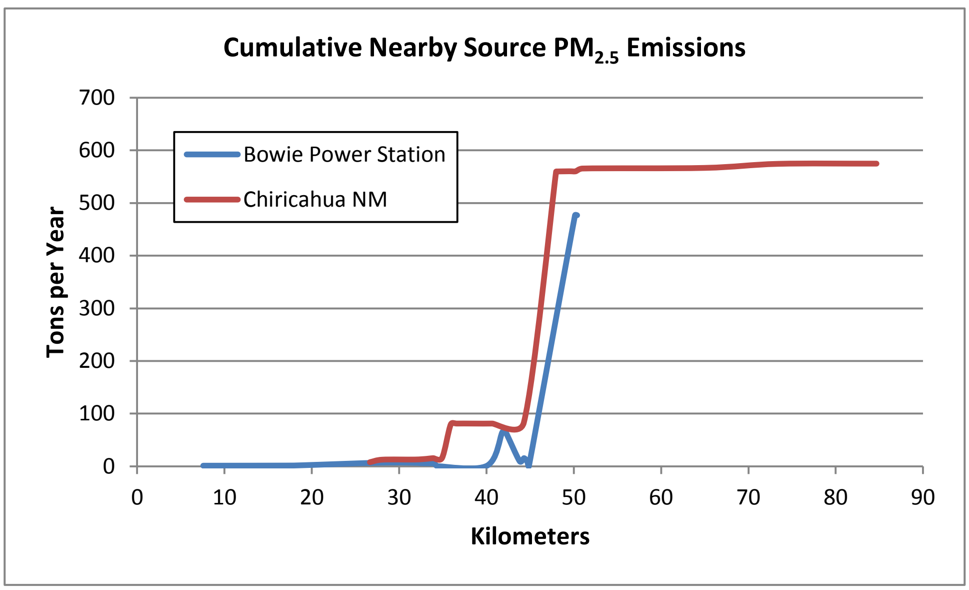


Figure 3-3. Nearby Point Source Emission Profiles with Distance from the Bowie Power Station and Chiricahua NM Monitor Locations

With respect to $PM_{2.5}$ precursors, the cumulative emissions profiles are almost identical and are dominated by emissions from the Apache Generating Station. For directly emitted $PM_{2.5}$ (and PM_{10}, which is not shown on the graphs because the profiles are virtually identical to those for $PM_{2.5}$), the Chiricahua NM monitoring site is slightly closer to the major particulate matter point sources in the region, rendering the monitoring data conservative relative to the Bowie Power Station location. As a result, the Chiricahua NM monitoring site may be considered representative of the Bowie Power Station impact area.

EPA has recently provided draft guidance on $PM_{2.5}$ modeling for New Source Review (EPA 2013). A secondary $PM_{2.5}$ analysis will be required for the Bowie Power Station. This makes the Chiricahua NM IMPROVE data particularly valuable for use in this analysis because the data are speciated and fractions of the major components of fine mass, including sulfate, nitrate, organic carbon etc., are expected to provide useful reference information for a qualitative analysis of the Bowie Power Station's secondary $PM_{2.5}$ impacts.

3.1.3 Sulfur Dioxide

SO_2 emissions from the Bowie Power Station are below the significant emission rate for PSD and this pollutant is being modeled at the request of ADEQ, rather than as a required part of the PSD impact analyses. SO_2 is currently monitored at only a few locations in Arizona. Most locations were sited to capture maximum impacts from large SO_2 point sources, including smelters and coal-fired power plants. As such, these monitors would not be representative of expected SO_2 concentrations in the Bowie area, where the nearest major point source of SO_2 (Apache Generating Station) is located approximately 50 km away.

SO_2 is monitored at one location in the Tucson metropolitan area in Pima County, approximately 80 mi to the west of the Bowie location. Unlike most other SO_2 monitoring sites in Arizona, the Pima County monitor was not located to capture maximum impacts from a specific point or group of sources but instead represents general population exposures to this pollutant. According to the Pima County Department of Environmental Quality (PDEQ 2011), ambient concentrations of SO_2 in Tucson have historically remained well below all federal standards and in recent years have been extremely low. The only major stationary sources of SO_2 possibly affecting ambient concentrations in the Tucson air planning area are the coal burning generators at the Irvington Generating Station operated by Tucson Electric Power.SO_2 was monitored for a number of years at the 22nd and Craycroft location but that site was discontinued in December 2010, after an SO_2 trace monitor was added at the Children's Park NCore location. Although slightly older, three years of SO_2 data from the 22nd and Craycroft (2008-2010) site are proposed as representative monitoring data because of the shorter period of record from the Children's Park location. These data are expected to be conservative relative to the Bowie Power Station location because of possible influence from the Irvington Generating Station (156 MW capacity coal), located 5.4 km from the 22nd and Craycroft monitor site. While the Bowie site is potentially impacted by a larger coal fired power plant (Apache Generating Station, ~400 MW coal), it is further away (50 km).

3.1.4 Carbon Monoxide

CO is another pollutant that is only monitored at a few sites in Arizona. The closest CO monitoring locations are in Pima County (Tucson metropolitan area). PDEQ monitors CO at five locations. Motor vehicles are the primary source of CO nationally as well as in the Tucson area. In spite of increased vehicular traffic, CO concentrations in Pima County have declined in the past three decades. This has been attributed to the use of cleaner burning oxygenated fuels, fuel efficient computer controlled vehicles, locally adopted Clean Air and Travel Reduction Programs, and various local traffic control measures.

Pima County was at one time designated nonattainment for the CO NAAQS and is operating under the auspices of the CO Limited Maintenance Plan (LMP). No exceedances of the CO NAAQS have been recorded in Tucson since 1988. Pima County's status for CO was reclassified to attainment with the implementation of the CO LMP on April 25, 2000 by EPA. The CO LMP was developed in conjunction with the Pima Association of Governments and approved by EPA to help mitigate any future violations.

According to EPA, the entire country now has air quality that meets current CO standards. Most sites have measured concentrations below the national standards since the early 1990s and improvements in motor vehicle emissions controls have contributed to significant reductions in ambient concentrations since that time. National data show a 73% decrease in CO (8-hour concentrations) between 1990 and 2010 and a 54% decrease between 2000 and 2010.

Because Tucson is a larger metropolitan area with higher traffic levels than the Bowie Power Station site, other CO monitoring sites in nearby states were examined to identify sources of monitoring data that are representative of the rural Bowie area. The only significant source of CO emissions in the immediate vicinity of Bowie is Interstate 10 (I-10), which has measured annual average daily traffic (AADT) volumes of 11,000-13,000 vehicles per day in recent years.

CO monitoring locations in Arizona, New Mexico, Colorado, Wyoming, Utah, and southern California were examined to identify sources of representative monitoring data for use in connection with the Bowie PSD permitting process. CO concentrations would be expected to be influenced by climate (colder areas have poorer winter dispersion, more fuel is burned to start motor vehicles, and emission control devices on vehicles operate less efficiently in cold weather), elevation (less oxygen in the air means less complete combustion, although this is mitigated in some areas by oxygenated fuel requirements), and population and traffic volumes on nearby roads, both of which relate to probable mobile source emissions. As a result of these factors, candidate sites were chosen that were located in cities smaller than Tucson or outside cities, that were inland, and that were near paved roadways, and that were therefore similar to the conditions facing the Bowie Power Station. This resulted in a list of 18 sites that were examined in more detail. The most recent three years of CO monitoring data (if available) were collected for these sites.

The 18 sites included the five Tucson monitoring locations, five in inland southern California (near Fresno, Barstow, Lancaster, Lake Elsinore, and Palm Springs), one site in rural southwestern Colorado (27 kilometers outside Durango), five sites near Albuquerque, New Mexico, and two sites in southern Wyoming (one in Cheyenne and one sited near oil and gas development in Sweetwater County). Population ranged from over 900,000 in Tucson to a site 26 kilometers from a town of 12,500. Elevations ranged from 89 meters to over 1,900 meters. Distances to the nearest road and to the largest road within a few kilometers also varied. The climate varied from hot, desert locales (Tucson, Barstow, Palm Springs) to cold winter areas (Colorado and Wyoming sites).

All sites show CO concentrations well below the NAAQS. Over the most recent three years, all sites show 1-hour CO concentrations below 10% of the NAAQS, and 8-hour concentrations are no more than 25% of the NAAQS. As demonstrated by the varied climate, population, elevation, and nearby traffic at the 18 stations analyzed, CO concentrations can be expected to be generally low and relatively insensitive to variations in population or traffic beyond the immediate vicinity of the monitor.

Based on population density, climate, proximity to roads with similar traffic volumes, elevation, and the presence of other potential contributors of CO, seven of the monitoring sites were chosen for further analysis as potential representative sites for CO data for the Bowie Power Station. The data on each site are shown in Table 3-2. It is worth noting that it would be reasonable to select any of these seven stations as having "representative" data such that its use in connection with the Bowie PSD permitting process satisfies the preconstruction monitoring requirements.

Table 3-2. Potentially Representative CO Monitoring Locations

AQS Site ID/Name	City/State	Nearest Population Center	Elevation (m MSL)	Nearest AADT	% 1-hr CO NAAQS	% 8-hr CO NAAQS	Notes
04-019-1011 22nd & Craycroft	Tucson,AZ	Tucson (980,263)	789	20,180	5%	11%	Nearest traffic count (3.9 km from monitor) likely higher than actual traffic near monitor. Neighborhood scale monitor.
04-019-1021 Cherry & Glenn	Tucson,AZ	Tucson (980,263)	732	12,845	5%	14%	Traffic count located 4.2 km from monitor. Neighborhood scale monitor.
04-019-1028 Children's Park NCore	Tucson,AZ	Tucson (980,263)	703	43,605	3%	7%	Traffic count located 445 m south of monitor. Neighborhood scale monitor.
06-071-0001 200 E. Buena Vista	Barstow, CA	Barstow (22,639)	690	18,000	6%	10%	Traffic count 1 km from site. Siting criteria and measurement scale unknown.
08-067-7001 Ignacio	27 km from Durango, CO	Durango (16,887)	1,983	10,400	3%	7%	Sum of two traffic counts (monitor is between) located 1.5 km and 2.3 km from monitor. Neighborhood scale monitor.
56-021-0100 North Cheyenne Soccer Complex	Cheyenne, WY	Cheyenne (91,738)	1,848	5,650	2%	4%	Nearest traffic counts 4-5 km from monitor.
56-037-0870 Tata Gaseous	25.8 km from Green River, WY	Green River (12,515)	1,912	6,289	3%	12%	Traffic count at nearest intersection with I-80, 5 km.
Bowie Power Station	**Bowie, AZ**	**Bowie (<1,000)**	**1,139**	**11,000-13,000**	**NA**	**NA**	**4 km to I-10.**

Notes:

AADT	=	Annual average daily traffic	AQS	=	Air Quality System
AZ	=	Arizona	CA	=	California
CO	=	Carbon monoxide, Colorado	km	=	Kilometer
m	=	Meter	MSL	=	(Above) Mean sea level
NAAQS	=	National Ambient Air Quality Standard	WY	=	Wyoming

Based on the factors found in EPA guidance, NACAA guidance, and relevant EAB decisions, the CO monitoring location identified as most representative of the Bowie Power Station location is located at 22nd and Craycroft in Pima County. This site is one of the oldest in the Pima County monitoring network, originally established in 1973, and has operated continuously to the present. The site is situated in a predominately residential area with commercial activity lining nearby arterial routes.

The NACAA Representative Background Concentrations Subgroup recommended that the factors to be considered in determining whether a monitoring site is representative of the maximum impact area for a proposed source should include: 1) proximity to the source modeled (the nearest monitoring site is preferable); 2) similarity of the surrounding sources, and 3) conservativeness of the background concentrations. With respect to the first criterion, the 22nd and Craycroft monitor and the other Tucson monitors are those in closest proximity to Bowie (approximately 80 mi west of Bowie). The climate is similar and the monitor is located at an elevation that is only a few hundred meters below that of Bowie, both factors that influence CO emissions.

With respect to the second criterion, similarity of surrounding sources, traffic is the primary CO source at each location. Local traffic is more important in determining representativeness than traffic over a larger area. The *Integrated Science Assessment for Carbon Monoxide* (ISA; EPA 2010) cites studies showing that CO concentrations decrease sharply, even exponentially, with downwind distance from a highway. For example, one study showed “on road” CO concentrations 10 times higher than upwind concentrations, while at 300 m downwind, the concentrations were reduced to only twice the upwind concentrations. The traffic monitor closest to the 22nd and Craycroft CO monitor has a traffic count of approximately 20,000 AADT vs 11,000-13,000 on I-10 at Bowie. In each case, the highway being measured is approximately 4 km from the CO monitoring site. Based on street maps, it is expected that traffic in the immediate vicinity of the 22nd and Craycroft monitor would be lower than the closest traffic count and the same would be true at the Bowie Power Station location.

The 22nd and Craycroft monitor is considered a “neighborhood” scale monitor. The ISA notes that neighborhood scale CO monitors are sited to measure representative concentrations within a 0.5-4.0 km radius and, “For the [Code of Federal Regulations]-defined neighborhood scale monitoring, the minimum monitor distance from a major roadway is directly related to the average daily traffic counts on that roadway, to ensure that measurements are not substantially influenced by any one roadway.

With respect to the third criterion, it is expected that the CO concentrations at the 22nd and Craycroft monitor would be conservative relative to Bowie simply because of the larger urban area it is located in.

Use of data from a monitor site that is not adjacent or in the immediate vicinity of the source is appropriate where, as here, the source is in a rural and remote area and not located in a multisource area. Moreover, the sites identified in Table 3-2 are indicative of CO concentrations that would be representative of the maximum impact area associated with the Bowie Power Station. Thus, per EPA guidance, NACAA guidance, and long-standing EPA and ADEQ practice, as upheld by the EAB, it would be reasonable for ADEQ to conclude that any of the sites in Table 3-2 have measured representative CO data. The 22nd and Craycroft monitor has been identified as the most representative due to the similarities in terrain, meteorological conditions, and proximity to comparable traffic concentrations; however, any of the sites in Table 3-2 would be representative of the proposed location for the Bowie Power Station. Thus, while this modeling protocol has identified the 22nd and Craycroft monitor as the source of the most representative data, it acknowledges and would defer to the ADEQ’s discretion with selecting any other site identified in Table 3-2 as a source of representative CO data.

3.1.5 Nitrogen Dioxide

In Arizona, NO_2 has only been monitored in urban areas such as Tucson and Phoenix, which would not be representative of NO_2 concentrations in the project area. Consequently, NO_2 ambient air quality data from Deming, New Mexico is proposed as representative monitoring data. Deming is a city of around 15,000 located due east of Bowie along I-10, approximately 104 mi (168 km) from Bowie. NO_2 data have been collected at this location since July 2006. The monitor is a State and Local Air Monitoring Station (SLAMS) site where NO_2 is monitored using the Federal Reference Method. It is operated by the New Mexico Environment Department (NMED).

ADEQ has provided a list of sources within 50 km of Bowie. Those sources are listed in Table 3-3. Stationary NO_x sources located within 50 km of Deming are shown in Table 3-4. Information about each facility's distance from the Deming monitor, permitted hours of operation, equipment type, and allowable NO_x emissions were taken from NMED's MergeMaster database, last updated in August 2009 (*www.nmenv.state.nm.us/aqb/modeling/mergemaster.html*), and supplemented with information contained in public notices and communication with NMED employees.

Figures 3-4 and 3-5 show the location and relative size (based on allowable tons of NO_x emissions per year) of various NO_x sources in the vicinity of the Bowie project and of the Deming monitor, along with the distribution of winds at Bowie and Deming.

The 1-hour NO_2 NAAQS is largely focused on concerns about short-term impacts from NO_x emissions due to heavy traffic and traffic hot spots. Both the Bowie Power Station and the Deming monitor are located near a major Interstate highway, I-10. The Deming monitor is located approximately 2 km from I-10, while the Bowie Power Station will be located approximately 4 km from I-10. Traffic volume on the portion of I-10 that runs through Bowie, Arizona is slightly lower than the link that runs through Deming, New Mexico (see *http://dot.state.nm.us/en/Planning.html#Data* and *www.azdot.gov/mpd/data/aadt.asp*), based on the most recent data available:

- I-10 Bowie:

  2010: 13,195 AADT

  2011: 12,119 AADT

  2012: 11,420 AADT

I-10 Deming:

2010: 18,730 AADT

2011: 18,696 AADT

2012: 17,595 AADT

NO_x sources in the vicinity of the Deming monitor, along with closer proximity to a major highway, and a larger local population suggest that the Deming monitor should provide a representative but conservative estimate of background NO_2 in the vicinity of Bowie.

Table 3-3. NO_x Emission Sources near Bowie Power Station

Source	Distance (km)	Hours per Year	Facility/Equipment Type	NO_x Potential to Emit (tpy)
Pistachio Corporation of America	7.6	8760	Natural gas roaster; 15 natural gas dryers (2.33-8.1 MMBtu/hr) Total facility fuel use is limited by permit condition	16.9
Level 3 Communications	16.9	8760	Telecommunications facility	3.5
EPNG-Bowie Compressor Station	18.9	8760	Natural gas turbine, 9,800 hp; two generators (96-226 hp)	316
EPNG-Cimarron Compressor Station	28.0	8760	Natural gas turbine, 11,080 hp; auxiliary natural gas generator, 588 hp	50
Biad Chili San SImon	32.4	Unknown	Food and beverage processing	30.3
EPNG-Willcox Compressor Station	32.4	8760	Two natural gas turbines (> 10,000 hp each); natural gas emergency generator (>1,000 hp)	487
Westlawn Chapel & Mortuary	34.4	8760	Natural gas cremator	0.09
Willcox Greenhouse #1	40.1	8760	Natural gas boilers (16 MMBtu/hr, 12 MMBtu/hr); diesel generators (366 hp, 158 hp)	15.7
Kansas Settlement Gin	41.8	8760	3 MMBtu/hr and 2 MMBtu/hr natural gas heaters	3.0[a]
EPNG-San Simon Compressor Station	42.4	8760	Three natural gas turbines, 4,920 hp each	261
Sunizona Greenhouses	43.8	8760	15 natural gas boilers (0.25-4.2 MMBtu/hr); 300 hp natural gas generator; 4.2 MMBtu/hr wood-fired boiler	14.8
Eurofresh Farms	44.3	8760	18 dual fuel (primarily natural gas) boilers (~ 40 MMBtu/hr each); 12 diesel generators (800-1,600 hp each); one standby generator	141.7
Federal Bureau of Prisons-FCI Safford	44.7	500	Emergency diesel generator, 1,200 hp	13.3
Faria Dairy	44.9	Unknown	Commercial animal feeding operation	4.5
Apache Generating Station	50.1	8760	One 75 MW steam unit (natural gas), two 195 MW steam units (coal, natural gas); three simple-cycle gas turbines, one 10.4 MW, 19.8 MW, 64.9 MW (natural gas, fuel oil); one 44 MW simple-cycle gas turbine (natural gas, diesel combination); one diesel startup engine, 430 hp	14,065

[a] Potential to emit (PTE); higher annual inventory value used in 20D calculations; see Section 5.4

Notes:

hp	=	Horsepower	km	=	Kilometer
MMBtu/hr	=	Million British thermal units per hour	MW	=	Megawatt
NO_x	=	Nitrogen oxides	tpy	=	Tons per year

Table 3-4. NO_x Emission Sources near Deming Monitor

Source	Distance (km)	Hours per Year	Equipment Type	NO_x Potential to Emit (tpy)
Border Foods Inc. – Canned Specialties	1.3	8760	Boilers, dehydrators, roasters	50-55
Luna Energy Facility	7.3	8760	Combined-cycle, gas turbine facility (2 GE 7FAs, 2 heat recovery steam generators (HRSGs) with duct burners, and 1 steam turbine generator) Became operational in April 2006	250
Turner Sand and Gravel Deming Pit	13.1	2000	Diesel generator (Deutz engine)	16
St Cloud Mining Company	16.5	8760	Diesel generator (1,000 kilowatts)	97
Intermountain Slurry	16.6	2080	Generator (Ingersoll Rand engine)	6
James Hamilton Construction	22.5	2640	650 ton per hour asphalt plant	42
Deming Compressor Station	25.7	8760	21 natural gas-fired internal combustion (IC) compressor engines, 1,100 hp each Deming facility has been operating in a backup capacity since 2004; station was abandoned December 22, 2011	331
Florida Compressor Station	28.7	8760	Natural gas-fired turbines (three 7,100 hp, one 1,000 hp, one 15,000 hp); one natural gas IC engine (215-585 hp) Florida facility has been operating since 2000	935
Southwest Concrete and Paving	33.2	4380	Quarrying, crushing, screening facility	95
Southwest Concrete and Paving	33.5	4380	Hot mix asphalt plant	95
Mountain States Constructors	39.7	4380	Crusher plant	95
ConocoPhillips San Juan	40.3	8760	Natural gas IC compressor engine, 384 hp	23

Notes:

hp	=	Horsepower
HRSG	=	Heat recovery steam generator
km	=	Kilometer
NO_x	=	Nitrogen oxides
tpy	=	Tons per year

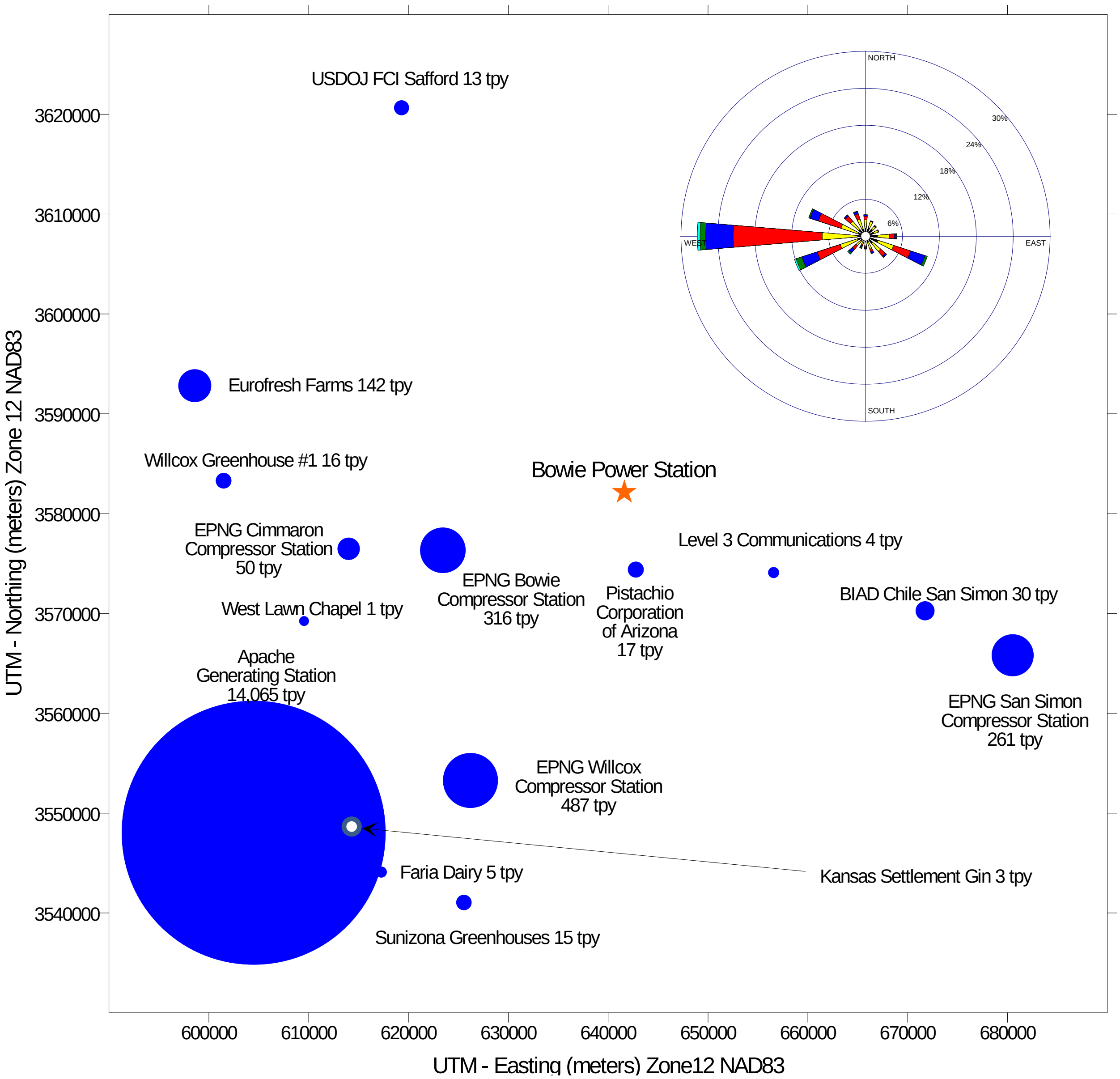


Figure 3-4. NO_x Sources within 50 Kilometers of Bowie Power Station

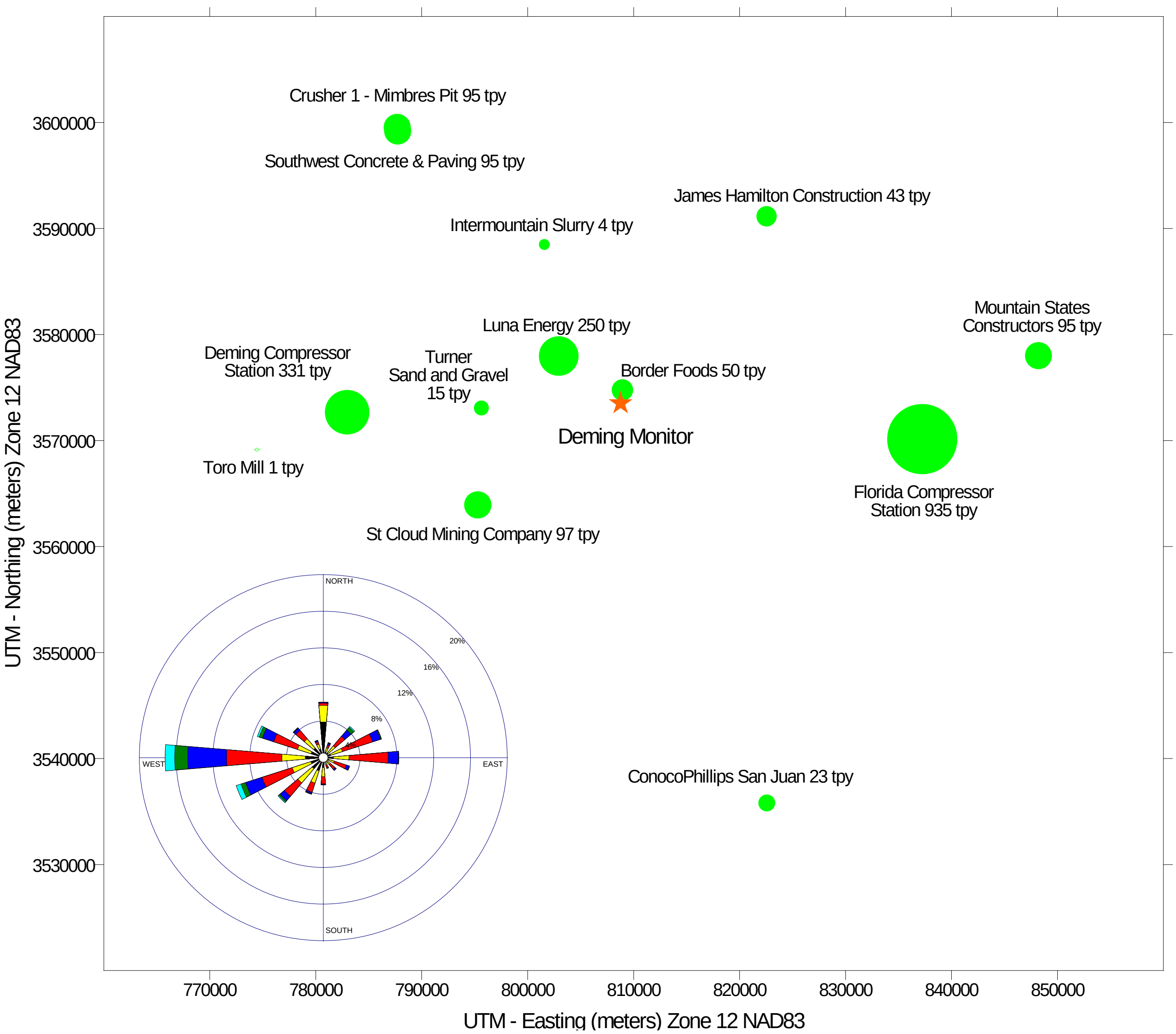


Figure 3-5. NO_x Sources within 50 Kilometers of Deming Monitor

3.2 Post-Construction Air Quality Monitoring

Post-construction monitoring is required at the discretion of the Director. No post-construction monitoring is proposed for the project at this time.

3.3 Meteorological Monitoring

Bowie Power Station, LLC began collecting meteorological data on the proposed plant site in late April 2001. A 12-month dataset has been approved by ADEQ for use with AERMOD (see Section 5.2.3 for more information) for modeling impacts within 50 km of the plant.

The on-site meteorological station was sited and the data were collected in accordance with *Meteorological Monitoring Guidance for Regulatory Modeling Applications* (EPA 2000). The following parameters were measured:

- Wind speed;
- Wind direction;
- Standard deviation of wind direction;
- Standard deviation of wind speed;
- Maximum 1-second wind speed;
- Air temperature;
- Relative humidity;
- Solar radiation;
- Barometric pressure; and
- Precipitation.

The major parameters needed for modeling were measured at a 10-meter (m) level. Data completeness for all parameters exceeded 99%.

The data have been reprocessed using the most recent version of the AERMOD Meteorological Preprocessor (AERMET; 12345) (see Section 5.2 for more information).

3.4 Background Concentrations

Background sources include all sources of air pollution other than those explicitly modeled (i.e., the proposed project, and those sources identified as "nearby" sources). Typically the impacts of non-nearby background sources are accounted for by using appropriate, monitored air quality data (i.e., a background concentration).

Title 40 of the Code of Federal Regulation (CFR), Part 50, Appendix W, Section 8.2 discusses requirements for background air quality concentrations that are "an essential part of the total air quality concentration to be considered in determining source impacts." Appendix W indicates, "Typically, air quality data should be used to establish background concentrations in the vicinity of the source(s) under consideration." For isolated single sources, such as the proposed Bowie Power Station, two options are presented: (1) Use air quality data collected in the vicinity of the source to determine the background concentrations for the averaging times of concern, or (2) If there are no monitors located in the vicinity of the source, a 'regional site' may be used to determine background. A 'regional site' is one that is located away from the area of interest but it impacted by similar natural and distant man-made sources."

For use in modeling compliance for 1-hour NO_2, EPA suggests using background NO_2 data that vary by season and hour of the day. The 98th percentiles of the daily maximum hourly NO_2 data from the

Deming monitor for 2010-2012 were averaged by season and hour of day for use in the modeling analysis. The proposed background concentrations, based on the representative monitors identified in Section 3.1, are shown in Tables 3-5 and 3-6.

Table 3-5. Background Concentrations

Pollutant	Averaging Period	Station Location/ID	Data Used	Background Value
PM_{10}	24-hour	Chiricahua NM	Average of maximum values 2009-2011	43 $\mu g/m^3$
	Annual		Average 2009-2011	8.3 $\mu g/m^3$
$PM_{2.5}$	24-hour	Chiricahua NM	Average of 2009-2011 98th percentile values	9.0 $\mu g/m^3$
	Annual		Average 2009-2011	3.5 $\mu g/m^3$
CO	1-hour	Pima County, 22nd and Craycroft	Maximum 2010-2012	2,414 $\mu g/m^3$
	8-hour		Maximum 2010-2012	1,264 $\mu g/m^3$
NO_2	1-hour	Deming, New Mexico SLAMS station	Average of 2010-2012 98th percentile values	Varies by season and hour of day. See Table 3-5
	Annual		Maximum 2010-2012	8.6 $\mu g/m^3$
SO2	1-hour	Pima County, 22nd and Craycroft	Average of 2008-2010 99th percentile values	22.6 $\mu g/m^3$
	3-hour		Maximum 2008-2010	37.7 $\mu g/m^3$
	24-hour		Maximum 2008-2010	10.5 $\mu g/m^3$
	Annual		Maximum 2008-2010	2.3 $\mu g/m^3$
Ozone	8-hour	Chiricahua NM	Average 2010-2012 4th high	73 ppb

Notes:

CO = Carbon monoxide
NM = National Monument
NO_2 = Nitrogen dioxide
PM_{10} = Particulate matter less than 10 micrometers
$PM_{2.5}$ = Particulate matter less than 2.5 micrometers
ppb = Parts per billion
$\mu g/m^3$ = Micrograms per cubic meter

Table 3-6. Background Concentrations for 1-Hour NO_2 Analysis

Hour of the Day	Winter (ppm)	Spring (ppm)	Summer (ppm)	Fall (ppm)
1	0.0190	0.0163	0.0130	0.0183
2	0.0177	0.0143	0.0133	0.0150
3	0.0180	0.0147	0.0130	0.0153
4	0.0173	0.0150	0.0130	0.0160
5	0.0177	0.0177	0.0140	0.0167
6	0.0167	0.0197	0.0140	0.0177
7	0.0177	0.0200	0.0130	0.0183
8	0.0183	0.0177	0.0097	0.0180
9	0.0183	0.0127	0.0067	0.0163
10	0.0163	0.0060	0.0040	0.0120
11	0.0120	0.0030	0.0033	0.0050
12	0.0063	0.0017	0.0030	0.0033
13	0.0043	0.0013	0.0027	0.0023
14	0.0033	0.0013	0.0023	0.0023
15	0.0030	0.0010	0.0023	0.0020
16	0.0027	0.0010	0.0027	0.0020
17	0.0040	0.0013	0.0023	0.0030
18	0.0093	0.0020	0.0027	0.0090
19	0.0183	0.0057	0.0040	0.0193
20	0.0253	0.0117	0.0077	0.0263
21	0.0247	0.0203	0.0147	0.0267
22	0.0247	0.0220	0.0157	0.0250
23	0.0233	0.0243	0.0173	0.0223
24	0.0200	0.0173	0.0190	0.0200

Notes:

NO_2 = Nitrogen dioxide

ppm = Parts per million

4.0 PROJECT EMISSION SOURCES

The major emissions sources associated with the Bowie Power Station and their approximate maximum annual emissions are summarized in Table 4-1.

Table 4-1. Expected Annual Criteria Pollutant Emissions[a]

Emission Unit Type	NO_x (tpy)	CO (tpy)	VOC (tpy)	SO_2 (tpy)	$PM_{10}/PM_{2.5}$ (tpy)
7FA.04 Turbines and Duct Burners (2 of Each)	131.2	137.2	23.8	30.1	67.1[b]
Auxiliary Boiler	0.4	0.4	<0.1	<0.1	<0.1
Emergency Fire Pump	<0.1	<0.1	<0.1	<0.1	<0.1
Evaporation Pond	--	--	Negligible	--	--
Cooling Tower	--	--	<1	--	4.3/2.0
Totals	**131.7**	**137.7**	**24.6**	**30.2**	**71.5/69.2**

[a] Based on preliminary data.
[b] $PM_{2.5}$ assumed = PM_{10}.
Notes:

CO	=	Carbon monoxide
NO_x	=	Nitrogen oxides
PM_{10}	=	Particulate matter less than 10 micrometers
$PM_{2.5}$	=	Particulate matter less than 2.5 micrometers
SO_2	=	Sulfur dioxide
tpy	=	Tons per year
VOC	=	Volatile organic compounds

Raw materials used to produce electricity are natural gas and water. The combustion turbines are equipped with dry low NO_x (DLN) combustors. SCR systems will be used to control NO_x and oxidation catalysts will be used to control CO, VOCs, and organic HAPs from the turbines and duct burners. The SCR systems will use industrial-grade aqueous ammonia.

The power generating unit will consist of two combustion turbines, two HRSGs equipped with duct firing (each 420 MMBtu/hr heat input), and one steam turbine electric generator. A process flow diagram illustrating the generating unit configuration is provided in Figure 4-1.

Each turbine will exhaust through a HRSG. Each HRSG will be equipped with a duct firing system. Steam from the two HRSGs will be directed to the steam turbine electric generator. Exhaust from each HRSG will exit through a stack.

Load and ambient temperature affect turbine and duct burner NO_x, CO, and VOC emissions. Annual turbine and duct burner emissions for these pollutants were calculated based on an average annual ambient temperature of 59°F. The turbine and duct burner annual emission calculations are based on a 95% capacity factor for the turbines, 4,224 hours of duct firing, 285 hours of startup, and 213.8 hours of shutdown for each turbine/duct burner pair.

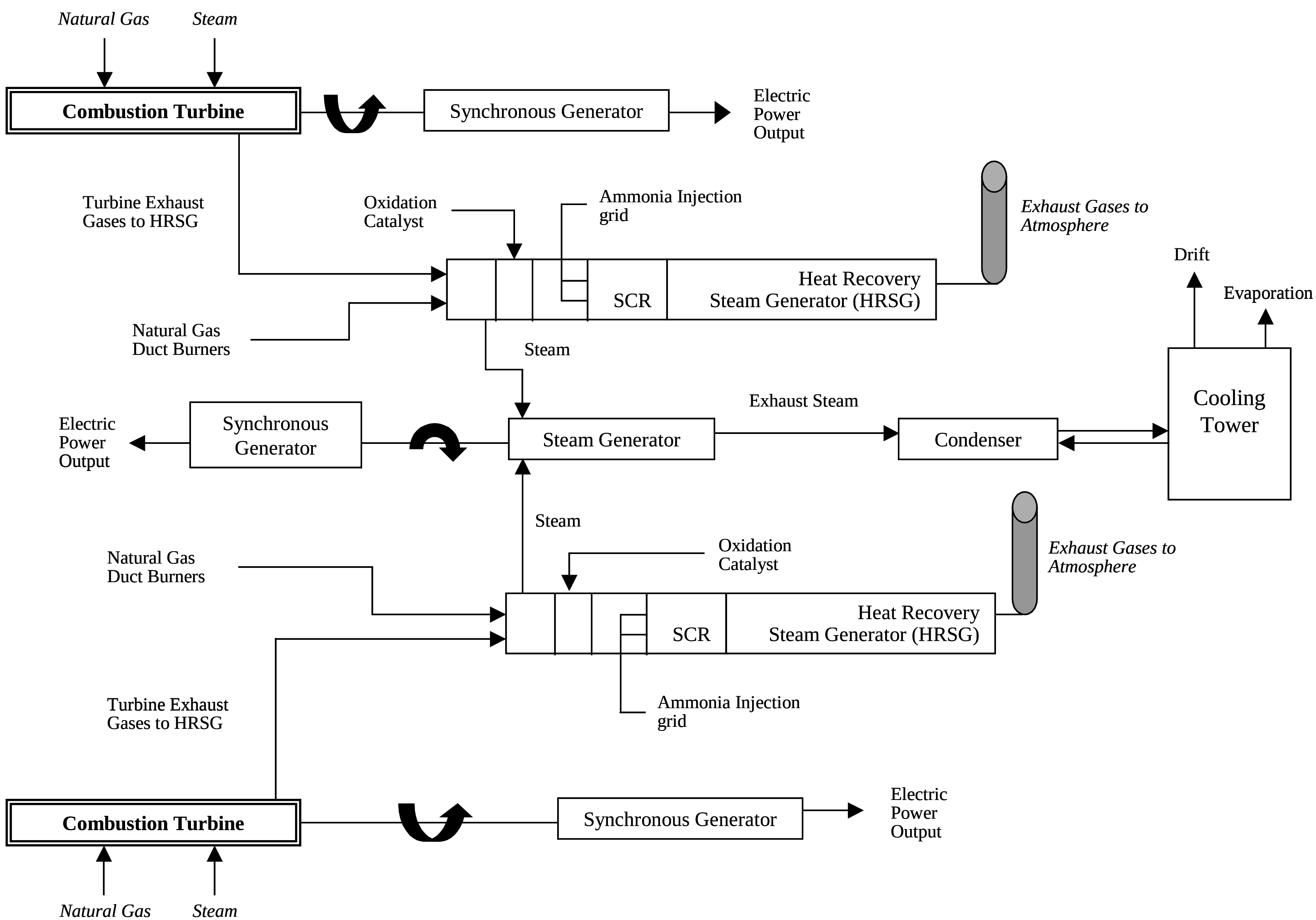


Figure 4-1. Process Flow Diagram

Turbine emissions profiles also vary during startup and shutdown. In general, NO_x, CO, and VOC emissions are higher during a startup or shutdown than during normal operations, while SO_2 and PM_{10} emissions are the same or lower. A cold or warm start will produce higher emissions of NO_x, CO, and VOC than a shutdown event. Startup (of both turbines) takes approximately one hour with the "fast start" configuration. Shutdown takes approximately three-quarters of an hour.

Annual emissions for the turbines include emissions from startups and shutdowns for each turbine.

Duct burner emissions do not vary with ambient temperature, nor do the duct burners operate at partial loads. The duct burners will burn natural gas.

Auxiliary fuel-burning equipment at the site will include a natural gas-fired auxiliary boiler (50 MMBtu/hr heat input) and a diesel-fired emergency fire pump (260 hp). The auxiliary boiler will be equipped with low NO_x burners to minimize NO_x emissions. The diesel fire pump will meet required emission limits based on the compression-ignition internal combustion engine New Source Performance Standard, 40 CFR 60, Subpart IIII.

The cooling tower will be a source of $PM_{10}/PM_{2.5}$ and VOC emissions. The evaporation pond will also be a negligible source of fugitive VOC emissions.

5.0 CLASS II AREA ANALYSES

5.1 Scope and Model Selection

Air quality impacts in the Class II areas surrounding the Bowie Power Station will be determined with the most recent version of the AMS/EPA Regulatory Model (AERMOD; 12345). Except for the treatment of NO_x to NO_2 conversion, AERMOD will be used with regulatory default options.

5.2 AERMOD Setup and Application

5.2.1 Receptors

A receptor grid, or network, defines the locations of predicted air concentrations that are used to assess compliance with the relevant standards or guidelines. All coordinates used in the modeling are referenced to North American Datum 1983 (NAD83). The network will use Cartesian (X, Y) receptors.

The following receptor network is proposed for this analysis:

- 25-m spaced receptors along the process area boundary;
- 100-m spaced receptors out to 1 km from the process area boundary;
- 250-m spaced receptors from beyond 1 km to 3 km from the process area boundary;
- 500-m spaced receptors from beyond 3 km to 10 km from the process area boundary;
- 1,000-m spaced receptors from beyond 10 km to 25 km from the process area boundary; and
- 2,500-m spaced receptors from beyond 25 km to 50 km from the process area boundary.

Figure 5-1 shows the process area boundary receptors and the close-in receptor grid. If any maximum impact exceeds 90% of an applicable limitation or significance level, where the Bowie Power Station contributes at least 3% of the total impact, a refined receptor grid will be defined around the maximum impact receptor with 25-m spacing, as described in Section 5.4.

5.2.1.1 Discrete Receptors

Maximum impacts associated with Indian reservations within 50 km of a project are typically determined. However, because the nearest Indian reservation is located approximately 75 km from the project site, no receptors will be needed in this category.

A map will be provided in the modeling report showing the location of nearby residences and businesses so that impacts at specific receptors may be estimated if necessary.

5.2.1.2 Nonattainment Area Boundary Receptors

There are no nonattainment areas within 50 km of the Bowie project location and therefore no special receptors to calculate nonattainment impacts will be required.

5.2.1.3 Receptor Elevations

Receptors will be modeled with terrain elevations interpolated from US Geological Survey (USGS) National Elevation Dataset (NED) data. The downloaded NED data has been processed in AERMAP (version 11103) and will be used for all receptors. The extent of the domain is sufficient to capture all necessary critical hill height information for AERMOD.

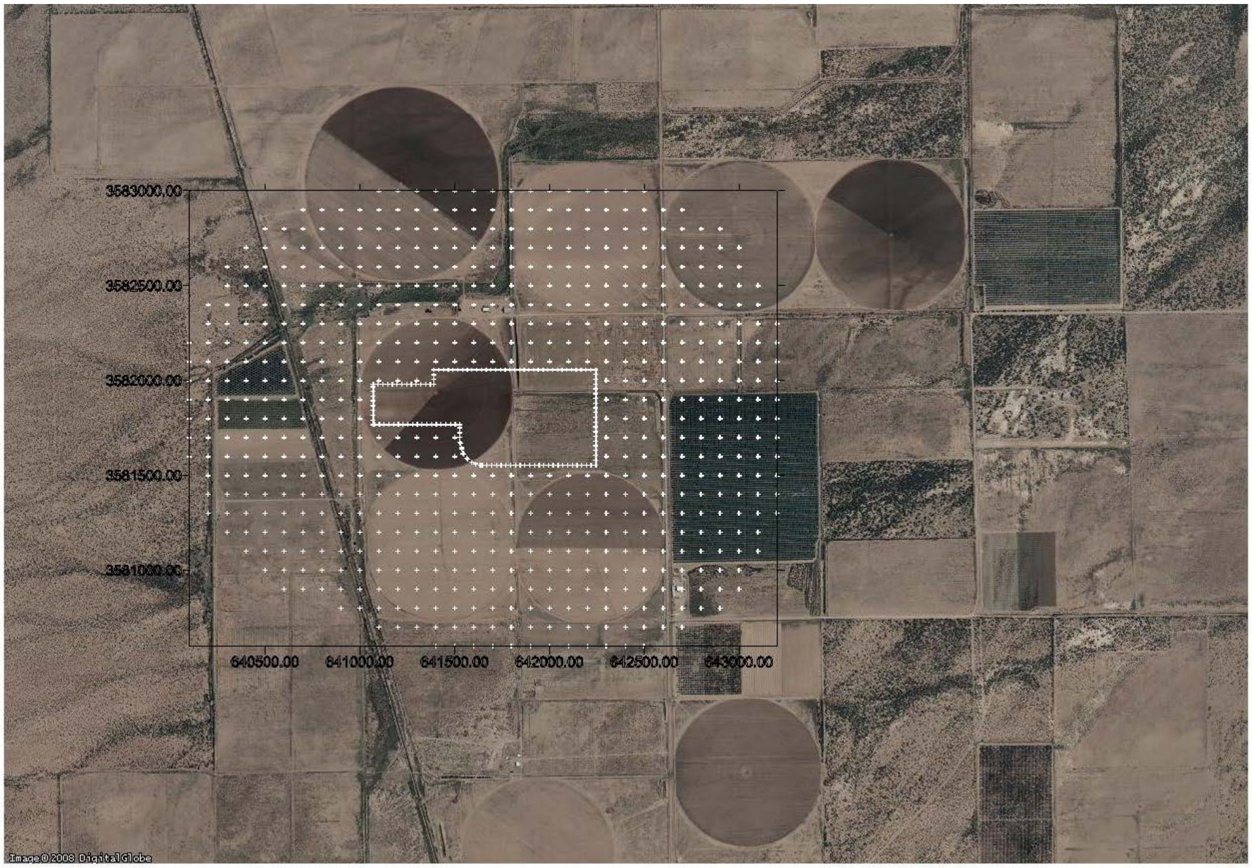


Figure 5-1. Process Boundary and Close-in Receptor Grid

5.2.2 Source Characteristics

This section describes how the project emission sources will be characterized for modeling.

5.2.2.1 Source Locations

The emission sources described in Section 4.0 are located within the process area boundary as shown in Figures 1-2 and 1-3. The locations of the major emission sources and structures are shown in Figure 5-2.

5.2.2.2 Turbine/Duct Burner Emission Scenarios

The pollutants that may be emitted by the proposed project are subject to standards or guidelines with differing averaging periods. Consequently, the emissions modeled will include expected annual operation of each emission source for prediction of annual average impacts and "worst-case" short-term emissions for prediction of short-term maximum concentrations.

The anticipated averaging periods and scenarios to be modeled are described below (note that these scenarios are based on preliminary emissions data and may change). Additional scenarios may be developed as necessary to address specific PSD-required additional impact analyses (discussed in Sections 6.0 and 7.0). Documentation regarding the selection of final modeled parameters will be provided as part of the application and modeling analysis report.

- For NO_x, annual average emissions will be modeled for comparison with ambient NO_2 standards, PSD increments, and SILs. Annual average emissions will also be used to address soil and vegetation impacts. Worst-case 1-hour NO_x emissions will be used to determine compliance with the 1-hour NAAQS. Emissions will be varied seasonally and matched to seasonal variations in stack parameters (see discussion below). In accordance with EPA's guidance on modeling intermittent sources (EPA 2011), the fire pump will not be included in the 1-hour NO_x modeling but will be included in 24-hour (visibility) and annual NO_x scenarios.
- For CO, maximum 1-hour emissions will be modeled for comparison with ambient standards and for soils and vegetation analyses, and will be paired with worst-case 1-hour and 8-hour stack parameters, determined through screening.
- For SO_2, annual average emissions will be modeled for comparison with ambient SO_2 standards and SILs. For comparison with 24-hour standards, multiple scenarios will be defined because there is a trade-off between emission levels and dispersion for various operational scenarios. These will include a scenario based on maximum normal operation emissions, paired with worst-case normal operations stack parameters determined through screening, and two scenarios that include startup emissions, with emissions for the rest of the 24-hour period based on either maximum normal operation emissions or minimum compliance load emissions, paired with weighted average 24-hour stack parameters for startup and normal operations.

  For comparison with the 1-hour and 3-hour SO_2 ambient standards, multiple scenarios will again be defined including a maximum normal operations emissions scenario, paired with corresponding stack parameters, and a second startup emissions scenario, paired with corresponding stack parameters. Stack parameters will be varied seasonally.

  In accordance with EPA's guidance on modeling intermittent sources (EPA 2011), the fire pump will not be included in the 1-hour SO_2 modeling but will be included in 3-hour, 24-hour, and annual SO_2 scenarios.

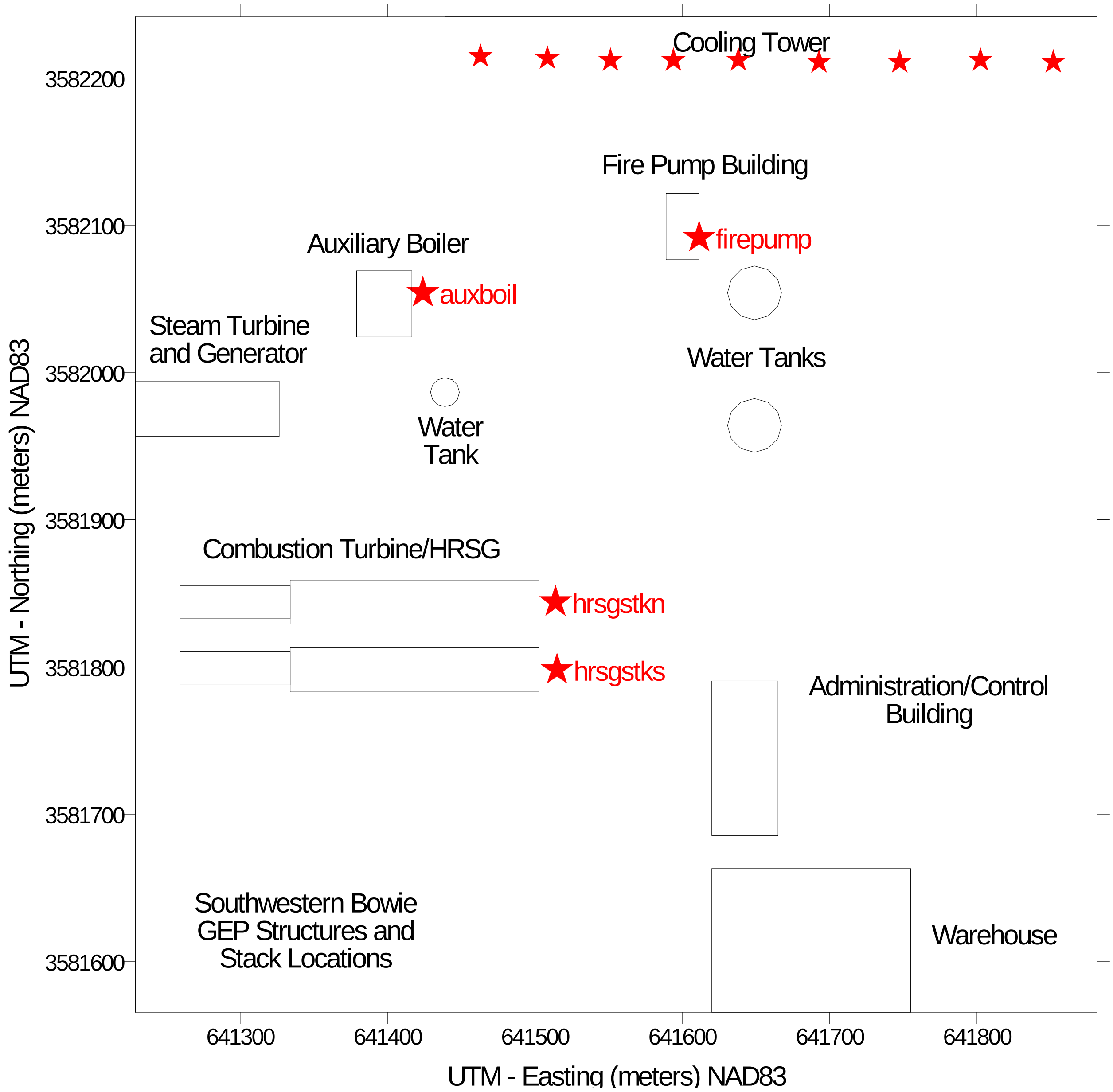


Figure 5-2. Location of Major Emission Points and Structures

- For PM_{10}, both 24-hour emissions and annual average emissions will be modeled for comparison with ambient standards, PSD increments, and SILs. Both 24-hour and annual emissions will also be used to evaluate impacts to soils and vegetation. $PM_{2.5}$ emissions are assumed to be the same as PM_{10} emissions for the turbines and duct burners; therefore, the PM_{10} 24-hour and annual turbine/duct burner emissions will also be used for comparison with $PM_{2.5}$ 24-hour and annual standards, PSD increments, and SILs. Cooling tower $PM_{2.5}$ emissions are calculated as outlined below.

  Several 24-hour turbine/duct burner emission scenarios will be defined for $PM_{10}/PM_{2.5}$ for modeling because there is a trade-off between emission levels and dispersion for various operational scenarios. These will include maximum normal operation emissions, paired with the corresponding stack parameters. Stack parameters will be varied seasonally (see below).

  A second scenario will include startup emissions, with emissions for the rest of the 24-hour period based on maximum normal operations, paired with weighted average 24-hour stack parameters for startup and normal operations. Stack parameters will be varied seasonally.

  A third scenario will include startup emissions, with emissions for the rest of the 24-hour period based on turbine-only emissions (no duct firing), paired with weighted average 24-hour stack parameters for startup and partial load stack parameters. Stack parameters will be varied seasonally.

5.2.2.3 Cooling Tower Emissions

Cooling tower emissions of PM_{10} and $PM_{2.5}$ will be calculated based on water flowrate, total dissolved solids (TDS) in the water, and the efficiency of the drift eliminators. Particle size distribution will be calculated using the method presented in "Calculating Realistic PM_{10} Emissions from Cooling Towers," Joel Reisman and Gordon Frisbie, *Environmental Progress*, Volume 21, Issue 2, pages 127-130, July 2002.

5.2.2.4 Turbine/Duct Burner Stack Parameters

For the combustion turbines, exit temperature and exit velocity will vary slightly with whether or not the duct burners are operating, during startup and shutdown, with load, and with ambient temperature (see Table 5-1). Screening analyses will determine the worst-case dispersion conditions that will lead to the highest impacts for a given emission rate and operating scenario. For short-term averaging periods, the exhaust parameters modeled may represent a "worst-case" profile of possible parameters; that is, the worst-case dispersion parameters will be paired with worst-case emissions to return maximum modeled concentrations. As necessary, more realistic combinations of emissions and stack parameters will be necessary to show compliance with SILs.

Stack parameters (and for NO_2, emissions) will be varied seasonally for the pollutants/averaging periods that are expected to be closest to the SILs. For 24-hour $PM_{10}/PM_{2.5}$ and 1-hour NO_2 and SO_2 modeling, 10˚F parameters/emissions will be used for months with average minimum temperatures below freezing (December and January), 102˚F parameters/emissions will be used for months with average maximum temperatures higher than 90˚F, and 59˚F parameters/emissions will be used for the remaining months.

For annual averaging periods, stack parameters will be based on an ambient temperature of 59˚F and a weighted average of temperatures and velocities based on the number of hours during the year for a given operating condition (i.e., turbine normal operation, duct firing, startup, and shutdown).

Table 5-1. Turbine/Duct Burner Stack Parameter Variation[a]

Load	Ambient Temperature (°F)	Duct Burners?	Temperature (K)	Exit Velocity (m/s)
100%	102	Yes	353.76	18.90
	59	Yes	352.87	19.81
	10	Yes	352.71	21.33
	102	No	362.76	19.20
	59	No	361.71	20.12
	10	No	361.71	21.64
80%	102	No	358.48	14.93
	59	No	357.87	16.46
	10	No	358.26	17.68
Minimum compliance load	102	No	358.21	13.72
	59	No	355.32	13.11
	10	No	356.09	15.24
Startup	10	No	321.54	11.86

[a] Based on preliminary data.
Notes:
K = Kelvin
m/s = Meters per second

For the turbines/duct burner exhaust points, modeling will initially be performed at a stack height of 54.86 m. If necessary, stack heights will be raised, up to good engineering stack height (65 m) as needed, and the project design will be amended accordingly.

5.2.2.5 Other Stack Parameters

The following will be modeled as point sources using expected physical stack heights, exit velocities, temperatures, and diameters:

- Auxiliary boiler;
- Cooling tower cells; and
- Fire pump.

All point sources are within good engineering stack height and will be modeled at their physical height. Stack parameters are shown in Table 5-2.

Table 5-2. Stack Parameters

Source	Stack Height (m)	Stack Diameter (m)	Temperature (K)	Velocity (m/s)
Turbine/Duct Burner	54.86 (up to 65 if necessary)	5.49	TBD	TBD
Auxiliary Boiler	13.7	0.76	422.04	15.24
Fire Pump	10.67	0.13	809.26	65.23
Cooling Tower[a]	14.00	10.00	294.26	8.59

[a] Each cell
Notes:
K = Kelvin
m = Meters
m/s = Meters per second
TBD = To be determined

5.2.3 Meteorological Data

One year of site-specific meteorological data (April 2001-April 2002) will be used to model Class II impacts in the vicinity of the Bowie Power Station project. The most recent version of the AERMOD Meteorological Preprocessor (AERMET; 12345) has been used to prepare the data for modeling.

5.2.3.1 On-Site Data

The raw data were edited to remove headers and were converted to the appropriate units for input to AERMET. The following parameters have been used from the on-site data set: wind speed, wind direction, standard deviation of wind direction, air temperature, relative humidity, barometric pressure, and precipitation. ADEQ has previously reviewed the on-site data collected and approved it for use in modeling impacts from the Bowie Power Station. Data completeness for all parameters used for modeling exceeds 99% for all quarters. Figure 5-3 shows the wind frequency distribution for the Bowie site.

5.2.3.2 Surface Data

Surface data from the Safford, Arizona, airport, located approximately 53 km north of the project site, have been obtained from the National Climatic Data Center (NCDC) and converted to CD144 format. Cloud cover data from Safford were used in the meteorological data processing rather than on-site solar radiation data. The Safford Municipal Airport Station is the closest station to Bowie that collects cloud cover data. Further, Safford and Bowie are in similar topographic settings, both being located within the San Simon Valley, and share similar climatology (see Table 5-3). Data capture for the Safford site for the period of record of the Bowie data set that will be used in modeling exceeds 98%.

5.2.3.3 Upper Air Data

The closest National Weather Service (NWS) station to the project site that routinely performs upper air soundings is the NWS station in Tucson. Tucson International Airport is located approximately 138 km to the west-southwest of the project site. Sounding data were downloaded from the NCDC Web site for 2001-2002 in FSL format.

5.2.3.4 Processing

Data were extracted from the upper air and surface files for the appropriate time period and read from the on-site data file, then merged in AERMET.

Surface characteristics were defined by sector and seasons based on aerial photographs and land use data around the project site. An aerial photograph of the site and surrounding area with the sectors marked is shown in Figure 5-4. Geo-registered land use and land cover files were obtained from the USGS and the 1992 National Land Cover Dataset (NLCD) data files were used as input to AERSURFACE along with the sector information. The site is surrounded by desert shrubland and cultivated fields. Sectors 1 and 2 (see Figure 5-4) are dominated by cultivated fields, while sectors 3 and 4 consist primarily of desert shrubland. The seasonal surface characteristics within the appropriate areas (1 km for surface roughness and 10 km for albedo and Bowen ratio) were determined in AERSURFACE and those geophysical values were input to the Stage 3 AERMET processing.

The geophysical parameters used in the AERMET processing are shown in Table 5-4. The geophysical parameters vary monthly.

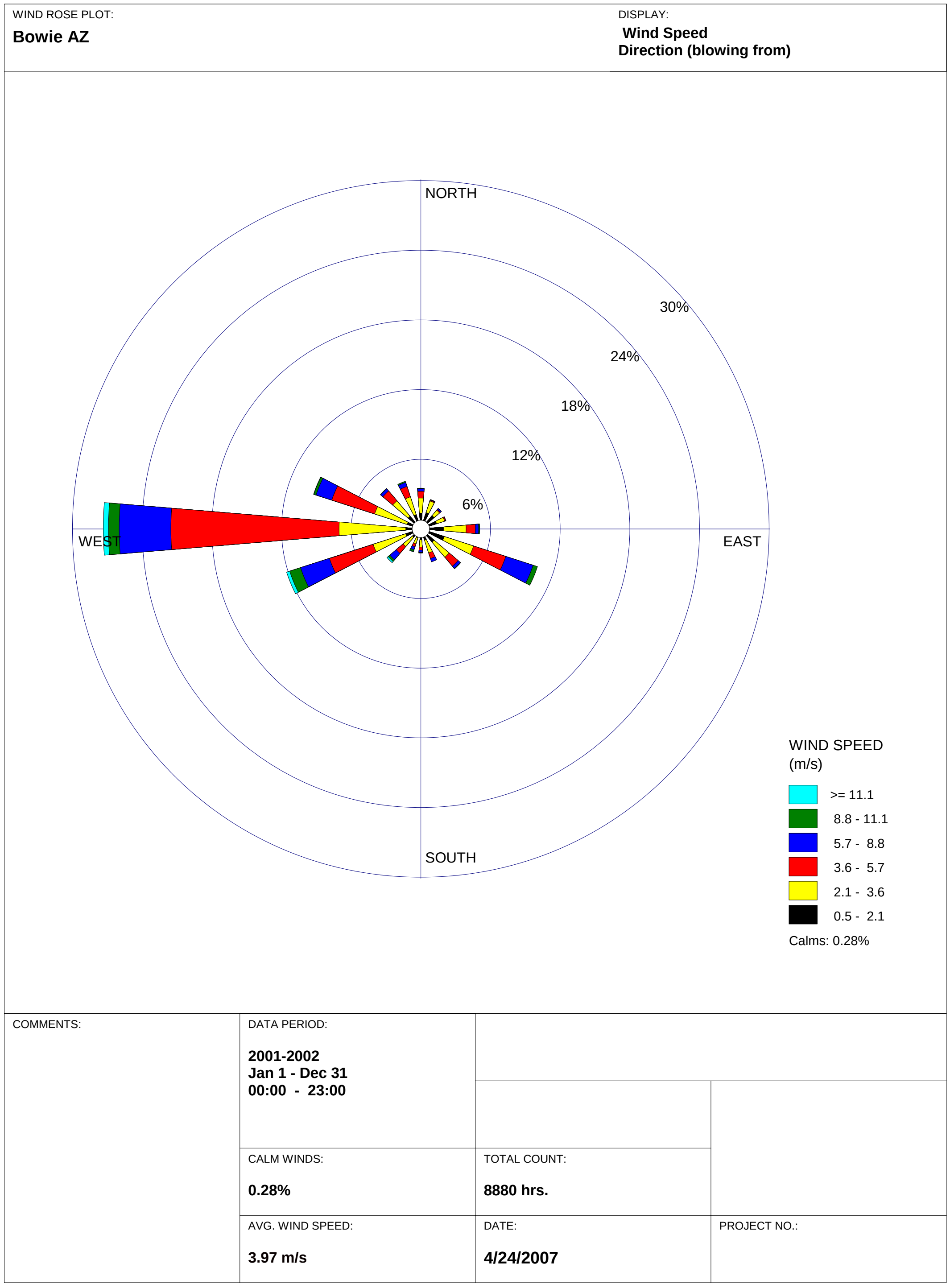


Figure 5-3. Bowie Wind Rose

Table 5-3. Comparison of Bowie and Safford Monthly Climate Summaries

BOWIE, ARIZONA (020958)
Period of Record : 1/1/1899 to 12/31/2005

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Maximum Temperature (F)	61.1	65.7	71.9	80.2	89.1	98.3	98.2	95.5	91.7	82.1	69.2	60.3	80.3
Average Minimum Temperature (F)	30.8	34.3	38.7	44.6	52.7	61.9	67.4	65.7	59.4	48.2	36.7	31.1	47.6
Average Total Precipitation (inches)	0.82	0.79	0.61	0.27	0.23	0.36	2.05	2.09	1.05	0.87	0.62	0.94	10.68
Average Total Snowfall (inches)	0.6	0.3	0.2	0	0	0	0	0	0	0	0.2	0.4	1.8
Average Snow Depth (inches)	0	0	0	0	0	0	0	0	0	0	0	0	0

SAFFORD, ARIZONA (027388)
Period of Record : 8/1/1898 to 6/30/1973

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Maximum Temperature (F)	61.1	65.9	71.7	80.7	89.4	98.3	99.5	96.5	93.1	83	70.2	61.1	80.9
Average Minimum Temperature (F)	28.9	32.2	37	43.3	51.1	60.1	68.9	67.2	60.1	47.3	35.6	29.2	46.7
Average Total Precipitation (inches)	0.58	0.59	0.65	0.23	0.09	0.23	1.9	1.57	1.03	0.72	0.54	0.78	8.91
Average Total Snowfall (inches)	0.6	0.2	0.3	0	0	0	0	0	0	0	0	0.7	1.8
Average Snow Depth (inches)	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Western Regional Climate Center (www.wrcc.dri.edu/)

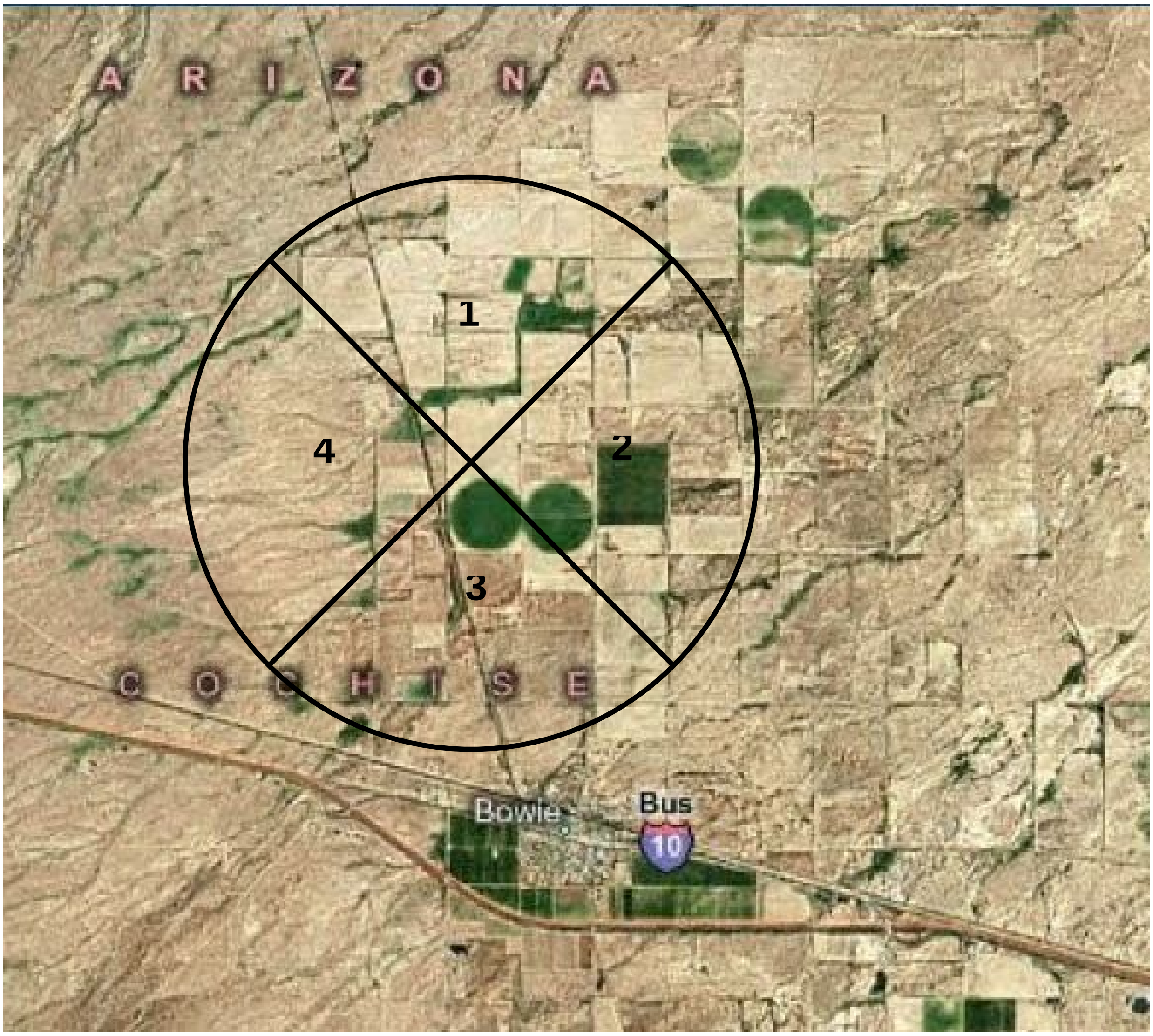


Figure 5-4. Aerial of Sectors and Land Use near Bowie Project Site

Table 5-4. Albedo, Bowen Ratio, and Roughness Values

Sector Definitions		
Sector Number	**From (degrees)**	**To (degrees)**
1	45	135
2	135	225
3	225	315
4	315	45

Monthly Surface Parameters by Sector				
Month	**Sector**	**Albedo**	**Bowen Ratio**	**Roughness**
1	1	0.22	2.42	0.021
1	2	0.22	2.42	0.02
1	3	0.22	2.42	0.02
1	4	0.22	2.42	0.021
2	1	0.22	2.42	0.021
2	2	0.22	2.42	0.02
2	3	0.22	2.42	0.02
2	4	0.22	2.42	0.021
3	1	0.2	1.14	0.032
3	2	0.2	1.14	0.03
3	3	0.2	1.14	0.03
3	4	0.2	1.14	0.032
4	1	0.2	1.14	0.032
4	2	0.2	1.14	0.03
4	3	0.2	1.14	0.03
4	4	0.2	1.14	0.032
5	1	0.2	1.14	0.032
5	2	0.2	1.14	0.03
5	3	0.2	1.14	0.03
5	4	0.2	1.14	0.032
6	1	0.23	1.67	0.173
6	2	0.23	1.67	0.189
6	3	0.23	1.67	0.186
6	4	0.23	1.67	0.192
7	1	0.23	1.67	0.173
7	2	0.23	1.67	0.189
7	3	0.23	1.67	0.186
7	4	0.23	1.67	0.192
8	1	0.23	1.67	0.173
8	2	0.23	1.67	0.189
8	3	0.23	1.67	0.186
8	4	0.23	1.67	0.192
9	1	0.23	2.42	0.173
9	2	0.23	2.42	0.189
9	3	0.23	2.42	0.186
9	4	0.23	2.42	0.192
10	1	0.23	2.42	0.173
10	2	0.23	2.42	0.189
10	3	0.23	2.42	0.186
10	4	0.23	2.42	0.192

Table 5-4. Continued

Month	Sector	Albedo	Bowen Ratio	Roughness
11	1	0.23	2.42	0.173
11	2	0.23	2.42	0.189
11	3	0.23	2.42	0.186
11	4	0.23	2.42	0.192
12	1	0.22	2.42	0.021
12	2	0.22	2.42	0.02
12	3	0.22	2.42	0.02
12	4	0.22	2.42	0.021

5.3 Building Wake Downwash

Downwash parameters for the Bowie Power Station structures have been determined with the EPA Building Profile Input Program (BPIP)-PRIME. Each structure corner coordinate and elevation was used as input to the program and wind direction-specific building parameters have been output in a format used by AERMOD. As shown in Figures 1-2 and 1-3, there are many structures that will be located at the site. Only those with the likelihood to influence emission sources (i.e., within 5L in accordance with the Good Engineering Practice (GEP) regulations in 40 CFR 51.100) have been included in the analysis.

5.4 AERMOD Impact Analysis

The dispersion modeling analysis required for major sources subject to PSD review typically involves two phases. The objective of the first phase is to perform a conservative, screening-level analysis (preliminary analysis) of the impacts of the proposed project alone, to determine whether the predicted impacts are expected to be significant. If no significant impacts are predicted for a particular pollutant, no further analysis is required for that pollutant.

If significant ambient impacts are predicted, then a full impact analysis must be completed for that pollutant. This requires conducting a NAAQS/AAAQS analysis for the pollutant, in which other emission sources in the area are modeled, and conducting a PSD increment analysis for the pollutant that incorporates emissions from other increment-affecting sources in the area. Procedures for performing preliminary and full analyses are outlined in ADEQ's modeling guidance (ADEQ 2004).

Table 5-5 summarizes the air quality standards and thresholds to which the project is subject.

VOC emissions will not be modeled for this project because project emissions will not be significant for VOC and also because VOC is a reactive pollutant that is regulated only as a precursor to ozone. VOCs are considered regional pollutants and VOC emissions and impacts are most appropriately evaluated on a regional basis, rather than by modeling emissions from a single facility.

5.4.1 Preliminary Analysis: General Methods

A screening analysis will be conducted for all pollutants and averaging periods. The highest predicted impact at any point on the receptor grid will be used for comparison with the modeling SILs identified in Table 5-5. Any receptor with an impact that exceeds 90% of a SIL will be modeled with a refined receptor grid (25-m spacing) centered on the receptor.

Table 5-5. Air Quality Significance Levels, Standards, and Increments

Averaging Period/ Pollutant	Class II Modeling Significant Impact Level (μg/m^3)	Class II PSD Increment (μg/m^3)	Class I Modeling Significant Impact Level (μg/m^3)	Class I PSD Increment (μg/m^3)	Limiting National or Arizona Ambient Air Quality Standard (μg/m^3)
1-hour NO_2	7.5	NA	NA	NA	188.7[a] (100 ppb)
Annual NO_2	1	25	0.1	2.5	100
1-hour SO_2	8	NA	NA	NA	196.4[b] (75 ppb)
3-hour SO_2	25	512[c]	1.0	25[c]	1,300[c]
24-hour SO_2	5	91[c]	0.2	5[c]	365[c,d]
Annual SO_2	1	20	0.1	2	80[d]
24-hour PM_{10}	5	30[e]	0.3	8[e]	150[e]
Annual PM_{10}	1	17	0.2	4	50[f]
24-hour $PM_{2.5}$	1.2	9[c,]	0.07	2[c,]	35[g]
Annual $PM_{2.5}$	0.3	4	0.06	1	12[h]
1-hour CO	2,000	NA	NA	NA	40,000[c]
8-hour CO	500	NA	NA	NA	10,000[c]

Note: Lead and ozone standards not shown. Project will not emit significant amounts of lead; ozone is more appropriately modeled in regional analyses.

[a] The 3-year average of the 98th percentile of the annual distribution of daily maximum 1-hour average concentrations must not exceed the standard.

[b] The 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average concentrations must not exceed the standard.

[c] Not to be exceeded more than once per year.

[d] National standard will be revoked following a transition period.

[e] Not to be exceeded more than once per year on average over three years.

[f] National standard revoked effective December 17, 2006; annual AAAQS is still listed at R18-2-201(A)(1)(a).

[g] The 3-year average of the 98th percentile of 24-hour concentrations must not exceed the standard.

[h] Revised standard promulgated December 14, 2012. The 3-year average of the weighted annual mean must not exceed the standard.

Notes:

μg/m^3	=	Micrograms per cubic meter
CO	=	Carbon monoxide
NA	=	Not applicable
NO_2	=	Nitrogen dioxide
PM_{10}	=	Particulate matter less than 10 micrometers
$PM_{2.5}$	=	Particulate matter less than 2.5 micrometers
ppb	=	Parts per billion
PSD	=	Prevention of Significant Deterioration
SO_2	=	Sulfur dioxide

The Plume Volume Molar Ratio Method (PVMRM) option in AERMOD will be used to account for the after stack conversion of emitted NO_x to downwind NO_2. This option requires an hourly ozone data file. Hourly ozone data from the Chiricahua NM monitoring station matching the Bowie meteorological data set time period will be used. The hourly ozone data obtained included periods of missing data. Nearly all these periods were of short duration lasting a couple of hours and were associated with late night calibration procedures. For these short periods, the missing values were filled by interpolation between the preceding and following hour valid data. There were two extended periods of missing data including May 12 - May 15, 2001 and January 1 - January 8, 2002. During these periods, valid preceding hourly data were inserted on a daily basis. That is, the missing hourly values were filled using valid daily values from the preceding 24-hour period for the matching hour (i.e., valid data from hour 9 was inserted for the missing hour 9 value, etc.). This 24-hour block of data was repeated until valid data were again available.

The use of PVMRM also requires use of an in-stack ratio for each source. The California Air Pollution Control Officers Association (CAPCOA) has produced a guidance document titled "Modeling Compliance of the Federal 1-Hour NO_2 NAAQS" (CAPCOA 2011) that includes recommended in-stack ratios in Appendix C. The following recommended in-stack NO_2/NO_x ratios will be used for the Bowie sources:

- The natural gas boiler default factor of 0.1 will be used for the auxiliary boiler;
- The diesel internal combustion engine default factor of 0.2 will be used for the fire pump; and
- The GE natural gas turbine recommended ratio of 0.091 will be used for the turbines/HRSGs.

In accordance with EPA's guidance on modeling intermittent sources (EPA 2011), the fire pump will not be included in the 1-hour SO_2 or NO_2 modeling but will be included in modeling all other pollutants and averaging periods.

5.4.2 Preliminary Analysis: $PM_{2.5}$

Due to the potentially large contributions of secondary $PM_{2.5}$ to total ambient $PM_{2.5}$ concentrations, EPA has provided draft guidance that includes analyses of both primary and secondary $PM_{2.5}$ from proposed new major sources, such as the Bowie Power Station (EPA 2013). AERMOD will be used to analyze primary $PM_{2.5}$ emissions, while potential secondary $PM_{2.5}$ from emissions of precursors (NO_x, SO_2) from the project will be assessed in a qualitative or semi-quantitative fashion. If necessary, a supplemental modeling protocol will be developed in consultation with ADEQ addressing the secondary $PM_{2.5}$ analysis after the primary $PM_{2.5}$ analyses are complete. The level and depth of the secondary $PM_{2.5}$ analysis performed will depend to some extent on the results of the primary $PM_{2.5}$ analysis; that is, how close the Bowie Power Station direct $PM_{2.5}$ impacts are to the NAAQS/AAAQS.

In determining whether a full analysis is needed for $PM_{2.5}$, EPA's draft guidance suggests that the applicable SIL value from the vacated sections (*Sierra Club v. EPA*, No. 10-1413) of 40 CFR 50.166(k)(2) and 52.21(k)(2) should only be used if the difference between the $PM_{2.5}$ NAAQS and the measured $PM_{2.5}$ background concentrations are greater than the SIL:

- Annual $PM_{2.5}$ NAAQS: 12 µg/m^3; SIL 0.3 µg/m^3. Measured background (2009-2011 average at Chiricahua NM) is 3.5 µg/m^3. Therefore, the difference is larger than the SIL and the numeric value of the SIL may be appropriate for use in determining whether a source may forego cumulative modeling.
- 24-Hour $PM_{2.5}$ NAAQS: 35 µg/m^3; SIL 1.2 µg/m^3. Measured background (2009-2011 98th percentile average at Chiricahua NM) is 9.0 µg/m^3. Therefore, the difference is

larger than the SIL and the numeric value of the SIL may be appropriate for use in determining whether a source may forego cumulative modeling.

As discussed in Section 3.1.2, $PM_{2.5}$ monitoring data from the Chiricahua NM is expected to be representative of the contribution of existing sources to $PM_{2.5}$ concentrations in the Bowie Power Station impact area. Speciated $PM_{2.5}$ data from the Chiricahua NM IMPROVE monitoring system (see Figure 5-5) show that the major components of $PM_{2.5}$ (excluding periodic contributions from wildfires) are ammonium sulfate (37%), soil (33%), and organic matter (25%). Ammonium nitrate provides 6% of total $PM_{2.5}$ at this location.

Ammonium sulfate is produced through chemical reactions of SO_2 (IMPROVE 2011). Source apportionment data from the Western Regional Air Partnership (WRAP) Technical Support System (TSS), developed through regional CAMx modeling to identify the sources and regions contributing to regional haze in the WRAP region, indicate that less than 10% of sulfate at Chiricahua NM on an annual basis is from Arizona sources, in spite of the fact that Chiricahua NM is located less than 50 km from a large source of SO_2 emissions (Apache Generating Station; 13,500 tons per year [tpy] SO_2 emissions). It is unlikely that a relatively small source of SO_2 emissions such as the Bowie Power Station (approximately 30 tpy) would appreciably increase $PM_{2.5}$ from ammonium sulfate in the project area.

Ammonium nitrate forms from the reversible reaction of gas-phase ammonia and nitric acid. The majority of ammonia sources are related to agricultural activities. Essentially all particle nitrate is derived from atmospheric oxidation of NO_x. The major anthropogenic source of NO_x is fossil fuel combustion. (NARSTO 2004). TSS source apportionment modeling shows that approximately 29% of nitrate at Chiricahua NM is derived from the Arizona source region. But nitrate is a relatively minor component of total $PM_{2.5}$ at Chiricahua NM, contributing only 6% of $PM_{2.5}$, and, as with SO_2, the monitoring location is located less than 50 km from a large source of NO_x emissions (Apache Generating Station, 14,000 tpy NO_x). Again, it appears that an additional 132 tpy NO_x from the Bowie Power Station would be unlikely to appreciably increase $PM_{2.5}$ from ammonium nitrate in the project area.

This preliminary assessment of secondary $PM_{2.5}$ formation from the proposed project will be expanded when the modeling of direct $PM_{2.5}$ emissions is complete. At that point, issues of seasonality may be compared with the patterns evident in the Chiricahua data, distance to impacts may be assessed, and a more complete picture of regional emissions may be available. The CALPUFF model, described in Section 6.1, may be used to provide estimates of sulfate and nitrate concentrations over the receptor grid due to the Bowie Power Station as part of this analysis. In addition, the relative distribution of the components of $PM_{2.5}$, seasonality, and the meteorological conditions favoring maximum concentrations on a 24-hour basis may also be analyzed for the Chiricahua NM data. ADEQ will be consulted regarding the results of the primary and secondary $PM_{2.5}$ analyses to determine whether a full impact analysis is needed for $PM_{2.5}$.

5.4.3 Full Impact Analyses

A full impact analysis will be performed for any pollutant and averaging period for which the preliminary analysis predicts a significant impact. Sources will be examined that are within approximately 50 km + the Bowie project's significant impact area. The significant impact area is the farthest point at which a predicted project impact is above an applicable SIL. A full impact analysis is expected to be required for the 1-hour NO_2 NAAQS and possibly for other pollutants and averaging periods.

Appendix W suggests that nearby and other sources that should be included in the modeled inventory for a full analysis are those that establish "a significant concentration gradient in the vicinity of the source." Appendix W also suggests that the number of such sources is expected to be small."

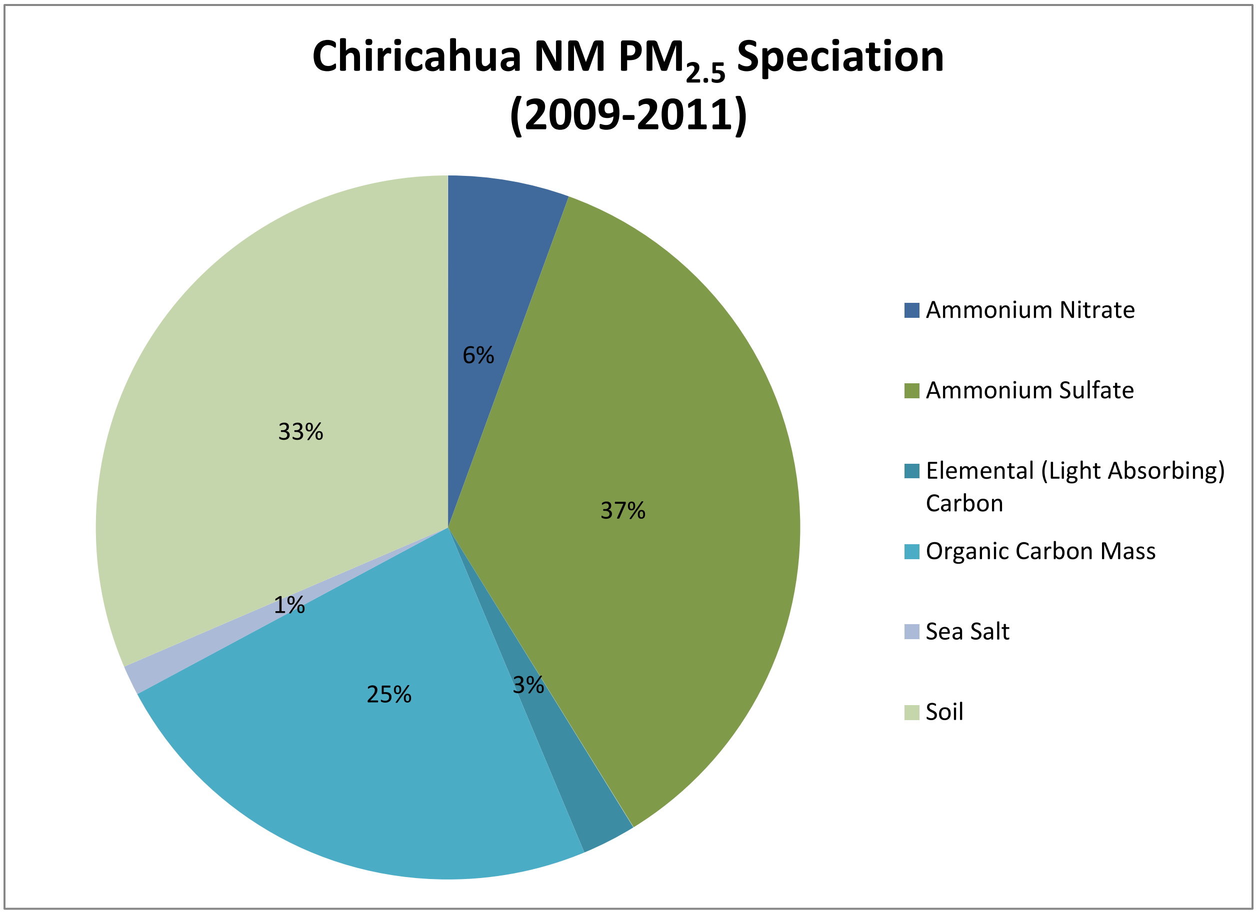


Figure 5-5. $PM_{2.5}$ Speciation at Chiricahua National Monument

EPA's March 1, 2011 guidance document, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 National Ambient Air Quality Standard* (EPA 2011) further discusses the concept of "significant concentration gradient" and notes that "... the emphasis on determining which nearby sources to include in the modeling analysis should focus on the area within about 10 kilometers of the project location in most cases." The guidance suggests tools to inform a case-specific exercise of professional judgment to determine which sources should be explicitly modeled in a full impact assessment. These include isopleth plots of project impacts, examination of impact patterns with respect to terrain, identification of the controlling meteorological conditions for project impacts, examination of the location of nearby sources and the background monitoring station relative to the project impact plots, wind roses, pollution roses, etc. The guidance goes on to state, " Many of the challenges ... related to cumulative assessments arise in the context of how best to combine a monitored and modeled contribution to account for background concentrations ... [to avoid] the potential for double counting of impacts from modeled sources that may be contributing to the monitored concentrations."

ADEQ's modeling guidance (ADEQ 2004) suggests that an analysis of emissions vs. distance is appropriate for screening out regional sources that are unlikely to have a significant impact in the project vicinity. The guidance describes the "20D" approach to determine whether to include a regional source in the analysis. The "20D" approach assumes a linear inverse proportional relationship between source emissions and impacts with distance. A "20D" facility-level screening approach is used to eliminate a majority of regional facilities from the NAAQS/AAAQS modeling analysis that would not be expected to have a significant impact on analysis results. Under this approach, the applicant may exclude sources that have potential allowable emissions (Q) in tons per year that are less than 20 times the distance ("20D") between the two sources in kilometers. Those sources that are not eliminated using the "20D" approach should be modeled in the full NAAQS/AAAQS analysis.

The "20D" analysis method was originally developed by the State of North Carolina using Gaussian Plume principles and has been adopted by several other state agencies, in addition to ADEQ. The screening-level modeling that resulted in the "20D" concept was based on an effective stack height of 10 m, D (neutral) stability, a 2.5 m/s wind speed, and a mixing height of 300 m. The State of North Caroline states that the method is conservative because of the restrictive source characteristics chosen and, consequently, actual modeled concentrations will most likely be lower than the "20D" method would indicate.

Once the preliminary analysis is complete and the potential scope of the full analysis has been determined, ADEQ will be consulted to determine which nearby sources to model in conjunction with the Bowie Power Station sources for the full impact analyses. It is expected that any sources within 10 km of Bowie would be modeled. Other tools, including but not limited to a "20D" analysis, will be used to determine whether or not to include additional sources beyond 10 km.

5.4.4 Full Impact Analysis Methods

Any cumulative assessment of the project's compliance with NAAQS/AAAQS will use the model, receptor grid, options, and meteorological data as outlined in this protocol for the Bowie Power Station preliminary analysis. Receptors modeled may be limited to those that show a significant impact from the Bowie Power Station. A cumulative (full) analysis is expected to be required for the 1-hour NO_2 NAAQS and may be required for other pollutants and averaging periods. Methods specific to each pollutant/averaging period that may be modeled are discussed below.

5.4.4.1 1-Hour NO_2 NAAQS

The AERMOD model has incorporated options to allow modeling compliance with the 1-hour NO_2 standard. Specifying "NO2" as the pollutant to be modeled invokes these options. The 98th percentile (high, 8th high) of the daily maximum 1-hour values from the Bowie project plus other nearby sources will be modeled. Background NO_2 concentrations that vary by season and hour of the day (see Table 3-5) will be added to the combined impact within the model. The total maximum 98th percentile (high, 8th high) of the daily maximum concentrations, including background, will be compared with the 1-hour NO_2 standard. Any receptor with a combined impact that exceeds 90% of the 1-hour NAAQS where Bowie's contribution is greater than 3% of the total impact will be modeled with a refined receptor grid (25-m spacing) centered on the receptor and the resulting maximum combined impact will be compared to the NAAQS (Bowie's contribution will be determined using the "MAXDCONT" option in AERMOD).

If the comparison indicates a possible exceedance of the 1-hour NO_2 NAAQS, Bowie's contribution to any combined impact that exceeds the NAAQS (including any exceeding impacts at a given receptor that are less than the 98th percentile concentration) will be determined. If the Bowie sources contribute less than the SIL (7.5 $\mu g/m^3$) to potential exceedances, the Bowie sources will be considered to not cause or contribute to any violation.

5.4.4.2 1-Hour SO_2 NAAQS

Compliance with the 1-hour SO_2 NAAQS is modeled much like 1-hour NO_2, except that the 99th percentile (4th high) of the daily maximum 1-hour values is used rather than the 98th percentile (8th high) concentration for comparison with the standard. If an exceedance of the standard would result, the SO_2 background data will be examined in greater detail and variations by season and hour of day will be calculated and added to maximum cumulative impacts for comparison with the standard (EPA 2011). Any receptor with a combined impact that exceeds 90% of the 1-hour NAAQS where Bowie's contribution is greater than 3% of the total impact will be modeled with a refined receptor grid (25-m spacing) centered on the receptor and the resulting maximum combined impact will be compared to the NAAQS (Bowie's contribution will be determined using the "MAXDCONT" option in AERMOD).

If the comparison indicates a possible exceedance of the 1-hour SO_2 NAAQS, Bowie's contribution to any combined impact that exceeds the NAAQS (including any exceeding impacts at a given receptor that are less than the 99th percentile concentration) will be determined. If the Bowie sources contribute less than the SIL (8 $\mu g/m^3$) to potential exceedances, the Bowie sources will be considered to not cause or contribute to any violation.

5.4.4.3 $PM_{2.5}$ NAAQS/AAAQS

As discussed in Section 5.4.2, EPA has provided draft guidance that includes analyses of both primary and secondary $PM_{2.5}$ from proposed new major sources, such as the Bowie Power Station (EPA 2013). AERMOD will be used to analyze primary $PM_{2.5}$ emissions, while potential secondary $PM_{2.5}$ from emissions of precursors (NO_x, SO_2) from the project will be assessed in a qualitative fashion.

With respect to the AERMOD analysis of primary $PM_{2.5}$ emissions, the 98th percentile (high, 8th high) 24-hour $PM_{2.5}$ impact from direct emissions from the Bowie Power Station and other nearby sources included in the analysis will be modeled and added to the 3-year average 98th percentile background concentration shown in Table 3-4. If an exceedance of the standard would result, the $PM_{2.5}$ background data will be examined in greater detail and variations by season will be calculated and added to cumulative impacts for comparison with the standard (EPA 2013). Any receptor with a combined impact that exceeds 90% of the 24-hour NAAQS/AAAQS where Bowie's contribution is greater than 3% of the total impact will be modeled with a refined receptor grid (25-m spacing) centered on the receptor. The resulting maximum combined impact will be compared to the NAAQS/AAAQS.

Similarly, the annual average $PM_{2.5}$ concentration from direct emissions from the Bowie Power Station and other nearby sources included in the analysis will be modeled and the annual average impact will be added to the 3-year average background concentration shown in Table 3-4. Any receptor with a combined impact that exceeds 90% of the annual NAAQS/AAAQS where Bowie's contribution is greater than 3% of the total impact will be modeled with a refined receptor grid (25-m spacing) centered on the receptor. The resulting maximum combined impact will be compared to the NAAQS/AAAQS.

If either comparison indicates a possible exceedance of the $PM_{2.5}$ NAAQS/AAAQS, Bowie's contribution to any combined impact that exceeds the NAAQS/AAAQS will be determined.

The results of the analysis of primary $PM_{2.5}$ emissions will be considered along with an analysis of the likely impact of secondary $PM_{2.5}$. As discussed previously, the Chiricahua $PM_{2.5}$ data are generally representative of the contribution of existing sources to $PM_{2.5}$ concentrations in the project area. Additional conservatism will result from explicitly modeling certain nearby sources in the AERMOD analysis of primary $PM_{2.5}$. Because the secondary $PM_{2.5}$ analysis will be largely or wholly qualitative, a weight of evidence approach will be used to determine whether or not the impact of the Bowie Power Station and other nearby and background sources would potentially exceed the $PM_{2.5}$ NAAQS/AAAQS.

5.4.4.4 Other NAAQS/AAAQS Analyses

Any other required NAAQS/AAAQS analysis will be modeled using the model, receptor grid, options, and meteorological data as outlined in this protocol. The proposed project sources will be modeled, along with any other sources in the NAAQS/AAAQS inventory, which will be determined in consultation with ADEQ. Maximum combined annual concentrations plus background will be used to determine compliance with annual NAAQS/AAAQS for NO_2, SO_2, and PM_{10}. Maximum combined high, second high concentrations plus background will be used to determine compliance with the short-term NAAQS/AAAQS for CO, SO_2 (excluding 1-hour standard), and PM_{10}. Any impact plus background exceeding 90% of the applicable NAAQS/AAAQS where Bowie's contribution exceeds 3% of the total impact will be modeled with a refined receptor grid with 25-m spacing.

5.4.4.5 Increment Analysis

Any required Class II increment analysis will be modeled using the model, receptor grid, options, and meteorological data outlined in this protocol. The proposed project sources will be modeled, along with any other increment-affecting sources, and the combined impacts, generally derived as described above with respect to NAAQS/AAAQS analyses, will be compared to the Class II increments to determine compliance with this requirement. The inventory of additional sources to model will be determined in consultation with ADEQ. For short-term increments, the appropriate value for comparison with increments is the high, 2nd high concentration, while the annual average is used to compare to annual increments. Any impact exceeding 90% of the applicable increment where Bowie's contribution exceeds 3% of the impact will be modeled with a refined receptor grid with 25-m spacing.

For $PM_{2.5}$, the minor source baseline date has not yet been set in the Southeast Arizona Intrastate Air Quality Control Region, while the major source baseline date is October 20, 2010. If an increment analysis is required for $PM_{2.5}$, ADEQ will be consulted regarding potentially increment-consuming sources, other than the Bowie Power Station. It is expected that most existing sources will be baseline, rather than increment consuming.

An analysis of changes in the background $PM_{2.5}$ recorded at the Chiricahua NM since the major source baseline date will be used to account for possible increment consumption due to secondary $PM_{2.5}$ from existing major sources. In addition, an analysis of emission trends in $PM_{2.5}$ precursor emissions in contributing source regions will be performed to the extent possible. EPA's draft guidance on $PM_{2.5}$ modeling explains: "Several existing rules, including the current $PM_{2.5}$ NAAQS, have resulted in reductions in precursor emissions in most areas in recent years. As a result, in many cases the potential increment-consumption due to secondary $PM_{2.5}$ impacts from background sources may easily be addressed through a qualitative assessment, supported by trends in available precursor emissions data and ambient $PM_{2.5}$ monitored concentrations that [show that] net secondary $PM_{2.5}$ impacts associated with increment-affecting precursor emissions from background sources have not consumed increment. In such cases, the $PM_{2.5}$ increment analysis may be simplified to focus solely on potential increment consumption associated with direct $PM_{2.5}$ emissions."

6.0 CLASS I AREA ANALYSES

The proposed project site is located within 100 km of four Class I areas, the Chiricahua NM, the Chiricahua Wilderness Area (WA), the Galiuro WA, and the Saguaro NP East Unit. Table 6-1 shows the approximate distances to these Class I areas and each area's Federal Land Manager (FLM). This protocol and the Bowie permit application will be submitted to each FLM for review and comment.

Table 6-1. Distances to Closest Class I Areas

Areas	Approximate Distance from Project Site (kilometers)	Federal Land Manager
Chiricahua NM	38	National Park Service
Chiricahua WA	47	USDA Forest Service
Galiuro WA	73	USDA Forest Service
Saguaro NP East Unit	99	National Park Service

Notes:
NP = National Park
NM = National Monument
USDA = US Department of Agriculture
WA = Wilderness Area

The Federal Land Managers' *Air Quality Related Values Work Group (FLAG) Phase I Report – Revised (2010)* (FLAG 2010) guidance incorporates findings from recent scientific studies and methodologies for conducting visibility analyses based on experience gained through implementation of the Regional Haze Rule. The guidance sets a threshold ratio of emissions to distance, below which AQRV review is not required for any Class I area greater than 50 km from the source. Specifically, if Q (tpy)/D (km) < 10, no AQRV analysis is required, where Q is the emissions increase of SO_2, NO_x, PM_{10}, and sulfuric acid mist, combined in tons per year and D is the nearest distance to a Class I area in kilometers. If Q/D is less than 10 for a Class I Area, then presumptively, there is no adverse impact and no Class I AQRV analysis is required.

Using expected annual emissions may underestimate potential visibility impacts because visibility is assessed on a 24-hour basis. Therefore, a worst-case 24-hour visibility scenario has been defined and used to estimate a conservative value of "Q" in tons per year for the Bowie project. Worst-case 24-hour NO_x emissions for turbines and duct burners include a combination of two startups and one shutdown and the highest normal operation emission rate for the remaining hours in a 24-hour period. Emissions of SO_2 and PM_{10} were based on the same operating scenario. The auxiliary boiler was assumed to run for 12 hours and the emergency fire pump for 4 hours in the worst-case 24-hour period, while cooling tower emissions will be continuous. Combining emissions from all project sources and converting to tons per year gives a combined emissions rate (Q) of 309 tpy.

The FLM guidance cited above suggests an emission (Q) over distance (D) screening threshold of 10. Applying this to the annualized aggregate emission rate suggests that for any Class I area beyond around 31 km, impacts are unlikely. Consequently, AQRVs will only be analyzed at the two Class I areas located less than 50 km from the Bowie Power Station, Chiricahua NM and Chiricahua WA.

The Fort Bowie National Historic Site is located approximately 23 km to the south-southeast of the proposed project location. Although the historic site is not a Class I area, the National Park Service (NPS) has previously asked that visibility impacts be assessed there.

Bowie also proposes to analyze PSD increment consumption at Chiricahua NM and Chiricahua WA. If significant impacts are estimated at these closest Class I areas, ADEQ will be consulted about potentially expanding the analysis to Galiuro WA and Saguaro NP East Unit.

6.1 Class I Analysis Methods

For NO_2, PM_{10}, and $PM_{2.5}$, impacts from the project will be estimated within Chiricahua NM and Chiricahua WA for comparison with Class I significance levels (there are no CO increments or AQRVs and SO_2 emissions from the Bowie Power Station are below PSD significant emission rates). Project impacts on visibility and acid deposition will also be assessed at these locations. Impacts on applicable AQRVs, deposition, and increments will be calculated at NPS-provided Class I area receptor locations, converted to the appropriate grid locations.

An analysis of the proposed source's effect on Class I increments and AQRVs in the Chiricahua WA will be made using the most recent EPA-approved version of the long-range transport model CALPUFF (version 5.8). The nearest boundary of the Chiricahua WA is approximately 47 km from the project site, while the farthest edge is approximately 77 km. CALPUFF will be applied for the Bowie project to estimate impacts at the Chiricahua WA, including for receptors that are within 50 km of the Bowie project site.

Given that Chiricahua NM lies completely within 50 km of the project site, however, only AERMOD will be used to predict impacts for comparison with the NO_2, PM_{10}, and $PM_{2.5}$ Class I significance levels shown in Table 5-5 at this Class I area. Deposition impacts at this Class I area will be assessed with CALPUFF because AERMOD lacks the required chemical processing capabilities for this type of impact analysis.

6.1.1 Emissions and Stack Parameters

To determine compliance with Class I significance levels (increments) at Chiricahua NM, the Bowie Power Station sources will be modeled using the emission scenarios and stack parameters described in Section 5.2.2. The visibility scenario described below will be used to model impacts for comparison with Class I significance levels at Chiricahua WA. The annual average scenarios described in Section 5.2.2 will be used to determine acid deposition impacts at both Class I areas.

Visibility impacts are based on 24-hour emission scenarios. The scenarios used for these analyses represent concurrent emissions of NO_x, SO_2, and PM_{10}. As noted in Section 5.2.2, NO_x emissions are significantly higher during startup events, while SO_2 and PM_{10} emissions vary only slightly. Maximum visibility impacts are therefore expected to result from a 24-hour scenario that includes two startups and one shutdown for each turbine/duct burner pair, with maximum normal operation emissions for the rest of the 24-hour period.

6.1.2 CALPUFF Methodology

CALPUFF (version 5.8, level 070623) will be used to assess Class I increment, visibility, and acid deposition impacts at Chiricahua WA and to assess acid deposition at Chiricahua NM.

6.1.2.1 CALMET

The CALPUFF model relies on meteorological and geophysical inputs to provide land use, terrain, and wind and temperature field parameters. These inputs are provided by the CALMET program, which processes the varying geophysical parameters and surface and upper air measurements into CALPUFF-ready formats.

There are several steps needed to provide this CALPUFF-ready format, including developing terrain and land use information (geo.dat) and compiling surface meteorological parameters (surf.dat), upper air data (ua.dat), and surface measured precipitation data (precip.dat). Augmenting the upper air data is a set of diagnostic wind, temperature, and other parameter fields available from mesocale modeled (MM) domains such as MM5.

The CALMET processor was run in 2007 in accordance with a protocol submitted to the ADEQ for a previous Bowie project. The input files (geo, MM5, surface and upper air meteorological and precipitation data) used in support of the 2007 CALMET processing will also be used for the current assessment. The MM5 data sets used in the 2007 CALMET processing were based on the 2001 EPA 36 km MM5 data set, the 2002 WRAP 12 km MM5 data set, and the 2003 Midwest Regional Planning Organization (MRPO) 36 km MM5 data set. CALMET was run for each month for the two years with 36-km MM data but for every two weeks for the single year (2002) with 12-km MM data.

These data sets were used in an approved manner as input to CALMET along with four surface meteorological stations (DUG, SAD, SUC, and TUS), one upper air station (TUS), and 11 precipitation stations. The Lambert Conformal Coordinate (LCC) projected domain consists of 75 NX grid cells and 60 NY grid cells spaced 4 km apart, in accordance with recent EPA guidance.

Specific values used in the 2007 CALMET processing included R1 of 30 km and R2 of 50 km, RMAX1 of 30 km and RMAX2 of 100 km. These values differ from more recent CALMET guidance (Tyler Fox, August 31, 2009 Memorandum: "Clarification on EPA- FLM Recommended Settings for CALMET"; EPA 2009). The CALMET data will be reprocessed for 2001-2003 using the current regulatory version of the model (version 5.8, level 070623) in accordance with the revised guidance using the switch settings as recommended in the EPA memorandum. All CALMET input files will be provided with the permit application, including the MM5 data, the meteorological data files (surf, precip, ua), and geophysical files (geo). The CALMET output file will be used in CALPUFF along with the same grid settings.

6.1.2.2 CALPUFF/CALPOST

Each year of the three year meteorological records (2001-2003) will be run in CALMET to generate CALPUFF-needed files. Each of the years will be used to generate CALPUFF output files based on modeling the proposed Bowie emissions and values of each modeled pollutant (primary and secondary) will be calculated at each receptor location.

The same data set from Chiricahua NM discussed previously will be used in CALPUFF as the hourly ozone file. Missing values will be filled using the same procedure as outlined for the PVMRM approach in AERMOD so that complete hourly ozone data will be available as background to apply to the CALPUFF calculations.

Results of the CALPUFF model will be passed along to CALPOST (version 6.221, level 082724). CALPOST will be used to calculate annual aggregate species values (total sulfur and total nitrogen) to compare to deposition thresholds. Short-term and annual increment impacts will be calculated for each receptor and maximum values determined for comparison with EPA threshold values. CALPOST will also be used to generate visibility impact projections.

6.1.2.3 Visibility/Haze Assessment

Emission rates of criteria pollutants will be apportioned in accordance with NPS guidance for applicable sources such as the combustion turbines to account for varying particulate matter speciation and associated extinction coefficients and emission rates. NPS guidance for natural gas-fired combustion turbines will be used in CALPUFF to account for varying emitted particle sizes and the potential effects on light scattering and visibility. The VOC emissions from the facility will be included as sulfate (SO_4) and organic carbon (OC). For those sources without such speciation guidance, standard emission rates will be used.

The visibility assessment will employ the MVISBK 8, sub-mode 5 approach, which uses Class I-specific values of annual natural background concentrations, monthly f(RH) values for hygroscopic species, and Rayleigh conditions. Appropriate values for each specific Class I area will be obtained from the 2010 FLAG (FLAG 2010) guidance. The 98th percentile change in light extinction will be compared to the annual average natural condition value for each Class I area to determine whether the 5% visibility threshold for concern will be exceeded..

6.2 Class I Determinations

This section discusses the determinations that will be made for project impacts at each Class I area.

6.2.1 Comparison with Significance Levels

Maximum impacts predicted in each Class I area for each pollutant and averaging period will be compared to the Class I significance levels shown in Table 5-5. If any of the impacts equal or exceed the significance levels, ADEQ will be contacted to determine the need for full/cumulative impact analyses or additional monitoring.

Any required Class I increment analysis will be modeled using the model, receptor grid, options, and meteorological data outlined in this protocol for AERMOD (Chiricahua NM) or CALPUFF (Chiricahua WA). The proposed project sources will be modeled, along with any other increment-affecting sources, and the combined impacts, generally derived as described above with respect to NAAQS/AAAQS analyses, will be compared to the Class I increments to determine compliance with this requirement. The inventory of additional sources to model will be determined in consultation with ADEQ. For short-term increments, the appropriate value for comparison with increments is the high, 2nd high concentration, while the annual average is used to compare to annual increments. Any impact exceeding 90% of the applicable increment where Bowie's contribution exceeds 3% of the impact will be modeled with a refined receptor grid with 25-m spacing.

For $PM_{2.5}$, ADEQ will be consulted regarding potentially increment-consuming sources, other than the Bowie Power Station. It is expected that most existing sources will be baseline, rather than increment consuming.

An analysis of changes in the background $PM_{2.5}$ recorded at the Chiricahua NM since the major baseline date may be used to account for possible increment consumption due to secondary $PM_{2.5}$ from existing sources major sources. In addition, an analysis of emission trends in $PM_{2.5}$ precursor emissions in contributing source regions will be performed to the extent possible, as described with respect to the Class II increment analyses.

6.2.2 Nitrogen Deposition

The CALPUFF model will be used to estimate nitrogen deposition within the respective Class I areas (to accommodate the atmospheric chemistry, CALPUFF will be used to assess deposition within Chiricahua NM as well). CALPOST version (version 6.221, level 082724) will be used to calculate annual aggregate species values to compare to deposition analysis thresholds. Deposition values will be compared to the NPS Deposition Analysis Thresholds (DATs) for the western United States of 0.005 kilograms per hectare per year. If the DATs are exceeded, ADEQ will be consulted regarding potential refined analyses.

6.2.3 Visibility Impacts beyond 50 Kilometers

For Chiricahua WA, impacts to visibility will be determined using the CALPUFF modeling system as described above. The visibility assessment will employ the MVISBK 8, sub-mode 5 approach, as outlined above.

6.2.5 Visibility Impacts within 50 Kilometers

VISCREEN will be used initially to assess visibility impacts in the Chiricahua NM and Fort Bowie National Historic Site. The VISCREEN model is a simple screening technique used to estimate the mass of pollutant in the atmosphere and its ability to scatter or absorb light and, therefore, to affect visibility. The VISCREEN model calculates rudimentary scattering and absorption coefficients and these values are compared to screening threshold levels to determine the potential magnitude and type of visibility impairment.

The analyses will focus on potential coherent plume impacts in relatively nearby areas (within 50 km), rather than uniform haze impacts in distant areas. Coherent plume impacts occur when a visible plume or colored layer is visible against the sky or distant terrain features. Coherent plume impacts may occur in areas that are close to a source of pollutants, while uniform haze may occur further downwind. Two measures of potential plume effects are used. One is a measure of plume contrast, which is the change in light extinction coefficient between views against a background feature (either sky or terrain) and views against the plume. The other measure is delta E, the total color contrast, which takes into account plume intensity, color, and brightness. If the plume is brighter than its background, it will have a positive contrast. If the plume is darker than its background, it will have a negative contrast. VISCREEN assumes that a terrain object is black, which maximizes the contrast.

VISCREEN reports two tests: one for plumes located inside the area of interest and one for plumes located outside the boundaries of the area of interest. The latter is only appropriate for Class I areas where “integral vistas” of objects outside the area are of concern, while the former is appropriate for all Class I areas.

A Level 1 assessment will be performed initially. Background visual range values will be obtained from FLAG 2010 guidance. The Level 1 assessment will assume “worst-case” conservative meteorological and input values and will include use of daily emission rates for the VISCREEN pollutants of concern. If a Level 2 assessment is required, hourly meteorological data from Bowie will be used to develop wind direction-dependent coherent plume impact statistics in accordance with the guidance documents.

If visibility impacts are not shown to be acceptable with VISCREEN, a PLUVUE analysis may be performed. A supplemental protocol will be developed if this is necessary.

7.0 ADDITIONAL IMPACT ANALYSES

An analysis will be made of the impairment to visibility, soils, and vegetation that would occur as a result of the revised project and general commercial, residential, industrial, and other growth associated with the source.

7.1 Growth Analysis

The purpose of the growth analysis is to project the industrial, commercial, and residential growth, and related emissions, that are anticipated to occur in the area due to the construction of the new proposed project. The emissions associated with such projected growth are those not directly related to the new source or modification.

7.2 Soils and Vegetation Analysis

An examination of the Bowie natural gas-fired combined cycle plant's potential impact to sensitive soils or vegetation in the project vicinity will be prepared. The intent of this requirement is to address the potential impact of the proposed project's emissions on sensitive soils and vegetation of commercial or recreational value that occur in the project's impact area. The NAAQS establish secondary standards that are intended to protect public welfare, including the consideration of economic interests, vegetation, and visibility. While ambient concentrations of criteria pollutants below the secondary NAAQS are expected to be protective of most soil types and vegetation, this may not be true for particularly sensitive soils or plant species (EPA 1998). The potential impacts of the proposed project will be compared to relevant thresholds, including but not limited to secondary NAAQS, to determine effects to soil and vegetation.

The possible effects of deposition of trace metals to soils and subsequent uptake by plants will also be screened using procedures outlined in *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals* (Screening Procedure; EPA 450/2-81-078; EPA 1980). Only a few of the trace metals addressed in the screening procedure will be emitted by the project, primarily from the turbines and duct burners. The screening procedure for deposited trace metals requires an estimation of annual average concentrations of these pollutants. The maximum annual average NO_2 impacts will be used in conjunction with scaling factors for cadmium, cobalt, lead, manganese, and nickel derived from the ratio of their expected emissions rates to the NO_x emission rate from the turbines and duct burners to determine maximum ambient trace element concentrations. For selenium, which will only be emitted from the cooling tower, the maximum annual average PM_{10} impacts from the cooling tower will be used in conjunction with scaling factors derived from the ratio of expected selenium emissions rates to the PM_{10} emission rate from the cooling tower to determine maximum ambient trace element concentrations. The screening procedure then outlines the calculations of trace element deposition and trace element concentrations in plant tissues, using very conservative assumptions. Finally, the estimated trace element concentrations in soil and plant tissues will be compared with three types of effects screening levels for direct effects on plant tissues and with potential effects on animals eating the plants. If the derived concentrations are below all three screening levels, no adverse impacts are expected.

8.0 PRESENTATION OF RESULTS

The modeling analysis included in the air permit application and modeling report will contain a comparison of the predicted impacts with the relevant air quality standards. A description of the methodology and inputs used to generate the predicted impacts will also be provided. All modeling input and output files will be provided to the ADEQ in electronic format, along with a “road map” for understanding file naming conventions.

Results will be presented in tabular format. In addition, concentration isopleths will be generated and shown, relative to nearby residences, for all criteria pollutants and averaging periods.

9.0 REFERENCES

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